#494

HELIOS A

REDUCED DATA TAPE 74-097A-11A

ZODIACAL LIGHT DATA 74-097A-11B

HELIOS B

REDUCED DATA TAPE 76-003A-11A

ZODIACAL LIGHT DATA 76-003A-11B

Table of Contents

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1. INTRODUCTION:

The documentation for this data set was originally on paper, kept in NSSDC's Data Set Catalogs (DSCs). The paper documentation in the Data Set Catalogs have been made into digital images, and then collected into a single PDF file for each Data Set Catalog. The inventory information in these DSCs is current as of July 1, 2004. This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system. The information existing in the DSCs is now not needed for locating the data files, but we did not remove that inventory information.

The offline tape datasets have now been migrated from the original magnetic tape to Archival Information Packages (AIP’s).

A prior restoration may have been done on data sets, if a requestor of this data set has questions; they should send an inquiry to the request office to see if additional information exists.

2. ERRATA/CHANGE LOG:

NOTE: Changes are made in a text box, and will show up that way when displayed on screen with a PDF reader.

When printing, special settings may be required to make the text box appear on the printed output.

Version	Date	Person	Page	Description of Change
01				
02				

3 LINKS TO RELEVANT INFORMATION IN THE ONLINE NSSDC INFORMATION SYSTEM:

http://nssdc.gsfc.nasa.gov/nmc/

[NOTE: This link will take you to the main page of the NSSDC Master Catalog. There you will be able to perform searches to find additional information]

4. CATALOG MATERIALS:

a. Associated Documents — To find associated documents you will need to know the document ID number and then click here.
http://nssdcftp.gsfc.nasa.gov/miscellaneous/documents/

b. Core Catalog Materials

HELIOS A

REDUCED DATA TAPES

74-097A-11A ASVI-00008

THIS DATA SET HAS BEEN RESTORED. THERE WERE ORIGINALLY 72 9-TRACK, 1600 BPI TAPES, WRITTEN IN BINARY. THERE ARE 18 RESTORED TAPES. THE DR TAPES ARE 3480 CARTRIDGES AND THE DS TAPES ARE 9-TRACK, 6250 BPI. THE ORIGINAL TAPES WERE CREATED ON AN IBM 360 COMPUTER. THE DR AND DS NUMBERS ALONG WITH THE CORRESPONDING D NUMBERS AND TIME SPANS ARE AS FOLLOWS:

DR#	DS#	DD#	FILES	TIME SPAN
DR004058	DS004058	D045812	1-90	12/11/74 - 12/31/74
		D045813	91-232	01/01/75 - 01/31/75
		D045814	233-358	02/01/75 - 02/28/75
		D045815	359-498	03/01/75 - 03/31/75
DR004059	DS004059	D045816	1-84	04/01/75 - 04/29/75
		D045817	85-94	05/05/75 - 05/29/75
		D045818	95-158	06/02/75 - 07/02/75
		D045819	159-266	07/03/75 - 08/01/75
DR004060	DS004060	D045820	1-100	08/01/75 - 08/30/75
		D045821	101-212	09/01/75 - 09/30/75
		D045822	213-314	10/01/75 - 10/30/75
		D405823	315-416	11/01/75 - 11/26/75
DR004061	DS004061	D045824	1-102	12/01/75 - 01/01/76
		D045825	103-172	01/01/76 - 01/31/76
		D045826	173-262	01/31/76 - 02/28/76
		D045827	263-384	02/29/76 - 03/31/76
DR004062	DS004062	D045828	1-122	03/31/76 - 04/30/76
		D045829	123-236	04/30/76 - 05/30/76
		D045830	237-305	05/30/76 - 07/08/76
		D045831	306-322	07/09/76 - 08/11/76
DR004063	DS004063	D045832	1-54	08/12/76 - 09/06/76
		D045833	55-107	09/07/76 - 10/01/76
		D045834	108-233	10/01/76 - 11/01/76
		D045835	234-370	11/01/76 - 12/01/76

74-097A-11A

DR#	DS#	DD#	FILES	TIME SPAN
DR004064	DS004064	D045836	1-135	12/01/76 - 12/31/76
		D045837	136-254	01/01/77 - 01/31/77
		D045838	255-367	02/01/77 - 02/28/77
		D045839	368-505	02/28/77 - 03/31/77
DR004065	DS004065	D045840	1-123	03/31/77 - 04/29/77
		D045841	124-261	04/29/77 - 05/31/77
		D045842	262-396	05/31/77 - 06/30/77
		D045843	397-448	06/30/77 - 07/11/77
DR004066	DS004066	D045844	1-93	08/11/77 - 08/31/77
		D045845	94-211	09/01/77 - 09/30/77
		D045846	212-351	10/01/77 - 11/06/77
		D045847	352-504	10/31/77 - 12/01/77
DR004067	DS004067	D045848	1-134	12/01/77 - 01/01/78
		D045849	135-175	02/20/78 - 02/28/78
		D045850	176-300	03/01/78 - 03/31/78
		D045851	301-425	03/31/78 - 04/30/78
DR004068	DS004068	D045852	1-131	04/30/78 - 06/01/78
		D045853	132-290	06/01/78 - 07/02/78
		D045854	291-322	10/10/78 - 11/01/78
		D045855	323-415	11/01/78 - 12/01/78
DR004069	DS004069	D045856	1-137	12/01/78 - 12/31/78
		D045857	138-175	01/01/79 - 01/08/79
		D045858	176-266	04/10/79 - 04/29/79
		D045859	267-398	05/03/79 - 05/31/79
DR004070	DS004070	D045860	1-119	06/01/79 - 06/30/79
		D045861	120-147	06/30/79 - 07/12/79
		D045862	148-199	10/16/79 - 11/01/79
		D045863	200-299	11/01/79 - 11/30/79
DR004071	DS004071	D045864	1-119	12/01/79 - 12/31/79
		D045865	120-187	01/01/80 - 01/17/80
		D045866	188-316	05/02/80 - 05/31/80
		D045867	317-450	06/01/80 - 07/01/80
DR004072	DS004072	D045868	1-51	07/01/80 - 07/12/80
		D045869	52-127	11/07/80 - 12/01/80
		D045870	128-201	12/02/80 - 12/31/80
		D045871	202-273	12/31/80 - 01/18/81
DR004073	DS004073	D072656	1-43	05/22/81 - 05/31/81
		D072657	44-177	05/31/81 - 06/30/81
		D072658	178-264	06/30/81 - 07/19/81
		D072659	265-367	11/27/81 - 12/31/81

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DR#	DS#	DD#	FILES	TIME SPAN
DR004074	DS004074	D072660	1-70	01/01/82 - 01/20/82
		D072661	71-178	06/02/82 - 06/30/82
		D072662	179-250	06/30/82 - 07/22/82
		D072663	251-320	06/23/83 - 07/29/83
DR004075	DS004075	D072664	1-17	02/02/84 - 02/07/84
		D072665	18-31	07/18/84 - 07/23/84
		D072666	32-45	01/21/85 - 01/26/85
		D072667	46-52	02/12/85 - 02/18/85

HELIOS-B

REDUCED DATA TAPE

76-003A-11A ASVI-00018

THIS DATA SET HAS BEEN RESTORED. THERE WERE ORIGINALLY 37 9-TRACK, 1600 BPI TAPES, WRITTEN IN BINARY. THERE ARE 7 RESTORED TAPES. THE DR TAPES ARE 3480 CARTRIDGES AND THE DS TAPES ARE 9-TRACK, 6250 BPI. THE ORIGINAL TAPES WERE CREATED ON A MODCOMP COMPUTER AND WERE RESTORED ON AN IBM 3081 COMPUTER. THE DR AND DS NUMBERS ALONG WITH THE CORRESPONDING D NUMBERS AND TIME SPANS ARE AS FOLLOWS:

DR#	DS#	D#	FILES	TIME SPAN
DR003147	DS003147	D043190	1-71	01/17/76 - 01/31/76
		D043191	72-206	02/01/76 - 02/29/76
		D043192	207-348	03/01/76 - 03/31/76
		D043193	349-488	04/01/76 - 04/30/76
		D043194	489-550	05/01/76 - 05/31/76
DR003175	DS003175	D043195	1-30	06/02/76 - 06/30/76
		D043196	31-49	07/02/76 - 07/30/76
		D043197	50-92	08/08/76 - 09/01/76
		D043198	93-117	09/01/76 - 09/26/76
		D043199	118-208	09/30/76 - 10/31/76
		D043200	209-337	11/01/76 - 11/30/76
		D043201	338-439	12/01/76 - 12/31/76
		D043202	440-554	01/01/77 - 01/31/77
DR003199	DS003199	D043203	1-126	02/01/77 - 03/01/77
		D043204	127-264	03/01/77 - 03/31/77
		D043205	265-390	04/01/77 - 04/30/77
		D043206	391-477	05/01/77 - 06/29/77
		D043207	478-523	07/01/77 - 07/31/77
		D043208	524-589	08/01/77 - 08/31/77
DR003176	DS003176	D043209	1-79	08/31/77 - 10/03/77
		D043210	80-168	10/03/77 - 10/31/77
		D043211	169-299	11/01/77 - 11/30/77
		D043212	300-434	11/30/77 - 01/01/78
		D043213	435-568	01/01/78 - 03/01/78

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DR#	DS#	D#	FILES	TIME SPAN
DR003200	DS003200	D043214	1-132	03/01/78 - 04/01/78
		D043215	133-260	04/01/78 - 04/30/78
		D043216	261-400	05/01/78 - 06/05/78
		D043217	401-441	06/05/78 - 07/07/78
		D043218	442-475	10/06/78 - 10/29/78
		D043219	476-576	10/31/78 - 12/01/78
DR003201	DS003201	D043220	1-155	12/01/78 - 04/06/79
		D043221	156-246	04/06/79 - 04/30/79
		D043222	247-370	04/30/79 - 05/31/79
		D043223	371-464	05/31/79 - 07/05/79
		D043224	465-536	10/04/79 - 11/01/79
DR003202	DS003202	D043225	1-117	11/02/79 - 11/30/79
		D043226	118-204	12/01/79 - 12/22/79

HELIOS A
REDUCED DATA TAPE, ASCII
74-097A-011C ASVI-00014

This data set consists of one 4mm tape containing an ASCII version of 18 restored tapes from data set, 74-097A-11A. The copy of the data is on a DLT. The tape numbers and time spans are below:

DD#	DC#	Files	Time Span
DD109136	DC033114	6712	12/11/74 - 02/18/85

HELIOS B
REDUCED DATA TAPE, ASCII
76-003A-11C ASVI-00012

This data set consists of one 4mm tape containing an ASCII version of 7 restored tapes from data set, 76-003A-11A. The copy of the data is on a DLT. The tape numbers and time span are below:

DD#	DC#	Files	Time Span
DD109138	DC033114	3577	01/17/76 - 12/22/79

HELIOS A
ZODIACAL LIGHT DATA, ASCII
74-097A-11D ASVI-00001

This data set consists of one 4mm tape containing an ASCII version of 14 restored tapes from data set, 74-097A-11B. The copy of the data is on a DLT. The tape numbers and time span are below:

DD#	DC#	Files	Time Span
DD109137	DC033114	6428	12/11/74 - 02/18/85

HELIOS B
ZODIACAL LIGHT DATA, ASCII
76-003A-11D ASVI-00015

This data set consists of one 4mm tape containing an ASCII version of 18 restored tapes from data set, 76-003A-11B. The copy of the data is on a DLT. The tape numbers and time span are below:

DD#	DC#	Files	Time Span
DD109139	DC033114	3725	01/01/76 - 12/22/79

REQ. AGENT	RAND NO.	ACQ. AGENT
LSM	V0076	HKH
GLS	V0090	HKH
SAR	V0321	HKH

HELIOS A

REDUCED DATA TAPE
ZODIACAL LIGHT DATA

74-097A-11A
74-097A-11B ASVI-00016

HELIOS B

REDUCED DATA TAPE
ZODIACAL LIGHT DATA

76-003A-11A
76-003A-11B ASVI-00017

This data set catalog consists of 4 data sets from Helios A and B satellite. Helios A contains 72 tapes for each of the two data sets. Helios B contains 37 tapes for each of the two data sets. Each data set is on multi-filed, 9-track, 1600 BPI, Binary magnetic tape. They were created on the PDP10 computer. Each tape contains one month of data. The D and C numbers along with the number of files and the time span are on the following pages.

HELIOS A REDUCED DATA TAPE 74-097A-11A

D#	C#	FILES	TIME SPAN
D-45812	C-21664	90	12/11/74 - 12/31/74
D-45813	C-21665	142	01/01/75 - 01/31/75
D-45814	C-21666	126	02/01/75 - 02/28/75
D-45815	C-21667	140	03/01/75 - 03/31/75
D-45816	C-21668	84	04/01/75 - 04/29/75
D-45817	C-21669	10	05/05/75 - 05/29/75
D-45818	C-21670	64	06/02/75 - 07/02/75
D-45819	C-21671	108	07/03/75 - 08/01/75
D-45820	C-21672	100	08/01/75 - 08/30/75
D-45821	C-21673	112	09/01/75 - 09/30/75
D-45822	C-21674	102	10/01/75 - 10/30/75
D-45823	C-21675	102	11/01/75 - 11/26/75
D-45824	C-21676	102	12/01/75 - 01/01/76
D-45825	C-21677	70	01/01/76 - 01/31/76
D-45826	C-21678	90	01/31/76 - 02/28/76
D-45827	C-21679	122	02/29/76 - 03/31/76
D-45828	C-21680	122	03/31/76 - 04/30/76
D-45829	C-21681	114	04/30/76 - 05/30/76
D-45830	C-21682	69	05/30/76 - 07/08/76
D-45831	C-21683	17	07/09/76 - 08/11/76
D-45832	C-21684	54	08/12/76 - 09/06/76
D-45833	C-21685	53	09/07/76 - 10/01/76
D-45834	C-21686	126	10/01/76 - 11/01/76
D-45835	C-21687	137	11/01/76 - 12/01/76
D-45836	C-21688	135	12/01/76 - 12/31/76
D-45837	C-21689	119	01/01/77 - 01/31/77
D-45838	C-21690	113	02/01/77 - 02/28/77
D-45839	C-21691	138	02/28/77 - 03/31/77
D-45840	C-21692	123	03/31/77 - 04/29/77
D-45841	C-21693	138	05/29/77 - 05/31/77
D-45842	C-21694	135	05/31/77 - 06/30/77
D-45843	C-21700	52	06/30/77 - 07/11/77
D-45844	C-21701	93	07/11/77 - 08/31/77
D-45845	C-21702	118	09/01/77 - 09/30/77
D-45846	C-21703	140	10/01/77 - 11/06/77
D-45847	C-21704	153	10/31/77 - 12/01/77
D-45848	C-21705	134	12/01/77 - 01/01/78
D-45849	C-21706	41	02/20/78 - 02/28/78
D-45850	C-21707	125	03/01/78 - 03/31/78
D-45851	C-21708	125	03/31/78 - 04/30/78
D-45852	C-21709	131	04/30/78 - 06/01/78
D-45853	C-21710	129	06/01/78 - 07/02/78
D-45854	C-21711	62	09/20/78 - 11/01/78
D-45855	C-21712	93	11/01/78 - 11/31/78
D-45856	C-21713	137	12/01/78 - 12/31/78
D-45857	C-21714	38	01/01/79 - 01/08/79
D-45858	C-21715	91	04/10/79 - 04/29/79
D-45859	C-21716	132	04/30/79 - 05/31/79
D-45860	C-21717	119	06/01/79 - 06/30/79
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HELIOS A REDUCED DATA TAPE 74-097A-11A

D#	C#	FILES	TIME SPAN
D-45861	C-21718	28	06/30/79 - 07/12/79
D-45862	C-21719	52	10/16/79 - 11/01/79
D-45863	C-21720	100	11/01/79 - 11/30/79
D-45864	C-21721	119	12/01/79 - 12/31/79
D-45865	C-21722	68	01/01/80 - 01/17/80
D-45866	C-21723	129	05/02/80 - 05/31/80
D-45867	C-21724	134	06/01/80 - 07/01/80
D-45868	C-21725	51	07/01/80 - 07/12/80
D-45869	C-21726	76	11/07/80 - 12/01/80
D-45870	C-21727	74	12/02/80 - 12/31/80
D-45871	C-21728	72	12/31/80 - 01/18/81
D-72656	C-25505	43	05/22/81 - 05/31/81
D-72657	C-25506	134	05/31/81 - 06/30/81
D-72658	C-25507	87	06/30/81 - 07/19/81
D-72659	C-25508	103	11/27/81 - 12/31/81
D-72660	C-25509	70	01/01/82 - 01/20/82
D-72661	C-25510	108	06/02/82 - 06/30/82
D-72662	C-21511	72	06/30/82 - 07/22/82
D-72663	C-25512	70	06/23/83 - 07/29/83
D-72664	C-25513	17	02/02/84 - 02/07/84
D-72665	C-25514	14	07/18/84 - 07/23/84
D-72666	C-25515	14	01/21/85 - 01/26/85
D-72667	C-25516	7	02/12/85 - 02/18/85

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HELIOS A ZODIACAL LIGHT DATA 74-097A-11B

D#	C#	FILES	TIME SPAN
D-46365	C-22035	91	12/11/74 - 12/31/74
D-46366	C-22036	143	01/01/75 - 01/31/75
D-46367	C-22037	127	02/01/75 - 02/28/75
D-46368	C-22038	141	03/01/75 - 03/31/75
D-46369	C-22039	85	04/01/75 - 04/29/75
D-46370	C-22040	11	05/05/75 - 05/29/75
D-46371	C-22041	65	06/02/75 - 07/02/75
D-46372	C-22042	109	07/03/75 - 08/01/75
D-46473	C-22043	101	08/01/75 - 08/30/75
D-46374	C-22044	113	09/01/75 - 09/30/75
D-46375	C-22068	107	10/01/75 - 10/31/75
D-46376	C-22069	103	11/01/75 - 11/30/75
D-46377		103	
D-46378	C-22070	71	01/01/76 - 01/31/76
D-46379	C-22071	91	01/31/76 - 02/28/76
D-46380	C-22047	123	02/29/76 - 03/31/76
D-46381	C-22048	123	03/31/76 - 04/30/76
D-46382	C-22049	115	04/30/76 - 05/30/76
D-46383	C-22050	70	05/31/76 - 07/08/76
D-46384	C-22051	18	07/09/76 - 08/11/76
D-46385	C-22052	55	08/12/76 - 09/06/76
D-46386	C-22053	54	09/07/76 - 10/01/76
D-46387	C-22054	127	10/01/76 - 11/01/76
D-46388	C-22055	138	11/01/76 - 12/01/76
D-46389	C-22056	136	12/01/76 - 12/31/76
D-46390	C-22072	120	01/01/77 - 01/31/77
D-46391	C-22073	114	02/01/77 - 02/28/77
D-46392	C-22074	139	02/29/77 - 03/31/77
D-46393	C-22075	124	03/31/77 - 04/29/77
D-46394	C-22076	139	04/29/77 - 05/31/77
D-46395	C-22079	136	05/31/77 - 06/30/77
D-46396	C-22080	53	06/30/77 - 07/11/77
D-46397	C-22081	94	08/11/77 - 08/31/77
D-46398	C-22082	119	09/01/77 - 09/30/77
D-46399	C-22083	113	10/01/77 - 10/31/77
D-46400	C-22084	154	10/31/77 - 12/01/77
D-46401	C-22085	135	12/01/77 - 01/01/78
D-46402	C-22086	42	02/20/78 - 02/28/78
D-46403	C-22087	126	03/01/78 - 03/31/78
D-46404	C-22088	126	03/31/78 - 04/03/78
D-46405	C-22111	132	04/30/78 - 06/01/78
D-46406	C-22112	130	06/01/78 - 07/02/78
D-46407	C-22113	63	09/20/78 - 11/01/78
D-46408	C-22114	94	11/01/78 - 11/30/78
D-46409	C-22115	138	12/01/78 - 12/31/78
D-46410	C-22116	39	01/01/79 - 01/08/79
D-46411	C-22117	92	04/10/79 - 04/29/79
D-46412	C-22118	133	04/30/79 - 05/31/79
D-46413	C-22119	120	06/01/79 - 06/30/79
		5045	

HELIOS A ZODIACAL LIGHT DATA 74-097A-11B

D#	C#	FILES	TIME SPAN
D-46414	C-22120	29	06/30/79 - 07/12/79
D-46415	C-22132	53	10/17/79 - 11/01/79
D-46416	C-22133	101	11/01/79 - 11/30/79
D-46417	C-22134	120	12/01/79 - 12/31/79
D-46418	C-22135	69	01/01/80 - 01/17/80
D-46419	C-22136	130	05/02/80 - 05/31/80
D-46420	C-22137	135	06/01/80 - 07/01/80
D-46421	C-22138	52	07/01/80 - 07/12/80
D-46422	C-22139	77	11/06/80 - 12/01/80
D-46423	C-22140	75	12/02/80 - 12/31/80
D-46424	C-22141	73	12/31/80 - 01/18/81
D-72668	C-25517	44	05/22/81 - 05/31/81
D-72669	C-25518	135	05/31/81 - 06/30/81
D-72670	C-25519	88	06/30/81 - 07/19/81
D-72671	C-25520	104	11/27/81 - 12/31/81
D-72672	C-25521	71	01/01/82 - 01/20/82
D-72673	C-25522	109	06/02/82 - 06/30/82
D-72674	C-25523	73	06/30/82 - 07/22/82
D-72675	C-25524	71	06/23/83 - 07/29/83
D-72676	C-25525	18	02/02/84 - 02/07/84
D-72677	C-25526	15	07/18/84 - 07/23/84
D-72678	C-25527	14	01/21/85 - 01/25/85
D-72679	C-25528	8	02/12/85 - 02/18/85

DLO=C
HCK=D

B32753

Return to HKH

Max-Planck-Institut für Astronomie
Heidelberg – Königstuhl

REDUCED

TRF B32753-000A

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Berichte

DESCRIPTION

OF THE

REDUCED-DATA-TAPE

OF THE

HELIOS ZODIACAL LIGHT EXPERIMENT E9

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1. Survey

This document describes the contents and the format of the reduced-data-tape.

The reduced-data-tape contains reduced data and repeats most of the data of the original experiment data tapes.

Reduced data means calibrated zodiacal light measurements, corrected for non-linearity, dark current and temperature effects. No correction for instrumental scattered light was necessary since this effect was demonstrated to be negligible in the Helios data (not measurable, less than 1%).

With the repetition of original data we want to give everybody the opportunity to check our reduction procedure and to improve it where necessary.

In detail this means:

a) Orbit-attitude information. The hourly blocks are copies of the original blocks. They should cover the time period of the measurements. On the first tapes a few may be missing or not be in chronological order due to teething troubles of the program.

b) Housekeeping information. Only part of the temperature information was kept. The hourly averages given in blocks with identification 10 may be misleading for two reasons: after switch on of a photometer it takes some time to reach equilibrium. During the first months some of the temperatures occasionally were affected by telemtry transmission errors. Care was taken not to use these erraneous temperature in the reduction procedure.

c) Test pulses. Copied from original blocks.

d) Dark current. Copied from original blocks. Average given in MC header block (identification 2).

e) Calibration lamps. Copied from original blocks. In addition the measurement cycle header blocks (with identification 2) contain averages of corrected (non-linearity, dark current, temperature effect) readings of the calibration lamps for medium sector length.

f) Sky light measurements. The count rates were copied from the original blocks.

Note: correted data always are reduced to nominal spin rate 1 Hz, which was not mentioned above.

2. Short experiment description

2.1 Function and operation

The function and operation of the experiment are described in the following copy of an article in Raumfahrtforschung.

A more complete description has been given by C. Leinert, E. Pitz, H. Link and N. Salm: Das Zodiakallichtexperiment E9 auf Helios A und B (1978) BMFT-FB W78-28 (series of the Bundesministerium für Forschung und Technologie, Bonn, in German). (Also available at NSSDC)

Note: it is not recommended to use Helios data without carefully studying sections 2, 3 and 9.

The HELIOS Zodiacal Light Experiment (E 9)

C. LEINERT, H. LINK, E. PITZ, N. SALM, D. KNÜPPELBERG,
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Es wird das Experiment 9 der deutsch-amerikanischen Sonnensonde Helios beschrieben. Es besteht aus 3 Photometern zur Messung des Zodiakallichts bei den ekliptikalen Breiten −15°, −30° und −90° (Südpol der Ekliptik). Die Intensität und Polarisation des Zodiakallichts wird in 3 Farbbereichen gemessen, die in etwa dem internationalen UBV-System entsprechen. Neben der Diskussion der Maßnahmen zur Unterdrückung unerwünschten Streulichts, werden die wesentlichsten optischen und mechanischen Parameter genannt. Es wird Pulszähltechnik verwendet und die Signalverarbeitung beschrieben. Die Stabilität der Sensoren während der ersten 130 Tage der Mission wird diskutiert.

Experiment 9 of the German-American solar probe Helios is described. It consists of 3 photometers to measure the zodiacal light at ecliptical latitudes of −15°, −30° and −90° (south pole of ecliptic). Intensity and polarization of zodiacal light is measured in three wavelength bands corresponding to the international UBV-System. Measures of stray light reduction are discussed and optical and mechanical parameters are given. Pulse counting technique is used and data handling within the experiment is described. The stability of the sensors during the first 130 days of the mission is discussed.

1. SCIENTIFIC OBJECTIVES

The experiment is measuring the zodiacal light, which is sunlight scattered on the extremely thin cloud of interplanetary particles. This cloud extends from near the Sun to the asteroid belt and contains about a dozen micron-sized particles per km³. From zodiacal light observations it is possible, in principle, to derive the spatial distribution, size distribution and material of the scattering dust particles. The observed intensity is mainly related to the number, the observed colour to the size and the observed polarization to the material of the particles. The Helios experiment is measuring intensity, colour and polarization as a function of Sun – Helios distance for various angles with respect to the sun. The main results to be expected from these measurements are:

(1) spatial distribution of interplanetary dust within 1 A.U.,
(2) detection of changes in the particle mixture of interplanetary dust, if present, and
(3) size and material of interplanetary dust particles.

These informations will allow a better interpretation of existing earthbound observations of zodiacal light.
They also provide a basis for the discussion of the sources of interplanetary dust, which is one of the main questions concerning interplanetary dust.

2. GROSS FEATURES OF THE EXPERIMENT

The experiment consists of three photometers mounted rigidly into the spacecraft with orientations of about 15°, 30° and 90° respectively south of the spacecraft X-Y-plane (see FIG. 1), and of one electronic box. The large baffle systems associated with the photometers are necessary for stray light protection. The total mass of the experiment is 8.93 kg. The maximum power consumption is 9.6 W, including a maximum heater power of 2.2 W for the thermal control of the sensors.

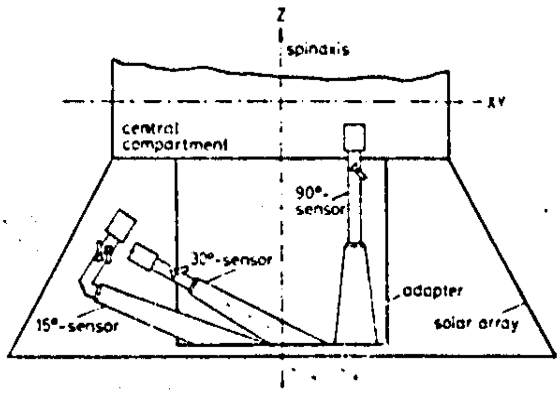


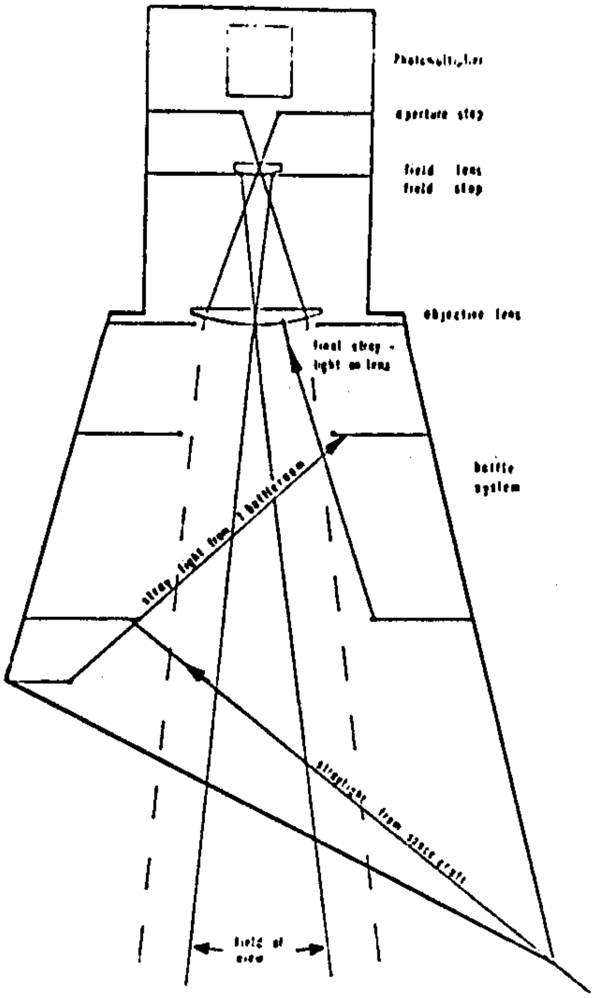
FIG. 1: Sectional view of the lower spacecraft part with the positions of the zodiacal light photometers

3. OPTICAL SYSTEM

The radiation enters the photometer through an extended stray light baffle, is collected by the objective lens and imaged onto the field stop, which determines the field of view on the sky. Behind the field stop, a field lens images the objective lens onto the aperture stop. The aperture stop defines the collecting area of the objective lens. Close behind the aperture stop is the photocathode of the photomultiplier. This design not only furnishes a homogeneous illumination of the photomultiplier cathode (by imaging the objective lens onto the cathode), but also images the stray light diffracted or reflected at the mounting of the objective lens outside the aperture stop. Similarly the brightest stray light sources, the rims of the baffle are imaged by the objective lens outside the field stop.
This is essentially a coronograph design and was chosen to give good stray light suppression. Since Helios is exposed to full sunlight and since the sun is 10^{12} to 10^{13} times brighter than the zodiacal light, good suppression of stray light is considered as one main problem of the experiment and as a guideline for the whole design. The suppression of 10^{-14} to 10^{-15} that is needed to have only 1 % stray light contribution to the signal is accomplished in three steps:

First Step:
The photometers are mounted in the shadow zone of the southern spacecraft cone and may only be illuminated by the inner rim of the spacecraft cone, which itself may be exposed to direct sunlight.

Second Step:
Stray light suppression in the baffle system. The light falling into the openings of the baffle systems is caught in the first baffle room (see FIG. 2). The baffle system is designed like



G. 2: **Principle of the optical system and stray light suppression**

a trumpet, so that the stray light emerging from the first baffle cannot hit the objective lens directly but only after attenuation by multiple reflections.

Third Step:

The coronograph like design of the optical system prevents stray light falling directly onto the photocathode. To keep the stray light level low, no optical element is allowed between the objective lens and field stop. Since the actual stray light level strongly depends on the amount of dust on the objective lens (it increases by a factor of ten for dusty optics and decreases by a factor of ten for very clean optics), the objective lens was exchanged shortly before launch to get rid of the dust which had accumulated during the instrument and system tests. The mechanical design allows this exchange, with fully integrated photometer. The lenses are made from fused quartz (Suprasil) to reduce radiation damage and scintillation. TABLE I gives the basic optical parameters for the three photometers.

TABLE I: **OPTICAL PARAMETERS OF THE PHOTOMETERS**

	15°-sensor	30°-sensor	90°-sensor
Diameter of aperture (mm)	30	36	36
Focal lenght of obj. lens (mm)	150	200	200
eld of view	1° x 1°	2° x 2°	3° ϕ
Focal lenght of fields lens (mm)	55	55	55
cm² x square degree	7.07	40.8	72.1

TABLE II: **DESCRIPTION OF FILTER WHEELS**

Filter wheel	Position	Function (Filter)
15°-photometer color	1	Dark and Calibration
	2	Ultraviolet (UG2)
	3	Blue (BG3 + GG 385)
	4	Visual (GG 10)
15°-photometer *polarization*	1	Pol.film 0° (quartz)
	2	*Pol.film 90° (quartz)*
	3	Pol.film 45° (quartz)
	4	Blank (quartz)
30°-photometer	1	Dark and Calibration
	2	Ultraviolet (UG2)
	3	Blue (BG3 + GG 385)
	4	Visual (GG 10)
	5	Blue and pol.film 0° (BG3+GG 385)
	6	Visual and pol.film 0° (GG 10)
	7	Visual and pol.film 90° (GG 10)
	8	Visual and pol.film 45° (GG 10)
90°-photometer	1	Dark and Calibration
	2	Ultraviolet and pol.film 0° (UG2)
	3	Blue + pol.film 0° (BG3 + GG 385)
	4	Visual and pol.film 0° (GG 10)

The filter wheels are the only movable parts of the experiment. They are driven by permanent magnet stepper motors with 1:16 gear reduction. The gear was introduced to improve positioning and holding torque. The zero position of the filter wheel is recorded by an opto-electronic device in the gear housing. The filter wheels have four positions

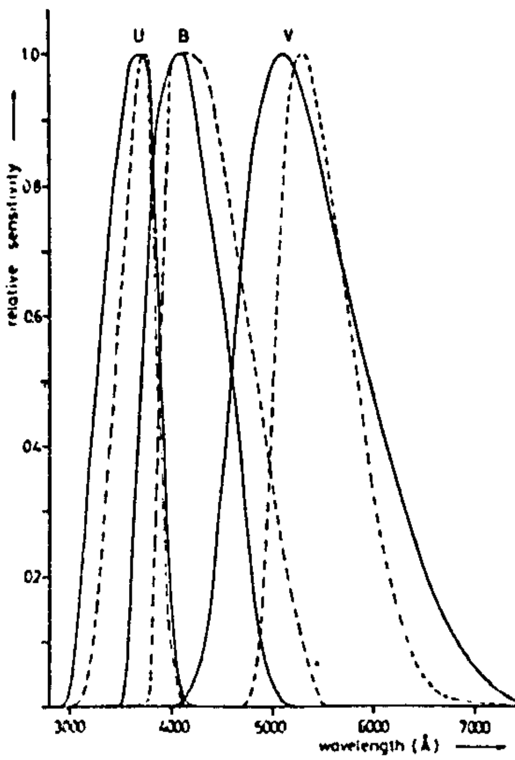


FIG. 3: **Spectral bandpasses compared with the international UBV system**

(8 in the 30°-photometer). In one position the light path is blocked and the light of an internal calibration lamp can be directed onto the photo-multiplier by a small folding mirror mounted on the filter wheel. The other positions contain the filters which define the spectral bandpasses and are Schott glasses with relatively high radiation resistance and low scintillation efficiency. The effective wavelength's for ultraviolet, blue and visual are 3600 Å, 4200 Å and 5300 Å respectively. Broad bandpasses ($\approx \pm$ 500 Å) were selected to allow the use of telescopes with small aperture. For polarization measurements, a polaroid film is used, Polacoat Formula 105 UV, which has a transmission of about 30% in natural light from 3000 Å to 7000 Å. The films are deposited directly on the Schott glasses; in the 15°-photometer they are coated on quartz disks (Suprasil) and mounted in a separate filter wheel, leaving one position blank (quartz). The content of the filter wheels is summarized in TABLE II, and the spectral bandpasses are compared to the international UBV System in FIG. 3. FIG. 4 shows the 15°-photometer together with the central electronic box.

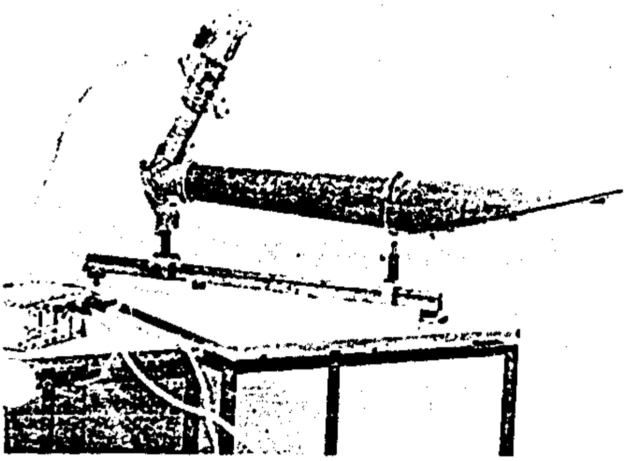


FIG. 4: **15°-photometer (mounted for component tests) together with the central electronic box. On the rear end of the sensor the two filter wheel motors and the analog electronic can be seen**

4. SENSOR UNIT

4.1 Amplifier

The same sensor is used in all three photometers: a head-on photomultiplier, type 541 N of EMR, which has been used in various space experiments. Since the expected dynamical range of the signal is less than 5×10^3, a pulse counting technique is used for ease of data handling. The single electron pulses at the anode of the photomultiplier are amplified and all pulses exceeding a level of 0.5 mV when measured across a resistor of 50 Ω are shaped and fed into a two stage ripple counter, which delivers ervery fourth pulse to the main electronics. The count rate is limited to 11 MHz by a fixed recovery time of the amplifier, introducing a known unlinearity at high photomultiplier pulse rates. For redundancy and to check the proper operation of the amplifier the instantaneous anode current of the photomultiplier is transmitted in an analog housekeeping channel (ratemeter) for each sensor.

High Voltage Converter

It provides the high voltage supply for the photo-multiplier and the low voltage supply (+ 12 V, −2.5 V) for the amplifier. As the H.-V. converter is located near the sensor only very short cable connections are necessary. The high voltage is individually adjusted ($\approx$ 2500 V) so that the photomultiplier gives a current amplification of 2×10^6. By command, the high voltage can be raised by 300 V to compensate aging of the sensor. The converter is externally synchronized by a 40 KHz pulse train.

5. MAIN ELECTRONIC BOX

In order to measure the angular distribution of the zodiacal light brightness, each revolution of the spacecraft – which means, each scan in the 15° and 30°-photometer – is divided into 32 sectors of different size. The 16 smallest sectors (1/64 revolution) are centered to the sun direction, the 8 largest (1/16 revolution) on the antisolar point and the gap is filled by 8 sectors of the size 1/32 revolution (see FIG. 5). The introduction of large sectors in the regions where a smooth variation of zodiacal light brightness is expected reduces the total number of sectors. Since during the short time of passing one sector the brightness of the zodiacal light cannot be determined with sufficient accuracy, the readings of 513 revolutions are combined for each sector.

In the 90°-photometer, 8 sectors of equal size are introduced to alow polarization measurements. The integration is carried out over 126 revolutions. The technique used to perform these integrations is shown in the block diagram (FIG. 6). Let us assume that the 15°-photometer is measuring and looking into the first sector. Then the output pulses of the 15° photometer sensor unit are going through the input switch into the counter A wich gives a 27 bit semi-logarithmical representation – four bit exponent, 23 bit mantissa – of the accumulated pulse number. As soon as the photometer field of view crosses the boundary to the second sector, the 18 most significant bits of the counter are transferred into the memory A, the nine least significant bits are dropped and the counter is ready to accept the

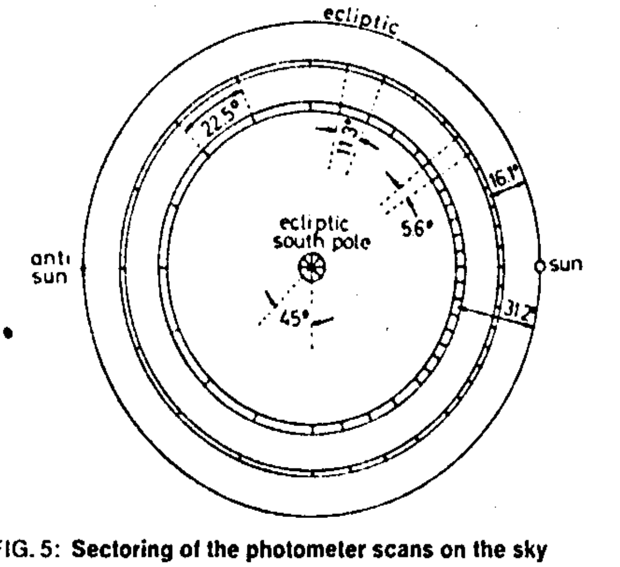


FIG. 5: **Sectoring of the photometer scans on the sky**

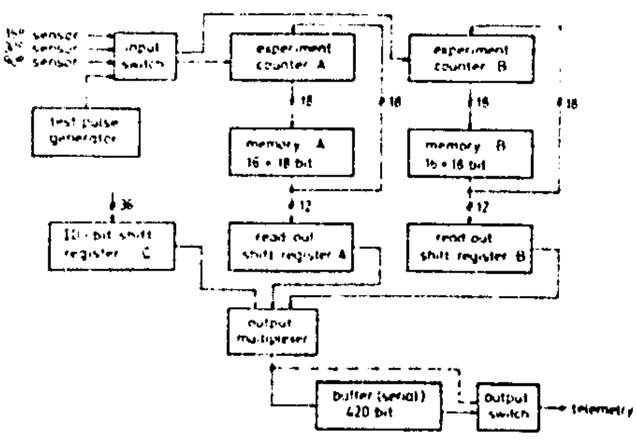


FIG. 6: **Block diagram of the digital electronics**

pulses of sector two. For redundancy, however, the pulses of sector two and all even sectors are handled in the identical counter B and memory B, while all odd sectors go into counter A. The result of any sector is kept in the memory for one revolution of the spacecraft and used as initial value for the counting of pulses during the following revolution, being replaced after that by the new value, etc. until the integration over 513 revolutions is complete. Then the 12 most significant bits for each sector are read out into a buffer and combined with 36 identification bits which describe the status of the experiment. Memory and counter are set to zero, the filter wheel is switched to the next position and a new measurement may begin.
The buffer is read out into the telemetry in a rhythm determined by the momentaneous bit rate and format used for data transmission to the Earth. The data of the 30°-photometer are handled in the same way. For the 90°-photometer, the results of four subsequent measurements are combined in the memory before read-out. Thus the experiment produces science data (as opposed to housekeeping) at a constant rate of $36 + 32 \times 12 = 420$ bit per 516 revolutions. The lacking time from 513 revolutions respectively 4×126 revolutions (integration times) to 516 revolutions is needed to switch the filter wheel(s).
The electronics uses TTL low power circuits. The special counter-memory arrangement has been chosen to give low power consumption, within the limits of this technology. The buffer is made of C-MOS – parts for power reduction. It may be bypassed by command if it fails. In that case the memory is read out directly into the telemetry.
After each cycle of measurements the distribution of the sectors with respect to the counters A and B is reversed. This makes a failure of either part A or B of the electronics less harmful, but has the effect of changing the chronological order of the sectors in the bitstream.
A logic control unit regulates the proper sectoring and sequencing of the measurement. It controls the motor switching, the calibration lamps and the switching of the H-V-converters. It synchronizes the sectoring to the see-sun-direction and regulates the data transfer.

6. CYCLE OF MEASUREMENT

The normal mode of operation consists of continuous repetition of the cycle of measurement. The three photometers are operated in sequence to save power. After switch-on of the 15°-photometer a test measurement is performed during which a pulse train of known frequency is fed into the data handling electronics to check the digital operations. After the dark current and internal calibration measurements the first color filter is moved into the light path for intensity and polarization measurements. The polarization is measured by the method of 3 polaroid settings, with one measurement for each polaroid orientation, the polaroids being exchanged by moving the second filter wheel between the measurements. These measurements are repeated for the second and third colour and followed by a repetition of the dark current and calibration measurements, giving a total of 20 measurements in the 15°-photometer. Each single measurement gives 32 results, one for each of the 32 sectors. In the 30°-photometer 12 measurements are performed beginning and ending with dark current and calibration measurements and using again the method of 3 polaroid settings for the polarization measurements. No test measurement is included because the digital operations are the same as with the 15°-photometer.
Since the 90°-photometer is mounted parallel to the spin axis, the polaroids which stay in fixed position relative to the photometer are rotated by the spin of the spacecraft. Using the method of rotating polaroid, intensity and polarization information for a given color can be obtained in one measurement. Each color is measured three times. Together with test, dark current and calibration measurements, 16 measurements are performed in the 90°-photometer which are combined to 4 read outs.
The time needed for one complete cycle of measurements is $(20 + 12 + 4) \times 516$ revolutions = 5.2 hours. About 40% of this time are used for test, calibration and dark current measurements.
If the data transmission for this experiment, falls to less than 420 bit/516 revolutions, a new measurement may be completed before the buffer is completely read into the telemetry. In that case, the cycle of measurements is stopped and the next measurement is started only after the buffer has been read out and then refilled with the data of the completed measurement. This mechanism prevents data loss from overwriting in the buffer or the memory but may enlarge the time needed for one cycle of measurements by a factor two or three for very low bit rates.

7. FLIGHT PERFORMANCE

7.1 Stability

As mentioned in section 3, the stability of the sensor sensitivity can be checked by the signal of an internal calibration lamp. FIG. 7 shows for example the signal of the calibration lamp of the 30°-photometer during the first 130 days of the mission. The change of signal is strongly correlated to the variation of the temperature of the sensor which is shown in the lower part of the figure. The two small circles show the expected signal according to ground testing.

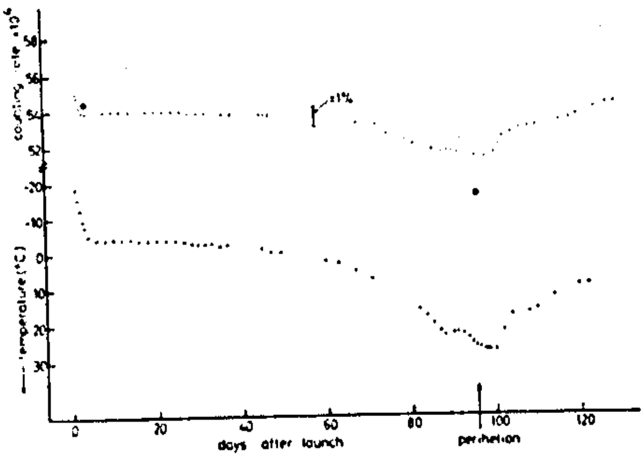


FIG. 7: **Signal of internal calibration lamp and temperature versus time after launch**

7.2 Stray Light

The amount of stray light expected in the data is dependent on the amount of direct sunlight entering the southern spacecraft cone. If the spacecraft is tilted with its spin axis toward the sun line no sunlight can enter the cone and no stray light contribution in the data is expected. However if the spin axis is tilted away from the sun line, the southern rim of the solar array is illuminated by direct sunlight and the antisolar zodiacal light data of the 15°-photometer may be contaminated by stray light. To prove the stray light contribution, two changes of the spacecraft attitude have been performed during the primary mission (one near Earth and one near perihelion) to have both "stray light conditions" during short time spans. The data with and without sunlight in the southern cone show no significant difference which can not be explained by the different star background. We conclude from this, without having reduced the data completely that the stray light contribution in the data is at least smaller than 10% and the stray light suppression of the photometers works perfectly.

Acknowledgement
This work was supported by Contract RS 21 of the Bundesministerium für Forschung und Technologie (BMFT).

2.2 Telemetry formats

The identification of a particular type of measurement of a science block is achieved by the ID-Word, bits 1,2,3 and 4-8 (see Table 2.1).

Table 2.1: Identification of type of measurements

ID-Word Bits 1,2,3	4-8		Meaning
101	0	Sensor 15°	Test pulses
101	1		Dark current
101	2		Calibration lamp through polarizing film 45°
101	3		Calibration lamp through quartz disk
101	4		UV through polarizing film 0°
101	5		UV through polarizing film 90°
101	6		UV through polarizing film 45°
101	7		UV through quartz disk
101	8		Blue through polarizing film 0°
101	9		Blue through polarizing film 90°
101	10		Blue through polarizing film 45°
101	11		Blue through quartz disk
101	12		Visual through polarizing film 0°
101	13		Visual through polarizing film 90°
101	14		Visual through polarizing film 45°
101	15		Visual through quartz disk
101	16		Dark current
101	29		Dark current
101	30		Calibration lamp through polarizing film 45°
101	31		Calibration lamp through quartz disk
110	0	Sensor 30°	Dark current
110	5		Calibration lamp
110	6		Calibration lamp
110	7		UV
110	8		Blue
110	9		Visual
110	10		Blue through polarizing film 0°
110	11		Visual through polarizing film 0°
110	12		Visual through polarizing film 90°
110	13		Visual through polarizing film 45°
110	14		Dark current
110	15		Calibration lamp
100	16	Sensor 90°	Test pulses, dark current, dark current, calibration lamp
100	29		UV, blue, visual, calibration lamp
100	30		UV, blue, visual, calibration lamp
100	31		UV, blue, visual, dark current

As may be seen from Table 2.1, for sensor 90° four consecutive measurements at 8 sectors each are contained in one data block.

Bit 16 of the ID-word of a science block governs the calibration lamps and the readout of the experiment.

Calibration lamps:

Bit 16 = 0: Calibration lamp A (bright) is on.
Bit 16 = 1: Calibration lamp B (dim) is on.
If a cycle of measurements on tape was assembled from more than one cycle of measurements in space, part or all of the calibration lamp measurements may not fit to Bit 16 of the first science block and therefore be by about a factor of two different from expectation, leading to anomalous values of ratio between different readings of calibration lamps.

Readout:

Sensors 15° and 30°:
The sectors on the reduced-data-tape should be in correct order. Only if Bit 16 of the ID-word was 1 during the measurement but unknown to the ground station due to data loss it may occur that even and uneven sectors are interchanged (1 with 2, 3 with 4, etc.).

Sensor 90°:
The sectors on the reduced-data-tape should be in correct order (sectors 1-8 (S1-S8) of measurement 1 (M1), followed by sectors 1-8 of measurements 2,3,4). However, if Bit 16 was not known to the ground station, the data were delivered in the scrambled form the came out of the experiment (see Table 2.2: Experiment-internal sequence of measurements for sensor 90°).

Also if a transmission error occured on Bit 16, the wrong column of Table 2.2 was used for rearrangement into correct order, leading to doubly scrambled data. Most, although not all of these errors were corrected on the reduced-data-tape. The user will recognize the few remaining scrambled data by unusual values for dark current and zodiacal light brightness. Table 2.2 allows to restore even these data.

Table 2.2: Experiment-internal sequence of measurements for sensor 90°

Sequence number of word	Measured quantity Bit 16 = 1		Bit 16 = 0	
1	S2	M2	S3	M1
2	S3	M1	S2	M2
3	S2	M3	S3	M2
4	S3	M2	S2	M3
5	S2	M4	S3	M3
6	S3	M3	S2	M4
7	S4	M1	S3	M4
8	S3	M4	S4	M1
9	S4	M2	S5	M1
10	S5	M1	S4	M2
11	S4	M3	S5	M2
12	S5	M2	S4	M3
13	S4	M4	S5	M3
14	S5	M3	S4	M4
15	S6	M1	S5	M4
16	S5	M4	S6	M1
17	S6	M2	S7	M1
18	S7	M1	S6	M2
19	S6	M3	S7	M2
20	S7	M2	S6	M3
21	S6	M4	S7	M3
22	S7	M3	S6	M4
23	S8	M1	S7	M4
24	S7	M4	S8	M1
25	S8	M2	S1	M1
26	S1	M1	S8	M2
27	S8	M3	S1	M2
28	S1	M2	S8	M3
29	S8	M4	S1	M3
30	S1	M3	S8	M4
31	S2	M1	S1	M4
32	S1	M4	S2	M1

Example: For Bit 16 = 1 the fifth number coming out of the experiment refers to the second sector of the fourth measurement of this particular point of the measurement programme.

In the science data block with Identification 100 31 M1 means measurement of UV, M2 of B, M3 of V and M4 of dark current.

3. Description of the reduction procedure

In order to allow a critical use of the scientific data of the reduced-data-tape the reduction procedure is presented here.

The reduction follows the subsequent scheme:

- correction for non-linearity
- dark current subtraction
- laboratory calibration
- correction due to calibration by stars.

This will be described in detail in the following. Only blocks were kept for reduction which contain valid measurements in at least 16 out of 32 sectors.

Correction for non-linearity

The observed count rates were converted to count rates at the photomultiplier by allowing for
- an integration time of 513 sec in sensors 15^o and 30^o, 126 sec in sensor 90^o
- a deviation of spin rate from the nominal value of 60.0 per minute
- a frequency divider by a factor of 4
- the sector length of 1/64, 1/32 oder 1/16 revolution in sensors 15^o and 30^o, 1/8 in sensor 90^o.

For example a countrate 1.0 in a short sector of sensor 15^o or 30^o corresponds to a count rate of 0.5/sec at the photomultiplier, while a count rate of 1.0 in the sensor 90^o corresponds to a countrate of 0.25 at the photomultiplier.

Count rates larger than 8.2×10^6 or less than 300 are invalid.

Table 3.1 gives the transformation from observed count rates f at the photomultiplier to corrected count rates f_o at the photomultiplier.

Table 3.1: Correction for non-linearity

Helios A Sensor 15°

$f \leq 3\times10^5$ Hz	$fo = f$
$f > 3\times10^5$ Hz	$fo = \left[1 + \frac{f-3\times10^5}{10^5} \cdot 0.0092\right] \cdot f$

Sensor 30°

$f \leq 10^5$ Hz	$fo = f$
10^5 Hz $< f \leq 3\times10^5$ Hz	$fo = \left[1 + \frac{f-10^5}{10^5} \cdot 0.017\right] \cdot f$
3×10^5 Hz $< f \leq 3\times10^6$ Hz	$fo = \left[\frac{1.00}{1.00 - fo/11.1\times10^6} + \frac{0.6}{100}\right] \cdot f$

Sensor 90°

$f \leq 6\times10^5$ Hz	$fo = f$

.elios B Sensor 15°

$f \leq 2.2\times10^6$ Hz	$fo = \left[1 + \frac{f}{10^5} \cdot 0.01\right] \cdot f$

Sensor 30°

$f \leq 2\times10^5$ Hz	$fo = f$
$2\times10^5 < f \leq 10^6$ Hz	$fo = \left[1 + \frac{f-2\times10^5}{10^5} \cdot 0.008\right] \cdot f$
$f > 10^6$ Hz	$fo = \left[1.064 + \frac{f-10^6}{10^5} \cdot 0.0135\right] \cdot f$

Sensor 90°

$f \leq 2\times10^6$	$fo = \left[1 + \frac{f-3\times10^5}{10^5} \cdot 0.01\right] \cdot f$

Dark current subtraction

The dark current for short, medium and long sectors as given in the measurement cycle header block (identification 2) was subtracted. During increases of cosmic ray intensity the dark current values may increase by one or two orders of magnitude.

The values in the header block are averages over all valid data in this cycle of measurements. If data are missing they are taking from the preceding cycle.

Laboratory calibration

Table 3.2 gives the laboratory calibration at 20°C

Table 3.2: Laboratory calibration at 20°C [S10 per count] (in sensors 15 and 30° referring to short sectors).

Photometer	ID-Word Bits 1,2,3	4-8	Helios A	Helios B
15°	101	4	0.0859	0.114
	101	5	0.0859	0.125
	101	6	0.0885	0.112
	101	7	0.0306	0.0406
	101	8	0.0390	0.0506
	101	9	0.0406	0.0537
	101	10	0.0412	0.0489
	101	11	0.0139	0.0176
	101	12	0.0274	0.0556
	101	13	0.0285	0.0578
	101	14	0.0290	0.0547
	101	15	0.0100	0.0194
30°	110	7	4.55-3	4.16-3
	110	8	2.33-3	2.13-3
	110	9	2.09-3	2.24-3
	110	10	6.33-3	5.95-3
	110	11	6.07-3	6.78-3
	110	12	5.95-3	6.66-3
	110	13	5.86-3	6.53-3
	Colour			
90°	UV		4.04-3	3.49-3
	Blue		2.28-3	1.62-3
	Visual		2.93-3	1.39-3

1 S10 is defined as the equivalent of 1 solar type star of m_{vis} = 10.00 per square degree, based on the solar spectrum (Labs and Neckel, 1970) and a solar visual magnitude of -26.73, solar (B-V) = 0.63, solar (U-B) = 0.15.

This laboratory calibration is applied to the zodiacal light count rates as they would result from the corrected count rate f_o at the photomultiplier. This calibration is not applied to the readings of the calibration lamps.

Example: A number of 2×10^{-5} in section 10 (medium length) of sector 15°, blue (identification 101 11) would correspond to an intensity of sky light of 1390 S10.

The temperature dependence as determined from laboratory calibration is given in Table 3.3.

Table 3.3: Temperature correction from laboratory calibration. The observed zodiacal light values and readings of the calibration lamps have to be divided by the following factors to be reduced to 20°

Photometer		Factor	Range
Helios A,	Sensor 15°	$1 + (20-t) \times 0.0033$	$< 20^\circ$
		$1 + (20-t) \times 0.0020$	$\geqslant 20^\circ$
	Sensor 30°	$1 + (20-t) \times 0.00285$	$< 60^\circ$
	Sensor 90°	$1 + (20-t) \times 0.0031$	$< 20^\circ$
		$1 + (20-t) \times 0.0044$	$\geqslant 20^\circ$
Helios B,	Sensor 15°	$1 + (20-t) \times 0.0036$	$< 20^\circ$
		$1 + (20-t) \times 0.0014$	$\geqslant 20^\circ$
	Sensor 30°	$1 + (20-t) \times 0.00308$	$< 20^\circ$
		$1 + (20-t) \times 0.0020$	$\geqslant 20^\circ$
	Sensor 90°	$1 + (20-t) \times 0.00298$	$< 60^\circ$

Here t is the temperature of the respective sensor, averaged between internal and external temperature, except for sensor 90° where it is external temperature + 1°.

For calibration lamps an additional correction has to be applied taking into account the change in supply voltage:

Helios A,	Sensor 15°	$1 + (20-t) \times 0.00068$	$< 20^\circ$
	Sensor 30°	$1 + (20-t) \times -0.00045$	$< 60^\circ$
	Sensor 90°	$1 + (20-t) \times -0.0001$	$< 60^\circ$
Helios B,	Sensor 15°	$1 + (20-t) \times -0.00136$	$< 20^\circ$
	Sensor 30°	$1 + (20-t) \times -0.0013$	$< 20^\circ$
		$1 + (20-t) \times -0.0004$	$\geqslant 20^\circ$
	Sensor 90°	$1 + (20-t) \times -0.00112$	$< 20^\circ$

Here t is the temperature of the electronics box.

Correction due to calibration by stars

There was general agreement between laboratory calibration and calibration by star crossings. In order to get an average of the two types of calibration, the following additional corrections were applied to the data.

The values obtained so far (S10 for sky light, corrected count rate for calibration lamps) have to be multiplied by

$$1 + (20-t) \times 0.00167/2.0$$

The temperature dependence as determined from laboratory calibration is given in Table 3.3.

Table 3.3: Temperature correction from laboratory calibration. The observed zodiacal light values and readings of the calibration lamps have to be divided by the following factors to be reduced to 20°

Photometer		Factor	Range
Helios A,	Sensor 15°	$1 + (20-t) \times 0.0033$	$< 20^\circ$
		$1 + (20-t) \times 0.0020$	$> 20^\circ$
	Sensor 30°	$1 + (20-t) \times 0.00285$	$< 60^\circ$
	Sensor 90°	$1 + (20-t) \times 0.0031$	$< 20^\circ$
		$1 + (20-t) \times 0.0044$	$> 20^\circ$
Helios B,	Sensor 15°	$1 + (20-t) \times 0.0036$	$< 20^\circ$
		$1 + (20-t) \times 0.0014$	$> 20^\circ$
	Sensor 30°	$1 + (20-t) \times 0.00308$	$< 20^\circ$
		$1 + (20-t) \times 0.0020$	$> 20^\circ$
	Sensor 90°	$1 + (20-t) \times 0.00298$	$< 60^\circ$

Here t is the temperature of the respective sensor, averaged between internal and external temperature, except for sensor 90° where it is external temperature + 1°.

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	Sensor 90°	$1 + (20-t) \times -0.0001$	$< 60^\circ$
Helios B,	Sensor 15°	$1 + (20-t) \times -0.00136$	$< 20^\circ$
	Sensor 30°	$1 + (20-t) \times -0.0013$	$< 20^\circ$
		$1 + (20-t) \times -0.0004$	$> 20^\circ$
	Sensor 90°	$1 + (20-t) \times -0.00112$	$< 20^\circ$

Here t is the temperature of the electronics box.

Correction due to calibration by stars

There was general agreement between laboratory calibration and calibration by star crossings. In order to get an average of the two types of calibration, the following additional corrections were applied to the data.

The values obtained so far (S10 for sky light, corrected count rate for calibration lamps) have to be multiplied by

$$1 + (20-t) \times 0.00167/2.0$$

where t is the temperature of the respective sensor as given in table 3.3

In addition the zodiacal light values have to be divided by

1.026 for observations in UV
1.012 for observations in blue
0.988 for observations in visual.

Colour equation

In order to derive the calibration by stars we had to implement the colour equation of the instrument, i.e. the factor by which the U,B or V brightness U_o, B_o, V_o of a star has to be multiplied to predict the reading U_i, B_i, V_i in our instrumental UV, blue and visual channels. The colour equation was determined by numerical integration over the bandpass of the instrument using known stellar spectra and the known instrument spectral sensitivity. The colour equations for the Helios sensors are given in the table 3.4.

Table 3.4: Colour equation for Helios sensors

Sensor	Factor		Range in (B-V)
Helios A, Sensor 15°	U: 1.0		$<$ 1.15
	1+((B-V)-1.15) x	0.61	$\geq$ 1.15
	B: 0.795+(1.43-(B-V)) x	0.255	$<$ 1.43
	0.795+(1.43-(B-V)) x	0.06	$\geq$ 1.43
	V: 0.975+(0.83-(B-V)) x	0.138	$<$ 0.83
	0.975+(0.83-(B-V)) x	0.02	$\geq$ 0.83
Sensor 30°	U: $0.985+\left(\frac{(B-V)-0.875}{0.995}\right)^2$ x	0.05	$<$ 2.0
	B: 0.731+(1.52-(B-V)) x	0.27	$<$ 1.52
	0.731+(1.52-(B-V)) x	0.09	$\geq$ 1.52
	V: 0.967+(0.85-(B-V)) x	0.143	$<$ 0.85
	0.967+(0.85-(B-V)) x	0.05	$\geq$ 0.85
Sensor 90°	U: 1.0+(0.63-(B-V)) x	0.055	$<$ 2.0
	B: 0.685+(1.55-(B-V)) x	0.343	$<$ 1.55
	0.685+(1.55-(B-V)) x	0.12	$\geq$ 1.55
	V: 0.95+(0.84-(B-V)) x	0.233	$<$ 0.84
	0.95+(0.84-(B-V)) x	0.157	$\geq$ 0.84
Helios B, Sensor 15°	U: 1.0		$<$ 0.77
	1.0+(0.77-(B-V)) x	-0.057	$\geq$ 0.77
	B: 1.0+(0.63-(B-V)) x	0.297	$<$ 2.0
	V: 1.0+(0.63-(B-V)) x	0.244	$<$ 0.63
	1.0+(0.63-(B-V)) x	0.195	$\geq$ 0.63
Sensor 30°	U: 1.0+(0.63-(B-V)) x	0.048	$<$ 2.0
	B: 1.0+(0.63-(B-V)) x	0.293	$<$ 2.0
	V: 1.0+(0.63-(B-V)) x	0.237	$<$ 0.63
	1.0+(0.63-(B-V)) x	0.155	$\geq$ 0.63
Sensor 90°	U: $0.99+\left(\frac{(B-V)-0.5}{0.66}\right)^2$ x	0.04	$<$ 1.16
	1.0+(1.16-(B-V)) x	(-1.28)	$\geq$ 1.16
	B: 1.0+(0.63-(B-V)) x	0.25	$<$ 1.16
	0.865		$\geq$ 1.16
	V: 1.0+(0.63-(B-V)) x	0.11	$<$ 0.75
	0.985		$\geq$ 0.75

4. Labelling

The reel-number of a reduced-data-tape informs the user about the contents of the reduced-data-tape: The reel-number contains 6 symbols:

1.: The first Symbol is always the letter "R" as an identification for a reduced-data-tape

2.-4.: These letters are always one of the two combinations "HEA" or "HEB", were "A" means Helios A (or Helios 1) and "B" means Helios B (or Helios 2)

5.-6.: means the month from launch of the data

For example: RHEB05

means: Reduced-data-tape, containing data of Helios B from the fifth month from launch
(=May 1976)
(see also chap. 13)

5. Contents and tape structure

Normally, a reduced-data-tape contains the measurement-cycles (MC) of one month.

Each measurement-cycle is contained in one file, the length of the file (=number of records within the file) depends on the duration of one MC.

Additionally, to the number of files describing the MC's, at the beginning of the tape, the tape header-file is located. So the total number of files on a reduction-tape is the number N of MC's + the tape-header file.

Every MC-file contains various records. The first record of each MC file is always the MC-header record (see chapter 8.1.2).

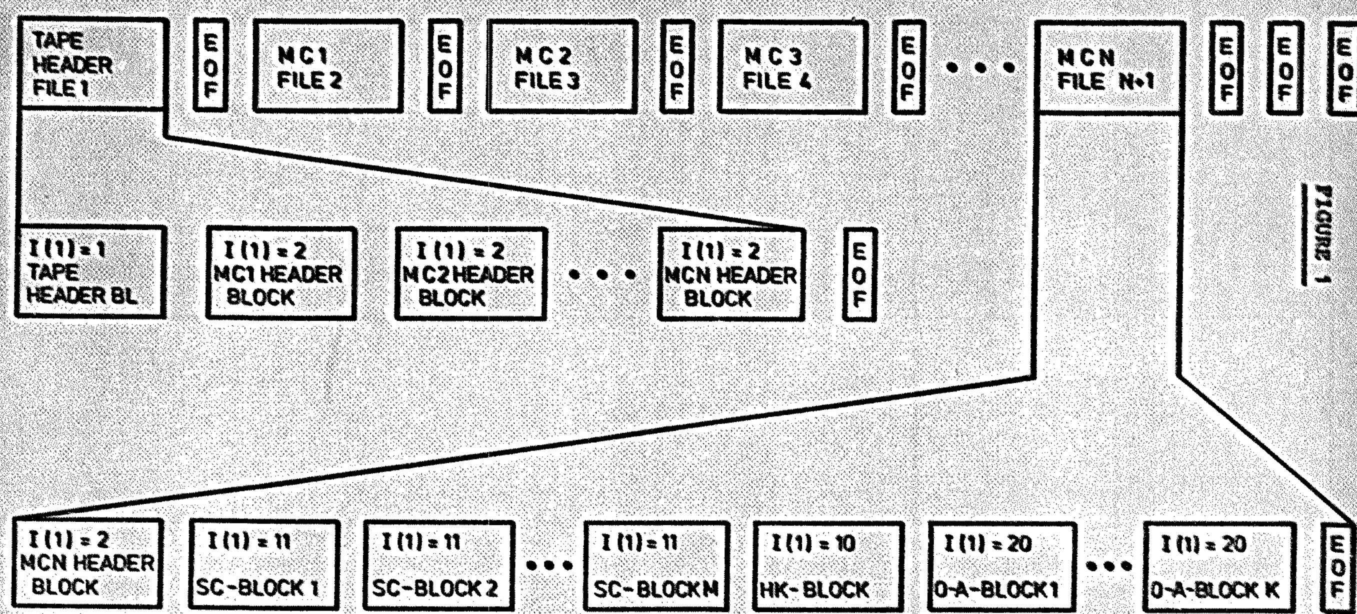
Immediately after this record follow the valid science records (nominally 36, see 8.2.2), one house-keeping record (see chapter 8.2.1) and some orbit-attitude-records (see chapter 8.2.3). The number of orbit-attitude records depends on the duration of one measurement-cycle.

The end of every file is marked by a EOF-mark, the end of the tape is marked with additional three EOF-marks.

As already mentioned above, the first file of the reduction-tape is the Tape-Header-File. The first record it contains is the Tape-Header-record (see chapter 8.1.1), the next records are the N MC Header Records, they are copies of the MC-header records of the N measurement cycles.

For better understanding see Figure 1: Structure of reduced-data-tape

STRUCTURE OF REDUCED-DATA-TAPE



1 BLOCK ≙ 1 RECORD

FIGURE 1

6. Word structure

The records of the reduced-tape are written on the tape in a binary DEC-mode. After all records of one file have been written, an EOF-mark was written. After the last file has been written three additional EOF are written to mark the end of the content of the tape.

The added program shows how the tape was written.

Additional to the program we added a copy of the hardware-reference-manual, describing the representation of integer and floating point numbers.

NUMBER SYSTEM

A program can interpret a data word as a 36-digit, unsigned binary number, or the left and right halves of a word can be taken as separate 18-bit numbers. The PDP-10 repertory includes instructions that add or subtract one from both halves of a word, so the right half can be used for address modification when the word is addressed as an index register, while the left half is used to keep a control count.

The fixed-point arithmetic instructions use 2's complement representations to do binary arithmetic. In a word used as a number, bit 0 (the leftmost bit) represents the sign, 0 for positive, 1 for negative. In a positive number the remaining 35 bits are the magnitude in ordinary binary notation. The negative of a number is obtained by taking its 2's complement. If x is an n-digit binary number, its 2's complement is $2^n - x$, and its 1's complement is $(2^n - 1) - x$, or equivalently $(2^n - x) - 1$. Subtracting a number from $2^n - 1$ (i.e., from all 1s) is equivalent to performing the logical complement, i.e., changing all 0s to 1s and all 1s to 0s. Therefore, to form the 2's complement one takes the logical complement (usually referred to merely as the complement) of the entire word including the sign, and adds 1 to the result. In a negative number the sign bit is 1, and the remaining bits are the 2's complement of the magnitude.

$+153_{10} = +231_8 =$ $\boxed{000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 010\ 011\ 001}$

0 35

$-153_{10} = -231_8 =$ $\boxed{111\ 111\ 111\ 111\ 111\ 111\ 111\ 111\ 111\ 101\ 100\ 111}$

0 35

MR-0196

A 2's complement addition actually acts as though the words represented 36-bit unsigned numbers, i.e., the signs are treated just like magnitude bits. In the absence of a carry into the sign stage, adding two numbers with the same sign produces a plus sign in the result. The presence of a carry gives a positive answer when the summands have different signs. The result has a minus sign when there is a carry into the sign bit and the summands have the same sign, or the summands have different signs and there is no carry. Thus the program can interpret the numbers processed in fixed point addition and subtraction as signed numbers with 35 magnitude bits or as unsigned 36-bit numbers. A computation on signed numbers produces a result that is correct as an unsigned 36-bit number even if overflow occurs, but the hardware interprets the result as a signed number to detect overflow. Adding two positive numbers whose sum is greater than or equal to 2^{35} gives a negative result, indicating overflow; but that result, which has a 1 in the sign bit, is the correct answer interpreted as a 36-bit unsigned number in positive form. Similarly adding two negatives gives a result which is always correct as an unsigned number in negative form.

Zero is represented by a word containing all 0s. Complementing this number produces all 1s, and adding 1 to that produces all 0s again. Hence there is only one zero representation and its sign is positive. Since the numbers are symmetrical in magnitude about a single zero representation, all even numbers both positive and negative end in 0, all odd numbers in 1 (a number all 1s represents −1). But since there are the same number of numbers with each sign and zero has a plus sign, there is one more negative number than there are positive numbers (nonzero numbers with a plus sign). This is the most negative number and it cannot be produced by negating any positive number (its octal representation is 400000 000000 and its magnitude is one greater than the largest positive number).

If 1's complements were used for negatives one could read a negative number by attaching significance to the 0s instead of the 1s. In 2's complement notation each negative number is one greater than the complement of the positive number of the same magnitude, so one can read a negative number by attaching significance to the rightmost 1 and attaching significance to the 0s at the left of it (the negative number of largest magnitude has a 1 in only the sign position). In a negative integer, 1s may be discarded at the left, just as leading 0s may be dropped in a positive integer. In a negative fraction, 0s may be discarded at the right. So long as only 0s are discarded, the number remains in 2's complement form because it still has a 1 that possesses significance; but if a portion including the rightmost 1 is discarded, the remaining part of the fraction is now a 1's complement. Single precision multiplication produces a double length product, and the programmer must remember that discarding the low order part of a double length negative leaves the high order part in correct 2's complement form only if the low order part is zero.

The computer does not keep track of a binary point – the programmer must adopt a point convention and shift the magnitude of the result to conform to the convention used. Two common conventions are to regard a number as an integer (binary point at the right) or as a proper fraction (binary point at the left); in these two cases the range of numbers represented by a single word is -2^{35} to $2^{35} - 1$ or -1 to $1 - 2^{-35}$. Since multiplication and division make use of double length numbers, there are special instructions for performing these operations with integral operands.

The format for double length fixed point numbers is just an extension of the single length format. The magnitude (or its twos complement) is the 70-bit string in bits 1–35 of the high and low order words. Bit 0 of the high order word is the sign, and bit 0 of the low order word is made equal to the sign. The range for double length integers and proper fractions is thus -2^{70} to $2^{70} - 1$ and -1 to $1 - 2^{-70}$. The double precision instructions actually use quadruple length numbers for products and dividends. But numbers of any length are just a further extension of the basic format: thirty-five additional bits of the number in each lower order word, and bit 0 made equal to the sign. Remember that truncating a multiple length negative requires an adjustment for the 2's complement unless the part discarded is zero. The convention for bit 0 of lower order words is inconsistent with that used for floating point format [*see below*]. This does not affect the arithmetic instructions themselves, as they ignore bit 0 in all lower order words. However instructions that negate a doubleword use the floating point convention. This means that if such instructions are used for fixed point numbers, a problem could arise when comparing one double precision number with another.

Floating Point Numbers. The floating point instructions provide for conversion between fixed and floating forms and handle both single and double precision floating point numbers. The same format is used for a single precision number and the high order word of a double precision number. A floating point instruction interprets bit 0 as the sign, but interprets the rest of the word as an 8-bit exponent and a 27-bit fraction. For a positive number the sign is 0, as before. But the contents of bits 9–35 are now interpreted only as a binary fraction, and the contents of bits 1–8 are interpreted as an integral exponent in excess 128 (200_8) code. Exponents from –128 to +127 are therefore represented by the binary equivalents of 0 to 225 (0–377_8). Floating point zero and negatives are represented in exactly the same way as in fixed point: zero by a word containing all 0s, a negative by the 2's complement. A negative number has a 1 for its sign and the 2's complement of the fraction, but since every fraction must ordinarily contain a 1 unless the entire number is zero [*see below*], it has the 1's complement of the exponent code in bits 1–8. Since the exponent is in excess 128 code, an actual exponent x is represented in a positive number by $x + 128$, in a negative number by $127 - x$. The programmer, however, need not be concerned with these representations as the hardware compensates automatically. For example, for the instruction that scales the exponent, the hardware interprets the integral scale factor in standard 2's complement form but produces the correct 1's complement result for the exponent.

$+153_{10} = +231_8 = +.462_8 \times 2^8 =$

0	10 001 000	100 110 010 000 000 000 000 000 000
0	1 8	9 35

$-153_{10} = -231_8 = -.462_8 \times 2^8 =$

1	01 110 111	011 001 110 000 000 000 000 000 000
0	1 8	9 35

MR-0197

The floating point instructions assume that all nonzero operands are normalized, and they normalize a nonzero result. A floating point number is considered normalized if the magnitude of the fraction is greater than or equal to 1/2 and less than 1. The hardware may not give the correct result if the program supplies an operand that is not normalized or that has a zero fraction with a nonzero exponent.

Single precision floating point numbers have a fractional range in magnitude of 1/2 to $1-2^{-27}$. Increasing the length of a number to two words does not significantly change the range but rather increases the precision; in any format the magnitude range of the fraction is 1/2 to 1 decreased by the value of the least significant bit. In all formats the exponent range is –128 to +127.

The precaution about truncation given for fixed point multiplication applies to single precision floating point operations as they are done in extra length; but the the programmer may request rounding, which automatically restores the high order part (the result) to 2's complement form if it is negative. In double precision floating point instructions, all operands and results are double length, and all instructions calculate an extra length answer, which is rounded to double length with the appropriate adjustment for a 2's complement negative. In double precision format the high order word is the same as a single precision number, and bits 1–35 of the low order word are simply an extension of the fraction, which is now sixty-two bits. Bit 0 of the low order word is made 0 in a result but is ignored in all operands; e.g., the number $2^{18} + 2^{-18}$ has this two-word representation in double precision format,

```
|0|10 010 011|100 000 000 000 000 000 000 000 000|
 0 1        8 9                                 35

|0|00 000 000 010 000 000 000 000 000 000 000 000|
 0 1                                            35
```

MR-0198

and its negative is

```
|1|01 101 100|011 111 111 111 111 111 111 111 111|
 0 1        8 9                                 35

|0|11 111 111 110 000 000 000 000 000 000 000 000|
 0 1                                            35
```

MR-0199

```
C         PROGRAM COPIES FILES FROM DISK TO TAPE.
C         IANF,IEND MEAN NUMBERS OF BEGINNING AND END OF FILES
          DOUBLE PRECISION ADRESS
          DIMENSION IZFILE(2),I(706)
          DATA IZFILE/'ZLI00','.DAT'/
          IWRITE=3
          LBLOCK = 0    !SC-BLOCK-COUNTER
          OPEN (UNIT=23,DEVICE='DSKC',ACCESS='SEQIN',MODE='ASCII',
     1          FILE='ZLBAND.DAT')

C         READING FROM ZLBAND.DAT-FILE IN I4-FORMAT
          READ (23,222) IANF,IEND
  222     FORMAT(5I4)
          CLOSE (UNIT=23)

          OPEN(UNIT=17,DEVICE=MTA,ACCESS='SEQOUT',MODE='BINARY',
     1          DENSITY='1600')

          DO 200 LL=IANF,IEND
          INN=LL

          CALL NAMEFI (INN,ADRESS,IZFILE)
          OPEN (UNIT=24,DEVICE='DSKB',ACCESS='SEQIN',MODE='BINARY',
     1          FILE=ADRESS)
          WRITE(IWRITE,1) ADRESS
    1     FORMAT(2X,'FILE  ',1A10,'  OPENED')

    2     DO 201 KK1=1,706
  201     I(KK1)=0
C         READING RECORD BY RECORD FROM FILE TO CORE
          READ (24,ERR=3,END=7)I

          LBLOCK=LBLOCK+1

C         WRITING ON TAPE
          WRITE(17)I
          GO TO 2

    7     CLOSE (UNIT=24)
          WRITE(IWRITE,8) ADRESS
    8     FORMAT(2X,'FILE  ',1A10,'  CLOSED')
          SET EOF ON TAPE
          END FILE 17
  200     CONTINUE

          WRITE(IWRITE,10) LBLOCK
   10     FORMAT(2X,'NUMBER OF SC-BLOCKS ON TAPE ',I6)
          WRITE(IWRITE,12)
   12     FORMAT(2X,' E O T ')
          GO TO 11
    3     WRITE(IWRITE,4)ADRESS,I(1),I(19),I(20),I(21),I(22)
    4     FORMAT(2X,'PARITY ERROR IN READING FROM FILE ',1A10,
     1          ', SC-BLOCK ',I2,',',4I2)
          STOP'PARITY ERROR'
C         SET ADDITIONAL 3 EOF'S TO MARK END OF ZODIACAL-LIGHT-
C .       DATA-TAPE
   11     END FILE 17
          END FILE 17
          END FILE 17
          WRITE (IWRITE,9)
    9     FORMAT(2X,'END OF PROGRAM')
          CLOSE(UNIT=17,DEVICE=MTA)
          END

C-----------------------------------------------------------------
C         SUBROUTINE NAMEFI
C-----------------------------------------------------------------
          SUBROUTINE NAMEFI (INN,IFIL,IFILES)
          DOUBLE PRECISION IFIL
          DIMENSION IFILES(2)
   20     FORMAT(2X,2A5,I4)
          IF (INN.GT.99) GO TO 80
          IF (INN.GT.9) GO TO 81
          ENCODE (10,30,IFIL)IFILES(1),INN,IFILES(2)
   30     FORMAT (A5,I1,A4)
          WRITE (3,20)IFIL,INN
          GO TO 2
   81     ENCODE (10,40,IFIL)IFILES(1),INN,IFILES(2)
   40     FORMAT (A4,I2,A4)
C         WRITE (3,20)
          GO TO 2
   80     ENCODE(10,13,IFIL)IFILES(1),INN,IFILES(2)
C                TYPE 20,IFIL,INN
C         WRITE(3,20)IFIL,INN
   13     FORMAT (A3,I3,A4)
```

```
20      WRITE (IR,25)
25      FORMAT(5X,'ERROR IN WRITING THE TAPE')
        GO TO 6
22      WRITE (IR,26)
26      FORMAT(5X,'E O F IN WRITE')
        GO TO 6
3       CONTINUE                       !5.2.80
C 3       WRITE (IR,600)IFIL           !5.2.80
600     FORMAT (40X,'END WRITING FILE:',1A10)
C   SET AND EOF MARK
        END FILE (17)
        CLOSE (UNIT=21)
50      CONTINUE
        GO TO 334
8       FORMAT (//20X,'EOF MARK')
1       WRITE (IR,333)
333     FORMAT (5X,'PARITY ERROR IN READING DISK')
        GO TO 334
33      WRITE (IR,444)
444     FORMAT (5X,'E O T')
C   SET ADDITIONAL 3 EOFS TO MARK END OF REDUCED DATA TAPE
334     END FILE(17)
        END FILE(17)
        END FILE(17)
        STOP 'ENDE DES PROG. *** REDUZIERTES BAND ERZEUGT ***'
        END
```

7. Type of Tape

The data are written on a 9 track-tape in DEC-mode, using a FORTRAN-programm.

A detailed description of the tape you can find in the added copy of the hardware reference manual.

PART II
STANDARD MAGNETIC TAPE

A system for handling industry-standard magnetic tape consists of a TM10 control and up to eight tape transports; each unit in the system occupies a separate cabinet. DEC supplies several types of transports that differ in tape speed and tape handling characteristics. Each type is available in two versions, for recording information in seven tracks and nine tracks. Thus data transfer rates and timing depend on the transport, but each transport supplies information to the control such that transports of different speeds and recording formats can be operated by a single control. Transports currently available move tape at speeds of 45, 75 and 150 inches per second. Every transport accommodates two 10½-inch reels (one for supply, one for takeup) and can record information in three densities: 200, 556 and 800 bytes per inch (bpi). A full reel has 2400 feet of half-inch tape and at 800 bpi can store over 135 million bits of data in the 7-track format, or over 180 million bits in the 9-track format.

The program communicates with the tape control, which in turn governs all tape transports but communicates with only one transport at a time. Reading and writing (recording) can occur only when tape is moving forward (from supply reel to takeup reel), but the control can space the tape (*ie* move it to a new position) in either direction. Although only one transport can be reading, writing or spacing at a time, rewinding the entire tape onto the supply reel at high speed requires only initiation by the control. The rewinding transport then proceeds automatically while the control can operate another transport.

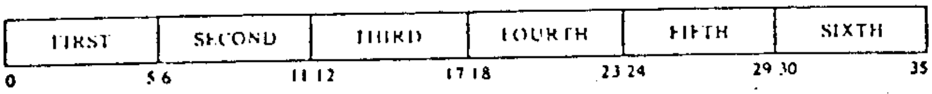
Data transfers between tape and control are governed entirely by the control. Transfers between a TM10A control and memory are handled by the program over the IO bus, whereas the TM10B control is connected to a data channel for automatic transfer of data to and from memory, thus bypassing the central processor [§5.1].

6.6 TAPE FORMAT

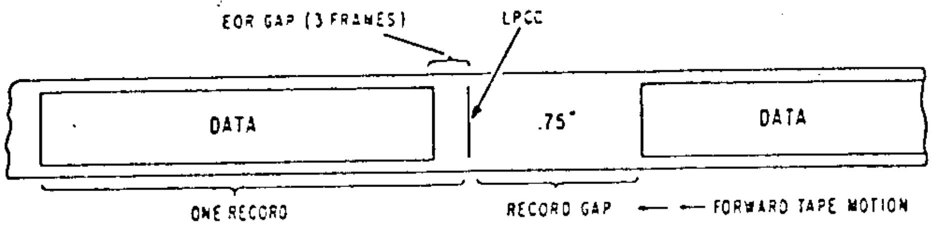
The recording technique used is NRZI (nonreturn to zero, inverting). In a given frame (*ie* character position) a change in the direction of magnetization in any track represents a 1 in the character bit corresponding to that track. Thus if the one bit is 0 in a string of characters, there is no change in the track corresponding to that bit; but for a string of 1s, the flux direction changes in every frame.

The control writes characters containing seven or nine bits of information; one bit is written in each track. Every character is part of a data record or a file mark. A data record contains both data characters and error-checking characters. Every data character consists of a data byte and a lateral parity bit, which the control generates so that the number of 1s in the character is odd or even as specified by the program. The data bytes in a record taken together correspond to a block of words sent from memory to the control. To separate adjacent records the control automatically erases a segment of tape between them; this segment is called a "record gap". The control always stops the tape in a gap.

Full words are transferred between memory and control even though the tape characters may contain 6-bit or 8-bit data bytes. To write, the control divides the words into data bytes, and when reading, the control reassembles the bytes into words. There are several ways in which this is done. For 7-track format, the program can select any density, and the control writes each word as six characters, each containing a 6-bit data byte. After the control writes the last data character for a record, it writes three blank frames (zero



7-TRACK BYTE DISTRIBUTION



7-TRACK RECORD FORMAT

characters) followed by a longitudinal parity check character (LPCC). The three blank frames constitute the end of record gap (EOR), which is used by the control to detect the end of record. The EOR is used in writing as well as reading since the tape encounters the write head first, and the control detects everything shortly after writing it. The LPCC (which may be zero) produces even parity in each of the tracks along the length of the record. The minimum record gap is .75 inch.

When the control reads or writes a data record, it checks that the (lateral) parity of every data character agrees with the parity specified by the program and checks that every track has even (longitudinal) parity.

The 9-track format is used for recording data compatible with systems based on 8-bit bytes. The program must select a density of 800 bpi, and the control writes bits 0–31 of each word in four characters, ignoring bits 32–35 altogether. The bits from left to right in each 8-bit byte are written in tracks 0–7. After writing the last data character, the control writes an EOR gap, a cyclic redundancy character (CRC), three more blank frames, and an LPCC. The control generates the CRC as described in §6 of USAS X3.22-1967, *USA Standard, Recorded Magnetic Tape for Information Interchange (800 CPI, NRZI)*. Taking the CRC bits as numbered in that document and the track scheme defined above, CRC bit 1 corresponds to the parity track and bits 2–9 correspond to tracks 0–7. The standard record gap is .5 inch minimum, .6 inch nominal, 25 feet maximum.

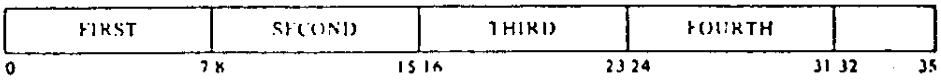
For industry compatibility the program must select 800 bpi and odd parity.

The difference in nominal gap length between 7-track and 9-track format is due entirely to a difference in head spacing.

When the control reads a record in 9-track format, it assembles data into 36-bit words. Each word is composed of four data bytes in bits 0–31 and the corresponding character parity error indicators in bits 32–35 (*eg* a 1 in bit 33

STANDARD MAGNETIC TAPE TM10

Characters are assembled into words in this manner by an IDPB loop or an ASCII or ASCIZ pseudoinstruction.



9-TRACK BYTE DISTRIBUTION

The "tracks" referred to here are simply a convenience for identifying the bits in the data bytes. The actual correspondence of character bits to physical tracks on tape is as follows:

```
BIT     2 0 4 P 5 6 7 1 3
TRACK   1 2 3 4 5 6 7 8 9
```

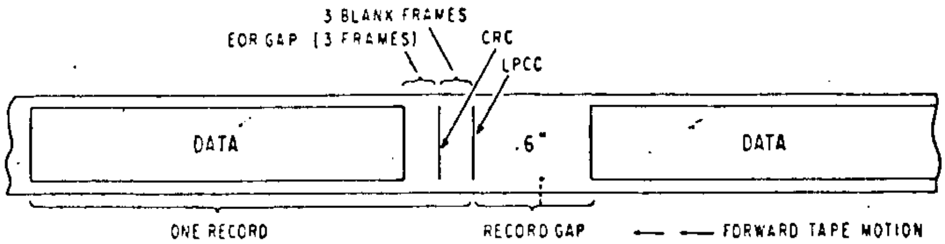
This scheme, which minimizes the effects of errors, is recommended in the standard referenced in the text.

A 1 in an error bit does not necessarily mean the corresponding byte is in error: the error could be in the parity track.

The program must use bit 32 and the parity being checked for in order to regenerate the bit actually read from the parity track of the CRC by the control, keeping in mind that the parity track does not contain an actual parity bit. The parity of the CRC will be odd if the number of data characters in the record is even, otherwise the CRC parity is even.

Errors discovered in a record in core dump format at 800 bpi can be corrected by rereading the record in 9-track format, if investigation of the CRC indicates the errors are confined to a single track. The program must then reconstruct the original words, four from each group of five 4-byte sets supplied by the control.

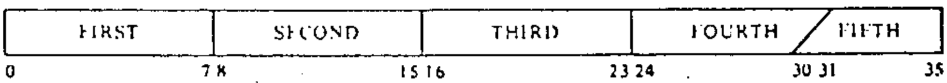
[illegible] or more contiguous missing characters would be interpreted by the control as an EOR gap. This sets the Bad Tape flag and terminates the function.



9-TRACK RECORD FORMAT

indicates an error in the character from which the byte in bits 8–15 was taken). If errors occur, the program can use the cyclic redundancy character to determine if the errors are confined to a single track, and if so, to correct them. After reading the data characters in a record, the control makes the CRC available in a word in which bits 0–7 contain information from the data tracks and bit 32 contains a parity error bit. The program can correct errors by using the procedure described in Appendix B of the standard. It is not necessary to reread the tape: the error pattern can be generated from the data in memory. If errors are confined to a single track, the program can correct the record by complementing the bit from the bad track in every byte whose error bit is 1.

To facilitate the use of 9-track tape for binary data applications, a core dump format is available in which the program can select any density, and the control uses the 9-track record format but writes full 36-bit words as five characters each. The first four bytes are taken from bits 0–31 of a word in the same manner as in 9-track format; the fifth data byte contains 0s in tracks



CORE DUMP BYTE DISTRIBUTION

0 and 1 and bits 30–35 of the word are contained in tracks 2–7. To reassemble the word during reading, the control ors the overlapping bits. The CRC is written in the usual fashion, but no error bits are supplied with the data bytes.

When writing in even parity in any recording format, the program must not supply a word containing a zero data byte, since this would result in a missing character (a blank frame), and no words beyond that point would be reassembled correctly. The control does not check for missing characters when reading, but such an event always terminates the function at the end of the current record.

To facilitate tape processing, the program can group sets of data records into files. The end of a file is indicated by a 3-inch gap followed by a file mark. The file mark is a special record containing a single, special data character and its LPCC, which is equivalent. The control always terminates a function when it encounters a file mark; in particular, the control can space by files as well as by numbers of records.

Each tape has two physical markers to indicate its extremities. These markers are reflective strips that are sensed by photoelectric cells in the transport (one marker can be seen on the tape in the illustration at the end of §H4.2). The loadpoint marker is located about fifteen feet in from the beginning of the reel and denotes the logical beginning of the tape. Reverse functions stop automatically at this marker. A load point gap of at least three inches (twenty-five feet maximum) precedes the first record on the tape. The endpoint marker is about twenty-five feet from the physical end of the tape; the final fifteen feet of tape should be left for trailer, *ie* the program should not record more than ten feet beyond the endpoint (this is enough for a 4000-word record at low density). A status bit indicates when the tape is beyond the endpoint, but this condition stops the tape automatically only when it is spacing forward.

Tapes recorded on some IBM transports have a substandard loadpoint gap of only .5 inch and are thus not compatible with the TM10.

The markers are on the shiny side of the tape; the endpoint marker is against the edge nearer the transport, the loadpoint marker is against the opposite edge.

An annular groove is molded into the back of every reel, and the control cannot write on the tape unless the supply reel has a plastic (write enable) ring in this groove. By leaving the ring out, the operator can protect the data on the tape from accidental destruction (overwriting or erasure).

While the control is actually processing the data portion of a record, the data transfer rate is fixed. However, in a lengthy tape run, the effective (average) transfer rate depends on record length, which determines the percentage of tape taken up by gaps (at the highest density in 7-track format, each record gap could hold 100 additional words). The effective transfer rate is therefore a function of record length as well as tape speed and density.

8. Data block structure

8.1 Labels

8.1.1 Tape header label

A detailled description of all labels is contained in tables 8-1-1 to 8-1-2.

Table 8-1-1 TAPE HEADER LABEL

Only the first ten words of this record are used, all are INTEGER words.

Word	Contents	Value
1	Label identification	1
2	Reel-number (insignificant)	variable
3	Helios A (=90), or Helios B (=91)	90,91
4	Level of tape processing (insignificant)	4
5	Experiment-identification	9
6	Sequence number of tape (=1 for month of launch)	variable
7	Code for computing center (insignific.)	20
8	Day } of Tape-generation	1 to 31
9	Month } of Tape-generation	1 to 12
10	Year } of Tape-generation	19..
11-286	not used	0

8.1.2 MC-header label

Table 8-1-2 MC-HEADER LABEL

This record contains 286 words, only the first 110 words are used, the first 70 words are to be read in INTEGER the rest is to be read in REAL (single precission)

Word		Contents	Value
1		Label identification	2
2		MC-number (counted from launch)	variable
3		Year	19..
4		Day	1...366
5		Hour	0...23
6		Min	1...59
7		Millisec	1...59999
		(Words 3–7: start of MC science data (ground receipt time))	
8-12		Same as above for end of MC science data	
13		Control for position of the filter-wheels: Motor 1 (15^{o} Pol.)	0,1,2
14		Control for position of the filter-wheels: Motor 2 (30^{o})	0,1,2
15		Control for position of the filter-wheels: Motor 3 (90^{o})	0,1,2
16		Control for position of the filter-wheels: Motor 4 (15^{o} colour)	0,1,2
	0	correct position recorded	
	1	failure to record zero position	
	2	no control bit available	
17		Dark-current control 15^{o} PMT, short sector	0,1,2
18		Dark-current control 15^{o} PMT, medium sector	0,1,2
19		Dark-current control 15^{o} PMT, long sector	0,1,2
	0	data available	
	1	not enough data available for averaging	
	2	no original experiment data blocks available	
		In cases 1 and 2 dark-current is taken from preceding MC.	
20		Dark-current flag 15^{o} PMT, short sector	0,1,2,...
21		Dark-current flag 15^{o} PMT, medium sector	0,1,2,...
22		Dark-current flag 15^{o} PMT, long sector	0,1,2,...
	0	all data $\leq$ upper limit	
	>0	n count rates $>$ upper limit	
23		Dark-current control 30^{o} PMT short sector	0,1,2
24		Dark-current control 30^{o} PMT medium sector	0,1,2
25		Dark-current control 30^{o} PMT long sector	0,1,2
	0	data available	
	1	not enough data avialable for averaging	
	2	no original experiment data blocks available	
		In cases 1 and 2 dark-current is taken from preceding MC.	
26		Dark-current flag 30^{o} PMT, short	0,1,2,...
27		Dark-current flag 30^{o} PMT, medium	0,1,2,...
28		Dark-current flag 30^{o} PMT, long	0,1,2,...
	0	all data $\leq$ upper limit	
	>0	n count rates $>$ upper limit	
29		Dark-current control 90^{o} PMT	0,1,2
	0	data available	
	1	not enough data available for averaging	
	2	no original experiment data blocks available	
		In cases 1 and 2 dark-current is taken from preceding MC.	

Table 8-1-2 (continued)

Word	Contents	Value
30	Dark-current flag 90° PMT	0,1,2,···
0	all data ≤ upper limit	
>0	n count rates > upper limit	
31-58	not used	0
59	Flag for Bit 16 (in EDR)	0,1,2,···
0	Bit 16 did not change	
>0	number of changes of bit 16 within 1 MC	
60	Bit 16 in the first EDF, is used for bit 16 for this MC	1,0
61-70	not used	
All the following words are to be read in REAL (single precission)		
71	Temperature PMT 15°	variable
72	Temperature PMT 30°	variable
73	Temperature PMT 90°	variable
74	Temperature electronic-box	variable
75-76	not used	
77	Dark-current PMT 15° short sector	variable
78	Dark-current PMT 15° medium sector	variable
79	Dark-current PMT 15° long sector	variable
80	Dark-current PMT 30° short sector	variable
81	Dark-current PMT 30° medium sector	variable
82	Dark-current PMT 30° long sector	variable
83	Dark-current PMT 90°	variable
77-83	means the average of all available data in this measurement cycle (sectors 5.6°, 11.3°, 22.5°)	
	Sensor 15°	
84	calibration lamp A, polarisation-foil, corrected average	variable
85	calibration lamp B, polarisation-foil, corrected average	variable
86	calibration lamp A, quartz, corrected average	variable
87	calibration lamp B, quartz, corrected average the value is set to -1.0 if no data or only one count rate are available.	variable
88	calibration lamps, ratio AQ/AP	variable
89	calibration lamps, ratio BQ/BP	variable
90	calibration lamps, ratio AQ/BQ	variable
91	calibration lamps, ratio AP/BP the value is set to -1.0 if no data or only one count rate are available.	variable
	Sensor 30°	
92	calibration lamp A, quartz	variable
93	calibration lamp B, quartz	variable
94	calibration lamps, ratio AQ/BQ the value is set to -1.0 if no data or only one count rate are available.	variable

Table 8-1-2 (continued)

Word	Contents	Value
	Sensor 90°	
95	calibration lamp A	variable
96	calibration lamp B	variable
97	calibration lamps, ratio A/B the value is set to -1.0 if no data or only one count rate are available.	variable
	Whole experiment:	
98	Spin-rate (taken from 1st OA-Block of this MC)	variable
99	Spin-rate (taken from the last OA-Block of this MC)	variable
100	λ(Helios) (taken from 1st OA-Block) of this MC	variable
101	λ(Helios) (taken from last OA-Block of this MC)	variable
102	Distance Helios-Sun (in AU) (from 1st OA Block)	variable
103	Distance Helios-Sun (in AU) (from last OA Block)	variable
104	SIGMA	variable
105	THETA	variable
106	Day of first OA-Block	variable
107	Hour of first OA-Block	variable
108	Day of last OA-Block	variable
109	Hour of last OA-Block	variable
110-286	not used	0.

8.2 Data blocks

There are three types of Data-blocks. The block formats are shown in Tables 8-2-1 to 8-2-3.

8.2.1 Housekeeping blocks

This record contains also 286 words, only the first 202 words are used. All words are INTEGER words.

Table 8-2-1 HOUSEKEEPING BLOCKS (HK-BLOCK)

Word	Contents	Value
1-n	$1 \leq n \leq 24$ Block identification n= number of hourly averages in this MC	10
n+1 to 24	not used	0
25 to 24+n	MC-number (counted from launch)	variable
25+n to 48	not used	0
49 to 48+n	seconds since beginning of the day	variable
or	seconds since beginning of the year	variable
49+n to 72	not used	0
73 to 72+n	one-hour-average of the external temperatures of sensor 15^{o}	variable
73+n to 96	not used	0
97 to 96+n	one-hour-average of the external temperatures of sensor 30^{o}	variable
9[illegible] to 120	not used	0
21 to 120+n	one-hour-average of the external temperatures of sensor 90^{o}	variable
21+n to 144	not used	0
45 to 144+n	one-hour-average of the external temperatures of the electronic box	variable
45+n to 168	not used	0
69 to 168+n	one-hour-average of the internal temperatures of sensor 30^{o}	variable
69+n to 192	not used	0
93 to 192+n	one-hour-average of the internal temperatures of sensor 15^{o}	variable
93+n to 286	not used	

The value is set -99 if no data are available

8.2.2 Science-block

This record contains 286 words only the first 138 words are used, the first 52 words are to be read in INTEGER, the rest is to be read in Real (single precission)

Table 8-2-2 SCIENCE-BLOCK (SC-BLOCK)

Word	Contents	Value
1	Block identification	11
2	Block sequence-number in file	variable
3	TLM-format	variable
4	Telemetry bitrate (bits/seconds)	variable
5	Number of the first SC-frame in block	variable
6	Number of the last SC-frame in block	variable
7	DM (distribution mode) If the value of the seventh word is equal seven so the time in words 9 to word 16 are fictitious times.	0,1,2,3,4,7
8	Bitrate while measuring (in Helios)	variable
9	Ground receipt time Day	1 to 366
10	Ground receipt time Hour	0 to 23
11	Ground receipt time Minutes	0 to 59
12	Ground receipt time Milliseconds	0 to 59999
13	SC-transmit-time Day	1 to 366
14	SC-transmit-time Hour	0 to 23
15	SC-transmit-time Minutes	0 to 59
16	SC-transmit-time Milliseconds	0 to 59999
17	Ground receipt time Year	19 ...
18	24 bit word to flag data transfer of telemetry words 1-24 0 = correct transmission 1 = telemetry word suspect or missing First 4 1/2 telemetry words cover the ID-bits. Then each 1 1/2 telemetry words correspond to one count rate	variable
19	Bit 1 of ID-word	1
20	Bit 2 of ID-word	0,1
21	Bit 3 of ID-word	0,1
22	Bits 4-8 of ID-word	0...31
23-50	Bits 9-36 of ID-word Word 19-50 are taken from word 45-76 from the EDR	0,1
51-52	24 bit words to flag data transfer of telemetry words 25-48 and 49-72, see also description of word 18	variable
	The following words are to be read in REAL (single precision)	
53-84	Count rates (sector 1 - sector 32) from original data blocks, 0, -0 or 1.6×10^8 means no data available	variable
85-116	S-10 values (sector 1 - sector 32). Only calculated for zodiacal light measurements. Empty for blocks containing dark current, calibration lamp or test pulses.	variable

Table 8-2-2 (continued)

Word	Contents	Value
117	Stokes Parameter Q (U)	
118	Stokes Parameter Q (B)	
119	Stokes Parameter Q (V)	
120	Angle of polarization in degrees* (U)	variable
121	Angle of polarization in degrees* (B)	
122	Angle of polarization in degrees* (V)	variable
	*Counted counter-clockwise from line sun-ecliptic pole .	variable
123	Stokes Parameter U (U)	
124	Stokes Parameter U (B)	
125	Stokes Parameter U (V)	
126	polarized intensity in U	variable
127	polarized intensity in B	variable
128	polarized intensity in V	variable
129	Intensity (S10) in U	variable
130	Intensity (S10) in B	variable
131	Intensity (S10) in V	variable
132	Rate of polarization (U)	variable
133	Rate of polarization (B)	variable
134	Rate of polarization (V)	variable
	Words 117-134 are only contained in the data of the PMT 90°. These words are O. for PMT 15° and PMT 30°.	
135	Distance Helios-sun	variable
136	λ(sun seen from Helios, equinox 1975)	variable
137	λ(Helios seen from sun, equinox 1975)	variable
138	Spin-rate (rps)	variable
139-286	not used	O.
	Words 135-138 are interpolated from the OA-blocks (ground receipt time). They are not added for blocks containing dark current, calibration lamp or test pulses. The ground-receipt-time from the first SC-block is taken for MC-start-time, MC-end time is taken from the ground-receipt time of the last SC-block.	

8.2.3 Orbit-attitude block

This record contains also 286 words, only the first 145 are used, the first 4 words are to be read in INTEGER, word 5-145 are to be read in REAL (single precission).
With exception of word 3 these are copies of the orbit-attitude-blocks on the EDR.

Table 8-2-3 ORBIT-ATTITUDE BLOCK (OA-BLOCK)

Word	Contents	Value
1	Block identification	20
2	Block sequence number in file	variable
3	Number of MC from launch	variable
4	Insignificant	variable
	The following words are to be read in REAL(single precission). Coordinates are given for epoch and mean equinox of 1950.0	
TIME-BLOCK		
5	Julian date in ephemeris time	variable
6	Time past January 1, 1950 in ephemeris time	variable
7	Year	19 ...
8	Month	1.-12.
9	Day	1.-31.
10	Hour	0.-23.
11	Minutes	0.-59.
12	Seconds	0.-59.
13	Time from launch in seconds	variable
14	Ephemeris time-UTC, in seconds	variable
15	X } Position coordinates of	variable
16	Y } Helios in A.U.	variable
17	Z }	variable
18	UX } Velocity coordinates of	variable
19	UY } Helios in A.U. per day	variable
20	UZ }	variable
21-26	Same as above for Mercury	variable
27-32	Same as above for Venus	variable
33-38	Same as above for Earth	variable
39-44	Same as above for Mars	variable
45-50	Same as above for Jupiter	variable
51-56	Same as above for Moon	variable
57	Ecliptical longitude, counted from mean equinox, of Helios	variable
58	Ecliptical longitude, counted from earth-sun line, of Helios	variable
59	Ecliptical latitude of Helios	variable
60	Distance in A.U. of sun-Helios	variable
61-64	Same as above for Mercury	variable
65-68	Same as above for Venus	variable
69-72	Same as above for Earth	variable
73-76	Same as above for Mars	variable
77-80	Same as above for Jupiter	variable
81-84	Same as above for Moon	variable

Table 8-2-3 (continued)

Word	Contents	Value
85	Radial velocity of Helios in A.U. per day	variable
86	Normal velocity of Helios in A.U. per day	variable
87	Heliographic longitude of Helios, counted from the ascending node	variable
88	Heliographic latitude of Helios	variable
	Number of rotation of the sun, in a launch at 16 heliographic latitude	
89	Same, referred to the earth	variable
90	Referred to Helios	variable
GEOMETRIC BLOCK		
91	Right ascension of Helios	variable
92	Declination of Helios	variable
93	Distance in A.U. of Earth-Helios	variable
94-96	Same as above for Moon	variable
97-99	Same as above for Sun	variable
100	Radial velocity of Helios in A.U. per day	variable
101	Normal velocity of Helios in A.U. per day	variable
102	X Position coordinates of Helios in A.U.	variable
103	Y Position coordinates of Helios in A.U.	variable
104	Z Position coordinates of Helios in A.U.	variable
105	UX Velocity coordinates of Helios in A.U. per day	variable
106	UY Velocity coordinates of Helios in A.U. per day	variable
107	UZ Velocity coordinates of Helios in A.U. per day	variable
108-113	Same as above for Sun	variable
114	Solar ecliptical latitude of Helios	variable
115	Solar ecliptical longitude of Helios	variable
116	X Solar magnetospheric coordinates of Helios	variable
117	Y Solar magnetospheric coordinates of Helios	variable
118	Z Solar magnetospheric coordinates of Helios	variable
DISTANCES BLOCK (all distances in A.U.)		
119	Helios-Mercury	variable
120	Helios-Venus	variable
121	Helios-Earth	variable
122	Helios-Mars	variable
123	Helios-Jupiter	variable
124	Helios-Moon	variable
125	Helios-Moon-orbit	variable
ANGLES BLOCK (in degrees)		
126	Earth-Helios-sun	variable
127	Helios-sun-earth	variable
128	Sun-earth-Helios	variable
129	Helios-earth-moon	variable
130	Ecliptic-plane - (earth-Helios) line	variable
131	Right ascension of orbit pole	variable
132	Declination of orbit pole	variable

Table 8-3-2 (continued)

Word	Contents	Value
ATTITUDE BLOCK		
133	Flag for black-out	variable
134	Solar aspect angle SIGMA	variable
135	3 sigma value of the solar aspect angle	variable
136	Pitch angle THETA	variable
137	3 sigma value of the pitch angle	variable
138	Angle between Z-axis and orbit plane	variable
139	Mercury aspect angle (angle between z-axis and Helios Mercury-line)	variable
140	Venus aspect angle	variable
141	Mean spin rate	variable
142	Ecliptical longitude of S/C-spin axis	variable
143	Ecliptical longitude of S/C-spin axis counted from earth-sun line	variable
144	Ecliptical latitude of S/C-spin axis	variable
145	Dummy	variable

9. Remarks

As mentioned in Chapter 1 a reduced-data-tape normally contains the data of one month.

But often it happens, that the reduced-data-tape contains the last days of the preceding month or the first days of the following month or both of them.

Some times it occurs that the tape covers the period of two total months. This happened when within one month only a few measurement cycles were received.

In the extended mission of the spacecraft the zodiacal light experiment had to be switch off during aphelion passages due to a decline in the available spacecraft power. Therefore there are months for which no data are available.

Other larger data gaps may be due to blackout periods (Helios behind the sun, no telemetry transmission possible).

If a measurement cycle contains more than one block with sky light data of a given identification (ID word bits 1,2,3 and 4-8), then only the data of the last of these blocks will be reduced.

Spikes in the data do occur from time to time. Usually they can be traced back to transmission errors.

Known peculiarities in Helios B reduced data tapes

1.) In October 1979 sensor 30^{o} slowly lost sensitivity until complete failure. For simplicity the data were kept on tape.

2.) Attitude maneuvers were performed on days 15 to 21/1976, 51/1976, 58/1976 and 341 to 342/1977. Orbit-attitude information on spin axis orientation (SIGMA, THETA) may be unreliable for those dates.

3.) Disorder of 90^{o} science blocks mentioned on page 2.7 occurred, e.g., on days 93 to 94/1977.

4.) MZY 579 (during blackout, July 1976) covers a period of 10 days. Values of λ, R, interpolated in the science blocks, therefore, may be slightly off.

Known peculiarities in Helios A reduced data tapes

1.) Orbit-attitude information on spin axis orientation (SIGMA, THETA) is unreliable from launch through d41/1975, also during attitude maneuvers on days 63/1975, 80/1975 102/1975 and 77/1976.

- to be continued -

10. Programm for reading the tape

This programm to read a reduced tape was used on a DEC-10 computer (36-bit word structure).

```
C*****************************************************************
C
C*****************************************************************
C------THIS PROGRAMM READS SOME FILES FROM A REDUCED-DATA-TAPE---
C*****************************************************************
C
C*****************************************************************
      DIMENSION  I(286),HEADER(39),DA(141),SC(86)

      EQUIVALENCE  (I(71),HEADER(1)),(I(53),SC(1)),(I(5),DA(1))
      IW=3
      L=0
      M=0
C--- L COUNTS THE NUMBER OF FILES---
C--- M COUNTS THE NUMBER OF RECORDS---
7     OPEN(UNIT=17,DEVICE='MTA',DENSITY='1600',MODE='BINARY',
      1ACCESS='SEQIN')
6     DO  3  I1=1,286
3     I(I1)=0
      READ(17,ERR=4,END=5)  I
      M=M+1
      TYPE 101,M
      IF(I(1).EQ.1)  GOTO  1
      IF(I(1).EQ.2)  GOTO  2
      IF(I(1).EQ.10) GOTO 10
      IF(I(1).EQ.11) GOTO 11
      IF(I(1).EQ.20) GOTO 20
      GOTO 6
1     WRITE(IW,100)  (I(K),K=1,10)
      WRITE(IW,500)
500   FORMAT(///)
100   FORMAT(3X,10I10)
      GOTO  6
2     WRITE(IW,100)  (I(K),K=1,70)
      WRITE(IW,200)  (HEADER(K),K=1,39)
      WRITE(IW,500)
200   FORMAT(10(1X,E10.4,1X))
      GOTO  6
10    WRITE(IW,100)  (I(K),K=1,286)
      WRITE(IW,500)
      GOTO  6
11    WRITE(IW,100)  (I(K),K=1,52)
      WRITE(IW,200)  (SC(K),K=1,86)
      WRITE(IW,500)
      GOTO  6
20    WRITE(IW,100)  (I(K),K=1,4)
      WRITE(IW,200)  (DA(K),K=1,141)
      WRITE(IW,500)
      GOTO  6
4     WRITE(IW,300)
300   FORMAT(10X,10(1H*),'PARITY-ERROR',10(1H*))
      GOTO  6
5     WRITE(IW,400)
400   FORMAT(10X,10(1H*),'E O F ',10(1H*))
      L=L+1
      TYPE 102,L
101   FORMAT(3X,'NUMBER OF RECORDS',I4)
102   FORMAT(10X,'NUMBER OF FILES',I4)
      IF(L.LT.2)  GOTO  7
      CLOSE(UNIT=17)
      STOP'2 FILES ARE READ'
      END
```

11. Example of a print-out of the tape

This is an example for the print-out of some files of the reduced tape.

day mo yr

1	1727	91	4	9	19	[illegible]	14	2	1980	TAPE HEADER

yr day hour

2	1610	1977	213	23	38	40640	1977	215	1
25	27790	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	13	1
0	0	0	0	0	0	0	0	0	0
-.1483E+02	-.6667E+01	-.1467E+02	-.7000E+01	.0000E+00	.0000E+00	.9140E+03	.1617E+04	.2871E+04	.9235E+03
.1591E+04	.2968E+04	.1541E+04	-.1000E+01	.5368E+06	-.1000E+01	.1557E+07	.0000E+00	.2901E+01	.0000E+00
.0000E+00	-.1000E+01	-.1000E+01	.0000E+00	-.1000E+01	-.1000E+01	.0000E+00	.1014E+01	.1014E+01	.1190E+03
.1198E+03	.9791E+00	.9776E+00	.8948E+02	.2700E+03	.2130E+03	.2300E+02	.2150E+03	.2000E+01	

yr day hr.

2	1611	1977	215	1	36	15780	1977	215	1
47	3780	0	0	0	0	0	0	0	0
0	0	2	2	2	0	0	0	2	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0
-.1483E+02	-.6667E+01	-.1467E+02	-.7000E+01	.0000E+00	.0000E+00	.9401E+03	.1638E+04	.2834E+04	.9235E+03
.1591E+04	.2968E+04	.1541E+04	-.1000E+01	-.1000E+01	-.1000E+01	-.1000E+01	.0000E+00	.2901E+01	.0000E+00
.0000E+00	-.1000E+01	-.1000E+01	.0000E+00	-.1000E+01	-.1000E+01	.0000E+00	.1014E+01	.1014E+01	.1190E+03
.1198E+03	.9791E+00	.9776E+00	.8948E+02	.2700E+03	.2130E+03	.2300E+02	.2150E+03	.2000E+01	

2	1612	1977	216	16	29	2280	1977	218	0
42	12870	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0
-.1450E+02	-.6750E+01	-.1450E+02	-.6500E+01	.0000E+00	.0000E+00	.9713E+03	.1581E+04	.2810E+04	.9187E+03
.1568E+04	.2854E+04	.1534E+04	-.1000E+01	.5367E+06	-.1000E+01	.1558E+07	.0000E+00	.2904E+01	.0000E+00
.0000E+00	-.1000E+01	-.1000E+01	.0000E+00	-.1000E+01	.5535E+06	.0000E+00	.1014E+01	.1014E+01	.1209E+03
.1219E+03	.9751E+00	.9726E+00	.8946E+02	.2700E+03	.2160E+03	.1600E+02	.2180E+03	.1000E+01	

2	1613	1977	218	0	53	870	1977	218	17
59	40	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	2	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
-.1450E+02	-.6750E+01	-.1450E+02	-.7000E+01	.0000E+00	.0000E+00	.9240E+03	.1665E+04	.2854E+04	.9340E+03
.1616E+04	.2990E+04	.1534E+04	.1159E+07	-.1000E+01	.3349E+07	-.1000E+01	.2889E+01	.2904E+01	.2149E+01
.2160E+01	.2416E+07	-.1000E+01	-.1000E+01	-.1000E+01	-.1000E+01	.0000E+00	.1014E+01	.1014E+01	.1219E+03
.1223E+03	.9725E+00	.9712E+00	.8946E+02	.2700E+03	.2180E+03	.2000E+01	.2180E+03	.1800E+02	

[illegible]	1672	1977	242	16	16	[illegible]	1977	242	21
4	41909	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0
-.1110E+02	-.5050E+01	-.9800E+01	-.3000E+01	.0000E+00	.0000E+00	.8625E+03	.1494E+04	.2719E+04	.8673E+03
.1608E+04	.2781E+04	.1502E+04	-.1000E+01	.5353E+06	-.1000E+01	.1552E+07	.2880E+01	.2899E+01	.2151E+01
.2166E+01	-.1000E+01	.1317E+07	.1822E+01	-.1000E+01	.5505E+06	.2016E+01	.1014E+01	.1014E+01	.1407E+03
.1409E+03	.8721E+00	.8708E+00	.8946E+02	.2700E+03	.2420E+03	.1700E+02	.2420E+03	.2200E+02	

2	1673	1977	242	21	23	35869	1977	243	8
20	55902	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
-.1121E+02	-.4778E+01	-.1011E+02	-.3000E+01	.0000E+00	.0000E+00	.9064E+03	.1498E+04	.2727E+04	.9203E+03
.1515E+04	.2798E+04	.1410E+04	.1158E+07	-.1000E+01	.3344E+07	-.1000E+01	.2887E+01	.2899E+01	.2155E+01
.2163E+01	.2405E+07	-.1000E+01	.1825E+01	.1111E+07	-.1000E+01	.2019E+01	.1014E+01	.1014E+01	.1409E+03
.1413E+03	.8705E+00	.8679E+00	.8946E+02	.2700E+03	.2420E+03	.2300E+02	.2430E+03	.9000E+01	

2	1674	1977	243	8	40	7948	1977	243	17
45	46338	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0
-.1123E+02	-.4600E+01	-.1000E+02	-.3000E+01	.0000E+00	.0000E+00	.8973E+03	.1536E+04	.2726E+04	.9211E+03
.1459E+04	.2861E+04	.1567E+04	-.1000E+01	.5352E+06	-.1000E+01	.1552E+07	.2887E+01	.2899E+01	.2155E+01
.2163E+01	-.1000E+01	.1315E+07	.1825E+01	-.1000E+01	-.1000E+01	.2019E+01	.1014E+01	.1014E+01	.1413E+03
.1416E+03	.8676E+00	.8655E+00	.8946E+02	.2700E+03	.2430E+03	.1000E+02	.2430E+03	.1800E+02	

**********E O F **********

MEASUREMENT CYCLE HEADER BLOCK

2	1610	1977	213	23	38	40640	1977	215	1
25	27790	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	13	1
0	0	0	0	0	0	0	0	0	0
-.1483E+02	-.6667E+01	-.1467E+02	-.7000E+01	.0000E+00	.0000E+00	.9140E+03	.1617E+04	.2871E+04	.9235E+03
.1591E+04	.2968E+04	.1541E+04	-.1000E+01	.5368E+06	-.1000E+01	.1557E+07	.0000E+00	.2901E+01	.0000E+00
.0000E+00	-.1000E+01	-.1000E+01	.0000E+00	-.1000E+01	-.1000E+01	.0000E+00	.1014E+01	.1014E+01	.1190E+03
.1198E+03	.9791E+00	.9776E+00	.8948E+02	.2700E+03	.2130E+03	.2300E+02	.2150E+03	.2000E+01	

11	48	3	64	208	215	0	64	213	23
38	40640	213	23	22	9585	1977	0	1	0
1	0	0	1	1	0	0	0	1	1
1	0	0	0	1	1	1	1	1	
0	1								

.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E.	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+.	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00				

SCIENCE BLOCK

11	3	2	64	36	63	0	64	213	23
51	52640	213	23	35	21594	1977	0	1	0
1	1	0	1	1	0	0	0	1	1
1	0	0	0	1	1	1	1	1	0
0	1	1	1	1	1	1	1	1	1
0	65535								
.9560E+03	.8720E+03	.9960E+03	.7840E+03	.1020E+04	.8000E+03	.7760E+03	.8840E+03	.1684E+04	.1720E+04
.1744E+04	.1540E+04	.3168E+04	.2576E+04	.2744E+04	.2880E+04	.2920E+04	.3336E+04	.2616E+04	.2728E+04
.1472E+04	.1772E+04	.1380E+04	.1620E+04	.8400E+03	.9120E+03	.1004E+04	.8040E+03	.8800E+03	.1052E+04
.9680E+03	.1076E+04	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00				

11	4	2	64	72	107	0	64	214	0
2	40630	213	23	46	9590	1977	0	1	0
1	2	0	1	1	0	0	0	1	1
1	0	0	0	1	0	1	1	1	0
0	1	1	1	1	1	1	1	1	1
0	0								
.1446E+06	.1441E+06	.1441E+06	.1441E+06	.1452E+06	.1441E+06	.1446E+06	.1446E+06	.2875E+06	.2885E+06
.2885E+06	.2885E+06	.5773E+06	.5752E+06	.5752E+06	.5752E+06	.5752E+06	.5752E+06	.5752E+06	.5752E+06
.2885E+06	.2885E+06	.2885E+06	.2885E+06	.1441E+06	.1446E+06	.1441E+06	.1441E+06	.1441E+06	.1441E+06
.1446E+06	.1441E+06	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00				

11	5	2	64	108	143	0	64	214	0
13	28630	213	23	56	57597	1977	0	1	0
1	3	0	1	1	0	0	0	1	1
1	0	0	0	1	0	1	1	1	0
0	1	1	1	1	1	1	1	1	1
3840	0								
.4114E+06	.4104E+06	.4114E+06	.4114E+06	.4114E+06	.4114E+06	.4104E+06	.4114E+06	.8230E+06	.8210E+06
.8210E+06	.8210E+06	.1642E+07	.1642E+07	.1642E+07	.1642E+07	.1642E+07	.1642E+07	.1642E+07	.1642E+07
.0000E+00	.8230E+06	.0000E+00	.0000E+00	.4114E+06	.4114E+06	.4114E+06	.4114E+06	.4104E+06	.4114E+06
.4114E+06	.4114E+06	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00				

HOUSEKEEPING BLOCK

1[illegible]	10	10	10	1610	1610	161[illegible]	[illegible]	[illegible]	[illegible]
16[illegible]	1610	1610	1610	1610	1610	16[illegible]	1610	1610	1610
[illegible]0	1610	1610	1610	1610	1610	[illegible]	1610	86400	90000
9[illegible]0	97200	100800	104400	108000	111600	115[illegible]0	118800	122400	126000
129600	133200	136800	140400	144000	147600	151200	154800	158400	162000
165600	169200	-16	-16	-16	-99	-99	-99	-99	-99
-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
-99	-99	-99	-99	-99	-99	-9	-8	-8	-99
-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
-15	-16	-16	-99	-99	-99	-99	-99	-99	-99
-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
-99	-99	-99	-99	-7	-7	-7	-99	-99	-99
-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
-99	-99	-15	-13	-13	-99	-99	-99	-99	-99
-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
-99	-99	-99	-99	-99	-99	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0				

OA BLOCK

20 2 1610 16777215

.2443E+07	.8705E+09	.1977E+04	.8000E+01	.1000E+01	.2300E+02	.0000E+00	.0000E+00	.4879E+08	.4500E+02
-.4750E+00	.8562E+00	-.9052E-04	-.9686E-02	-.6804E-02	.6257E-05	-.2610E+00	-.3769E+00	-.7443E-02	.1746E-01
-.1461E-01	-.2794E-02	.6661E+00	.2837E+00	-.3432E-01	-.7995E-02	.1852E-01	.7233E-03	.6410E+00	-.7867E+00
.4613E-04	.1306E-01	.1080E-01	-.2676E-06	.1208E+01	.7817E+00	-.1293E-01	-.7052E-02	.1293E-01	.4451E-03
.1025E+01	.4982E+01	-.4271E-01	-.7486E-02	.1676E-02	.1607E-03	.6434E+00	-.7875E+00	.1751E-03	.1328E-01
.1136E-01	-.4159E-04	.1190E+03	.1699E+03	-.5297E-02	.9791E+00	.2353E+03	.2861E+03	-.9300E+00	.4585E+00
.2307E+02	.7390E+02	-.2714E+01	.7248E+00	.3092E+03	.0000E+00	.2605E-02	.1015E+01	.3291E+02	.8374E+02
-.5151E+00	.1439E+01	.7837E+02	.1292E+03	-.4811E+00	.5086E+01	.3092E+03	.7720E-01	.9868E-02	.1017E+01
-.1250E-02	.1177E-01	.4334E+02	-.4995E+01	.2068E+02	.1922E+02	.1269E+03	.1912E+02	.1986E+01	-.1738E+02
-.4222E+01	.2532E-02	.1320E+03	.1786E+02	.1015E+01	-.1590E-02	.2871E-01	-.1116E+01	.1643E+01	-.1366E-03
-.2274E-01	-.1760E-01	.6525E-05	-.6410E+00	.7867E+00	-.4613E-04	-.1306E-01	-.1060E-01	.2676E-06	-.3942E-02
-.4983E+01	-.1330E+00	-.9197E+00	.3085E+00	.1252E+01	.1277E+01	.1966E+01	.1684E+01	.4390E+01	.1988E+01
.1983E+01	.5165E+01	.1699E+03	.4983E+01	.1421E+03	-.3916E-02	-.8994E+02	.6657E+02	.0000E+00	.8948E+02
.1000E+00	.2700E+03	.1000E+01	.8946E+02	.8881E+02	.8726E+02	.6083E+02	.2957E+03	.3466E+03	-.8948E+02
-.2337E+27									

20 3 1610 16777215

.2443E+07	.8705E+09	.1977E+04	.8000E+01	.2000E+01	.0000E+00	.0000E+00	.0000E+00	.4880E+08	.4500E+02
-.4754E+00	.8559E+00	-.9026E-04	-.9679E-02	-.6815E-02	.6258E-05.	-.2603E+00	-.3775E+00	-.7559E-02	.1750E-01
-.1456E-01	-.2793E-02	.6657E+00	.2845E+00	-.3429E-01	-.8017E-02	.1851E-01	.7244E-03	.6415E+00	-.7863E+00
.4612E-04	.1305E-01	.1061E-01	-.2645E-06	.1207E+01	.7822E+00	-.1291E-01	-.7057E-02	.1293E-01	.4452E-03
.1025E+01	.4982E+01	-.4270E-01	-.7486E-02	.1876E-02	.1607E-03	.6439E+00	-.7870E+00	.1734E-03	.1326E-01
.1137E-01	-.4188E-04	.1191E+03	.1698E+03	-.5282E-02	.9791E+00	.2354E+03	.2862E+03	-.9444E+00	.4586E+00
.2314E+02	.7393E+02	-.2712E+01	.7248E+00	.3092E+03	.0000E+00	.2604E-02	.1015E+01	.3294E+02	.8373E+02
-.5143E+00	.1439E+01	.7838E+02	.1292E+03	-.4811E+00	.5086E+01	.3093E+03	.7834E-01	.9770E-02	.1017E+01
-.1257E-02	.1177E-01	.4337E+02	-.4998E+01	.2068E+02	.1922E+02	.1269E+03	.1911E+02	.1986E+01	-.1684E+02
-.4045E+01	.2534E-02	.1320E+03	.1785E+02	.1015E+01	-.1597E-02	.2871E-01	-.1117E+01	.1642E+01	-.1364E-03
-.2273E-01	-.1763E-01	.6523E-05	-.6415E+00	.7863E+00	-.4612E-04	-.1305E-01	-.1081E-01	.2645E-06	-.3934E-02
-.4988E+01	-.1486E+00	-.9247E+00	.2853E+00	.1252E+01	.1277E+01	.1986E+01	.1685E+01	.4390E+01	.1988E+01
.1983E+01	.5171E+01	.1698E+03	.4986E+01	.1416E+03	-.3916E-02	-.8994E+02	.6657E+02	.0000E+00	.894[illegible]E+02
.1000E+00	.2700E+03	.1000E+01	[illegible]	[illegible]	[illegible]				

12. List of abbreviations and symbols

MC:	Measurement-cycle through all sensors and all filter combinations, duration normally $\approx$ 5h
ID:	Identification word, the first 36 bits of science data block, often only the first 8 bits are meant, which identify the type of measurement
PMT:	Sensor, photometer
SIGMA:	Solar aspect angle, angle between spin axis and Helios-sun line
THETA:	Pitch angle, measured as rotation about Helios-sun line, 0^{o} if spin axis points in flight direction, 90^{o} if spin axis points north in solar meridian
TLM-Format:	Five different formats (distribution of frame under experiments) are available, see detailed experiment description
SC-frame:	Spacecraft transmits data in frames of 8 x 144 bits
DM:	Refers to handling of data in spacecraft, DM 7 = data stored in the core memory
EDR:	Experiment data frame = science data block
OA-Block:	Block containing Orbit and Attitude information

λ(Helios) in OA Block: Heliocentric ecliptic longitude of Helios counted from vernal equinox (1950.0)

CG-Fixed Coordinate System

Definition

Reference system centered at CG of s/c

ξ and η axis in the orbit plane (perpendicular to each other)

η axis pointing to the sun

ζ axis perpendicular to the orbit plane

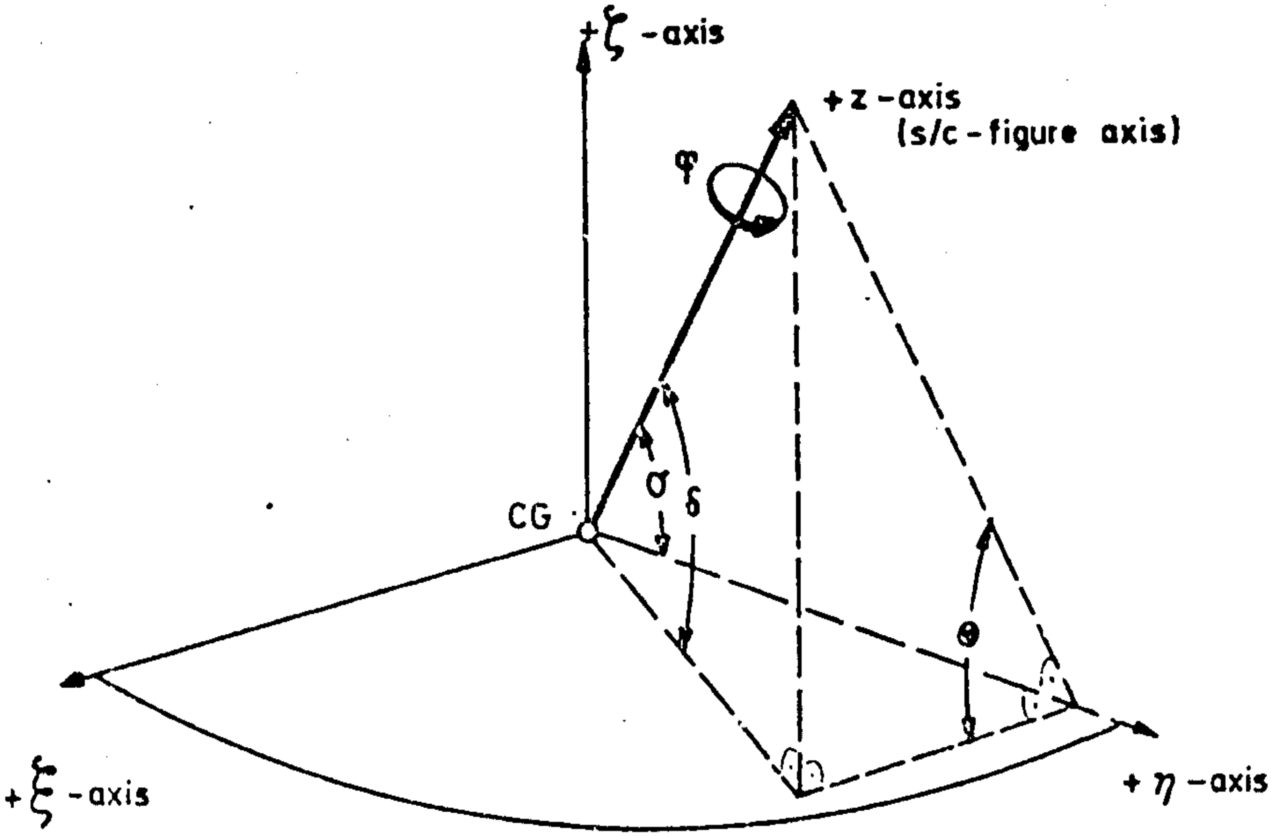


FIG. C-2

Definition of Attitude Coordinate System

CG : Center of Gravity

σ : Solar Aspect Angle (angle between +z- and +η-axis)

Θ : Pitch Angle (angle between orbit plane and plane +z /+η-axes)

δ : Angle between +z- axis and orbit plane

φ : Spin Angle (angle about +z-axis measured by See Sun Pulse)

List of available and missing reduced-data-tapes
"Helios B"

June 1977 is contained in the tape of May 1977
February 1978 is contained in the tape of January 1978
January 1979 is contained in the tape of December 1978

July, August, September of 1978 are missing
February, March of 1979 are missing
July, August, September of 1979 are missing
because the experiment was off.

No data for were received for Helios B later than December 1979.

List of number of files per reduced-data-tape and the association of the reel-number to the month from launch.
(Helios B)

Table 13.1

Reel-number	Files	Month	Year
RHEB01	71	January	1976
RHEB02	135	February	1976
RHEB03	142	March	1976
RHEB04	140	April	1976
RHEB05	62	May	1976
RHEB06	30	June	1976
RHEB07	19	July	1976
RHEB08	43	August	1976
RHEB09	25	September	1976
RHEB10	91	October	1976
RHEB11	129	November	1976
RHEB12	102	December	1976
RHEB13	115	January	1977
RHEB14	126	February	1977
RHEB15	138	March	1977
RHEB16	126	April	1977
RHEB17	87	May, June	1977
RHEB18	46	July	1977
RHEB19	66	August	1977
RHEB20	79	September	1977
RHEB21	89	October	1977
RHEB22	131	November	1977
RHEB23	135	December	1977
RHEB24	134	January, February	1978
RHEB25	132	March	1978
RHEB26	128	April	1978
RHEB27	140	May	1978
RHEB28	41	June	1978
RHEB29	34	October	1978
RHEB30	101	November	1978
RHEB31	155	December, January	1978, 1979
RHEB32	91	April	1979
RHEB33	124	May	1979
RHEB34	94	June	1979
RHEB35	72	October	1979
RHEB36	117	November	1979
RHEB37	87	December	1979

List of missing reduced-data-tapes of Helios A

- to be supplied -

List of number of files per reduced-data-tape and the association of the reel-number to the month from launch (Helios A)

Table 13.2

Reel-number	Files	Month	Year
RHEA01	90	December	1974
RHEA02	142	January	1975
RHEA03	126	February	1975
RHEA04	140	March	1975
RHEA05	84	April	1975
RHEA06	10	May	1975
RHEA07	64	June	1975
RHEA08	108	July	1975
RHEA09	100	August	1975
RHEA10	112	September	1975
RHEA11	106	October	1975
RHEA12	102	November	1975
RHEA13	102	December	1975
RHEA14	70	January	1976
RHEA15	90	February	1976
RHEA16	122	March	1976
RHEA17	122	April	1976
RHEA18	114	May	1976
RHEA19	69	June	1976
RHEA20	17	July	1976
RHEA21	54	August	1976
RHEA22	53	September	1976
RHEA23	126	October	1976
RHEA24	138	November	1976
RHEA25	135	December	1976
RHEA26	119	January	1977
RHEA27	113	February	1977
RHEA28	138	March	1977
RHEA29	123	April	1977
RHEA30	138	May	1977
RHEA31	135	June	1977
RHEA32	52	July	1977
RHEA33	93	August	1977
RHEA34	118	September	1977
RHEA35	140	October	1977

- to be supplied -

14. Plots of temperature, dark current, calibration lamps

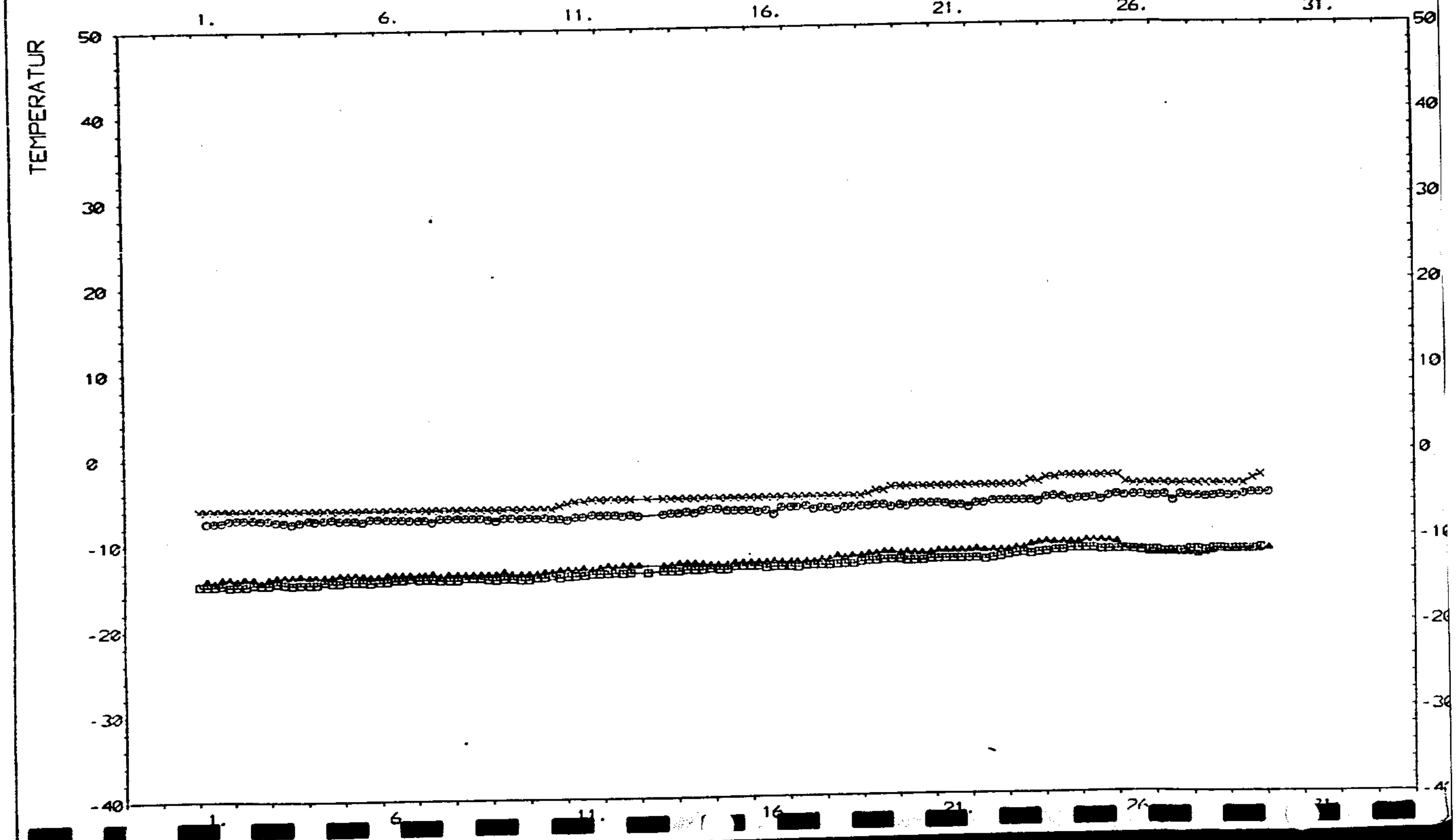
As example plots are presented for Helios B, February 1976.

For the calibration lamps the ratio of measurement to prediction (based on preflight measurements) is given. A refers to the brighter, B to the dimmer lamp. The ratio of the two readings also is given. Stars denote values outside limits.

TEMPERATURMITTEL PRO MESSZYKLUS

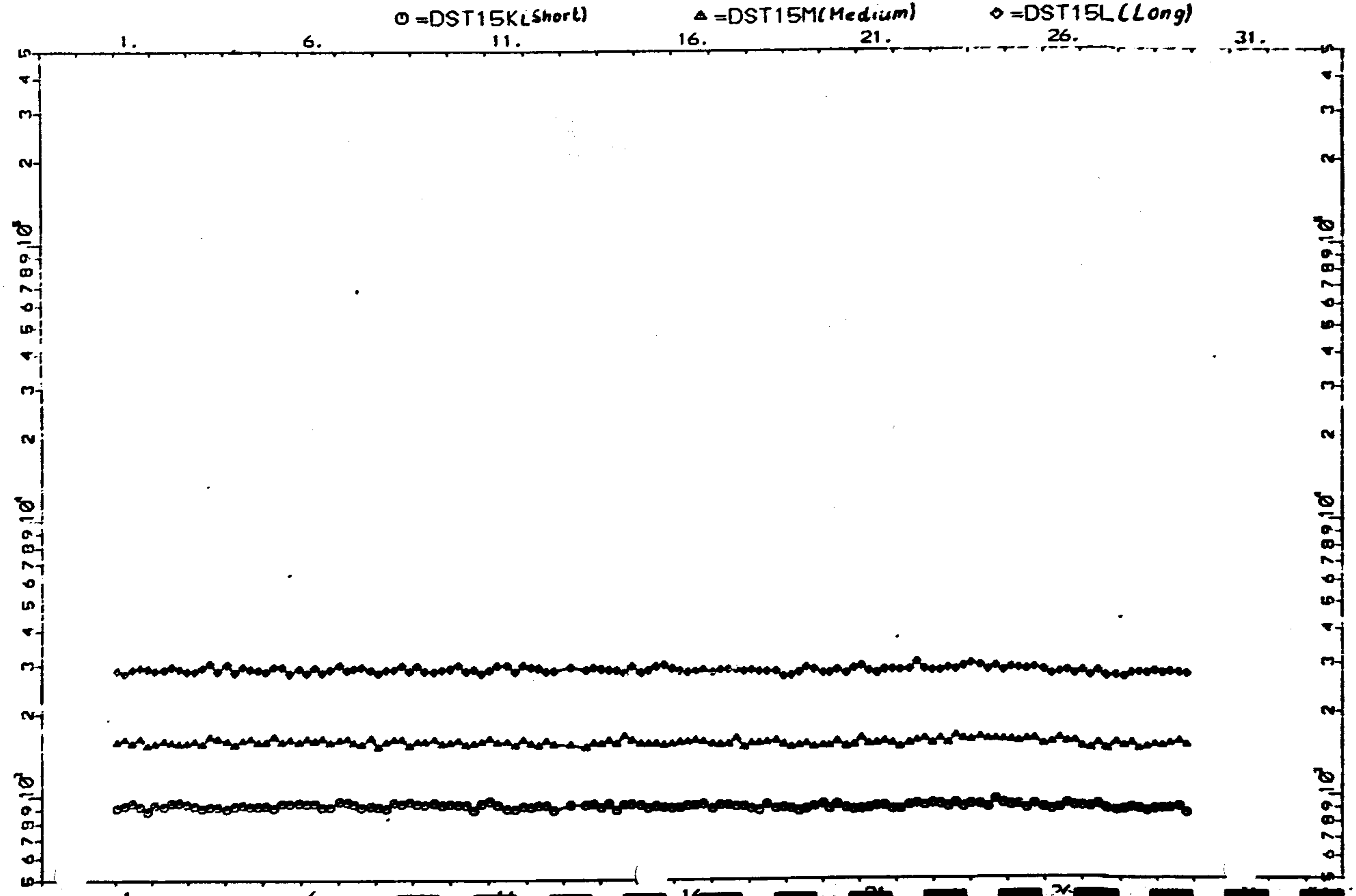
MONAT: FEB JAHR: 1976 HELIOS B R= 0.9601 - 0.8029

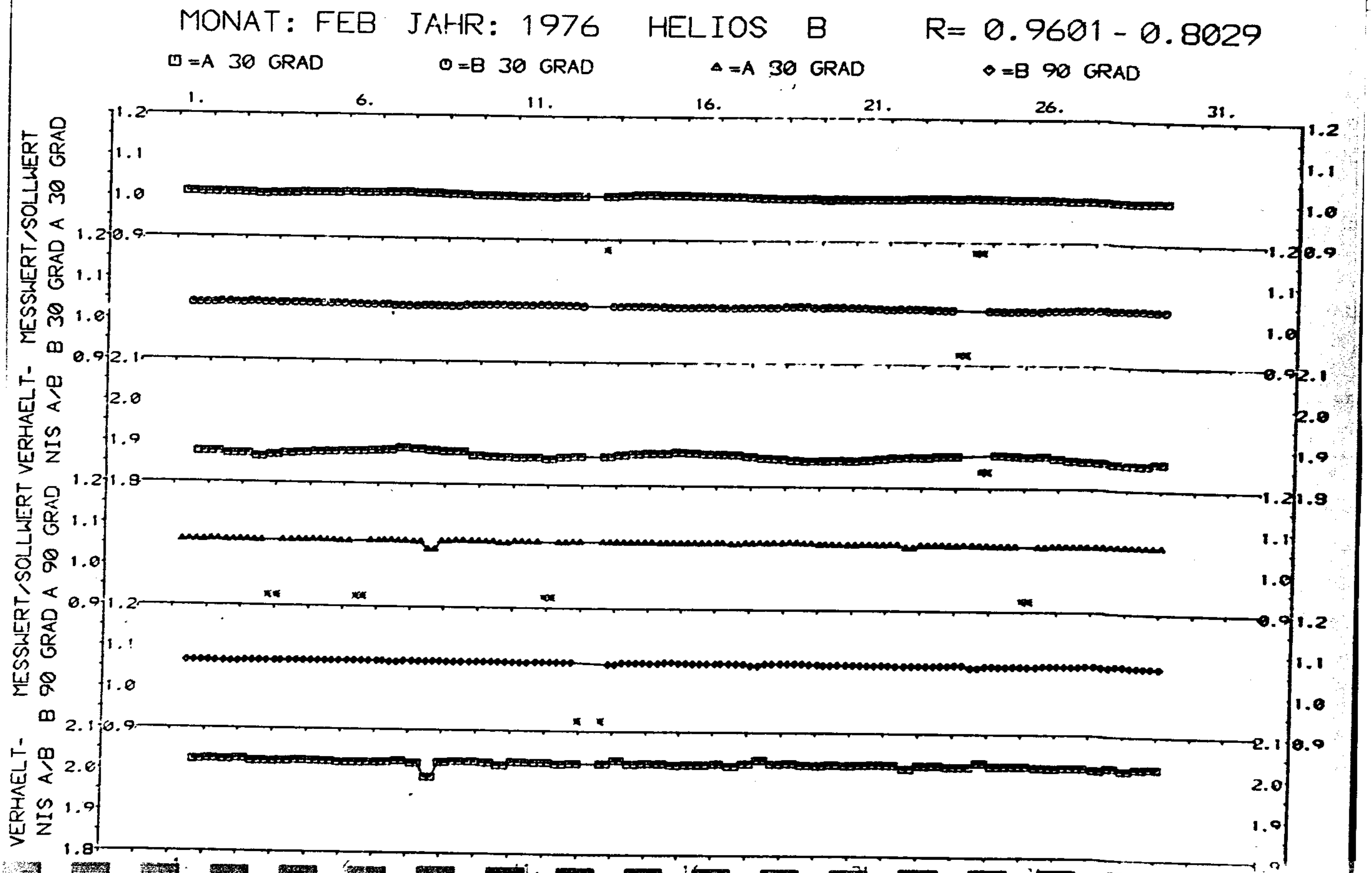
□ =TEMP.15 GRAD ⊙ =TEMP.30 GRAD △ =TEMP.90 GRAD × =TEMP.E-BOX



DUNKELSTROMMESSUNGEN 15 GRAD PHOTOMETER

MONAT: FEB JAHR: 1976 HELIOS B R= 0.9601 - 0.8029





MONAT: FEB JAHR: 1976 HELIOS B R= 0.9601 - 0.8029
▫ =A 30 GRAD
○ =B 30 GRAD
△ =A 30 GRAD
◇ =B 90 GRAD
1.
6.
11.
16.
21.
26.
31.
MESSWERT/SOLLWERT A 30 GRAD
MESSWERT/SOLLWERT B 30 GRAD
VERHAELT-NIS A/B
MESSWERT/SOLLWERT A 90 GRAD
MESSWERT/SOLLWERT B 90 GRAD
VERHAELT-NIS A/B

15. List of events
(Helios A and Helios B, in german)

Stand: 16.10.1980

Helios A Ereignistabelle

Tag		Zeit	Ereignis
10.12.74	344	8h11:00	Start = 0. Aphel
11.12.74	345	22h10:41	E9 ein, erster EDF
13.12.74	347	05h10	Step II abgeschlossen
14.12.74	348	22h09:00	E9 aus, E7 Integrity Check
		23h19:17	E9 ein, erster EDF
16.12.74	349	0314	Lagekorrektur $\theta = -0.2^{o}$
10. 2.75	041	0737	1. Lagemanöver Beginn
		15h27	1. Lagemanöver Ende
4. 3.75	063	7h43	2. Lagemanöver Beginn
			Spin-Up um 0.12 rpm
		16h29	2. Lagemanöver Ende
15. 3.75	074	9h12:15	1. Perihel
21. 3.75	080	7h08:00	3. Lagemanöver Beginn
		10h30	3. Lagemanöver Ende
24. 3.75	083	18h	Alle Experimente aus
			(1. Regulator schalten)
25. 3.75	084	1h01	E9 ein, erster EDF
		11h36	E9 aus
		17h26	E9 ein, erster EDF
12. 4.75	102	7h30	4. Lagemanöver Anfang
		11h47:00	4. Lagemanöver Ende
27. 4.75	117	18h00	1. Blackout Beginn
15. 5.75	135	18h	Blackout Ende
17. 6.75	168		1. Aphel
29. 8.75	241	22h00	2. Blackout Beginn
1. 9.75	244	6h	2. Blackout Ende
11. 9.75	254		Spin-Up um 0.12 rpm
18. 9.75	261		Spin-Up um 0.12 rpm
21. 9.75	264	12h16	2. Perihel
25.11.75	329		Erdnächster Punkt

Tag		Zeit	Ereignis
25.12.75	359	14h00	2. Aphel
17. 3.76	077	13h-14h	5. Lagemanöver (Keppler)
29. 3.76	089	15h52	3. Perihel
6.4.76	097		Spin-Down/Spin-Up (Musmann
22. 6.76	174	04h10:46	Ausschalten durch Überlast (2. Regulator schalten)
29. 6.76	181		E9 an für 10h
2. 7.76	184	18h	3. Aphel
8. 7.76	190		E9 an für 28h
13. 7.76	195		E9 an für 21h
20. 7.76	202		E9 an für 23h
27. 7.76	209		E9 an für 23h
3. 8.76	216		E9 an für 44h
16. 8.76	229	21h10	E9 an
19. 9.76	263	06h40	3. Blackout Beginn
23. 9.76	267	21h05	3. Blackout Ende
1.11.76	306	16h49	M3 bleibt stehen in C3 bei
5.10.76	279	19h07	4. Perihel
19.11.76	324	16h15	M4 schaltet nicht von C2 nach C3, bleibt stehen
8.12.76	343		Versuch, Motoren wieder zu starten
8. 1.77	008	20h51	4. Aphel
3. 4.77	93	17h16:19	Alle Experimente aus (3. Regulator schalten)
3. 4.77	93	23h55	E9 wieder an
13. 4.77	103	22h31	5. Perihel
11. 7.77	192	23h45	Alle Experimente aus (4. Regulator schalten)
18. 7.77	199	0h25	5. Aphel - E9 aus
11. 8.77	223	10h21:07	E9 wieder eingeschaltet
10.10.77	283	16h48	4. Blackout Beginn
12.10.77	285	23h27	4. Blackout Ende
21.10.77	294	2h20:30	6. Perihel
2. 1.78	002	2h47:09	5. Regulator schalten, E9 a

Tag		Zeit	Ereignis
8. 1.78	008	2h44	6. Regulator schalten
9. 1.78	009	21h35:50	7. Regulator schalten
10. 1.78	010	18h37:21	8. Regulator schalten
24. 1.78	024	4h16	6. Aphel
20. 2.78	051	14h05	E9 wieder eingeschaltet
29. 4.78	119	6h13:30	7. Perihel
17. 6.78	168	20h25	M1 bleibt stehen in Stellung P1
2. 7.78	183	21h40:00	E9 ausgeschaltet (Aphel)
12. 7.78	193	8h35:00	Heater group 1 ausgeschaltet (E2-E4)
18. 7.78	198		Heater group 2 aus (E9, E10)
23. 7.78	204	1h18	9. Regulatorschalten
2. 8.78	214	8h11	7. Aphel
17. 8.78	229	9h02	Heater group 1 an (E2, E3, E4)
2. 9.78	245		Heater group 2 an (E9, E10)
7. 9.78	250	21h05	E9 wieder eingeschaltet
7. 9.78	250	22h50:25	10. Regulatorschalten (E9 aus)
10.10.78	283	7h30:00	E9 wieder eingeschaltet
27.10.78	300	9h00	5. Blackout Anfang
1.11.78	305	20h30	5. Blackout Ende
5.11.78	309	10h11	8. Perihel
11.11.78	315	16h48:25	11. Regulatorschalten (E9 aus)
12.11.78	316	4h30	E9 wieder eingeschaltet
24.11.78	358	11h30	Heater group 3 aus (Zentralteil)
3. 1.79	003	7h40	Heater group 1 aus (E2, E3, E4)
8. 1.79	008	8h10	E9 ausgeschaltet (Aphel)
16. 1.79	016	7h02	Heater group 2 aus (E9, E10)
8. 2.79	039	12h00	8. Aphel
9. 4.79	099	9h05	Alle Heizer ein
10. 4.79	100	9h40	E9 ein M2 bleibt stehen in C2
ab 10. 4.79	100-125		Signal von Sensor 30° sinkt auf "Null"
14. 5.79	134	12h41	9. Perihel
2. 6.79	153	12h30	12. Regualtorschalten (E9 aus)

Tag		Zeit	Ereignis
2. 6.79	153	21h	E9 wieder eingeschaltet
15. 6.79	166	15h50	Heizergruppe 3 aus (Zentralteil
8. 7.79	189	13h45	13. Regulatorschalten, E9 aus
		23h10	E9 wieder ein
11. 7.79	192	7h00	Heater group 1 aus (E2,E3,E4)
13. 7.79	194	0h00	E9 aus zum Aphel
18. 7.79	199	13h40	Heater group 2 aus (E9,E10)
17. 8.79	229	14h31	9. Aphel
16.10.79	289		Heizer ein
17.10.79	290	6h45	E9 ein
20.11.79	324	16h25	10. Perihel
19.12.79	353	13h43	Heizergruppe 3 aus
10. 1.80	010	17h21	14. Regulator schalten
			Heizergruppe 1 aus
17. 1.80	017	2h09	15. Regulator schalten
			Heizergruppe 2 aus, E9 aus
4. 2.80	035	12h17	16. Regulator schalten
9. 2.80	040	12h34	17. Regulator schalten
23. 2.80	054	19h51	10. Aphel
30. 4.80	121	12h48	Heizergruppe 2 an
2. 5.80	123		E9 an
28. 5.80	149	21h50	11. Perihel
12. 7.80	194		Heizergruppe 2 aus
			E9 aus
31. 8.80	244	23h52	11. Aphel

Stand: 16.10.1980

Helios B Ereignistabelle

Tag		Zeit	Ereignis
15. 1.76	015	05h34:00	Start = 0. Aphel
17. 1.76	017	00h47:25	E9 ein, erster EDF
18. 1.76	018	21h54:27	E9 aus, E7 Integrity Check
19. 1.76	019	00h04:05	E9 ein, erster EDF
21. 1.76	021	01h33	Abschluß Lagemanöver
20. 2.76	051	13h30	1. Lagekorrektur
27. 2.76	058	14h12-14h37	2. Lagekorrektur
17. 4.76	108	2h29:00	1. Perihel
14. 5.76	135	11h40	1. Blackout Beginn
19. 5.76	140	11h45	1. Blackout Ende
4. 7.76	186	16h:00	2. Blackout Beginn
16. 7.76	198	8h:00	2. Blackout Ende
18. 7.76	200	22h	1. Aphel
4. 9.76	248		TWT2 verloren
20. 9.76	264	03h07	3. Blackout Beginn
29. 9.76	273	23h59	3. Blackout Ende
19.10.76	293	19h08	2. Perihel
7. 1.77	7	3h36	CMD-Empfänger 1 verloren
20. 1.77	020	16h00	2. Aphel
23. 4.77	113	13h03	3. Perihel
17. 5.77	137	12h38-15h06	Störung Übertragung durch Aktivität
29. 5.77	149		4. Blackout Beginn
29. 6.77	180		4. Blackout Ende
25. 7.77	206	10h49	3. Aphel
4.10.77	277	22h20	5. Blackout Beginn
8.10.77	281		5. Blackout Ende
26.10.77	299	8h34:00	4. Perihel
7.12.77	341	7h30	Beginn Lagemanöver
8.12.77	342	18h30	Ende Lagemanöver
12.12.77	346	16h30	Gas ablassen bis auf 0.25 kg

Tag		Zeit	Ereignis
16. 1.78	016	7h47	Beginn Spin-Down wegen Leck
16. 1.78	016	7h49:41	1. Regulatorschalten - E9 aus
16. 1.78	016	9h29:30	Ende Spin-Down
27. 1.78	027	6h48	4. Aphel
13. 2.78	044	8h15	E9 wieder eingeschaltet
1. 3.78	060		Mit letztem Gas stabilen Punkt eingestellt
30. 4.78	120	5h08	5. Perihel
8. 6.78	159		6. Blackout Beginn
1. 7.78	182		6. Blackout Ende
7. 7.78	188	21h15	2. Regulatorschalten - E9 aus
15. 7.78	196	15h35:00	Heater group 2 aus (E9, E10)
17. 7.78	198	14h00:00	Heater group 1 aus (E2, E3, E4)
1. 8.78	213	3h36	5. Aphel
17. 8.78	229	2h50	Heater group 1 an (E2, E3, E4)
28. 8.78	240	8h	Heater group 2 an (E9, E10)
6.10.78	279	12h30	E9 ein
9.10.78	282		7. Blackout Beginn
20.10.78	293	23h25	7. Blackout Ende
22.12.78	356	7h33	Heater group 3 aus (Zentralteil)
2.11.78	306	2h00	6. Perihel
2. 1.79	002	9h00	Heater group 1 aus (E2, E3, E4)
7. 1.79	007	3h00	E9 aus (Aphel)
11. 1.79	011	7h33	Heater group 2 aus (E9, E10)
3. 2.79	034	1h00	6. Aphel
4. 4.79	094	8h58	Alle Heizer ein
6. 4.79	096	9h10	E9 ein
6. 5.79	126	22h44	7. Perihel
15. 6.79	166		Heizergruppe 3 aus (Zentralteil)
27. 6.79	178	18h12:26	3. Regulatorschalten, E9 aus
28. 6.79	179	8h35	E9 wieder eingeschaltet
30. 6.79	181	14h00	Heizergruppe 1 aus (E2,E3,E4)

Tag		Zeit	Ereignis
1. 7.79	182	16h00	E9 ausgeschaltet
3. 7.79	184	8h40	E9 wieder eingeschaltet
5. 7.79	186	9h30	E9 ausgeschaltet
7. 7.79	188	8h25	Heizergruppe 2 aus (E9,E10)
7. 8.79	219	21h08	7. Aphel
28. 9.79	271	12h20:32	4. Regulatorschalten bei Heizer ein
4.10.79	277	20h50	E9 eingeschaltet
24.10.79	297	20h45:18	8. Blackout Beginn
27.10.79	300	1h33:03	8. Blackout Ende
8.11.79	312	19h34	8. Perihel
	um Tag 300		Sensor 30° verliert an Empfindlichkeit, fällt aus
18.12.79	352	12h30	Heizergruppe 3 aus
23.12.79	357	7h22	5. Regulatorschalten, E9 ausgeschaltet
30.12.79	364	4h50	6. Regulatorschalten Heizergruppe 2 aus
1. 1.80	001	9h00	Heizergruppe 1 aus
15. 1.80	015	6h44:28	7. Regulatorschalten
28. 1.80	028	6h11	8. Regulatorschalten
9. 2.80	040	18h56	8. Aphel (Start +1487 d)
8. 3.80	068	17h45	9. Regulatorschalten S/C-Emergency

- ENDE DER MISSION -

Acknowledgement: The programme for the generation of reduced-data-taped was written by M. Al-Makadsi. The general frame of data reduction and analysis was developed by I. Mistrik. This work was supported by the Bundesministerium für Forschung und Technologie with grant WRS 0 108.

D-43190 1/31/76

DUMP OF TAPE LSOUT1

INPUT TAPE LSOUT1 ON MT2
DATA INPUT HY NF 71 FL 1 1 0 SR 71 1 1

Helios B | Level# | Exper. id | month of launch

Header Label

FILE 1 RECORD 1 LENGTH 640BYTES

		1	12	1978	91		4	9	1	20
(0)	00800008	00000000	00010000	00040600	0000050B	00000000	04000000	00090000	00000100	00000104
(40)	00000000	01000000	000C0000	007B3A00	00000000	00000000	00000000	00000000	00000000	00000000
(80)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(120)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(160)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(200)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(240)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(280)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(320)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(360)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(400)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(440)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(480)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(520)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(560)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(600)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000

FILE	INPUT RECS.	DATA RECORDS INPUT	MAX. SIZE	READ ERROR SUMMARY PERM	ZERO B	SHORT	UNDEF.	INPUT RETRIES #RECS.	TOTAL#
1	164	164	640	0	3	0	0	3	3

MC HEADER LABEL
JUN 31, 1976

FILE 71 RECORD 1 LENGTH 640BYTES

		1976	2	70	1976		31	19	47	
(0)	00800008	00000000	00020000	00040600	00007B08	00000001	0F000000	01030000	00020F00	00006305
(40)	000007B8	08000000	02000000	00000000	000002DD	00000C40	04000000	00000000	00000000	00000000
(80)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(120)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(160)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(200)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(240)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(280)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(320)	00000000	00000000	00000000	00000000	00000000	00000000	01000000	00000000	00000000	00000000
(360)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	000000BD	85999909
(400)	8F0A2222	02BD6833	3303BE20	00000000	00000000	00000000	C0457378	000045E4	68000046	5AAE8B0A
(440)	45775200	3045E4DC	0000465A	AC006045	DAEC6509	4AC834AC	0C4A42E8	73094D68	2F900E4A	E0F43A0C
(480)	415C587F	0C415CBD	73084144	B2270E41	45053600	4E4B114E	054ACFBC	490340F8	A2AE0A4A	C2276B0B
(520)	4A4177BE	0D4140A7	D20E40C0	A1A70C40	C0A1A70C	43FD568B	0843FD75	4207407A	F4840540	7AE53D0C
(560)	43092D23	0444C353	FF0842FC	00000042	00000000	43400000	00000000	00000000	00000000	00000000
(600)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(640)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000

FILE	INPUT RECS.	DATA RECORDS INPUT	MAX. SIZE	READ ERROR SUMMARY PERM	ZERO B	SHORT	UNDEF.	INPUT RETRIES #RECS.	TOTAL#
71	98	98	640	0	1	0	0	1	1

EOJ DUMP STOPPED AFTER FILE 71 # OF PERMANENT READ ERRORS 0

START TIME 06/19/81 14:27:55 STOP TIME 06/19/81 14:30:03

74-097A-11B
76-003A-11B

HELIOS-A

ZODIACAL LIGHT DATA ON TAPE

74-097A-11B ASVI-00017

THIS DATA SET HAS BEEN RESTORED. THERE WERE ORIGINALLY 72 9-TRACK, 1600 BPI TAPES, WRITTEN IN BINARY. THERE ARE 14 RESTORED TAPES. THE DR TAPES ARE 3480 CARTRIDGES AND THE DS TAPES ARE 9-TRACK, 6250 BPI. THE FOLLOWING TAPES D046403, D046405, D046414 WERE NOT RESTORED BECAUSE THEY WERE BAD. ALL TAPES WERE STACKED IN TIME SEQUENTIAL ORDER WITH THE EXCEPTION OF THE LAST DR/DS TAPE. THE ORIGINAL TAPES WERE CREATED ON AN IBM 360 COMPUTER AND WERE RESTORED ON THE MRS. THE DR AND DS NUMBERS ALONG WITH THE CORRESPONDING D NUMBERS AND TIME SPANS ARE AS FOLLOWS:

DR#	DS#	DD#	FILES	TIME SPAN
DR005657	DS005657	D046365	1-91	12/11/74 - 12/31/74
		D046366	92-234	01/01/75 - 01/31/75
		D046367	235-361	02/01/75 - 02/28/75
DR005658	DS005658	D046368	1-141	03/01/75 - 03/31/75
		D046369	142-226	04/01/75 - 04/29/75
		D046370	227-237	05/05/75 - 05/29/75
		D046371	238-302	06/02/75 - 07/02/75
		D046372	303-411	07/03/75 - 08/01/75
DR005659	DS005659	D046373	1-101	08/01/75 - 08/30/75
		D046374	102-214	09/01/75 - 09/30/75
		D046375	215-321	10/01/75 - 10/31/75
		D046376	322-424	11/01/75 - 03/31/76
DR005660	DS005660	D046378	1-71	01/01/76 - 01/31/76
		D046379	72-162	01/31/76 - 02/28/76
		D046380	163-285	03/01/76 - 04/01/76
DR005661	DS005661	D046381	1-123	03/31/76 - 04/30/76
		D046382	124-238	04/30/76 - 05/30/76
		D046383	239-308	05/31/76 - 07/08/76
		D046384	309-326	07/09/76 - 08/11/76
		D046385	327-381	08/12/76 - 09/06/76
		D046386	382-435	09/07/76 - 10/01/76
		D046387	436-562	10/01/76 - 11/01/76

74-097A-11B

DR#	DS#	DD#	FILES	TIME SPAN
DR005662	DS005662	D046388	1-138	11/01/76 - 12/01/76
		D046389	139-274	12/01/76 - 12/31/76
		D046390	275-394	01/01/77 - 01/31/77
DR005663	DS005663	D046391	1-114	02/01/77 - 02/28/77
		D046392	115-253	02/28/77 - 03/31/77
		D046393	254-377	03/31/77 - 04/29/77
		D046394	378-516	04/29/77 - 05/31/77
DR005664	DS005664	D046395	1-135	05/31/77 - 06/30/77
		D046396	136-188	06/30/77 - 07/11/77
		D046397	189-282	08/10/77 - 08/31/77
		D046398	283-401	09/01/77 - 09/30/77
DR005665	DS005665	D046399	1-113	10/01/77 - 10/31/77
		D046400	114-267	10/31/77 - 12/01/77
		D046401	268-402	12/01/77 - 01/01/78
		D046402	403-444	02/20/78 - 02/28/78
DR005666	DS005666	D046404	1-126	04/01/78 - 04/30/78
		D046406	127-256	06/01/78 - 07/02/78
		D046407	257-319	10/10/78 - 11/01/78
		D046408	320-413	11/01/78 - 11/30/78
		D046409	414-551	12/01/78 - 12/31/78
DR005667	DS005667	D046410	1-39	01/01/79 - 01/08/79
		D046411	40-131	04/10/79 - 04/29/79
		D046412	132-264	04/30/79 - 05/31/79
		D046413	265-384	06/01/79 - 06/30/79
		D046415	385-437	10/17/79 - 11/01/79
		D046416	438-538	11/01/79 - 11/30/79
		D046417	539-658	12/01/79 - 12/31/79
DR005668	DS005668	D046419	1-130	05/03/80 - 06/01/80
		D046420	131-265	06/03/80 - 07/01/80
		D046421	266-317	07/03/80 - 07/12/80
		D046422	318-394	11/08/80 - 12/01/80
		D046423	395-469	12/04/80 - 12/31/80
		D046424	470-542	12/31/80 - 01/18/81
DR005669	DS005669	D072668	1-44	05/22/81 - 05/31/81
		D072669	45-179	05/31/81 - 06/30/81
		D072670	180-267	06/30/81 - 07/19/81
		D072671	268-371	11/27/81 - 12/31/81
		D072672	372-442	01/01/82 - 01/20/82
		D072673	443-551	06/01/82 - 06/30/82
		D072674	552-624	06/30/82 - 07/22/82
		D072675	625-695	06/23/83 - 07/29/83
		D072676	696-713	02/01/84 - 02/07/84
		D072677	714-728	07/18/84 - 07/23/84

74-097A-11B

DR#	DS#	DD#	FILES	TIME SPAN
DR005670	DS005670	D072678	1-14	01/21/85 - 01/25/85
		D072679	15-22	02/12/85 - 02/18/85
		D046377	23-60	01/01/79 - 01/20/79
		D046418	61-151	12/11/74 - 01/01/79

HELIOS-B

ZODIACAL LIGHT DATA

76-003A-11B ASVI-00017

This data set has been restored. There was originally 37 Binary 9-Track, 1600 BPI tapes. There are 18 restored tapes. The DR tapes are 3480 cartridges and the DS tapes are 9-track, 6250 BPI. The tapes were created on a PDP computer. The DR and DS numbers along with the corresponding D numbers and the time spans are as follows:

DR#	DS#	D#	FILES	TIME SPAN
DR03291	DS03291	D45446	1-75	01/01/76 - 02/01/76
		D45447	76-214	02/02/76 - 02/29/76
DR03292	DS03292	D45448	1-146	03/01/76 - 03/31/76
		D45449	147-290	04/01/76 - 04/30/76
DR03293	DS03293	D45450	1-66	05/05/76 - 05/31/76
		D45451	67-100	06/02/76 - 06/30/76
DR03294	DS03294	D45452	1-23	07/02/76 - 07/30/76
		D45453	24-70	08/02/76 - 09/01/76
DR03295	DS03295	D45454	1-29	09/01/76 - 09/30/76
		D45455	30-124	09/30/76 - 11/01/76
DR03296	DS03296	D45456	1-133	11/01/76 - 11/30/76
		D45457	134-239	12/01/76 - 12/31/76
DR03298	DS03298	D45458	1-119	01/01/77 - 01/31/77
		D45459	120-249	02/02/77 - 03/01/77
DR03299	DS03299	D45460	1-142	03/01/77 - 04/01/77
		D45461	143-272	04/01/77 - 04/30/77
DR03300	DS03300	D45462	1-91	05/01/77 - 06/30/77
		D45463	92-141	07/01/77 - 07/31/77
DR03301	DS03301	D45464	1-70	08/01/77 - 08/31/77
		D45465	71-153	08/31/77 - 09/21/77
DR03302	DS03302	D45466	1-93	09/29/77 - 10/31/77
		D45467	94-228	10/31/77 - 11/30/77

DR#	DS#	D#	FILES	TIME SPAN
DR03303	DS03303	D45468	1-139	11/30/77 - 01/01/78
		D45469	140-277	01/01/78 - 03/01/78
DR03304	DS03304	D45470	1-136	03/01/78 - 04/01/78
		D45471	137-268	04/01/78 - 05/01/78
DR03325	DS03325	D45472	1-144	05/01/78 - 06/05/78
		D45473	145-189	06/05/78 - 07/07/78
DR03326	DS03326	D45474	1-38	10/06/78 - 10/29/78
		D45475	39-143	10/31/78 - 12/01/78
DR03327	DS03327	D45476	1-159	12/02/78 - 01/06/79
		D45477	160-254	04/02/79 - 04/30/79
DR03328	DS03328	D45478	1-128	04/30/79 - 05/31/79
		D45479	129-226	05/31/79 - 07/05/79
DR03329	DS03329	D45480	1-76	10/04/79 - 11/01/79
		D45481	77-197	11/02/79 - 11/30/79
		D45482	198-288	12/01/79 - 12/23/79

RETURN TO Gail Schneider

B33009-000
HCK=D
DLO=C

Max-Planck-Institut für Astronomie
Heidelberg – Königstuhl

DESCRIPTION

OF THE

ZODIACAL-LIGHT-DATA-TAPE

OF THE

HELIOS ZODIACAL LIGHT EXPERIMENT E9

Vorabdrucke
Preprints
Berichte

DESCRIPTION

OF THE

ZODIACAL-LIGHT-DATA-TAPE

OF THE

HELIOS ZODIACAL LIGHT EXPERIMENT E9

MAX-PLANCK-INSTITUT FÜR ASTRONOMIE
Federal Republic of Germany
6900 Heidelberg
Königstuhl

April 1981

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Table of contents

1. Survey

This document describes the contents and the format of the zodiacal-light-data-tape.

The zodiacal-light-data-tape contains zodiacal light, starlight, light scattered by interplanetary plasma, polarization of zodiacal light and normalized zodiacal light values for the measured sky areas, together with helioecliptic, equatorial, ecliptic and galactic coordinates.

The zodiacal-light-data-tape also repeats the raw data (skylight measurements), copied from original data-tapes and the reduced-data, as well as dark current, temperature, calibration lamps readings and orbit-attitude-information, copied from reduced-data-tapes (see "Description of the reduced-data tape", available at NSSDC).

In detail the repeated data mean:

a) orbit-attitude-information. Some data, copied from the orbit-attitude-blocks (OA-blocks) of reduced-data-tape are given in the measurement cycle (MC) header block (identification 2, see section 8)

b) temperature information. The average of all available data in a measurement-cycle are given in MC header block (identification 2)

c) dark current. Average given in MC header block (identification 2)

d) calibration lamps. The MC header block (identification 2), contains the ratios measured value/predicted value and the ratios between measured values of two different calibration lamps. The measured value means the averages of corrected (non-linearity, dark current, temperature effect) readings of the calibration lamps for medium sector length.

e) raw-data (sky light measurements). The count rates were copied from the original blocks.

f) reduced data means as measured by an ideal instrument the intensities being corrected for non-linearity, dark current, temperature effects and for nominal spin rate 1 Hz (details see "Description of the reduced data tape", available at NSSDC).

The separation of zodiacal light, starlight and light scattered by plasma from the reduced data and the processing of polarization and normlaization of zodiacal light will be described in section 3.

2. Short experiment description

2.1 Function and operation

The function and operation of the experiment are described in the following copy of an article in "Raumfahrtforschung."

A more complete description has been given by C. Leinert, E. Pitz, H. Link, and N. Salm: Das Zodiakallichtexperiment E9 auf Helios A und B (1978) BMFT-FB W78-28 (series of the Bundesministerium für Forschung und Technologie, Bonn, in German). (Also available at NSSDC)

The calibration of the experiment is given in moderate detail by C. Leinert, E. Pitz, H. Link and N. Salm: Calibration and in-flight-performance of the zodiacal light experiment on Helios, J. Space Sci. Instr. 1981, in press.

Note: it is not recommended to use Helios data without carefully studying sections 2, 3 and 9 and without being willing to resort to the "Description of the reduced-data-tape of the Helios zodiacal light experiment E9" (also available at NSSDC), if necessary.

The HELIOS Zodiacal Light Experiment (E 9)

C. LEINERT, H. LINK, E. PITZ, N. SALM, D. KNÜPPELBERG,
Max-Planck-Institut für Astronomie und Landessternwarte Heidelberg

Es wird das Experiment 9 der deutsch-amerikanischen Sonnensonde Helios beschrieben. Es besteht aus 3 Photometern zur Messung des Zodiakallichts bei den ekliptikalen Breiten −15°, −30° und −90° (Südpol der Ekliptik). Die Intensität und Polarisation des Zodiakallichts wird in 3 Farbbereichen gemessen, die in etwa dem internationalen UBV-System entsprechen. Neben der Diskussion der Maßnahmen zur Unterdrückung unerwünschten Streulichts, werden die wesentlichsten optischen und mechanischen Parameter genannt. Es wird Pulszähltechnik verwendet und die Signalverarbeitung beschrieben. Die Stabilität der Sensoren während der ersten 130 Tage der Mission wird diskutiert.

Experiment 9 of the German-American solar probe Helios is described. It consists of 3 photometers to measure the zodiacal light at ecliptical latitudes of −15°, −30° and −90° (south pole of ecliptic). Intensity and polarization of zodiacal light is measured in three wavelength bands corresponding to the international UBV-System. Measures of stray light reduction are discussed and optical and mechanical parameters are given. Pulse counting technique is used and data handling within the experiment is described. The stability of the sensors during the first 130 days of the mission is discussed.

1. SCIENTIFIC OBJECTIVES

The experiment is measuring the zodiacal light, which is sunlight scattered on the extremely thin cloud of interplanetary particles. This cloud extends from near the Sun to the asteroid belt and contains about a dozen micron-sized particles per km³. From zodiacal light observations it is possible, in principle, to derive the spatial distribution, size distribution and material of the scattering dust particles. The observed intensity is mainly related to the number, the observed colour to the size and the observed polarization to the material of the particles. The Helios experiment is measuring intensity, colour and polarization as a function of Sun – Helios distance for various angles with respect to the sun. The main results to be expected from these measurements are:

(1) spatial distribution of interplanetary dust within 1 A.U.,
(2) detection of changes in the particle mixture of interplanetary dust, if present, and
(3) size and material of interplanetary dust particles.

These informations will allow a better interpretation of existing earthbound observations of zodiacal light.
They also provide a basis for the discussion of the sources of interplanetary dust, which is one of the main questions concerning interplanetary dust.

2. GROSS FEATURES OF THE EXPERIMENT

The experiment consists of three photometers mounted rigidly into the spacecraft with orientations of about 15°, 30° and 90° respectively south of the spacecraft X-Y-plane (see FIG. 1), and of one electronic box. The large baffle systems associated with the photometers are necessary for stray light protection. The total mass of the experiment is 8.93 kg. The maximum power consumption is 9.6 W, including a maximum heater power of 2.2 W for the thermal control of the sensors.

3. OPTICAL SYSTEM

The radiation enters the photometer through an extended stray light baffle, is collected by the objective lens and imaged onto the field stop, which determines the field of view on the sky. Behind the field stop, a field lens images the objective lens onto the aperture stop. The aperture

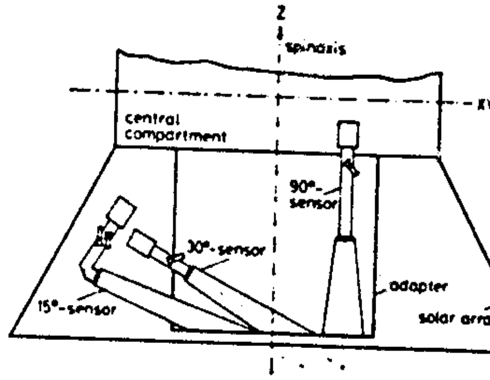

FIG. 1: **Sectional view of the lower spacecraft part with the positions of the zodiacal light photometers**

stop defines the collecting area of the objective lens. Close behind the aperture stop is the photocathode of the photomultiplier. This design not only furnishes a homogeneous illumination of the photomultiplier cathode (by imaging the objective lens onto the cathode), but also images the stray light diffracted or reflected at the mounting of the objective lens outside the aperture stop. Similarly the brightest stray light sources, the rims of the baffle are imaged by the objective lens outside the field stop.
This is essentially a coronograph design and was chosen to give good stray light suppression. Since Helios is exposed to full sunlight and since the sun is 10^{12} to 10^{13} times brighter than the zodiacal light, good suppression of stray light is considered as one main problem of the experiment and as a guideline for the whole design. The suppression of 10^{-14} to 10^{-15} that is needed to have only 1 % stray light contribution to the signal is accomplished in three steps:

First Step:

The photometers are mounted in the shadow zone of the southern spacecraft cone and may only be illuminated by the inner rim of the spacecraft cone, which itself may be exposed to direct sunlight.

Second Step:

Stray light suppression in the baffle system. The light falling into the openings of the baffle systems is caught in the first baffle room (see FIG. 2). The baffle system is designed like

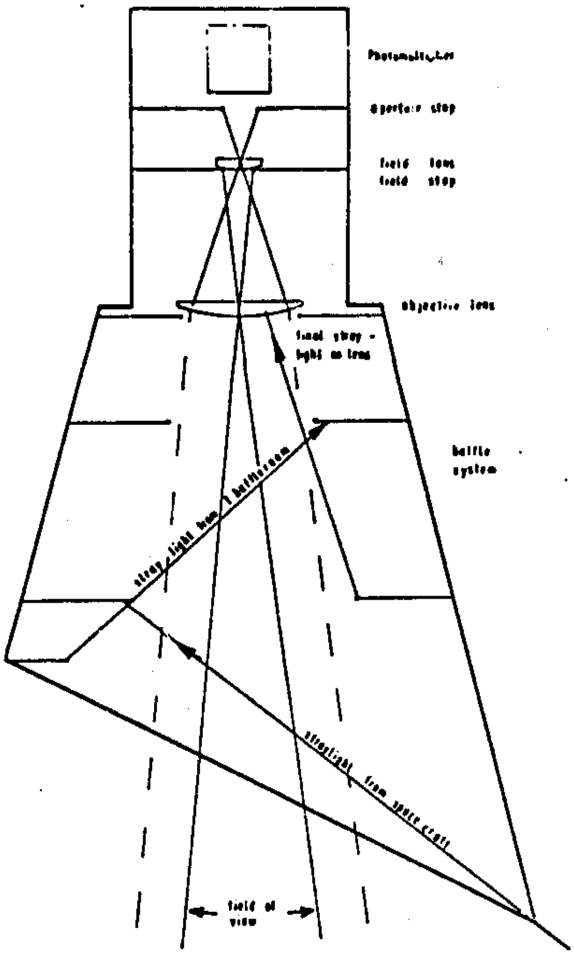

FIG. 2: **Principle of the optical system and stray light suppression**

a trumpet, so that the stray light emerging from the first baffle cannot hit the objective lens directly but only after attenuation by multiple reflections.

Third Step:

The coronograph like design of the optical system prevents stray light falling directly onto the photocathode. To keep the stray light level low, no optical element is allowed between the objective lens and field stop. Since the actual stray light level strongly depends on the amount of dust on the objective lens (it increases by a factor of ten for dusty optics and decreases by a factor of ten for very clean optics), the objective lens was exchanged shortly before launch to get rid of the dust which had accumulated during the instrument and system tests. The mechanical design allows this exchange, with fully integrated photometer. The lenses are made from fused quartz (Suprasil) to reduce radiation damage and scintillation. TABLE I gives the basic optical parameters for the three photometers.

TABLE I: **OPTICAL PARAMETERS OF THE PHOTOMETERS**

	15°-sensor	30°-sensor	90°-sensor
Diameter of aperture (mm)	30	36	36
Focal lenght of obj. lens (mm)	150	200	200
Field of view	1° x 1°	2° x 2°	3° ∅
Focal lenght of fields lens (mm)	55	55	55
cm² x square degree	7.07	40.8	72.1

TABLE II: **DESCRIPTION OF FILTER WHEELS**

Filter wheel	Position	Function (Filter)
15°-photometer color	1	Dark and Calibration
	2	Ultraviolet (UG2)
	3	Blue (BG3 + GG 385)
	4	Visual (GG 10)
15°-photometer polarization	1	Pol.film 0° (quartz)
	2	Pol.film 90° (quartz)
	3	Pol.film 45° (quartz)
	4	Blank (quartz)
30°-photometer	1	Dark and Calibration
	2	Ultraviolet (UG2)
	3	Blue (BG3 + GG 385)
	4	Visual (GG 10)
	5	Blue and pol.film 0° (BG3+GG 385)
	6	Visual and pol.film 0° (GG 10)
	7	Visual and pol.film 90° (GG 10)
	8	Visual and pol.film 45° (GG 10)
90°-photometer	1	Dark and Calibration
	2	Ultraviolet and pol.film 0° (UG2)
	3	Blue + pol.film 0° (BG3 + GG 385)
	4	Visual and pol.film 0° (GG 10)

The filter wheels are the only movable parts of the experiment. They are driven by permanent magnet stepper motors with 1:16 gear reduction. The gear was introduced to improve positioning and holding torque. The zero position of the filter wheel is recorded by an opto-electronic device in the gear housing. The filter wheels have four positions

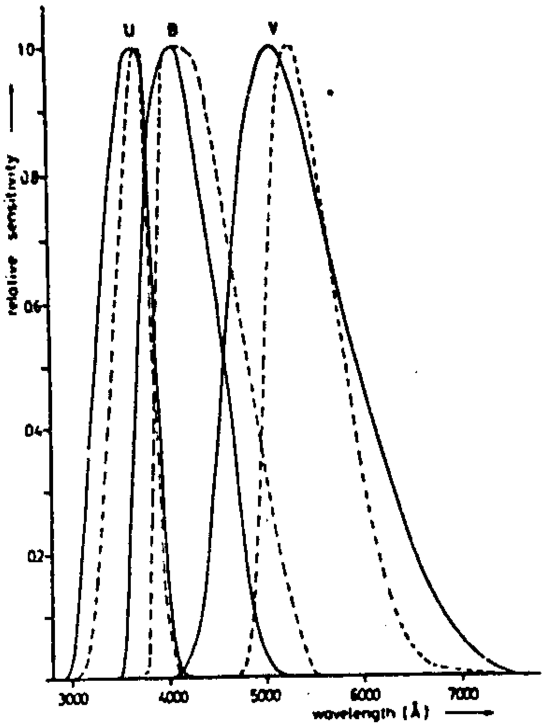

FIG. 3: **Spectral bandpasses compared with the international UBV system**

(8 in the 30°-photometer). In one position the light path is blocked and the light of an internal calibration lamp can be directed onto the photo-multiplier by a small folding mirror mounted on the filter wheel. The other positions contain the filters which define the spectral bandpasses and are Schott glasses with relatively high radiation resistance and low scintillation efficiency. The effective wavelength's for ultraviolet, blue and visual are 3600 Å, 4200 Å and 5300 Å respectively. Broad bandpasses ($\approx \pm$ 500 Å) were selected to allow the use of telescopes with small aperture. For polarization measurements, a polaroid film is used, Polacoat Formula 105 UV, which has a transmission of about 30% in natural light from 3000 Å to 7000 Å. The films are deposited directly on the Schott glasses; in the 15°-photometer they are coated on quartz disks (Suprasil) and mounted in a separate filter wheel, leaving one position blank (quartz). The content of the filter wheels is summarized in TABLE II, and the spectral bandpasses are compared to the international UBV System in FIG. 3. FIG. 4 shows the 15°-photometer together with the central electronic box.

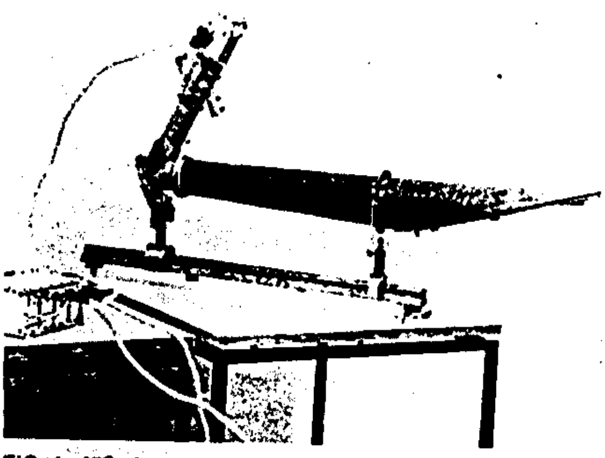

FIG. 4: 15°-photometer (mounted for component tests) together with the central electronic box. On the rear end of the sensor the two filter wheel motors and the analog electronic can be seen

4. SENSOR UNIT

4.1 Amplifier

The same sensor is used in all three photometers: a head-on photomultiplier, type 541 N of EMR, which has been used in various space experiments. Since the expected dynamical range of the signal is less than 5×10^3, a pulse counting technique is used for ease of data handling. The single electron pulses at the anode of the photomultiplier are amplified and all pulses exceeding a level of 0.5 mV when measured across a resistor of 50 Ω are shaped and fed into a two stage ripple counter, which delivers ervery fourth pulse to the main electronics. The count rate is limited to 11 MHz by a fixed recovery time of the amplifier, introducing a known unlinearity at high photomultiplier pulse rates. For redundancy and to check the proper operation of the amplifier the instantaneous anode current of the photomultiplier is transmitted in an analog housekeeping channel (ratemeter) for each sensor.

4.2 High Voltage Converter

It provides the high voltage supply for the photo-multiplier and the low voltage supply (+ 12 V, −2.5 V) for the amplifier. As the H.-V. converter is located near the sensor only very short cable connections are necessary. The high voltage is individually adjusted ($\approx$ 2500 V) so that the photomultiplier gives a current amplification of 2×10^6. By command, the high voltage can be raised by 300 V to compensate aging of the sensor. The converter is externally synchronized by a 40 KHz pulse train.

5. MAIN ELECTRONIC BOX

In order to measure the angular distribution of the zodiacal light brightness, each revolution of the spacecraft – which means, each scan in the 15° and 30°-photometer – is divided into 32 sectors of different size. The 16 smallest sectors (1/64 revolution) are centered to the sun direction, the 8 largest (1/16 revolution) on the antisolar point and the gap is filled by 8 sectors of the size 1/32 revolution (see FIG. 5). The introduction of large sectors in the regions where a smooth variation of zodiacal light brightness is expected reduces the total number of sectors. Since during the short time of passing one sector the brightness of the zodiacal light cannot be determined with sufficient accuracy, the readings of 513 revolutions are combined for each sector.

In the 90°-photometer, 8 sectors of equal size are introduced to alow polarization measurements. The integration is carried out over 126 revolutions. The technique used to perform these integrations is shown in the block diagram (FIG. 6). Let us assume that the 15°-photometer is measuring and looking into the first sector. Then the output pulses of the 15° photometer sensor unit are going through the input switch into the counter A wich gives a 27 bit semilogarithmical representation – four bit exponent, 23 bit mantissa – of the accumulated pulse number. As soon as the photometer field of view crosses the boundary to the second sector, the 18 most significant bits of the counter are transferred into the memory A, the nine least significant bits are dropped and the counter is ready to accept the

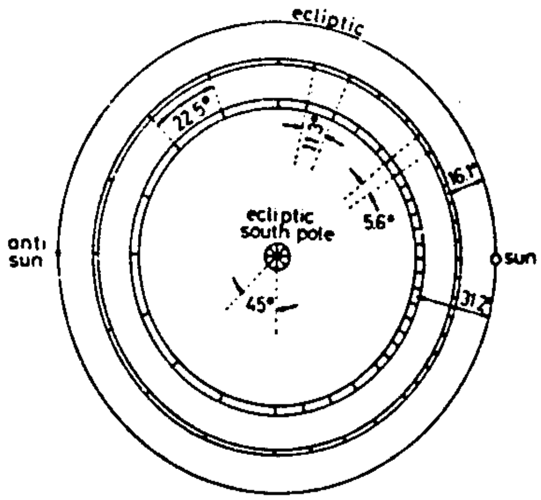

FIG. 5: **Sectoring of the photometer scans on the sky**

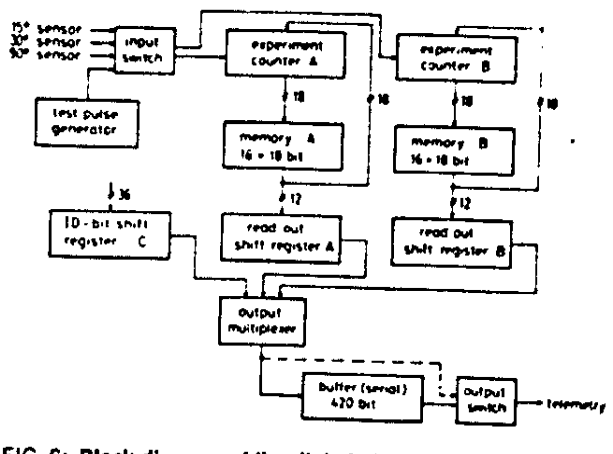

FIG. 6: **Block diagram of the digital electronics**

pulses of sector two. For redundancy, however, the pulses of sector two and all even sectors are handled in the identical counter B and memory B, while all odd sectors go into counter A. The result of any sector is kept in the memory for one revolution of the spacecraft and used as initial value for the counting of pulses during the following revolution, being replaced after that by the new value, etc. until the integration over 513 revolutions is complete. Then the 12 most significant bits for each sector are read out into a buffer and combined with 36 identification bits which describe the status of the experiment. Memory and counter are set to zero, the filter wheel is switched to the next position and a new measurement may begin.
The buffer is read out into the telemetry in a rhythm determined by the momentaneous bit rate and format used for data transmission to the Earth. The data of the 30°-photometer are handled in the same way. For the 90°-photometer, the results of four subsequent measurements are combined in the memory before read-out. Thus the experiment produces science data (as opposed to housekeeping) at a constant rate of 36 + 32 x 12 = 420 bit per 516 revolutions. The lacking time from 513 revolutions respectively 4 x 126 revolutions (integration times) to 516 revolutions is needed to switch the filter wheel(s).
The electronics uses TTL low power circuits. The special counter-memory arrangement has been chosen to give low power consumption, within the limits of this technology. The buffer is made of C-MOS – parts for power reduction. It may be bypassed by command if it fails. In that case the memory is read out directly into the telemetry.
After each cycle of measurements the distribution of the sectors with respect to the counters A and B is reversed. This makes a failure of either part A or B of the electronics less harmful, but has the effect of changing the chronological order of the sectors in the bitstream.
A logic control unit regulates the proper sectoring and sequencing of the measurement. It controls the motor switching, the calibration lamps and the switching of the H-V-converters. It synchronizes the sectoring to the see-sun-direction and regulates the data transfer.

6. CYCLE OF MEASUREMENT

The normal mode of operation consists of continuous repetition of the cycle of measurement. The three photometers are operated in sequence to save power. After switch-on of the 15°-photometer a test measurement is performed during which a pulse train of known frequency is fed into the data handling electronics to check the digital operations. After the dark current and internal calibration measurements the first color filter is moved into the light path for intensity and polarization measurements. The polarization is measured by the method of 3 polaroid settings, with one measurement for each polaroid orientation, the polaroids being exchanged by moving the second filter wheel between the measurements. These measurements are repeated for the second and third colour and followed by a repetition of the dark current and calibration measurements, giving a total of 20 measurements in the 15°-photometer. Each single measurement gives 32 results, one for each of the 32 sectors. In the 30°-photometer 12 measurements are performed beginning and ending with dark current and calibration measurements and using again the method of 3 polaroid settings for the polarization measurements. No test measurement is included because the digital operations are the same as with the 15°-photometer.
Since the 90°-photometer is mounted parallel to the spin axis, the polaroids which stay in fixed position relative to the photometer are rotated by the spin of the spacecraft. Using the method of rotating polaroid, intensity and polarization information for a given color can be obtained in one measurement. Each color is measured three times. Together with test, dark current and calibration measurements, 16 measurements are performed in the 90°-photometer which are combined to 4 read outs.
The time needed for one complete cycle of measurements is (20 + 12 + 4) x 516 revolutions = 5.2 hours. About 40% of this time are used for test, calibration and dark current measurements.
If the data transmission for this experiment, falls to less than 420 bit/516 revolutions, a new measurement may be completed before the buffer is completely read into the telemetry. In that case, the cycle of measurements is stopped and the next measurement is started only after the buffer has been read out and then refilled with the data of the completed measurement. This mechanism prevents data loss from overwriting in the buffer or the memory but may enlarge the time needed for one cycle of measurements by a factor two or three for very low bit rates.

7. FLIGHT PERFORMANCE

7.1 Stability

As mentioned in section 3, the stability of the sensor sensitivity can be checked by the signal of an internal calibration lamp. FIG. 7 shows for example the signal of the calibration lamp of the 30°-photometer during the first 130 days of the mission. The change of signal is strongly correlated to the variation of the temperature of the sensor which is shown in the lower part of the figure. The two small circles show the expected signal according to ground testing.

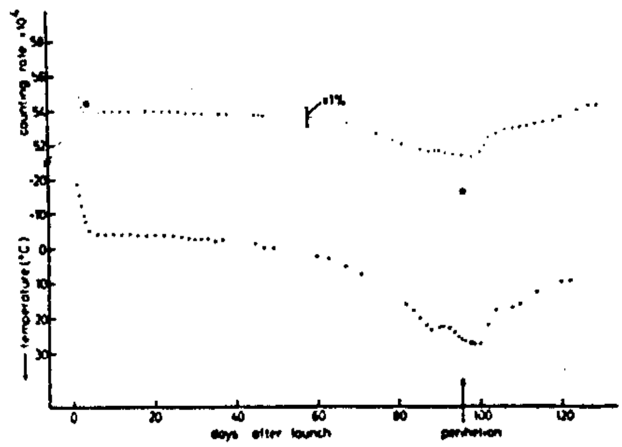

FIG. 7: Signal of internal calibration lamp and temperature versus time after launch

7.2 Stray Light

The amount of stray light expected in the data is dependent on the amount of direct sunlight entering the southern spacecraft cone. If the spacecraft is tilted with its spin axis toward the sun line no sunlight can enter the cone and no stray light contribution in the data is expected. However if the spin axis is tilted away from the sun line, the southern rim of the solar array is illuminated by direct sunlight and the antisolar zodiacal light data of the 15°-photometer may be contaminated by stray light. To prove the stray light contribution, two changes of the spacecraft attitude have been performed during the primary mission (one near Earth and one near perihelion) to have both "stray light conditions" during short time spans. The data with and without sunlight in the southern cone show no significant difference which can not be explained by the different star background. We conclude from this, without having reduced the data completely that the stray light contribution in the data is at least smaller than 10% and the stray light suppression of the photometers works perfectly.

Acknowledgement

This work was supported by Contract RS 21 of the Bundesministerium für Forschung und Technologie (BMFT).

2.2 Telemetry formats

The identification of a particular type of measurement of a science block is achieved by the ID-Word, bits 1,2,3 and 4-8 (see Table 2.1).

Table 2.1: Identification of type of measurements for science data blocks (word 1 = 11) on the zodiacal-light-data tape

ID-Word Bits 1,2,3	4-8		Meaning
101	4	Sensor 15°	UV through polarizing film 0°
101	5		UV through polarizing film 90°
101	6		UV through polarizing film 45°
101	7		UV through quartz disk
101	8		Blue through polarizing film 0°
101	9		Blue through polarizing film 90°
101	10		Blue through polarizing film 45°
101	11		Blue through quartz disk
101	12		Visual through polarizing film 0°
101	13		Visual through polarizing film 90°
101	14		Visual through polarizing film 45°
101	15		Visual through quartz disk
110	7	Sensor 30°	UV
110	8		Blue
110	9		Visual
110	10		Blue through polarizing film 0°
110	11		Visual through polarizing film 0°
110	12		Visual through polarizing film 90°
110	13		Visual through polarizing film 45°
100	29	Sensor 90°	UV or blue or visual
100	30		UV or blue or visual
100	31		UV or blue or visual

In addition, the zodiacal-light-data tape contains blocks with polarization data (word 1 = 13). These have the ID-word corresponding to polarizing film orientation 90°, for example 101 5 or 110 12.

3. Description of the zodiacal light data-processing

In order to allow a critical use of the scientific data of the zodiacal light data tape the zodiacal light-data-processing is presented here. (Actually we also summarize all the numerical factors necessary for repeating or redoing our work.)

The evaluation follows the subsequent scheme:

Calibrated data from reduced-data-tape (in S10 units)
- contribution from bright stars
- contribution of star background
- contribution by interplanetary plasma

= zodiacal light intensity (through color filter or through color filter plus polarizing film).

This, of course, requires the calculation of coordinates.

From measurements through polarizing films we derive polarized intensity, degree and angle of polarization of zodiacal light. For comparison the same quantities also are given for zodiacal light plus electron scattered light.

For plotting and more general use intensities are also given in normalized form (reduced to nominal conditions).

1 S10 unit = equivalent number of V = 10.0 mag solar type stars per square degree, with solar values of V = -26.73 mag, (B-V) = 0.63, (U-B) = 0.15

3.1 Calculation of coordinates for sector centers

Spacecraft attitude is given by the two angles Sigma and Theta (see Figure 1).

Various quantities describing the geometry of the experiment are summarized in Table 3.1

Table 3.1 Geometry of the experiment

	HELIOS A		HELIOS B	
	PMT 15°	PMT 30°	PMT 15°	PMT 30°
h	16.2	31.3	16.23	31.02
DAZ	0.49	0.50	0.0	-0.43
FOV	0.975	3.93	0.975	3.94
D2L	0.4955	0.99	0.4945	0.9935
INR	0.452	0.9525	0.453	0.9515
OUTR	0.532	1.0325	0.533	1.0315
D2B	0.63	1.13	0.63	1.13

h	elevation below the spacecraft x-y-plane
DAZ	lag of photometer azimuth behind nominal value
FOV	field of view size in square degrees
D2L	half-width of FOV in azimuth (in degrees)
INR	half-width of FOV in elevation, minus 0.04°
OUTR	half-width of FOV in elevation, plus 0.04°
D2B	additional boundary farther out, = OUTR +0.1°

Photometer 90° has its FOV in the -z-axis, at least in the average over one rotation.

The position of the field of views on the sky, as given by the known spin axis orientation and the mounting of the experiment into the spacecraft, was checked by bright stars drifting across the boundaries. After the resulting small (0.01 - 0.1°) corrections in photometer elevation to the values of Table 3.1 the position in general appear to be accurate to better than 0.1°.

CG-Fixed Coordinate System

Definition

Reference system centered at CG of s/c

ξ and η axis in the orbit plane (perpendicular to each other)

η axis pointing to the sun

ζ axis perpendicular to the orbit plane

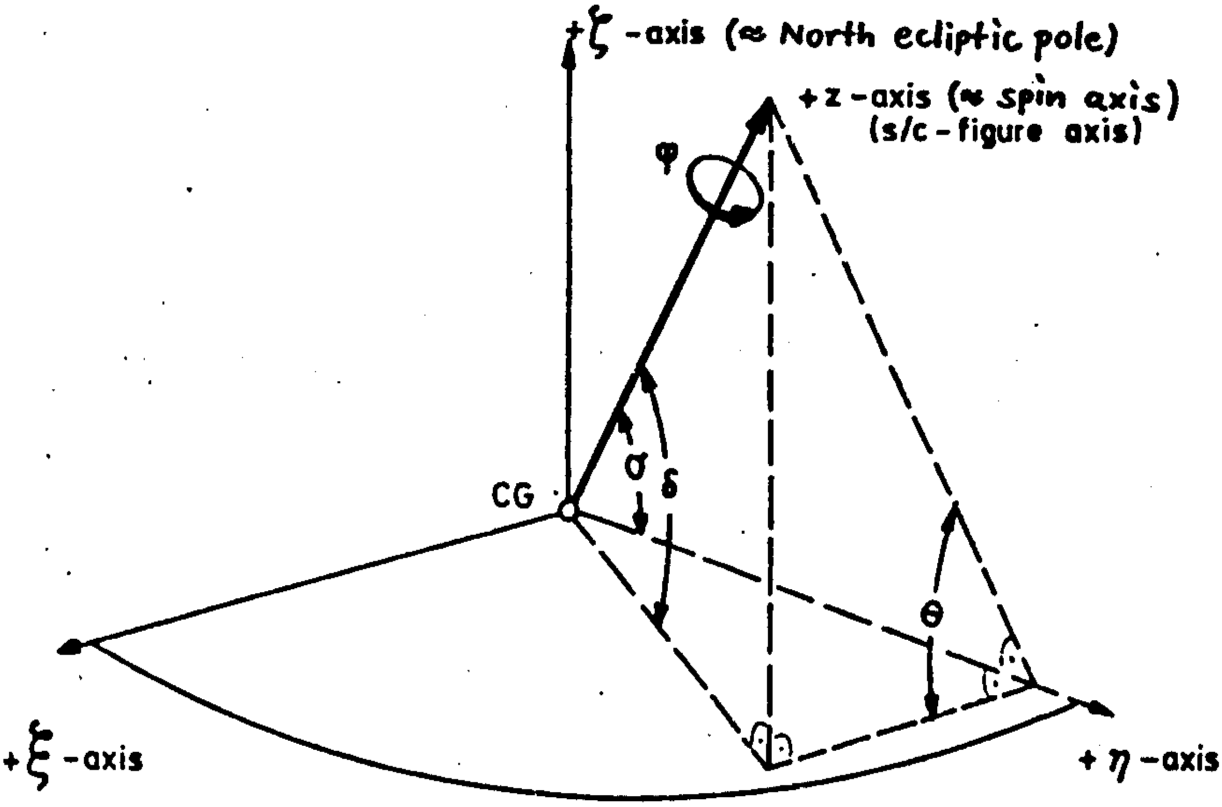

FIG. 1

Definition of Attitude Coordinate System

CG : Center of Gravity

σ : Solar Aspect Angle (angle between +z- and +η-axis)

θ : Pitch Angle (angle between orbit plane and plane +z/+η-axes)

δ : Angle between +z- axis and orbit plane

φ : Spin Angle (angle about +z-axis measured by See Sun Pulse)

3.1.1 Helioecliptic coordinates ε, i

From record (identification 2) we have sigma (σ), Theta (θ),
from record (identification 11) we have λ sun ($\lambda_\odot$),
λHelios (λ_H)
from table 3.1 we have the photometer elevation (h), and the deviation of azimuth (DAZ),
from section 2.1 (page 2.4) we have the arrangement of sectors with respect to the sun, the sizes of sectors are given to 5.625° (short sectors), 11.25° (medium sectors) and 22.50° (long sectors), so we can determine the sector azimuth (ϕ)

$\phi_1 = 2.81° + DAZ$ (ϕ for sector 1)

$\phi_2 = 8.43° + DAZ$

$\phi_3 = 14.06° + DAZ$

$\phi_9 = 50.62° + DAZ$

$\phi_{10} = 61.87° + DAZ$

$\phi_{13} = 101.25° + DAZ$

$\phi_{14} = 123.75° + DAZ$

and so on.

ε,i are given to equinox 1975.0

$$\underline{\varepsilon_n} = \operatorname{acos}(-\sin h \cdot \cos \sigma + \cos h \sin \sigma \cos \phi_n) \qquad n = 1, \dots 32$$

$$0° \leq \varepsilon \leq 180°$$

$$\underline{i_n} = \theta - k_n$$

$$k_n = 180° - \operatorname{asin}\left(-\frac{\sin \phi_n \cos h}{\sin \varepsilon_n}\right) \qquad n = 1, \dots 32$$

$$90° \leq k \leq 270°$$

3.1.2 Ecliptic coordinates

β, λ are given to equinox 1975.0

$$\underline{\beta_n} = \mathrm{asin}\,(\sin \varepsilon_n \cdot \sin i_n) \qquad n = 1, \ldots 32$$

$$-90^\circ \le \beta_n \le +90^\circ$$

$$\lambda_n - \lambda_\odot = \mathrm{acos}\left(\frac{\cos \varepsilon_n}{\cos \beta_n}\right)$$

$$\text{if } \cos i_n > 0\,, \quad \lambda_n - \lambda_\odot = 360^\circ - (\lambda_n - \lambda_\odot)$$

$$\underline{\lambda_n} = \lambda_\odot + (\lambda_n - \lambda_\odot) \qquad 0 \le \lambda_n \le 360^\circ$$

For photometer 90°:

$$\underline{\beta_{90}} = -\,\mathrm{asin}\,(\sin \theta \sin \sigma) \qquad -90^\circ \le \beta_{90} \le +90^\circ$$

$$\underline{\lambda_{90}} = \lambda_z + 180^\circ$$

$$\lambda_z = (\lambda_z - \lambda_\odot) + \lambda_\odot$$

$$\begin{cases} \cos(\lambda_z - \lambda_\odot) = \dfrac{\cos \sigma}{\cos \beta_{90}} \\[2mm] \sin(\lambda_z - \lambda_\odot) = \dfrac{\sin \sigma \cos \theta}{\cos \beta_{90}} \end{cases} \qquad 0 \le \lambda_{90} \le 360^\circ$$

3.1.3 Equatorial coordinates

α, δ are given to equinox 1950.0

$$\underline{\delta_n} = \mathrm{asin}\,(\cos \beta_n \sin \lambda'_n \sin e + \sin \beta_n \cos e)$$

$$-90^\circ \le \delta \le +90^\circ$$

$$e = 23.446^\circ \text{ (obliquity of ecliptic)}$$

$$\lambda'_n = \lambda_n - 0.3491^\circ$$

$$\begin{cases} \cos \underline{\alpha_n} = \dfrac{\cos \beta_n \cos \lambda'_n}{\cos \delta_n} \\[2mm] \sin \alpha_n = \dfrac{\cos \beta_n \sin \lambda'_n \cos e - \sin \beta_n \sin e}{\cos \beta_n} \end{cases}$$

$$0 \le \alpha \le 360^\circ$$

3.1.4 Galactic coordinates

$\alpha_0 = 190^\circ.625, \; \delta_0 = 27^\circ.725$

$$\underline{b_n^I} = \operatorname{asin}\left(\sin\delta_n \sin\delta_0 + \cos\delta_n \cos\delta_0 \cos(\alpha_n - \alpha_0)\right)$$

$$-90^\circ \le b^I \le +90^\circ$$

$$\begin{cases} \cos \underline{\ell^I} = \dfrac{\cos\delta_n \sin(\alpha_n - \alpha_0)}{\cos b_n^I} \\ \sin \ell^I = \dfrac{\cos\delta_0 \sin\delta_n - \sin\delta_0 \cos\delta_n \cos(\alpha_n - \alpha_0)}{\cos b_n^I} \end{cases}$$

$$0 \le \ell_n^I \le 360^\circ$$

A = $77^\circ.65$
B = $109^\circ.95$
C = $1^\circ.4866$

$$\underline{b_n^{II}} = \operatorname{asin}\left(\sin b_n^I \cos C - \cos b_n^I \sin(\ell_n^I - A) \sin C\right)$$

$$-90^\circ \le b^{II} \le +90^\circ$$

$$\underline{\ell_n^{II}} = (\ell_n^{I} - B) + B$$

$$\begin{cases} \cos(\ell_n^{II} - B) = \dfrac{\cos b_n^I \cos(\ell_n^I - A)}{\cos b_n^{II}} \\ \sin(\ell_n^{II} - B) = \dfrac{\sin b_n^I \sin C + \cos b_n^I \sin(\ell_n^I - A)\cos C}{\cos b_n^{II}} \end{cases}$$

$$0 \le \ell^{II} \le 360^\circ$$

3.2 Separation of the various intensity-components

All intensities are given in S10-units.

3.2.1 Bright stars

Bright stars given in the Bright star catalogue (Hoffleit, 1964) and in the Naval Observatory Photoelectric catalogue (Blanco et al. 1968) were limited to the magnitude V = 6.50, B = 7.13, U = 7.28, corresponding to a solar type spectrum. The chosen magnitude limits correspond to the level at which the catalogues are nearly complete and they fit the magnitude limits used in star background works. Stars with magnitudes equal or less than the above given limits were individually subtracted. Stars fulfilling the criterion only in one or two of the wavelengths bands were nevertheless subtracted in all colours.

The star brightness in S10-units, corresponding to the instrumental system are given to

$$I = 10.^{0.4(10.-m)} \times f(B-V) \times C$$

For the colour equation f(B-V) see table 3.2.
C transforms to solar spectrum: $C = 1.79$ for I_B

$C = 2.05$ for I_U

$C = 1.00$ for I_V

Table 3.2: Colour equation for Helios sensors

Sensor		Factor	Range in(B-V)
Helios A, Sensor 15°	U:	$1.0 + 0.198 \times (B-V)^2 - 0.126 \times (B-V)$	< 1.15
		$1+((B-V)-1.15) \times 0.66$	≥ 1.15
	B:	$0.795+(1.43-(B-V)) \times 0.255$	< 1.43
		$0.795+(1.43-(B-V)) \times 0.06$	≥ 1.43
	V:	$0.975+(0.83-(B-V)) \times 0.138$	< 0.83
		$0.975+(0.83-(B-V)) \times 0.02$	≥ 0.83
Sensor 30°	U:	$0.985+\left(\frac{(B-V)-0.875}{0.995}\right)^2 \times 0.05$	< 2.0
	B:	$0.731+(1.52-(B-V)) \times 0.27$	< 1.52
		$0.731+(1.52-(B-V)) \times 0.09$	≥ 1.52
	V:	$0.967+(0.85-(B-V)) \times 0.143$	< 0.85
		$0.967+(0.85-(B-V)) \times 0.05$	≥ 0.85
Sensor 90°	U:	$1.0+(0.63-(B-V)) \times 0.055$	< 2.0
	B:	$0.685+(1.55-(B-V)) \times 0.343$	< 1.55
		$0.685+(1.55-(B-V)) \times 0.12$	≥ 1.55
	V:	$0.95+(0.84-(B-V)) \times 0.233$	< 0.84
		$0.95+(0.84-(B-V)) \times 0.157$	≥ 0.84
Helios B, Sensor 15°	U:	1.0	< 0.77
		$1.0+(0.77-(B-V)) \times -0.057$	≥ 0.77
	B:	$1.0+(0.63-(B-V)) \times 0.297$	< 2.0
	V:	$1.0+(0.63-(B-V)) \times 0.244$	< 0.63
		$1.0+(0.63-(B-V)) \times 0.195$	≥ 0.63
Sensor 30°	U:	$1.0+(0.63-(B-V)) \times 0.048$	< 2.0
	B:	$1.0+(0.63-(B-V)) \times 0.293$	< 2.0
	V:	$1.0+(0.63-(B-V)) \times 0.237$	< 0.63
		$1.0+(0.63-(B-V)) \times 0.155$	≥ 0.63
Sensor 90°	U:	$0.99+\left(\frac{(B-V)-0.5}{0.66}\right)^2 \times 0.04$	< 1.16
		$1.0+(1.16-(B-V)) \times (-1.28)$	≥ 1.16
	B:	$1.0+(0.63-(B-V)) \times 0.25$	< 1.16
		0.865	≥ 1.16
	V:	$1.0+(0.63-(B-V)) \times 0.11$	< 0.75
		0.985	≥ 0.75

A further factor relates the instantaneous FOV to the sector.

$$\text{Factor 1} = \frac{2 \times D2L}{n \times 5.625 \times FOV \times \cos h}$$

(compare Figure 2 and Table 3.1)

n = 1 for short sector
n = 2 for medium sector
n = 4 for long sector

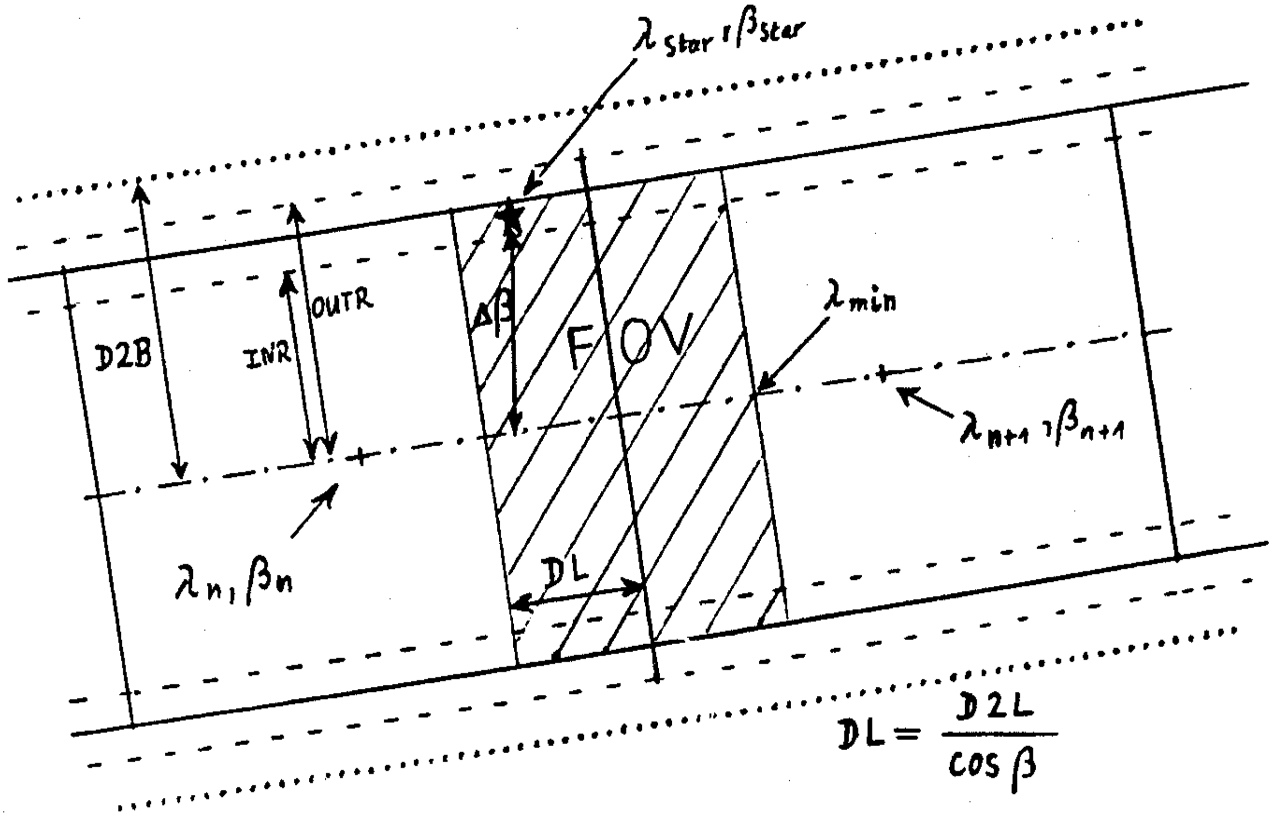

Figure 2: Contribution of star at sector boundary between sectors n and n+1 to sector n (Helios B).

$$\text{Factor 2} = 1 - \frac{\Delta\beta - INR}{OUTR - INR}$$

considers the location of the star between inside and outside margins of the sector.

		V	B-C	SPTYPE	VAR	MULT
		.8?	0.00	?2 V		
		.1?	0.00	?3 II		
		.9?	0.00	?5 V		
		.58	0.00	?5		
		.8?	0.00	?2 V		
		.??	0.00	?2 V		AB
		.14	0.00	?7		AB
		.6?	0.00	?2 V		
		.6?	0.00	?2 V		
		.5?	0.00	F? IV		
		.7?	0.00	? M		
		.61	0.00	?	5	
		.71	0.00	?3 V		
		.7?	0.00	?5		
		.9?	0.00	A5 V		
		.68	0.00	B9 V		AB
		.6?	0.00	K? II		A
157		.77	0.00	A2 V		
		.91	0.00	G5		
175		.9?	0.00	K2 V		
22?		.78	0.00	G8 II		
21?	506?	.80	0.00	B5 V		
212	51??	.58	0.00	A1 V		
26?	544?	.36	0.00	G K3		
	5858	.14	0.00	A4 II		A
29?	61??	.45	0.00	A0		
32?	63??	.1?	0.00	A7 V		A
	6586	.06	0.00	A2 N		
324	6658	.14	0.00	DF8		
341	6925	.32	0.00	A2		
?72	764?	.35	0.00	F8 V		
	820?	.56	0.00	K5		
	844?	.95	0.00	K0 II		
409	86??	.77	0.00	A2 P		
41?	88??	.48	0.00	D F6		
41?	87??	.51	0.00	A3		
422	88??	5.24	0.00	F4 IV		AB
452	9712	6.10	0.00	B9 II		
458	982?	8.49	0.00	K1 II		
465	9906	.68	0.00	F8 V		A
469	1007?	.32	0.00	A0 P		
47?	1020?	.41	0.00	G8 II		
47?	1020?	.48	0.00	B8 IV		A
483	10307	5.98	0.00	SG A9		
495	1048?	.69	0.00	G2 V		
504	1059?	.29	0.00	GK2		
518	1087?	.81	0.00	G K5		
526	1103?	.76	0.00	F5		
	1118?	.18	0.00	A2 A2		AB
	11689	.97	0.00	B9		
619	13011	.99	0.00	F2		
643	13520	8.01	0.00	G8 III		
647	13594	8.04	0.00	K4 II		
653	13818	6.39	0.00	F0		AB
		8.04	0.00	G9 III		
671	14211	6.20	0.00	A3		

Table 1.3: Star catalogue

a) β = +31°.1 ± 3°.2

YALE	HD	PHOELC	λ	β	κ	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR
670	14212	2358	49.00	31.42	34.01	47.15	5.340	.000E	5.34	0.00M	5.34	0.00	A0	
673	14221	0	49.74	32.86	34.03	48.72	6.350	.290E	6.64	0.02M	6.66	0.00	F0	
679	14372	0	49.23	31.26	34.36	47.09	6.100	-.080E	6.02	-0.48M	5.54	0.00	B5 V	
682	14392	2384	50.58	33.86	34.41	49.92	5.580	-.130	5.45	-0.38	5.07	0.00	A0	
694	14770	2462	51.13	33.52	35.27	49.78	5.180	.980	6.16	0.76	6.92	0.00	G8 II	
699	14872	2475	51.47	33.69	35.57	50.05	4.700	1.530	6.23	1.90	8.13	0.00	K4 II	A
700	15138	0	52.00	33.82	36.13	50.34	6.140	.400E	6.54	0.05M	6.59	0.00	D F1	
792	16780	0	53.72	30.79	39.92	48.07	6.450	.680E	7.13	0.21M	7.34	0.00	G5	
799	16895	2700	54.31	31.62	40.19	49.02	4.120	.480	4.60	-0.01	4.59	0.00	F7 V	A
842	17656	2768	54.74	28.94	42.08	46.64	5.880	.910	6.79	0.62	7.41	0.00	G5	
849	17818	0	55.71	30.47	42.49	48.36	6.380	.810E	7.19	0.48M	7.67	0.00	K0	
865	18155	0	55.75	28.96	43.29	46.95	6.023	1.338E	7.36	1.49M	8.85	0.00	G K3	
864	18153	0	57.39	32.81	43.34	51.05	6.360	1.500E	7.86	1.80M	9.66	0.00	K5 III	
885	18474	2885	56.38	28.84	44.11	47.02	5.470	.890	6.36	0.61	6.97	0.00	G P	
890	18537	2891	58.53	33.63	44.32	52.15	5.280	-.050	5.23	-0.45	4.78	0.00	B7 IV	A
891	18538	2892	58.54	33.63	44.33	52.15	6.740	.000	6.74	-0.15	6.59	0.00	A1 N	R
933	19279	3003	57.87	28.50	46.09	47.12	6.380	.140	6.52	0.15	6.67	0.00	A0	
930	19268	0	59.72	33.14	46.12	52.02	6.300	-.010E	6.29	-0.44M	5.85	0.00	B5 V	
937	19373	3013	58.90	30.63	46.36	49.42	4.040	.600	4.64	0.10	4.74	0.00	G0 V	A
0	19624	3052	60.33	32.92	47.02	51.98	6.880	.025	6.91	-0.24	6.67	0.00	B5	
949	19735	3062	58.86	28.66	47.24	47.54	6.330	1.430	7.76	1.64	9.40	0.00	K5 II	A-
0	19805	3071	59.42	29.85	47.39	48.82	7.940	.121	8.06	0.03	8.09	0.00	A0	
956	19845	3077	59.19	29.04	47.48	47.99	5.900	.971	6.87	0.81	7.68	0.00	F5	
0	19893	3083	59.76	30.34	47.58	49.38	7.150	.040	7.19	-0.11	7.08	0.00	B9	
0	20017	3107	59.65	29.46	47.85	48.51	7.910	.290	8.20	-0.14	8.06	0.00	B7 E	
969	20123	3125	60.66	31.53	48.15	50.75	5.030	1.150	6.18	0.83	7.01	0.00	G5 II	
0	20191	3138	60.87	31.77	48.20	51.03	7.190	.034	7.22	-0.19	7.03	0.00	B9	
987	20365	3170	60.84	30.73	48.76	50.04	5.160	-.050	5.11	-0.58	4.53	0.00	B3 V	
0	20391	3173	60.71	30.30	48.80	49.59	7.940	.120	8.06	0.07	8.13	0.00	A0	
989	20418	3180	60.89	30.58	48.89	49.91	5.030	-.050	4.98	-0.55	4.43	0.00	B5 V	
0	20487	3191	60.51	29.16	49.07	48.45	7.640	.073	7.71	0.01	7.72	0.00	A0	
1001	20675	0	61.03	29.49	49.58	48.90	5.930	.420E	6.35	-0.04M	6.31	0.00	D F5	
1011	20809	3234	61.32	29.55	49.92	49.04	5.320	-.060	5.26	-0.56	4.70	0.00	B5 V	
0	20842	3241	62.28	31.97	50.02	51.59	7.850	.104	7.95	0.04	7.99	0.00	A0	
0	20863	3246	61.22	28.94	50.06	48.43	6.990	.015	7.01	-0.15	6.85	0.00	B9	
1017	20902	3256	61.73	30.12	50.18	49.68	1.800	.480	2.28	0.34	2.62	0.00	F5 IB	A
0	20931	3262	61.53	29.42	50.24	48.96	7.870	.088	7.96	0.06	8.02	0.00	A2	
0	20961	3267	61.20	28.23	50.34	47.74	7.630	.114	7.74	0.04	7.78	0.00	B9	
1020	21004	0	63.39	33.93	50.51	53.74	6.510	.290E	6.80	0.07M	6.87	0.00	A9 III-	
1029	21071	3282	61.78	29.34	50.60	48.95	6.090	-.070	6.02	-0.50	5.52	0.00	B5	
0	21091	3283	61.58	28.62	50.66	48.21	7.500	.040	7.54	-0.06	7.48	0.00	B9	
0	21152	3280	61.55	28.13	50.83	47.74	7.720	.113	7.83	0.03	7.86	0.00	B9	
0	21181	3291	61.69	28.40	50.89	48.03	6.830	-.016	6.81	-0.19	6.62	0.00	G3	
0	21239	3296	61.81	28.44	51.02	48.10	7.950	.104	8.05	0.11	8.16	0.00	A0	
0	21279	3301	61.64	27.91	51.10	47.56	7.260	.047	7.31	-0.16	7.15	0.00	B9	
1034	21278	3300	62.14	29.18	51.12	48.89	4.980	-.080	4.90	-0.56	4.34	0.00	B3 V	
1037	21362	3307	62.54	29.90	51.32	49.68	5.590	-.040	5.55	-0.47	5.08	0.00	B5	
0	21375	3310	62.29	29.15	51.33	48.90	7.470	.110	7.58	0.03	7.61	0.00	A0	
0	21398	3313	62.10	28.40	51.40	48.13	7.370	.020	7.39	-0.16	7.23	0.00	B9	
1044	21428	3317	62.52	29.55	51.44	49.34	4.660	-.080	4.58	-0.59	3.99	0.00	B5 V	AB
0	21479	3326	62.51	29.24	51.57	49.04	7.280	.100	7.38	0.01	7.39	0.00	A0	
0	21481	3328	62.12	28.06	51.57	47.81	7.680	.100	7.78	0.02	7.80	0.00	A0	
0	21488	3330	63.80	32.75	51.64	52.72	7.290	1.390	8.68	1.34	10.02	0.00	K2	A-
1052	21552	3337	62.26	28.04	51.76	47.82	4.370	1.350	5.72	1.54	7.26	0.00	K3 II	
1051	21551	3336	62.30	28.14	51.77	47.93	5.830	-.030	5.80	-0.33	5.47	0.00	B9	
1056	21620	0	62.81	29.17	51.98	49.04	6.270	.000E	6.27	0.00M	6.27	0.00	A0	

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	[illegible]
1059	21661	3352	62.93	29.33	52.06	49.23	6.310	.090	6.40	-0.14	6.26	0.00	B9		
0	21672	3358	62.73	28.70	52.08	48.57	6.630	-.020	6.61	-0.32	6.29	0.00	[illegible]		
1063	21699	3362	62.55	27.99	52.15	47.85	5.460	-.100	5.38	-0.58	[illegible]	[illegible]			
0	21931	3393	63.11	28.47	52.66	48.45	7.340	.040	7.38	-0.14	7.24	0.00	A0		
1087	22192	3419	63.40	27.97	53.23	48.03	4.230	-.060	4.17	-0.58	3.59	0.00	[illegible]		
1127	23049	0	64.88	27.96	55.13	48.37	6.059	1.554E	7.61	1.82M	9.43	0.00	K4 III		
0	23384	3578	66.35	30.91	55.86	51.55	6.850	.370E	7.22	0.00M	7.22	0.00	F0		
0	23452	3596	66.38	30.72	55.98	51.37	7.230	.200E	7.43	0.15M	7.58	0.00	A1 V		
1160	23552	3620	66.26	29.93	56.15	50.58	6.130	.060E	6.19	-0.33M	5.86	0.00	[illegible]		
0	23565	3621	66.64	30.97	56.22	51.67	7.600	.660E	8.26	0.21M	8.47	0.00	[illegible]		
0	23581	3625	66.51	30.53	56.23	51.22	7.210	1.220E	8.43	1.05M	9.48	0.00	[illegible]		
0	23623	3635	66.40	30.01	56.30	50.69	7.310	.410E	7.72	0.00M	7.72	0.00	[illegible]		
0	23675	3647	67.03	31.74	56.42	52.50	6.720	.420	7.14	-0.56	6.58	0.00	[illegible]		
0	23800	3588	67.14	31.54	56.66	52.33	6.940	.320	7.26	-0.54	6.72	0.00	[illegible]		
0	24129	3726	67.18	30.05	57.31	50.90	7.830	.130E	7.96	0.00M	7.96	0.00	[illegible]		
0	24341	3771	67.89	31.32	57.76	52.28	7.920	.680	8.60	0.11	8.71	0.00	[illegible]		
0	24432	3783	67.06	28.00	57.94	48.89	6.820	.550	7.37	-0.17	7.20	0.00	[illegible]		
0	24431	3782	68.09	31.50	57.96	52.50	6.720	.370	7.09	-0.61	6.48	0.00	[illegible]		
1210	24546	3804	67.72	29.57	58.22	50.55	5.280	.410E	5.69	0.00M	5.69	0.00	F5		
0	24688	3834	68.34	30.91	58.54	51.98	7.960	1.020E	8.98	0.92M	9.90	0.00	K0 III		
0	24733	3840	68.98	32.70	58.69	53.85	7.020	.250E	7.27	0.20M	7.47	0.00	[illegible]		
0	24775	3850	68.33	30.27	58.77	51.36	7.580	1.640E	9.22	1.55M	10.77	0.00	[illegible]		
0	25056	3886	69.16	32.48	59.44	53.73	7.030	1.200	8.23	0.92	9.15	0.00			
0	25292	3928	69.68	31.83	60.00	53.14	7.780	.580E	8.36	0.05M	8.41	0.00	[illegible]		
1255	25602	3982	70.35	32.45	60.68	53.88	6.310	.990	7.30	0.75	8.05	0.00	[illegible]		
1261	25642	3988	69.40	28.88	60.71	50.22	4.290	.020	4.31	-0.04	4.27	0.00	[illegible]		
1276	25948	0	71.02	33.16	61.35	54.70	6.160	.350E	6.51	0.00M	6.51	0.00	F2		
1314	26764	4113	71.96	31.74	63.20	53.49	5.190	.052E	5.24	0.05M	5.29	0.00	F2		
1324	26961	4137	71.47	28.44	63.62	50.17	4.650	.050	4.70	0.05	4.75	0.00	A2		
1330	27084	0	71.59	28.16	63.87	49.92	5.450	.220E	5.67	0.12M	5.79	0.00	A7 V		
1333	27192	4157	71.95	29.00	64.10	50.80	5.540	-.004	5.54	-0.76	4.77	0.00	[illegible]		
1417	28446	0	74.64	31.61	67.01	53.81	5.770	.160E	5.93	-0.73M	5.20	0.00	[illegible]		
1467	29317	4452	75.83	30.59	68.99	52.98	5.050	1.070	6.12	0.69	7.01	0.00	K0 III		
1466	29316	0	75.91	30.98	69.00	53.38	5.370	.310E	5.68	0.05M	5.73	0.00	A5 n		
1511	30121	4551	77.86	34.05	70.96	56.67	5.260	.250	5.51	0.12	5.63	0.00	A m	A	
1515	30144	0	77.67	32.91	71.00	55.52	6.250	.290E	6.54	0.02M	6.56	0.00	F0		
1546	30752	0	78.07	30.06	72.30	52.75	6.310	.050E	6.36	0.05M	6.41	0.00	A2		
1555	30958	0	78.77	32.43	72.74	55.18	5.510	.000E	5.51	0.00M	5.51	0.00	A0		
1561	31134	0	78.59	30.02	73.04	52.78	5.640	.050E	5.69	0.05M	5.74	0.00	A2		
1568	31278	4726	78.92	30.88	73.32	53.67	4.470	-.020	4.45	-0.03	4.42	0.00	A1 V	AB	
1588	31579	0	79.26	30.24	73.95	53.07	6.084	1.459E	7.54	1.60M	9.14	0.00	G K3		
1637	32537	4871	80.26	28.58	75.69	51.53	4.960	.340	5.30	-0.03	5.27	0.00	F0 V	A	
1692	33654	0	81.85	30.08	77.68	53.16	6.130	.000E	6.13	0.00M	6.13	0.00	A0		
1707	34019	0	82.32	30.40	78.31	53.52	10.200	1.800E	12.00	2.00M	14.00	0.00	G M7 e	2	
1751	34787	0	83.74	34.29	79.80	57.50	5.140	.000E	5.14	0.00M	5.14	0.00	A0		
0	35961	5230	84.83	31.33	81.84	54.62	7.720	.620	8.34	0.09	8.43	0.00	G1 V	A	
1828	36066	0	85.18	33.88	82.07	57.18	6.400	.490E	6.89	0.00M	6.89	0.00	D F7		
1866	36678	0	85.68	31.07	83.12	54.40	5.735	1.633F	7.37	1.75M	9.12	0.00	G M0		
0	37008	5504	85.81	26.08	83.57	51.42	7.710	.850	8.56	0.45	9.01	0.00	K0		
1925	37394	5672	86.44	30.09	83.32	53.46	6.230	.840	7.07	0.51	7.58	0.00	K0	A	
1941	37601	5737	86.86	33.18	84.70	56.56	6.050	.950	7.00	0.73	7.73	0.00	GG9		
1969	38091	0	87.41	32.68	85.57	56.08	5.940	.170E	6.11	0.12M	6.23	0.00	A4 V N		
1992	38618	0	88.10	33.48	86.57	56.90	6.370	.050E	6.42	0.05M	6.47	0.00	A2 N		
2003	38765	0	88.05	28.08	86.74	51.50	6.289	1.046E	7.33	1.06M	8.40	0.00	K1 III		
2029	39283	5973	88.79	32.27	87.66	55.70	4.980	.050	5.03	0.12	5.15	0.00	A2 P		
2045	39551	0	88.99	28.35	88.06	51.79	6.450	.080E	6.53	0.07M	6.60	0.00	A3		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
2077	40035	6046	89.57	30.84	88.85	54.28	3.690	.990	4.68	0.86	5.54	0.00	K0 II		A
2079	40062	0	89.61	31.88	88.90	55.32	6.450	.000E	6.45	0.00M	6.45	0.00	[illegible]		
2080	40083	0	89.62	31.12	88.92	54.56	6.160	1.190E	7.35	1.33M	8.68	0.00	[illegible]		
2123	40873	0	90.44	28.13	90.13	51.58	6.450	.180E	6.63	0.16M	6.79	[illegible]			
2172	42083	0	91.70	29.22	91.94	52.66	6.240	.050E	6.29	[illegible]	6.34	[illegible]			
2264	43905	6347	93.39	30.08	94.43	53.48	5.360	.430	5.79	0.12	5.91	[illegible]			
2291	44691	0	94.01	32.93	95.55	56.31	5.640	.240E	5.88	0.12M	6.00	[illegible]			
2376	46101	0	95.43	32.09	97.59	55.40	6.380	.810E	7.19	0.48M	7.67	0.00	[illegible]		
2402	46590	0	95.81	33.60	98.35	56.89	5.770	.000E	5.77	0.00M	5.77	0.00	[illegible]		
2463	47979	0	97.26	30.14	100.04	53.35	6.267	1.077E	7.34	1.00M	8.34	0.00	[illegible]		
2477	48432	6664	97.28	34.03	100.64	57.22	5.340	.960	6.30	0.73	7.03	[illegible]			
2485	48767	0	97.68	32.59	101.01	55.76	6.280	.460E	6.74	0.00M	6.74	[illegible]			
2486	48766	0	97.68	32.59	101.01	55.76	5.520	.467E	5.94	0.00M	5.94	[illegible]			
2644	52859	0	101.04	29.94	105.42	52.82	6.170	.050E	6.22	0.05M	6.27	0.00			
2703	54895	0	102.59	28.81	107.37	51.52	5.475	1.669E	7.14	1.90M	9.04	0.00	[illegible]		
2737	55866	0	103.21	29.58	108.41	52.21	5.922	1.256E	7.18	1.20M	8.38	0.00	[illegible]		
0	57129	7109	103.95	30.42	109.67	52.94	7.720	1.260	8.98	1.31	10.29	0.00			
2783	57102	0	103.52	32.82	109.69	55.37	6.530	.000E	6.53	0.00M	6.53	0.00	[illegible]		
2784	57103	0	103.53	32.82	109.70	55.37	5.610	-.120E	5.49	-0.34M	5.15	0.00	[illegible]		
2804	57646	0	104.54	29.53	110.26	51.98	5.798	1.610E	7.41	1.70M	9.11	0.00	[illegible]		
2894	60294	0	105.74	33.66	113.18	55.87	5.917	1.123E	7.04	1.06M	8.10	0.00	[illegible]		
2969	61931	7388	108.22	28.65	115.07	50.55	5.270	.000	5.27	0.00	5.27	[illegible]			
3023	63332	0	108.54	32.49	116.79	54.26	6.070	.461E	[illegible]	[illegible]	[illegible]	[illegible]			
3039	63586	0	108.51	33.59	117.16	55.34	6.300	.000E	[illegible]	[illegible]	[illegible]	[illegible]			
3173	67006	7755	112.25	30.55	121.18	51.65	4.760	.050	[illegible]	[illegible]	[illegible]	[illegible]			
3246	69149	0	113.13	33.47	123.60	54.29	6.269	1.543E	[illegible]	[illegible]	[illegible]				
3258	69682	0	113.70	33.01	124.17	53.72	6.320	[illegible]	[illegible]	[illegible]	[illegible]				
3277	70313	0	114.37	32.62	125.00	53.39	5.510	.050E	[illegible]	[illegible]	[illegible]				
0	71881	8092	116.65	30.67	127.07	50.79	7.430	.630	8.06	0.14	8.20	[illegible]			
3351	71952	8099	115.91	33.10	127.20	53.29	6.240	1.010	7.25	0.83	8.08	[illegible]	[illegible]		
3400	73017	0	116.80	33.63	128.66	53.58	5.664	.964E	6.63	0.80M	7.43	[illegible]			
3405	73131	0	117.08	33.19	128.82	53.09	6.350	.810E	7.16	0.48M	7.64	[illegible]			
3408	73171	0	117.21	33.01	128.90	52.89	5.906	1.171E	7.08	1.20M	[illegible]	[illegible]			
3569	76644	8669	122.45	29.58	133.95	48.24	3.120	.160	3.30	0.06	3.36	[illegible]			
3594	77327	6719	123.58	28.98	135.05	47.36	3.610	-.010	3.60	0.02	3.62	0.00	[illegible]		
3603	77601	0	123.39	30.37	135.49	48.73	5.970	.440E	6.41	0.15M	6.56	0.00	[illegible]		
3619	78209	8761	122.77	33.45	136.34	51.81	4.470	.270	4.74	0.11	4.85	0.00	[illegible]		
3676	79763	0	126.77	29.45	138.54	47.03	5.680	.010E	5.69	0.03M	5.72	0.00	[illegible]		
3697	80290	0	124.96	33.79	139.31	51.47	6.050	.380E	6.43	0.00M	6.43	0.00	[illegible]		
3743	81688	0	125.83	29.00	141.35	45.82	5.407	.984E	6.39	0.80M	7.19	0.00	[illegible]		
3778	82380	0	127.99	32.85	142.44	49.67	6.490	.060E	6.57	0.07M	6.64	0.00	[illegible]		
3797	82582	9118	129.33	30.57	142.76	47.13	6.490	.240	6.73	0.12	6.85	0.00	[illegible]		
3854	83869	0	130.18	32.52	144.86	48.66	6.340	.000E	6.34	0.00M	6.34	0.00	A0		
0	84453	9225	132.41	29.72	145.88	45.35	6.620	.950	7.77	0.74	8.51	0.00	[illegible]		
3881	84737	9239	132.35	30.69	146.34	46.26	5.070	.600	5.67	0.16	5.83	0.00	G3 V		
3929	86166	9319	134.39	30.77	148.70	45.65	6.310	1.130	7.44	0.99	8.43	0.00	K0		
4033	89021	9526	139.20	29.88	153.52	43.16	3.460	.010	3.47	0.06	3.53	0.00	A2 IV		
0	89269	9542	138.99	31.05	153.96	44.30	6.650	.660	7.31	0.15	7.46	0.00	G5		
4044	89268	0	137.63	33.51	153.97	47.02	6.350	1.070E	7.42	1.06M	8.48	0.00	K1 III		A
4067	89744	0	140.98	28.73	154.80	41.48	5.780	.530E	6.31	0.06M	6.37	0.00	F6		
4069	89758	9576	140.89	28.99	154.84	41.75	2.990	1.580	4.57	1.83	6.40	0.00	GK5		
4096	90470	9640	141.84	29.49	156.13	41.86	6.000	.190	6.19	0.12	6.31	0.00	A2		
4103	90602	9657	140.24	32.84	156.40	45.47	6.370	1.350	7.72	1.45	9.17	0.00	K0		
4132	91312	9702	143.54	28.88	157.58	40.68	4.740	.230	4.97	0.08	5.05	0.00	A7 IV		
4248	94334	9987	146.17	33.06	162.78	43.46	4.710	-.050	4.66	-0.06	4.60	0.00	A1 V		
4264	94669	10016	147.24	32.20	163.35	42.28	6.030	1.130	7.16	1.08	8.24	0.00	K2 II		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
4277	95128	10048	148.72	31.06	164.17	40.70	5.060	.600	5.66	0.12	5.78	0.00	G0		
4285	95241	0	147.56	33.34	164.38	43.18	6.050	.580E	6.63	0.00M	6.63	0.00	D G0		
4288	95310	10061	149.62	30.09	164.51	39.48	5.080	.240	5.32	0.17	5.49	0.00	F0		
4309	95934	10107	150.87	29.54	165.44	38.51	5.980	.160	6.14	0.10	6.24	0.00	[illegible]		
4333	96813	0	152.81	28.22	166.64	36.58	5.740	1.514E	7.25	1.10M	8.35	0.00	[illegible]		
4345	97334	10212	153.72	28.07	167.45	35.09	6.400	.600	7.00	0.12	7.12	0.00	G2		A
4351	97501	0	151.18	32.87	167.72	41.36	6.330	1.150E	7.48	1.12M	8.60	0.00	K0		
4380	98353	10297	153.65	30.78	169.10	38.46	4.790	.120	4.91	0.03	4.94	0.00	A2 V		
4422	99787	10379	155.25	32.69	171.60	39.61	5.250	.000E	5.25	0.01M	5.26	0.00	A1 V		A
4452	100470	10429	157.63	30.90	172.82	37.09	6.400	1.050	7.45	0.93	8.38	0.00	[illegible]		
4482	101151	10499	160.27	28.49	173.98	33.90	6.280	1.350	7.63	1.52	9.15	0.00	[illegible]		
4496	101501	10546	160.49	29.24	174.60	34.48	5.330	.690	6.02	0.27	6.29	0.00	G5		
4536	102713	0	161.93	30.71	176.77	35.21	5.700	.462E	6.16	0.07M	6.23	0.00	[illegible]		
4545	102942	10663	163.07	29.46	177.14	33.65	6.270	.320	6.59	0.11	6.70	0.00	[illegible]		
4550	103095	10675	160.98	33.53	177.53	38.08	6.490	.750	7.24	0.17	7.41	0.00	[illegible]		
4562	103500	0	162.09	32.85	178.16	37.04	6.500	1.570E	8.07	1.82M	9.89	0.00	[illegible]		
4581	104075	0	164.92	30.05	179.18	33.44	5.970	1.150E	7.12	1.10M	8.22	0.00	A1 III		
4584	104179	0	164.60	30.89	179.35	34.31	6.510	.230E	6.74	0.14M	6.88	0.00	A0 III		
0	104204	10764	163.15	33.29	179.40	37.01	7.480	.110	7.59	0.11	7.70	0.00	[illegible]		
4593	104438	0	163.85	32.83	179.77	36.32	5.590	1.010E	6.60	0.79M	7.39	0.00	K0 III		
0	105388	10886	167.94	29.03	181.39	31.33	7.450	-.020	7.43	0.02	7.45	0.00	A0		
0	106152	10969	168.59	30.15	182.58	32.07	7.770	.530	8.30	0.06	8.36	0.00	F5		
0	106223	10975	169.48	28.85	182.69	30.56	7.410	.270	7.68	-0.08	7.60	0.00	[illegible]		
0	106365	10989	168.33	31.15	182.90	33.06	6.870	1.130	8.00	1.07	9.07	0.00	[illegible]		
4668	106760	11019	168.70	31.64	183.50	33.34	5.000	1.140	6.14	1.08	7.22	0.00	[illegible]		
4673	106887	11037	171.10	28.06	183.75	29.21	5.680	.140	5.82	0.14	5.96	0.00	[illegible]		
4680	107054	11049	170.64	29.34	184.00	30.53	6.240	.290	6.53	0.02	6.55	0.00	[illegible]		
4737	108381	11182	173.53	28.40	186.11	28.55	4.350	1.130	5.48	1.15	6.63	0.00	[illegible]		
4783	109317	11283	172.36	33.48	187.80	33.52	5.430	1.020	6.45	0.83	7.28	0.00	[illegible]		
4784	109345	11285	172.31	33.62	187.83	33.66	6.240	1.050	7.29	0.90	9.19	0.00	[illegible]		
0	110248	11364	175.49	31.63	189.53	30.65	7.670	.290	7.96	0.16	8.12	0.00	[illegible]		
0	110297	11368	177.27	28.78	189.62	27.41	7.820	.441	8.26	0.04	8.30	0.00	[illegible]		
0	110326	11374	175.58	31.73	189.67	30.71	6.970	.260	7.23	0.05	7.28	0.00	[illegible]		
0	110524	11405	177.03	30.04	190.05	28.63	7.510	.378	7.89	-0.02	7.86	0.00	[illegible]		
0	110628	11421	178.32	28.11	190.21	26.40	6.700	.360	7.06	0.14	7.20	0.00	[illegible]		
0	110883	11445	178.07	29.42	190.65	27.67	7.470	1.079	8.55	0.95	9.50	0.00	K2 II		
0	111271	11499	177.59	31.59	191.35	29.80	7.250	.362	7.61	0.06	7.67	0.00	F0		
4869	111469	11521	176.96	29.97	191.71	27.82	5.780	.030	5.81	0.06	5.87	0.00	A0		A
4883	111812	11570	179.52	30.21	192.32	27.81	4.930	.670	5.60	0.19	5.79	0.00	G0		
0	112001	11603	180.21	29.68	192.65	27.07	7.680	.627	8.31	0.17	8.47	0.00	G0 IV		
0	112127	11627	180.42	29.75	192.87	27.05	6.920	1.267	8.19	1.42	9.61	0.00	K1 II		
0	112257	11657	180.19	30.75	193.18	28.04	7.840	.660	8.50	0.18	8.68	0.00	G5		
0	112734	11708	180.69	31.59	194.04	28.59	6.970	.232	7.20	0.04	7.24	0.00	A5		
0	112753	11710	181.16	30.65	194.07	27.75	7.970	.653	8.62	0.18	8.80	0.00	G0 V		AB
0	112887	11724	181.05	31.45	194.28	28.33	7.190	.418	7.61	-0.02	7.59	0.00	F5		
4924	112989	11732	179.74	33.94	194.47	31.05	4.900	1.156	6.06	1.05	7.10	0.00	K1 P		A
0	113284	11775	180.45	33.78	194.99	30.63	7.940	.352	8.29	0.03	8.32	0.00	F1 IV		
4948	113865	11834	182.07	32.98	195.95	29.30	6.520	.078	6.60	0.07	6.67	0.00	A3 V		A
4954	113996	11849	183.05	31.82	196.19	27.89	4.790	1.491	6.28	1.85	8.13	0.00	K5 II		
4956	114092	11861	183.26	31.83	196.38	27.82	6.190	1.364	7.55	1.64	9.19	0.00	K4 II		
4983	114710	11934	184.03	32.50	197.38	28.13	4.300	.560	4.86	0.05	4.91	0.00	G0 V		A
4984	114724	0	185.94	29.29	197.44	24.52	6.310	1.070E	7.38	1.06M	8.44	0.00	K1 III		
0	115708	12029	186.39	31.83	199.06	26.63	7.810	.250	8.06	0.06	8.12	0.00	A2		
5057	116706	12105	189.21	30.20	200.68	24.11	5.810	.050	5.86	0.10	5.96	0.00	A2		
5102	117876	12168	190.81	31.41	202.61	24.61	6.110	.960	7.07	0.70	7.77	0.00	K0 II		AB
5123	118508	0	191.70	32.04	203.66	24.86	5.740	1.554E	7.29	1.85M	9.14	0.00	M2 III		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
5144	119055	12243	194.84	28.18	204.57	20.21	5.780	.000	5.78	-0.01	5.77	0.00	A1 V		*
5149	119126		193.72	30.53	204.67	22.75	5.620	1.007E	6.63	0.85M	7.48	0.00	G9 III		
5164	119584		194.29	30.97	205.35	22.95	6.130	1.418E	7.55	1.65M	9.20	0.00	K4 III		
5182	120064		193.51	33.98	206.10	25.95	5.950	.494E	6.44	0.00M	6.44	0.00	F6 IV-V		
5201	120539	12331	196.44	30.23	206.84	21.51	4.900	1.440	6.34	1.65	7.99	0.00	K4 II		
5235	121370	12376	198.99	28.09	208.08	18.65	2.700	.590	3.29	0.20	3.49	0.00	[illegible]		
5255	121996	12413	198.45	31.48	209.08	21.94	5.400	-.040	5.36	0.02	5.38	0.00	A0 V		
0	124347	12509	201.64	33.40	212.58	22.61	7.970	.430	8.40	0.04	8.44	0.00	F0		
5333	124713	12539	202.39	33.13	213.09	22.11	6.370	.170	6.54	0.09	6.63	0.00	A8 V		
5340	124897	12551	203.88	30.77	213.34	19.44	-0.060	1.230	1.17	1.26	2.43	0.00	K2 II		
5343	124953	12554	204.11	30.52	213.43	19.14	5.960	.300	6.26	0.08	6.34	0.00	A5		
5346	125040		203.69	31.69	213.56	20.35	6.300	.420E	6.72	0.00M	6.72	0.00	D F4		
5370	125560	12586	206.18	28.44	214.35	16.53	4.850	1.240	6.09	1.37	7.46	0.00	K3 II		
5405	126661		206.61	31.76	216.03	19.46	5.270	.150E	5.42	0.09M	5.51	0.00	[illegible]5		
5462	128750	12768	210.08	31.91	218.98	18.51	5.900	1.100	7.00	0.99	7.99	0.00	GK2		
5475	129174	12795	211.50	30.37	219.59	16.63	4.940	-.020	4.92	-0.33	4.59	0.00	A P		
5476	129175		211.51	30.37	219.60	16.63	5.810	.080E	5.89	0.08M	5.97	0.00	A M		A
5502	129972	12872	212.47	31.26	220.73	17.17	4.610	.970	5.58	0.73	6.31	0.00	K0 II		
5507	130025		211.69	33.06	220.76	19.09	6.230	.810E	7.04	0.48M	7.52	0.00	K0		
5512	130144	12892	213.43	29.61	220.94	15.34	5.820	1.500	7.32	1.31	8.63	0.00	GK5		
5544	131156	12949	213.19	33.78	222.27	19.31	4.540	.760	5.30	0.28	5.58	0.00	G5		AB
5550	131473		215.11	30.75	222.76	15.91	6.350	.560E	6.91	0.04M	6.95	0.00	D F9 2X		
5553	131511	12969	213.72	33.98	222.78	19.35	6.000	.840	6.84	0.49	7.33	0.00	GK1		
5567	131951		216.33	29.79	223.46	14.65	5.840	-.060E	5.78	-0.08M	5.70	0.00	B9.[illegible]		
5575	132146		215.85	31.69	223.72	16.58	5.610	.900E	6.51	0.55M	7.06	0.00	[illegible]		
5639	134323	13091	220.14	29.62	226.63	13.42	6.110	.990	7.10	0.66	7.76	0.00	[illegible]		
5717	136831	13228	223.98	29.98	230.00	12.75	6.240	.030	6.27	0.02	6.29	0.00	[illegible]		
5739	137471	13260	223.93	32.96	230.87	15.60	5.170	1.660	6.83	1.95	8.78	0.00	[illegible]		
0	137569	13262	224.33	32.30	231.00	14.87	7.860	.240E	8.10	-0.61M	7.49	1.26	F5		
5770	138527	13306	225.46	34.00	232.46	16.22	6.130	-.050	6.08	-0.21	5.87	0.00	[illegible]		
5788	138917	13328	227.99	28.88	233.10	10.70	3.790	.260	4.05	0.12	4.17	0.00	F0 IV		AB
5789	138918		228.00	28.88	233.11	10.70	14.230	.000E	14.23	0.00M	14.23	0.00	F0 IV		
5796	139087		228.07	29.65	233.38	11.42	6.066	1.092E	7.16	1.00M	8.16	0.00	G K0		
5802	139195	13339	228.60	28.49	233.52	10.18	5.260	.950	6.21	0.67	6.88	0.00	K0		
0	139457	13351	228.93	28.81	233.89	10.41	7.100	.500	7.60	-0.06	7.54	0.00	F6		
5831	139862		228.98	30.71	234.45	12.23	6.255	.939E	7.19	0.75M	7.94	0.00	G8 II-I		
5843	140160		229.18	31.57	234.86	13.01	5.330	.040E	5.37	0.05M	5.42	0.00	A0 VAR		
5850	140438		229.31	32.44	235.21	13.82	6.330	.850E	7.18	0.60M	7.78	0.00	G8 III-		
5870	141187	13442	230.32	33.14	236.24	14.27	5.700	.090	5.79	0.06	5.85	0.00	A2 V		
5874	141353		230.68	32.88	236.47	13.94	5.999	1.247E	7.25	1.25M	8.50	0.00	G K2		
5911	142267	13494	232.25	32.62	237.72	13.35	6.100	.600E	6.70	0.00M	6.70	0.00	G2 V		A
5919	142500	13507	233.94	28.23	238.06	8.73	6.280	.180	6.46	0.07	6.53	0.00	A2 N		
5940	142980	13541	233.03	34.04	238.73	14.56	5.540	1.140	6.68	1.16	7.84	0.00	K1 IV		
5992	144426	13634	237.07	28.36	240.80	8.23	6.280	.080	6.36	0.10	6.46	0.00	A2		
6004	144874		237.18	30.23	241.31	10.03	5.632	.196E	5.83	0.19M	6.02	0.00	A5		
6010	145002	13670	237.74	28.95	241.51	8.67	5.720	1.610	7.33	1.68	9.01	0.00	GM3	*	
6032	145589	13770	238.31	30.25	242.28	9.84	6.520	.250	6.77	0.08	6.85	0.00	A3		AB
0	145958	13787	237.84	34.08	242.74	13.66	6.670	.760	7.43	0.34	7.77	0.00	DK0		A
6111	147869		242.44	28.17	245.43	7.07	5.840	-.010E	5.83	0.01M	5.84	0.00	A0		
6121	148228		242.06	32.63	245.96	11.52	6.107	1.032E	7.14	0.85M	7.99	0.00	K0		
0	148683	13942	243.15	31.98	246.76	10.70	7.600	.930	8.53	0.61	9.14	0.00	G5 II		A
0	148979	13974	244.21	29.81	247.27	8.40	6.980	.910	7.89	0.60	8.49	0.00	G5		A
6159	149161	13999	243.88	33.00	247.57	11.59	4.850	1.500	6.35	1.82	8.17	0.00	K4 II		
6203	150483	14123	246.08	34.24	249.63	12.49	5.940	.050	5.99	0.03	6.02	0.00	A2 V		
0	151090	14185	248.40	28.16	250.64	6.18	6.550	.890	7.44	0.53	7.97	0.00	DG6		A
6228	151217	14199	248.21	30.66	250.86	8.67	5.140	1.540	6.68	1.90	8.58	0.00	K5 II		A

YALE HD	PHOELC λ	β α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR
0151879	14246249.26	31.64251.9?	9.51	6.910	.910	7.82	0.51	8.33	0.00		
6250151956	14252249.70	29.49251.97	7.33	5.500	.100	5.60	0.10	5.70	0.00		
6281152614	14323250.29	32.51252.91	10.25	4.380	-.080	4.30	-0.32	3.98	0.00		
6299153210	14354251.47	31.84253.82	9.45	3.190	1.160	4.35	1.17	5.52	[illegible]		
6317153653	14373252.67	29.?6254.51	6.66	6.580	.230	6.81	0.07	6.88	[illegible]		
6329153914	14386252.84	31.05254.89	8.52	6.320	.090	6.41	0.05	6.46	[illegible]		
6358154610	14423253.88	32.45255.95	9.60	6.360	1.450	7.81	1.73	9.54	0.00		
6359154619	0253.79	33.16255.96	10.52	6.350	.850E	7.20	0.60*	7.80	0.00		
6390155500	14509255.71	30.75257.33	7.95	6.320	1.040	7.36	0.87	8.23	0.00		
6393155644	0255.61	33.45257.53	10.64	5.330	1.570E	6.90	1.85*	8.75	[illegible]		
6433156681	14753257.39	33.88259.07	10.92	5.030	1.550	6.59	1.90	8.46	[illegible]		
6434156697	14756257.93	29.12259.11	6.14	6.500	.390	6.89	0.12	7.01	[illegible]		
0156968	14780257.99	32.50259.45	9.51	7.970	.600	8.57	0.06	[illegible]	[illegible]		
6476157617	14826259.14	31.97260.39	8.90	5.760	1.250	7.01	1.27	8.28	[illegible]		
6497157978	14876259.93	30.76260.98	7.64	6.050	.580	6.63	0.26	[illegible]	[illegible]		
0 0	14966262.20	32.86263.06	9.61	7.810	.300	8.11	0.05	[illegible]	[illegible]		
6548159480	14965262.20	32.67263.06	9.62	5.910	.030	5.94	-0.01	[illegible]	[illegible]		
0159481	14968262.46	29.32263.09	6.06	7.410	.520	7.93	0.09	[illegible]	[illegible]		
6590160781	15037264.36	29.68264.77	6.34	5.940	1.260	7.20	1.18	8.38	[illegible]		
6603161096	15049264.99	27.95265.25	4.59	2.760	[illegible]	[illegible]	1.24	[illegible]			
0161184	15054265.05	29.23265.35	5.87	7.980	.056	8.04	-0.19	7.85	[illegible]		
0161273	15059265.10	29.44265.40	6.08	7.430	.334	7.76	0.15	7.91	[illegible]		
0161242	15060265.17	28.63265.44	5.27	7.800	[illegible]	9.0?	1.1?	[illegible]			
0161480	15084265.54	29.11265.78	5.73	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
0161542	15088265.64	29.31265.87	5.93	7.500	.128	7.63	0.07	[illegible]			
0161572	15093265.65	29.09265.87	5.71	7.590	[illegible]	7.59	-0.4?	[illegible]			
0161573	15094265.71	28.93265.92	5.55	6.850	.011	6.86	-0.54	[illegible]			
0161603	15100265.71	29.06265.93	5.68	7.340	.020	7.36	-0.46	[illegible]			
0161622	15105265.80	28.80266.00	5.42	7.920	.460	8.38	0.02	8.40	[illegible]		
0161638	15107265.79	29.63266.01	6.25	7.880	1.040	8.92	0.81	9.73	[illegible]		
0161660	15112265.82	29.52266.04	6.14	7.740	-.009	7.73	-0.55	7.18	[illegible]		
0161677	15114265.86	29.17266.06	5.79	7.120	.018	7.14	-0.40	6.66	0.00		
0161733	15123265.96	29.10266.15	5.71	7.990	.037	8.03	-0.48	7.55	[illegible]		
0161885	15150266.18	29.81266.36	6.42	7.530	1.631	9.16	1.70	10.86	[illegible]		
0162028	15165266.44	29.12266.57	5.72	7.490	.016	7.51	-0.41	7.10	0.00	B9	
0162056	15166266.52	28.38266.62	4.98	7.490	.451	7.94	0.18	8.12	0.00	F0	
0162319	15191266.75	33.27266.95	9.86	6.740	1.390	8.13	1.53	9.66	0.00	K5	A
6670162917	15227267.72	29.54267.70	6.11	5.760	.420	6.18	-0.03	6.15	0.00	F4	
6690163641	15252268.77	29.93268.62	6.49	6.230	.000	6.28	-0.25	6.03	0.00	A0	
6719164432	15309269.90	29.72269.61	6.27	6.360	-.100	6.26	-0.84	5.42	0.00	B3 II	
0165401	15382271.24	28.10270.79	4.66	6.790	.630	7.42	0.04	7.46	0.00	G2 V	
6770165760	15403271.79	32.17271.23	8.73	4.640	.970	5.61	0.73	6.34	0.00	G8 II	
6771165777	15405271.81	33.00271.24	9.56	3.730	.120	3.85	0.09	3.94	0.00	A4 V	
6857168387	15589275.17	30.62274.18	7.24	5.440	1.100	6.54	1.01	7.55	0.00	GK2	AH
6873168797	15613275.75	28.77274.75	5.41	6.130	-.040	6.09	-0.62	5.47	0.00	B5 III	A
6900169578	15657276.77	28.38275.67	5.06	6.740	.010	6.75	-0.21	6.54	0.00	B9	
6902169689	15659277.09	31.31275.81	8.00	5.640	.920	6.56	0.45	7.01	0.00	GG2	
0169822	15671277.29	32.05275.95	8.75	7.850	.680	8.53	0.17	8.70	0.00	G7 V	
6928170200	15698277.64	29.44276.38	6.16	5.710	-.030	5.68	-0.36	5.32	0.00	B9	
6967171247	15788279.35	31.43277.75	8.23	6.410	-.030	6.38	-0.34	6.04	0.00	B8	
6976171505	15802279.97	34.03278.11	10.85	6.330	.080	6.41	0.05	6.46	0.00	A1 V	A
0171586	15806279.71	28.07278.28	4.89	6.440	.082	6.52	0.08	6.60	0.00	A2 P	
6985171802	15823280.31	32.23278.52	9.08	5.380	.380	5.76	-0.04	5.72	0.00	DF2	A
6987171834	15824280.15	29.79278.55	6.63	5.440	.380	5.82	-0.06	5.76	0.00	DF1	
7002172171	0280.83	31.89278.99	8.77	6.400	1.800E	8.20	1.88M	10.08	0.00	GK B6 F	A
7008172365	15867280.87	28.33279.29	5.22	6.380	.790	7.17	0.52	7.69	0.00	F8 IH	

YALE HD	PHOELC λ	β α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
0172401	15870281.20	31.79279.32	8.69	6.980	1.070E	8.05	1.06H	9.11	0.00	K0 III		
7010172424	15873281.13	30.41279.36	7.31	6.290	.980	7.27	0.68	7.95	0.00	[illegible]		
0172522	15880281.43	31.90279.50	8.82	6.910	.220E	7.13	0.25M	7.38	0.00	[illegible]		
0172588	15885281.57	31.81279.59	8.74	7.220	.350E	7.57	0.20M	7.77	0.00	[illegible]		
7048173495	15945282.54	28.44280.75	5.45	5.820	.040	5.86	-0.03	5.83	0.00	[illegible]		
7099174569	0284.68	33.77282.10	10.92	6.490	1.500E	7.99	1.88M	9.87	0.00	[illegible]		
7135175515	16067285.49	29.30283.25	6.55	5.560	1.050	6.61	0.89	7.50	0.00	K0 III		
7163176095	16116286.28	28.85283.99	6.17	6.200	.470	6.67	-0.01	6.66	0.00	[illegible]		
7173176304	16121287.06	32.69284.23	[illegible]	6.750	.260	7.01	-0.46	6.55	0.00	[illegible]		
7208176981	16154287.69	30.85284.99	8.30	6.290	1.610	7.90	1.84	9.74	0.00	[illegible]		
0177624	16186288.68	32.02285.69	9.57	6.860	.190E	7.05	-0.08H	6.97	0.00	[illegible]		
0177725	16192289.05	33.62285.79	11.19	7.610	.100E	7.71	0.09M	7.80	0.00	[illegible]		
7243177940	0288.82	30.59285.94	8.16	6.850	1.900E	8.75	1.90M	10.65	0.00	[illegible]		
7248178125	0289.43	33.37286.15	10.99	5.090	-.060E	5.03	-0.39M	4.64	0.00	[illegible]		
7266178596	16240289.23	28.35286.64	5.99	5.230	.340	5.57	0.01	5.58	0.00	[illegible]		
0180028	16297290.83	28.13288.07	5.96	6.970	.810	7.78	0.61	8.39	0.00	[illegible]		
7315180868	16326292.69	33.49288.87	11.50	5.290	.220	5.51	0.14	5.65	0.00	[illegible]		
7325181122	16339292.61	31.51289.12	9.53	6.310	1.050	7.36	0.89	8.25	0.00	[illegible]		
7331181333	16340293.37	34.19289.33	12.28	5.560	.290	5.85	0.20	6.05	0.00	[illegible]		
7332181383	16348293.27	33.36289.38	11.44	6.020	.680E	6.10	0.07M	6.17	0.00	[illegible]		
7354182101	16407293.80	31.63290.11	9.81	6.340	.450	6.79	-0.05	6.74	0.00	[illegible]		
0182296	16418293.79	30.37290.31	8.56	7.070	1.320	8.39	1.17	9.56	0.00	[illegible]		
7373182572	16443294.81	33.55290.65	11.84	5.150	.790	5.94	0.40	6.34	0.00	[illegible]		
0183401	16534296.09	33.90291.66	12.37	7.940	.305	8.24	0.10	8.34	0.00	[illegible]		
7429184406	16593296.46	28.66292.91	7.27	4.440	1.170	5.61	1.27	6.88	0.00	[illegible]		
7445184884	0297.85	32.25293.44	11.02	6.480	.050E	6.53	0.05M	6.58	0.00	[illegible]		
0184982	16637297.24	28.71293.58	7.44	7.590	.170E	7.76	0.20M	7.96	0.00	[illegible]		
7456185018	0298.09	32.36293.63	11.16	5.978	.881E	6.86	0.50M	7.36	0.00	[illegible]		
0185310	16666297.90	29.81293.95	8.63	7.790	.050E	7.84	0.07M	7.91	0.00	[illegible]		
0185608	16694298.11	28.86294.31	7.73	8.390	.310E	8.70	0.21M	8.41	0.00	[illegible]		
0185667	16705298.14	28.57294.39	7.45	7.220	.970E	8.19	0.60M	8.79	0.00	[illegible]		
7493186122	16746299.83	32.99294.97	12.07	6.240	-.080	6.16	-0.42	5.74	0.00	[illegible]		
7497186203	0299.84	32.62295.05	11.70	5.220	.200E	5.42	0.07M	5.49	0.00	[illegible]		
0186226	16756299.09	29.24295.09	8.26	6.880	.495	7.38	0.06	7.44	0.00	F5		
0186293	16763299.43	30.31295.17	9.37	7.790	1.170E	8.96	1.15M	10.11	0.00	K0 IB		A
0186312	16765299.49	30.31295.22	9.38	7.790	1.470E	9.26	1.56H	10.82	0.00	K3 II		
0186442	16782299.71	30.29295.41	9.40	6.520	1.230E	7.75	0.90M	8.65	0.00	[illegible]		
7511186547	16794300.78	33.96295.56	13.18	6.120	-.030	6.09	-0.20	5.89	0.00	[illegible]		
0186535	16791299.71	29.49295.57	8.61	6.410	.920E	7.33	0.70M	8.03	0.00	[illegible]		
7519186689	16809299.72	28.34295.81	7.49	5.900	.180	6.08	0.07	6.15	0.00	[illegible]		
7525186791	16822300.59	31.25295.97	10.49	2.710	1.520	4.23	1.69	5.92	0.00	[illegible]		
7542187203	16857301.24	31.21296.53	10.57	6.430	.960	7.39	0.69	8.08	0.00	F5 IB		
7544187259	0301.58	32.30296.59	11.69	5.610	.200E	5.81	0.07M	5.88	0.00	F2+A2		
7554187567	16882301.06	28.38296.97	7.77	6.450	-.100	6.35	-0.73	5.62	0.00	[illegible]		
7557187642	16885301.41	29.30297.08	8.73	0.750	.230	0.98	0.07	1.05	0.00	A5		
7560187691	16888301.88	30.81297.16	10.29	5.160	.560	5.72	0.07	5.79	0.00	[illegible]		
7562187753	16889301.75	30.03297.22	9.50	6.250	.100	6.35	0.08	6.43	0.00	A0		A
7569187923	16906302.49	31.94297.43	11.50	6.130	.650	6.78	0.13	6.91	0.00	G0		
7572187961	0302.21	30.68297.47	10.22	6.530	-.010E	6.52	-0.39M	6.13	0.00	B7 V		A
7595188310	16955302.29	28.73297.96	8.33	4.680	1.050	5.73	0.90	6.63	0.00	K0		
7610188728	16995303.60	31.51298.47	11.29	5.280	.060	5.34	-0.02	5.32	0.00	A1 V		
7648189695	17074304.16	28.45299.64	8.42	5.900	1.520	7.42	1.89	9.31	0.00	GK5		
7693191104	17297306.26	28.87301.36	9.25	6.420	.460	6.88	-0.04	6.84	0.00	DF2		
7700191263	0306.64	30.10301.56	10.57	6.300	-.110E	6.19	-0.67M	5.52	0.00	B3 V		AB
7724192425	17485309.76	34.08302.99	15.04	4.950	.090	5.04	0.01	5.05	0.00	A2 V		
7771193373	0310.59	31.84304.29	13.06	6.211	1.627E	7.84	1.90M	9.74	0.00	G 4I		

YALE HD	PHOELC λ	β α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
7774193472	17607310.83	32.13304.41	13.39	5.920	.320	6.24	0.14	6.38	0.00	A5		
7778193556	17617311.25	33.09304.50	14.41	6.130	.930	7.06	0.67	7.73	0.00	[illegible]		
7793194012	17664311.94	32.90305.13	14.39	6.180	.510	6.69	-0.04	6.65	0.00	[illegible]		
7810194526	0311.31	28.39305.83	9.90	6.310	1.560E	7.87	1.93*	[illegible]	[illegible]			
7836195325	17783312.60	28.69306.98	10.73	5.920	.020	5.94	-0.15	[illegible]	[illegible]			
0195481	17792314.66	33.54307.20	15.64	6.850	.140	6.99	0.08	7.07	[illegible]			
7840195483	0313.16	29.16307.21	11.08	7.110	.030E	7.11	0.40*	7.54	[illegible]			
7852195810	17820313.72	29.07307.71	11.13	4.040	-.120	3.92	-0.48	3.44	0.00	B5 II		
7858195943	17832314.48	30.67307.90	12.85	5.400	.090	5.49	0.04	5.53	0.00	A2		
7871196180	17860315.41	32.16308.24	14.50	4.690	.110	4.80	0.11	4.91	0.00	A1 V		
7882196524	17888315.99	31.92308.80	14.42	3.630	.440	4.07	0.08	4.15	0.00	F5		
7883196544	17890314.98	28.62308.66	11.20	5.440	.040	5.48	0.04	5.52	0.00	A2 V		
7892196725	17904315.87	30.62309.09	13.14	5.720	1.530	7.25	1.73	8.98	[illegible]			
7899196775	0316.86	33.00309.19	15.66	5.970	-.140E	5.83	-0.70M	5.13	0.00	[illegible]		
7906196867	17924317.03	33.02309.33	15.73	3.770	-.060	3.71	-0.23	3.48	0.00	[illegible]		
7907196885	0315.47	28.56309.36	11.07	6.440	.540E	6.98	0.01*	6.99	0.00	[illegible]		
7918197121	0317.00	31.65309.73	14.41	5.986	1.242E	7.23	1.42M	8.65	0.00	[illegible]		
7928197461	17962317.77	31.94310.28	14.69	4.470	.320	4.79	0.10	4.89	0.00	[illegible]		
0197645	17969317.55	30.41310.57	13.37	7.520	.050	7.57	0.00	7.57	0.00	[illegible]		
0197913	17982318.82	32.53310.97	15.72	7.550	.760	8.31	0.34	8.65	0.00	[illegible]		
0197925	17984317.72	29.39311.03	12.44	7.960	.200	8.16	-0.12	8.28	0.00	A2		
7947197963	17991319.02	32.71311.08	15.94	5.140	.490	5.63	0.08	5.71	[illegible]			
7948197964	17990319.02	32.71311.08	15.94	4.270	1.040	5.31	0.97	[illegible]	[illegible]			
7973198390	0318.52	29.07311.81	12.35	6.000	.620E	6.42	-0.13M	[illegible]				
7981198552	18043320.84	34.23312.08	17.86	6.460	.040	6.50	0.00	[illegible]				
8011199253	18102320.53	29.74313.31	13.53	5.180	1.120	6.28	0.97	[illegible]				
8012199254	18103320.12	28.65313.31	12.38	5.540	.120	5.66	0.07	[illegible]				
8037199941	18172322.84	32.35314.38	16.63	6.580	.380	6.96	-0.10	[illegible]				
8057200430	0322.88	30.11315.17	14.53	6.313	1.671E	7.98	1.84M	9.82	0.00			
8088201196	0324.43	30.64316.30	15.47	6.360	.810E	7.17	0.48M	7.65	0.00			
0201891	18337326.43	32.21317.42	17.53	7.380	.510	7.89	-0.09	7.80	[illegible]			
8116202128	18353326.11	30.45317.78	15.78	6.270	.240	6.51	0.06	6.57	[illegible]			
8173203504	18440329.96	33.29319.94	19.59	4.090	1.100	5.19	1.05	[illegible]				
0204133	18492330.27	31.32320.95	17.85	6.820	.020	6.84	0.02	[illegible]				
8210204188	0330.92	32.52321.03	19.17	6.030	.100E	6.13	0.09M	6.22	0.00	[illegible]		
8221204560	18510330.94	30.93321.66	17.69	6.460	1.410	7.87	1.68	9.55	0.00	[illegible]		
8267205852	0333.81	31.45323.86	19.09	5.450	.305E	5.76	-0.14M	5.89	0.00	[illegible]		
8276206043	0334.55	32.22324.17	20.04	5.870	.310E	6.18	0.01M	6.19	0.00	[illegible]		
8313206859	18668334.66	29.03325.54	17.12	4.310	1.180	5.49	0.96	6.45	0.00	[illegible]		
8321207089	18682337.61	34.05325.94	22.72	5.290	1.430	6.72	1.32	8.04	0.00	[illegible]		
0207201	18693336.39	31.19326.13	19.69	7.120	1.430	8.55	1.55	10.10	0.00	[illegible]		
8339207223	0335.24	28.66326.17	16.97	6.230	.330E	6.56	-0.01M	6.55	0.00	[illegible]		
8341207563	18709337.30	31.45326.78	20.23	6.250	-.100	6.15	-0.66	5.49	0.00	[illegible]		
8344207652	0336.05	26.46326.94	17.05	5.316	.386E	5.70	0.00M	5.71	0.00	[illegible]		
8348207840	18722337.53	30.67327.30	19.59	5.780	-.080	5.70	-0.38	5.32	0.00	[illegible]		
8350207932	0338.39	31.93327.49	21.03	6.840	1.550E	8.39	1.15M	9.54	0.00	[illegible]		
8358208108	18743337.98	30.33327.82	19.43	5.680	.010	5.69	0.01	5.70	0.00	[illegible]		
0208188	18749337.41	28.76327.98	17.79	7.890	1.570	9.46	1.98	11.44	0.00	K5 II		
8364208202	18750338.17	30.32327.98	19.48	6.390	.970	7.36	0.68	8.04	0.00	K0 II		
8372208527	0339.40	31.53328.51	21.01	6.510	1.150E	7.66	1.08M	8.74	0.00	K5		
0208609	18774337.94	28.19328.66	17.44	7.120	1.520	8.64	1.74	10.38	0.00	K3 II		
0208702	18779339.28	30.54328.83	20.06	7.250	.030	7.28	0.00	7.28	0.00	A0		
8430210027	18902344.06	34.26331.17	25.10	3.760	.440	4.20	-0.05	4.15	0.00	F5 V		
8435210074	0341.33	26.86331.27	19.22	6.180	.350E	6.53	0.00M	6.53	0.00	F2		
8438210129	18914342.47	30.87331.37	21.46	5.780	-.100	5.68	-0.41	5.27	0.00	B7 V		
8155210467	0342.10	28.73331.98	19.37	6.184	.694E	6.88	0.20M	7.08	0.00	G0		

YALE HD	PHOELC λ	β α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE
8459210516	18961342.78	29.95332.03	20.73	6.370	.120	6.49	0.11	6.60	0.00	[illegible]
8466210762	0345.13	33.42332.45	24.72	5.920	1.514E	7.43	1.15M	6.58	0.00	[illegible]
8532212395	0345.93	28.58335.31	20.60	6.010	.400E	6.41	0.00M	6.41	0.00	[illegible]
8564213179	0350.21	33.39336.71	26.51	5.787	1.251E	7.04	1.20M	8.24	0.00	[illegible]
0213216	19220350.60	33.96336.75	27.17	7.680	.300	7.98	0.14	8.12	0.00	[illegible]
8667215665	19518352.71	28.80341.03	23.30	3.950	1.070	5.02	0.89	5.91	0.00	[illegible]
8684216131	19566354.04	29.39341.90	24.34	3.480	.940	4.42	0.67	5.09	0.00	[illegible]
0216285	19584355.29	30.86342.26	26.13	6.950	.230	7.18	0.12	7.30	0.00	[illegible]
0216632	19628356.78	32.03342.95	27.75	7.680	.500	8.18	0.01	8.19	0.00	[illegible]
8753217477	0359.96	34.12344.58	30.82	6.600	-.040E	6.56	-0.35M	6.21	0.00	[illegible]
8775217906	0359.03	31.14345.34	27.81	2.420	1.670E	4.09	1.95M	6.04	0.00	[illegible]
8796218356	19801358.46	28.47346.17	25.20	4.770	1.350	6.12	1.15	7.27	0.00	[illegible]
8827218935	19848360.24	29.24347.35	26.58	6.160	.940	7.10	0.67	7.77	0.00	
8831219110	19857 1.88	31.43347.65	29.17	6.340	.950	7.29	0.65	7.94	0.00	[illegible]
8838219291	0 2.34	31.58347.93	29.49	6.440	.440E	6.88	-0.04M	6.84	0.00	[illegible]
0219361	19885 1.58	30.02348.13	27.60	7.070	.060	7.13	0.05	7.18	0.00	[illegible]
8842219477	0 1.85	30.09348.33	27.97	6.330	1.280E	7.61	1.42M	9.03	0.00	[illegible]
8882220088	0 4.15	31.52319.60	30.14	5.590	1.502E	7.09	1.84M	8.93	0.00	[illegible]
8887220222	20029 5.16	32.65349.87	31.54	5.350	-.100	5.25	-0.40	4.85	0.00	[illegible]
8888220242	0 2.43	28.02349.88	26.34	6.640	.360E	7.00	-0.01M	6.99	0.00	[illegible]
8899220460	0 5.97	33.11350.33	32.26	6.720	.440E	7.16	-0.15M	7.01	0.00	[illegible]
8903220599	20085 6.13	32.87350.60	32.11	5.580	-.100	5.48	-0.26	5.22	0.00	
0221170	20180 6.09	30.68351.75	30.16	7.660	1.130	8.79	0.64	9.43	0.00	
0221264	20200 6.52	30.94351.99	30.55	7.380	.500	7.88	0.02	7.90	0.00	
8933221394	20224 5.54	28.65352.31	28.13	6.410	.010	6.42	0.03	6.45	0.00	
8943221673	20264 7.57	31.03352.87	31.05	4.950	1.420	6.37	1.65	8.02	0.00	[illegible]
8948221758	0 8.91	32.89353.04	33.22	5.626	1.029E	6.65	0.85M	7.51	0.00	[illegible]
0221830	20280 7.73	30.61353.24	30.74	6.850	.590	7.44	0.07	7.51	0.00	
8955221970	0 8.99	32.17353.51	32.62	6.380	.450E	6.83	-0.02M	6.81	0.00	[illegible]
0222033	20309 7.91	30.15353.65	30.40	7.210	.600	7.81	0.13	7.94	0.00	
8997222842	20408 8.75	28.29355.37	29.08	4.940	.950	5.89	0.65	6.54	[illegible]	[illegible]
9024223460	0 13.82	33.99356.79	36.14	5.904	.786E	6.69	0.30M	6.99	0.00	[illegible]
9068224544	20593 13.56	29.54359.07	32.10	6.510	-.080	6.43	-0.60	5.83	0.00	[illegible]

Missing in this table and erroneously not used in our data evaluation is the star:

9074224635	0 14.42	30.66359.24	33.44	6.580	.580E	7.16	0.05M	7.21	0.00	D G0

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)c	SPTYPE	[illegible]	[illegible]
22	448	0	9.13	15.76	1.61	17.92	5.532	1.03[illegible]E	[illegible]	[illegible]	[illegible]				
0	873	127	11.18	17.67	2.66	20.47	6.900	1.050E	[illegible]	[illegible]	[illegible]	[illegible]			
45	1013	148	11.25	17.05	3.00	19.93	4.800	1.580	[illegible]	1.92	[illegible]				
103	2411	0	13.27	13.62	6.36	17.61	5.000	1.660E	6.66	1.90M	8.56	[illegible]			
131	2910	405	15.29	15.39	7.49	20.02	5.376	1.080F	6.46	0.96M	7.42	[illegible]			
0	2925	409	16.55	18.02	7.51	22.92	6.820	.920	7.74	0.60	8.34	[illegible]			
0	3029	419	15.59	15.41	7.76	20.16	7.840	.270	8.11	0.08	[illegible]				
156	3411	0	17.89	18.35	8.62	23.74	6.440	1.000E	7.44	0.00M	8.24	[illegible]			
166	3651	512	17.21	15.61	9.19	20.98	5.840	.860	6.70	0.56	7.26	[illegible]			
167	3690	515	17.40	15.73	9.32	21.16	5.360	1.160	6.52	1.05	7.57				
0	3743	526	18.61	18.08	9.42	23.78	7.210	.190	7.40	0.14	7.54	[illegible]			
178	3883	0	19.14	18.49	9.74	24.36	5.930	.140E	[illegible]	[illegible]	[illegible]				
215	4502	0	20.23	17.61	11.17	23.99	4.060	1.120E	[illegible]	0.57M	9.05				
217	4568	0	18.96	14.51	11.32	20.66	6.560	.490E	7.35	0.03M	7.06				
258	5286	808	21.63	16.33	13.07	23.36	5.460	1.020	6.48	0.90	7.38	[illegible]			
259	5316	0	22.08	17.15	13.14	24.29	6.202	1.625E	7.83	0.92M	8.75	[illegible]			
271	5516	0	22.04	15.93	13.64	23.15	4.390	.950F	5.34	0.64M	[illegible]	[illegible]			
277	5641	890	21.44	13.98	13.91	21.13	6.340	.090	6.43	0.11	6.54	[illegible]			
341	6953	0	25.73	16.62	16.90	25.20	5.604	1.467E	[illegible]	[illegible]	[illegible]				
360	7318	1292	26.11	15.50	17.76	24.32	4.660	1.030	5.69	0.84	8.53	[illegible]			
0	7615	1348	26.31	14.35	16.44	23.33	6.690	.030E	[illegible]	[illegible]					
383	7964	1411	28.44	17.46	19.18	27.00	4.760	.030	6.79	0.10	[illegible]				
0	10126	1698	33.08	16.53	24.19	27.86	7.700	.740	6.44	[illegible]	[illegible]	[illegible]			
484	10308	0	32.53	14.18	24.63	25.48	6.180	.440E	6.62	0.00M	6.67				
485	10348	1721	34.28	18.16	24.70	29.80	5.940	1.010	7.00	0.84	7.84	[illegible]			
544	11443	1876	36.52	16.80	27.56	29.34	3.440	.490	3.93	0.08	4.01	[illegible]			
564	11928	0	36.82	14.75	28.72	27.54	5.822	1.596E	7.42	1.92M	9.34	[illegible]			
634	13372	2179	41.09	17.20	32.12	31.29	6.150	.110	6.26	0.14	6.40	[illegible]			
642	13480	2200	40.86	15.98	32.37	30.07	4.940	.783E	5.72	0.60M	6.32	[illegible]			
655	13869	2264	42.71	18.59	33.24	33.13	5.280	-.010	5.27	-0.03	5.24	[illegible]			
0	0	2308	41.37	14.14	33.63	26.51	7.770	-.015	8.39	0.08	8.47	0.00			
0	14082	2307	41.37	14.15	33.63	26.52	7.020	.500	7.52	-0.03	7.49	0.00	[illegible]	[illegible]	
675	14252	2363	41.65	13.93	34.01	26.41	5.030	.030	5.06	0.06	5.12	0.00	[illegible]	[illegible]	
680	14373	0	42.44	15.31	34.29	2[illegible].97	6.440	.900E	7.34	0.70M	8.04	0.00	[illegible]		
0	14800	2464	44.41	18.15	35.23	33.28	7.380	.120	7.50	0.08	7.58	0.00			
712	15176	0	44.51	16.29	36.12	31.57	5.542	1.117E	6.66	1.03M	7.69	0.00	[illegible]		
717	15257	0	43.97	14.23	36.31	29.44	5.280	.190E	5.47	0.11M	5.58	0.00	[illegible]		
720	15335	0	44.19	14.43	36.47	29.71	5.888	.581E	6.47	0.11M	6.58	0.00			
726	15464	0	45.83	18.02	36.81	33.61	6.247	1.074E	7.32	1.03M	8.35	0.00	[illegible] III		
738	15755	0	46.61	18.51	37.46	34.32	5.842	1.075E	6.91	1.03M	7.94	0.00	[illegible]		
750	16058	0	47.27	18.45	38.19	34.47	5.352	1.658E	7.01	1.10M	8.11	0.00	[illegible]		
757	16187	2589	46.41	15.47	38.43	31.39	6.110	1.070	7.18	0.83	8.01	0.00	[illegible]		
758	16210	0	47.37	17.97	38.50	34.05	5.500	1.590E	7.09	1.73M	8.82	0.00	[illegible]		
761	16220	0	46.92	16.66	38.52	32.67	6.270	.480E	6.75	-0.01M	6.74	0.00	[illegible]		
0	16397	2607	46.53	14.61	38.88	30.61	7.380	.600E	7.98	0.00M	7.98	0.00	[illegible] V		
820	17240	0	49.86	18.53	41.00	35.34	6.280	.360E	6.64	0.03M	6.67	0.00	[illegible]		
0	17606	2762	49.40	14.91	41.85	31.77	6.570	-.056	6.62	-0.02	6.64	0.00	A0		
843	17709	2771	50.61	17.79	42.11	34.86	4.540	1.560	6.10	1.94	8.04	0.00	[illegible]		
873	18296	2847	50.82	14.44	43.56	31.73	5.100	-.003	5.10	-0.24	4.85	0.00	[illegible]		
882	18449	2850	52.19	17.43	43.99	34.98	4.940	1.250	6.19	1.28	7.47	0.00	K2 [illegible]		
0	20099	3116	54.70	14.09	47.93	32.48	7.970	.960	8.93	0.55	9.48	0.00	[illegible]		
975	20193	0	54.96	14.22	48.17	32.67	6.290	.310E	6.60	0.06M	6.66	0.00	F0		
976	20210	3140	55.52	15.98	48.22	34.51	6.240	.298	6.54	0.12	6.65	0.00	[illegible]		[illegible]
991	20468	3187	55.95	15.37	48.90	34.04	4.820	1.490	6.31	1.57	7.88	0.00	K2 [illegible]		
1019	20995	3272	56.96	14.40	50.34	33.36	5.580	-.030	5.55	-0.16	5.39	0.00	B95V		[illegible]
1041	21402	3314	57.83	14.46	51.30	33.64	5.590	.020	5.61	0.14	5.75	0.00	A2 V		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	[illegible]
0	21753	3370	59.23	16.87	52.14	36.31	7.820	.200	8.02	0.11	8.13	0.00	A3		
1074	21856	3382	59.15	15.83	52.37	35.29	5.910	-.050	5.86	-0.85	5.01	0.00	B1 V		
0	21943	3399	60.02	18.26	52.60	37.85	7.240	-.030	7.21	-0.27	6.94	0.00	[illegible]		
0	22114	3414	60.32	18.19	52.98	37.85	7.580	.070	7.65	-0.35	7.30	0.00	[illegible]		
0	22327	3437	59.92	15.23	53.43	34.69	7.440	.140	7.58	-0.18	7.40	0.00	[illegible]		
1113	22780	3482	61.41	17.48	54.47	37.42	5.580	-.070	5.51	-0.42	5.09	0.00	[illegible]		
0	22859	3491	61.53	17.46	54.61	37.43	7.770	.080	7.85	-0.01	7.84	0.00	A0		
1123	22951	3505	60.79	13.91	54.80	33.81	4.980	-.030	4.95	-0.83	4.12	0.00	[illegible]		
0	23060	3519	61.03	14.00	55.05	33.96	7.510	.110	7.62	-0.56	7.06	0.00	[illegible]		
1133	23193	3536	61.82	16.23	55.32	36.30	5.540	.060	5.60	0.15	5.75	0.00	A2		
1191	24131	3727	62.85	13.85	57.17	34.21	5.760	.010	5.77	-0.81	4.96	0.00	[illegible]		
0	24190	3739	62.91	13.69	57.28	34.07	7.440	.060	7.50	-0.62	6.88	0.00	[illegible]		
1215	24640	3830	63.96	14.35	58.31	34.94	5.480	-.030	5.45	-0.75	4.70	0.00	B2		
1223	24809	0	64.22	14.02	58.70	34.67	6.360	.140E	6.50	0.11M	6.61	0.00	A5		
1226	24843	0	65.19	17.93	58.79	38.69	6.303	1.078E	7.38	-1.03M	8.41	0.00	K1		
1228	24912	3862	64.63	14.94	58.93	35.65	4.040	.010	4.05	-0.92	3.13	0.00	O7		
1229	24982	3876	65.42	17.87	59.08	38.68	6.160	.100	6.26	0.13	6.39	0.00	A1		
1234	25152	3900	65.35	16.02	59.49	36.85	6.300	-.020	6.28	-0.03	6.25	0.00	[illegible]		
0	25893	4034	66.85	16.83	61.06	37.94	7.130	.860	7.99	0.48	8.47	0.00	[illegible]		
1277	25975	4043	66.93	16.46	61.24	37.60	6.090	.950	7.04	0.75	7.79	0.00	[illegible]		
1278	25998	4045	67.06	16.76	61.32	37.91	5.520	.540E	6.06	0.00M	6.06	0.00	[illegible]		
1301	26605	0	68.12	16.48	62.66	37.84	6.430	1.000E	7.43	0.85M	8.28	0.00	[illegible]		
0	26702	4101	68.23	16.03	62.89	37.42	6.310	.970	7.28	0.73	8.01	0.00	[illegible]		
1424	28503	4331	71.98	17.91	66.99	39.90	6.170	.040	6.21	-0.37	5.84	0.00	[illegible]		
0	29132	4421	72.67	15.21	68.37	37.34	7.620	.070E	7.69	0.00M	[illegible]	[illegible]	[illegible]		
1489	29645	0	73.80	15.89	69.61	38.17	6.010	.560E	6.57	0.03M	6.60	0.00	[illegible]		
1500	29866	4525	74.64	18.32	70.19	40.69	6.060	.090	6.15	-0.29	5.86	0.00	[illegible]		
1514	30138	0	75.07	17.79	70.82	40.22	5.969	.927E	6.90	0.69M	7.59	0.00	G9 III		
1533	30504	4604	75.33	14.91	71.63	37.40	4.670	1.440	6.31	1.70	8.01	0.00	[illegible]		
1551	30834	4664	75.80	14.06	72.32	36.62	4.800	1.420	6.22	1.58	7.80	0.00	[illegible]		
1592	31647	4772	77.28	15.10	73.96	37.82	4.940	.050	4.99	0.01	5.00	0.00	A0		
1599	31761	0	77.67	16.57	74.22	39.32	5.970	.400E	6.37	-0.05M	6.32	[illegible]	[illegible]		
1602	31780	0	77.72	16.81	74.24	39.57	6.560	1.540E	8.10	1.80M	9.90	0.00	[illegible]		
1612	32068	0	78.29	18.20	74.75	41.01	3.750	1.220E	4.97	0.38M	5.35	0.00	K+B	[illegible]	
0	0	0	78.29	18.20	74.75	41.01	13.000	1.000E	14.00	1.00M	15.00	0.00	?XX		
1615	32188	4834	78.49	18.54	74.95	41.37	6.140	.160E	6.30	0.10M	6.40	0.00	A3 III		
1641	32630	4878	79.10	18.26	75.75	41.17	3.160	-.170	2.99	-0.68	2.31	0.00	B3 V		
1669	33203	0	79.48	14.30	76.73	37.25	6.025	.716E	6.74	0.25M	6.99	0.00	B2+F3		
0	33364	4955	79.73	14.27	77.04	37.24	7.500	1.430	8.93	1.57	10.50	0.00	K0		
0	33461	4961	80.22	18.16	77.18	41.16	7.760	.270	8.05	-0.55	7.50	0.00	B2 V		
0	33604	4972	80.32	17.13	77.43	40.14	7.260	.050	7.31	-0.70	6.61	0.00	B2 V		
1689	33641	4976	80.22	15.42	77.50	38.43	4.900	.190	5.09	0.09	5.18	0.00	A		
1725	34332	0	81.43	17.30	78.79	40.40	6.181	1.369E	7.55	1.20M	8.75	0.00	K0		
1729	34411	5041	81.49	16.95	78.90	40.06	4.710	.670	5.38	0.10	5.48	0.00	G0 V		A
1738	34557	0	81.79	17.91	79.18	41.03	5.420	.080E	5.50	0.08M	5.58	0.00	A3		
0	34921	5088	82.01	14.48	79.79	37.63	7.510	.140	7.65	-0.86	6.79	0.00	B0 IV		
1760	34904	0	82.30	17.62	79.83	40.98	5.510	.080E	5.59	0.08M	5.67	0.00	A3		
1773	35186	0	82.42	14.17	80.31	37.35	4.990	1.42[illegible]	6.41	1.75M	8.16	0.00	K4 III		
1823	36041	0	83.80	16.53	81.82	39.79	6.380	1.00[illegible]	7.38	0.80M	8.18	0.00	G9 III		
1824	36040	0	83.90	18.16	81.82	41.42	6.010	1.11[illegible]	7.12	1.12M	8.24	0.00	K1 III		
1884	36891	5461	85.04	16.83	83.34	40.15	6.080	1.03[illegible]	7.11	0.69	7.80	0.00	G3 Ib		
1974	38189	0	86.83	17.10	85.58	40.49	6.440	.08[illegible]E	6.52	0.08M	6.60	0.00	A3		
0	38230	5876	86.78	13.88	85.65	37.27	7.360	.830	8.19	0.51	8.70	0.00	K0		A
1995	38656	5919	87.47	15.76	86.43	39.17	4.480	.940	5.42	0.68	6.10	0.00	G8 II		A
2011	38944	5943	87.82	13.67	86.91	37.29	4.730	1.620	6.35	1.93	8.26	0.00	M1		
2012	39003	5945	87.94	15.72	87.01	39.14	4.020	1.170	5.19	0.97	6.16	0.00	K0 II		A

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YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR
2025	39182	5965	88.17	16.13	67.29	39.56	6.400	.090	6.49	0.17	6.66	0.00		
2095	40312	6064	89.59	13.77	89.08	37.21	2.630	-.080	2.55	-0.18	[illegible]	[illegible]		
2137	41162	0	90.67	14.52	90.40	37.97	6.320	.540E	6.86	0.06M	6.92	0.00		
2143	41357	6148	90.98	15.05	90.78	38.49	5.350	.230	5.58	0.11	5.69	0.00		
2147	41467	0	91.11	18.42	90.97	41.86	6.175	1.220E	7.34	1.10M	8.44	0.00		
2153	41636	6171	91.31	17.62	91.21	41.06	6.360	1.050	7.41	0.82	8.23	0.00		
0	42616	6240	92.35	18.28	92.54	41.71	7.140	.096	7.24	0.05	7.28	0.00		
2405	46687	0	97.06	15.24	98.28	38.49	5.290	2.600E	7.89	2.00M	9.89	0.00		
2419	47070	0	97.42	16.21	98.80	39.44	5.686	1.352E	7.04	1.66M	8.70	0.00		
2420	47100	6563	97.41	16.72	98.83	39.95	5.200	-.070	5.13	-0.40	4.73	0.00		
2464	48073	0	98.51	14.04	99.96	37.20	6.195	1.027E	7.22	0.90M	8.12	0.00		
0	48228	6647	98.44	17.52	100.20	40.68	6.840	1.590	8.43	1.79	10.22	0.00		
2539	50018	6784	100.35	15.91	102.40	38.93	6.140	.380	6.52	0.14	6.66	0.00		
2541	50037	0	100.43	15.50	102.45	38.51	6.300	.493E	6.79	0.02M	6.81	0.00		
2547	50204	6796	100.57	15.57	102.63	38.57	6.240	-.050	6.19	-0.19	6.00	0.00		
2600	51440	6863	101.65	15.22	103.91	38.12	5.490	1.230	7.22	1.16	8.38	0.00		
2675	53925	0	103.66	14.83	106.30	37.53	6.156	1.212E	7.37	1.14M	8.51	0.00		
2696	54716	6986	104.04	16.76	107.05	39.40	4.890	1.450	6.34	1.74	8.08	0.00		
2753	56221	0	105.09	18.48	108.64	40.98	5.710	.080E	5.79	0.08M	5.87	0.00		
2793	57264	7116	106.51	14.51	109.68	36.86	5.130	1.080	6.21	0.94	7.15	0.00		
2792	57263	0	106.20	16.72	109.70	39.09	6.350	.900E	7.25	0.90M	8.15	0.00		
2805	57669	7137	106.33	18.44	110.17	40.77	5.170	1.240	6.41	1.24	7.65	0.00		
2872	59507	7247	108.17	16.91	112.13	39.00	6.440	.070	6.51	0.03	6.54	0.00		
2915	60654	0	109.04	18.21	113.47	40.14	6.340	1.500E	7.84	1.75M	9.59	0.00		
2935	61294	0	109.94	16.64	114.22	38.45	5.728	1.028E	7.36	1.90M	9.26	0.00		
0	62301	7408	110.65	18.02	115.39	39.69	6.760	.540	7.30	-0.04	7.26	0.00		
2999	62647	0	111.39	16.06	115.83	37.64	5.180	1.560E	6.76	2.90M	9.66	0.00		
3083	64491	7622	113.66	14.35	118.11	35.55	6.140	.280	6.42	-0.02	6.40	0.00		
3130	65801	0	114.95	14.59	119.67	35.54	6.337	1.563E	7.90	1.75M	9.65	0.00		
3193	67827	0	116.10	18.25	122.01	36.88	6.590	.590E	7.18	[illegible]	7.97	0.00		
3292	70771	0	119.80	15.28	125.47	35.17	6.063	1.266E	7.33	1.20M	8.53	0.00		
3348	71906	8094	120.49	17.78	127.02	37.43	6.040	-.060	5.98	-0.13	5.85	0.00	K0	
3360	72184	8108	120.61	18.59	127.42	38.19	5.900	1.110	7.01	1.17	8.18	0.00	F2 II	
3365	72291	0	121.12	17.10	127.54	36.62	6.260	.350E	6.61	-0.10M	6.51	0.00	F1 D	
3377	72524	8134	121.41	17.14	127.88	36.59	5.710	.040	5.75	0.02	5.77	0.00	A2 II	
3409	73192	0	123.13	13.83	128.80	32.97	5.942	1.119E	7.06	1.10M	8.16	0.00	F2 G	
3451	74243	0	123.18	18.13	130.24	37.10	6.280	.360E	6.64	0.03M	6.67	0.00	F2	
3499	75332	0	125.54	15.01	131.86	33.48	6.270	.480E	6.75	-0.01M	6.74	0.00	F7 D	
3519	75698	0	126.19	14.35	132.37	32.67	5.760	.140E	5.90	0.11M	6.01	0.00	A	
3528	75896	8603	125.57	17.36	132.70	35.73	5.950	.040	5.99	0.11	6.10	0.00	A3 II	
3555	76398	8645	126.98	15.02	133.47	33.10	5.450	.120	5.57	0.12	5.69	0.00	A3	
3566	76595	8666	126.41	17.88	133.83	36.00	6.440	-.010	6.43	0.01	6.44	0.00	A1 V	
3575	76813	0	127.67	14.70	134.12	32.61	5.205	.927E	6.13	0.70M	6.83	0.00	G0 G	
3587	77104	8702	128.10	14.66	134.58	32.45	6.760	.000	6.76	0.09	6.85	0.00	A3 V	
0	77408	8725	128.30	15.38	135.05	33.08	7.030	.500	7.53	-0.04	7.49	0.00	F7 V	
3606	77660	0	128.80	15.00	135.46	32.58	6.380	.140E	6.52	0.11M	6.63	0.00	A5	
3620	78234	0	129.40	15.36	136.25	32.75	6.270	.360E	6.63	0.03M	6.66	0.00	F2	
3625	78366	0	129.15	16.70	136.45	34.10	5.929	.597E	6.53	0.11M	6.64	0.00	G0 D	
3639	78712	0	130.43	14.03	136.90	31.18	5.850	1.580E	7.43	0.90M	8.33	0.00	M6 VAR	
3664	79452	8841	130.22	17.80	138.04	34.84	5.970	.860	6.83	0.37	7.20	0.00	G8 II	
3705	80493	8897	131.49	17.96	139.50	34.61	3.140	1.550	4.69	1.93	6.62	0.00	K5	
3707	80546	8907	132.08	16.58	139.61	33.12	6.170	1.110	7.28	1.08	8.36	0.00	K0	
0	80580	8910	132.33	15.99	139.66	32.48	6.800	.130	6.93	0.10	7.03	0.00	A0	
3764	82087	0	133.74	17.92	141.93	33.88	5.849	1.046E	6.90	0.80M	7.70	0.00	G8 G	
3820	83069	0	135.85	15.99	143.44	31.39	5.561	1.592E	7.15	1.92M	9.07	0.00	F2 G	
3850	83787	0	136.83	16.46	144.66	31.51	5.887	1.599E	7.49	1.87M	9.36	0.00	K0 G	

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
3861	84107	9209	137.71	15.38	145.16	30.21	5.620	.130	5.75	0.13	5.88	0.00	[illegible]		
3936	86358	0	141.67	14.42	146.89	27.99	6.370	.310E	6.68	0.06M	6.74	0.00	[illegible]		
3942	86513	0	141.22	16.27	149.18	29.87	5.730	1.059E	6.79	0.86M	7.65	0.00	[illegible]		
0	86680	9345	141.99	15.00	149.45	26.42	7.990	.605	8.59	0.12	8.72	0.00			
3951	86728	9350	140.65	18.52	149.53	32.17	5.350	.660	6.01	0.28	[illegible]	[illegible]			
0	87680	9431	142.99	16.50	151.10	29.48	7.960	.670	8.63	0.11	[illegible]	[illegible]			
4006	88639	0	145.19	15.08	152.75	27.38	6.040	.848E	6.89	0.60M	[illegible]	[illegible]			
4024	88960	9521	144.86	17.30	153.35	29.56	5.350	.010	5.36	0.01	5.37	[illegible]			
4027	88986	9524	145.16	16.73	153.41	28.93	6.490	.605	7.09	0.16	[illegible]	[illegible]			
4032	89024	0	146.48	13.69	153.43	25.63	5.830	1.210E	7.04	1.22M	8.24	[illegible]			
0	89055	9529	146.34	14.15	153.53	26.11	7.560	.640	8.20	0.05	[illegible]	[illegible]			
4041	89239	9539	146.01	15.70	153.84	27.67	6.500	-.020	6.48	-0.04	6.44	0.00			
4078	89993	9614	146.32	18.20	155.22	29.87	6.410	1.110	7.52	0.95	8.47	[illegible]			
0	91148	9696	150.24	13.76	157.25	24.34	7.940	.720	8.66	0.22	[illegible]	[illegible]			
4189	92769	9826	151.78	16.82	160.07	26.59	5.430	.170	5.60	0.09	5.69	0.00			
4192	92825	9834	153.13	13.96	160.17	23.45	5.000	.040	5.04	0.05	[illegible]	[illegible]			
4254	94480	0	154.65	17.09	163.00	25.75	6.250	.290E	6.54	0.10M	[illegible]	[illegible]			
4260	94602	0	155.16	16.50	163.23	25.02	6.300	.030E	6.33	0.03M	6.36	0.00			
4259	94601	10010	155.16	16.50	163.23	25.02	4.500	.010	4.51	0.02	4.53	[illegible]			
4269	94720	10023	156.29	14.36	163.40	22.62	6.100	1.580	7.68	1.94	[illegible]	0.00			
4270	94747	0	155.05	17.27	163.47	25.77	6.360	1.050E	7.41	0.69M	[illegible]	[illegible]			
0	96094	10117	157.07	17.79	165.65	25.47	7.630	.560	8.19	-0.03	8.16	[illegible]			
4322	96524	10150	158.36	16.29	166.25	23.59	6.300	.170	6.47	0.12	[illegible]	[illegible]			
4332	96738	10173	158.06	17.62	166.53	24.93	5.640	.060	5.70	0.12	[illegible]				
0	97005	10186	159.23	15.97	166.92	27.97	7.560	.340	7.84	[illegible]	[illegible]				
0	97561	10234	161.04	13.93	167.76	20.40	6.920	.750	7.67	0.33	[illegible]				
4357	97603	10242	160.96	14.33	167.86	20.80	2.570	.110	[illegible]	[illegible]	[illegible]				
4362	97778	10253	160.13	16.79	168.14	23.37	4.600	1.660	6.26	1.85	[illegible]				
4433	100006	0	165.49	13.97	171.97	18.69	5.500	[illegible]	[illegible]	[illegible]	[illegible]				
4459	100655	0	165.65	16.25	173.11	20.71	6.310	1.000E	7.31	0.60M	8.11	[illegible]			
4495	101484	10542	166.53	17.64	174.55	21.63	5.260	.980	6.24	0.78	[illegible]				
4505	101688	0	166.43	18.55	174.87	22.49	6.540	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
4527	102509	10623	168.62	17.31	175.35	20.50	4.560	.530	5.09	0.28	5.37	[illegible]			
4535	102660	10639	170.61	13.81	176.67	16.52	5.970	.260	6.23	0.14	[illegible]				
4564	103578	10710	172.32	13.90	176.28	15.92	5.500	.120	5.62	0.10	[illegible]	[illegible]			
0	104207	10765	171.68	17.77	179.38	19.70	7.000	1.570	8.57	1.67	10.24	0.00	[illegible]		
4632	105778	10927	175.18	16.43	181.99	17.09	6.410	.050	6.46	0.07	6.53	0.00	[illegible]		
0	106542	11004	176.21	16.98	183.17	17.18	6.800	1.220	8.02	1.17	9.19	0.00	[illegible]		
4663	106661	11012	177.25	15.24	183.37	15.18	5.160	.060	5.22	0.07	5.29	0.00	[illegible]		
4676	106926	0	177.54	15.63	183.80	15.42	6.400	.900E	7.30	0.70M	8.00	0.00			
0	107146	11059	177.25	17.05	184.15	16.83	7.070	.620	7.69	0.08	7.77	0.00	[illegible]		
0	107170	11064	178.16	15.24	184.20	14.82	6.510	1.150	7.66	1.01	8.67	0.00	K0		
4697	107383	11083	177.07	18.34	184.55	16.07	4.750	1.010	5.76	0.77	6.53	0.00	[illegible]		
0	107415	11066	178.07	16.30	184.57	15.82	6.470	1.040	7.51	0.83	8.34	0.00	K0		
0	107612	11106	177.83	17.51	184.88	17.02	6.680	.010	6.69	0.04	6.73	0.00	[illegible]		
0	108957	11245	179.97	18.30	187.15	16.89	7.450	1.130	8.58	1.08	9.66	0.00	K2		
4824	110377	0	185.01	13.68	189.76	10.69	6.190	.167E	6.38	0.11M	6.49	0.00	A7	VAR	
0	0	11454	184.24	17.67	190.73	14.64	7.750	.410	8.16	-0.05	8.11	0.00	A0		
0	110932	11453	184.24	17.68	190.73	14.65	7.230	-.110	7.12	-0.36	6.76	0.00	A0	W	A
4855	111164	0	185.69	15.65	191.18	12.23	6.070	.124E	6.19	0.12M	6.31	0.00	A3 V		
4861	111308	11503	185.24	17.21	191.43	13.83	6.560	-.010	6.55	0.05	6.60	0.00	A0		
4865	111397	11510	185.15	17.60	191.60	14.40	5.700	.020E	5.72	0.07M	5.79	0.00	A2 V		
4900	112097	11625	187.03	16.72	192.83	12.69	6.250	.270E	6.52	0.05M	6.57	0.00	A7 P		
4932	113226	11767	189.59	16.21	194.92	11.23	2.820	.940	3.76	0.71	4.47	0.00	G9 II		A
4960	114256	0	191.63	16.02	196.67	10.28	5.780	1.002E	6.78	0.90M	7.68	0.00	K0 III		
4986	114780	0	191.78	17.76	197.51	11.82	5.770	1.506E	7.28	1.86M	9.14	0.00	K0 III		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
4998	115046	11975	192.34	17.76	198.01	11.60	5.670	1.500	7.17	1.86	9.03	0.00	K0 II		A
	0115080	11978	192.61	17.33	198.08	11.10	7.040	.690E	7.73	0.24M	7.97	1.77	DG3 D		[illegible]
5011	115383	12004	193.66	16.21	198.57	9.68	5.220	.580	5.80	0.09	5.89	0.00	G0		[illegible]
5087	117405	12142	198.14	14.33	201.66	6.27	6.500	.960	7.46	0.60	8.06	0.00	G8		
5086	117404	12141	197.69	15.41	201.87	7.44	6.160	1.470	7.63	1.80	9.43	0.00	K5		
5156	119288	12257	200.15	17.68	204.94	8.64	6.150	.420	6.57	-0.06	6.51	0.00	DF4		
5183	120066	12300	202.08	16.23	206.12	6.60	6.340	.630	6.97	0.16	7.13	0.00	DG2		
	0120500	12329	201.94	18.39	206.81	8.66	6.590	.130E	6.72	0.08M	6.80	1.54	A0		
5205	120602	12337	203.23	15.74	206.97	5.74	6.000	.900	6.90	0.59	7.49	0.00	G5		
5275	122797	12444	206.72	16.41	210.35	5.14	6.230	.400	6.63	-0.04	6.59	0.00	F2		
5283	122910	12451	207.84	14.04	210.52	2.54	6.270	1.020	7.29	0.88	8.17	0.00	K0		
5307	124115	12497	209.84	13.76	212.24	1.60	6.440	.480	6.92	0.05	6.97	0.00	F5		
5313	124224	12504	209.65	14.80	212.43	2.64	5.000	S -.110	4.89	-0.39	4.50	0.00	[illegible]	[illegible]	[illegible]
5331	124681	12537	209.95	15.90	213.09	3.57	6.440	S 1.600	8.04	1.71	9.75	0.00	[illegible]		
	0124757	12543	210.14	15.74	213.20	3.36	7.060	.545	7.61	0.01	7.62	0.00	[illegible]		
5384	126053	12618	212.77	14.63	215.17	1.47	6.270	.630	6.90	0.08	6.98	0.00	[illegible]		
	0126515	12649	212.[illegible]	14.63	215.85	1.22	7.110	.008	7.12	-0.02	7.10	0.00	[illegible]		
5418	127167	12685	214.46	14.79	216.82	1.05	5.930	.160	6.09	0.10	6.19	0.00	[illegible] N		
5424	127337	12697	213.35	18.58	217.06	4.99	6.010	1.420	7.43	1.66	9.09	0.00	[illegible]		
	0128272	12748	216.19	14.71	218.36	0.44	7.690	.980	8.67	0.77	9.44	0.00	G5		[illegible]
5496	129902	12865	218.97	13.87	220.65	-1.21	6.060	1.610	7.67	1.93	9.60	0.00	[illegible]		
5501	129956	12870	218.36	15.93	220.74	0.93	5.680	-.030	5.65	-0.08	5.57	0.00	[illegible]		
5511	130109	12888	218.17	17.10	220.93	-2.10	3.750	-.010	3.74	-0.03	3.71	0.00	[illegible]		
5522	130557		0219.70	14.70	221.58	-0.64	6.130	-.040E	6.09	-0.10M	5.99	0.00	[illegible]		
5536	130970	12939	220.03	15.43	222.11	-0.05	6.170	1.400	7.57	1.68	9.25	[illegible]			
5573	132132	12997	221.63	16.00	223.75	0.03	5.520	1.130	6.65	1.11	7.76	0.00	[illegible]		
5590	132833	13017	223.34	13.80	224.68	-2.56	5.510	1.680	7.19	2.00	9.19	[illegible]			
5594	132933	13026	222.68	16.34	224.81	0.06	5.700	1.520	7.22	1.55	8.77	[illegible]	[illegible]		
5599	133112	13037	223.78	13.64	225.04	-2.84	6.600	.200	6.80	0.17	6.97	[illegible]			
5601	133165	13039	222.27	18.56	225.09	2.29	4.400	1.040	5.44	0.89	6.33	[illegible]			
	0135204	13130	226.05	16.04	227.63	-1.16	6.600	.770	7.37	0.33	7.70	[illegible]	[illegible]		[illegible]
5679	135559	13155	226.04	17.83	228.32	0.56	5.620	.180	5.80	0.07	5.87	0.00	[illegible]		
5690	136028	13177	226.94	17.20	228.97	-0.28	5.880	1.510	7.39	1.81	9.20	[illegible]	[illegible]		
5706	136342	13210	228.07	15.48	229.55	-2.23	6.340	1.060	7.40	1.07	8.47	0.00	DK2		
5710	136514	13216	227.26	18.51	229.62	0.90	5.340	1.190	6.53	1.22	7.75	0.00	GK4		[illegible]
5721	137006	13237	228.43	17.00	230.29	-0.85	6.110	.250	6.36	0.07	6.43	0.00	DA5 N		
5772	138562	13309	230.81	17.44	232.6[illegible]	-1.02	5.500	1.090	6.59	1.02	7.61	0.00	GG9		
9199	139137	13337	231.57	18.27	233.50	-0.40	6.500	.720	7.22	0.43	7.65	0.00	DF5		
5863	140873	13420	234.31	17.63	235.88	-1.65	5.400	-.050	5.35	-0.40	4.95	0.00	B8		
5875	141378	13446	235.51	15.82	236.58	-3.67	5.560	.130	5.69	0.16	5.85	0.00	A3		
5881	141513	13452	235.59	16.24	236.75	-3.28	3.550	-.040	3.51	-0.10	3.41	0.00	A0 V		
5895	141851	13460	235.92	16.67	237.16	-2.94	5.100	.120	5.22	0.06	5.28	0.00	A0 N		
5989	144362	13627	240.28	14.29	240.77	-6.16	6.340	.410	6.75	-0.04	6.71	0.00	F5		[illegible]
5990	144390	13632	240.31	14.45	240.83	-6.01	6.400	1.030	7.43	0.80	8.23	0.00	K0		A
6016	145206	13685	240.75	17.25	241.80	-3.34	5.360	1.450	6.81	1.46	8.27	0.00	GK5		
6041	145788	13781	241.70	16.67	242.58	-4.09	6.240	.130	6.37	0.04	6.41	0.00	A0		
6056	146051	13793	241.95	17.25	242.93	-3.57	2.720	1.580	4.30	1.95	6.25	0.00	M1 III		A
6067	146514	13829	242.66	17.11	243.57	-3.83	6.170	.310	6.48	-0.01	6.47	0.00	DA6 N		
6075	146791	13839	243.16	16.45	243.92	-4.57	3.240	.950	4.19	0.74	4.93	2.04	G9 III		A
6128	148349	13917	246.06	13.98	246.26	-7.49	5.240	S 1.720	6.96	2.05	9.01	0.00	GK2	V	
6144	148743	13952	246.74	14.17	246.95	-7.41	6.490	.370	6.86	0.17	7.03	0.00	A5		
	0148833	13961	246.90	14.17	247.10	-7.43	7.880	.140	8.02	0.01	8.03	0.00	A0		
	0149363	14016	247.53	15.69	247.95	-6.03	7.800	.010	7.81	-0.87	6.94	0.00	B05V		
6179	149911	14062	248.51	15.42	248.84	-6.44	6.080	.160	6.24	0.12	6.36	0.00	A0		
6280	152601	14322	252.69	16.34	252.98	-6.07	5.240	1.080	6.32	1.06	7.38	0.00	GK2		
6318	153687	14375	254.14	18.43	254.60	-4.15	4.820	1.480	6.30	1.80	8.10	2.52	K4 III		A

YALE-HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
0154363	14406	255.29	17.72	255.62	-4.98	7.740	1.160	8.90	1.05	9.95	0.00	K5 V		A
6413156227	14660	758.41	16.78	258.51	-6.19	6.080	1.100	7.18	0.97	8.15	0.00	K0		
0156802	14766	259.39	15.07	259.32	-7.97	7.970	.680	8.65	0.07	8.72	0.00	G2 V		AE
6439156826	14768	259.23	17.18	259.33	-5.86	6.310	.850	7.16	0.47	7.63	0.00	G5		
6493157950	14875	260.90	18.11	260.99	-5.04	4.530	.390	4.92	-0.03	4.89	1.58	F3 V		
6504158170	14893	261.46	15.01	261.33	-6.17	6.360	.580	6.94	0.15	7.09	0.00	F8		
6512158463	14912	261.78	17.32	261.78	-5.88	6.360	.930	7.29	-0.67	[illegible]	[illegible]			
6534159170	14947	262.74	17.54	262.71	-5.71	5.610	.180	5.79	0.07	5.86	0.00	[illegible]		
6567159975	14997	263.97	15.22	263.78	-6.09	4.620	.120	4.74	-0.20	4.54	1.47	[illegible]		
0160388	15018	264.34	18.39	264.28	-4.94	7.760	.470	8.23	-0.05	8.28	0.00	F2		A
6601161056	15046	265.46	16.31	265.27	-7.06	6.280	.380	6.66	-0.51	6.15	0.00	[illegible]		
6661162714	0	267.74	17.30	267.49	-6.12	6.200	1.400E	7.60	1.00M	8.60	0.00	G?*VAR		
0162756	15217	267.85	15.51	267.57	-7.91	7.640	.620	8.26	0.07	8.33	0.00	[illegible]		
0163153	15235	268.35	15.70	268.06	-7.73	6.920	.760	7.68	0.43	8.11	0.00	G5		
6698163917	15273	269.41	13.67	269.07	-9.77	3.340	1.000	4.34	-0.88	5.22	2.10	G9 II		
6732164716	15332	270.39	18.09	270.03	-5.36	6.750	.160	6.91	-0.12	6.79	[illegible]	[illegible]		
6733164764	15333	270.43	15.27	270.08	-6.18	4.780	.380E	5.16	0.03M	5.19	1.60	F3		A
6734164765	0	270.44	15.27	270.09	-6.18	11.260	.780E	12.04	-0.28M	12.32	0.00	F?		
6755165402	15383	271.22	15.11	270.85	-6.33	5.840	.210	6.05	-0.22	5.83	[illegible]	[illegible]		
6843167833	15544	274.06	13.62	273.66	-9.78	6.300	.380	6.68	-0.24	[illegible]	[illegible]	[illegible]		
6884169156	15635	275.68	14.39	275.23	-8.96	4.680	.950	5.63	0.72	6.35	[illegible]	[illegible]		
6892169370	15647	276.03	16.24	275.50	-7.10	6.290	1.170	7.46	1.07	8.53	[illegible]	[illegible]		
6940170547	15722	277.54	17.51	276.89	-5.76	6.270	.950	7.22	-0.65	7.87	[illegible]	[illegible]		
6963171149	15783	278.35	17.28	277.68	-5.95	6.350	.020	6.37	-0.04	6.33	0.00	A0		
6973171443	15798	278.67	14.93	278.12	-6.28	3.860	1.330	5.19	1.52	[illegible]	[illegible]			
7007172348	15866	279.92	15.30	279.32	-7.84	5.830	1.550	7.38	1.82	[illegible]	[illegible]			
0172488	15878	280.06	14.36	279.52	-6.77	7.620	.540	8.16	-0.40	[illegible]	[illegible]			
7020172748	0	280.41	14.00	279.88	-9.10	4.710	.350E	5.06	0.16M	[illegible]	[illegible]			
7024172831	15898	280.65	15.97	279.98	-7.12	6.140	1.000	7.14	0.69	[illegible]	[illegible]			
7032173009	15908	280.79	14.75	280.20	-8.33	4.900	1.130	6.03	0.87	[illegible]	[illegible]			
7034173093	15918	280.99	16.20	280.29	-6.87	6.310	.480E	6.79	0.02M	[illegible]	[illegible]			
0173219	15928	281.14	15.89	280.46	-7.16	7.800	.220	8.02	-0.77	7.25	[illegible]			
0173744	15972	281.92	17.05	281.12	-5.95	7.050	.095	7.15	0.12	[illegible]	[illegible]			
7063173764	15973	282.03	18.20	281.13	-4.80	4.220	1.100	5.32	0.79	[illegible]	[illegible]			
7066173819	0	282.02	17.22	281.20	-5.77	6.860	1.460E	8.32	1.64M	[illegible]	[illegible]			
0174005	15989	282.30	16.91	281.49	-6.06	6.520	.250	6.77	0.15	[illegible]	[illegible]			
7083174208	15997	282.58	16.98	281.75	-5.97	5.990	1.600	7.59	1.63	9.22	[illegible]			
7089174325	0	282.55	14.98	281.90	-7.96	6.700	2.930E	9.63	2.00M	11.63	0.00	[illegible]		
0175518	16068	284.20	17.00	283.30	-5.81	7.470	.750	8.22	0.40	8.62	0.00	K0 IV		
7149175751	16091	284.50	16.87	283.60	-5.91	4.840	1.080	5.92	0.99	6.91	2.18	K? III		
7193176678	16146	285.70	16.85	284.75	-5.81	4.020	1.090	5.11	1.02	6.13	[illegible]	[illegible]		
7220177336	0	286.40	16.83	285.43	-5.76	6.730	3.990E	10.72	3.00M	13.72	0.00	[illegible]		
7225177463	16178	286.75	18.45	285.58	-4.11	5.410	1.120	6.53	1.01	7.54	0.00	[illegible]		
7236177756	16194	286.99	17.57	285.90	-4.96	3.410	-.100	3.31	-0.26	3.05	0.00	[illegible]		
0179002	16252	287.89	14.90	287.08	-7.51	6.760	.795	7.56	0.44	8.00	0.00	G0		
7279179406	16264	288.24	14.35	287.49	-6.02	5.340	.140	5.48	-0.47	5.01	0.00	B3 IV		
7333181391	16349	290.60	16.58	289.47	-5.51	5.000	.920	5.92	0.63	6.55	0.00	[illegible]		
7347181858	16387	290.65	13.75	289.91	-8.30	6.660	-.040	6.62	-0.54	6.08	0.00	B5		
7353182038	16404	290.95	14.52	290.09	-7.50	6.310	1.450	7.76	1.68	9.44	0.00	[illegible]		
7366182475	16430	291.83	16.94	290.59	-4.98	6.510	.330	6.84	0.09	6.93	0.00	[illegible]		
7402183344	0	292.59	14.64	291.66	-7.15	6.480	1.060E	7.54	0.74M	8.28	0.00	F8 VAR		
7432184573	16603	294.08	13.98	293.20	-7.57	6.330	1.120	7.45	0.92	8.37	0.00	K0		
7446184915	16628	294.51	14.35	293.55	-7.14	4.960	-.010	4.95	-0.87	4.08	0.00	B0.5III		
7460185124	16648	295.15	16.56	293.78	-4.76	5.680	.390E	6.07	0.08M	6.15	0.00	F1 [illegible]		
7516186660	16805	297.56	18.03	295.81	-3.01	6.470	.050	6.52	-0.55	5.97	0.00	B3 [illegible]		
7559187660	16886	299.01	18.20	297.14	-2.59	6.120	1.570	7.69	1.80	9.49	0.00	K5		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
7575	188041	16921	299.44	17.45	297.68	-3.24	5.640	.200	5.84	0.09	5.93	0.00			
7599	188405	16968	299.20	13.80	298.16	-6.87	6.500	.390	6.89	0.03	6.92	0.00	F2		AB
7681	190664	17221	302.50	15.84	300.89	-4.22	6.460	1.160	7.62	1.00	8.62	0.00	K0		
7720	192107	17448	305.01	18.44	302.66	-1.16	5.460	1.430	6.89	1.29	8.18	0.00	K5	II	
	0192461	17489	304.91	15.90	303.14	-3.66	6.920	.370	7.29	0.05	7.34	0.00	F0		A
7768	193329	17593	306.65	17.99	304.28	-1.24	6.050	1.090	7.14	1.02	8.16	0.00	K0		
7809	194454		0307.74	15.96	305.78	-2.96	6.100	1.190E	7.29	1.19M	8.48	0.00	[illegible]		
	0194766	17733	308.35	16.52	306.21	-2.28	7.500	.520	8.02	-0.02	8.00	0.00	F6		
	0194765	17732	308.36	16.52	306.22	-2.27	6.700	.520	7.22	-0.02	[illegible]	[illegible]	[illegible]		
7821	194939	17746	308.28	15.26	306.45	-3.52	6.120	-.060	6.06	-0.17	5.89	0.00	[illegible]		
7831	195135	17764	308.71	15.63	306.76	-3.05	4.900	1.150	6.05	1.22	7.27	0.00	K0		
7873	196321	17871	310.57	15.51	308.53	-2.72	4.880	1.600	6.48	1.94	8.42	0.00	[illegible]		
7878	196426		0311.45	18.03	308.69	-0.07	6.226	-.093E	6.13	-0.39M	5.74	0.00	[illegible]		
7884	196574	17894	311.37	16.79	306.94	-1.28	4.300	.940	5.24	0.68	5.92	0.00	[illegible]		
7890	196712	17902	311.23	15.47	309.15	-2.59	6.210	-.100	6.11	-0.41	5.70	0.00	B9	[illegible]	
7897	196758	17908	312.06	18.26	309.21	0.31	5.160	1.050	6.21	0.97	7.18	0.00	[illegible]		
7946	197954	17987	313.16	14.88	311.11	-2.67	6.260	1.550	7.81	1.95	9.76	0.00	[illegible]		
	0198272	18018	314.27	16.57	311.68	-0.75	6.400	$ 1.540	7.94	1.30 $	9.24	0.00	K		
8006	199124	18086	315.50	15.38	313.14	-1.56	6.540	.300	6.84	0.02	6.86	0.00	F0		
8017	199442	18122	316.55	16.99	313.65	0.27	6.040	1.220	7.26	1.36	8.62	0.00	K2		
8054	200340	18208	317.57	15.24	315.10	-1.12	6.490	-.100	6.39	-0.48	5.91	0.00	[illegible]		
8056	200375	18212	318.35	17.57	315.13	1.33	6.210	.480E	6.69	0.02M	6.71	0.00	[illegible]		
8068	200663	18249	319.01	18.16	315.55	2.07	6.320	.970	7.29	0.62	[illegible]	[illegible]	[illegible]		
	0200932	18271	318.71	15.75	316.00	-0.31	6.900	$ 1.510	8.41	1.72	10.13	0.00	[illegible]		
8095	201507	18312	320.53	18.40	316.86	2.74	6.440	.380	6.82	0.04	6.86	0.00	[illegible]		
8121	202259	18358	320.76	15.32	318.01	-0.12	6.370	1.610	7.98	1.92 $	9.90	0.00	K4		
	0202260	18359	320.49	14.44	318.03	-1.04	7.460	.110	7.57	0.02	7.59	0.00	[illegible]		
	0203993	18479	321.09	16.32	320.74	1.83	7.530	.010	7.54	-0.10	7.44	0.00	A0		
8203	204041		0323.67	14.86	320.82	0.32	6.450	.160E	6.61	0.04M	6.65	0.00	A0		
8205	204121	18489	324.01	15.35	320.98	0.89	6.120	.450	6.57	-0.01	6.56	0.00	[illegible]		
8277	206067	18600	327.60	15.35	324.25	2.02	5.090	1.040	6.13	0.90	7.03	0.00	[illegible]		
8287	206445	18630	327.90	14.22	324.90	1.06	5.660	1.440	7.10	1.67	8.77	0.00	[illegible]		
8289	206487	18636	329.49	18.34	324.94	5.45	5.280	1.640	6.92	1.94	8.86	0.00	K2		
8328	207203	18694	329.62	15.10	326.17	2.45	5.630	.060	5.69	0.10	5.79	0.00	A0		
8359	208110	18744	332.80	18.43	327.87	6.63	6.140	.800	6.94	0.26	7.20	0.00	G0		
	0208776	18787	332.75	15.14	328.99	3.54	6.940	.600	7.54	0.08	7.62	0.00	G0	V	
8385	209008	18805	334.25	17.74	329.41	6.48	5.990	-.130	5.86	-0.56	5.30	0.00	B5		
8413	209747	18873	334.96	15.69	330.79	4.81	4.850	1.420	6.27	1.81	8.08	0.00	K4	II	
8450	210418	18949	336.48	16.34	331.92	5.95	3.520	.060	3.60	0.10	3.70	0.00	A2	V	
8491	211287	19048	338.80	17.99	333.38	8.30	6.200	.020	6.22	-0.04	6.18	0.00	A0		
8513	211924	19112	338.79	15.02	334.49	5.54	5.360	-.020	5.34	-0.47	4.87	0.00	B6		
8514	211976	19117	339.84	17.19	335.61	7.93	6.160	.450	6.61	-0.05	6.56	0.00	DF4		
	0212291	19153	340.88	16.17	335.16	9.21	7.920	.680	8.60	0.17	8.77	0.00	DG6		
8562	213119	19215	342.18	17.29	336.66	8.87	5.570	1.550	7.12	1.90	9.02	0.00	DK5		
8634	214923	19416	345.80	17.68	339.74	10.57	3.390	-.070	3.32	-0.28	3.04	0.00	B8 V		
8653	215243		0346.38	17.55	340.31	10.67	6.330	.430E	6.76	0.00M	6.76	0.00	F5		
8665	215648	19514	347.60	18.42	341.05	11.92	4.190	.500	4.69	-0.03	4.66	0.00	F7	V	A
8681	216048	19558	347.57	16.57	341.76	10.21	6.530	.300	6.83	0.02	6.85	0.00	F0	N	
8697	216385	19594	347.97	15.71	342.47	9.57	5.160	.470	5.63	-0.04	5.59	0.00	F7	IV	
8717	216735	19647	348.22	14.49	343.18	8.55	4.920	-.010	4.91	-0.01	4.90	0.00	A1	V	
8724	216900		0349.66	17.11	343.59	11.58	6.390	.120E	6.51	0.10M	6.61	0.00	A3		
8737	217166	19694	349.22	14.67	344.01	9.09	6.740	.630	7.07	0.13	7.20	0.00	DG1		AB
8739	217232		0350.36	16.79	344.17	11.47	5.?50	.320E	6.07	0.08M	6.15	0.00	F0 V		
8795	218329	19797	351.22	13.88	346.12	9.14	4.500	1.560	6.06	1.81	7.87	0.00	M2	III	
	0218550	19815	352.28	15.13	346.57	10.69	7.600	.450	8.05	-0.02	8.03	0.00	F5		AB
8821	218700	19833	352.09	13.96	346.88	9.55	5.380	-.080	5.30	-0.28	5.02	0.00	B8		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)	SPTYPE
8833	219139		0353.40	14.76	347.73	10.79	5.820	1.008E	6.83	0.80M	7.63	0.00	G5
8893	220363	20050	356.16	14.95	350.14	12.04	5.080	1.310	6.39	1.49	7.88	0.00	K3 II
8923	221115	20168	357.74	14.75	351.66	12.48	4.560	.940	5.50	0.75	6.25	0.00	G8 II
8960	222098	20318	1.43	17.62	353.78	16.55	6.080	.000	6.08	0.08	6.16	0.00	A2 V
9036	223768	20490	5.81	18.23	357.48	18.84	5.107	1.599E	6.71	1.88M	8.58	0.00	K2 G

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
9095	225045	20664	352.05	-18.63	0.10	-20.33	6.240	.530	6.77	0.06	6.83	0.00	[illegible]		
9098	225132	20678	353.41	-16.23	0.29	-17.61	4.560	-.040E	4.52	-0.12M	4.40	1.42	[illegible]		
9101	225197	0	353.69	-15.56	0.44	-16.81	5.777	1.098E	6.87	1.10M	7.97	0.00	[illegible]		
10	256	38	354.20	-16.64	1.19	-17.67	6.160	.140	6.30	0.10	6.40	0.00	[illegible]		
18	402	57	354.40	-16.93	1.50	-17.66	6.050	$ 1.670	7.72	1.97 $	9.69	0.00	[illegible]		
33	693	101	355.93	-15.27	2.18	-15.74	4.902	.494E	5.40	-0.01M	5.38	1.60	[illegible]		
37	787	117	355.06	-17.62	2.40	-18.22	5.240	1.480	6.72	1.63	8.35	0.00	[illegible]		
0	890	129	355.63	-17.03	2.67	-17.46	7.530	1.240	8.77	1.32	10.09	0.00	[illegible]		
0	955	142	355.63	-17.43	2.84	-17.62	7.340	-.150	7.19	-0.67	6.52	0.00	[illegible]		
0	1879	270	358.41	-16.88	5.13	-16.22	6.470	1.600	8.07	1.85	9.92	0.00	[illegible]		
115	2630	364	0.43	-16.58	6.83	-15.14	6.130	.360E	6.51	-0.03M	6.48	1.58	[illegible]		
150	3325	462	1.81	-17.29	8.38	-15.25	6.440	1.060	7.50	0.92	8.42	0.00	[illegible]		
190	4145	0	4.88	-15.35	10.33	-12.27	6.018	1.099E	7.12	1.09M	8.20	0.00	[illegible]		
194	4188	596	5.55	-14.11	10.42	-10.88	4.760	1.020	5.78	0.84	6.62	0.00	[illegible]		
203	4307	0	4.89	-16.32	10.74	-13.15	6.140	.610E	6.75	0.08M	6.83	0.00	[illegible]		
227	4730	0	5.52	-17.32	11.73	-13.82	5.840	1.540E	7.38	1.80M	9.18	0.00	[illegible]		
235	4813	684	6.91	-14.73	11.90	-10.91	5.200	.500	5.70	-0.02	5.68	0.00	[illegible]		
0	5096	763	6.53	-17.08	12.54	-13.21	7.900	.360E	8.28	0.00M	8.28	0.00	[illegible]		
267	5437	840	8.02	-15.89	13.38	-11.54	5.300	1.520E	6.82	1.80M	8.62	0.00	[illegible]		
279	5722	0	8.60	-16.25	14.05	-11.65	5.615	.968E	6.58	0.66M	7.25	0.00	[illegible]		
315	6482	1090	10.80	-15.65	15.78	-10.25	6.130	1.000	7.13	0.86	7.99	0.00	[illegible]		
317	6530	1104	10.96	-15.56	15.89	-10.11	5.580	.010E	5.59	0.03M	5.62	1.52	A0 IV		
329	6706	0	11.38	-15.67	16.31	-10.05	5.840	.420E	6.26	0.00M	6.26	0.00	F2		
334	6805	1165	11.41	-16.12	16.52	-10.45	3.440	1.160	4.60	1.19	5.79	0.00	K0		A
346	6976	1219	12.32	-15.10	16.92	-9.17	6.390	1.030	7.42	0.88	8.30	0.00	GG6		
365	7389	0	13.70	-14.59	17.96	-8.18	7.826	.784E	8.61	0.35M	8.96	0.00	K0		
365	7438	1319	13.70	-14.59	17.96	-8.18	7.870	.780	8.65	0.35	9.00	0.00	DG7		H
366	7439	1320	13.70	-14.61	17.97	-8.19	5.170	.410	5.58	-0.07	5.51	0.00	DF2		A
388	8121	0	13.79	-18.25	19.50	-11.51	6.150	1.106E	7.26	1.03M	8.29	0.00	K0		
402	8512	1486	15.88	-15.77	20.38	-8.44	3.600	1.070	4.67	0.95	5.62	0.00	K0		A
401	8511	1485	15.95	-15.61	20.38	-8.27	6.200	.240	6.44	0.07	6.51	0.00	A5		A
404	8556	1492	16.46	-14.63	20.46	-7.18	5.900	.420	6.32	-0.07	6.25	0.00	F0		AB
425	8921	0	15.66	-18.63	21.32	-11.16	6.128	1.322E	7.45	1.36M	8.81	0.00	K0		
444	9484	1615	17.69	-17.39	22.64	-9.27	6.580	-.040	6.54	-0.10	6.44	0.00	A0		
448	9562	1624	18.64	-15.62	22.80	-7.28	5.740	.650	6.39	0.20	6.59	0.00	DG2		
466	10009	1678	18.62	-18.19	23.78	-9.66	6.230	.530	6.76	-0.02	6.74	0.00	F5		AB
507	10658	1760	21.95	-14.48	25.35	-5.02	6.180	1.540	7.72	1.89	9.61	0.00	K0		
513	10824	1787	22.08	-15.56	25.87	-5.98	5.330	1.510	6.84	1.88	8.72	0.00	GK4		
611	12642	2090	26.96	-15.64	30.29	-4.34	5.600	1.580	7.18	1.97	9.15	0.00	CK5		
639	13468	2198	29.69	-14.19	32.26	-2.06	5.920	.970	6.89	0.71	7.60	0.00	GG9		
0	0	2225	29.77	-14.83	32.55	-2.63	7.740	.680	8.42	0.22	8.64	0.00	DG4		
650	13612	2224	29.78	-14.83	32.56	-2.63	5.670	.560	6.23	0.07	6.30	0.00	DF9		
681	14386	0	31.16	-15.95	34.21	-3.21	4.000	1.600F	5.60	1.10M	6.70	0.00	M VAR	2	
684	14417	[illegible]	30.77	-17.25	34.29	-4.57	6.490	.080	6.57	0.08	6.65	0.00	A2		
691	14690	[illegible]	32.59	-14.21	34.91	-1.11	5.410	.320	5.73	0.07	5.80	0.00	A5		
704	15004	2489	32.61	-16.23	35.61	-3.01	6.320	.000	6.32	-0.14	6.18	0.00	A0		
732	15633	2541	35.07	-13.63	37.05	0.04	5.990	.170	6.16	0.15	6.31	0.00	A2		
739	15779	2559	34.97	-15.17	37.40	-1.25	5.340	1.010	6.35	0.85	7.20	0.00	GG3		
0	16141	2584	34.91	-17.81	38.21	-3.77	6.820	.660	7.48	0.21	7.69	0.00	G5 IV		
771	16400	2609	35.54	-17.85	38.79	-3.61	5.640	1.020	6.66	0.66	7.52	0.00	GG5		
779	16582	2626	37.22	-14.47	39.23	0.11	4.070	-.220E	3.85	-0.86M	2.99	0.00	B2V	6	
0	16619	2635	37.25	-14.67	39.32	-0.07	7.830	.650	8.48	0.16	8.64	0.00	DG4		AB
790	16765	2679	37.32	-15.58	39.67	-0.91	5.700	.520	6.22	-0.04	6.18	0.00	DF6		AB
795	16824	2691	36.62	-18.01	39.82	-3.43	6.040	1.160	7.20	1.14	8.34	0.00	GG9		
0	18368	2867	42.07	-14.33	43.66	1.69	7.580	.580	8.16	0.00	8.16	0.00	G0		AB
899	18633	2907	41.34	-18.67	44.29	-2.56	5.550	-.080	5.47	-0.18	5.29	0.00	B9		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)	SPTYPE	VAR	
0	18975	2960	42.30	-18.55	45.12	-2.28	7.510	.520	8.03	0.02	8.05	0.00	[illegible]		
926	19121	2978	43.89	-14.89	45.51	1.67	6.090	1.070	7.16	0.89	8.05	0.00	[illegible]		
962	19994	3104	45.03	-18.40	47.55	-1.38	5.050	.570	5.62	0.11	5.73	0.00	[illegible]		
992	20559	3198	46.52	-18.53	48.95	-1.11	5.370	1.040	6.41	0.81	7.22	0.00	[illegible]		
996	20630	3208	47.97	-14.45	49.18	3.19	4.820	.690	5.50	0.18	5.68	0.00	[illegible]		
1007	20791	3228	48.49	-14.27	49.62	3.50	5.680	.970	6.65	0.77	7.42	0.00	[illegible]		
1099	22468	3453	51.63	-18.25	53.55	0.43	5.880	.920	6.80	0.43	7.23	0.00	[illegible]		
1101	22484	3458	51.61	-18.44	53.58	0.24	4.280	.570	4.85	0.05	4.90	0.00	[illegible]		
1115	22796	3485	53.03	-16.04	54.31	2.90	5.560	.940	6.50	0.67	7.17	0.00	[illegible]		
0	24550	3805	57.20	-14.80	57.95	5.03	7.420	.380	7.80	0.16	7.96	0.00	[illegible]		
1224	24817	3854	58.04	-14.09	58.59	5.90	6.080	.060	6.14	0.04	6.18	0.00	[illegible]		
1251	25490	3964	59.57	-14.46	60.12	5.85	3.900	.030	3.93	0.08	4.01	0.00	[illegible]		
1253	25558	3977	59.60	-15.03	60.27	5.30	5.320	-.080	5.24	-0.56	4.68	0.00	[illegible]		
1257	25621	3985	59.16	-17.61	60.39	2.69	5.350	.500	5.85	0.02	5.87	0.00	[illegible]		
1292	26462	4077	61.54	-15.32	62.17	5.39	5.730	.355E	6.08	0.03M	6.11	0.00	[illegible]		
1321	26913	4134	62.71	-14.83	63.19	6.08	7.000	.680	7.68	0.19	7.87	0.00	[illegible]		
1322	26923	4133	62.71	-14.85	63.20	6.06	6.370	.560	6.95	0.08	7.03	0.00	[illegible]		
1360	27497	4197	64.02	-15.13	64.50	6.01	5.760	.920	6.68	0.67	7.35	0.00	[illegible]		
0	28069	4274	65.19	-16.32	65.82	5.04	7.380	.514	7.89	0.02	7.91	[illegible]	[illegible]		
1436	28736	4359	66.80	-16.31	67.35	5.30	6.360	.430	6.79	-0.01	6.78	0.00	[illegible]		
1448	28978	4395	67.36	-16.23	67.87	5.47	5.680	.050	5.73	0.08	5.81	0.00	[illegible]		
0	29441	4471	68.69	-13.81	68.97	8.08	7.640	.000E	7.64	-0.68M	6.96	1.23	[illegible]		
1480	29499	4476	68.97	-14.14	69.10	7.77	5.380	.270	5.65	0.13	5.78	0.00	[illegible]		
0	30544	4609	70.83	-18.64	71.51	3.56	7.320	-.062	7.26	-0.31	6.95	0.00	[illegible]		
1543	30652	4635	71.57	-15.39	71.78	6.88	3.190	.450	3.64	-0.01	3.63	0.00	[illegible]		
1552	30836	4665	71.75	-16.78	72.13	5.52	3.690	-.170	3.52	-0.81	2.71	0.00	[illegible]		
1571	31296	4730	72.94	-14.73	73.02	7.70	5.320	1.220	6.54	1.18	7.72	0.00	[illegible]		
1578	31411	4743	72.96	-17.13	73.33	5.32	6.490	.020	6.51	-0.01	6.50	0.00	A0		
1664	33054	4924	76.34	-14.35	76.29	8.43	5.340	.320	5.66	0.11	5.77	0.00	[illegible]		
1709	34043	5011	77.81	-17.83	78.02	5.10	5.490	1.370	6.86	1.55	8.41	0.00	GK4		
1763	34989	5096	79.86	-14.69	79.75	8.38	5.780	-.120	5.66	-0.87	4.79	0.00	B2		
1777	35242	5126	80.10	-17.82	80.21	5.26	6.340	.120	6.46	0.08	6.54	0.00	A0		
1790	35468	5149	80.60	-16.82	80.61	6.31	1.640	-.230	1.41	-0.87	0.54	0.00	B2		
1807	35656	5176	81.02	-16.32	80.99	6.83	6.410	-.030	6.38	-0.03	6.35	0.00	B9		
1839	36267	5282	82.04	-17.31	82.03	5.91	4.210	-.150	4.06	-0.52	3.54	0.00	B5 IV		AB
0	36824	5438	83.05	-17.64	83.01	5.63	6.690	-.150E	6.54	-0.72M	5.82	0.00	B3 V		
1876	36822	5437	83.26	-13.81	83.02	9.46	4.400	-.170	4.23	-0.95	3.28	0.00	B0		
1907	37160	5576	83.78	-14.03	83.54	9.27	4.080	.950	5.03	0.69	5.72	0.00	G8 II		
1913	37232	5600	83.87	-14.36	83.65	8.92	6.110	-.180	5.93	-0.82	5.11	0.00	B3		
1920	37320	5637	83.99	-15.80	83.83	7.51	5.870	-.070	5.80	-0.36	5.44	0.00	B8		
1987	38527	5907	86.32	-13.88	86.03	9.51	5.780	.890	6.66	0.58	7.24	0.00	GG7		
1999	38710	5928	86.54	-16.96	86.33	6.44	5.260	.240	5.50	0.15	5.65	0.00	DA5 N		A
2061	39801	0	88.40	-16.04	88.11	7.39	0.420	1.640E	2.26	2.11M	4.37	0.00	M2 I	6	AB
2075	39985	6044	88.75	-13.94	88.43	9.50	5.980	-.070	5.91	-0.14	5.77	0.00	B9		
2124	40932	6112	90.26	-13.80	89.91	9.65	4.120	.160	4.28	0.10	4.38	0.00	A M		AB
2144	41361	6149	90.96	-18.02	90.58	5.42	5.660	1.050	6.71	0.83	7.54	0.00	GG7		
2167	42035	6194	91.89	-14.76	91.51	8.68	6.540	-.080	6.46	-0.16	6.30	0.00	B9		
0	42618	6241	92.76	-16.63	92.33	6.80	6.870	.630	7.50	0.13	7.63	0.00	G4 V		
0	42773	6251	93.00	-16.13	92.57	7.29	7.000	1.560	8.56	1.94	10.50	0.00	K2		
2231	43285	6293	93.73	-17.33	93.25	6.08	6.040	-.110	5.93	-0.57	5.36	0.00	B5 E		
2248	43526	6310	94.04	-16.33	93.57	7.07	6.560	-.140	6.42	-0.50	5.92	0.00	B8		
2251	43587	6317	94.18	-18.28	93.65	5.12	5.700	.610	6.31	0.09	6.40	0.00	G0G		A
2259	43821	6336	94.41	-14.32	93.98	9.07	6.230	.870	7.10	0.52	7.62	0.00	[illegible]		
2300	44783	6399	95.79	-14.44	95.33	8.91	6.250	-.080	6.17	-0.30	5.87	0.00	A0		
2310	44990	0	96.17	-16.22	95.63	7.11	5.970	1.220E	7.19	1.04M	8.23	0.00	G5	S	
0	45789	6468	97.38	-16.13	96.81	7.15	7.090	-.130E	6.96	-0.70M	6.26	1.25	B2 V		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	N	T
0	45829	6472	97.36	-15.32	96.83	7.96	6.630	1.580	8.21	1.67	9.88	0.00				
2362	45827	6471	97.32	-14.22	96.84	9.06	6.560	.140	6.70	-0.07	6.63	[illegible]				
0	45910	6473	97.62	-17.37	96.97	5.90	6.770	.320	7.09	-0.68	6.41	0.00				
0	46106	6489	97.94	-18.20	97.24	5.06	7.930	.140	8.07	-0.77	7.30	[illegible]				
0	46149	6495	98.00	-18.18	97.30	5.07	7.590	.160	7.75	-0.80	6.95	[illegible]				
0	46150	6496	98.03	-18.27	97.32	4.98	6.750	.120	6.87	-0.85	6.02	0.00				
0	46223	6500	98.09	-18.39	97.37	4.86	7.270	.210	7.48	-0.78	6.70	0.00				
2382	46241	6503	98.14	-18.36	97.42	4.89	5.860	.990	6.85	0.76	7.61	0.00				
2385	46300	6506	98.13	-15.87	97.55	7.37	4.490	.020	4.51	-0.28	4.23	[illegible]				
0	46484	6520	98.56	-18.52	97.81	4.70	7.740	.360	8.10	-0.61	7.49	0.00				
2404	46642	6533	98.60	-15.61	98.07	7.61	6.440	-.020	6.42	-0.03	6.39	[illegible]				
2413	46885	6552	99.13	-18.65	98.34	4.54	6.540	-.060	6.48	-0.27	6.21	[illegible]				
0	46966	6556	99.13	-17.06	98.44	6.13	6.840	-.040	6.80	-0.92	5.88	[illegible]				
2422	47129	6566	99.38	-16.99	98.68	6.18	6.040	.040	6.08	-0.87	5.21	[illegible]				
2432	47240	6576	99.58	-18.16	98.80	5.00	6.150	.140	6.29	-0.73	5.56	[illegible]				
0	47382	6586	99.77	-18.50	98.96	4.65	7.140	.170	7.31	-0.76	6.55	[illegible]				
0	47417	6591	99.69	-16.20	99.03	6.95	6.970	.010	6.98	-0.86	6.12	[illegible]				
2441	47431	6594	99.85	-18.40	99.04	4.75	6.560	-.070	6.49	-0.32	6.17	0.00				
2454	47756	6616	100.17	-16.70	99.46	6.42	6.500	-.150	6.35	-0.45	5.90	0.00				
2467	48099	6641	100.55	-16.71	99.83	6.39	6.360	-.050	6.31	-0.94	5.37	0.00				
2494	48977	6715	101.53	-14.38	100.95	8.64	5.920	-.180	5.74	-0.68	5.06	[illegible]				
2503	49161	6725	101.78	-14.91	101.15	8.09	4.760	1.400	6.16	1.65	7.61	[illegible]				
0	49409	6742	102.16	-15.29	101.49	7.69	7.930	.600	8.53	0.10	8.63	0.00				
0	50083	6790	103.20	-17.75	102.28	5.15	6.920	.060	6.98	-0.76	6.22	0.00	B2	F		
2551	50277	6802	103.15	-14.45	102.53	8.44	5.760	.270	6.03	0.08	6.11	0.00	A5	N		
0	50868	6838	104.06	-17.37	103.14	5.50	7.920	-.200E	7.72	-0.71M	7.01	1.22	B5	N		
2584	50931	0	103.86	-14.45	103.22	8.38	6.280	.040E	6.32	0.06M	6.38	0.00	A0			
2606	51693	6871	104.71	-15.06	103.99	7.69	6.260	.110	6.37	0.09	6.46	0.00	A2			
2613	51892	6884	104.92	-15.34	104.16	7.39	6.340	-.120	6.22	-0.46	5.76	0.00	B8			
2629	52479	6913	105.81	-17.77	104.76	4.89	6.620	.060	6.68	0.09	6.77	0.00	A0			
2633	52559	6916	105.78	-17.03	104.81	5.63	6.580	-.020	6.56	-0.64	5.92	0.00	B2			
2676	53929	6964	107.20	-17.52	106.11	4.99	6.100	-.140	5.96	-0.46	5.50	0.00	B8			
2682	54079	6969	107.07	-14.96	106.28	7.55	5.740	1.180	6.92	1.08	8.00	0.00	GK0			
2710	55111	7002	108.34	-16.63	107.30	5.74	6.080	-.020	6.06	-0.05	6.01	0.00	A0			
2713	55184	7011	108.43	-16.80	107.37	5.56	6.150	1.140	7.29	0.97	8.26	0.00	K0			
2747	56031	7054	108.99	-14.20	108.24	8.07	5.810	1.600	7.41	1.69	9.10	0.00	G 4			
2760	56446	7069	109.58	-15.44	108.65	6.77	6.640	-.120	6.52	-0.40	6.12	0.00	F.9			
2779	57006	7101	110.15	-14.89	109.27	7.24	5.900	.530	6.43	0.05	6.48	0.00	DF6			
2851	58923	7214	112.28	-14.79	111.34	7.05	5.220	.210	5.43	0.18	5.61	0.00	GF0		AB	
2887	60111	7272	114.21	-18.19	112.64	3.40	5.580	.320	5.90	0.07	5.97	0.00	F0	N		
2901	60357	7290	114.47	-18.07	112.91	3.48	5.800	-.020	5.78	-0.09	5.69	0.00	A0	N	A	
2904	60489	0	114.72	-18.69	113.04	2.83	6.560	.220E	6.78	0.15M	6.93	0.00	A3 4			
2918	60803	7310	114.63	-15.52	113.48	5.97	5.900	.600	6.50	0.09	6.59	0.00	F8			
2943	61421	7352	115.44	-16.01	114.17	5.35	0.360	.440	0.80	-0.01	0.79	1.60	F5	I	A-	
2950	61563	7361	115.65	-15.98	114.37	5.35	6.010	-.040	5.97	-0.17	5.80	0.00	A0		A-	
2966	61887	7381	116.32	-17.50	114.74	3.74	5.940	-.040	5.90	-0.08	5.82	0.00	A0	N		
2989	62437	7415	117.20	-18.56	115.38	2.53	6.460	.210	6.67	0.12	6.79	0.00	F0			
3033	63435	7530	118.08	-16.46	116.59	4.46	6.530	.790	7.32	0.38	7.70	0.00	G0		AB	
3050	63799	7560	118.75	-17.41	117.04	3.41	6.170	1.120	7.29	1.02	8.31	0.00	K0			
3061	64052	0	119.09	-17.35	117.37	3.41	6.310	1.590E	7.90	1.61M	9.51	0.00	M4			
3093	64938	7647	119.93	-15.95	118.44	4.62	6.160	.980	7.14	0.74	7.88	0.00	GG9			
0	65079	7651	120.42	-17.42	118.61	3.09	7.630	-.140	7.69	-0.76	6.93	0.00	B2	E		
3110	65345	7666	120.91	-18.07	118.93	2.36	5.280	.910	6.19	0.72	6.91	0.00	K0	II	A	
0	65372	7667	120.80	-17.37	118.97	3.07	6.640	.160	6.80	0.23	7.03	0.00	A3			
3136	65900	7699	121.08	-15.32	119.65	5.02	5.650	.000E	5.65	0.01M	5.66	0.00	A0		A	
3135	66141	7720	121.90	-17.76	119.92	2.47	4.400	1.250	5.65	1.24	6.89	0.00	K0			

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
0	66665	7747	121.68	-13.86	120.53	6.33	7.800	-.260	7.54	-1.04	6.50	0.00	[illegible]		
3269	70013	7982	125.97	-15.19	124.30	4.11	6.040	.970	7.01	0.64	7.65	0.00	[illegible]		[illegible]
0	70923	8028	127.96	-17.95	125.50	0.98	7.050	.600E	7.65	0.11M	7.76	1.69	[illegible]		A
3305	71095	8038	127.89	-16.64	125.75	2.27	5.720	1.530	7.25	1.86	9.11	0.00	[illegible]		
0	71597	8075	129.05	-18.28	126.42	0.41	7.300	1.160	8.46	1.13	9.59	0.00	[illegible]		
3392	72908	8156	130.19	-15.40	128.20	2.92	6.320	1.020	7.34	0.88	8.22	0.00	[illegible]		
3418	73471	8226	130.87	-14.60	129.04	3.52	4.440	1.220	5.66	1.27	6.93	0.00	[illegible]		
3454	74280	8422	131.95	-14.26	130.15	3.58	4.310	-.196	4.11	-0.74	3.37	0.00	[illegible]		
0	75012	8512	133.98	-17.16	131.25	0.26	7.830	.082	7.91	0.09	8.00	0.00	[illegible]		[illegible]
0	75138	8530	134.03	-16.65	131.43	0.74	7.240	1.477	8.72	1.78	10.50	0.00	[illegible]		A
3573	76757	8676	136.19	-15.00	133.89	1.74	6.580	.060	6.64	0.08	6.72	0.00	[illegible]		[illegible]
0	77236	8713	138.22	-18.69	134.68	-2.36	7.540	1.150	8.69	1.02	9.71	0.00	[illegible]		
3596	77353	8722	137.75	-16.66	134.85	-0.29	5.680	1.140	6.82	1.04	7.86	0.00	[illegible]		
3618	78196	8760	138.40	-14.43	136.10	1.66	6.170	1.660	7.83	1.99	9.82	[illegible]			
3741	81567	9004	144.11	-15.70	140.96	-1.25	6.000	1.320	7.32	1.44	8.76	[illegible]			
3758	81980	9045	144.69	-15.29	141.62	-1.04	6.260	.280	6.54	0.08	6.62	[illegible]			
3759	81997	9046	145.23	-16.71	141.65	-2.55	4.610	.470	5.08	0.01	5.09	[illegible]			
0	0	9047	145.23	-16.69	141.65	-2.53	7.190	.860	8.05	0.57	8.62	[illegible]			
3760	82043	9048	145.11	-16.15	141.72	-1.99	6.130	.220	6.35	0.11	[illegible]	[illegible]			
3762	82074	9051	145.85	-18.07	141.76	-4.03	6.250	.840	7.09	0.40	7.49	0.00			
3787	82446	9095	145.39	-14.97	142.36	-0.96	4.560	.110	4.67	0.05	4.72	0.00			
0	83161	9152	147.03	-16.10	143.48	-2.55	6.960	1.020	7.98	0.79	8.77	0.00			
3845	83618	9185	147.30	-14.27	144.33	-0.91	3.890	1.330	5.22	1.48	6.70	0.00			
3899	85364	9267	151.17	-16.22	147.18	-4.01	6.000	.170	6.17	0.09	6.26	[illegible]			
3901	85380	9269	151.91	-18.02	147.22	-5.95	6.410	.580	6.99	0.10	7.09	[illegible]			
0	87855	9448	156.45	-17.90	151.32	-7.39	6.620	1.610E	8.23	1.85M	10.08	2.54	[illegible]		
3989	88195	9465	157.32	-18.40	151.91	-8.16	5.900	.020	5.92	-0.05	5.87	0.00	[illegible]		
3996	88333	9477	157.52	-18.34	152.11	-8.17	5.640	1.300	6.94	1.42	8.36	0.00	[illegible]		
4000	88372	9481	157.18	-17.28	152.20	-7.07	6.240	.010	6.25	0.01	6.26	1.49	[illegible]		
0	88697	9498	157.80	-17.12	152.81	-7.14	7.210	.490E	7.70	0.03M	7.73	1.65	[illegible]		
0	88764	9503	158.13	-17.64	152.91	-7.74	6.970	1.030E	8.00	0.87M	8.87	2.11	[illegible]		
4042	89254	9540	159.01	-17.39	153.79	-7.82	5.240	.290	5.53	0.15	5.68	0.00	[illegible]		
4059	89490	9556	158.30	-14.47	154.25	-4.85	6.360	.900	7.26	0.60	7.86	0.00	[illegible]		
4060	89565	0	159.97	-18.10	154.38	-8.82	6.320	.330E	6.65	0.03M	6.68	0.00	F2		
4092	90362	9635	160.55	-15.70	155.81	-6.81	5.550	1.520	7.07	1.83	8.90	0.00	[illegible]		
0	90711	9665	160.96	-15.04	156.43	-6.34	7.900	.810	8.71	0.46	9.17	0.00	[illegible]		
4122	91106	9690	162.02	-15.74	157.12	-7.38	6.190	1.380	7.57	1.18	8.75	0.00	[illegible]		[illegible]
4155	91858	9738	164.47	-17.95	158.45	-10.32	6.570	.290E	6.86	0.13M	6.99	1.58	[illegible]		
0	91962	9752	163.94	-16.27	158.63	-8.58	7.030	.620E	7.65	0.11M	7.76	1.68	[illegible]		[illegible]
4233	93833	9948	167.35	-15.98	161.80	-9.59	5.860	1.060	6.92	0.92	7.84	0.00	[illegible]		
4237	93903	9955	167.10	-15.04	161.95	-8.63	5.780	.160	5.94	0.12	6.06	0.00	A2		[illegible]
4305	95808	10100	171.13	-15.98	165.19	-11.03	5.500	.940E	6.44	0.74M	7.18	2.04	[illegible]		[illegible]
4308	95870	10103	172.11	-17.90	165.28	-13.16	6.290	.890	7.18	0.63	7.81	0.00	[illegible]		
4315	96220	10129	171.57	-15.57	165.76	-10.82	6.080	.310E	6.39	0.10M	6.49	1.56	[illegible]		
4362	98430	10301	176.34	-17.58	169.21	-14.51	3.560	1.120	4.68	0.96	5.64	2.16	[illegible]		
4416	99564	10369	177.12	-14.58	171.16	-12.08	5.940	.490E	6.43	0.00M	6.43	1.61	[illegible]		[illegible]
0	99565	10370	178.53	-17.58	171.17	-15.37	7.630	.750	8.38	0.22	8.60	0.00	[illegible]		[illegible]
4451	100418	10428	180.19	-17.55	172.68	-16.00	6.050	.600E	6.65	0.26M	6.91	1.70	[illegible]		
4488	101198	10513	180.11	-14.72	174.03	-12.93	5.480	.520E	6.00	-0.01M	5.99	1.60	[illegible]		[illegible]
4491	101370	0	181.85	-17.21	174.33	-16.34	6.190	1.630E	7.82	1.90M	9.72	0.00	[illegible]		
4490	101369	10536	180.92	-15.25	174.33	-14.19	6.210	.000E	6.21	-0.02M	6.19	1.48	[illegible]		A
4514	102070	10584	183.72	-18.29	175.56	-18.07	4.720	.970	5.69	0.75	6.44	0.00	[illegible]		
4539	102845	10651	183.90	-15.49	176.94	-15.59	6.130	.950E	7.08	0.69M	7.77	2.01	[illegible]		
4567	103532	10718	185.75	-16.09	178.37	-16.87	5.170	-.030	5.14	-0.06	5.08	[illegible]	[illegible]		
4590	104337	0	187.93	-17.88	179.57	-19.37	5.280	-.250E	5.03	-0.90M	4.13	[illegible]	[illegible]		
4655	106485	10998	191.62	-17.59	163.10	-20.57	5.830	1.050E	6.88	0.96M	7.84	2.16	[illegible]		

YALE HD PHOEIC λ β α δ V B-V B U-B U (U-B)0 SPTYPE

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4662106625 11010190.38-14.49183.31-17.26 2.590   -.110    2.48-0.34    2.14 1.34
    0     0     0191.37-15.69184.26-18.9810.500   .000   10.50 0.00   10.50
4691107295 1107319?36-18.29184.40-21.90 5.970    .820E   6.79 0.50M   7.29 1.91
4696107348 1108219 .45-18.29184.49-21.9? 5.300  -.110    5.19-0.39    4.80 0.00
4778109238 1127619 .26-14.85187.69-19.52 6.260   .290E   6.55 0.17M   6.72 1.60
4786109379 112871  .02-18.04187.94-23.12 2.720   .890    3.61 0.59    4.20 0.00
4797109585 113121  .14-15.27188.34-20.25 6.190   .340E   6.53-0.04M   6.49 1.58
4827110385 113811  .12-14.01189.50-19.48 6.030   .400E   6.43-0.02M   6.41 1.50
4857111226 114912  .51-18.10191.31-24.58 6.430  -.060E   6.37-0.35M   6.02 1.34
4918112519 11695   .83-15.28193.72-22.48 6.300  1.070E   7.37 0.78M   8.15 0.00
4958114149     0   .49-14.57196.59-22.85 4.940  1.050E   5.99 0.93M   6.92
4978114576 11917   .47-17.50197.23-26.29 6.500   .190E   6.69 0.14M
   0114597 11919   .71-15.65197.30-24.30 7.970  1.340E   9.31 1.35M
   0115577 12020   .65-18.54198.91-28.07 6.800   .980E   7.78 0.71M
5020115659 12027206.67-13.74199.05-22.91 2.980   .910    3.84 0.64
   0117105 12126210.44-16.80201.44-27.14 7.200   .580    7.78-0.04    7.82
5090117558 12148211.37-17.21202.19-27.86 6.460   .100E   6.56 0.08M   6.64
5098117718 12157212.17-18.46202.34-29.31 6.440   .440E   6.88 0.00M   6.88 1.61
5097117716     0211.83-17.66202.45-28.44 5.690   .040E   5.73 0.00M   5.73
    0     0 12203211.86-15.26203.51-26.24 6.720   .240    6.96 0.09    7.05
5120118349 12202211.86-15.26203.51-26.24 5.780   .220    6.00 0.20    6.20
5128118646 12222213.47-17.95203.97-29.31 5.830   .400E   6.23-0.04M   6.19
5167119752 12282213.60-14.18205.70-25.87 5.810   .020E   5.83 0.07M   5.90 1.54
5197120455 12322215.70-16.57206.82-28.83 6.100  -.030    6.07-0.13    5.94 0.00
   0120691 12345216.89-18.52207.20-31.07 7.160   .520    7.68 0.02    7.70 0.00
5228121156     0216.39-15.77207.86-28.33 4.550   .770E   5.32 0.70M   6.02 0.00
5237121397     0217.72-18.17208.21-31.04 6.470   .920E   7.39 0.70M   8.09 0.00
   0121579 12388216.60-14.71208.51-27.32 7.810 $ .490 $ 8.30 0.05 $ 8.35 0.00
   0121730 12396218.06-17.70208.76-30.72 7.580  1.070E   8.65 0.85M   9.50 2.10
5265122430     0217.69-14.06209.88-27.19 5.740  1.300E   7.04 1.44M   8.48 0.00
5268122510 12428219.40-17.98210.03-31.44 6.170   .480E   6.65-0.01M   6.64 1.60
5324124576     0221.05-14.83213.03-29.05 6.030   .000E   6.03 0.00M   6.03 0.00
5337124780     0222.75-18.46213.34-33.02 6.560   .290E   6.85 0.02M   6.87 0.00
5348125150 12561223.17-18.28213.86-32.99 6.540   .270E   6.81 0.01M   6.82 1.62
5407126769 12662223.91-14.07216.31-29.27 4.970  -.060    4.91-0.40    4.51 0.00
5428127624     0225.37-14.86217.55-30.49 6.110   .920E   7.03 0.70M   7.73 0.00
5474129161     0227.28-14.48219.72-30.72 6.470  -.060E   6.41-0.19M   6.22 0.00
   0129216 12799227.95-16.21219.80-32.56 6.640   .920E   7.56 0.63M   8.19 0.00
5485129456 12815229.04-18.39220.15-34.96 4.040  1.350    5.39 1.53    6.92 2.42
5489129685 12831229.32-18.32220.48-34.98 4.910   .010    4.92-0.03    4.89 1.45
5549131432     0230.68-15.89222.89-33.08 5.940   .820E   6.76 0.47M   7.23 0.00
5558131625     0231.10-16.37223.17-33.65 5.340   .000E   5.34 0.00M   5.34 0.00
   0131751 12981231.50-17.06223.36-34.43 7.350   .530E   7.88 0.06M   7.94 0.00
5562131774     0230.88-15.15223.37-32.43 6.190   .920E   7.11 0.70M   7.81 0.00
5587132763     0232.54-16.48224.72-34.17 6.380   .050E   6.43 0.05M   6.48 0.00
5595132955 13028232.23-14.77224.98-32.45 5.440  -.123E   5.32-0.63M   4.69 1.29
5615133550 13056233.98-18.04225.77-36.07 6.270  1.650E   7.92 2.04M   9.96 2.63
5653134837 13112235.33-17.48227.49-35.90 6.090  -.080E   6.01-0.31M   5.70 1.36
5689136014 13176236.92-18.09229.08-36.91 6.190   .960E   7.15 0.60M   7.75 1.96
5705136422 13209237.15-17.17229.66-36.08 3.550  1.530    5.08 1.67    6.95 2.54
5712136664 13222237.59-17.68229.99-36.68 4.530  -.150    4.38-0.61    3.77 1.25
5736137432 13258238.40-17.37231.02-36.59 5.440  -.141E   5.30-0.61M   4.69 0.00
   0137597 13263238.75-17.90231.25-37.19 7.030  1.630E   8.66 1.50M  10.16 2.49
5820139521 13358240.35-14.46234.15-34.25 4.660   .980    5.64 0.74    6.38 2.04
5837139980     0241.68-17.25234.85-37.26 5.310  1.040E   6.35 0.90M   7.25 0.00
5839140008 13379241.02-14.61234.87-31.55 4.740  -.150    4.59-0.52    4.07 1.28
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YALE	HD	PHOELC	λ	β	α	δ	V		B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
5860	140784	13412	241.85	-14.40	235.88	-34.53	5.600		-.120	5.48	-0.41	5.07	1.32	B6 VN		AB
5864	140901	13423	242.78	-17.51	236.06	-37.76	6.020		.720	6.74	0.29	7.03	0.00	G0		A
5929	142691		0244.38	-15.39	238.52	-36.04	5.950		.610E	6.56	0.14M	6.70	0.00	G1 D		
5935	142889		0244.90	-16.63	238.80	-37.36	6.410		1.000E	7.41	0.79M	8.20	0.00	G9 G		
5948	143118	13554	245.42	-17.44	239.20	-38.26	3.400		-.230	3.17	-0.83	2.34	1.16	B2 V		A
5967	143699	13590	246.13	-17.50	240.02	-38.46	4.880		-.140	4.74	-0.56	4.18	0.00	B7 IV		
	0143646	13597	246.01	-16.21	240.22	-37.17	7.860		.600E	8.46	0.06M	8.52	1.66	G0		
5975	143928	13601	246.22	-16.74	240.33	-37.73	5.900		.400E	6.30	0.06M	6.24	1.56	F4 IV-V		A
5987	144294	13623	246.40	-15.62	240.83	-36.67	4.220		-.170	4.05	-0.68	3.37	1.22	B2 VN		
5991	144415	13633	246.52	-15.54	240.99	-36.62	5.730		.290E	6.02	-0.05M	5.97	1.57	F0 V		A
5999	144668		0247.26	-17.80	241.30	-38.97	6.690		-.070E	6.62	-0.44M	6.18	0.00	A0		
6000	144667		0247.26	-17.80	241.30	-38.97	7.070		.360E	7.43	0.25M	7.68	0.00	A0		
6080	146954	13849	249.72	-17.69	244.29	-39.31	6.120		-.080E	6.04	-0.23M	5.81	1.39	A0		A
6094	147513	13078	250.37	-17.34	245.16	-39.08	5.390	$	.620E	6.01	0.13M	6.14	1.72	G5 D		
6100	147628	13886	250.19	-15.72	245.30	-37.45	5.420		-.110E	5.31	-0.35M	4.96	1.34	B8 N		AB
6122	148247		0250.88	-15.21	246.23	-37.06	5.870		1.040E	6.91	0.89M	7.80	0.00	K0 G		
	0148704	13947	251.84	-16.92	247.03	-38.90	7.250		.870E	8.12	0.60M	8.72	1.96	DK1 D		
6178	149886	14060	253.09	-14.93	248.93	-37.12	5.930		.000E	5.93	-0.12M	5.81	1.46	A0		
6206	150573		0254.60	-18.66	250.07	-41.02	6.290		.090E	6.38	0.08M	6.46	0.00	A3		
6210	150608	14138	254.18	-15.72	250.10	-38.06	6.050		-.060E	5.99	-0.29M	5.70	1.37	A0		A
6209	150591		0254.62	-18.64	250.10	-41.01	6.120		-.070E	6.05	-0.53M	5.52	0.00	B8		
6214	150742		0254.75	-18.35	250.31	-40.74	5.710		-.120E	5.59	-0.64M	4.95	0.00	B25V		
6221	151078		0254.96	-16.86	250.84	-39.29	5.520		.950E	6.47	0.69M	7.16	0.00	G8 G		
6244	151771		0255.56	-14.90	251.91	-37.42	6.220		.080E	6.30	0.08M	6.38	0.00	A P		
6245	151804	14238	256.15	-18.59	252.02	-41.15	5.220		.080	5.30	-0.76	4.54	0.00	O8 FP		
6247	151890		0255.81	-15.42	252.12	-37.97	3.040		-.202E	2.84	-0.86M	1.98	0.00	B3 V P	6	
6252	151985	14254	255.90	-15.37	252.24	-37.93	3.560		-.210	3.35	-0.83	2.52	0.00	B2		
	0152246	14287	256.63	-18.38	252.65	-41.00	7.290		.160E	7.45	-0.76M	6.69	0.00	O9 III		
	0152405	14309	256.72	-17.80	252.86	-40.44	7.200		.110E	7.31	-0.75M	6.56	1.23	B0 IB		
6272	152408	14310	256.81	-18.43	252.87	-41.07	5.770	$	.160E	5.93	-0.76M	5.17	1.24	O8 F P		A
	0152623	14325	257.00	-17.91	253.19	-40.58	6.690		.120E	6.81	-0.83M	5.98	0.00	O75V		
6283	152667	14327	257.10	-18.07	253.28	-40.75	6.100	$	.280E	6.38	-0.66M	5.72	1.27	B0 IAP	*	
	0152685	14328	257.16	-18.40	253.31	-41.08	7.480		.190E	7.67	-0.57M	7.10	1.30	B2 I		
	0152723	14329	257.12	-17.75	253.36	-40.43	7.100		.140E	7.24	-0.76M	6.48	1.23	O6		C
6298	153072	14348	257.18	-14.83	253.87	-37.54	6.080		.190E	6.27	0.11M	6.38	1.58	A3 V		AB
	0153102	14350	257.34	-15.77	253.93	-38.49	7.590		.040E	7.63	-0.41M	7.22	1.32	B5 VNNK		
6327	153890	14384	258.25	-15.26	255.11	-38.08	5.920		.370E	6.29	-0.07M	6.22	1.56	F3 D		
6344	154310		0258.66	-14.28	255.74	-37.15	6.140		.060E	6.20	0.06M	6.26	0.00	A2		
6381	155259	14461	260.07	-16.46	257.20	-39.45	5.670		.040E	5.71	0.05M	5.76	1.53	A0		
6382	155276		0260.02	-15.77	257.21	-38.76	6.450		1.100E	7.55	1.03M	8.58	0.00	K1 G		
6392	155603	14520	260.54	-16.68	257.75	-39.71	6.560		2.200	8.76	1.35	10.11	0.00	G5 IA		A
	0155775	14551	260.59	-15.12	257.99	-38.16	6.720		-.010E	6.71	-0.78M	5.93	1.20	O9SK		
6398	155826	14557	260.66	-15.49	258.04	-38.53	5.960		.560E	6.54	0.09M	6.63	1.69	G3 IV		AB
	0156688	14755	261.66	-14.85	259.32	-37.97	7.190		.090E	7.28	-0.51M	6.77	1.28	B2 IIIK		
6450	157038	14784	262.04	-14.61	259.81	-37.76	6.410		.610	7.02	-0.30	6.72	0.00	B4 IA		AB
6456	157097	14795	262.05	-14.02	259.88	-37.17	5.920		1.080E	7.00	0.97M	7.97	2.16	K0		A
6503	158156	14889	263.46	-15.24	261.50	-38.48	6.380		.090E	6.47	0.12M	6.59	1.57	A2 V		AB
6508	158408	14908	263.66	-14.00	261.84	-37.26	2.700		-.230	2.47	-0.82	1.65	1.17	B3 IB		
6523	158799		0264.34	-17.84	262.40	-41.13	5.840		.060E	5.90	-0.18M	5.72	0.00	B9		
6527	158926	14937	264.23	-13.78	262.55	-37.07	1.620		-.240	1.38	-0.88	0.50	1.14	B1 V		A
6539	159312	14953	264.69	-14.10	263.08	-37.41	6.480		.010E	6.49	0.00M	6.49	1.50	A0		
6546	159433	14961	264.90	-15.28	263.27	-38.60	4.280		1.080	5.36	0.91	6.27	0.00	GK0		
6557	159633	14979	265.06	-14.71	263.50	-38.04	6.260		1.250E	7.51	1.10M	8.61	2.22	K0		
	0159704	14982	265.14	-14.50	263.61	-37.83	6.660		.770E	7.45	0.35M	7.80	1.83	G8 V		AB
6580	160578	15027	266.12	-15.64	264.76	-39.01	2.410		-.240	2.17	-0.88	1.29	1.14	B2 IV		
6613	161390	15075	267.03	-14.69	265.92	-38.09	6.420		-.020E	6.40	0.00M	6.40	0.00	B9		AB

YALE HD	PHOEBC λ β α δ	V		B-V	B U-B		U (U-B)C	SPTYPE	VAR	MULT
6615161471	15082267.17-16.71266.02-40.11	3.020		.510	3.53 0.24		3.77 1.64	F2 IA	A	
0161653	15109267.31-14.71266.26-38.12	7.200		.000E	7.20-0.73M		6.47 1.72	BUSIK		
0161807	15138267.52-15.56266.49-38.97	7.610		-.080E	6.93-0.84M		6.09 1.16	B3 VNNK		
6631161912	15152267.59-16.66266.67-40.08	4.800		.280	5.08-0.02		5.06 0.00	A2		
6643162189	0267.98-17.35267.01-40.77	5.960		1.560E	7.52-1.92M		9.44 0.00	M1 G		
6649162396	15197268.26-18.55267.33-41.98	6.190		.540E	6.73 0.00M		6.73 1.61	F8 V		
6678163234	0269.04-16.85268.36-40.29	6.480		1.250E	7.73 1.30M		9.03 0.00	K5		
0163254	15237269.09-18.53268.40-41.97	6.760		-.110E	6.65-0.59M		6.06 1.76	B5 V**		
6682163376	15241269.22-18.27268.56-41.71	4.870		1.650	6.52 1.96	S	8.48 2.58	M1		
6683163433	0269.24-15.68268.62-39.12	6.390		.000E	6.39 0.00M		6.39 0.00	A0		
6786166114	15429271.84-17.93271.89-41.37	5.660		.290E	6.15 0.07M		6.22 1.59	F0 V		
6804166596	15458272.26-17.92272.42-41.35	5.460		-.180E	5.28-0.80M		4.48 1.19	[illegible]		
6856168357	0273.93-14.12274.38-37.51	6.480		.920F	7.40 [illegible]		[illegible]	[illegible]		
6862168592	0274.17-15.30274.72-38.88	5.000		.920E	5.92 0.70M		6.62 0.00	K0		
6910169853	0275.39-15.68276.25-39.02	5.650		.060E	5.71 0.06M		5.77 [illegible]	[illegible]		
0169942	15678275.51-14.73276.34-38.06	7.650		1.580E	9.23-1.85M		11.08 2.54	K4 III		
6921170040	15687275.57-15.55276.46-38.88	6.620		-.020E	6.60-0.20M		6.40 1.40	B8 N		
6931170384	0275.74-18.63276.87-41.95	6.270		.120E	6.39 0.10M		6.49 0.00	A4P		
6942170642	15732276.13-16.44277.22-39.74	5.160		.080E	5.24 0.10M		5.34 1.56	A3 VN		
6948170773	15758276.25-16.64277.38-39.93	6.230		.420E	6.65-0.03M		6.62 1.59	F5 IV		
6952170868	0276.39-15.48277.48-38.77	6.550		-.070E	6.48-0.30M		6.18 0.00	B8		
6953170867	0276.39-15.48277.46-38.77	5.950		.060E	6.01 0.08M		6.09 0.00	A		
7021172777	15892278.53-15.21280.09-38.37	5.130	S	.090E	5.22 0.07M		5.29 1.54	A2 VN		
7031172991	0278.65-16.58280.37-39.73	5.480		.030E	5.51-0.03M		5.54 0.00	G5+A		
7050173540	15947279.15-17.35281.06-40.46	5.230		.780E	6.01 0.40M		6.41 0.00	G2		
0174152	15994279.73-18.06281.87-41.12	6.430		-.090E	6.34-0.41M		5.93 1.32	B5 III	A	
0175073	16041280.95-14.59282.98-37.56	7.950		.850E	8.80 0.58M		9.38 1.95	G5		
7129175362	0281.24-14.46283.32-37.40	5.370		-.148E	5.22-0.70M		4.52 0.00	B8 IV		
7136175529	0281.16-16.94283.52-39.88	6.360		.090E	6.45 0.07M		6.52 0.00	A3		
7152175813	0281.69-14.27283.84-37.17	4.910		.310E	5.22 0.06M		5.28 0.00	F0 V	2	
7156175855	0281.52-16.69283.93-39.60	6.450		.000E	6.45 0.00M		6.45 0.00	A0		
7169176269	0282.17-14.27284.42-37.13	6.840		-.090E	6.75-0.30M		6.45 0.00	B8		
7170176270	0282.17-14.27284.42-37.13	6.620		-.090E	6.53-0.30M		6.23 0.00	B8		
7197176723	16150282.49-15.51284.97-38.33	5.740		.320E	6.06-0.02M		6.04 1.59	F0 III		
7226177474	16179283.27-14.39285.76-37.13	4.210		.520E	4.73 0.02M		4.75 1.63	F8		
7227177475	0283.27-14.38285.76-37.12	5.010		.540E	5.55 0.06M		5.61 0.00	F8 V		
7232177565	16184283.27-15.14285.87-37.88	6.160		.710E	6.87 0.30M		7.17 1.81	G5 IV		
7242177873	16203283.23-17.86286.22-40.58	4.580		1.080	5.66 1.04		6.70 0.00	K0		
7254178253	16222283.79-15.30286.52-37.98	4.100		.050	4.15 0.08		4.23 1.54	A2 N		
7255178254	0283.57-17.22286.55-39.91	6.420		1.100E	7.52 1.03M		8.55 0.00	K1 G		
7259178345	16228283.71-16.74286.65-39.42	4.100		1.200	5.30 1.07		6.37 2.21	G5		
7268178628	0283.96-16.43286.90-39.08	6.240		.050E	6.29 0.05M		6.34 0.00	A P		
7273178937	16251284.38-15.06287.20-37.67	6.570		1.020E	7.59 0.70M		8.29 0.00	G2 G		
7348181869	16392286.29-18.37290.11-40.71	3.960		-.110	3.85-0.32		3.53 0.00	B9 II		
7422184035	0288.42-18.11292.68-40.14	5.900		.090E	5.99 0.09M		6.08 0.00	A2		
7464185257	16660289.67-17.71294.13-39.55	6.610		.230E	6.84 0.19M		7.03 1.61	A2		
7491186042	0290.77-15.97295.07-37.65	6.160		-.090E	6.07-0.30M		5.77 0.00	B8		
7552187474	16877291.96-18.57297.11-40.00	5.300		-.050	5.25-0.23		5.02 0.00	A P		
7605188642	16988293.51-17.02298.59-38.19	6.540		.400E	6.94-0.04M		6.90 1.58	F6 V		
7623189103	17027294.52-14.38299.12-35.41	4.350		-.150	4.20-0.66		3.54 1.24	B3 IV		
7624189118	0294.66-13.81299.15-34.83	5.340		.080E	5.42 0.08M		5.50 0.00	A		
7629189195	0294.11-16.77299.24-37.83	5.946		.957E	6.94 0.77M		7.71 0.00	K0		
7652189831	17089294.72-17.14300.06-38.08	4.760		1.410	6.17 1.68		7.85 0.00	M0		
0189931	17101294.83-17.09300.18-38.01	6.930		.600	7.53 0.14		7.67 0.00	G6		
7703191408	0296.69-15.65301.98-36.22	5.320		.870E	6.19 0.74M		6.93 0.00	K3 V		
7728192472	0297.66-16.28303.78-36.62	6.480		1.560E	8.04 1.50M		9.54 0.00	M4		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
7729	192486	17491	297.98	-15.05	303.31	-35.35	6.530	.370E	6.90	-0.05M	6.85	1.56	F2 V		
7765	193302	0	298.77	-15.71	304.41	-35.82	6.510	1.000E	7.51	0.80M	8.31	0.00	K2		
7808	194433	0	299.56	-17.70	305.91	-37.57	6.240	.960E	7.20	0.77M	7.97	0.00	K2 [illegible]		
7817	194783	0	300.41	-16.05	306.30	-35.77	6.220	.000E	6.22	0.00M	6.22	0.00	A0		
7893	196737	0	303.37	-14.56	309.30	-33.61	5.470	1.110E	6.59	1.08M	7.67	[illegible]	K2		
7935	197649	17970	303.84	-17.48	310.78	-36.30	6.460	.400E	6.88	-0.01M	6.87	1.60	F2		
7965	198232	18014	305.27	-15.44	311.71	-33.97	4.880	1.000	5.88	0.74	6.62	0.00	[illegible]		
7970	198356	0	305.94	-13.82	311.92	-32.23	6.460	1.350E	7.81	1.40M	9.21	0.00	K5		
7979	198529	18040	305.87	-14.98	312.22	-33.37	6.040	.030E	6.07	-0.01M	6.06	1.49	A2 [illegible]		
0	198752	18056	305.32	-17.97	312.63	-36.38	7.130	1.440E	8.57	1.65M	10.22	2.46	K3 III		
8031	199684	18154	306.62	-18.28	314.21	-36.32	6.100	.400E	6.50	-0.05M	6.45	1.57	F0		
8039	199951	18175	308.08	-14.66	314.56	-32.45	4.660	.890	5.55	0.54	6.09	0.00	[illegible]	A	
8076	200763	18251	309.13	-15.06	315.84	-32.54	5.180	1.100E	6.28	1.05M	7.33	[illegible]	[illegible]		
0	200973	18278	309.80	-13.92	316.18	-31.26	7.220	.460E	7.68	-0.05M	7.63	1.56	F[illegible] V-[illegible]		
8135	202627	18385	311.59	-15.64	318.73	-32.38	4.700	.070	4.77	0.01	4.78	0.00	A1 V		
0	202993	18404	312.65	-14.16	319.33	-30.65	7.370	1.440E	8.81	1.70M	10.51	[illegible]	[illegible]		
0	203448	18435	313.10	-14.71	320.02	-31.03	7.820	.570E	8.39	0.10M	8.49	0.00	[illegible]		
8214	204394	18500	314.22	-15.52	321.52	-31.46	6.500	.030E	6.53	0.07M	6.60	1.51	A0		
8230	204854	0	313.95	-18.30	322.31	-34.17	5.990	.060E	6.05	0.06M	6.11	0.00	A2 [illegible]		
8244	205265	0	315.97	-14.47	322.98	-29.91	6.560	-.090E	6.47	-0.30M	6.17	0.00	[illegible]		
8256	205529	18565	315.20	-17.77	323.45	-33.27	6.100	.220E	6.32	0.14	6.46	1.58	[illegible]		
8268	205672	0	315.45	-18.53	324.02	-33.91	6.280	.920E	7.20	0.55M	7.75	[illegible]	[illegible]		
8305	206742	18652	316.90	-18.33	325.49	-33.25	4.320	-.050	4.27	-0.10	4.17	0.00	[illegible]		
0	206868	18669	318.57	-14.35	325.66	-28.96	7.640	.400E	8.04	-0.02M	8.02	1.59	F2 V		
8326	207155	18690	318.26	-16.55	326.20	-31.13	5.000	.040E	5.04	0.04M	5.08	1.52	A2 [illegible]		
8365	208285	18757	320.08	-16.89	328.25	-30.84	6.410	.930E	7.34	0.66M	8.00	2.00	G5		
8386	209014	18806	321.92	-15.26	329.49	-28.69	5.420	-.100E	5.32	-0.36M	4.96	1.35	B8 V	[illegible]	
0	209336	18822	321.30	-18.25	330.09	-31.69	7.200	$ 1.480E	8.68	0.95M	9.63	2.15	[illegible] III		
8398	209335	18821	321.69	-16.82	330.10	-30.15	7.100	.320E	7.42	-0.05M	7.37	1.56	F0 IIIN		
8405	209476	18835	322.13	-16.91	330.38	-30.16	6.460	1.630E	8.09	1.80M	9.89	0.00	K5		
8408	209522	18844	323.33	-14.05	330.44	-27.07	5.950	-.150E	5.80	-0.66M	5.14	1.24	B5 V		
0	209740	18863	322.98	-15.93	330.85	-28.95	7.440	1.290E	8.73	1.37M	10.10	2.35	K2 III		
8446	210300	0	323.93	-15.85	331.79	-28.54	6.460	.080E	6.54	0.08M	6.62	0.00	A3		
8464	210739	18982	325.31	-14.27	332.54	-26.58	6.160	.170E	6.33	0.12M	6.45	1.57	A2		
0	210756	18985	325.28	-14.42	332.57	-26.74	7.630	1.010E	8.64	0.93M	9.57	2.14	K0		
8478	210934	19011	325.05	-15.71	332.67	-28.02	5.440	-.120	5.32	-0.36	4.96	0.00	B8 II		
8492	211291	19049	326.26	-14.16	333.45	-26.15	6.140	1.120E	7.26	1.01M	8.27	2.18	K0		
0	212231	19146	327.71	-14.66	335.11	-26.09	7.860	.610E	8.47	0.10M	8.57	1.68	G2		
8563	213135	19216	328.61	-16.38	336.74	-27.36	5.940	.340E	6.28	-0.05M	6.23	1.57	F0		
8570	213296	0	329.27	-15.53	337.03	-25.33	6.530	1.040E	7.57	0.89M	8.46	0.00	K0 G		
8596	213986	0	331.11	-14.00	338.21	-24.24	5.972	.988E	6.96	0.81	7.77	0.00	K0 G		
0	214385	19349	330.28	-17.42	338.65	-27.70	7.870	.630E	8.50	0.16M	8.66	0.00	G2 V		
8614	214462	19360	329.86	-18.67	338.99	-29.61	6.460	1.030E	7.49	0.90M	8.39	0.00	K0		
8619	214599	19375	330.25	-18.37	339.24	-28.59	6.300	1.010E	7.31	0.81M	8.12	2.08	K0 IV	A	
0	214600	19376	330.25	-18.39	339.25	-28.61	7.110	.470E	7.58	-0.03M	7.55	1.59	F5 V	AC	
8628	214748	19399	330.98	-17.26	339.47	-27.30	4.200	-.110	4.09	-0.33	3.76	0.00	B8 V		
8674	215782	19531	333.01	-16.87	341.30	-26.17	6.300	.910E	7.21	0.54M	7.75	1.93	G5 III		
0	217004	19676	335.06	-17.93	343.77	-26.37	7.370	.680E	8.05	0.18M	8.23	1.74	G0	A	
8743	217303	0	335.96	-17.28	344.35	-25.43	5.651	1.255E	6.91	1.20M	8.11	0.00	K0 G		
0	217357	19713	337.10	-14.88	344.41	-22.79	7.890	1.390	9.28	1.24	10.52	0.00	M A		
8746	217358	0	335.82	-17.73	344.42	-25.90	6.440	1.100E	7.54	1.03M	8.57	0.00	K1 G		
8756	217498	0	337.22	-15.23	344.67	-23.07	6.320	.060E	6.38	0.06M	6.44	0.00	A2		
8789	218240	19788	337.99	-16.58	346.00	-24.01	4.460	.900	5.36	0.58	5.94	0.00	GG9	AB	
8812	218594	19821	339.67	-14.49	346.70	-21.44	3.670	1.220	4.89	1.24	6.13	0.00	K0 II		
8817	218640	19827	339.23	-15.71	346.81	-22.73	4.690	.660	5.35	0.39	5.74	1.78	GG2	AB	
0	219339	19881	339.40	-18.39	348.16	-25.12	7.260	.170E	7.43	0.15M	7.58	1.59	A5 V		

YALE HD	PHOELC λ β α δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
8892220321	20042343.11-14.78350.09-20.37	3.950	1.100	5.05	0.95	6.00	0.00	[illegible]		
8906220704	20106343.56-15.58350.66-20.92	4.350	1.480	5.83	1.83	7.66	2.54	[illegible]		
8932221357	0344.50-16.77352.27-21.64	6.310	.320E	6.63	0.14M	6.77	0.00	[illegible]		
8939221565	20249345.05-16.52352.67-21.19	4.690	.020	4.71	-0.02	4.69	0.00	[illegible]		[illegible]
0222332	20344345.76-18.61354.27-22.81	7.290	.120E	7.41	0.05M	7.46	1.53	[illegible]		
8980222547	0348.12-14.69354.74-18.31	5.344	1.572E	6.92	1.93M	8.85	0.00	[illegible]		
8982222574	20376348.26-14.51354.79-18.09	4.800	.820	5.62	0.47	6.09	0.00	[illegible]		[illegible]
8998222847	20409348.61-15.17355.40-18.55	5.300	-.100	5.20	-0.28	4.92	0.00	[illegible]		
9002223024	20417348.84-15.71355.85-18.96	5.290	.280E	5.57	0.17M	[illegible].74	[illegible]			
9031223640	20475349.94-16.45357.19-19.19	5.170	-.169	5.00	-0.43	4.57	0.00	[illegible]		
0223785	20493350.39-16.26357.52-18.84	6.810	.090F	6.90	0.08M	6.98	1.66			
9065224481	20582352.54-14.35358.95-16.13	6.250	1.080	7.33	1.04	8.37	0.00	[illegible]		

YALE	HD	PHOELC	λ	β	α	δ	V	B−V	B	U−B	U	(U−B)C	SPTYPE	VAR	MULT
13	344	49	346.61	-31.23	1.38	-33.81	5.680	1.120E	6.80	1.05M	7.85	2.20	K0		
35	739	110	346.52	-33.00	2.30	-35.41	5.250	.440E	5.69	-0.02M	5.67	1.59	F4 V		
54	1089	166	347.34	-33.11	3.11	-35.18	6.170	1.340E	7.51	1.60M	9.11	2.44	K0		
57	1187	179	349.50	-30.16	3.41	-31.72	5.660	1.350E	7.01	1.55M	8.56	2.42	K5 III		
84	1737	256	351.96	-28.50	4.75	-29.26	5.180	1.000E	6.18	0.84M	7.02	2.09	G5		
89	1909	278	351.27	-30.49	5.18	-31.31	6.540	-.060E	6.48	-0.30M	6.18	1.36	B9		
105	2479	340	351.23	-32.70	6.36	-33.28	4.810	1.640E	6.45	1.80M	8.25	2.52	M5		
116	2632	365	352.14	-32.10	6.83	-32.39	6.570	1.340E	7.91	1.60M	9.51	2.44	K0		
139	3059	424	354.38	-30.21	7.80	-29.83	5.550	1.270E	6.82	1.29M	8.11	2.31	K2 III		
0	4208	600	358.38	-28.57	10.49	-26.79	7.780	.670E	8.45	0.15M	8.60	1.73	G5 V		
0	4673	652	357.71	-31.45	11.38	-29.62	7.580	.320E	7.90	-0.02M	7.88	1.59	F0 III		AB
0	5133	772	358.30	-32.84	12.64	-30.63	7.150	.950E	8.10	0.68M	8.78	2.03	K3 V		
268	5445	842	0.37	-30.84	13.38	-28.05	6.100	1.670E	7.77	1.96M	9.73	2.58	M		
0	5524	865	1.80	-28.76	13.59	-25.63	7.190	.140	7.33	0.10	7.43	0.00	A5 V		
280	5737	907	360.14	-32.52	14.05	-29.63	4.300	-.140	4.16	-0.52	3.64	0.00	[illegible]		
0	5934	952	2.48	-29.48	14.53	-26.02	7.340	1.030E	8.37	0.73M	9.10	2.04	[illegible]		
300	6269	1026	1.13	-33.13	15.23	-29.79	6.280	.930E	7.21	0.60M	7.81	1.96	G5 IV		
320	6559	0	4.65	-28.46	15.92	-24.27	6.144	1.089E	7.23	1.00M	8.23	[illegible]	[illegible]		
325	6668	1138	4.91	-28.57	16.20	-24.26	6.360	.170	6.53	0.09	6.62	0.00	[illegible]		
0	6722	1151	3.10	-31.95	16.31	-27.99	7.980	1.090E	9.07	0.86M	9.93	2.09	[illegible]		
0	7629	1351	6.96	-29.41	18.37	-24.24	7.130	.300E	7.43	-0.03M	7.40	1.58	F0 III		
0	7908	1401	8.03	-28.79	19.00	-23.28	7.270	.280E	7.55	0.07M	7.62	1.54	A7 III		
0	7931	1408	5.11	-33.94	19.04	-29.00	7.890	1.030E	8.92	0.90M	9.82	2.17	K0 IV-V		
0	8144	1439	5.42	-34.35	19.51	-29.25	7.370	1.080E	8.45	0.94M	9.39	2.14	K0 III-		
0	8487	1475	8.60	-30.50	20.30	-24.61	6.650	.240E	6.89	0.17M	7.06	1.60	A7 Vn		AB
0	9063	1562	9.62	-31.42	21.61	-25.06	7.020	.250E	7.27	0.16M	7.43	1.57	[illegible]		
433	9132	1569	11.37	-28.63	21.80	-21.89	5.100	.010	5.11	0.02	5.13	0.00	[illegible]		
436	9228	1580	9.28	-32.85	22.01	-26.47	5.920	1.340E	7.26	1.48M	8.74	2.39	[illegible]		
0	9411	1611	11.00	-30.70	22.44	-23.90	7.240	.260E	7.52	-0.03M	7.49	1.55	F0 V		
0	9451	1613	9.56	-33.34	22.49	-26.81	7.660	.300E	7.96	0.16M	8.12	1.59	A7 IV		A
0	9540	1621	11.01	-31.29	22.72	-24.43	6.960	.770E	7.73	0.41M	8.14	1.86	G8 V		
0	9673	1642	9.61	-34.26	22.99	-27.62	7.920	.230	8.15	0.06	8.21	0.00	A5 V		
473	10148	0	13.78	-29.21	24.12	-21.53	5.680	.120E	5.80	0.08M	5.88	0.00	A4 [illegible]		
474	10161	1702	11.93	-32.60	24.12	-25.28	6.740	-.090	6.65	-0.17	6.48	0.00	A0		A
0	10254	1716	13.24	-30.80	24.38	-23.17	7.260	1.640E	8.90	1.93M	10.83	2.57	M5 III		
514	10830	1788	13.58	-33.29	25.83	-25.30	5.300	.400E	5.70	-0.03M	5.67	1.58	F1 V		AB
0	10998	1615	16.13	-29.65	26.32	-21.04	6.550	1.390E	7.94	1.62M	9.56	2.45	K0		
565	11930	0	17.55	-32.05	28.58	-22.78	4.850	1.420E	6.27	1.66N	7.93	0.00	GK4		
583	12255	2023	19.13	-30.78	29.35	-21.07	5.410	1.620	7.03	2.00	9.03	0.00	MA		
585	12274	2025	19.07	-31.04	29.41	-21.32	3.960	1.570	5.55	1.95	7.50	0.00	MA		
0	12369	2043	17.63	-34.15	29.60	-24.66	7.040	1.420E	8.46	1.65N	10.11	2.46	K2		
625	13215	0	22.76	-28.82	31.69	-16.02	6.260	1.540E	7.60	1.70N	9.50	0.00	M1		
651	13692	0	22.38	-32.17	32.67	-21.23	5.864	1.010E	6.87	0.78N	7.66	0.00	G6 G		
0	13730	2241	21.55	-33.91	32.73	-23.11	7.210	.970E	8.18	0.70N	8.88	2.02	G8 IV		
693	14728	2460	26.18	-29.91	34.93	-17.89	5.890	1.250	7.14	1.40	8.54	0.00	K0		
697	14830	2471	26.10	-30.63	35.15	-18.58	6.220	.940E	7.16	0.65N	7.81	1.99	G5		
710	15144	2495	28.16	-28.10	35.91	-15.57	5.660	.130	5.99	0.12	6.11	0.00	A2		A
713	15220	2499	26.29	-32.52	36.07	-20.27	5.870	1.260E	7.13	1.16M	8.29	0.00	K0		
740	15798	2563	29.76	-28.53	37.43	-15.46	4.770	.460	5.23	-0.03	5.20	0.00	F5		
745	15996	2574	28.14	-33.10	37.84	-20.22	6.190	1.100E	7.29	1.00M	8.29	2.18	K0		
796	16825	0	32.17	-28.70	39.80	-14.77	5.978	.420E	6.41	-0.02M	6.38	0.00	F7 [illegible]		
811	17081	2717	33.41	-28.25	40.41	-14.07	4.220	-.130	4.09	-0.43	3.66	0.00	B5 V		
818	17206	2729	31.75	-32.75	40.69	-18.78	4.460	.480	4.94	-0.01	4.93	0.00	F6 V		
0	19467	3026	39.53	-30.00	46.24	-13.95	6.940	.640	7.58	0.12	7.70	0.00	DG5		
957	19887	3082	39.76	-32.45	47.24	-16.21	6.060	1.210	7.27	1.31	8.58	0.00	K0		
0	21161	3289	43.46	-33.07	50.52	-15.83	7.510	.610E	8.12	0.13M	8.25	0.00	G0		AB

d) $\beta = -31^\circ.2 \pm$ [illegible]

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
0	21252	3297	43.92	-32.54	50.73	-15.21	7.970	.670E	8.64	0.10H	8.74	1.69	DG0		
1050	21530	3333	45.93	-29.15	51.41	-11.46	5.730	1.100E	6.83	1.07H	7.90	2.21	K2		
1062	21688	3361	45.90	-30.59	51.81	-12.85	5.550	.110	5.66	0.14	5.80	0.00	A2		
1091	22243	3426	48.14	-28.22	53.05	-10.03	6.240	.020	6.26	0.00	6.26	1.50	A1		
1098	22409	3448	48.10	-29.59	53.39	-11.36	5.570	.910E	6.48	0.60H	7.08	1.96	G7		
1117	22799	0	49.27	-29.10	54.26	-10.61	6.350	.800E	7.15	0.40H	7.55	0.00	G5		
1120	22905	3495	47.98	-33.76	54.47	-15.39	6.330	.880E	7.21	0.56H	7.77	1.94	G5		
1125	23010	3513	49.35	-30.52	54.71	-11.96	6.460	.370E	6.85	-0.01H	6.84	1.60	F2		
1136	23249	3549	50.51	-28.69	55.21	-9.93	3.550	.920	4.47	0.69	5.16	0.00	K0		*
1139	23281	3557	50.38	-29.40	55.29	-10.64	5.560	.240E	5.82	0.12H	5.94	1.58	A3		
1162	23614	3634	50.61	-31.13	55.94	-12.26	4.470	S 1.640E	6.06	2.00H	8.06	2.58	M2	VAR	
1217	24712	3838	53.15	-31.67	58.23	-12.24	5.990	.330E	6.32	0.17H	6.49	1.60	GA9		
0	24834	3856	53.05	-33.20	58.53	-13.74	6.410	1.660	8.07	2.15	10.22	0.00	[illegible]		
1225	24832	3855	54.18	-29.47	58.56	-9.89	6.190	.280E	6.47	-0.04H	6.43	1.55	F0		
1231	25025	3879	53.51	-33.21	58.92	-13.65	2.950	1.570	4.52	1.98	6.50	0.00	[illegible]		
1235	25165	3903	54.20	-32.38	59.29	-12.71	5.600	1.480E	7.08	1.83H	8.91	2.53	K5		*
1265	25723	4008	55.51	-32.88	60.51	-12.93	5.610	1.080E	6.69	0.95H	7.64	2.14	K0 C		
1272	25910	4035	56.97	-29.12	60.88	-8.99	6.260	.060	6.32	0.08	6.40	1.54	[illegible]		
1293	26464	4078	58.32	-29.35	62.10	-8.95	5.690	1.060	6.75	0.94	7.69	0.00	[illegible]		
1318	26846	4127	58.98	-30.93	63.00	-10.38	4.860	1.180	6.04	1.14	7.18	0.00	K3 II		A
1325	26965	4139	59.87	-28.39	63.24	-7.73	4.480	.820	5.30	0.45	5.75	0.00	G5		A
1363	27563	4207	61.35	-28.63	64.57	-7.71	5.840	-.130	5.71	-0.48	5.23	0.00	B8		
1423	28497	4330	62.53	-34.38	66.70	-13.16	5.900	-.200	5.70	-0.89	4.81	0.00	B1 E		
1447	28970	0	64.24	-32.34	67.75	-10.89	6.064	1.380E	7.44	1.45H	8.90	0.00	K0		
1449	29009	4400	65.19	-28.37	67.87	-6.84	5.710	-.130	5.58	-0.45	5.13	0.00	B9		
1451	29064	4408	64.99	-29.85	67.95	-8.33	5.100	1.700E	6.80	2.01H	8.81	0.00	M3	VAR	
1452	29065	4409	64.84	-30.58	67.95	-9.07	5.270	1.460	6.73	1.70	8.43	0.00	K4 II		
1450	29063	4407	65.26	-28.49	67.95	-6.94	6.090	1.380	7.47	1.64	9.11	0.00			
1460	29173	0	64.98	-31.40	68.21	-9.85	6.370	.110E	6.48	0.10H	6.58	0.00	A0		
0	29172	4433	64.99	-31.39	68.22	-9.84	6.360	.110	6.47	0.09	6.56	0.00	A2		
1483	29573	4481	65.56	-33.89	69.14	-12.22	5.010	.070E	5.08	0.04H	5.12	1.54	A2		
1505	30020	4540	67.53	-30.79	70.29	-8.89	6.820	S .390	S 7.21	0.16	S 7.37	0.00	G5 II		A
1506	30021	4539	67.54	-30.79	70.30	-8.69	6.700	S .920	S 7.62	0.61	S 8.23	0.00	G6 II		A
1508	30076	4549	67.73	-30.52	70.42	-8.60	5.920	-.110	5.81	-0.83	4.98	0.00	B15E		
1608	32008	0	71.97	-32.79	74.37	-10.34	5.364	.798E	6.18	0.35H	6.53	0.00	G40		
1614	32147	4830	72.86	-28.32	74.58	-5.81	6.210	1.060	7.27	1.00	8.27	0.00	K0		
1617	32249	4836	72.65	-29.77	74.75	-7.25	4.800	-.200	4.60	-0.71	3.89	0.00	B2 V		
1671	33224	4941	74.63	-31.44	76.48	-8.73	5.770	-.060	5.71	-0.35	5.36	0.00	B8		
1679	33328	4952	74.87	-31.55	76.69	-8.82	4.270	-.210	4.06	-0.89	3.17	0.00	B2		
1697	33833	4990	76.21	-28.96	77.59	-6.12	5.890	.960	6.85	0.73	7.58	0.00	G07		
1704	33948	5002	76.21	-31.05	77.79	-8.20	6.360	-.140	6.22	-0.53	5.69	0.00	A0		
1713	34085	5016	76.48	-31.13	78.03	-8.26	0.080	-.030	0.05	-0.69	-0.64	0.00	B8 IA		A
1735	34503	5047	77.49	-29.85	78.79	-6.90	3.560	-.110	3.45	-0.46	2.99	0.00	B8 II		A
1759	34880	5086	78.44	-28.43	79.50	-5.42	6.380	-.030	6.35	-0.36	5.99	0.00	B9		A
1778	35281	5127	78.99	-31.52	80.23	-8.46	5.990	-.040	5.95	-0.36	5.59	0.00	A0		A
1784	35369	5141	79.22	-30.93	80.38	-7.85	4.140	.960	5.10	0.69	5.79	0.00	G8 II		A
1799	35536	5161	79.33	-33.46	80.67	-10.37	5.600	1.560E	7.16	1.80H	8.96	0.00	K5 G		
1806	35640	5174	80.01	-28.68	80.90	-5.56	6.240	-.050	6.19	-0.23	5.96	0.00	B9		
0	36120	5258	80.86	-29.00	81.67	-5.83	7.960	-.030	7.93	-0.36	7.57	0.00	B9		
0	36151	5265	80.84	-30.47	81.75	-7.30	6.710	-.130	6.58	-0.57	6.01	0.00	B5 V		A
1840	36285	5286	81.09	-30.66	81.98	-7.47	6.330	-.170	6.16	-0.86	5.30	0.00	B15V		
0	36379	5305	81.10	-33.30	82.16	-10.11	6.910	.560E	7.47	0.05H	7.52	1.65	G0		
1848	36430	5319	81.44	-29.95	82.23	-6.74	6.230	-.150	6.08	-0.77	5.31	0.00	B3		
0	36487	5332	81.51	-30.29	82.32	-7.08	7.810	-.110	7.70	-0.54	7.16	0.00	B8		
1855	36512	5339	81.56	-30.55	82.38	-7.34	4.590	-.270	4.32	-1.11	3.21	0.00	B0 V		
0	36541	5347	81.65	-29.96	82.42	-6.74	7.690	-.080	7.61	-0.45	7.16	0.00	B9		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
0	36843	5445	82.41	-28.09	82.98	-4.84	6.600	.180	6.98	0.11	7.09	0.00	[illegible]		
1886	36959	5489	82.52	-29.30	83.14	-6.04	5.670	-.220	5.45	[illegible]	[illegible]	[illegible]			
1887	36960	5488	82.53	-29.29	83.15	-6.03	4.770	-.250	4.52	-1.04	[illegible]	[illegible]			
0	36981	5494	82.59	-28.50	83.16	-5.24	7.600	-.120	7.68	-0.59	7.09	0.00	[illegible]		
0	37000	5502	82.57	-29.22	83.18	-5.96	7.490	-.130	7.36	-0.67	[illegible]	[illegible]			
1893	37020	5511	82.63	-28.68	83.20	-5.42	6.750	.060	6.81	-0.92	5.89	0.00	[illegible]		
1895	37022	5512	82.63	-28.68	83.20	-5.42	5.140	.060	5.20	-0.97	4.23	0.00	[illegible]	[illegible]	
0	37025	5515	82.59	-29.32	83.20	-6.06	7.170	-.120	7.05	-0.63	[illegible]	0.00	[illegible]		
1894	37021	0	82.64	-28.68	83.21	-5.42	7.960	-.240E	7.72	-0.49M	[illegible]	[illegible]	[illegible]		
1896	37023	5513	82.64	-28.68	83.21	-5.42	6.700	-.110	[illegible]	-0.64	[illegible]	[illegible]	[illegible]		
1892	37018	5509	82.69	-28.14	83.23	-4.87	4.590	-.200	4.39	-0.94	3.45	0.00	[illegible]		
1897	37041	5523	82.66	-28.72	83.23	-5.45	5.190	-.160	5.03	-0.95	4.08	0.00	[illegible]		
0	37042	5524	82.68	-28.72	83.25	-5.45	6.380	-.100	6.28	-0.94	5.34	0.00	[illegible]		
1899	37043	5526	82.65	-29.21	83.25	-5.94	2.740	-.250	2.49	-1.11	1.38	0.00	[illegible]		
0	0	0	82.74	-28.14	83.27	-4.87	8.350	.000	8.35	[illegible]	[illegible]	[illegible]			
1901	37077	5539	82.77	-28.16	83.30	-4.89	5.270	.230	5.50	[illegible]	5.67	0.00			
0	37115	5559	82.79	-28.92	83.36	-5.65	7.030	-.010	7.02	[illegible]	[illegible]	[illegible]	[illegible]		
0	37151	5574	82.76	-30.70	83.42	-7.43	7.400	-.080	7.32	-0.40	6.32	0.00	[illegible]		
1906	37150	5573	82.90	-28.96	83.45	-5.68	6.500	-.160	6.34	-0.82	5.52	0.00	[illegible]		
1911	37209	5595	82.97	-29.37	83.54	-6.09	5.710	-.230	5.48	-0.93	4.55	0.00	[illegible]		
1918	37303	5633	83.22	-29.26	83.75	-5.97	6.020	-.200	5.82	-0.96	4.86	0.00	[illegible]		
0	37334	5647	83.32	-28.25	83.79	-4.96	7.190	-.170	7.02	-0.77	6.25	0.00	[illegible]		
1923	37356	5655	83.40	-28.14	83.85	-4.84	6.210	-.050	6.16	-0.73	5.43	0.00	[illegible]		
0	37444	5688	83.55	-28.37	84.00	-5.07	7.640	.330	7.97	0.17	8.14	0.00	[illegible]		
1933	37481	5705	83.53	-29.91	84.05	-6.60	5.960	-.230	5.73	-0.92	4.81	0.00	[illegible]		
1937	37507	5710	83.57	-30.55	84.12	-7.24	4.790	.130	4.92	0.11	5.03	0.00	[illegible]		
0	37526	5716	83.70	-28.53	84.14	-5.22	7.610	-.120	7.49	-0.56	6.93	0.00	[illegible]		
1942	37635	5744	83.63	-33.04	84.29	-9.73	6.480	-.110	6.37	-0.46	5.91	0.00	[illegible]		
1957	37808	5802	83.96	-33.7[illegible]	84.60	-10.43	6.360	-.160	6.20	-0.53	5.67	0.00	[illegible]		
0	37889	5820	84.30	-30.30	84.74	-6.96	7.670	-.120	7.55	-0.70	6.85	0.00	[illegible]		
1967	38089	5851	84.74	-30.17	85.12	-6.82	5.960	.440	6.40	-0.04	6.36	0.00	F5		
2001	38735	5929	85.93	-33.94	86.27	-10.55	6.030	.160E	6.19	0.17M	6.36	1.60	[illegible]		AB
0	38755	5931	86.16	-29.84	86.34	-6.45	7.680	-.110E	7.57	-0.46M	7.11	0.00	[illegible]		
2004	38771	5932	86.05	-33.08	86.35	-9.69	2.040	-.180	1.86	-1.06	0.80	0.00	[illegible]		
2031	39291	5976	87.16	-30.95	87.24	-7.53	5.350	-.220	5.13	-0.82	4.31	0.00	[illegible]		
2039	39421	5985	87.35	-32.47	87.44	-9.05	5.960	.100	6.06	0.07	6.13	0.00	[illegible]		
2070	39910	6036	88.38	-28.05	88.24	-4.62	5.860	1.180	7.04	1.21	8.25	0.00	[illegible]		
2071	39927	6038	88.40	-28.22	88.23	-4.79	6.270	.060	6.33	0.06	6.39	0.00	[illegible]		
2107	40535	0	89.36	-32.82	89.16	-9.38	6.110	.290E	6.40	0.10M	6.50	0.00	FOIIIVAR		
2108	40536	6082	89.37	-33.00	89.17	-9.56	5.020	.200	5.22	0.12	5.34	0.00	[illegible]		
2128	40967	6119	90.19	-34.05	89.87	-10.60	4.940	-.120	4.82	-0.59	4.23	0.00	[illegible]		
2142	41335	6147	90.87	-30.16	90.45	-6.71	5.200	-.060	5.14	-0.86	4.28	0.00	[illegible]		
2150	41547	6164	91.26	-33.68	90.77	-10.24	5.870	.360E	6.23	-0.01M	6.22	1.60	[illegible]		
2179	42278	6211	92.39	-29.13	91.79	-5.70	6.160	.350	6.51	-0.02	6.49	0.00	F0		
2195	42536	6233	92.82	-30.17	92.15	-6.74	6.150	.010E	6.16	-0.03M	6.19	1.49	A0		
2202	42657	6242	92.96	-28.08	92.31	-4.65	6.160	-.080	6.08	-0.36	5.72	0.00	B9		
2205	42690	6246	93.06	-29.96	92.36	-6.54	5.050	-.220	4.83	-0.77	4.06	0.00	B3 IV		AB
0	42911	6265	93.40	-28.41	92.69	-4.99	7.340	1.020E	8.36	0.85M	9.21	2.10	DG7		
2227	43232	6288	93.90	-29.67	93.10	-6.26	3.980	1.320	5.30	1.41	6.71	2.38	K3 II		A
2234	43319	6296	94.04	-28.30	93.26	-4.90	5.960	.060	6.06	0.09	6.15	0.00	A2		AB
2237	43362	6298	94.16	-32.42	93.26	-9.02	6.090	-.080	6.01	-0.30	5.71	0.00	B9		AB
2255	43760	6330	94.87	-34.10	93.81	-10.71	6.740	.380E	7.12	0.02M	7.14	1.63	GF2		
2267	43993	6356	95.18	-32.75	94.12	-9.37	5.350	1.240	6.59	1.32	7.91	0.00	GK1		
2270	44037	6361	95.22	-31.94	94.18	-8.56	6.210	-.040	6.17	-0.13	6.04	0.00	B9		
2273	44112	6364	95.36	-31.17	94.33	-7.80	5.240	-.200E	5.04	-0.74M	4.30	0.00	B2 V		
2301	44816	6402	96.60	-33.18	95.31	-9.65	6.180	1.840	8.02	2.04	10.06	0.00	K5		

YALE	HD	PHOELC	λ	β	κ	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	
2321	45239	6424	97.17	-31.17	95.89	-7.86	6.400	.150	6.55	0.11	6.66	0.00	A2		
-2328	45380	6433	97.37	-30.78	96.08	-7.48	6.260	-.040	6.22	-0.09	6.13	0.00	A0		
2344	45546	6449	97.54	-28.02	96.37	-4.73	5.060	-.190	4.87	-0.75	4.12	1.21	[illegible]		
2356	45725	6464	97.94	-30.27	96.60	-7.00	4.600	$ -.100	$ 4.50	-0.63	$ 3.87	0.00	B3		
-2358	45727	0	97.94	-30.27	96.60	-7.00	5.400	-.070E	5.33	-0.52M	4.81	0.00	B3		
2357	45726	6465	97.94	-30.27	96.60	-7.00	4.970	$ -.290E	4.68	-0.93M	3.75	0.00	[illegible]		
2367	45976	6478	98.56	-33.30	96.96	-10.05	5.920	1.380E	7.30	1.35M	8.65	0.00	K0		
2381	46229	6502	98.89	-31.35	97.36	-8.12	5.420	1.370	6.79	1.52	8.31	0.00	[illegible]		
2386	46304	6507	98.87	-29.06	97.48	-5.83	5.590	.260	5.85	0.05	5.90	0.00	A5		
-2392	46407	6517	99.40	-34.34	97.61	-11.13	6.260	1.110	7.37	0.66	8.03	0.00	[illegible]		
2418	47054	6562	100.01	-28.33	98.53	-5.17	5.520	-.090	5.43	[illegible]	[illegible]	[illegible]			
2469	48217	6645	101.91	-32.17	99.89	-9.12	5.180	1.540	6.72	1.69	8.41	[illegible]			
-2502	49147	6724	103.38	-33.00	101.07	-10.05	5.650	-.050	5.60	-0.10	5.50	0.00	[illegible]		
2508	49331	6737	103.54	-31.87	101.31	-8.94	5.060	1.800	6.86	1.87	8.73	0.00	[illegible]		
0	49787	6764	103.80	-28.34	101.87	-5.45	7.540	-.050	7.49	-0.80	6.69	0.00			
-2534	49976	6778	104.31	-30.84	102.07	-7.98	6.240	-.020E	6.26	-0.01M	6.27	0.00	[illegible]		
2552	50282	6806	104.47	-28.09	102.48	-5.25	6.290	.980	7.27	0.77	8.04	[illegible]			
-2570	50700	6827	105.02	-28.58	102.92	-5.79	6.400	.170	6.57	0.14	[illegible]	[illegible]			
2599	51424	6862	106.13	-30.81	103.65	-8.11	6.330	.640	6.97	0.25	7.22	[illegible]			
0	52266	6899	106.76	-28.38	104.47	-5.76	7.230	-.010	7.22	-0.90	6.32	0.00	O9	V	
-2624	52312	6902	107.14	-30.94	104.50	-8.34	5.950	-.080	5.87	-0.33	5.54	0.00	A0		
2627	52382	6907	107.33	-31.72	104.57	-9.13	6.460	.220	6.70	-0.78	5.92	0.00	B2		
0	52721	6924	107.98	-33.77	104.87	-11.23	6.590	.060	6.65	-0.78	5.87	0.00	[illegible]		
-2639	52665	6920	107.20	-28.23	104.87	-5.65	5.200	1.080	6.88	2.04	8.92	0.00	[illegible]		
2656	53240	6938	108.42	-32.53	105.40	-10.05	6.440	-.080	6.36	-0.30	6.06	0.00	B8		
0	53367	6915	108.59	-32.85	105.51	-10.38	6.970	.440	7.41	-0.59	6.82	0.00	[illegible]		
0	53456	6947	108.83	-33.90	105.57	-11.45	7.220	.000E	7.22	-0.71*	6.51	1.22			
0	53667	6952	108.67	-31.10	105.80	-8.65	7.750	.240	7.99	-0.71	7.28	0.00			
-2670	53755	6960	109.04	-33.00	105.87	-10.58	6.460	-.050	6.43	-0.89	5.54	[illegible]			
2678	53974	6966	109.39	-33.61	106.08	-11.22	5.380	.050	5.43	-0.8[illegible]	4.2[illegible]	[illegible]			
0	54439	6977	109.98	-34.10	106.51	-11.77	7.710	.040	7.75	-0.77	6.98	[illegible]	[illegible]		
-2694	54662	6984	110.00	-32.58	106.74	-10.27	6.210	.030	6.24	-0.88	5.36	0.00			
0	54879	6992	110.49	-33.99	106.95	-11.72	7.650	.000	7.66	-0.86	6.80	0.00	[illegible]		
0	55135	7005	110.59	-32.58	107.24	-10.34	7.300	-.050	7.25	-0.60	6.65	0.00	[illegible]		
2723	55589	0	111.25	-33.32	107.69	-11.15	5.783	1.508E	7.29	1.76*	9.05	0.00	K0		
2732	55832	7042	111.35	-32.00	107.97	-9.86	5.900	1.520	7.42	1.70	9.12	0.00	[illegible]		
-2739	55879	7047	111.47	-32.36	108.02	-10.23	6.000	-.180E	5.82	-0.96M	4.86	-1.12	[illegible]		
2752	56207	0	111.89	-32.57	108.34	-10.49	5.954	1.176E	7.13	1.18*	8.31	0.00	[illegible]		
0	56495	7073	111.70	-29.52	108.63	-7.44	7.580	.339	7.92	0.06	7.98	0.00	A3		
0	56593	7080	112.56	-33.96	108.69	-11.94	6.720	.430	7.15	-0.06	7.09	0.00	F5		
2765	56614	7082	111.71	-28.65	108.77	-6.59	6.280	1.630	7.91	1.96	9.87	0.00	A2		
0	57386	7122	112.92	-30.25	109.58	-8.33	7.990	.010	8.00	-0.76	7.24	0.00	B2	E	
2798	57517	7128	113.16	-30.68	109.72	-8.78	6.540	.540	7.08	0.02	7.10	0.00	F5		
2806	57682	7139	113.40	-30.75	109.91	-8.88	6.440	-.190	6.25	-1.04	5.21	0.00	09	V	
-2859	59067	7222	115.58	-33.04	111.38	-11.45	5.780	-.560E	6.36	-1.00M	7.36	1.52	G8 I		AB
0	59211	7231	115.46	-31.53	111.55	-9.94	6.620	-.118	6.50	-0.57	5.93	0.00	B5		
2867	59381	7240	115.75	-31.77	111.75	-10.22	5.740	1.620E	7.36	1.97M	9.33	2.59	GK5	G	
-2866	59380	7239	115.20	-29.04	111.75	-7.45	5.860	.460	6.34	-0.04	6.30	0.00	DF9		
0	0	0	116.03	-31.17	112.10	-3.67	7.100	.000	7.10	0.00	7.10	0.00			5
0	59730	7261	116.16	-31.48	112.15	-10.00	6.580	1.622	8.20	2.00	10.20	0.00	K2		
2883	59984	7268	116.21	-30.22	112.42	-8.77	5.890	.540	6.43	-0.10	6.33	0.00	F5		A
0	60139	7273	116.51	-30.72	112.59	-9.30	7.360	1.420	8.78	1.63	10.41	0.00	K2		
0	60156	7275	116.06	-28.21	112.64	-6.76	7.290	1.120	8.41	-1.05	9.46	-0.00	K0		
2920	60853	7313	117.27	-29.48	113.47	-8.20	6.260	1.540	7.80	1.88	9.68	0.00	K2		
2958	61749	7375	118.44	-29.15	114.54	-8.07	6.010	.140	6.15	0.10	6.25	0.00	A2		
-2970	61935	7390	118.93	-30.46	114.71	-9.43	3.940	1.020	4.96	-0.88	5.84	0.00	K0 II		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
3019	63112	7502	121.24	-33.24	116.10	-12.55	6.380	-.020	6.36	-0.08	6.28	1.40			
3029	63336	0	121.46	-32.71	116.40	-12.07	5.482	.484E	5.97	-0.02M	5.94	0.00			
3042	63655	7546	122.20	-33.76	116.79	-13.23	6.120	-.090	6.03	-0.48	5.55	0.00			
3047	63752	7555	121.34	-29.65	116.94	-9.06	5.600	1.450	7.05	1.56	8.61	0.00			
3054	63894	0	122.03	-31.52	117.14	-11.01	6.320	.900E	7.22	0.70M	7.92	0.00			
3063	64077	0	122.69	-33.12	117.34	-12.69	6.460	.360E	6.82	0.03M	6.85	0.00			
3064	64096	7580	122.99	-34.16	117.36	-13.76	5.160	.600	5.76	0.06	5.82	0.00			
0	64259	7593	123.19	-34.09	117.54	-13.73	6.610	1.100	7.71	1.00	8.71	0.00			
0	67158	7758	125.83	-28.79	121.01	-9.09	7.930	-.030	7.90	-0.08	7.82	0.00			
3174	67159	7757	125.84	-28.80	121.01	-9.10	6.230	-.060	6.17	-0.12	6.05	0.00			
3189	67725	7781	127.10	-30.69	121.64	-11.19	6.310	.000E	6.31	-0.07M	6.24	1.46			
3202	68146	7804	128.32	-32.96	122.09	-13.65	5.530	.490E	6.02	-0.02M	6.00	1.63			
3211	68290	7822	128.22	-32.09	122.23	-12.78	4.710	.950	5.66	0.71	6.37	0.00			
0	69530	7957	130.48	-33.88	123.64	-15.00	7.170	1.480E	8.65	[illegible]	10.35	2.18			
3259	69830	7967	130.10	-31.33	124.01	-12.46	6.000	.760	6.76	0.32	[illegible]	[illegible]			
3265	69997	7978	129.59	-28.91	124.21	-10.01	6.320	.330	6.65	0.14	6.79	0.00			
3289	70673	8019	131.44	-31.46	125.11	-12.89	5.960	1.000	6.96	0.93	7.89	0.00			
3320	71267	8055	132.92	-33.06	125.90	-14.77	5.970	.170E	6.14	0.12M	6.26	1.58			
3324	71377	8065	132.34	-30.71	126.08	-12.37	5.540	1.190	6.73	1.14	7.87	0.00			
3374	72462	8130	134.79	-32.69	127.56	-14.86	6.370	.280E	6.65	0.17M	[illegible]	[illegible]			
3431	73840	8325	135.93	-29.72	129.41	-12.30	4.960	1.430E	6.39	1.75M	8.14	2.50			
3441	74137	8391	137.61	-32.90	129.85	-15.76	4.870	1.050	5.92	0.92	6.84	0.00			
3446	74190	8403	136.34	-29.08	129.95	-11.79	6.440	.160	6.60	0.12	6.72	1.58	A2		
3484	74918	8502	138.00	-30.28	131.00	-13.36	4.310	.900	5.21	0.60	5.81	0.00	G8		
3529	75916	0	139.54	-29.51	132.54	-13.04	6.128	1.144E	7.27	1.14M	8.42	0.00			
3554	76376	8642	142.16	-34.05	133.23	-18.05	5.750	1.320E	7.07	1.50M	8.57	2.40			
3564	76579	8663	141.92	-32.50	133.56	-16.52	5.960	1.540E	7.50	1.87M	9.37	2.55			
3578	76932	8690	142.27	-31.78	134.10	-15.94	5.860	.530	6.39	0.08	6.47	0.00			
0	78558	8784	144.46	-30.07	136.52	-14.94	7.320	.610	7.93	0.01	7.94	0.00			
3638	78702	8795	145.91	-33.02	136.69	-18.13	5.726	.001E	5.73	0.06M	5.78	1.50			
3653	79181	8821	147.27	-34.09	137.42	-19.54	5.730	.980E	6.71	0.74M	7.45	2.04			
3675	79752	8858	146.23	-29.39	138.26	-14.82	6.050	.020	6.07	0.03	6.10	0.00			
3687	80050	8873	146.50	-28.82	138.69	-14.36	5.780	1.080	6.86	0.94	[illegible]	[illegible]			
3704	80479	8895	147.63	-29.80	139.30	-15.62	5.770	1.290E	7.05	[illegible]	8.34	[illegible]			
3714	80719	8921	147.90	-29.46	139.64	-15.40	6.330	.460E	6.79	[illegible]	[illegible]	[illegible]			
3763	82077	9052	152.25	-33.54	141.73	-20.53	5.660	1.600E	7.26	[illegible]	[illegible]	[illegible]			
3772	82232	9070	150.32	-28.63	142.00	-15.36	5.850	1.200E	7.05	1.28M	8.33	2.31			
3796	82573	9115	152.45	-32.02	142.50	-19.18	5.740	.140E	5.88	0.13M	6.01	1.56			
3808	82734	9126	153.45	-33.52	142.73	-20.89	5.010	1.020E	6.03	0.89M	6.92	[illegible]			
3822	83104	9150	153.36	-31.90	143.31	-19.36	6.310	.060E	6.37	0.10M	6.47	1.50	A1		
3921	85905	9299	159.53	-32.84	148.05	-22.25	6.230	.040	6.27	0.00	6.27	1.50	A2		
3923	85951	9300	158.00	-29.61	148.13	-18.77	4.940	1.540	6.48	1.95	8.43	[illegible]			
0	86083	9310	159.02	-31.13	148.36	-20.51	7.710	.590E	8.30	[illegible]	[illegible]	[illegible]			
3946	86612	9339	161.59	-33.74	149.20	-23.71	6.200	-.100	6.10	-0.68	5.42	1.26			
3965	87427	9405	162.87	-33.55	150.51	-24.0[illegible]	5.700	.300E	6.00	0.17M	6.17	1.60	[illegible]		
0	87870	9449	162.77	-31.61	151.30	-22.2	7.020	1.520E	8.54	1.30M	9.84	2.32	[illegible]		
0	87998	9455	161.69	-29.04	151.50	-19.5	7.260	.610	7.89	0.04	7.93	0.00	[illegible]		
4005	88595	9491	162.46	-28.08	152.56	-18.90	6.440	.500	6.94	0.00	6.94	1.62	[illegible]		
0	88806	9508	165.05	-32.19	152.95	-23.57	6.340	1.630E	7.97	1.90M	9.87	2.56	[illegible]		
4040	89169	9537	164.17	-29.07	153.60	-20.42	6.570	.480E	7.05	0.00M	7.05	1.62	F8 V		
0	89391	9548	167.46	-34.20	154.02	-26.25	7.940	.940E	8.88	0.66M	9.54	2.00	K0 IV		
4071	89816	9582	166.79	-31.38	154.78	-23.46	6.500	.200E	6.70	0.13M	6.83	1.58	A3		
4073	89828	9585	166.24	-30.30	154.81	-22.28	6.510	.070	6.58	0.00	6.58	1.50	A0		
0	89885	9593	165.41	-28.48	154.91	-20.32	7.110	1.170E	8.28	1.19M	9.47	2.27	[illegible] III		
0	90197	9628	167.90	-31.92	155.47	-24.35	7.090	.690	7.78	0.12	7.90	0.00	G0 V		
4125	91135	9695	170.47	-32.97	157.13	-26.23	6.500	.540E	7.04	0.08M	7.12	1.67	F5		

YALE	HD	PHOELC	λ	β	α	δ	V	B−V	B	U−B	U	(U−B)C	SPTYPE	VAR	MULT
4145	91550	9718	169.83	-30.19	157.91	-23.49	5.080	1.600E	6.68	1.90M	8.58	2.5[illegible]	[illegible]		
4149	91706	9726	169.77	-29.59	158.14	-22.92	6.100	.500E	6.60	0.02M	6.62	1.64	[illegible]		
4157	91881	9740	171.81	-32.62	158.43	-26.41	6.280	.480E	6.76	-0.06M	6.70	1.5[illegible]	[illegible]		
4162	92036	9758	172.47	-33.17	158.72	-27.15	4.890	1.620E	6.51	1.85M	8.36	2.54	[illegible]		
0	92860	9840	171.33	-28.20	160.12	-22.25	7.920	.430E	8.35	-0.04M	8.31	1.58	[illegible]		
0	93410	9907	174.00	-31.01	161.06	-25.78	6.700	1.030E	7.73	0.90M	8.63	0.00	K0		
4302	95698	10091	176.06	-30.15	165.00	-26.56	6.220	.320E	6.54	-0.04M	6.50	1.58	F1 [illegible]	AB	
4314	96202	10127	176.96	-30.28	165.73	-27.02	4.940	.350	5.29	0.04	5.33	0.00	F5	AB	
4317	96314	10136	179.11	-30.22	165.88	-27.02	5.800	-.060	5.74	-0.25	5.49	0.00	B9		
4320	96441	10145	180.03	-31.43	166.06	-28.46	6.760	.040E	6.80	0.05M	6.85	1.51	A0		
4328	96700	10169	181.10	-32.59	166.38	-29.90	6.530	.600E	7.13	0.06M	7.19	1.70	G2 [illegible]		
4331	96723	10172	181.07	-32.38	166.46	-29.70	6.480	.030	6.51	0.05	6.56	1.52	A0		
4334	96819	10175	180.17	-30.64	166.58	-27.81	5.430	.070	5.50	0.05	5.55	1.5[illegible]	[illegible]		
4339	97023	10188	182.77	-34.34	166.87	-32.10	5.800	.040E	5.84	0.03M	[illegible]	[illegible]			
0	97343	10213	179.91	-28.58	167.39	-25.86	7.060	.760	7.82	0.38	8.2[illegible]	[illegible]			
4346	97393	10217	183.34	-34.16	167.46	-32.16	6.470	1.740	8.21	1.75	9.96	0.00	[illegible]		
0	99332	10358	183.75	-28.48	170.81	-27.27	7.930	.320E	8.25	-0.06M	8.19	1.56	[illegible]		
4443	100286	0	186.10	-29.36	172.45	-28.99	5.860	.510E	6.37	0.04M	6.41	0.00	[illegible]		
4444	100287	0	186.10	-29.36	172.45	-28.99	5.780	.470E	6.25	0.03M	6.28	0.00			
4449	100393	10425	187.21	-30.92	172.61	-30.81	5.030	1.580E	6.61	1.95M	8.56	2.58	K2		
4450	100407	10427	187.64	-31.60	172.63	-31.58	3.530	.950	4.48	-0.71	5.19	0.00	G G7	A	
4458	100623	10441	188.52	-32.32	173.01	-32.57	5.980	.810	6.79	0.39	7.18	0.[illegible]			
4469	100893	10461	189.37	-32.76	173.52	-33.29	5.710	1.020E	6.73	0.85M	7.58	2.10	[illegible]		
0	100910	10463	190.00	-33.70	173.54	-34.37	7.570	.490E	8.06	-0.03M	8.03	1.58	F5		
4473	100953	10470	189.14	-32.20	173.63	-32.71	6.290	.460E	6.75	0.00M	6.75	1.5[illegible]	[illegible]		
4494	101431	10541	190.83	-33.44	174.43	-34.47	4.700	-.080	4.62	-0.21	4.41	0.00	B9		
4498	101563	10549	188.04	-28.43	174.66	-28.92	6.440	.660E	7.10	0.15M	7.25	1.72	[illegible]		
4503	101666	10553	189.91	-31.31	174.81	-32.22	5.200	1.480E	6.68	1.85M	8.53	2.59	[illegible]		
4524	102397	10616	192.98	-33.79	176.15	-35.63	6.160	.960E	7.12	0.75M	7.87	2.04	[illegible]		
4525	102438	10617	189.95	-28.80	176.19	-30.01	6.480	.680	7.16	0.24	7.40	0.00	[illegible]		
0	102540	10625	192.80	-33.10	176.39	-34.95	7.090	.770E	7.86	0.29M	8.15	1.7[illegible]			
0	102902	10659	192.20	-31.00	177.04	-32.86	7.340	.740E	8.08	-0.25M	8.3[illegible]	[illegible]			
4548	103026	10670	191.20	-28.95	177.29	-30.55	5.840	.550	6.39	0.05	6.44	[illegible]			
4552	103192	10679	193.10	-31.47	177.59	-33.63	4.260	-.100	4.18	-0.32	3.86	[illegible]	[illegible]		
4553	103266	10682	193.86	-32.44	177.73	-33.79	6.170	.080E	6.25	0.10M	6.35	1.57			
0	103391	10691	191.78	-28.68	177.91	-30.63	7.310	1.620E	8.93	1.88M	10.81	2.5[illegible]	[illegible] III		
4571	103789	10731	193.68	-30.54	178.63	-33.04	6.200	-.040E	6.16	-0.11M	6.05	1.44	[illegible]		
0	104471	10783	195.40	-31.27	179.80	-34.37	6.900	.590E	7.49	0.11M	7.60	1.70	G0	[illegible]	
4612	105078	10854	196.86	-31.80	180.84	-35.42	6.220	-.080E	6.14	-0.34M	5.80	1.35	B9	A	
4628	105686	10916	197.19	-30.54	181.86	-34.43	6.160	-.030E	6.19	-0.01M	6.18	1.49	A0	[illegible]	
4631	105776	10926	199.04	-33.28	181.99	-37.59	6.050	.210E	6.26	0.14M	6.40	1.58	A2		
4647	106198	0	197.56	-29.71	182.66	-33.84	6.500	1.620E	8.12	1.90M	10.02	0.00	[illegible]		
4648	106231	10977	200.24	-33.94	182.70	-38.65	5.750	-.140E	5.61	-0.59M	5.02	1.26	[illegible]		
4651	106257	0	197.46	-29.38	182.75	-33.51	6.330	.080E	6.41	0.00M	6.41	0.00	B9		
4675	106922	11041	199.57	-31.04	183.79	-35.82	6.140	.010E	6.15	-0.03M	6.12	1.48	A0	AB	
4712	107832	11126	200.42	-29.89	185.74	-35.14	5.310	-.080E	5.23	-0.25M	4.98	1.38	B9		
4713	107833	11127	202.55	-33.33	185.24	-39.03	6.390	.300E	6.69	0.17M	6.86	1.60	A5		
4714	107860	11131	202.35	-32.97	185.28	-38.63	5.780	-.080E	5.70	-0.18M	5.52	1.41	B9 N		
4724	108114	0	200.67	-29.52	185.68	-34.91	5.700	-.060E	5.64	-0.19M	5.45	0.00	B9		
4748	108541	11201	203.37	-32.66	186.43	-38.76	5.440	-.080E	5.36	-0.25M	5.11	1.38	B8		
4794	109536	11307	205.97	-33.75	188.26	-40.75	5.130	.220E	5.35	0.14M	5.49	1.58	A5		
4796	109573	11311	205.38	-32.70	188.33	-39.59	5.790	.010E	5.80	0.03M	5.83	1.52	A0	A	
4817	110073	11350	206.22	-32.46	189.29	-39.71	4.640	-.090	4.55	-0.39	4.16	0.00	A P		
4836	110575	11409	207.04	-32.31	190.18	-39.90	6.430	.260E	6.69	0.14M	6.83	1.58	A M		
0	110593	11411	207.69	-33.33	190.19	-41.05	7.140	1.590E	8.73	1.70M	10.43	2.48	M4 III		
0	110619	11417	205.78	-30.69	190.26	-37.43	7.520	.670E	8.19	0.12M	8.31	1.70	G5 V		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)c	SPTYPE	VAR	MULT
4838	110653	11423	205.13	-28.86	190.32	-36.08	6.380	-.060E	6.32	-0.25M	6.07	1.34	B8		
4879	111774	11563	208.48	-31.13	192.30	-39.41	5.980	-.100E	5.86	-0.35M	5.53	1.31	A7 II		
4889	111968	11598	209.04	-31.45	192.66	-39.91	4.260	.210	4.47	0.10	4.57	0.00	[illegible]		
4906	112213	11643	210.90	-33.71	193.13	-42.64	5.460	1.680E	7.14	2.01M	[illegible]	[illegible]	[illegible]		
4938	113523	11798	211.83	-31.38	195.49	-40.93	6.250	3 1.680E	7.93	1.90M	[illegible]	[illegible]	[illegible]		
4941	113778	11823	212.39	-31.58	195.94	-41.37	5.590	1.050E	6.64	0.91M	7.55	[illegible]	[illegible]		
4970	114435	11898	213.62	-31.78	197.07	-41.97	5.780	.520E	6.30	0.06M	[illegible]	[illegible]	F8 I		
4973	114474	11905	214.27	-32.77	197.13	-43.10	5.250	1.050E	6.30	0.91M	7.21	[illegible]	[illegible]		
4982	114707	11933	214.19	-32.05	197.49	-42.43	6.220	1.060E	7.28	0.91M	[illegible]	[illegible]	[illegible]		
4991	114873	11947	214.64	-32.36	197.77	-42.67	6.150	1.380E	7.53	1.67M	9.15	[illegible]	K5 II		
	0114921	11957	213.70	-30.61	197.85	-40.95	7.600	1.030E	8.63	0.74M	[illegible]	[illegible]	[illegible]		
5008	115331	11998	215.72	-32.85	198.58	-43.72	5.840	.190E	6.03	0.18M	6.21	[illegible]	[illegible]		
	0115773	12035	214.82	-30.12	199.28	-40.93	6.740	.520E	7.26	0.06M	7.32	0.00	[illegible]		
	0115988	12053	216.34	-32.20	199.63	-43.37	6.700	-.020E	6.68	-0.03M	6.59	[illegible]	[illegible]		
5058	116713	12106	215.31	-28.32	200.80	-39.49	5.090	1.200	6.29	1.02	7.31	[illegible]	[illegible]		
5060	116835	12109	216.32	-29.84	201.00	-41.24	5.690	1.470E	7.16	1.60M	[illegible]	[illegible]	[illegible]		
5065	116873		0215.74	-28.61	201.09	-39.91	6.520	.900E	7.12	0.70M	[illegible]	[illegible]	[illegible]		
	0117145	12127	218.62	-33.30	201.57	-45.28	6.620	-.030E	6.59	-0.15M	6.44	1.42	B9		
5118	118338	12200	219.60	-31.44	203.53	-43.89	5.980	.940E	6.92	0.74M	7.66	2.03	[illegible]		
5121	118354	12204	220.81	-33.47	203.59	-46.17	5.900	-.120E	5.78	-0.30M	[illegible]	[illegible]	[illegible]		
	0119103	12247	220.04	-30.16	204.75	-42.89	7.150	-.070E	7.08	-0.14M	6.90	[illegible]	[illegible]		
	0119222	12253	220.70	-31.05	204.95	-43.94	7.010	-.110E	6.90	-0.40M	[illegible]	[illegible]	[illegible]		
5155	119250	12255	219.39	-28.50	204.98	-41.15	5.980	1.020E	7.00	0.85M	[illegible]	[illegible]	[illegible]		
5157	119361	12263	219.65	-29.05	205.17	-41.82	5.980	-.080E	5.90	-0.35M	[illegible]	[illegible]	[illegible]		
	0119430	12266	220.59	-30.27	205.28	-43.19	7.100	-.020E	7.08	[illegible]	[illegible]	[illegible]	[illegible]		
5190	120307	12315	220.80	-28.26	206.62	-41.44	3.400	-.240	3.16	-0.84	[illegible]	[illegible]	[illegible]		
5193	120324		0221.19	-28.96	206.65	-42.23	3.470	-.220E	3.25	-0.81M	7.44	[illegible]	[illegible]		
	0120592	12334	224.38	-34.14	207.10	-48.05	7.360	.800	8.16	0.32	[illegible]	[illegible]	[illegible]		
	0120593	12335	224.39	-34.13	207.11	-48.05	7.460	-.480	7.94	-0.33	7.97	0.00	[illegible]		
5206	120640	12338	223.72	-32.85	207.17	-46.65	5.770	-.160E	5.61	-0.77M	[illegible]	1.27	[illegible]		
5223	120991		0224.23	-32.90	207.71	-46.88	6.120	-.070E	6.05	-0.92M	[illegible]	[illegible]	[illegible]		
	0121141	12365	224.88	-33.77	207.89	-47.89	7.170	.360E	7.53	0.03M	7.56	[illegible]	[illegible]		
5231	121263	12371	224.60	-32.94	208.10	-47.04	2.540	-.230	7.31	[illegible]	[illegible]	[illegible]	[illegible]		
	0121288	12372	222.41	-28.67	208.13	-42.38	7.700	1.220E	8.92	1.14M	[illegible]	[illegible]	[illegible]		
5239	121416	12379	224.41	-32.25	208.30	-46.35	5.820	1.140E	6.96	1.14M	[illegible]	[illegible]			
	0121483	12383	224.40	-32.03	208.42	-46.14	6.950	-.130E	6.82	-0.62M	6.20	1.25	B2 V		
	0121746	12399	225.72	-33.80	208.82	-48.22	7.160	.460E	7.64	-0.04M	7.68	0.00	F5 V		
5249	121790	12400	223.99	-30.45	208.89	-44.56	3.860	-.210	3.65	-0.79	2.86	0.00	B2 V		
	0121852	12405	224.40	-31.03	209.01	-45.23	7.370	.520E	7.89	0.05M	7.94	0.00	F7 V		
5260	122223	12418	224.94	-30.96	209.65	-45.36	4.340	.610	4.95	0.26	5.21	0.00	F7 IA		
5286	123004	12454	224.65	-28.34	210.77	-42.85	6.200	.980E	7.18	0.75M	7.93	2.04	K0 [illegible]		
5294	123445	12469	225.33	-28.50	211.44	-43.23	6.170	-.060E	6.11	-0.20M	5.91	1.40	B9		
	0123797	12483	226.16	-33.25	211.95	-48.55	6.620	.920E	7.54	0.60M	8.14	1.96	G5 IV		
5325	124580	12526	227.27	-29.46	213.11	-44.77	6.300	.600E	6.90	0.10M	7.00	1.08	G4 V		
5354	125238	12570	228.44	-30.19	214.05	-45.83	3.560	-.200	3.36	-0.71	2.65	0.00	B3 IV		
5364	125442	12579	228.31	-29.29	214.38	-44.96	4.760	.320E	5.08	-0.04M	5.04	1.58	[illegible]		
	0125649	12592	228.34	-28.71	214.72	-44.43	7.740	1.220E	8.96	1.07M	10.03	[illegible]	[illegible]		
5375	125721	12595	230.04	-32.07	214.84	-48.09	6.090	-.140E	5.95	-0.91M	5.04	[illegible]	[illegible] V		[illegible]
5377	125810	12599	231.30	-34.29	215.00	-50.55	6.020	1.360E	7.38	1.26M	8.64	2.30	K0 [illegible]		
5395	126341	12641	229.34	-28.97	215.73	-45.00	4.410	S -.160	4.25	-0.78	3.47	1.19	B3 II	2	[illegible]
5396	126354	12642	229.41	-29.11	215.74	-45.15	4.340	.430	4.77	0.16	4.93	1.64	F8		[illegible]
5401	126504	12648	229.92	-29.75	215.99	-45.91	5.820	.310	6.13	0.13	6.26	1.62	A M		[illegible]
	0126759	12660	231.02	-31.38	216.39	-47.77	6.390	-.120	6.27	-0.32	5.95	1.35	[illegible]		
5412	126981	12675	230.14	-28.81	216.73	-45.10	5.490	-.080	5.41	-0.26	5.15	1.37	B6 IV		[illegible]
5413	126983	12676	231.97	-32.70	216.75	-49.30	5.360	.050E	5.41	0.05M	5.46	1.53	A2		[illegible]
	0127154	12684	231.07	-30.37	217.00	-46.65	7.300	-.030E	7.27	-0.20M	7.07	1.40	B9		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	u-B	u	(u-B)c	SPTYPE	VAR	MULT
5425	127381	12702	232.79	-33.44	217.31	-50.24	4.420	-.190	4.23	-0.84	3.39	0.00	B2 V		
0	127864	12725	231.53	-29.56	217.97	-46.24	6.880	-.020	6.86	-0.15	6.71	1.41	[illegible]		
0	127976	12729	231.80	-29.65	218.13	-46.60	6.770	.960	7.73	0.66	8.39	2.00	[illegible]		
5444	128068	12732	231.66	-29.29	218.26	-46.03	5.540	1.480	7.02	1.73	8.75	0.00	[illegible]		
5450	128266	12745	231.80	-29.12	218.51	-45.92	5.430	1.060 6	6.51	0.92	7.43	0.00	[illegible]		
5453	128345	12751	233.27	-32.16	218.63	-49.21	4.040	-.150	3.89	-0.55	3.34	1.28	[illegible]		
0	128344	12750	232.68	-30.86	218.64	-47.81	6.630	-.020	6.61	-0.27	6.34	1.38	[illegible]		
0	128413	12755	231.86	-28.83	218.73	-45.66	6.820	1.170	7.99	1.22	9.21	2.27	[illegible]		
5457	128582	12760	232.33	-29.43	218.97	-46.37	6.060	.510	6.57	0.02	6.59	1.64	[illegible]		
5458	128617	12763	233.39	-31.73	219.01	-48.84	6.380	.440E	6.82	-0.01M	6.81	1.60	[illegible]		
0	128775	12772	232.22	-28.62	219.26	-45.58	6.600	-.110	6.49	-0.35	6.14	1.35	[illegible]		
5469	129056	12788	233.16	-30.01	219.65	-47.17	2.300	-.200	2.10	-0.88	1.22	1.15	F2		
0	129070	12789	232.74	-28.99	219.68	-46.08	7.350	-.020	7.33	-0.14	7.19	1.43	A0		
0	129281	12804	233.47	-30.12	219.97	-47.36	6.920	-.050E	6.87	-0.38M	6.49	1.33	B8		
5494	129858	12856	234.01	-29.80	220.78	-47.23	5.730	.070	5.80	0.08	5.88	1.54	A2		
5495	129893	12864	236.16	-34.40	220.88	-52.17	5.210	.980F	6.19	0.79M	6.98	2.07	[illegible]		
5498	129932	0	236.11	-34.22	220.93	-51.99	6.260	.000E	6.26	0.00M	6.26	0.00	A0		
0	130761	12924	234.80	-29.18	222.04	-46.88	7.990	.440	8.43	-0.04	8.39	1.60	K2		
0	130932	12935	234.84	-28.83	222.26	-46.56	6.860	S 1.640E	8.50	1.93M	10.43	2.57	M3 III		
0	131464	12965	235.33	-28.54	222.99	-46.43	7.300	.980	8.28	0.64	8.92	1.99	[illegible]		
5556	131562	12972	237.93	-34.30	223.18	-52.61	5.380	.130E	5.51	0.12M	[illegible]	[illegible]			
5559	131657	12979	236.02	-29.65	223.28	-47.68	5.630	-.040	5.59	-0.26	5.33	[illegible]	[illegible]		
0	131678	12980	235.68	-28.77	223.30	-46.75	7.090	.580	7.67	0.30	7.97	1.77	[illegible]		
5560	131705	0	237.50	-32.99	223.38	-51.25	6.490	1.520E	8.01	1.60M	9.61	0.00			
5566	131923	1298[illegible]	236.68	-30.49	223.67	-46.66	6.350	.710	7.06	0.24	7.30	0.00	[illegible]		
5606	133243	0	237.29	-28.40	225.43	-46.86	4.820	-.160E	4.66	-0.54M	4.12	0.00	B5 IV		
5605	133242	13044	237.29	-28.41	225.43	-46.87	3.860	-.140	3.74	-0.57	3.17	1.27	[illegible]		
0	133518	13054	239.46	-33.03	225.84	-51.84	6.390	-.100E	6.29	-0.62M	5.67	1.25	B3 III		
5617	133631	13060	238.11	-30.30	225.53	-48.89	5.760	.920E	6.68	0.70M	7.38	0.00	K0		
5646	134481	13098	239.12	-29.65	227.11	-48.55	3.860	-.050	3.81	-0.13	3.68	0.00	[illegible]		
5647	134482	13099	239.14	-29.66	227.12	-48.56	5.680	.140	5.82	0.08	5.90	0.00	[illegible]		
0	134483	13101	240.39	-32.84	227.14	-51.92	6.650	.480	7.13	0.02	7.15	0.00	F8	R	
5649	134505	13102	240.41	-32.82	227.17	-51.91	3.400	.920	4.32	0.66	4.98	0.00	G8 II	A	
5650	134597	13105	239.05	-29.12	227.26	-48.03	6.320	1.120E	7.44	1.06M	8.50	0.00	K0-2G		
5663	135235	0	239.61	-28.81	228.10	-47.88	6.190	.100E	6.29	0.10M	6.39	0.00	A N		
5683	135734	13169	240.02	-28.48	228.76	-47.68	4.260	-.100	4.16	-0.36	3.80	0.00	B8 N		
5699	136352	13204	240.79	-28.75	229.60	-48.13	5.640	.650	6.29	0.06	6.35	0.00	G2 V		
5698	136351	13203	240.70	-28.37	229.66	-47.75	4.990	.500E	5.49	0.04M	5.53	1.64	F5		
0	136466	13212	240.79	-28.34	229.78	-47.74	7.690	.690E	8.38	0.13M	8.51	1.71	G5 V	AB	
5738	137465	13259	243.04	-31.59	231.20	-51.42	6.080	1.060E	7.14	0.75M	7.89	2.04	K0	A	
0	137676	13267	242.65	-29.98	231.43	-49.78	7.660	.780E	8.44	0.28M	8.72	1.79	G5 V		
0	0	0	243.70	-29.25	233.09	-49.34	10.200	.000	10.20	0.00	10.20	0.00		Z	
5798	139129	13336	245.10	-31.89	233.77	-52.21	5.430	.000	5.43	0.00	5.43	1.49	B9 V		
5832	139871	0	244.89	-28.94	234.75	-49.32	6.060	.900E	6.96	0.70M	7.66	0.00	K0		
0	0	0	246.84	-34.20	235.05	-54.83	9.800	.000	9.80	0.00	9.80	0.00		S	
0	140079	13381	245.86	-31.23	235.08	-51.75	7.230	-.020	7.21	-0.38	6.83	0.00	B9		
0	140605	13404	246.41	-31.35	235.76	-51.99	7.070	-.040E	7.03	-0.41M	6.62	1.32	B5 VNN		
0	140882	13422	245.97	-28.97	236.14	-49.59	7.450	1.580E	9.03	1.80M	10.83	2.52	K5		
5865	140979	13429	246.86	-31.56	236.27	-52.29	6.050	1.390E	7.44	1.50M	8.94	2.40	K0	AH	
5869	141168	13438	247.31	-32.26	236.58	-53.06	5.760	-.080	5.68	-0.22	5.46	1.40	B8 V	A	
5871	141194	13443	246.05	-28.10	236.58	-48.76	5.830	.070	5.90	0.05	5.95	1.53	A2		
5873	141318	13445	248.03	-34.01	236.80	-54.91	5.730	.050E	5.78	-0.72M	5.06	1.24	B2 II	A	
5890	141724	0	247.04	-29.64	237.29	-50.47	6.420	1.000E	7.42	1.00M	8.42	0.00	K2		
0	142468	13505	248.87	-33.08	238.38	-54.19	7.850	.580	8.43	-0.38	8.05	0.00	B2		
5937	142919	13537	249.20	-32.69	239.00	-53.88	6.100	.000E	6.10	-0.46M	5.64	1.30	B9 N		
5946	143101	13551	249.57	-33.19	239.30	-54.44	6.120	.260E	6.38	0.17M	6.55	1.60	A7 III		

YALE	HD	PHOECC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
0	144556	13641	251.09	-33.51	241.31	-55.05	7.270	1.780E	9.05	1.96M	11.01	2.58	K5		
0	144816	13652	251.35	-33.63	241.63	-55.22	7.620	.080	7.70	-0.44	7.26	0.00	[illegible]		
6022	145384	0	251.39	-31.91	242.34	-53.55	5.980	1.600E	7.58	1.90M	9.48	[illegible]	[illegible]		
6019	145361	13740	251.88	-33.72	242.35	-55.41	5.810	.340E	6.15	-0.06M	[illegible]	[illegible]			
6024	145397	0	251.66	-32.83	242.38	-54.50	4.940	1.040E	5.98	0.81M	6.79	0.00	[illegible]		
6055	146003	0	252.01	-31.94	243.20	-53.69	5.440	1.730E	7.17	1.89M	9.06	0.00	[illegible]		
0	146059	13794	252.03	-31.81	243.27	-53.57	6.410	.780E	7.19	0.32M	7.51	[illegible]	[illegible]		
6058	146143	13799	251.20	-28.26	243.32	-49.95	4.970	.760	5.73	0.51	6.24	0.00	[illegible]		
6059	146145	13800	251.95	-31.20	243.37	-52.96	6.330	.260E	6.61	0.15M	6.76	[illegible]			
6072	146686	13836	251.72	-28.25	244.02	-50.03	4.010	1.080	5.09	1.17	6.26	2.19	[illegible]		
6073	146690	0	252.96	-33.13	244.11	-55.02	5.910	.950E	6.86	0.70M	7.56	0.00	[illegible]		
0	147075	13853	253.18	-32.58	244.62	-54.52	7.900	1.200E	9.10	1.14M	10.24	2.24	K2 III		
0	149160	13993	255.15	-31.26	247.84	-53.54	7.210	-.080E	7.13	-0.71M	6.42	1.22	B3	VAR	
0	149342	14015	255.69	-32.54	248.23	-54.68	7.190	1.480E	8.67	1.50M	10.17	2.40	K2		
6207	150576	0	256.66	-30.55	250.17	-53.06	5.970	.900E	6.87	0.70M	7.57	0.00	[illegible]		
6275	152527	14314	258.56	-29.44	253.13	-52.20	5.940	-.080E	5.86	-0.25M	5.61	1.38	[illegible] III		
6285	152786	14332	259.48	-33.08	253.62	-55.91	3.120	1.600	4.72	1.96	6.68	2.58	[illegible]		
6295	152980	14344	259.23	-30.26	253.90	-53.09	4.040	1.440	5.48	1.71	7.19	0.00	[illegible]		
6297	153053	14347	259.52	-31.67	254.01	-54.52	5.640	.190E	[illegible]	[illegible]	[illegible]	[illegible]			
0	153075	14349	259.99	-34.35	254.06	-57.22	7.000	.600	7.60	-0.01	7.59	0.00	[illegible]		
6312	153370	14364	259.34	-28.21	254.47	-51.06	6.440	.280E	6.72	0.19M	6.91	1.61	[illegible]		
6314	153580	0	259.86	-30.27	254.79	-53.16	5.360	.510E	5.87	[illegible]	[illegible]	[illegible]			
6384	155341	0	262.16	-33.73	257.50	-56.82	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
6442	156854	14771	263.58	-33.28	259.72	-56.46	5.800	1.000E	6.80	0.75M	7.55	[illegible]			
6461	157244	14805	263.85	-32.26	260.28	-55.49	2.840	1.460	4.30	1.56	5.86	[illegible]			
6462	157246	14806	263.94	-33.10	260.29	-56.33	3.330	-.140	3.19	-0.95	2.24	[illegible]	[illegible]		[illegible]
6475	157599	0	263.86	-28.67	260.75	-51.91	6.460	-.090E	6.37	-0.30M	[illegible]	[illegible]			
6483	157753	0	264.06	-29.01	261.00	-52.26	5.770	1.160E	6.93	1.16M	8.09	0.00	K2 [illegible]		
6487	157819	0	264.39	-31.86	261.13	-55.12	6.000	.950E	6.95	0.70M	7.65	0.00	[illegible]		
6505	158220	14896	264.97	-33.59	261.78	-56.88	5.940	-.080E	5.86	-0.35M	5.51	1.34	[illegible]		
6530	159018	0	265.40	-30.00	262.82	-53.32	6.270	.010E	6.28	0.01M	6.29	0.00	A0		
6549	159492	14971	265.94	-31.12	263.50	-54.47	5.240	.200	5.44	0.08	5.52	[illegible]			
6585	160691	15030	266.86	-28.42	265.04	-51.81	5.140	.700E	5.84	0.32M	6.16	1.82	[illegible]		
6586	160720	0	267.21	-34.13	265.16	-57.52	6.140	.700E	6.84	0.30M	7.14	0.00	G5		
6614	161420	0	267.75	-31.97	266.12	-55.38	6.280	.310E	6.59	0.06M	6.65	0.00	F0		
6622	161783	0	268.02	-30.18	266.60	-53.60	5.900	-.190E	5.71	-0.65M	5.06	0.00	[illegible]		
6632	161917	0	268.13	-29.70	266.79	-53.12	6.090	.000E	6.09	0.00M	6.09	0.00	A0		
6819	167128	15495	272.49	-32.62	273.23	-56.04	5.340	-.060E	5.28	-0.71M	4.57	1.22	B5		
6908	169836	0	274.50	-34.20	276.41	-57.55	5.790	.950E	6.74	0.70M	7.44	0.00	G8 [illegible]		
6954	170873	0	275.62	-29.62	277.62	-52.93	6.300	1.160E	7.46	1.16M	8.62	0.00	K2 [illegible]		
7022	172781	0	277.08	-33.72	280.29	-56.93	6.300	.950E	7.25	0.80M	8.05	0.00	K0		
7087	174295	0	278.86	-29.07	282.17	-52.16	5.170	.940E	6.11	0.70M	6.81	0.00	G8 [illegible]		
7093	174430	0	278.98	-28.91	282.31	-51.99	6.480	-.090E	6.39	-0.30M	6.09	0.00	B8		
7134	175510	0	279.77	-30.00	283.62	-53.00	5.030	-.030E	5.00	-0.35M	4.65	0.00	B9 III		
0	176354	16124	279.97	-34.12	284.75	-57.07	7.060	.890E	7.95	0.63M	8.58	[illegible]	[illegible] IV		
7190	176664	16142	280.99	-28.20	285.02	-51.09	5.930	1.250E	7.18	1.15M	8.33	0.00	K5		
7213	177171	16162	281.21	-29.56	285.59	-52.42	5.150	.530E	5.68	0.02M	5.70	1.63	F2		
7233	177693	16189	281.11	-32.96	286.18	-55.80	6.480	1.100E	7.58	1.05M	8.63	2.20	K1 IV		
0	178734	16244	282.36	-29.16	287.12	-51.69	7.040	1.480E	8.52	1.50M	10.02	0.00	K2		
0	179775	16279	282.99	-29.88	288.17	-52.53	6.760	1.020E	7.78	0.90M	8.68	0.00	[illegible]		
7297	180134	16294	283.08	-30.85	288.54	-53.48	6.370	.490E	6.86	-0.02M	6.84	1.69	[illegible]		
0	180575	16312	283.66	-29.09	288.93	-51.66	6.580	.040E	6.62	0.04M	6.66	0.00	A0		
7329	181296	16344	283.69	-31.98	289.71	-54.52	5.050	.020E	5.07	0.03M	5.10	1.52	A0		
0	182160	16409	284.19	-32.50	290.58	-54.96	7.550	1.060E	8.61	0.85M	9.46	2.10	K0 III		
7370	182509	0	284.55	-32.00	290.95	-54.42	5.688	1.398E	7.09	1.68M	8.77	0.00	K2		
7388	182893	0	284.66	-33.15	291.45	-55.53	6.130	.977E	7.11	0.81M	7.91	0.00	G9 [illegible]		

YALE	HD	PHOELC	λ	β	α	δ	V	B-V	B	U-B	U	(U-B)C	SPTYPE	VAR	MULT
7393	183028		0284.85	-32.86	291.63	-55.22	6.410	.470E	6.88	0.02M	6.90	0.00			
7411	183552		0285.66	-31.02	292.21	-53.23	5.760	.300E	6.06	0.23M	6.29	0.00			
7459	185075	16647	286.64	-32.44	294.08	-54.53	6.260	1.000E	[illegible]	[illegible]	[illegible]	[illegible]			
7521	186756		0286.48	-31.21	296.26	-53.01	6.250	1.132E	7.38	1.11	[illegible]	[illegible]			
7548	187420	16870	288.57	-33.36	297.16	-55.10	5.750	.920	6.67	0.07	7.34	[illegible]			
7549	187421	16871	288.57	-33.37	297.17	-55.11	6.500	.100	6.57	0.13	6.71	[illegible]			
7621	189020		0291.41	-28.15	299.19	-49.48	6.164	1.062E	7.23	0.92M	8.15	[illegible]			
7673	190421	17167	291.66	-31.85	300.87	-53.03	4.920	S 1.620	6.54	1.84	8.38	0.00			
7674	190422	17168	291.06	-33.92	300.91	-55.16	6.250	.530E	6.78	0.04	6.82	[illegible]			
7714	191829	17409	292.99	-31.69	302.63	-52.60	5.650	1.500E	7.15	1.90S	9.05	2.95			
7766	193307	17591	295.04	-29.63	304.52	-50.16	6.270	.550	6.82	-0.02	6.80	[illegible]			
	0195903	17824	297.31	-31.13	308.11	-51.07	7.960	.960E	8.94	0.72	[illegible]	[illegible]			
7920	197157	17946	298.31	-32.48	310.09	-52.10	4.500	.280	4.78	-0.06	4.84	1.59			
7968	198308		0299.73	-32.55	311.97	-51.80	5.053	1.130E	6.18	1.05M	7.23	0.00			
7992	198766		0300.61	-31.66	312.75	-50.91	6.460	-.066E	6.40	-0.19M	6.21	[illegible]			
8027	199673	18144	301.42	-32.67	314.20	-51.46	5.765	.472E	6.24	-0.06M	6.17	1.58			
	0200114	18193	301.30	-34.37	314.98	-53.09	7.430	1.560E	8.99	1.90	10.89	[illegible]			
	0200334	18207	304.09	-28.17	315.29	-46.45	7.040	.580E	7.62	0.50M	8.12	0.00			
	0200856	18259	303.68	-30.89	316.11	-49.14	6.670	.000	6.67	-0.06	6.61	[illegible]			
8152	203010	18406	305.66	-32.59	319.46	-50.15	6.370	1.320E	7.69	1.30M	8.99	0.00			
8177	203548	18446	307.61	-29.66	320.26	-46.83	6.300	.200E	6.50	0.17M	6.62	[illegible]			
	0203915	18470	308.76	-28.16	320.84	-45.06	7.870	.450E	8.32	0.50M	8.82	0.00			
	0203985	18477	308.84	-28.16	320.94	-45.03	7.470	.900E	8.37	0.70M	[illegible]	[illegible]			
8236	204960	18538	310.03	-28.59	322.54	-45.07	5.570	1.040E	6.61	0.85M	7.46	0.00			
	0205390	18557	307.97	-34.36	323.32	-51.07	7.140	.680E	8.02	0.57M	8.59	[illegible]			
8303	206690	18650	310.14	-33.67	325.50	-49.73	6.440	1.150E	7.59	1.00M	8.59	[illegible]			
	0206948	18674	311.87	-30.91	325.91	-46.62	7.550	1.150E	8.70	1.16M	9.86	[illegible]			
8323	207129	18684	311.71	-31.83	326.25	-47.53	5.570	.610	6.18	0.07	6.25	0.00			
	0207852	18725	312.86	-31.75	327.53	-47.07	7.420	.580E	8.00	-0.12M	8.12	1.70			
	0208215	18752	313.31	-32.01	326.19	-47.16	6.520	.460E	6.98	-0.02M	6.96	1.5[illegible]			
	0208323	18760	313.67	-31.67	328.40	-46.72	7.440	.390E	7.83	-0.04M	[illegible]	[illegible]			
	0208627	18776	315.13	-29.57	328.87	-44.30	6.540	.900E	7.44	0.60M	8.04	[illegible]			
	0208710	18781	314.21	-31.72	329.05	-46.58	7.580	1.240E	8.82	1.30M	10.12	[illegible]			
	0209661	18856	316.60	-30.02	330.75	-44.21	6.930	1.040E	7.97	0.80M	8.77	2.08			
8425	209952	18893	315.55	-32.90	331.27	-47.20	1.730	-.130	1.60	-0.46	1.14	1.10			
	0210051	18905	317.52	-29.37	331.40	-43.29	7.010	1.200E	8.21	1.27M	9.48	2.30			
8440	210204	18923	315.29	-34.07	331.70	-48.35	6.420	1.390E	7.81	1.65M	9.46	2.40			
	0210441	18953	317.68	-30.31	332.10	-44.09	6.590	.990E	7.58	0.72M	8.30	2.0[illegible]			
8477	21091R	19008	319.44	-28.28	332.90	-41.62	6.230	.660	6.89	0.14	7.03	0.00	G5 V		
8484	211053	19024	318.17	-31.16	333.13	-44.70	6.080	1.020	7.10	0.82	7.92	2.08	K0		
8486	211088	19029	319.64	-28.34	333.15	-41.60	4.790	.800	5.59	0.47	6.06	0.00	G4		
8488	211202	19040	319.68	-28.66	333.36	-41.88	5.090	.920E	6.01	0.70M	6.71	2.02	G5		
8521	212087		0318.76	-33.05	334.92	-46.20	6.440	2.010E	8.45	1.80M	10.25	0.00	B VAR		
8524	212132	19137	318.85	-33.07	335.02	-46.18	5.610	.370	5.98	-0.01	5.97	1.58	F0		
	0212180	19141	318.51	-33.75	335.09	-46.92	6.910	.060	6.97	-0.07	7.04	1.54	A2		
8556	213009	19203	321.25	-31.34	336.57	-43.75	3.960	1.030	4.99	0.81	5.80	2.07	G2		
8560	213080	19212	321.21	-31.61	336.69	-44.01	4.100	S 1.570	5.67	1.70 S	7.37	2.44	M4	V	A
	0213155	19217	322.04	-30.34	336.83	-42.55	6.910	-.040	6.87	-0.11	6.76	1.45	A0		
	0213220	19221	321.22	-31.99	336.93	-44.35	6.920	.070	6.99	0.08	7.07	1.54	A0		
	0213363	19234	320.12	-34.32	337.20	-46.84	7.230	.460	7.69	-0.01	7.68	1.60	F8		
	0213413	19239	321.74	-31.61	337.25	-43.81	7.400	S 1.550E	8.95	1.55M	10.50	2.42	A	V	
	0213457	19252	321.93	-31.36	337.31	-43.52	6.900	.980	7.88	0.77	8.65	0.00	G5		
	0213658	19277	321.52	-32.78	337.73	-44.95	6.780	.950	7.73	-0.68	8.41	1.99	K0-II		
	0213785	19287	321.11	-33.83	337.95	-46.04	7.770	.360	8.13	-0.05	8.08	1.57	F0		
8600	214085	19317	324.09	-29.28	338.39	-40.84	6.270	.120E	6.39	0.15M	6.54	1.58	A3 V		
	0214094	19318	322.69	-31.91	338.44	-43.73	6.750	.530	7.28	-0.01	7.29	1.63	F6 V		

YALE	HD	PHOELC	λ	β	α	δ	V		B-V	B	U-B		U	(U-B)C	SPTYPE	VAR	MULT
6602	214150	19321	324.19	-29.33	338.52	-40.85	5.850		.060E	5.91	0.08M		5.99	1.55	AZ		[illegible]
0	214174	19327	322.19	-33.02	338.59	-44.92	7.920		1.250	9.17	1.23	S	10.40	2.29	[illegible]		
8639	214987	19421	323.44	-33.08	339.95	-44.51	6.060		.980	7.04	0.69		7.73	2.01	K1 IV		
8644	215104	19435	325.06	-30.61	340.15	-41.68	4.840		1.030	5.87	0.81		6.68	2.07	[illegible]		
0	215627	19507	325.63	-31.16	341.07	-41.96	6.830		1.280	8.11	1.34		9.45	2.34	K3 II		
0	215657	19515	323.94	-34.10	341.13	-45.23	7.210		.600	7.81	0.07		7.88	1.67	[illegible]		
8671	215724	19523	327.50	-28.09	341.24	-38.49	6.760		.480E	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]		
0	215818	19539	324.97	-32.83	341.40	-43.71	7.060		.990	8.05	0.73		8.78	2.04	[illegible]		
0	216054	19559	326.34	-31.22	341.83	-41.75	7.760		.740	8.50	0.32		8.82	1.81			
8685	216149	19569	327.69	-29.20	342.05	-39.42	5.420		1.430E	6.85	1.78M		8.63	2.51	[illegible]		
0	216743	19648	326.89	-32.65	343.27	-42.82	7.250		.160	7.41	0.06		7.47	1.56	[illegible]		
0	217766	19747	328.07	-33.76	345.16	-43.35	7.760	S	.540E	8.30	0.06M		8.36	0.00	[illegible]		
8771	217842	0	329.06	-32.38	345.30	-41.75	5.790		1.076E	6.87	0.95M		7.81	0.00	[illegible]		
0	217988	19771	328.41	-33.85	345.56	-43.30	7.700		.980E	8.68	0.81M		9.49	0.00	[illegible]		[illegible]
8790	218242	19789	331.01	-30.32	346.03	-39.16	5.620		.010E	5.63	-0.07M		5.56	1.16	[illegible]		[illegible]
8814	218630	0	329.47	-34.11	346.79	-43.12	5.820		.490E	6.31	-0.02M		6.29	0.00	[illegible]		
8818	218655	0	330.76	-32.13	346.85	-40.87	6.040		1.600E	7.64	1.90M		9.54	0.00	[illegible]		
8835	219263	19874	331.43	-33.00	348.05	-41.38	5.770		1.180E	6.95	1.17M		8.12	[illegible]	[illegible]		
8847	219531	19906	331.75	-33.24	348.52	-41.47	6.460		1.080E	7.54	0.97M		8.51	[illegible]	[illegible]		
8859	219693	19938	332.22	-33.03	348.85	-41.10	5.490		.470	5.96	-0.05		5.91	[illegible]	[illegible]		
8914	220929	20139	337.06	-29.23	351.33	-35.62	6.310		1.200E	7.51	1.22		8.73	[illegible]	[illegible]		
8937	221507	20244	336.88	-31.71	352.57	-38.10	4.390		-.110	4.28	-0.28		[illegible]	[illegible]	[illegible]		

UV-Intensities [S10]

λ	β = 18.1°	β = 16.1°	β = 14.1°
0.	31.	32.	33.
10.	35.	33.	32.
20.	40.	36.	35.
25.	42.	38.	37.
30.	44.	41.	39.
33.7	47.	44.	42.
40.6	52.	48.	45.
46.8	92.	88.	95.
48.5	98.	95.	92.
50.4	99.	96.	93.
55.	88.	85.	76.
58.	79.	78.	82.
60.4	73.	72.	83.
62.4	72.	72.	93.
64.	69.	80.	95.
66.	66.	90.	101.
68.	77.	97.	97.
70.	101.	104.	99.
71.	117.	107.	99.
73.	141.	116.	101.
75.	167.	124.	106.
77.	195.	148.	126.
78.6	208.	165.	145.
80.8	194.	173.	165.
82.4	194.	173.	170.
84.3	165.	156.	158.
86.2	137.	136.	141.
88.	117.	126.	141.
90.	109.	116.	134.
92.	96.	109.	111.
98.	86.	96.	94.
100.	84.	92.	91.
105.	76.	81.	86.
110.	69.	71.	68.
115.	54.	60.	65.
120.	48.	49.	54.
125.	35.	41.	41.
130.	31.	30.	32.
135.	33.	30.	29.
140.	33.	32.	30.
145.	31.	33.	31.
150.	26.	32.	33.
155.	24.	30.	32.
160.	24.	28.	30.
165.	24.	26.	27.
170.	23.	25.	26.
175.	23.	24.	26.
180.	23.	24.	27.
185.	23.	26.	26.
190.	24.	26.	26.
195.	27.	25.	26.
200.	29.	26.	26.
205.	29.	30.	31.
210.	30.	31.	34.
215.	34.	33.	34.
220.	36.	37.	34.
225.	36.	39.	38.
230.	36.	38.	39.
235.	40.	40.	41.
240.	44.	46.	52.
242.	46.	47.	56.
245.	49.	50.	60.
247.	51.	52.	71.
250.0	54.	55.	67.
255.	55.	58.	59.
260.	58.	61.	65.
267.0	60.	60.	64.
269.4	63.	63.	69.
272.	62.	65.	73.
273.5	58.	60.	67.
275.	61.	67.	75.
276.6	63.	70.	74.
277.9	66.	81.	83.
279.0	131.	170.	161.
280.0	138.	211.	189.
281.0	174.	261.	230.
281.7	144.	275.	248.
282.5	215.	321.	294.
283.5	221.	324.	300.
283.9	192.	280.	259.
284.6	182.	254.	245.
285.5	167.	225.	221.
287.1	136.	163.	169.
289.1	115.	138.	144.
291.	112.	124.	130.
293.	105.	110.	114.
294.6	90.	96.	102.
299.0	67.	58.	63.
301.9	95.	60.	66.
305.0	91.	83.	90.
309.5	69.	68.	64.
317.0	59.	57.	54.
325.	52.	56.	49.
330.	51.	49.	47.
335.	45.	44.	46.
340.	43.	47.	43.
345.	40.	37.	40.
350.	34.	33.	33.
355.	34.	33.	33.

Blue-Intensities [S10]

λ	β = 18.1°	β = 16.1°	β = 14.1°
0.	36.	35.	33.
10.	38.	36.	34.
20.	43.	39.	38.
25.	45.	41.	40.
30.	47.	44.	42.
33.7	49.	47.	44.
40.6	55.	50.	47.
46.8	[illegible]	61.	78.
48.8	92.	88.	85.
50.8	92.	89.	85.
55.	81.	76.	77.
57.2	74.	72.	70.
60.6	73.	72.	84.
62.	74.	74.	95.
64.	67.	78.	117.
66.4	60.	62.	92.
68.	69.	87.	87.
70.	92.	94.	89.
71.	105.	96.	89.
72.	114.	98.	91.
73.	122.	100.	87.
74.	130.	102.	88.
75.	145.	111.	93.
76.	158.	119.	101.
77.	172.	131.	112.
78.	185.	144.	126.
79.	198.	156.	138.
80.6	205.	172.	161.
82.5	193.	178.	175.
84.3	174.	167.	169.
86.2	140.	144.	149.
88.1	114.	125.	144.
90.	111.	119.	143.
95.	93.	106.	105.
98.	86.	97.	95.
100.	84.	92.	91.
105.	75.	80.	85.
110.	69.	71.	68.
115.	52.	57.	61.
120.	47.	46.	53.
125.	38.	44.	44.
130.	31.	32.	34.
135.	35.	37.	31.
140.	36.	34.	32.
145.	33.	36.	33.
150.	28.	34.	35.
155.	26.	32.	34.
160.	26.	30.	32.
165.	26.	28.	29.
170.	25.	27.	28.
175.	25.	26.	28.
180.	25.	26.	29.
185.	25.	28.	26.
190.	26.	26.	28.
195.	24.	27.	28.
200.	31.	31.	30.
205.	31.	32.	33.
210.	32.	33.	37.
215.	36.	35.	36.
220.	34.	40.	37.
225.	39.	42.	41.
230.	39.	41.	42.
235.	43.	43.	44.
240.	47.	44.	50.
242.	49.	51.	60.
245.	53.	54.	71.
247.	55.	56.	76.
250.	54.	58.	72.
255.	59.	62.	63.
260.	62.	66.	70.
265.0	77.	71.	70.
268.8	71.	71.	75.
273.5	66.	68.	76.
275.9	76.	81.	88.
277.3	78.	85.	92.
278.0	100.	123.	126.
279.1	153.	186.	187.
280.0	183.	254.	232.
280.9	196.	294.	266.
282.7	225.	337.	306.
283.4	247.	354.	327.
283.6	213.	358.	328.
284.5	211.	290.	283.
285.5	188.	253.	246.
286.5	154.	199.	197.
287.5	132.	163.	164.
288.9	121.	147.	153.
290.	120.	139.	146.
291.	119.	132.	136.
292.1	116.	125.	130.
294.	108.	100.	114.
299.3	78.	73.	80.
303.9	79.	72.	79.
306.7	58.	60.	90.
311.	71.	69.	65.
317.0	62.	64.	62.
321.7	66.	65.	60.
325.6	56.	60.	53.
330.	59.	57.	51.
335.	46.	52.	49.
340.	47.	50.	46.
345.	41.	40.	43.
350.	37.	35.	37.
355.	37.	35.	35.

VIS - Intensities [S10]

λ	β = 18.1°	β = 16.1°	β = 14.1°
0.0	38.9	37.9	35.0
10.0	40.9	38.9	36.0
20.0	45.7	41.6	40.9
25.0	48.6	43.6	44.8
30.0	50.5	46.7	44.7
33.7	51.5	49.5	46.7
40.1	57.5	52.5	49.5
43.2	66.5	60.5	57.5
46.8	83.5	70.5	70.5
49.2	88.5	85.5	82.5
52.6	88.5	85.5	80.5
55.0	85.5	82.5	75.5
56.0	79.5	78.5	82.5
60.0	80.5	79.5	90.5
62.8	80.5	80.5	101.5
66.4	59.5	82.5	92.5
68.0	67.5	85.5	85.5
70.0	88.5	90.5	85.5
72.1	113.5	95.5	86.5
74.0	134.5	105.5	90.5
75.2	146.5	111.5	94.5
77.0	177.5	143.5	113.5
78.6	194.5	153.5	135.5
80.4	194.5	166.5	155.5
82.4	190.5	159.5	166.5
84.4	169.5	163.5	165.5
86.2	144.5	140.5	155.5
88.0	125.5	134.5	151.5
90.0	116.5	124.5	149.5
94.0	96.5	108.6	114.5
98.0	85.5	96.5	94.5
100.0	80.5	88.5	87.5
105.0	77.5	82.5	87.5
110.0	71.5	73.5	70.5
115.0	62.5	64.5	70.5
120.0	53.5	54.5	60.5
125.0	40.9	46.7	40.7
130.0	35.6	34.0	36.0
135.0	37.9	34.0	33.1
140.0	37.9	36.0	34.0
145.0	35.0	38.9	35.0
150.0	30.2	36.0	37.9
155.0	28.2	34.0	30.0
160.0	28.2	32.1	34.0
165.0	28.2	30.2	31.1
170.0	27.2	29.2	30.2
175.0	27.2	28.2	30.2
180.0	27.2	28.2	31.1
185.0	27.2	30.2	30.2
190.0	28.2	30.2	30.2
195.0	31.1	29.2	30.2
200.0	33.1	32.1	32.1
205.0	33.1	31.0	35.0
210.0	34.0	35.0	36.0
215.0	38.9	37.9	36.9
220.0	41.8	42.6	39.9
225.0	41.8	44.7	43.8
230.0	41.6	43.6	44.7
235.0	45.7	45.7	46.7
240.0	50.5	52.5	60.5
242.0	52.5	54.5	64.5
245.0	56.5	57.5	76.5
247.0	59.5	60.5	82.5
250.0	62.5	62.5	78.5
255.0	63.5	66.5	67.5
260.0	66.5	71.5	75.5
267.6	92.5	92.5	94.5
270.0	93.5	93.5	103.5
271.4	97.5	93.5	103.5
273.0	68.5	90.5	100.5
275.0	95.5	99.5	111.5
276.0	107.5	119.5	127.5
277.0	179.5	157.5	162.5
278.3	162.5	203.5	203.5
279.0	261.5	261.5	246.5
280.2	237.5	341.5	406.5
281.1	257.5	388.5	351.5
281.9	276.5	419.5	366.5
282.7	304.5	458.5	415.5
283.5	310.5	460.5	418.5
284.5	267.5	353.5	353.5
286.5	202.5	252.5	259.5
288.1	157.5	189.5	194.5
289.4	139.5	157.5	174.5
291.0	136.5	151.5	157.5
292.1	131.5	141.5	146.5
293.0	125.5	126.5	131.5
295.0	120.5	119.5	123.5
300.0	89.5	74.5	92.5
301.0	76.5	72.5	79.5
303.0	81.5	74.5	81.5
306.0	96.5	84.5	93.5
309.5	74.5	76.5	72.5
315.0	67.5	74.5	69.5
317.0	74.5	71.5	67.5
320.0	66.5	73.5	60.5
325.0	60.5	54.5	56.5
330.0	59.5	56.5	54.5
335.0	51.5	55.5	52.5
340.0	50.5	53.5	49.5
345.0	45.7	42.8	45.7
350.0	39.4	37.4	34.4
355.0	39.9	37.9	37.9

UV - Intensities [S10]

λ	β = 33.1°	β = 31.1°	β = 29.1°
0.0	60.	54.	50.
2.92	62.	56.	52.
5.0	63.	57.	53.
18.3	69.	64.	58.
26.0	77.	71.	66.
30.0	86.	81.	75.
34.0	89.	90.	84.
38.8	103.	106.	99.
40.8	106.	110.	102.
44.8	118.	113.	103.
50.0	131.	119.	119.
53.6	139.	123.	128.
56.0	137.	172.	146.
58.0	118.	122.	153.
60.0	110.	122.	149.
62.0	110.	119.	150.
64.0	110.	116.	155.
66.0	111.	114.	145.
68.0	114.	114.	131.
70.0	117.	113.	120.
72.0	119.	112.	115.
74.0	117.	108.	109.
76.0	109.	104.	106.
78.0	107.	100.	106.
80.0	95.	96.	104.
84.0	85.	83.	92.
90.0	75.	75.	89.
94.0	68.	64.	81.
102.0	56.	56.	59.
108.0	48.	49.	50.
116.4	36.	37.	37.
120.0	33.	33.	34.
125.0	32.	32.	32.
130.0	30.	30.	30.
140.0	26.	26.	26.
150.0	23.	23.	22.
160.0	21.	21.	20.
170.0	20.	19.	19.
180.0	19.	19.	20.
190.0	20.	20.	20.
200.0	21.	22.	22.
210.0	24.	24.	24.
220.0	27.	27.	27.
230.0	33.	33.	33.
240.0	41.	41.	41.
250.0	53.	52.	52.
255.0	58.	58.	57.
259.00	64.	62.	66.
262.0	77.	75.	82.
264.0	82.	82.	99.
265.74	84.	92.	113.
268.0	80.	94.	116.
269.67	87.	95.	119.
270.85	94.	99.	124.
273.12	106.	110.	136.
274.0	107.	112.	131.
275.55	113.	130.	140.
278.74	156.	167.	154.
279.58	168.	173.	156.
280.10	173.	168.	152.
282.47	175.	146.	130.
284.0	183.	140.	114.
286.25	139.	101.	85.
287.83	122.	91.	87.
289.40	112.	91.	99.
290.5	107.	101.	107.
291.44	104.	107.	115.
292.15	106.	115.	127.
294.	121.	131.	146.
295.0	144.	143.	160.
296.46	184.	162.	170.
297.26	201.	170.	169.
297.87	204.	171.	165.
298.50	209.	169.	159.
300.05	190.	156.	138.
300.82	187.	154.	137.
301.58	174.	157.	141.
302.44	160.	163.	148.
303.24	180.	166.	151.
304.04	183.	178.	156.
304.86	182.	179.	152.
305.70	178.	176.	154.
307.62	161.	159.	134.
310.11	143.	131.	121.
310.82	136.	125.	116.
311.71	131.	121.	113.
313.10	126.	122.	114.
315.86	114.	115.	105.
317.91	109.	110.	99.
320.11	104.	103.	92.
323.67	90.	91.	83.
326.0	83.	85.	81.
330.64	82.	81.	77.
335.0	82.	75.	75.
340.0	74.	69.	63.
351.15	60.	54.	50.
355.79	60.	54.	50.

Blue - Intensities [S10]

λ	$\beta = 33.1^\circ$	$\beta = 31.1^\circ$	$\beta = 29.1^\circ$
0.0	62.	56.	52.
2.9	62.	56.	62.
5.0	67.	61.	56.
29.1	87.	77.	72.
36.0	87.	83.	78.
40.0	96.	99.	92.
42.4	114.	113.	103.
46.0	127.	118.	109.
50.0	134.	121.	121.
52.0	147.	121.	117.
53.6	137.	121.	126.
56.0	127.	118.	141.
58.8	104.	114.	141.
62.2	105.	113.	148.
66.0	109.	112.	142.
68.0	112.	112.	129.
70.0	116.	111.	118.
74.0	114.	107.	108.
76.0	109.	105.	106.
78.0	103.	102.	108.
80.0	98.	98.	105.
84.0	90.	88.	97.
86.0	85.	84.	96.
94.0	70.	71.	83.
100.6	67.	64.	65.
104.6	57.	54.	59.
116.4	39.	40.	40.
120.0	36.	36.	37.
125.0	34.	34.	34.
130.0	32.	32.	32.
140.	28.	28.	24.
150.0	25.	25.	24.
160.	23.	23.	22.
170.	22.	21.	21.
180.	21.	21.	22.
190.	22.	22.	22.
200.	23.	24.	25.
210.	26.	26.	29.
220.	29.	29.	29.
230.	35.	35.	35.
240.	44.	44.	44.
250.	57.	56.	56.
255.	62.	62.	61.
260.08	69.	67.	65.
264.0	85.	85.	103.
265.78	86.	94.	115.
268.50	90.	102.	128.
270.07	96.	104.	130.
271.11	104.	108.	136.
273.23	117.	123.	151.
274.56	119.	132.	152.
275.65	124.	142.	153.
276.31	131.	151.	155.
277.60	150.	169.	158.
278.48	175.	186.	179.
279.53	188.	194.	177.
280.13	192.	193.	175.
282.05	190.	171.	152.
283.30	190.	153.	129.
285.27	168.	125.	109.
286.81	157.	109.	97.
288.10	135.	101.	98.
288.81	127.	102.	106.
290.13	110.	106.	112.
291.44	113.	116.	125.
292.45	117.	127.	141.
294.0	141.	152.	170.
295.0	166.	165.	184.
296.19	209.	188.	192.
297.72	231.	192.	187.
298.50	234.	190.	176.
300.35	211.	173.	153.
300.42	198.	169.	151.
302.44	181.	174.	157.
303.24	192.	180.	161.
304.04	195.	189.	166.
304.53	195.	197.	168.
304.46	194.	191.	168.
305.70	187.	183.	161.
307.0	175.	172.	150.
309.0	161.	150.	138.
310.42	145.	133.	123.
312.34	136.	126.	119.
314.40	132.	127.	114.
316.20	121.	122.	111.
317.91	117.	113.	107.
320.11	103.	92.	91.
323.57	94.	95.	86.
326.0	90.	92.	88.
328.	87.	90.	85.
330.69	88.	87.	83.
335.0	84.	76.	78.
347.71	68.	63.	58.
347.11	65.	54.	55.
355.72	62.	56.	52.

VIS-Intensities [S10]

λ	$\beta = 33.1^\circ$	$\beta = 31.1^\circ$	$\beta = 29.1^\circ$
0.0	60.5	54.5	50.5
2.9	61.5	55.5	51.5
10.0	65.5	59.5	54.5
21.8	71.5	66.5	61.5
30.0	78.5	73.5	68.5
36.8	94.5	97.5	90.5
40.8	98.5	100.5	93.5
46.0	119.5	111.5	102.5
50.0	127.5	115.5	115.5
52.0	134.5	118.5	114.5
53.6	136.5	120.5	125.5
55.5	132.5	120.5	140.5
57.2	121.5	119.5	147.5
63.0	108.5	115.5	153.5
66.0	109.5	112.5	142.5
68.0	109.5	109.5	126.5
70.0	117.5	108.5	115.5
72.0	114.5	107.5	110.5
74.0	114.5	105.5	106.5
76.0	108.5	104.5	105.5
78.0	103.5	101.5	107.5
80.0	96.5	97.5	105.5
83.6	93.5	91.5	101.5
89.2	86.5	85.5	101.5
103.3	58.5	59.5	60.5
116.4	39.9	39.9	40.9
120.0	38.9	38.9	39.4
125.0	36.0	36.0	36.0
130.0	34.0	34.0	34.0
140.0	30.2	30.2	30.2
150.0	27.2	27.2	26.3
160.0	24.3	24.3	23.3
170.0	23.3	22.4	22.4
180.0	22.4	22.4	23.3
190.0	23.3	23.3	23.3
200.0	24.3	25.3	25.3
210.0	28.2	29.2	26.2
220.0	31.1	31.1	31.1
230.0	37.9	37.9	37.9
240.0	46.7	46.7	46.7
250.0	61.5	60.5	61.5
255.0	66.5	66.5	65.5
260.0	86.5	83.5	80.5
264.0	96.5	96.5	116.5
265.8	94.5	103.5	127.5
267.2	96.5	109.5	135.5
269.4	104.5	115.5	145.5
272.4	128.5	131.5	166.5
273.8	133.5	143.5	170.5
275.1	141.5	159.5	178.5
276.0	149.5	172.5	182.5
277.9	180.5	202.5	187.5
278.4	202.5	215.5	197.5
279.6	217.5	223.5	203.5
280.4	228.5	222.5	201.5
281.2	236.5	216.5	192.5
283.0	227.5	188.5	159.5
285.7	198.5	145.5	117.5
287.8	168.5	125.5	119.5
289.0	153.5	123.5	127.5
289.4	148.5	124.5	131.5
290.8	137.5	133.5	142.5
291.7	136.5	142.5	155.5
292.5	139.5	151.5	167.5
294.0	169.5	183.5	204.5
295.0	202.5	201.5	225.5
296.5	256.5	226.5	237.5
297.0	263.5	220.5	229.5
298.2	277.5	225.5	214.5
299.0	270.5	217.5	200.5
300.1	241.5	201.5	175.5
301.0	237.5	198.5	176.5
302.4	216.5	196.5	177.5
303.4	211.5	199.5	175.5
304.0	214.5	207.5	182.5
304.5	214.5	209.5	184.5
305.0	209.5	200.5	182.5
306.4	192.5	189.5	161.5
309.7	170.5	158.5	133.5
311.3	151.5	139.5	130.5
313.4	141.5	134.5	125.5
316.9	124.5	124.5	113.5
320.1	109.5	108.5	96.5
321.7	105.5	106.5	97.5
326.0	94.5	97.5	92.5
334.8	90.5	83.5	83.5
341.4	77.5	67.5	62.5
346.5	66.5	60.5	55.5
355.4	67.5	56.5	51.5

[illegible]-Intensities [S[illegible]]

λ	β=-29.2°	β=-31.2°	β=-33.2
0.	25.	22.	22.
5.	27.	25.	24.
10.	26.	25.	24.
20.	24.	24.	24.
25.	24.	24.	24.
30.	25.	25.	25.
35.	26.	26.	26.
40.	27.	27.	28.
45.	29.	29.	29.
48.7	31.	31.	32.
64.4	66.	77.	69.
68.8	80.	89.	85.
72.8	[illegible]	95.	90.
80.4	118.	106.	89.
86.0	124.	116.	104.
89.8	138.	126.	121.
96.7	160.	141.	131.
99.2	177.	159.	146.
101.1	196.	176.	157.
103.0	217.	195.	171.
104.8	240.	220.	149.
106.7	255.	243.	235.
108.6	264.	261.	266.
110.5	275.	273.	269.
112.3	270.	275.	255.
114.2	249.	264.	250.
116.1	222.	240.	246.
118.0	194.	210.	232.
119.9	167.	181.	206.
121.7	150.	165.	188.
125.5	119.	133.	153.
128.1	97.	112.	123.
133.9	94.	103.	115.
136.8	84.	93.	101.
141.0	77.	79.	86.
145.1	77.	76.	76.
150.2	68.	70.	66.
154.0	63.	67.	64.
156.8	60.	64.	63.
169.8	52.	54.	55.
175.	45.	47.	47.
180.	47.	47.	47.
185.	47.	47.	52.
190.	51.	52.	58.
195.	54.	56.	61.
200.	55.	55.	62.
205.	57.	60.	65.
210.	66.	71.	73.
215.3	83.	85.	91.
216.9	94.	98.	104.
219.3	102.	110.	115.
222.6	114.	129.	140.
225.0	125.	140.	154.
227.2	144.	150.	157.
229.6	156.	158.	152.
231.7	159.	166.	155.
234.0	168.	172.	164.
236.4	163.	179.	170.
237.4	168.	182.	175.
238.0	192.	185.	179.
240.6	208.	219.	224.
241.3	213.	231.	236.
242.0	216.	241.	244.
243.2	229.	261.	256.
243.8	239.	273.	263.
244.1	243.	277.	265.
244.3	243.	275.	262.
244.9	239.	265.	249.
246.1	225.	244.	231.
246.9	223.	236.	234.
247.1	221.	234.	235.
247.6	223.	230.	245.
248.1	220.	242.	262.
249.3	253.	276.	325.
249.7	262.	311.	360.
250.4	269.	339.	381.
251.0	279.	364.	397.
251.6	289.	372.	396.
253.0	321.	416.	392.
253.5	376.	420.	376.
254.2	330.	416.	358.
254.6	329.	403.	344.
255.5	332.	384.	324.
257.2	292.	310.	270.
258.3	275.	286.	257.
260.0	261.	259.	241.
261.1	253.	241.	223.
263.1	233.	221.	204.
268.9	166.	158.	148.
270.3	150.	141.	134.
272.0	148.	130.	124.
273.1	138.	120.	114.
275.1	129.	113.	104.
277.9	114.	99.	90.
280.	105.	89.	84.
285.	77.	81.	76.
290.	65.	65.	62.
295.	56.	55.	52.
300.	50.	48.	48.
305.	46.	45.	45.
310.	41.	41.	41.
315.	37.	37.	37.
320.	33.	33.	35.
325.	31.	31.	31.
330.	29.	29.	29.
335.	26.	27.	27.
340.	25.	25.	26.
345.	23.	24.	24.
350.	22.	23.	23.
355.	22.	23.	23.

Blue-Intensities [S10]

λ	β=-29.2°	β=-31.2°	β=-33
0.	27.	24.	24.
5.	29.	27.	26.
10.	28.	27.	26.
20.	26.	26.	26.
25.	26.	26.	26.
30.	27.	27.	27.
35.	28.	28.	28.
40.	29.	29.	30.
45.	31.	31.	31.
50.	32.	33.	34.
53.0	34.	35.	37.
60.0	41.	44.	45.
65.0	47.	56.	49.
69.6	68.	68.	66.
74.8	74.	78.	69.
85.0	94.	92.	83.
90.2	122.	110.	105.
94.0	151.	125.	118.
95.8	155.	134.	125.
99.6	183.	164.	150.
101.5	201.	189.	160.
105.2	221.	204.	187.
107.1	233.	225.	221.
109.0	241.	240.	245.
110.9	249.	249.	242.
112.7	245.	251.	232.
114.6	229.	244.	235.
116.5	211.	229.	238.
118.4	189.	205.	227.
120.3	170.	185.	211.
122.1	153.	166.	193.
125.9	122.	137.	157.
127.7	108.	124.	139.
131.5	98.	106.	118.
140.0	83.	87.	95.
144.2	80.	80.	81.
149.2	71.	73.	69.
156.8	59.	62.	61.
169.3	49.	51.	52.
175.	48.	51.	51.
180.	50.	51.	51.
185.	51.	51.	56.
190.	55.	56.	62.
195.	59.	60.	66.
200.	59.	59.	67.
205.	61.	64.	70.
210.	71.	76.	79.
215.8	90.	92.	99.
218.9	110.	117.	123.
222.8	120.	135.	149.
227.1	150.	155.	162.
230.7	163.	166.	158.
233.9	177.	176.	168.
236.6	204.	200.	190.
238.3	219.	214.	208.
240.4	236.	247.	251.
243.2	255.	291.	266.
243.8	260.	298.	287.
244.0	262.	300.	287.
244.4	264.	298.	283.
245.2	255.	281.	264.
246.4	238.	256.	246.
246.9	216.	253.	250.
247.2	237.	251.	253.
247.5	239.	253.	263.
247.8	211.	256.	270.
248.5	258.	288.	324.
250.0	287.	351.	404.
251.1	317.	415.	444.
251.6	325.	429.	445.
252.5	318.	457.	440.
253.0	357.	465.	436.
253.5	362.	467.	420.
254.2	380.	461.	396.
254.4	369.	444.	376.
255.3	344.	403.	340.
256.1	326.	367.	305.
257.9	294.	309.	274.
260.2	268.	264.	245.
263.6	231.	219.	203.
265.1	202.	177.	182.
267.2	185.	190.	166.
268.9	174.	163.	153.
271.1	168.	146.	139.
273.4	152.	133.	126.
275.2	137.	120.	111.
277.3	121.	107.	98.
278.9	119.	102.	94.
280.	113.	86.	90.
285.	83.	87.	82.
290.	70.	70.	67.
295.	60.	59.	56.
300.	54.	53.	52.
305.	49.	48.	48.
310.	41.	44.	44.
315.	40.	40.	40.
320.	36.	36.	38.
325.	33.	33.	33.
330.	31.	31.	31.
335.	24.	29.	29.
340.	27.	27.	28.
345.	25.	26.	26.
350.	21.	25.	25.
355.	24.	25.	25.

UV-Intensities [S10]

λ	β=-29.2	β=-34.2	β=-3?.2
0.	29.	26.	26.
5.	31.	29.	28.
10.	30.	29.	28.
20.	28.	26.	28.
25.	24.	28.	28.
30.	29.	29.	29.
35.	30.	30.	30.
40.	31.	31.	32.
45.	33.	31.	33.
50.	34.	35.	36.
54.4	35.	37.	39.
59.9	42.	44.	46.
63.3	47.	48.	44.
70.0	56.	56.	54.
78.3	71.	74.	59.
84.6	98.	86.	77.
90.7	109.	97.	93.
94.5	127.	107.	100.
96.3	134.	117.	109.
98.2	149.	135.	124.
100.1	173.	155.	141.
102.0	195.	176.	155.
103.9	216.	195.	171.
105.7	225.	209.	195.
107.6	226.	220.	221.
109.5	225.	223.	225.
111.4	221.	222.	212.
113.2	209.	216.	200.
115.1	194.	208.	204.
117.0	178.	193.	204.
118.9	163.	177.	198.
120.8	149.	163.	186.
122.6	138.	152.	175.
124.5	128.	143.	165.
126.4	118.	134.	153.
130.2	110.	119.	132.
133.9	93.	104.	116.
136.6	80.	86.	92.
145.2	80.	79.	78.
152.6	66.	69.	66.
160.0	59.	60.	61.
169.3	53.	54.	55.
175.	51.	53.	52.
180.	54.	55.	55.
185.	55.	55.	60.
190.	59.	60.	66.
195.	63.	64.	71.
200.	63.	63.	72.
205.	65.	66.	75.
210.	76.	81.	85.
213.6	84.	91.	97.
215.6	96.	99.	106.
219.9	109.	118.	123.
223.1	118.	133.	146.
226.0	136.	149.	163.
228.5	163.	165.	165.
230.5	175.	179.	169.
232.5	190.	198.	186.
234.4	215.	218.	208.
236.1	238.	234.	222.
237.5	260.	252.	242.
238.9	277.	270.	267.
240.8	281.	299.	306.
242.3	292.	328.	330.
243.2	304.	347.	340.
243.9	305.	350.	336.
244.2	305.	347.	330.
245.2	290.	320.	300.
246.2	270.	292.	277.
247.0	270.	285.	284.
247.6	273.	289.	301.
248.6	296.	314.	362.
249.1	316.	318.	409.
250.0	355.	434.	500.
250.5	458.	453.	507.
251.2	383.	507.	539.
252.0	408.	543.	546.
252.9	437.	571.	538.
253.1	442.	575.	534.
254.0	440.	570.	492.
254.6	443.	544.	484.
255.5	424.	490.	413.
256.4	403.	442.	376.
257.2	378.	402.	349.
258.0	356.	373.	332.
259.1	340.	335.	317.
260.5	327.	311.	291.
261.9	306.	290.	268.
263.2	284.	268.	247.
264.9	249.	242.	222.
266.6	222.	218.	201.
268.4	206.	196.	183.
270.4	197.	178.	170.
271.4	187.	165.	157.
273.1	171.	152.	144.
275.5	155.	135.	124.
277.1	145.	126.	115.
278.8	135.	116.	107.
280.4	122.	111.	104.
282.0	114.	104.	98.
283.9	98.	94.	92.
285.7	94.	91.	88.
287.2	86.	85.	84.
287.5	83.	85.	80.
289.1	79.	79.	76.
295.	64.	63.	60.
300.	58.	57.	58.
305.	57.	51.	51.
310.	47.	47.	47.
315.	43.	41.	43.
320.	39.	39.	41.
325.	35.	35.	35.
330.	33.	33.	33.
335.	30.	31.	31.
340.	29.	29.	30.
345.	27.	28.	28.
350.	26.	27.	27.
355.	26.	27.	27.

λ	β=-14.2°	β=-16.2°	β=-18.2°
0.	26.	26.	25.
10.	24.	24.	24.
20.	25.	25.	25.
30.	25.	25.	25.
35.	26.	26.	26.
40.	27.	27.	26.
45.	41.	32.	27.
50.	50.	35.	37.
55.	52.	40.	51.
57.2	53.	47.	53.
59.0	54.	52.	54.
62.7	59.	58.	55.
64.6	64.	60.	58.
68.4	78.	76.	76.
70.5	90.	88.	92.
72.2	98.	96.	100.
75.9	106.	103.	108.
77.9	111.	109.	116.
79.6	119.	117.	126.
83.4	160.	139.	145.
87.3	193.	165.	140.
91.0	201.	179.	146.
92.9	207.	184.	152.
94.7	217.	203.	171.
98.6	225.	230.	227.
100.5	220.	232.	233.
102.3	214.	227.	220.
106.2	192.	197.	193.
110.0	150.	154.	152.
111.7	132.	141.	142.
113.6	109.	121.	121.
115.5	97.	112.	111.
117.3	86.	96.	97.
119.2	78.	83.	88.
123.0	78.	81.	86.
124.9	79.	80.	89.
126.8	77.	77.	86.
130.4	74.	73.	81.
134.4	68.	66.	64.
136.3	63.	62.	59.
138.0	58.	57.	54.
141.	52.	53.	52.
150.	43.	47.	47.
155.	38.	41.	45.
160.	36.	38.	42.
165.	34.	40.	42.
170.	33.	40.	40.
175.	33.	39.	38.
180.	33.	34.	37.
185.	34.	35.	40.
190.	36.	35.	38.
195.	40.	39.	38.
200.	41.	41.	42.
205.	45.	42.	45.
210.	47.	48.	47.
215.	48.	54.	55.
220.	53.	60.	64.
223.0	59.	64.	70.
233.0	61.	67.	81.
235.3	64.	70.	91.
239.4	80.	72.	114.
241.1	87.	83.	106.
249.2	84.	79.	85.
249.9	86.	81.	88.
251.1	94.	93.	92.
251.7	111.	114.	111.
254.0	216.	255.	257.
254.6	225.	270.	272.
255.8	224.	274.	265.
256.7	228.	271.	250.
257.1	222.	261.	234.
257.8	215.	243.	216.
258.8	201.	219.	194.
259.5	195.	210.	185.
260.0	195.	204.	169.
261.1	194.	212.	198.
261.9	207.	221.	215.
264.7	265.	290.	294.
268.	373.	350.	321.
268.0	395.	367.	322.
269.3	404.	367.	310.
269.[illegible]	410.	362.	309.
271.3	371.	320.	270.
274.	290.	257.	222.
277.1	224.	206.	141.
279.4	164.	167.	161.
281.7	155.	141.	130.
283.7	137.	125.	121.
284.9	126.	116.	112.
285.	115.	106.	103.
287.	103.	99.	94.
290.7	93.	92.	87.
294.4	87.	86.	79.
297.4	78.	75.	69.
300.0	71.	66.	61.
305.	60.	60.	58.
310.	54.	48.	54.
315.	51.	43.	55.
320.	36.	35.	41.
325.	33.	33.	32.
330.	31.	31.	30.
335.	29.	29.	29.
340.	28.	28.	27.
345.	29.	28.	26.
350.	28.	27.	26.
355.	27.	26.	25.

VIS- Intensities [S10]

λ	β=-14.2°	β=-16.2°	β=-18.2°
0.	28.	28.	27.
10.	26.	26.	26.
20.	27.	27.	27.
30.	27.	27.	27.
35.	28.	28.	28.
40.	29.	29.	28.
45.	41.	34.	29.
50.	54.	38.	40.
55.	57.	43.	55.
57.1	57.	50.	57.
59.0	58.	56.	58.
60.8	59.	58.	57.
62.8	61.	54.	56.
64.6	64.	61.	57.
70.3	69.	68.	71.
72.1	74.	72.	75.
74.0	83.	80.	84.
75.9	94.	91.	90.
77.8	103.	100.	107.
83.5	140.	121.	126.
85.5	154.	130.	132.
87.4	165.	141.	124.
89.2	179.	156.	129.
91.0	197.	175.	143.
92.8	213.	195.	173.
94.7	226.	212.	183.
96.8	226.	219.	203.
98.7	215.	220.	218.
100.4	213.	224.	226.
102.5	213.	225.	216.
104.5	207.	214.	206.
106.0	188.	193.	188.
108.0	164.	169.	170.
110.0	144.	149.	151.
111.8	126.	135.	136.
113.7	112.	125.	125.
115.5	101.	116.	115.
117.5	93.	104.	106.
121.1	90.	94.	101.
124.7	85.	87.	96.
128.6	81.	80.	90.
130.4	76.	75.	84.
132.4	67.	66.	64.
134.3	62.	60.	58.
136.2	58.	57.	54.
137.9	56.	55.	53.
141.7	53.	54.	53.
150.	46.	51.	51.
155.	41.	49.	48.
160.	39.	42.	45.
165.	37.	43.	45.
170.	36.	42.	43.
175.	36.	36.	39.
180.	36.	37.	40.
185.	37.	36.	43.
190.	41.	38.	41.
195.	43.	42.	41.
200.	44.	44.	45.
205.	48.	45.	49.
210.	50.	52.	51.
215.	52.	56.	59.
220.	57.	64.	69.
223.	63.	68.	75.
226.6	72.	76.	84.
227.6	74.	76.	87.
231.1	74.	78.	88.
234.4	72.	80.	100.
235.3	73.	81.	105.
237.8	97.	96.	119.
243.[illegible]	98.	99.	114.
245.[illegible]	96.	94.	107.
246.9	97.	90.	99.
249.5	98.	92.	98.
250.0	102.	96.	99.
250.6	107.	105.	105.
251.3	119.	120.	116.
252.0	135.	141.	137.
253.2	168.	186.	187.
253.7	174.	207.	202.
254.5	180.	216.	217.
255.4	186.	224.	221.
256.0	188.	226.	216.
259.5	207.	223.	196.
260.5	212.	225.	204.
261.2	218.	231.	217.
261.6	224.	239.	229.
262.7	234.	258.	256.
263.5	249.	278.	284.
264.8	294.	326.	334.
265.9	344.	361.	356.
266.9	378.	376.	360.
267.9	400.	344.	350.
268.6	416.	343.	337.
269.6	423.	377.	323.
270.3	418.	366.	311.
272.7	363.	314.	266.
277.2	236.	213.	198.
279.0	205.	145.	176.
280.5	178.	131.	156.
281.[illegible]	168.	152.	147.
282.4	155.	142.	136.
285.4	127.	116.	113.
286.[illegible]	116.	110.	105.
287.6	111.	107.	102.
288.[illegible]	104.	105.	100.
293.7	97.	96.	88.
295.0	94.	93.	85.
299.8	76.	71.	80.
305.	64.	64.	62.
310.	58.	52.	50.
315.	55.	46.	59.
320.	39.	38.	44.
325.	36.	39.	34.
330.	33.	33.	32.
335.	31.	31.	31.
340.	30.	30.	29.
345.	31.	30.	28.

λ	β=-14.2°	β=-16.2°	β=-18.2°
0.	30.	30.	29.
10.	28.	28.	28.
20.	29.	27.	29.
30.	24.	29.	29.
35.	30.	30.	30.
40.	31.	31.	30.
45.	47.	36.	31.
50.	58.	41.	43.
55.	60.	46.	59.
57.1	59.	52.	59.
60.9	57.	57.	56.
64.6	63.	60.	55.
70.2	74.	66.	61.
72.2	71.	70.	73.
74.0	81.	79.	82.
77.2	109.	106.	114.
78.5	116.	114.	122.
80.4	130.	125.	135.
84.3	163.	138.	141.
87.9	180.	155.	132.
89.8	186.	163.	134.
91.7	185.	167.	138.
93.6	188.	173.	137.
95.5	184.	175.	155.
99.3	190.	197.	198.
101.1	194.	205.	203.
103.1	189.	196.	191.
104.3	178.	184.	176.
108.7	150.	154.	156.
110.3	142.	148.	151.
112.4	128.	139.	140.
116.2	93.	106.	106.
117.3	92.	102.	104.
119.3	88.	94.	99.
123.0	87.	84.	92.
124.9	79.	80.	88.
128.7	77.	76.	86.
132.4	77.	75.	78.
134.2	75.	73.	71.
138.0	65.	63.	61.
139.8	62.	61.	60.
141.8	59.	60.	59.
150.	49.	55.	55.
155.	44.	47.	51.
160.	42.	45.	48.
165.	40.	46.	48.
170.	39.	45.	46.
175.	39.	41.	42.
180.	39.	40.	43.
185.	40.	41.	46.
190.	44.	41.	44.
195.	46.	45.	44.
200.	47.	47.	46.
205.	51.	48.	51.
210.	54.	56.	55.
215.	56.	62.	63.
220.	61.	68.	74.
223.0	68.	74.	80.
227.0	79.	83.	93.
233.0	80.	87.	103.
236.1	85.	93.	126.
240.1	103.	104.	143.
241.6	105.	106.	131.
246.9	108.	103.	116.
247.7	111.	104.	120.
249.0	117.	110.	120.
250.1	135.	129.	132.
252.0	182.	182.	185.
254.0	212.	250.	252.
254.5	217.	260.	262.
255.2	217.	261.	261.
256.3	218.	261.	246.
257.2	222.	260.	236.
258.4	239.	264.	243.
259.2	257.	273.	240.
260.2	264.	287.	252.
261.3	279.	296.	276.
263.2	320.	358.	363.
265.4	405.	425.	422.
266.4	444.	448.	427.
268.0	495.	472.	425.
268.5	516.	476.	418.
269.0	526.	475.	410.
269.6	525.	467.	406.
270.2	499.	438.	372.
272.1	394.	341.	290.
273.1	358.	311.	266.
275.0	307.	275.	241.
277.1	261.	236.	219.
280.7	195.	176.	171.
281.5	172.	166.	160.
282.0	166.	152.	146.
286.1	138.	130.	124.
288.1	119.	116.	111.
289.1	113.	111.	106.
290.3	111.	110.	105.
292.0	111.	111.	104.
292.[illegible]	111.	110.	103.
293.0	107.	106.	98.
296.2	96.	94.	86.
299.8	82.	77.	71.
305.	68.	68.	66.
310.	62.	56.	60.
315.	54.	49.	63.
320.	47.	41.	47.
325.	39.	39.	36.
330.	35.	35.	34.
335.	33.	33.	33.
340.	32.	32.	31.
345.	31.	32.	30.
350.	33.	[illegible]	[illegible]

Factor 3 $= \frac{\lambda_{STAR} - \lambda_{min}}{2 \times DL}$

considers the location of the star in the FOV in the transition region between two neighbouring sectors.

So we have the total signal I_{tot} of a single bright star:

I_{tot} = I x Factor 1 x Factor 2 x Factor 3

For very bright stars, located near the sector edge the intensity I_{tot} can't be determined precisely. For that case there is a notice for user (see section 8).
In detail this means:

If (for sector n) $B_{STAR} \begin{array}{l} < 3.50 \text{ (PMT } 15^{\circ}) \\ < 2.75 \text{ (PMT } 30^{\circ}) \end{array}$ <u>and</u> $\Delta\beta <$ (D2B+0.1)

a'*'is put in the corresponding word (see section 8.2.2, words 513-544).

If (for sector n) $B_{STAR} \begin{array}{l} < 5.50 \text{ (PMT } 15^{\circ}) \\ < 4.75 \text{ (PMT } 30^{\circ}) \end{array}$ <u>and</u> $\Delta\beta <$ D2B and $\Delta\beta >$ (INR-0.1)

a'+'is put in the corresponding word (see section 8.2.2, words 545-576).

If a bright star is in the transition region between two sectors, the warnings only are given in one of them.

In the field of view of the 90°-photometer from Helios B there are no stars brighter than the magnitude-limits V = 6.50, B = 7.13, U = 7.28.

Table 3.3 is a printout of the star catalogue we used. It covers the latitude bands $-16.2 \pm 2.5^{\circ}$, $-31.2 \pm 3.2^{\circ}$, $+16.1 \pm 2.5^{\circ}$, $+31.1 \pm 3.2^{\circ}$, which is sufficient except for the few days on which attitude maneuvers occured (see section 9).

3.2.2 Background starlight

For galactic latitudes $|b^{II}| < 20^o$ UBV-brightnesses of the milky way were derived from Helios-data (see Leinert and Richter, Astron. Astrophys., in press). For medium galactic latitudes Classens (1976) Blue Photometry of the Milky Way was used, the required values for U and V were derived from blue Values by the colours B-V = 0.70, U-B = 0.23, corresponding to Mattila's (1980) milky way model.

For galactic latitudes $|b^{II}| > 50^o$ the averages of star counts from Roach and Megill (1961) and Sharov and Lipaeva (1973) were used, the U and V values were derived in the same way as mentioned above. Table 3.4 shows the UBV intensities of starlight background given for λ and three ecliptic latitude bands for the photometer -31^o, -16^o, $+16^o$, $+31^o$. (A detail: at $|b| < 20^o$ the relative intensities essentially are from Classen, being normalized by the absolute values of the Helios measurements.) The starbackground was interpolated from table 3.4 for each sector; thereby the medium and long sectors were divided in segments of 5.625 degrees, so we have 64 short sectors. If the sector latitude β is outside of the three latitude bands, a warning is given in the appropriate word (*) (see section 8.2.2, words 449-480). During an orbit of Helios B the intensity of starbackground at north ecliptic pole was changing by about 1-2 S10 with a constant gradient. So the starbackground in the field of view of the 90^o photometer after calculation of ecliptical coordinates is given by

$$I_U = 48.6 \cdot I_o$$
$$I_B = 52.0 \cdot I_o \qquad \text{(S10)}$$
$$I_V = (62.7) \cdot I_o$$

$$I_o = 1.0 + 0.0265 \cdot (0.882 \cdot (90.0-\beta) \cos\lambda + 0.471 \cdot (90.0-\beta) \cdot \sin\lambda).$$

The factor in parantheses is of historical interest only, although it was used to create the zodiacal-light-data tapes. Meanwhile we prefer to use here Mattila's predicted colours, too. The factor is 52.0 x 1.067 = 55.5 in V, while it does not have to be changed in U.

3.2.3 Light scattered by interplanetary plasma

The scattering by the electrons of the interplanetary plasma was calculated from the spatial distribution

$$n_{el} = 7.4 \times (1\ \text{A.U.}/r)^{2.2} \quad cm^{-3} \tag{1}$$

which Edenhofer et al. (1976) derived from an analysis of the Helios telemetry signals. This represents a large scale average in the ecliptic during the minimum of solar cycle 1975/76, the time interval to which most of our data refer. A gradual decrease of plasma density outside the solar equatorial plane was added, calculated on the assumption of constant flux from the velocity increase with heliographic latitude Ø

$$V(\emptyset) = 425 + 2.1\ \emptyset\ (^{o}) \quad km/s \tag{2}$$

which is an average of what Coles and Rickett (1976) found from interplanetary scintillations during the period 1971-75. The well known scattering function for electrons is

$$S_1(V) = \frac{1}{2}\left(\frac{e^2}{mc^2}\right)^2, \quad S_2(V) = \frac{1}{2}\left(\frac{e^2}{mc^2}\right)^2 \cdot \cos^2\vartheta \quad cm^2\ sr^{-1} \qquad \text{(cgs-units)} \tag{3}$$

where ϑ is the scattering angle and the suscripts refer to scattering of the incoming unpolarized light perpendicular and parallel to the scattering plane.

For measurements with polarizing film the effect of this film has to be taken into account.

First we calculate what the direction of polarization of electron scattered light (perpendicular to the scattering plane) is in the spacecraft frame.

$$\text{REPHI (sector n)} = \pm \text{ asin } (\sin\sigma \sin(i_n - \theta)/\sin(90^o + h))$$

The + is valid for $\varepsilon_n > 90^o$, the - for $\varepsilon_n < 90^o$

$-90^o \leq \text{REPHI} \leq +90^o$, counterclockwise on the sky,
$= 90^o$ for direction parallel to spin axis.

The contribution of electron scattered light through a polarizing film at angle φ with polarizing ability q then is

$$\text{REFILT} = I_{(el.)} + I_{pol}(el.) \cdot q \cdot \cos 2(\varphi - \text{REPHI (sector n)})$$

For photometer 90^{o}, based on calculations with the above assumptions (1), (2) and (3) we adopted a contribution interplanetary plasma of

$$I_{el} = (0.54 + 0.0155 \cdot \sin \lambda_{Hel}) \cdot (\varepsilon/90^{o})^{-1.52} \cdot R^{-3.2} . \quad (S10)$$

The polarization is taken as $P_{el} = 0.60$.

3.2.4 Zodiacal light

Finally the zodiacal light is given by subtraction of starlight and scattered light by plasma from reduced data.

Table 3.5 summarizes isophote wavelengths, effective wavelength for solar spectrum and equivalent power per 1 S10 for the experimente channels.

Table 3.5 Wavelengths and sensitivities of experiment channels

		λ_{iso} (nm)	λ_{eff} (nm)	10^{-12} W cm^{-2} sr^{-1} μm^{-1} per S10
-16°	U	362	364	0.639
	B	422	428	1.029
	V	544	540	1.221
-31°	U	360	363	0.644
	B	418	424	1.017
	V	538	535	1.230
-90°	U	360	362	0.645
	B	414	421	1.002
	V	521	519	1.251
$+16^{\circ}$	U	364	366	0.659
	B	417	424	1.023
	V	522	520	1.249
$+31^{\circ}$	U	359	362	0.643
	B	417	423	1.017
	V	523	522	1.248
$+90^{\circ}$	U	366	370	0.651
	B	424	430	1.011
	V	547	543	1.213

Helios A zodiacal light data tapes contain no data of photometer 90°: the evaluation is more difficult because of the proximity of the Large Magellanic Cloud and a wobble of 0.35° (one antenna did not extend); we preferred not to computerize it. The measured values are on the reduced-data-tape.

3.3 Processing of polarization data

This was the only tough task in the Helios data evaluation, and some manipulation was necessary before the data appeared credible to us. There is no problem with photometer 90°, which, by the spacecraft spin, is rotated once per second about its optical axis. Insertion of a polarizing foil leads to a modulation of transmitted intensity with twice the spin frequency, from which the polarization is extracted by the standard method of measuring in eight 45° intervals.

In the other photometers polarization is being determined by consecutive measurements through three polarizing foils, oriented at 0°, 45° and 90° with respect to the sapcecraft equatorial plane. For each sector we thus

Table 3.6: Properties of polarizing films

		Polarizing ability			Orientation in spacecraft system		
		q_0	q_{90}	q_{45}	φ_0	φ_{90}	φ_{45}
- 16°	U	0.831	0.832	0.813	-2.08	90.08	134.10
	B	0.824	0.827	0.831		"	
	V	0.964	0.980	0.970		"	
- 31°	V	0.967	0.991	0.979	-1.7	84.8	44.4
+ 16°	U	0.905	0.925	0.861	1.09	92.50	136.82
	B	0.956	0.972	0.916		"	
	V	0.972	0.993	0.966		"	
+ 31°	V	0.967	0.991	0.991	0.4	88.8	44.3

obtain measured signals in S10 units, So, S45 and S90, from each of which the contributions of stellar background and interplanetary plasma are subtracted. For the latter correction which consists of light polarized by typically 60% perpendicular to the scattering plane we have to take care of the actual orientation φ and polarizing ability q of each individual polarizing foil. Values for q were 0.81-0.92 in U, 0.75-0.97 in B, 0.96-0.99 in V. The resulting corrected signals S_o^c, S_{45}^c, S_{90}^c are related to the Stokes parameters I_{Z1}, Q_{Z1}, U_{Z1} of the zodiacal light by the equations

$$
\begin{aligned}
S_o^c &= I_{Z1} + Q_{Z1}\, q_o \cos 2\varphi_o + U_{Z1}\, q_o \sin 2\varphi_o \\
S_{45}^c &= I_{Z1} + Q_{Z1}\, q_{45} \cos 2\varphi_{45} + U_{Z1}\, q_{45} \sin 2\varphi_{45} \\
S_{90}^c &= I_{Z1} + Q_{Z1}\, q_{90} \cos 2\varphi_{90} + U_{Z1}\, q_{90} \sin 2\varphi_{90}
\end{aligned}
\tag{4}
$$

where φ_o, φ_{45}, φ_{90} give the actual orientation of the polarizing foils with respect to the spacecraft equatorial plane as measured on ground. The equations were solved for the Stokes parameters to give the degree of polarization

$$p = \frac{\sqrt{Q_{Z1}^2 + U_{Z1}^2}}{I_{Z1}} \tag{5}$$

and angle of polarization

$$\theta_{Pol} = \frac{1}{2}\, a \tan \left(\frac{U_{Z1}}{Q_{Z1}} \right) \tag{6}$$

of the zodiacal light. By simple spherical geometry θ_{Pol} is transformed into an angle relative to the scattering plane (see section 3.2.3). (S_0^c and S_{90}^c are corrected to heliocentric distance R of S_{45}^c).

Two unexpected difficulties appeared:

First we noticed that even in perihelion, where background corrections are small, the calculated polarization showed several unwanted features (see Figure 3):

a) The direction of polarization deviated by about 5^o from the expected direction normal to the scattering plane. This effect was not symmetric with respect to the sun.

b) The degree of polarization at equal angular distances east or west of the sun was different by several percent.

c) The polarization near the antisolar direction still was up to several percent.

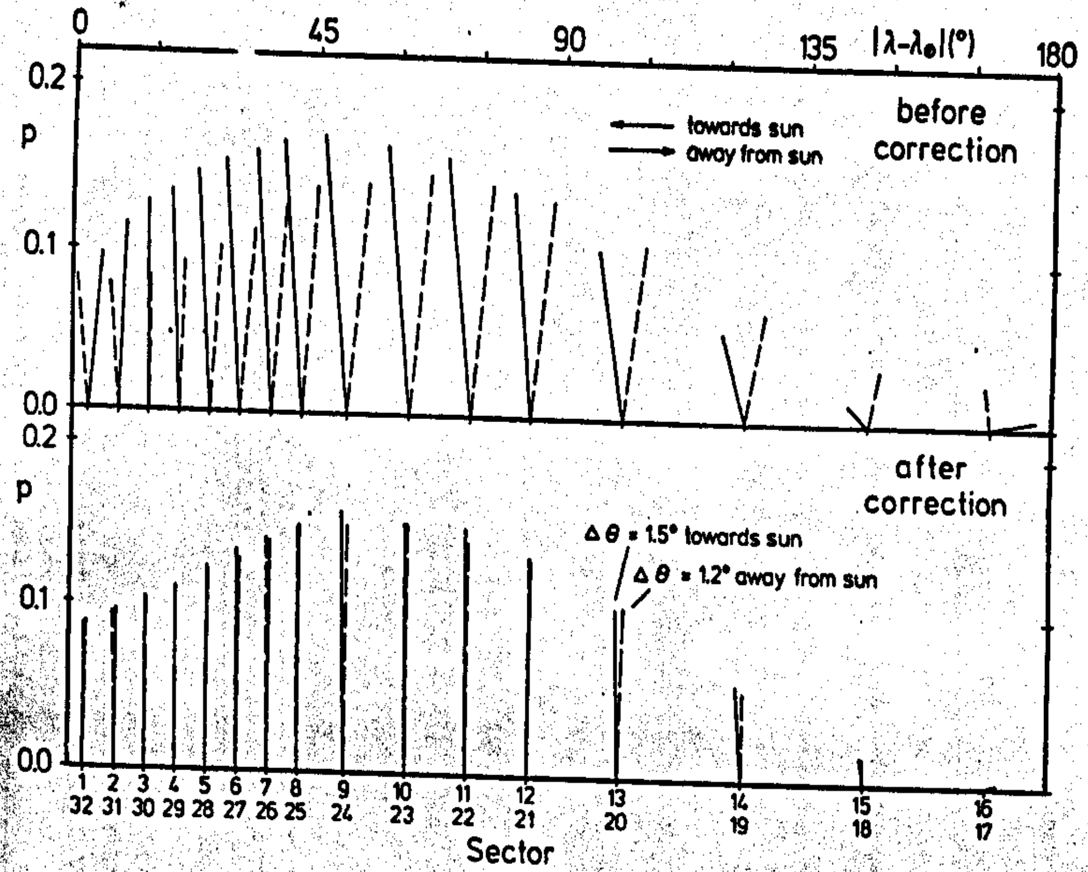
d) Bright stars showed polarizations of 2-3%.

Instrumental scattered light and star background were excluded as source of the trouble. Tests on the spare unit did not show such a malfunction. Since the effects were repeatable from orbit to orbit we decided it was an instrumental effect, some parameters being different in flight with respect to the laboratory calibration.

From equations (4) we found that the only parameters on which the result depended strongly were the relative calibration of the signals S_o, S_{45}, S_{90}. Accordingly, for each photometer and each colour we varied the relative calibration of S_{45}/S_o and S_{90}/S_o independently in steps of 0.5% and calculated the polarization of zodiacal light in perihelion, including the contribution of interplanetary plasma. We then determined, for each point of the resulting grid, the average deviation of the direction of polarization from the nominal value perpendicular to the scattering plane, for the eight sectors east and west of the sun which are at less than 50^o elongation. We judged that this quantity,

$$D = \left(\frac{1}{16} \sum_{i=1}^{16} \Delta \theta_{i_{Pol}}^{2} \right)^{1/2} \tag{7}$$

would be least affected by uncertainties in star background or three dimensional distribution of interplanetary dust. We adopted that change in relative calibration which minimized the deviation D. For the case shown in Figure 3 this was a 2% change in the relative calibration S_{45}/S_o, retaining the relative calibration S_{90}/S_o. Now the directions of polarization showed an offset of $+1^o$ (counter clockwise on the sky). Since this effect appeared in all photometers and colours considered here, we took it for real and corrected for it. Instrumental reasons for this, although small, effect could be an error in our test equipment or, more probably, a change



<u>Fig. 3 :</u>

Effect of the correction in relative transmission of the polarization foils in Helios 2, photometer 15^{o} V. Data are from day 108/1976, measured in perihelion (R=0.29 A.U.). Polarization for each sector is given by a bar (—— east, --- west of the sun), the length of which gives the degree of polarization. The direction of polarization with respect to the scattering plane is given by the direction of the bar, perpendicular orientation corresponding to the nominal direction perpendicular to the scattering plane. In this case the relative calibration S_{45}/S_{o} was changed by a factor of 0.98.

from the idle position during tests on ground to the rapid spinning in flight. Finally the following improvements were achieved (numbers in a,b,c referring to Figure 3):

a) The direction of polarization for $\varepsilon < 50^{\circ}$ could nearly be forced into nominal direction, with $D = 0.4^{\circ}$ instead of $D = 3.7^{\circ}$. But also for other sectors and for observations at other heliocentric distances no systematic deviation remained.

b) The difference in degree of polarization east and west of the sun effectively disappeared, changing from 0.037 to 0.002 in perihelion, being reduced below 0.01 also in aphelion.

c) The degree of polarization near the antisolar direction was reduced from 2.6% to 0.4% in perihelion and similarly in aphelion.

d) The polarization in the signal of bright stars decreased from 2-3% to $\approx$0.5%.

e) As should be expected, the polarization data now were smoothest in V and showed the largest scatter in U.

This general behaviour increased our confidence that we were correcting for a real effect and not forcing the data into an arbitrary mould.The corrections necessary in the relative calibrations of the polarizing foils in the average were 1.3% with a maximum of 3.0% in the ratio S_{90}/S_{0} in U of photometer 16° of Helios B.

The above procedure is not as arbitrary as might appear at a first glance. The transmission of one of the polarizing foils in photometer 16^o is being checked by a monitoring lamp. It showed a decrease by 2% with respect to ground-based operation. In addition, the average transmission of the three polarization foils in one photometer can be determined by comparing the zodiacal light intensities observed through a naked colour filter with that resulting from equations (4). The measurements with polarization foil were lower by 2% in V, 6% in B, 9% in U for photometer 16^o of Helios 2 and by a somewhat smaller amount for Helios 1. We blame slight differences in the degradation of the polarizing foils and slight errors in the laboratory calibration of their relative transmission for the corrections discussed above. To summarize, we calculated polarizations from equations (4) only after two corrections to the signals S_o, S_{45}, S_{90}: a correction to the relative calibration as discussed above and a correction to the absolute calibration of all three polarizing foils taking care of the observed decrease in transmission.

The second unexpected difficulty was the large scatter in the degree of polarization observed in photometer 16^o in aphelion at large angular distances from the sun. In these cases the zodiacal light signal in U with polarizing foil may be as low as 450 counts per second at the photomultiplier, only slight by higher than the dark count rate, and about twice this value in B and V. The scatter in the dark current, which in flight increased to about 10 times the value expected from statistics, then gave rise to spurious "observed" polarizations of up to 10-20%. Averaging the Stokes Parameters of 5-10 subsequent measurements reduced this noise to a level where meaningful polarizations could be derived also for the least luminous parts of our strips on the sky. (see section 14.)

Table 3.7 summarizes the adopted change in relative calibration and orientation of the polarizing films (see table 3.6).

Table 3.7: Adopted change in properties of polarizing films

		Multiply S10 by factor Film 90°	Film 45°	Change φ for all three film by
- 16°	U	0.99	1.025	- 1.1°
	B	0.98	0.995	- 1.1°
	V	0.985	0.99	- 1.1°
- 31°	V	0.998	1.008	- 0.5°
+ 16°	U	1.03	0.995	- 1.0°
	B	1.02	1.011	- 1.0°
	V	1.00	0.98	- 1.0°
+ 31°	V	1.015	1.005	- 0.6°

Note that application of these factors also changes the absolute intensity. This change does not appear in the data. It is absorbed in the correction for decreased transmission.

3.4 Normalization of zodiacal light to the plane of symmetry of interplanetary dust and to 1 A.U.

Table 3.8 gives a survey about the parameter of the orbits of Helios 1 and Helios 2

	Helios 1	Helios 2
Perihel	0.310 AE	0.290 AE
a	0.647 AE	0.637 AE
e	0.522	0.554
i	0.016°	0.019°
Länge des Aphels	77.5°	113.9°
Startdatum	10.12.74	15.1.76
Periode	190.1 d	185.7 d

Even if the zodiacal light were perfectly constant in time the Helios photometers would notice a temporal change for the following reasons:

a) the intensity strongly depends on the heliocentric distance of Helios, the increase towards the sun being $I(R) \sim R^{-2.3}$.

b) Because of the tilt of the plane of symmetry of interplanetary dust with respect to the ecliptic ($i = 3.0^{\circ}$, $\Omega = 87^{\circ}$, Leinert et al., 1980) there is an asymmetry between observations east and west of the sun which varies along the orbit of Helios approximately proportional to $\cos(\lambda_{Helios} - \Omega)$. (See Leinert et al., 1980, Figures 4 and 5.). The size of this effect, up to ±7%, was determined individually for each sector from Helios 2 observations, when the spacecraft was in the node. It was assumed that the effect had the same size for Helios 1. This effect only applies to sensors 15° and 30°.

It is taken into account by the factor

$$\text{RELIAS} = 1 + \text{AS}(k,n) \cdot \cos(\lambda_{\text{Hel}} - \Omega), \quad n = 1 \ldots 16$$
$$K = 1,2 \; (\hat{=} \text{ PMT } 15^\circ, \text{ PMT } 30^\circ)$$

For sectors 17 to 32 $\text{AS}(k, 33-n) = -\text{AS}(k,n)$

Numerical values of the constants are as follows:

```
     DATA((AS(K,N),N=1,16),K=1,2)/0.007,0.024,0.035,0.044,0.050,
  +  0.056,0.061,0.065,0.068,0.068,0.064,0.058,0.047,0.034,0.021,
  +  0.004,0.005,0.013,0.019,0.025,0.028,0.034,0.038,0.043,0.048,
  +  0.052,0.050,0.046,0.039,0.027,0.015,0.004/
```

c) The motion of Helios with the respect to the plane of symmetry still leads to a modulation of the average of observations east and west of the sun, now approximately proportional to $\sin(\lambda_{\text{Helios}} - \Omega)$ (Dumont and Levasseur-Regourd, 1978). From Helios this cannot be observed directly, but inferred from the difference between observations on the ingoing and outgoing branch of the orbit, which is approximately proportional to $\sin(\lambda_{\text{Helios}} - \lambda_{\text{aphelion}})$. From these two modulations the second, observable one is smaller by a factor $\cos(\Omega - \lambda_{\text{aphelion}})$, as follows from the geometric relation of the angles involved. The observed variation for Helios 2 was $\pm 6\%$ in sensor 15°, $\pm 8.5\%$ in sensor 30°. For sensor 90° the modulation of $\pm 3.8\% \cdot i(^\circ)$ was taken from Dumont and Levasseur-Regourd (1978). It was assumed that the effect had the same size for Helios 1, except for the correction for the different longitude of aphelion.

To summarize, this factor is

$$BAHNEF = 1 + \left[BC/\cos(\Omega - \lambda_{aphelion})\right] \cdot \sin(\lambda_{Hel} - \Omega) \cdot FHEL$$

FHEL = 1 for Helios B, -1 for Helios A

BC = 0.06, 0.085 for photometers 15°, 30°.

d) Any change in spin axis orientation moves the field of view on the sky, changing the observed zodiacal light intensity. A rotation of the spin axis around the sun-Helios-line leads to an asymmetry in observations east and west of the sun. Since the effect of the 3° tilt of the plane of symmetry is known, any such rotation of the spin axis also can be corrected for. For a tilt of the spin axis towards or away from the sun we read the correction factor between the intensity in the actual field of view and that expected for nominal spin axis orientation from the table given by Dumont and Sanchez (1976). For $\varepsilon <$ 30° this factor was determined by model calculations.

Similarly as in b) the deviation of spin-axis angle θ from nominal value (90° for Helios A, 270° for Helios B) is taken into account by

$$SPACHS = AS\ (k,n) \cdot \Delta\theta\ /\ 3.0^{\circ}.$$

Quantitatively the correction for deviation of spin axis angle σ from nominal value 90° reads

$$SIGEFF = 1 - CSIG\ (k,n) \cdot \Delta\sigma$$

n = 1 ...16
K = 1,2 ($\hat{=}$ PMT 15°, PMT 30°)

For sector 17 to 32: CSIG (k,33-n) = CSIG(n),

with the following numerical values:

```
    DATA((CSIG(K,N),N=1,16),K=1,2)/0.125,0.118,0.095,0.079,0.066,
 +  0.055,0.046,0.038,0.028,0.019,0.011,0.004,-0.003,-0.011,
 +  -0.016,-0.018,0.063,0.061,0.058,0.054,0.048,0.043,0.038,
 +  0.033,0.026,0.017,0.009,0.005,-0.001,-0.007,-0.012,-0.016/
```

Applying corrections b-d to our data, we obtain intensities as they would be observed by an observer in the plane of symmetry at a latitude of $|\beta| = 16.2^o$, 31.0^o or 90^o with respect to that plane. Scaling to a heliocentric distance of 1 A.U. is done with a factor $R^{+2.3}$.

In formulae, the observed intensity is normalized to 1 A.U. in the plane of symmetry, nominal spin axis position by

$$I_{norm} = I \cdot R^{2.3} / \text{BAHNEF} \cdot \text{SIGEFF} \cdot (\text{RELIAS} + \text{SPACHS})$$

For photometer 90^o the case is much simpler according to Dumont and Levasseur-Regourd (1978).

$$I_{Norm} = I \cdot R^{2.3} / [1 + 0.0382 \cdot i\ (^o) \cdot \sin\ (\lambda_{Hel} - \Omega)]$$

The correction to nominal spin axis orientation is <u>not</u> applied on the tape. It would amount to

$$\text{Factor } 90 = (\varepsilon/90)^{-1.125}$$

or typically +0.7% for Helios B.

Also we give 90^o-intensities transformed to the average between inbound and outbound parts of the orbit:

$$I_{between} = I \cdot R^{2.3} / (1 + 0.1 \sin\ (\lambda_{Hel} - \lambda_{Aphelion}) .$$

I_{norm} and $I_{between}$ of photometer 90^o refer to the adopted calibration. (See "Description of the reduced data tape ...", available at NSSDC).

The possibility for confusions is enlarged by the fact that we also calculated corrected intensities I_c (see section 8.2.3), applying the correction for decreased transmission of polarizing films as determined from sensor 16^o of Helios B (see section 3.3). We also calculate "normalized" and "between" intensities from these corrected intensities.

4. Labelling

The reel-number of a zodiacal-light-data-tape informs the user about the contents of the zodiacal-light-data tape: The reel-number contains 6 symbols:

1.: The first symbol is always the letter "Z" as an identification for a zodiacal-light-data-tape

2.-4.: These letters are always one of the two combinations "HEA" or "HEB" were "A" means Helios A (or Helios 1) and "B" means Helios B (or Helios 2)

5.-6.: means the month from launch of the data

For example: ZHEB05

means: zodiacal-light-data-tape, containing data of Helios B from the fifth month from launch (=May 1976)
(see also chap. 13)

5. Contents and tape structure

Normally a zodiacal-light-data-tape contains the measurement-cycles (MC) of one month.

The various records (single measurements for the various filter combination) of photometer 15° and 30°, to be contained in one MC are contained in one file.

The first record of each MC-file is always the MC-header-record (see Figure 4), the number of sequenced records is at most 23, so the MC-file may be containing between 1 and 24 records.

All records of the 90°-photometer contained in the N MC's of one month, are summarized - separately for the colours UV, Blue, VIS - in three files.

The three 90°-Files don't contain MC-header-records. Every 90°-File contains a maximum of 3N records. (Each colour is measured three times, see description of reduced-data-tape, and Figure 4.)

The last file of the zodiacal-light-data-tape contains the N MC-header-records of the N MC's, they are copies of the MC-header-records of each MC-file.

The first file of the zodiacal-light-data-tape is the tape-header-file, containing always two records (see Figure 4). The first record is the tape-header-record (see Figure 4), the second record contains a list of all records representing polarization-data (see Figure 4).

So we have in this sequence:

The tape-header-file
N MC-files

the 90° File in U
the 90° File in B
the 90° File in V

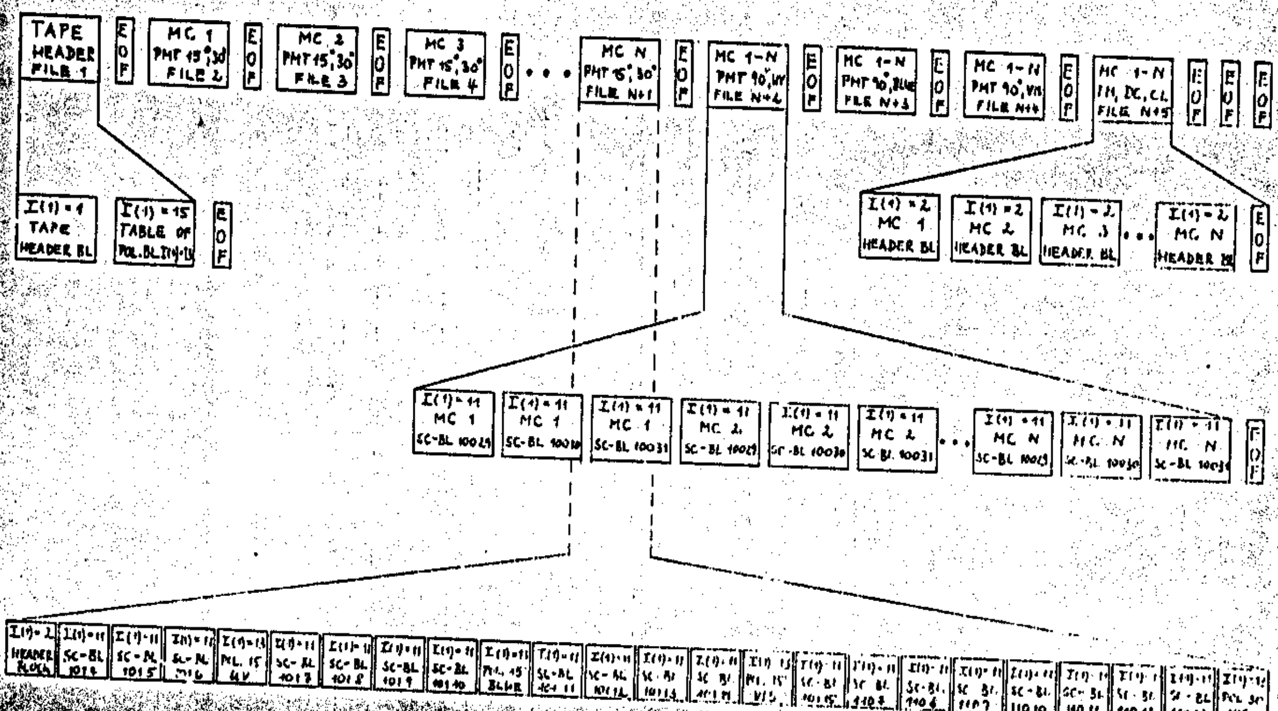
(The three 90°-Files are missing on tapes for Helios A)

The MC-header-File

All records of all files contain 706 words.
The end of every-file is marked by a EOF-mark, the end of the tape is marked with additional three EOF-marks.

For better understanding see Figure 4: Structure of zodiacal-light-data-tape.

FIGURE 4: STRUCTURE OF ZODIACALLIGHT - DATA - TAPE



6. Word structure

The records of the zodiacal-light-data-tape are written on the tape in a binary DEC-mode. After all records of one file have been written, an EOF-mark was written. After the last file has been written three additional EOF are written to mark the end of the content of the tape.

The added program shows how the tape was written.

Additional to the program we added a copy of the hardware-reference-manual, describing the representation of integer and floating point numbers.

NUMBER SYSTEM

A program can interpret a data word as a 36-digit, unsigned binary number, or the left and right halves of a word can be taken as separate 18-bit numbers. The PDP-10 repertory includes instructions that add or subtract one from both halves of a word, so the right half can be used for address modification when the word is addressed as an index register, while the left half is used to keep a control count.

The fixed-point arithmetic instructions use 2's complement representations to do binary arithmetic. In a word used as a number, bit 0 (the leftmost bit) represents the sign, 0 for positive, 1 for negative. In a positive number the remaining 35 bits are the magnitude in ordinary binary notation. The negative of a number is obtained by taking its 2's complement. If x is an n-digit binary number, its 2's complement is $2^n - x$, and its 1's complement is $(2^n - 1) - x$, or equivalently $(2^n - x) - 1$. Subtracting a number from $2^n - 1$ (i.e., from all 1s) is equivalent to performing the logical complement, i.e., changing all 0s to 1s and all 1s to 0s. Therefore, to form the 2's complement one takes the logical complement (usually referred to merely as the complement) of the entire word including the sign, and adds 1 to the result. In a negative number the sign bit is 1, and the remaining bits are the 2's complement of the magnitude.

$+153_{10} = +231_8 =$ | 000 000 000 000 000 000 000 000 000 010 011 001 | (bits 0 … 35)

$-153_{10} = -231_8 =$ | 111 111 111 111 111 111 111 111 111 101 100 111 | (bits 0 … 35)

MR-0196

A 2's complement addition actually acts as though the words represented 36-bit unsigned numbers, i.e., the signs are treated just like magnitude bits. In the absence of a carry into the sign stage, adding two numbers with the same sign produces a plus sign in the result. The presence of a carry gives a positive answer when the summands have different signs. The result has a minus sign when there is a carry into the sign bit and the summands have the same sign, or the summands have different signs and there is no carry. Thus the program can interpret the numbers processed in fixed point addition and subtraction as signed numbers with 35 magnitude bits or as unsigned 36-bit numbers. A computation on signed numbers produces a result that is correct as an unsigned 36-bit number even if overflow occurs, but the hardware interprets the result as a signed number to detect overflow. Adding two positive numbers whose sum is greater than or equal to 2^{35} gives a negative result, indicating overflow; but that result, which has a 1 in the sign bit, is the correct answer interpreted as a 36-bit unsigned number in positive form. Similarly adding two negatives gives a result which is always correct as an unsigned number in negative form.

Zero is represented by a word containing all 0s. Complementing this number produces all 1s, and adding 1 to that produces all 0s again. Hence there is only one zero representation and its sign is positive. Since the numbers are symmetrical in magnitude about a single zero representation, all even numbers both positive and negative end in 0, all odd numbers in 1 (a number all 1s represents −1). But since there are the same number of numbers with each sign and zero has a plus sign, there is one more negative number than there are positive numbers (nonzero numbers with a plus sign). This is the most negative number and it cannot be produced by negating any positive number (its octal representation is 400000 000000 and its magnitude is one greater than the largest positive number).

If 1's complements were used for negatives one could read a negative number by attaching significance to the 0s instead of the 1s. In 2's complement notation each negative number is one greater than the complement of the positive number of the same magnitude, so one can read a negative number by attaching significance to the rightmost 1 and attaching significance to the 0s at the left of it (the negative number of largest magnitude has a 1 in only the sign position). In a negative integer, 1s may be discarded at the left, just as leading 0s may be dropped in a positive integer. In a negative fraction, 0s may be discarded at the right. So long as only 0s are discarded, the number remains in 2's complement form because it still has a 1 that possesses significance; but if a portion including the rightmost 1 is discarded, the remaining part of the fraction is now a 1's complement. Single precision multiplication produces a double length product, and the programmer must remember that discarding the low order part of a double length negative leaves the high order part in correct 2's complement form only if the low order part is zero.

The computer does not keep track of a binary point – the programmer must adopt a point convention and shift the magnitude of the result to conform to the convention used. Two common conventions are to regard a number as an integer (binary point at the right) or as a proper fraction (binary point at the left); in these two cases the range of numbers represented by a single word is -2^{35} to $2^{35} - 1$ or -1 to $1 - 2^{-35}$. Since multiplication and division make use of double length numbers, there are special instructions for performing these operations with integral operands.

The format for double length fixed point numbers is just an extension of the single length format. The magnitude (or its twos complement) is the 70-bit string in bits 1–35 of the high and low order words. Bit 0 of the high order word is the sign, and bit 0 of the low order word is made equal to the sign. The range for double length integers and proper fractions is thus -2^{70} to $2^{70} - 1$ and -1 to $1 - 2^{-70}$. The double precision instructions actually use quadruple length numbers for products and dividends. But numbers of any length are just a further extension of the basic format: thirty-five additional bits of the number in each lower order word, and bit 0 made equal to the sign. Remember that truncating a multiple length negative requires an adjustment for the 2's complement unless the part discarded is zero. The convention for bit 0 of lower order words is inconsistent with that used for floating point format [*see below*]. This does not affect the arithmetic instructions themselves, as they ignore bit 0 in all lower order words. However instructions that negate a doubleword use the floating point convention. This means that if such instructions are used for fixed point numbers, a problem could arise when comparing one double precision number with another.

Floating Point Numbers. The floating point instructions provide for conversion between fixed and floating forms and handle both single and double precision floating point numbers. The same format is used for a single precision number and the high order word of a double precision number. A floating point instruction interprets bit 0 as the sign, but interprets the rest of the word as an 8-bit exponent and a 27-bit fraction. For a positive number the sign is 0, as before. But the contents of bits 9–35 are now interpreted only as a binary fraction, and the contents of bits 1–8 are interpreted as an integral exponent in excess 128 (200_8) code. Exponents from −128 to +127 are therefore represented by the binary equivalents of 0 to 225 (0–377_8). Floating point zero and negatives are represented in exactly the same way as in fixed point: zero by a word containing all 0s, a negative by the 2's complement. A negative number has a 1 for its sign and the 2's complement of the fraction, but since every fraction must ordinarily contain a 1 unless the entire number is zero [*see below*], it has the 1's complement of the exponent code in bits 1–8. Since the exponent is in excess 128 code, an actual exponent x is represented in a positive number by $x + 128$, in a negative number by $127 - x$. The programmer, however, need not be concerned with these representations as the hardware compensates automatically. For example, for the instruction that scales the exponent, the hardware interprets the integral scale factor in standard 2's complement form but produces the correct 1's complement result for the exponent.

$+153_{10} = +231_8 = +.462_8 \times 2^8 =$

0	1–8	9–35
0	10 001 000	100 110 010 000 000 000 000 000 000

$-153_{10} = -231_8 = -.462_8 \times 2^8 =$

0	1–8	9–35
1	01 110 111	011 001 110 000 000 000 000 000 000

MR-0197

The floating point instructions assume that all nonzero operands are normalized, and they normalize a nonzero result. A floating point number is considered normalized if the magnitude of the fraction is greater than or equal to 1/2 and less than 1. The hardware may not give the correct result if the program supplies an operand that is not normalized or that has a zero fraction with a nonzero exponent.

Single precision floating point numbers have a fractional range in magnitude of 1/2 to $1-2^{-27}$. Increasing the length of a number to two words does not significantly change the range but rather increases the precision; in any format the magnitude range of the fraction is 1/2 to 1 decreased by the value of the least significant bit. In all formats the exponent range is −128 to +127.

The precaution about truncation given for fixed point multiplication applies to single precision floating point operations as they are done in extra length; but the the programmer may request rounding, which automatically restores the high order part (the result) to 2's complement form if it is negative. In double precision floating point instructions, all operands and results are double length, and all instructions calculate an extra length answer, which is rounded to double length with the appropriate adjustment for a 2's complement negative. In double precision format the high order word is the same as a single precision number, and bits 1–35 of the low order word are simply an extension of the fraction, which is now sixty-two bits. Bit 0 of the low order word is made 0 in a result but is ignored in all operands; e.g., the number $2^{18} + 2^{-18}$ has this two-word representation in double precision format,

```
|0|10 010 011|100 000 000 000 000 000 000 000 000|
 0 1        8 9                                35

|0|00 000 000 010 000 000 000 000 000 000 000 000|
 0 1                                           35
```

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and its negative is

```
|1|01 101 100|011 111 111 111 111 111 111 111 111|
 0 1        8 9                                35

|0|11 111 111 110 000 000 000 000 000 000 000 000|
 0 1                                           35
```

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```
      IANF,IEND MEAN NUMBERS OF BEGINNING AND END OF FILES
      DOUBLE PRECISION ADRESS
      DIMENSION IZFILE(2),I(706)
      DATA IZFILE/'ZLI00','.DAT'/
      IWRITE=3
      LBLOCK = 0     !SC-BLOCK-COUNTER
      OPEN (UNIT=23,DEVICE='DSKC',ACCESS='SEQIN',MODE='ASCII',
     1      FILE='ZLBAND.DAT')
C     READING FROM ZLBAND.DAT-FILE IN I4-FORMAT
      READ (23,222) IANF,IEND
  222 FORMAT(5I4)
      CLOSE (UNIT=23)

      OPEN(UNIT=17,DEVICE=MTA,ACCESS='SEQOUT',MODE='BINARY',
     1     DENSITY='1600')

      DO 200 LL=IANF,IEND
      INN=LL

      CALL NAMEFI (INN,ADRESS,IZFILE)
      OPEN (UNIT=24,DEVICE='DSKB',ACCESS='SEQIN',MODE='BINARY',
     1      FILE=ADRESS)
      WRITE(IWRITE,1) ADRESS
    1 FORMAT(2X,'FILE  ',1A10,'  OPENED')
    2 DO 201 KK1=1,706
  201 I(KK1)=0
C     READING RECORD BY RECORD FROM FILE TO CORE
      READ (24,ERR=3,END=7)I

      LBLOCK=LBLOCK+1

C     WRITING ON TAPE
      WRITE(17)I
      GO TO 2

    7 CLOSE (UNIT=24)
      WRITE(IWRITE,8) ADRESS
    8 FORMAT(2X,'FILE  ',1A10,'  CLOSED')
C     SET EOF ON TAPE
      END FILE 17
  200 CONTINUE

      WRITE(IWRITE,10) LBLOCK
   10 FORMAT(2X,'NUMBER OF SC-BLOCKS ON TAPE ',I6)
      WRITE(IWRITE,12)
   12 FORMAT(2X,' E O T ')
      GO TO 11
    3 WRITE(IWRITE,4)ADRESS,I(1),I(19),I(20),I(21),I(22)
    4 FORMAT(2X,'PARITY ERROR IN READING FROM FILE ',1A10,
     1       ',  SC-BLOCK ',I2,',',412)
      STOP'PARITY ERROR'
C     SET ADDITIONAL 3 EOF'S TO MARK END OF ZODIACAL-LIGHT-
C     DATA-TAPE
   11 END FILE 17
      END FILE 17
      END FILE 17
      WRITE (IWRITE,9)
    9 FORMAT(2X,'END OF PROGRAM')
      CLOSE(UNIT=17,DEVICE=MTA)
      END

C-----------------------------------------------------------------
C     SUBROUTINE NAMEFI
C-----------------------------------------------------------------
      SUBROUTINE NAMEFI (INN,IFIL,IFILES)
      DOUBLE PRECISION IFIL
      DIMENSION IFILES(2)
   20 FORMAT(2X,2A5,I4)
      IF (INN.GT.99) GO TO 80
      IF (INN.GT.9) GO TO 81
      ENCODE (10,30,IFIL)IFILES(1),INN,IFILES(2)
   30 FORMAT (A5,I1,A4)
      WRITE (3,20)IFIL,INN
      GO TO 2
   81 ENCODE (10,40,IFIL)IFILES(1),INN,IFILES(2)
   40 FORMAT (A4,I2,A4)
C     WRITE (3,20)
      GO TO 2
   80 ENCODE(10,13,IFIL)IFILES(1),INN,IFILES(2)
C           TYPE 20,IFIL,INN
C     WRITE(3,20)IFIL,INN
   13 FORMAT (A3,I3,A4)
    2 RETURN
```

7. Type of Tape

The data are written on a 9 track-tape in DEC-mode, using a FORTRAN-programm.

A detailed description of the tape you can find in the added copy of the hardware reference manual.

PART II
STANDARD MAGNETIC TAPE

A system for handling industry-standard magnetic tape consists of a TM10 control and up to eight tape transports; each unit in the system occupies a separate cabinet. DEC supplies several types of transports that differ in tape speed and tape handling characteristics. Each type is available in two versions, for recording information in seven tracks and nine tracks. Thus data transfer rates and timing depend on the transport, but each transport supplies information to the control such that transports of different speeds and recording formats can be operated by a single control. Transports currently available move tape at speeds of 45, 75 and 150 inches per second. Every transport accommodates two 10½-inch reels (one for supply, one for takeup) and can record information in three densities: 200, 556 and 800 bytes per inch (bpi). A full reel has 2400 feet of half-inch tape and at 800 bpi can store over 135 million bits of data in the 7-track format, or over 180 million bits in the 9-track format.

The program communicates with the tape control, which in turn governs all tape transports but communicates with only one transport at a time. Reading and writing (recording) can occur only when tape is moving forward (from supply reel to takeup reel), but the control can space the tape (*ie* move it to a new position) in either direction. Although only one transport can be reading, writing or spacing at a time, rewinding the entire tape onto the supply reel at high speed requires only initiation by the control. The rewinding transport then proceeds automatically while the control can operate another transport.

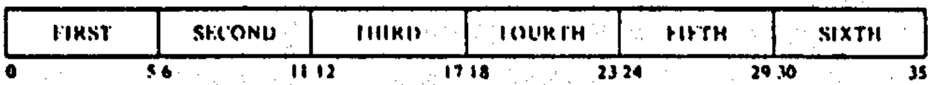
Data transfers between tape and control are governed entirely by the control. Transfers between a TM10A control and memory are handled by the program over the IO bus, whereas the TM10B control is connected to a data channel for automatic transfer of data to and from memory, thus bypassing the central processor [§5.1].

6.6 TAPE FORMAT

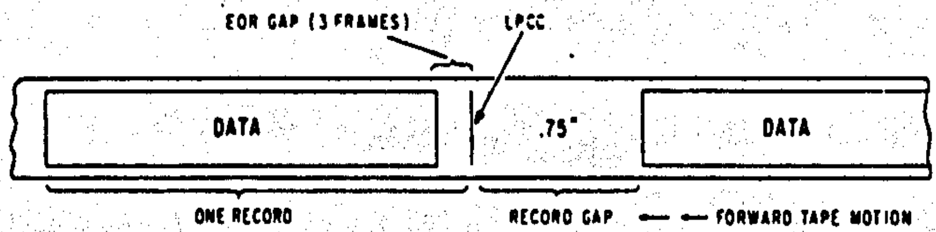
The control writes characters containing seven or nine bits of information; one bit is written in each track. Every character is part of a data record or a file mark. A data record contains both data characters and error-checking characters. Every data character consists of a data byte and a lateral parity bit, which the control generates so that the number of 1s in the character is odd or even as specified by the program. The data bytes in a record taken together correspond to a block of words sent from memory to the control. To separate adjacent records the control automatically erases a segment of tape between them; this segment is called a "record gap". The control always stops the tape in a gap.

The recording technique used is NRZI (nonreturn to zero, inverting). In a given frame (*ie* character position) a change in the direction of magnetization in any track represents a 1 in the character bit corresponding to that track. Thus if the same bit is 0 in a string of characters, there is no change in the track corresponding to that bit; but for a string of 1s, the flux direction changes in every frame.

Full words are transferred between memory and control even though the tape characters may contain 6-bit or 8-bit data bytes. To write, the control divides the words into data bytes, and when reading, the control reassembles the bytes into words. There are several ways in which this is done. For 7-track format, the program can select any density, and the control writes each word as six characters, each containing a 6-bit data byte. After the control writes the last data character for a record, it writes three blank frames (zero



7-TRACK BYTE DISTRIBUTION



7-TRACK RECORD FORMAT

characters) followed by a longitudinal parity check character (LPCC). The three blank frames constitute the end of record gap (EOR), which is used by the control to detect the end of record. The EOR is used in writing as well as reading since the tape encounters the write head first, and the control detects everything shortly after writing it. The LPCC (which may be zero) produces even parity in each of the tracks along the length of the record. The minimum record gap is .75 inch.

When the control reads or writes a data record, it checks that the (lateral) parity of every data character agrees with the parity specified by the program and checks that every track has even (longitudinal) parity.

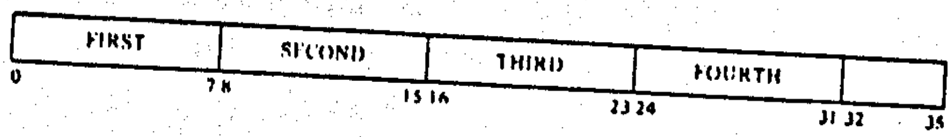
The 9-track format is used for recording data compatible with systems based on 8-bit bytes. The program must select a density of 800 bpi, and the control writes bits 0–31 of each word in four characters, ignoring bits 32–35 altogether. The bits from left to right in each 8-bit byte are written in tracks 0–7. After writing the last data character, the control writes an EOR gap, a cyclic redundancy character (CRC), three more blank frames, and an LPCC. The control generates the CRC as described in §6 of USAS X3.22-1967, *USA Standard, Recorded Magnetic Tape for Information Interchange (800 CPI, NRZI)*. Taking the CRC bits as numbered in that document and the track scheme defined above, CRC bit 1 corresponds to the parity track and bits 2–9 correspond to tracks 0–7. The standard record gap is .5 inch minimum, .6 inch nominal, 25 feet maximum.

For industry compatibility the program must select 800 bpi and odd parity.

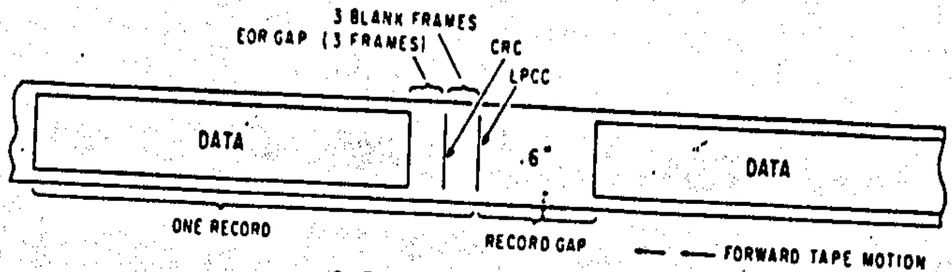
The difference in nominal gap length between 7-track and 9-track format is due entirely to a difference in head spacing.

When the control reads a record in 9-track format, it assembles data into 36-bit words. Each word is composed of four data bytes in bits 0–31 and the corresponding character parity error indicators in bits 32–35 (*eg* a 1 in bit 33

STANDARD MAGNETIC TAPE TM10



9-TRACK BYTE DISTRIBUTION



9-TRACK RECORD FORMAT

Characters are assembled into words in this manner by an IDPB loop or an ASCII or ASCIZ pseudoinstruction.

The "tracks" referred to here are simply a convenience for identifying the bits in the data bytes. The actual correspondence of character bits to physical tracks on tape is as follows:

BIT	2 0 4 P 5 6 7 1 3
TRACK	1 2 3 4 5 6 7 8 9

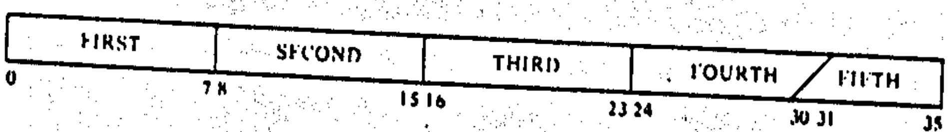
This scheme, which minimizes the effects of errors, is recommended in the standard referenced in the text.

A 1 in an error bit does not necessarily mean the corresponding byte is in error: the error could be in the parity track.

The program must use bit 32 and the parity being checked for in order to regenerate the bit actually read from the parity track of the CRC by the control, keeping in mind that the parity track does not contain an actual parity bit. The parity of the CRC will be odd if the number of data characters in the record is even, otherwise the CRC parity is even.

indicates an error in the character from which the byte in bits 8–15 was taken). If errors occur, the program can use the cyclic redundancy character to determine if the errors are confined to a single track, and if so, to correct them. After reading the data characters in a record, the control makes the CRC available in a word in which bits 0–7 contain information from the data tracks and bit 32 contains a parity error bit. The program can correct errors by using the procedure described in Appendix B of the standard. It is not necessary to reread the tape: the error pattern can be generated from the data in memory. If errors are confined to a single track, the program can correct the record by complementing the bit from the bad track in every byte whose error bit is 1.

To facilitate the use of 9-track tape for binary data applications, a core dump format is available in which the program can select any density, and the control uses the 9-track record format but writes full 36-bit words as five characters each. The first four bytes are taken from bits 0–31 of a word in the same manner as in 9-track format; the fifth data byte contains 0s in tracks



CORE DUMP BYTE DISTRIBUTION

Errors discovered in a record in core dump format at 800 bpi can be corrected by rereading the record in 9-track format, if investigation of the CRC indicates the errors are confined to a single track. The program must then reconstruct the original words, four from each group of five 4-byte sets supplied by the control.

0 and 1 and bits 30–35 of the word are contained in tracks 2–7. To reassemble the word during reading, the control ors the overlapping bits. The CRC is written in the usual fashion, but no error bits are supplied with the data bytes.

When writing in even parity in any recording format, the program must not supply a word containing a zero data byte, since this would result in a missing character (a blank frame), and no words beyond that point would be reassembled correctly. The control does not check for missing characters when reading, but such an event always terminates the function at the end of the current record.

Two or more contiguous missing characters would be interpreted by the control as an EOR gap. This sets the Bad Tape flag and terminates the function.

To facilitate tape processing, the program can group sets of data records into files. The end of a file is indicated by a 3-inch gap followed by a file mark. The file mark is a special record containing a single, special data character and its LPCC, which is equivalent. The control always terminates a function when it encounters a file mark: in particular, the control can space by files as well as by numbers of records.

Each tape has two physical markers to indicate its extremities. These markers are reflective strips that are sensed by photoelectric cells in the transport (one marker can be seen on the tape in the illustration at the end of §H4.2). The loadpoint marker is located about fifteen feet in from the beginning of the reel and denotes the logical beginning of the tape. Reverse functions stop automatically at this marker. A load point gap of at least three inches (twenty-five feet maximum) precedes the first record on the tape. The endpoint marker is about twenty-five feet from the physical end of the tape: the final fifteen feet of tape should be left for trailer, *ie* the program should not record more than ten feet beyond the endpoint (this is enough for a 4000-word record at low density). A status bit indicates when the tape is beyond the endpoint, but this condition stops the tape automatically only when it is spacing forward.

Tapes recorded on some IBM transports have a substandard loadpoint gap of only .5 inch and are thus not compatible with the TM10.

The markers are on the shiny side of the tape; the endpoint marker is against the edge nearer the transport, the loadpoint marker is against the opposite edge.

An annular groove is molded into the back of every reel, and the control cannot write on the tape unless the supply reel has a plastic (write enable) ring in this groove. By leaving the ring out, the operator can protect the data on the tape from accidental destruction (overwriting or erasure).

While the control is actually processing the data portion of a record, the data transfer rate is fixed. However, in a lengthy tape run, the effective (average) transfer rate depends on record length, which determines the percentage of tape taken up by gaps (at the highest density in 7-track format, each record gap could hold 100 additional words). The effective transfer rate is therefore a function of record length as well as tape speed and density.

8. Data block structure

8.1 Labels

8.1.1 Tape header label

Word	Contents	Value
1	Label identification	1
2	Reel-number (insignificant)	variable
3	Helios A (=90), or Helios B (=91)	90,91
4	Level of tape processing (insignificant)	5
5	Experiment-identification	9
6	Sequence-number of calender month counted from launch (=1 for month of launch)	variable
7	Code for computing center (insignificant)	20
8	Day } of Tape-generation	1 to 31
9	Month } of Tape-generation	1 to 12
10	Year } of Tape-generation	19...
11-706	not used	0

8.1.2 MC-header label

Table 8-1-2 MC-HEADER LABEL

This record contains 706 words, only the first 110 words are used, the first 70 words are to be read in INTEGER the rest is to be read in REAL (single precission)

Word	Contents	Value
1	Label identification	2
2	MC-number (counted from launch)	variable
3	Year ⎫ start of MC science data (ground receipt time)	19..
4	Day	1...366
5	Hour	0...23
6	Min	1...59
7	Millisec ⎭	1...59999
8-12	Same as above for end of MC science data	
13	Control for position of the filter-wheels: Motor 1 (15^o Pol.)	0,1,2
14	Motor 2 (30^o)	0,1,2
15	Motor 3 (90^o)	0,1,2
16	Motor 4 (15^o colour)	0,1,2
	0 correct position recorded	
	1 failure to record zero position	
	2 no control bit available	
17	Dark-current control 15^o PMT, short sector	0,1,2
18	Dark-current control 15^o PMT, medium sector	0,1,2
19	Dark-current control 15^o PMT, long sector	0,1,2
	0 data available	
	1 not enough data available for averaging	
	2 no original experiment data blocks available	
	In cases 1 and 2 dark-current is taken from preceding MC.	
20	Dark-current flag 15^o PMT, short sector	0,1,2,...
21	Dark-current flag 15^o PMT, medium sector	0,1,2,...
22	Dark-current flag 15^o PMT, long sector	0,1,2,...
	0 all data $\leq$ upper limit	
	>0 n count rates > upper limit	
23	Dark-current control 30^o PMT short sector	0,1,2
24	Dark-current control 30^o PMT medium sector	0,1,2
25	Dark-current control 30^o PMT long sector	0,1,2
	0 data available	
	1 not enough data avialable for averaging	
	2 no original experiment data blocks available	
	In cases 1 and 2 dark-current is taken from preceding MC.	
26	Dark-current flag 30^o PMT, short	0,1,2,...
27	Dark-current flag 30^o PMT, medium	0,1,2,...
28	Dark-current flag 30^o PMT, long	0,1,2,...
	0 all data $\leq$ upper limit	
	>0 n count rates > upper limit	
29	Dark-current control 90^o PMT	0,1,2
	0 data available	
	1 not enough data available for averaging	
	2 no original experiment data blocks available	
	In cases 1 and 2 dark-current is taken from preceding MC.	

Table 8-1-2 (continued)

Word		Contents	Value
30		Dark-current flag 90° PMT	0,1,2,...
	0	all data ≤ upper limit	
	>0	n count rates > upper limit	
31-58		not used	0
59		Flag for Bit 16 (in EDR)	0,1,2,...
	0	Bit 16 did not change	
	>0	number of changes of bit 16 within 1 MC	
60		Bit 16 in the first EDF, is used for bit 16 for this MC	1,0
61-70		not used	
All the following words are to be read in REAL (single precission)			
71		Temperature PMT 15°	variable
72		Temperature PMT 30°	variable
73		Temperature PMT 90°	variable
74		Temperature electronic-box	variable
75-76		not used	
77		Dark-current PMT 15° short sector	variable
78		Dark-current PMT 15° medium sector	variable
79		Dark-current PMT 15° long sector	variable
80		Dark-current PMT 30° short sector	variable
81		Dark-current PMT 30° medium sector	variable
82		Dark-current PMT 30° long sector	variable
83		Dark-current PMT 90°	variable
77-83		means the average of all available data in this measurement cycle (sectors 5.6°, 11.3°, 22.5°)	
		Sensor 15°	
84		calibration lamp A, polarisation-foil, corrected average, ratio measured/predicted	variable
85		calibration lamp B, polarisation-foil, corrected average, ratio measured/predicted	variable
86		calibration lamp A, quartz, corrected average, m/p	variable
87		calibration lamp B, quartz, corrected average, m/p	variable
		the value is set to -1.0 if no data or only one count rate are available.	
88		calibration lamps, ratio AQ/AP	variable
89		calibration lamps, ratio BQ/BP	variable
90		calibration lamps, ratio AQ/BQ	variable
91		calibration lamps, ratio AP/BP	variable
		the value is set to -1.0 if no data or only one count rate are available.	
		Sensor 30°	
92		calibration lamp A, quartz, ratio meas./predict.	variable
93		calibration lamp B, quartz, ratio meas./predict.	variable
94		calibration lamps, ratio AQ/BQ	variable
		the value is set to -1.0 if no data or only one count rate are available.	

Table 8-1-2 (continued)

Word	Contents	Value
	Sensor 90^{o}	
95	calibration lamp A, ratio measured/predicted	variable
96	calibration lamp B, ratio measured/predicted	variable
97	calibration lamps, ratio A/B the value is set to -1.0 if no data or only one count rate are available.	variable
	Whole experiment:	
98	Spin-rate (taken from 1st OA-Block of this MC)	variable
99	Spin-rate (taken from the last OA-Block of this MC)	variable
100	λ(Helios) (taken from 1st OA-Block) 1950.0 of this MC	variable
101	λ(Helios) (taken from last OA-Block of this 1950.0 MC)	variable
102	Distance Helios-Sun (in AU) (from 1st OA Block)	variable
103	Distance Helios-Sun (in AU) (from last OA Block)	variable
104	SIGMA	variable
105	THETA	variable
106	Day of first OA-Block	variable
107	Hour of first OA-Block	variable
108	Day of last OA-Block	variable
109	Hour of last OA-Block	variable
110-706	not used	0.

The words 98-109 are copied from reduced-data tape. OA-Block means orbit-attitude-block, which is not contained on the zodiacal-light-data-tape (details see "Description of the reduced data tape ...", available at NSSDC).

8.2 Records

8.2.1 Polarization Table Record

The record with Identification I(1) = 15 represents a list of available records of type I(1) = 13 for each MC, giving to the user a summary about the available polarization-data of the measurement period stored on this tape.

Word	Contents	Value
1	Block identification	15
2	MC-number K (counted from launch	variable
3	Block with identification I(1) = 13 for PMT 15°, in UV is available (=1), or missing (=0)	0,1
4	Block with identification I(1) = 13 for PMT 15°, in Blue is available (=1), or missing (=0)	0,1
5	Block with identification I(1) = 13 for PMT 15°, in VIS is available (=1), or missing (=0)	0,1
6	Block with identification I(1) = 13 for PMT 30°, in VIS is available (=1) or missing (=0)	0,1
7	MC-number K+1	variable
8-11	Same as in 3-6 (for MC K+1)	0,1
702	MC number K+140	variable
703	Same as in 3 (for MC K+140)	0,1
704	Same as in 4 (for MC K+140)	0,1
705	Same as in 5 (for MC K+140)	0,1
706	Same as in 6 (for MC K+140)	0,1

For the few tapes containing more than 141 measurement cycles this block nevertheless ends with word 706.

8.2.2 Science data block photometer 15° or 30°

This record contains 706 words, only 704 words are used. The first 22 words are to be read in INTEGER, the rest is to be read in REAL (single precision). Watch word No. 4. If it is 3, this is the science data block of photometer 90° (8.2.3). Missing data are indicated by intensities of -1.0.

Word	Contents	Value
1	Block identification	11
2	MC-number (counted from launch)	variable
3	Helios A (=90), or Helios B (=91)	9o,91
4	PMT 15° (=1), or PMT 30° (=2)	1,2
5	Colour: UV (=1), or Blue (=2), or VIS (=3)	1,2,3
6	dark-current, short sector (counts)	variable
7	dark-current, medium sector (counts)	variable
8	dark-current, long sector (counts)	variable
6-8	means the average of all available data in this measurement cycle (sectors 5.6°, 11.3°, 22.5°) copied from reduced tape	
9	ground receipt time day (day of year)	1 to 366
10	ground receipt time hour	0 to 23
11	ground receipt time minutes	0 to 59
12	ground receipt time milliseconds	0 to 59999
13	ground receipt time year	19 ...
14	polaroid orientation polarizing film 0° (=1), or polarizing film 90° (=2), or polarizing film 45° (=3), or quartz-disk (=4)	1,2,3,4
15	TLM-Format	variable
16	24 bit word to flag data transfer of telemetry words 1-24 0 = correct transmission 1 = telemetry word suspect or missing first 4 1/2 telemetry words cover the ID-bits. Then each 1 1/2 telemetry words correspond to one count rate	variable
17-18	24 bit words to flag data transfer of telemetry words 25-48 and 49-72, see also description of word 16	variable
19	Bit 1 of ID-word	1
20	Bit 2 of ID-word	0,1
21	Bit 3 of ID-word	0,1
22	Bits 4-8 of ID-word	4...15
	the following words are to be read in REAL (single precision)	
23	Temperature	variable
24	Real polaroid orientation in degrees	variable

Word	Contents	Value
25	Distance Helios-sun (AU)	variable
26	λ Sun (seen from Helios, equinox 1975)	variable
27	λ Helios (seen from sun, equinox 1975)	variable
28	Spin-rate (rps)	variable
29	SIGMA	variable
30	THETA	variable
31-32	not used	0.0
33-64	Elongation of sector 1-32	variable
65-96	Inclination of sector 1-32	variable
97-128	Ecliptic latitude of sector 1-32	variable
129-160	Ecliptic longitude of sector 1-32	variable
161-192	Declination of sector 1-32	variable
193-224	Rectascension of sector 1-32	variable
225-256	Galactic latitude (b^{I}) of sector 1-32	variable
257-288	Galactic longitude (l^{I}) of sector 1-32	variable
289-320	Galactic latitude (b^{II}) of sector 1-32	variable
321-352	Galactic longitude(l^{II}) of sector 1-32	variable
353-384	Raw data of sector 1-32 (counts)	variable
385-416	Reduced data of sector 1-32	variable
417-448	Background starlight of sector 1-32	variable
449-480	Remarks to background of sector 1-32	blank,*
481-512	Brightness of individual stars of sector 1-32	variable
513-544	Remarks to brightstars of sector 1-32	blank,*
545-576	Remarks to stars near sector margin of sector 1-32	blank,+
577-608	Light scattered by interplanetary plasma of sector 1-32 (REFILT)	variable
609-640	Zodiacal light intensity of sector 1-32	variable
641-672	Normalized intensity of zodiacal light of sector 1-32	variable
673-704	Direction of polarization of light scattered by interplanetary plasma of sector 1-32 (REPHI)	variable
705-706	not used	

641-672	not used in blocks with polarizing film data
673-704	not used in blocks with colour glass only data

8.2.3 Science data block photometer 90^c

Word	Contents	Value
1	Block identification	11
2	MC-number (counted from launch)	variable
3	Helios B (=91)	91
4	PMT 90^o (=3)	3
5	Colour: UV (=1), or Blue (=2), or VIS (=3)	1,2,3
6	not used	O
7	Dark-current (counts)	variable
8	not used	O
9	Ground receipt time day (day of year)	1 to 366
10	Ground receipt time hour	O to 23
11	Ground receipt time minutes	O to 59
12	Ground receipt time milliseconds	O to 59999
13	Ground receipt time year	19...
14	The same as word 5	1,2,3
15	TLM-format	variable
16	24bit word to flag data transfer of telemetry words 1-24 O=correct transmission 1=telemetry word suspect or missing first 4 1/2 telemetry words cover the ID-bits. Then each 1 1/2 telemetry words correspond to one count rate	variable
17	24 bit words to flag data transfer of telemetry words 25-48 and 49-72, see also description of word 16	variable
19	Bit 1 of ID-word	1
20	Bit 2 of ID-word	O
21	Bit 3 of ID-word	O
22	Bits 4-8 of ID-word	29,30,31

the following words are to be read in REAL (singe precision)

Word	Contents	Value
23	Temperature	variable
24	Calibration lamps, ratio A/B	variable
25	Distance Helios-sun	variable
26	λ sun (seen from Helios, equinox 1975)	variable
27	λ Helios (seen from sun, equinox 1975)	variable
28	Spin-rate (rps)	variable
29	SIGMA	variable
30	THETA	variable
31	Calibration lamp, A, ratio, predicted value/measured value	variable
32	Calibration lamp, B, ratio predicted value/measured value	variable
33	Average over words 63 this MC	variable
34	"Normalized" polarized intensity of zodiacal light <u>after</u> correction film transmission	variable
35	Ecliptic latitude	variable

Word	Contents	Value
36	Ecliptic longitude	variable
37	Declination	variable
38	Rectascension	variable
39	Galactic latitude (b^{I})	variable
40	Galactic longitude (l^{I})	variable
41	Galactic latitude (b^{II})	variable
42	Galactic longitude (l^{II})	variable
43	"Normalized" polarized intensity of zodiacal light	variable
44	Reduced data (sky brightness)	variable
45	Background starlight	variable
46-49	not used	0,0
50	Light scattered by plasma	variable
51	Zodiacal light intensity I	variable
52	"Normalized" intensity of zodiacal light I(norm)	variable
53	"Between" intensity of zodiacal light I(between)	variable
54	direction of polarization, nominal value 90.0° counterclockwise on sky	variable
55	degree of polarization of zodiacal light	variable
56	Average over words 52 this MC	variable
57	Average over words 53 this MC	variable
58	Polarized intensity of zodiacal light	variable
59	Sky brightness <u>after</u> correction film transmission	variable
60	Zodiacal light intensity I_c <u>after</u> correction film transmission	variable
61	Polarized intensity of zodiacal light <u>after</u> ...	variable
62	Degree of polarization of zodiacal light <u>after</u>...	variable
63	"Normalized" intensity of zodiacal light $(I_c)_{norm}$ <u>after</u> ...	variable
64	"Between" intensity of zodiacal light $(I_c)_{between}$ <u>after</u> ...	variable

Averages always are in the last of the 1 to 3 blocks (10029,10030,10031) of one measurement cycle. Other blocks contain 0.0 in this position.

Missing data are indicated by intensities of -1.0.

8.2.4 Polarization data block

Nominally each measurement-cycle contains 4 records with identification I(1) = 13 representing polarization-data for PMT 15° in three colours (UV, Blue, VIS) and for PMT 30° in VIS.

When some science-block with measurements for some polaroid orientation is missing the record with identification I(1)= 13 for the corresponding colour will be missing also. All data in the records (I(1)=13) are evaluated, not measured.

Word	Contents	Value
1	Block identification	13
2-352 *	The same as in record with Identification I(1)=11, photometer 15° or 30°, polarizing film at 90° (word 14 equal 2)	variable
353-384	Polarized intensity of zodiacal light including light scattered by plasma for sector 1-32	variable
385-416	Degree of polarization of zodiacal light including light scattered by plasma for sector 1-32	variable
417-448	Angle of polarization of zodiacal light with light scattered by plasma for sector 1-32 nominal value 0.0°, counterclockwise on sky	variable
449-480	Polarized intensity of zodiacal light, light scattered by plasma subtracted for sector 1-32	variable
481-512	Degree of polarization of zodiacal light, light scattered by plasma subtracted for sector 1-32	variable
513-544	Angle of polarization of zodiacal light, light scattered subtracted by plasma for sector 1-32 nominal value 0.0°, counterclockwise on sky	variable
545-576	not used	0,0
577-608	not used	0,0
609-640	Polarized intensity of zodiacal light including light scattered by plasma, normalized to 1 A.U. for sector 1-32	variable
641-672	Polarized intensity of zodiacal light, light scattered by plasma subtracted, normalized to 1 A.U. for sector 1-32	variable
673-704	The same as in record with Identification I(1)= 11, photometer 15° or 30° polarizing film at 90° (word 14 equal 2) (REPHI)	variable
705	not used	0,0
706	not used	0,0

* By mistake galactic longitude l^{II} is given for the record with polarizing film at 45°. For most practical purposes this is negligible.

9. Remarks

As mentioned in Chapter 1 a zodiacal-light-data-tape normally contains the data of one month.

But often it happens, that the zodiacal-light-data-tape contains the last days of the preceding month or the first days of the following month or both of them.

Some times it occurs that the tape covers the period of two total months. This happened when within one month only a few measurement cycles were received.

In the extended mission of the spacecraft the zodiacal light experiment had to be switched off during aphelion passages due to a decline in the available spacecraft power. Therefore there are months for which no data are available.

Other larger data gaps may be due to blackout periods (Helios behind the sun, no telemetry transmission possible).

Spikes in the data do occur from time to time. Usually they can be traced back to transmission errors.

Occasionaly the data read out from the core memory (DM 7) contain errors. If the timing is wrong they appear in the wrong place, get the wrong background corrections and may appear twice on the tape. If the identification (e.g. 101 8) is wrong their true place is difficult to recover. These errors break the regular intervals between the measurements and, as a rule, are considered by the programme as start of a new cycle of measurements, while in reality the old one not yet has been finished. The may be detected by watching for this type of irregularity. Examples are given below.

<u>Known peculiarities in Helios B zodiacal-light-data tapes</u>

1.) In October 1979 sensor 30° slowly lost sensitivity until complete failure. For simplicity the data were kept on tape. The data-tapes for the months November 1979 and December 1979 don't contain data of 30° photometer.

2.) Attitude maneuvers were performed on days 15 to 21/1976, 51/1976, 58/1976 and 341 to 342/1977. Orbit-attitude information on spin axis orientation (SIGMA,THETA) may be unreliable for those dates.

3.) Disorder of 90° science blocks on original data tapes occured, e.g., on days 93 to 94/1977 leading to meaningless results. Recovery of the data is only possible from the reduced tape.

4.) MZY 579 (during blackout, July 1976) covers a period of 10 days. Values of λ, R, interpolated in the science blocks, therefore, may be slightly off.

5.) In February 1976, MC 154, block 101 13, sector 15
and in March 1976,MC 222, block 110 7, sector 16
block 110 9, sector 16
α,b^{I},l^{I},b^{II},l^{II} are wrong. Use word of neighbouring blocks.
In March 1976, MC 166, blocks 1017, 1018, 1019, 101 10, 101 11, sector 16:
l^{I}, b^{II}, l^{II} are wrong. Use word of neighbouring blocks.

6.) In November 1976, MC 861 only reduced data (sky brightnesses) are right.

7.) Examples for erroneous data from core memory (DM 7)

MC 3378-3392	The timing of DM 7 -science blocks with ID 110 5 to 100 31 is wrong, leading to a erroneously large number of MC's, the last blocks being the wrong ones in this case.

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MC 3378-3392 — The timing of DM 7 -science blocks with ID 110 5 to 100 31 is wrong, leading to a erroneously large number of MC's, the last blocks being the wrong ones in this case.

Known peculiarities in Helios A zodiacal-light-data-tapes

1.) Orbit-attitude information on spin axis orientation (SIGMA,THETA) is unreliable during attitude maneuvers on days 63/1975, 80/1975,102/1975 and 77/1976. From launch through day 41/1975 it was corrected, based on observations of star crossings.

2.) Failure of stepping motors:
No problem until November 1, 1976.
On November 1, 1976, 16h49 the motor of photometer 90° (M3) got stuck in colour V.
On November 19, 1976, 16h15, in MC 2185, the motor with colour filters in photometer 15° (M4) got stuck in colour B.
On June 17, 1978, 20h25, the motor with polarizing films in photometer 15° (M1) got stuck in position 0°.
In December 15, 1978, 13h28, the motor of photometer 30° got stuck in colour B.

3.) In June 1975, MC 587 (photometer 15° and 30°) and MC 588 (photometer 30°) erroneously no dark current was subtracted.

4.) In March 1976, MC 1432, block 1016 (UV) is wrong.

5.) In April 1979 sensor 30° slowly lost sensitivity until complete failure. For simplicity the data were kept on tape for this month.

6.) In November 1976, MC 2185 the blocks from 101 8 (GMT: 16h 15m 34s) to 101 11 (GMT: 16h 41m 50s) have wrong calibration.

7.) In October 1977 the MC-header file (see section 5) contains erroneously 139 MC-header records, but the last 28 MC-header-records (No. 3503-3530) belong to November 1977; in the corresponding tape they are contained too. (No. 3531-3558).
The MC-header-records No. 3503-3530 (October 1977) are not correct, use No. 3531-3558 (November 1977). Owing to this mistake the last MC-File* in October 1977 ends with MC-number 3502, the first MC-File in November 1977 beginns with number 3531.
*(see section 5)

8.) Examples for erroneous data from core memory (DM 7)

MC 3107	DM 7 data have wrong time or identification
MC 3193	Block with ID 110 7 appears twice with different times
MC 3194	Block 101 31 bears wrong identification
MC 3339, 3350	DM 7 blocks with wrong identification occur
MC 3603	DM 7 blocks have incorrect time
MC 3614	DM 7 block 100 31 bears wrong identification

10. Programm for reading the tape

This programm to read a zodiacal-light-data-tape was used on a DEC-10 computer (36-bit word structure).

```
      COMMON I(706)                                    ...ACAL-FLIGHT-DATA-TAPE.
      DIMENSION B(10),C(672),FILEMZ(50)
      EQUIVALENCE (I(71),FILEMZ(1))
      EQUIVALENCE (I(23),B(1)),(I(33),C(1))

      IWRITE=3
C     IEND MEANS NUMBER OF FILES.
      TYPE 23
23    FORMAT (1X,'INPUT OF IEND IN I4')
      ACCEPT 222,IEND
222   FORMAT(I4)

      DO 200 LL=1,IEND
      INN=LL
      OPEN (UNIT=17,DEVICE=MTA,ACCESS='SEQIN',MODE='BINARY',
     1     DENSITY='1600')
300   CONTINUE
      DO 201 KK1=1,706
201   I(KK1)=0
C     READING RECORD BY RECORD FROM TAPE TO CORE
      READ (17,ERR=91,END=93)I
      IF (I(1).EQ.1) GO TO 420
      IF (I(1).EQ.2) GO TO 250
      IF (I(1).EQ.11) GO TO 301
      IF (I(1).EQ.13) GO TO 401
      IF (I(1).EQ.15) GO TO 415
      GO TO 300
301   IF (I(4).EQ.3) GO TO 410
      WRITE(IWRITE,3001)(I(K),K=1,22)
3001   FORMAT(2X,11I8)
      WRITE(IWRITE,3002)(B(K),K=1,10)
3002  FORMAT(2X,10F10.2)
      WRITE(IWRITE,3003)(C(K),K=1,320)
3003  FORMAT(2X,16F8.2)
      WRITE(IWRITE,3005)(C(K),K=321,352)
3005  FORMAT(2X,16F8.1)
      WRITE(IWRITE,3003)(C(K),K=353,416)
      WRITE(IWRITE,3004)(C(K),K=417,448)
3004  FORMAT(2X,16A1)
      WRITE(IWRITE,3003)(C(K),K=449,480)
      WRITE(IWRITE,3004)(C(K),K=481,544)
      WRITE(IWRITE,3003)(C(K),K=545,672)

      GO TO 300

250   WRITE(IWRITE,251)(I(K),K=1,70)
251   FORMAT(2X,10I8)
      WRITE(IWRITE,253) FILEMZ
253   FORMAT(2X,10F10.2)

      GO TO 300

401   WRITE(IWRITE,3001)(I(K),K=1,22)
      WRITE(IWRITE,3002)(B(K),K=1,10)
      WRITE(IWRITE,3003)C

      GO TO 300

410   WRITE(IWRITE,3001)(I(K),K=1,22)
      WRITE(IWRITE,3002)(B(K),K=1,10)
      WRITE(IWRITE,3003)(C(K),K=1,32)

      GO TO 300

415   LX=MZZAHL*5
      LX=LX+1
      WRITE(IWRITE,3007)(I(K),K=1,LX)
3007  FORMAT(2X,20I5)

      GO TO 300

420   MZZAHL=I(1)
      WRITE(IWRITE,3001)(I(K),K=1,36)

      GO TO 300

91    WRITE (IWRITE,92)INN
92    FORMAT (5X, 'PARITY ERROR IN READING FROM TAPE,FILE-NR.',1X,I5)
      STOP 1
93    WRITE(IWRITE,94)
94    FORMAT(5X,'E O F MARK')
200   CONTINUE
      CLOSE (UNIT=17,DEVICE=MTA)
779   WRITE(IWRITE,780)
780   FORMAT(1X,'END OF PROGRAM')
```

11. Example of a print-out of the tape

This is an example for the print-out of some files of the zodiacal-light-data-tape.

Explanations:

MZY = measurement cycle (MC)
SEKT = sector

in following see section 8.2.2, block identification I(1)=11:

TM	see word 23
DSK	
DSM	see words 6-8
DSL	
SPINR	see word 28
HINTER	see words 417-448
REFILT	see words 577-608
REPHI	see words 673-704
ZLSYM	see words 641-672

in following see section 8.2.3, block identification I(1)=11:

TM90	see word 23
DS90	see word 7
HINT	see word 45
ZODLIC	see word 52
PINTZR	see word 43

in following see section 8.2.4, block identification I(1)=13:

IMEL	see words 353-384
PMEL	see words 385-416
PHIMEL	see words 417-448
IOEL	see words 449-480
POEL	see words 481-512
PHIOEL	see words 513-544
PIMELR	see words 609-640
PIOELR	see words 641-672

I(1) = 1

H E L I O S A

ZODIAKALLICHT-BAND NR.HA1703, BAND-KENNUNG: 5, ERZEUGT AM 26- 2-1981, LAUFENDE MONATS-NR AB STARTMONAT: 24, ANZAHL DER MZY: 136

2 1

DIESE TABELLE GIBT AUSKUNFT UEBER DAS VORHANDENSEIN ALLER 3 SC-BLOECKE MIT POLARISATIONS-FILTER-MESSUNGEN IN DEN FARBEN U,B,V FUER DIE PHOTOMETER 15 UND 30 GRAD PRO MESS-ZYKLUS

1 VORHANDEN 0 NICHT VORHANDEN

I(1)=15

MZY-NR	B15	B15	B15	V30
2101	0	0	1	1
2102	1	1	1	0
2103	1	1	1	1
2104	1	1	0	1
2105	1	1	1	1
2106	1	1	1	1
2107	0	0	0	1
2108	1	0	0	0
2109	0	0	0	1
2110	0	0	1	1
2111	1	1	1	1
2112	1	1	1	1
2113	1	1	0	1
2114	1	1	1	0
2115	1	1	1	0
2116	1	1	0	0
2117	0	0	0	1
2118	1	1	1	1
2119	1	1	1	1
2120	0	0	1	1
2121	1	0	0	0
2122	1	1	1	1
2123	1	1	0	1
2124	0	1	1	0
2125	1	1	1	0
2126	1	1	1	1
2127	1	1	0	1
2128	1	1	1	1
2129	0	0	1	1
2130	1	0	1	0
2131	0	0	0	0
2132	1	1	1	1
2133	1	0	1	1
2134	1	1	1	1
2135	1	1	1	0
2136	1	0	0	0
2137	0	0	0	0
2138	0	0	0	1
2139	1	1	1	0
2140	1	1	1	1
2141	1	1	1	1
2142	1	0	1	0
2143	0	0	0	0
2144	1	1	1	1
2145	1	1	0	0
2146	1	1	1	1
2147	1	1	1	1
2148	1	1	1	1
2149	1	1	1	1
2150	1	1	0	0
2151	0	1	1	0
2152	0	0	0	0
2153	1	1	0	1
2154	0	1	1	1
2155	1	1	1	1
2156	1	1	1	1
2157	1	0	1	1
2158	1	1	1	1
2159	1	1	1	1
2160	1	1	1	0
2161	1	1	0	1
2162	0	0	0	1
2163	1	1	1	0
2164	1	0	1	1
2165	1	1	1	0
2166	0	0	0	0
2167	1	1	1	0
2168	1	1	1	1
2169	0	1	1	1

4/=2

1971	A	1977	334	23	18	-6.1	-0.2	844	14[illegible]	2710	1.037	-1.000	1.056	-1.000	2.886	0.000	-1.000	[illegible]000
	B	1977	335	4	16	-1.1		915	14[illegible]	2883			0.989	-1.000			-1.000	
	C	1977	335	4	16	-6.7			1399				1.083	-1.000			-1.000	
1972	A	1977	335	4	24	-6.0	-0.6	852	1439	2591	-1.000	1.011	-1.000	1.034	2.886	2.901	-1.000	-1.000
	B	1977	335	9	51	-0.6		865	1432	2773			-1.000	1.043			-1.000	
	C	1977	335	9	51	-7.0			1425				-1.000	1.092			-1.000	
1973	A	1977	335	10	0	-6.0	-0.7	863	1426	2617	1.035	-1.000	1.054	-1.000	2.886	2.901	2.157	2.164
	B	1977	336	2	4	-0.9		889	1464	2758			0.988	-1.000			1.829	
	C	1977	336	2	4	-7.3			1444				1.086	-1.000			2.022	
1974	A	1977	336	2	12	-6.3	-1.0	853	1421	2603	-1.000	1.010	-1.000	1.033	2.886	2.901	2.152	2.164
	B	1977	336	7	30	-1.3		842	1518	2698			-1.000	1.043			1.829	
	C	1977	336	7	30	-7.3			1412				-1.000	1.093			2.022	
1975	A	1977	336	7	41	-6.0	-1.0	854	1480	2708	1.038	-1.000	1.058	-1.000	2.887	2.901	2.162	2.173
	B	1977	336	12	47	-1.0		874	1446	2767			0.988	-1.000			1.828	
	C	1977	336	12	47	-7.2			1478				1.083	-1.000			2.016	
1976	A	1977	336	13	0	-6.8	-1.0	848	1509	2638	-1.000	1.009	-1.000	1.032	2.887	2.901	2.162	2.173
	B	1977	336	18	36	-1.2		926	1495	2779			-1.000	1.043			1.828	
	C	1977	336	18	36	-7.7			1475				-1.000	1.091			2.016	
1977	A	1977	336	18	45	-6.6	-1.0	865	1455	2710	-1.000	-1.000	1.055	-1.000	-1.000	2.901	2.159	-1.000
	B	1977	336	23	51	-1.3		927	1470	2845			0.988	-1.000			1.829	
	C	1977	336	23	51	-7.6			1447				1.084	-1.000			2.020	
1978	A	1977	337	0	8	-6.7	-1.0	860	1427	2676	-1.000	1.009	-1.000	1.032	-1.000	2.902	2.159	-1.000
	B	1977	337	5	5	-1.2		909	1522	2779			-1.000	1.045			1.829	
	C	1977	337	5	5	-7.6			1485				-1.000	1.093			2.020	
1979	A	1977	337	5	13	-6.9	-1.0	896	1485	2720	1.034	-1.000	1.054	-1.000	2.887	2.902	2.156	2.167
	B	1977	337	10	10	-1.7		893	1510	2749			0.988	-1.000			1.825	
	C	1977	337	10	10	-7.5			1408				1.084	-1.000			2.018	
1980	A	1977	337	10	19	-7.2	-1.0	916	1480	2674	-1.000	1.008	-1.000	1.031	2.887	2.902	2.156	2.167
	B	1977	337	21	18	-1.8		893	1510	2749			-1.000	-1.000			1.825	
	C	1977	337	21	18	-7.7			1432				-1.000	-1.000			2.018	
1981	A	1977	337	21	27	-7.1	-1.0	878	1493	2699	-1.000	1.010	-1.000	1.031	2.887	2.898	2.156	2.167
	B	1977	338	2	23	-1.5		875	1526	2755			-1.000	1.044			1.825	
	C	1977	338	2	23	-7.8			1468				-1.000	1.093			2.018	
1982	A	1977	338	2	32	-7.1	-1.0	893	1433	2703	1.037	-1.000	1.057	-1.000	2.888	2.898	2.164	2.171
	B	1977	338	7	29	-1.5		893	1581	2885			0.988	-1.000			1.828	
	C	1977	338	7	29	-7.6			1472				1.085	-1.000			2.018	
1983	A	1977	338	7	37	-7.3	-1.0	865	1493	2736	-1.000	1.010	-1.000	1.032	2.868	2.901	2.164	2.171
	B	1977	338	12	34	-1.6		918	1530	2821			-1.000	1.045			1.828	
	C	1977	338	12	34	-7.8			1493				-1.000	1.094			2.018	
1984	A	1977	338	12	43	-7.3	-1.0	902	1511	2714	1.037	-1.000	1.058	-1.000	2.889	2.901	2.162	2.171
	B	1977	338	18	21	-1.6		949	1616	2862			0.989	-1.000			1.827	
	C	1977	338	18	21	-8.3			1565				1.084	-1.000			2.015	
1985	A	1977	338	18	31	-7.0	-1.0	876	1572	2715	-1.000	1.010	-1.000	1.033	2.889	2.902	2.162	2.171
	B	1977	338	23	46	-1.6		916	1587	2917			-1.000	1.045			1.827	
	C	1977	338	23	46	-7.8			1560				-1.000	1.093			2.015	
1986	A	1977	338	23	54	-7.0	-1.0	909	1495	2706	1.037	-1.000	1.057	-1.000	2.887	2.902	2.159	2.170
	B	1977	339	4	52	-1.6		889	1553	2898			0.989	-1.000			1.827	
	C	1977	339	4	52	-8.0			1513				1.084	-1.000			2.016	
1987	A	1977	339	5	0	-7.0	-1.0	903	1513	2762	-1.000	1.011	-1.000	1.034	2.887	2.900	2.159	2.170
	B	1977	339	9	57	-1.7		925	1555	2788			-1.000	1.043			1.827	
	C	1977	339	9	57	-8.2			1560				-1.000	1.093			2.016	
1988	A	1977	339	10	6	-7.1	-1.0	897	1440	2654	1.038	-1.000	1.058	-1.000	2.887	2.900	2.160	2.170
	B	1977	339	15	2	-2.0		942	1600	2936			0.990	-1.000			1.832	
	C	1977	339	15	2	-8.2			1540				1.085	-1.000			2.018	
1989	A	1977	339	15	12	-7.2	-1.0	904	1503	2835	-1.000	1.012	-1.000	1.034	2.887	2.900	2.160	2.170
	B	1977	339	20	8	-2.0		938	1607	2841			-1.000	1.045			1.832	
	C	1977	339	20	8	-8.4			1549				-1.000	1.093			2.018	
1990	A	1977	339	20	16	-7.4	-1.0	894	1514	2775	1.035	-1.000	1.054	-1.000	2.886	2.900	2.152	2.162
	B	1977	340	1	26	-2.3		951	1592	2951			0.991	-1.000			1.831	
	C	1977	340	1	26	-8.5			1549				1.085	-1.000			2.019	
1991	A	1977	340	1	35	-7.9	-1.8	915	1511	2805	-1.000	1.010	-1.000	1.033	2.886	2.900	2.152	2.162
	B	1977	340	7	11	-2.2		939	1583	2915			-1.000	1.043			1.831	
[redacted]																		

1971	1977	-6.7	1399	1.083	-1.000	-1.000														
							155.2	1.7	49.0	10029	65.24	.6978	104.5	335	3	59	47.7	10.7	93.2	.223
							154.9	1.7	49.0	10030	65.25	.6978	104.2	335	4	7	47.6	10.5	93.6	.222
							155.4	1.7	49.0	10031	65.26	.6979	104.7	335	4	16	47.8	10.6	93.7	.222
															MITTEL :		47.7	10.6		
1972	1977	-7.0	1425	-1.000	1.092	-1.000														
							153.6	1.7	49.0	10029	65.56	.7002	102.9	335	9	35	47.3	10.7	94.0	.227
							153.2	1.7	49.0	10030	65.57	.7003	102.5	335	9	43	47.1	10.2	93.3	.217
							153.5	1.7	49.0	10031	65.57	.7004	102.8	335	9	51	47.3	10.5	94.1	.221
															MITTEL :		47.3	10.5		
1973	1977	-7.3	1444	1.086	-1.000	2.022														
							150.7	1.6	49.0	10029	66.46	.7073	100.0	336	1	47	47.0	10.2	94.0	.217
							150.7	1.6	49.0	10030	66.46	.7073	100.1	336	1	55	47.0	10.1	94.1	.216
							150.5	1.6	49.0	10031	66.47	.7074	99.9	336	2	4	47.0	10.4	93.7	.220
															MITTEL :		47.0	10.2		
1974	1977	-7.3	1412	-1.000	1.093	2.022														
							149.4	1.6	49.0	10029	66.75	.7096	98.8	336	7	8	46.7	9.9	93.1	.213
							149.8	1.6	49.0	10030	66.76	.7096	99.2	336	7	19	46.9	9.9	93.4	.212
							149.5	1.6	49.0	10031	66.77	.7097	98.9	336	7	30	46.8	10.5	94.6	.224
															MITTEL :		46.8	10.1		
1975	1977	-7.2	1478	1.083	-1.000	2.016														
DUE**							149.7	1.6	49.0	10029	67.04	.7119	99.1	336	12	30	47.2	10.5	93.2	.222
							149.9	1.6	49.0	10030	67.05	.7119	99.3	336	12	39	47.3	10.1	92.3	.213
							149.8	1.6	49.0	10031	67.06	.7120	99.2	336	12	47	47.2	10.2	93.5	.216
															MITTEL :		47.2	10.3		
1976	1977	-7.7	1475	-1.000	1.091	2.016														
							148.4	1.6	49.0	10029	67.36	.7143	97.8	336	18	17	46.9	10.1	93.6	.215
							148.7	1.6	49.0	10030	67.36	.7144	98.1	336	18	26	47.1	10.7	94.1	.227
							148.4	1.6	49.0	10031	67.37	.7145	97.8	336	18	36	46.9	10.6	93.2	.227
															MITTEL :		47.0	10.5		
1977	1977	-7.6	1447	1.084	-1.000	2.020														
							148.5	1.5	49.0	10029	67.65	.7166	98.0	336	23	42	47.3	10.6	94.6	.223
							148.5	1.5	49.0	10030	67.65	.7167	98.0	336	23	51	47.3	10.7	93.8	.226
															MITTEL :		47.3	10.6		
1978	1977	-7.6	1485	-1.000	1.093	2.020														
							148.3	1.5	49.0	10029	67.92	.7188	97.8	337	4	48	47.5	10.7	94.3	.226
							148.2	1.5	49.0	10030	67.93	.7188	97.7	337	4	57	47.5	10.7	94.8	.225
							147.8	1.5	49.0	10031	67.93	.7189	97.3	337	5	5	47.3	10.8	93.4	.228
															MITTEL :		47.4	10.7		
1979	1977	-7.5	1408	1.084	-1.000	2.018														
							147.5	1.5	49.0	10029	68.19	.7209	97.0	337	9	54	47.5	10.6	93.6	.223
							147.4	1.5	49.0	10030	68.20	.7210	96.9	337	10	2	47.4	10.4	94.0	.219
							147.8	1.5	49.0	10031	68.20	.7210	97.3	337	10	10	47.6	10.6	94.3	.222
															MITTEL :		47.5	10.5		
1980	1977	-7.7	1432	-1.000	-1.000	2.018														
DUF**							146.1	1.5	49.0	10029	68.77	.7255	95.6	337	21	1	47.4	11.0	93.3	.232
							146.7	1.5	49.0	10031	68.79	.7257	96.2	337	21	18	47.7	10.6	93.7	.223
															MITTEL :		47.6	10.8		
1981	1977	-7.8	1468	-1.000	1.093	2.018														
							144.9	1.5	49.0	10029	69.04	.7277	94.4	338	2	6	47.1	10.3	93.3	.218
							145.4	1.5	49.0	10030	69.05	.7277	94.9	338	2	15	47.4	10.5	93.8	.222
							145.7	1.5	49.0	10031	69.05	.7278	95.2	338	2	23	47.5	10.6	94.2	.224
															MITTEL :		47.3	10.5		
1982	1977	-7.8	1472	1.085	-1.000	2.018														
							145.5	1.5	49.0	10029	69.30	.7298	95.1	338	7	12	47.7	10.6	91.1	.223
							144.9	1.5	49.0	10030	69.31	.7299	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			

R = .5949 SPINR = 1.0058

SEKT	ELONG	INCL	BETA	LAMDA	DELTA	ALPHA		L2	RAW DATEN	SIO(V)	HINTER	ELEKT	STEPHE	ZLICHT	ZLSY
1	16.00	-102.00	-15.64	194.80	-20.06	186.92	42.26	296.28	.79027E+06	7732.7	45.1	317.0	8.6	7364.0	1969.[illegible]
2	17.97	-119.29	-15.61	200.41	-22.22	192.23	40.38	303.01	.67354E+06	6553.8	47.2	229.6	5.5	6271.5	1671.[illegible]
3	21.24	-137.18	-15.57	206.02	-24.35	197.64	37.99	309.27	.51789E+06	5019.5	50.3	141.9	0.0	4827.4	1296.4
4	25.32	-141.18	-15.55	211.62	-26.42	203.16	35.17	315.01	.38886E+06	3766.7	56.9	85.3	13.8	3610.7	974.2
5	29.87	-147.48	-15.53	217.23	-28.41	208.82	31.98	320.25	.29261E+06	2832.0	62.5	52.8	28.0	2688.7	728.6
6	34.71	-151.97	-15.52	222.84	-30.29	214.62	28.48	325.00	.22451E+06	2170.8	71.6	34.3	0.0	2064.9	561.4
7	39.74	-155.27	-15.51	228.45	-32.06	220.60	24.71	329.34	.18150E+06	1753.2	82.3	23.3	13.0	1634.5	445.6
8	44.88	-157.72	-15.52	234.05	-33.67	226.73	20.74	333.30	.14925E+06	1439.9	86.4	16.6	0.9	1336.1	365.2
9	52.74	-160.34	-15.53	242.46	-35.76	236.26	14.44	338.65	.24448E+06	1179.3	103.5	10.7	30.5	1034.6	284.0
10	63.38	-162.53	-15.57	253.67	-37.84	249.51	5.57	344.92	.22502E+06	1084.8	200.7	6.7	123.8*	753.6	207.9
11	74.12	-163.73	-15.63	264.89	-38.95	263.23	-3.68	350.51	.23731E+06	1144.5	394.3	4.6	147.3*+	598.3	166.0
12	84.92	-164.21	-15.72	276.11	-39.02	277.14	-13.19	355.69	.16358E+06	786.5	268.2	3.5	23.8 +	491.0	137.0
13	101.12	-163.80	-15.89	292.95	-37.19	297.65	-27.76	3.29	.21683E+06	519.3	106.2	2.7	16.2 +	394.3	110.9
14	122.53	-160.75	-16.14	315.43	-31.66	323.05	-47.33	14.99	.17536E+06	418.6	49.8	2.3	12.7 +	353.8	100.5
15	143.16	-151.89	-16.41	337.94	-23.87	345.88	-66.00	35.55	.16614E+06	396.2	32.9	2.1	18.1	343.1	98.2
16	160.18	-122.36	-16.64	0.48	-15.18	6.90	-76.81	99.77	.17126E+06	408.6	29.6	2.2	23.5 +	353.3	101.9
17	159.65	-56.25	-16.81	23.04	-6.80	27.20	-65.00	160.32	.16358E+06	390.0	28.9	2.2	1.3	357.6	103.4
18	142.30	-26.36	-16.88	45.61	0.23	47.66	-46.21	179.89	.15898E+06	378.8	37.8	2.1	0.0	338.9	98.6
19	121.60	-19.90	-16.85	68.19	4.97	68.76	-26.64	191.39	.18049E+06	432.3	70.6	2.3	18.8	340.6	99.3
20	100.18	-17.00	-16.72	90.76	6.72	90.40	-7.32	201.55	.27418E+06	658.5	160.7	2.7	131.6*+	363.6	106.1
21	83.98	-16.67	-16.57	107.67	5.88	106.67	6.60	209.84	.13491E+06	647.3	163.3	3.5	9.4	471.1	137.6
22	73.20	-17.21	-16.45	118.94	4.32	117.40	15.42	216.21	.26291E+06	1268.8	97.4	4.7	456.5*+	710.2	207.1
23	62.46	-18.48	-16.32	130.20	2.02	127.97	23.65	223.64	.16717E+06	803.9	76.2	6.8	4.7	716.2	208.4
24	51.83	-20.77	-16.19	141.45	-0.91	138.37	31.06	232.50	.21837E+06	1052.5	60.4	11.0	11.8 +	969.3	280.7
25	43.98	-23.52	-16.09	149.89	-3.46	146.07	35.85	240.34	.14259E+06	1375.3	54.7	17.2	8.0	1295.4	372.7
26	38.86	-26.10	-16.02	155.50	-5.31	151.16	38.58	246.20	.17485E+06	1668.5	46.5	24.3	0.0	1617.7	462.7
27	33.86	-29.57	-15.96	161.12	-7.25	156.23	40.86	252.57	.22451E+06	2170.8	44.8	36.0	17.0	2073.0	589.0
28	29.06	-34.32	-15.90	166.74	-9.28	161.29	42.62	259.41	.29466E+06	2851.9	44.7	55.9	8.3	2743.0	773.0
29	24.57	-41.02	-15.84	172.36	-11.37	166.35	43.81	266.65	.39501E+06	3826.3	42.4	91.0	18.8	3674.1	1026.1
30	20.61	-50.60	-15.78	177.97	-13.51	171.43	44.37	274.12	.52608E+06	5099.1	40.1	151.8	0.8	4906.3	1354.2
31	17.52	-64.25	-15.73	183.58	-15.68	176.54	44.30	281.68	.68173E+06	6636.2	40.5	242.7	25.5 +	6327.5	1718.8
32	15.83	-82.21	-15.68	189.19	-17.87	181.70	43.59	289.12	.79232E+06	7753.5	41.6	323.0	0.0	7388.9	1986.7

T	ELONG	INCL.	BETA	LAMDA	DELTA	ALPHA	B2	L2	RAW DATEN	SIO(V)	HINTER	STERNE	RKFILT	Z.IC	REPHI
1	16.88	80.67	16.65	242.24	-4.21	243.09	31.70	8.39	.81664E+05	3713.4	50.7	83.5 +	192.7	3652.3	-9.7
2	18.61	63.83	16.64	236.61	-3.11	237.60	36.59	5.62	.78080E+05	3548.0	44.8	190.6 +	180.5	3386.3	-27.3
3	21.67	50.83	16.64	230.97	-1.83	232.54	41.47	2.64	.61696E+05	2793.1	41.0	8.2	124.6	2919.3	-41.1
4	25.58	41.50	16.62	225.34	-0.40	227.33	46.33	359.38	.47744E+05	2151.2	41.2	4.6	76.9	2182.6	-51.3
5	30.01	34.85	16.61	219.69	1.17	222.16	51.16	355.69	.37376E+05	1674.8	39.5	59.6 +	47.0	1648.7	-58.7
6	34.76	30.05	16.59	214.06	2.88	217.04	55.91	351.38	.29184E+05	1298.7	34.8	0.0	29.6	1327.3	-64.4
7	39.72	26.50	16.57	208.42	4.71	211.94	60.57	346.14	.23488E+05	1037.4	32.5	8.0	19.5	1051.7	-68.8
8	44.81	23.83	16.54	202.79	6.64	206.88	65.03	339.48	.19456E+05	852.5	31.1	5.5	13.4	863.6	-72.3
9	52.62	20.94	16.50	194.34	9.69	199.29	71.09	324.92	.31552E+05	689.5	28.1	58.6	8.2	643.9	-76.6
10	63.22	18.47	16.43	183.08	13.96	189.16	76.26	290.28	.21824E+05	466.6	26.7	6.1	4.7	462.5	-81.1
11	73.93	17.04	16.35	171.82	18.35	178.68	74.73	246.55	.17536E+05	368.4	26.4	5.1	3.1	360.2	-84.7
12	84.71	16.34	16.27	160.57	22.73	168.33	67.86	219.91	.15904E+05	331.0	29.5	33.8	2.2	289.3	-88.0
13	100.92	16.45	16.15	143.69	28.90	151.66	54.35	200.85	.25856E+05	264.9	33.6	10.9	1.5	237.7	87.2
14	122.38	19.04	16.00	121.21	35.53	127.29	34.97	187.19	.24320E+05	247.3	48.0	2.4	1.2	213.3	79.9
15	143.16	27.16	15.88	98.74	39.02	100.41	15.51	176.75	.28672E+05	297.1	97.2	18.6	1.2	201.4	67.9
16	160.69	55.51	15.82	76.28	38.42	72.64	-3.32	166.07	.31936E+05	334.5	125.7	17.4 +	1.3	214.1	36.1
17	160.69	124.49	15.62	53.83	33.90	46.39	-20.69	152.91	.28288E+05	292.7	78.2	17.5	1.4	216.6	-36.1
18	143.16	157.84	15.88	31.37	26.63	22.77	-35.03	134.54	.25536E+05	261.2	44.8	15.5	1.4	218.2	-67.9
19	122.38	160.96	16.00	8.91	18.04	1.30	-43.33	108.67	.23296E+05	235.6	36.3	5.1	1.5	209.6	-79.9
20	100.92	163.55	16.15	346.43	9.39	340.91	-42.29	79.11	.28032E+05	289.8	41.1	42.1	1.6	225.7	-87.2
21	84.72	163.66	16.27	329.56	3.53	325.71	-35.53	60.14	.14016E+05	287.8	54.9	0.0	1.9	251.6	88.0
22	73.94	162.97	16.35	318.30	0.15	315.45	-29.00	49.95	.16320E+05	340.6	65.3	0.8	2.3	296.5	84.7
23	63.23	161.53	16.43	307.05	-2.67	305.02	-21.37	41.48	.20096E+05	427.0	75.2	16.0 +	3.0	363.4	81.1
24	52.63	159.07	16.50	295.78	-4.82	294.41	-12.99	34.34	.25024E+05	539.9	97.6	16.3	4.3	460.4	76.6
25	44.82	156.18	16.54	287.33	-5.95	286.35	-6.35	29.63	.17408E+05	758.6	161.8	33.1	6.0	612.1	72.3
26	39.73	153.51	16.57	281.70	-6.45	280.95	-1.80	26.73	.22336E+05	984.5	286.7	26.0	7.8	732.5	68.8
27	34.77	149.96	16.59	276.06	-6.75	275.51	2.84	23.95	.21056E+05	925.8	80.4	2.9	10.4	898.4	64.4
28	30.02	145.16	16.61	270.43	-6.84	270.08	7.54	21.29	.26368E+05	1169.5	69.8	0.0	14.3	1169.1	58.7
29	25.59	138.51	16.62	264.79	-6.72	264.64	12.31	18.70	.34176E+05	1527.8	71.0	7.8	21.0	1537.4	51.3
30	21.68	129.19	16.64	259.16	-6.39	259.22	17.11	16.16	.45312E+05	2039.4	64.3	3.9	34.3	2083.0	41.2
31	18.62	116.20	16.64	253.52	-5.86	253.80	21.95	13.61	.59648E+05	2698.8	60.2	8.6	66.3	2756.9	27.4
32	16.88	99.36	16.65	247.88	-5.13	248.43	26.82	11.04	.73728E+05	3347.4	56.4	0.0	131.1	3399.6	9.8

KT	ELONG	INCL	BETA	LAMDA	DELTA	ALPHA	R1	L2	IMEL	PMEL	PHIMEL	IOEL	POEL	PHIOEL	MELR	PIOELR
1	31.62	86.01	31.53	273.26	8.11	272.51	12.35	35.88	447.3	0.1604	1.0	437.8	0.1502	1.1	61.1	55.9
2	32.44	77.05	31.52	267.61	8.09	267.64	16.65	33.66	443.5	0.1576	0.1	434.6	0.1478	0.1	58.9	54.1
3	34.09	68.78	31.50	261.95	8.26	262.77	21.05	31.56	416.6	0.1629	0.2	408.8	0.1538	0.2	56.8	52.6
4	36.45	61.50	31.47	256.31	8.61	257.92	25.52	29.59	377.6	0.1691	0.1	371.0	0.1607	0.1	53.0	49.5
5	39.40	55.28	31.44	250.65	9.15	253.06	30.05	27.73	353.3	0.1694	0.5	347.9	0.1619	0.5	49.4	46.5
6	42.80	50.09	31.41	245.00	9.86	248.24	34.63	25.96	301.1	0.1931	-0.2	296.8	0.1864	-0.2	47.5	45.2
7	46.57	45.81	31.38	239.35	10.75	243.41	39.27	24.29	269.1	0.1958	-0.4	265.7	0.1896	-0.4	42.8	40.9
8	50.60	42.30	31.34	233.71	11.80	238.62	43.93	22.71	235.9	0.2195	-0.3	233.2	0.2140	-0.3	41.8	40.2
9	57.04	38.22	31.27	225.25	13.66	231.46	51.01	20.50	196.8	0.2257	-0.2	194.8	0.2208	-0.2	35.5	34.4
10	66.11	34.49	31.18	213.97	16.64	221.96	60.54	17.90	158.9	0.2331	-0.9	157.5	0.2288	-1.0	29.4	28.6
11	75.50	32.22	31.06	202.71	20.11	212.49	70.14	15.92	118.1	0.2522	0.1	117.1	0.2482	0.1	23.6	23.0
12	85.08	31.10	30.97	191.46	23.98	202.96	79.78	15.91	125.8	0.1900	2.0	125.0	0.1669	2.1	18.9	18.5
13	99.53	31.30	30.82	174.60	30.28	188.32	85.50	172.17	109.7	0.1559	0.8	109.1	0.1536	0.8	13.6	13.3
14	118.38	35.42	30.65	152.17	39.00	167.38	66.28	177.43	100.7	0.0986	0.5	100.2	0.0972	0.5	8.0	7.8
15	135.53	46.49	30.54	129.77	46.96	143.26	47.21	172.37	84.0	0.0451	0.7	83.5	0.0442	0.7	3.1	3.0
16	147.55	71.04	30.50	107.39	52.50	114.51	28.67	165.75	98.9	0.0122	-11.7	98.4	0.0117	-12.2	1.0	0.9
17	147.82	107.48	30.53	85.01	53.83	82.20	11.05	157.45	100.9	0.0376	-16.1	100.4	0.0373	-16.4	3.1	3.1
18	136.11	132.67	30.64	62.61	50.41	51.08	-4.95	146.70	94.6	0.0576	1.8	94.1	0.0569	1.9	4.6	4.5
19	119.04	144.12	30.[illegible]	40.18	43.54	24.53	-18.18	132.39	91.4	0.1114	-1.6	90.9	0.1100	-1.6	8.6	8.5
20	100.26	148.43	31.01	17.71	35.06	2.08	-26.80	113.73	104.4	0.1687	-0.0	103.8	0.1665	-0.0	15.2	14.9
21	85.82	148.74	31.16	0.83	28.53	346.69	-29.01	97.56	107.9	0.2089	1.3	107.1	0.2057	1.3	19.6	19.2
22	76.24	147.71	31.26	349.56	24.36	337.18	-28.17	86.62	124.0	0.2322	0.6	123.0	0.2285	0.6	25.2	24.6
23	66.82	145.54	31.35	338.27	20.46	327.64	-25.55	76.23	142.9	0.2348	1.6	141.6	0.2303	1.6	29.6	28.7
24	57.73	141.93	31.42	326.98	16.95	318.16	-21.34	66.77	167.6	0.2456	1.0	165.7	0.2404	1.0	36.3	35.1
25	51.25	137.98	31.47	318.50	14.63	311.05	-17.31	60.41	203.1	0.2269	1.6	200.5	0.2210	1.7	40.6	39.0
26	47.18	134.58	31.49	312.86	13.25	306.29	-14.27	56.52	239.9	0.2047	0.7	236.7	0.1983	0.8	43.1	41.2
27	43.36	130.42	31.51	307.20	12.01	301.51	-10.99	52.99	271.8	0.1927	0.5	269.8	0.1857	0.5	46.2	43.9
28	39.69	125.38	31.53	301.55	10.93	296.72	-7.50	49.54	321.3	0.1829	0.0	316.3	0.1754	0.0	51.3	48.5
29	36.87	119.33	31.54	295.69	10.01	291.91	-3.81	46.41	354.7	0.1808	0.7	348.5	0.1725	0.7	56.0	52.5
30	34.41	112.22	31.54	290.24	9.27	287.08	0.03	43.50	399.6	0.1738	0.5	392.1	0.1649	0.6	60.4	56.2
31	32.64	104.08	31.54	284.57	8.70	282.23	4.02	40.78	432.9	0.1682	-0.4	424.2	0.1587	-0.5	63.0	58.3
32	31.69	95.21	31.54	278.92	8.31	277.38	8.12	38.25	458.2	0.1537	-1.4	448.8	0.1437	-1.6	60.5	55.4

E O F-MARKE
ENDE DER MZY FUER 15- UND 30-GRD-PMT

=13

HELIOS B 30 GRAD PMT C3 POLARISATIONSMESSUNG MZY-NR= 2104 TM= -5.1 DSK= 895 DSM= 1613 DSL= 2860

LAMDAHELIOS = 95.72 LAMDASONNE = 275.72 SIGMA = 89.48 THETA = 269.90 TAG 1/ 1978 GMT= 4/17/51 R = .9266 SPINR = 1.01285

SEKT	ELONG	INCL	BETA	LAMDA	DELTA	ALPHA	B2	L2	IMEL	PMEL	PHIMEL	IOEL	POEL	PHIOEL	PIMELR	PIOELP
1	31.62	86.01	31.53	273.26	8.11	272.51	12.35	35.88	447.3	0.1604	1.0	437.8	0.1502	1.1	61.1	55.9
2	32.44	77.05	31.52	267.61	8.09	267.64	16.65	33.66	443.5	0.1576	0.1	434.6	0.1478	0.1	58.9	54.1
3	34.09	68.78	31.50	261.95	8.26	262.77	21.05	31.56	416.6	0.1629	0.2	408.8	0.1538	0.2	56.8	52.6
4	36.45	61.50	31.47	256.31	8.61	257.92	25.52	29.59	377.6	0.1691	0.1	371.0	0.1607	0.1	53.0	49.5
5	39.40	55.78	31.44	250.65	9.15	253.06	30.05	27.73	353.3	0.1694	0.5	347.9	0.1619	0.5	49.4	45.5
6	42.80	50.09	31.41	245.00	9.86	248.24	34.63	25.96	301.1	0.1931	-0.2	296.8	0.1864	-0.2	47.5	45.2
7	46.57	45.81	31.38	239.35	10.75	243.41	39.27	24.29	269.1	0.1958	-0.4	265.7	0.1896	-0.4	42.8	40.9
8	50.60	42.30	31.34	233.71	11.80	238.62	43.93	22.71	235.9	0.2195	-0.3	233.2	0.2140	-0.3	41.8	40.2
9	57.04	38.22	31.27	225.25	13.66	231.46	51.01	20.50	196.8	0.2257	-0.2	194.8	0.2208	-0.2	35.5	34.4
10	66.11	34.49	31.18	213.97	16.64	221.96	60.54	17.90	158.9	0.2331	-0.9	157.5	0.2288	-1.0	29.4	28.6
11	75.50	32.22	31.06	202.71	20.11	212.49	70.14	15.92	118.1	0.2522	0.1	117.1	0.2482	0.1	23.6	23.0
12	85.08	31.10	30.97	191.46	23.98	202.96	79.78	15.91	125.8	0.1900	2.0	125.0	0.1869	2.1	18.9	18.5
13	99.53	31.30	30.82	174.60	30.28	188.32	85.50	172.17	109.7	0.1559	0.8	109.1	0.1536	0.8	13.6	13.3
14	118.38	35.42	30.65	152.17	39.00	167.36	66.28	177.43	100.7	0.0986	0.5	100.2	0.0972	0.5	8.0	7.8
15	135.53	46.49	30.54	129.77	46.96	143.26	47.21	172.37	84.0	0.0451	0.7	83.5	0.0442	0.7	3.1	3.0
16	147.55	71.04	30.50	107.39	52.50	114.51	28.67	165.75	98.9	0.0122	-11.7	98.4	0.0117	-12.2	1.0	0.9
17	147.82	107.48	30.53	85.01	53.83	82.20	11.05	157.45	100.9	0.0376	-16.1	100.4	0.0373	-16.4	3.1	3.1
18	136.11	132.67	30.64	62.61	50.41	51.08	-4.95	146.70	94.6	0.0576	1.8	94.1	0.0569	1.9	4.6	4.5
19	119.04	144.12	30.[illegible]	40.18	43.54	24.53	-18.18	132.39	91.4	0.1114	-1.6	90.9	0.1100	-1.6	8.6	8.5
20	100.26	148.43	31.01	17.71	35.06	2.08	-26.80	113.73	104.4	0.1687	-0.0	103.8	0.1665	-0.0	15.2	14.9
21	85.82	148.74	31.16	0.83	28.53	346.69	-29.01	97.56	107.9	0.2089	1.3	107.1	0.2057	1.3	19.6	19.2
22	76.24	147.71	31.26	349.56	24.36	337.16	-28.17	86.62	124.0	0.2322	0.6	123.0	0.2285	0.6	25.2	24.6
23	66.82	145.54	31.35	338.27	20.46	327.64	-25.55	76.23	142.9	0.2348	1.6	141.6	0.2303	1.6	29.6	28.7
24	57.73	141.93	31.42	326.98	16.95	318.16	-21.34	66.77	167.6	0.2456	1.0	165.7	0.2404	1.0	36.3	35.1
25	51.25	137.98	31.47	318.50	14.63	311.05	-17.31	60.41	203.1	0.2269	1.6	200.5	0.2210	1.7	40.6	39.0
26	47.18	134.58	31.49	312.86	13.25	306.29	-14.27	56.52	239.9	0.2047	0.7	236.7	0.1983	0.8	43.1	41.2
27	43.36	130.42	31.51	307.20	12.01	301.51	-10.99	52.90	273.8	0.1927	0.5	269.8	0.1857	0.5	46.2	43.9
28	39.69	125.38	31.53	301.55	10.93	296.72	-7.50	49.54	321.3	0.1829	0.0	316.3	0.1754	0.0	51.3	48.5
29	36.87	119.33	31.54	295.69	10.01	291.91	-3.81	46.41	354.7	0.1808	0.7	348.5	0.1725	0.7	56.0	52.5
30	34.41	112.22	31.54	290.24	9.27	287.08	0.03	43.50	399.6	0.1738	0.5	392.1	0.1649	0.6	60.4	56.2
31	32.64	104.08	31.54	284.57	8.70	282.23	4.02	40.78	432.9	0.1682	-0.4	424.2	0.1587	-0.5	63.0	58.3
32	31.69	95.21	31.54	278.92	8.31	277.38	8.12	38.25	458.2	0.1537	-1.4	448.8	0.1437	-1.6	60.5	55.4

E O F-MARKE
ENDE DER MZY FUER 15- UND 30-GRD-PMT

12. List of abbreviations and symbols

MC:	Measurement-cycle through all sensors and all filter combinations, duration normally ≈ 5h
ID:	Identification word, the first 36 bits of science data block, often only the first 8 bits are meant, which identify the type of measurement
PMT:	Sensor, photometer
SIGMA:	Solar aspect angle, angle between spin axis and Helios-sun line
THETA:	Pitch angle, measured as rotation about Helios-sun line, 0^{o} if spin axis points in flight direction, 90^{o} if spin axis points north in solar meridian
TLM-Format:	Five different formats (distribution of frame under experiments) are available, see detailed experiment description
SC-frame:	Spacecraft transmits data in frames of 8 x 144 bits
DM:	Refers to handling of data in spacecraft, DM 7 = data stored in the core memory
EDF:	Experiment data frame = science data block
OA-Block:	Block containing Orbit and Attitude information
$\lambda_{(Helios)}$ in OA-Block:	Heliocentric ecliptic longitude of Helios counted from vernal equinox (1950.0) $\lambda_{(Helios)}$ in SC-Block: calculated for equinox (1975.0
EDR:	Experiment data record = Original data tape
TM:	Temperature
DC:	Dark current
CL:	Calibration lamp

List of available and missing zodiacal-light-data-tapes "Helios B"

June	1977	is contained in the tape of	May 1977
February	1978	is contained in the tape of	January 1978
January	1979	is contained in the tape of	December 1978

July, August, September of 1978 are missing
February, March of 1979 are missing
July, August, September of 1979 are missing
because the experiment was off.

No data were received for Helios B later than December 1979.

List of number of files per zodiacal-light-data-tape and the association of the reel-number to the month from launch. (Helios B)

Table 13.1

Reel-number	Files	Month	Year
ZHEB01	75	January	1976
ZHEB02	139	February	1976
ZHEB03	146	March	1976
ZHEB04	144	April	1976
ZHEB05	66	May	1976
ZHEB06	34	June	1976
ZHEB07	23	July	1976
ZHEB08	47	August	1976
ZHEB09	29	September	1976
ZHEB10	95	October	1976
ZHEB11	133	November	1976
ZHEB12	106	December	1976
ZHEB13	119	January	1977
ZHEB14	130	February	1977
ZHEB15	142	March	1977
ZHEB16	130	April	1977
ZHEB17	91	May, June	1977
ZHEB18	50	July	1977
ZHEB19	70	August	1977
ZHEB20	83	September	1977
ZHEB21	93	October	1977
ZHEB22	135	November	1977
ZHEB23	139	December	1977
ZHEB24	138	January, February	1978
ZHEB25	136	March	1978
ZHEB26	132	April	1978
ZHEB27	144	May	1978
ZHEB28	45	June	1978
ZHEB29	38	October	1978
ZHEB30	105	November	1978
ZHEB31	159	December, January	1978, 1979
ZHEB32	95	April	1979
ZHEB33	128	May	1979
ZHEB34	98	June	1979
ZHEB35	76	October	1979
ZHEB36	121	November	1979
ZHEB37	91	December	1979

List of missing zodiacal-light-data-tapes of Helios A

- to be supplied -

List of number of files per zodiacal-light-data-tape and the a
tion of the reel-number to the month from launch (Helios A)

Table 13.2

Reel-number	Files	Month	Year
ZHEA01	91	December	1974
ZHEA02	143	January	1975
ZHEA03	127	February	1975
ZHEA04	141	March	1975
ZHEA05	85	April	1975
ZHEA06	11	May	1975
ZHEA07	65	June	1975
ZHEA08	109	July	1975
ZHEA09	101	August	1975
ZHEA10	113	September	1975
ZHEA11	107	October	1975
ZHEA12	103	November	1975
ZHEA13	103	December	1975
ZHEA14	71	January	1976
ZHEA15	91	February	1976
ZHEA16	123	March	1976
ZHEA17	123	April	1976
ZHEA18	115	May	1976
ZHEA19	70	June	1976
ZHEA20	18	July	1976
ZHEA21	55	August	1976
ZHEA22	54	September	1976
ZHEA23	127	October	1976
ZHEA24	138	November	1976
ZHEA25	136	December	1976
ZHEA26	120	January	1977
ZHEA27	114	February	1977
ZHEA28	139	March	1977
ZHEA29	124	April	1977
ZHEA30	139	May	1977
ZHEA31	136	June	1977
ZHEA32	53	July	1977
ZHEA33	94	August	1977
ZHEA34	119	September	1977
ZHEA35	113	October	1977

14. Plots of zodiacal light intensity, colour and polarization

Examples for the different kind of plots are presented, including the summary over all available orbits of the intensity measurements in one particular sector.

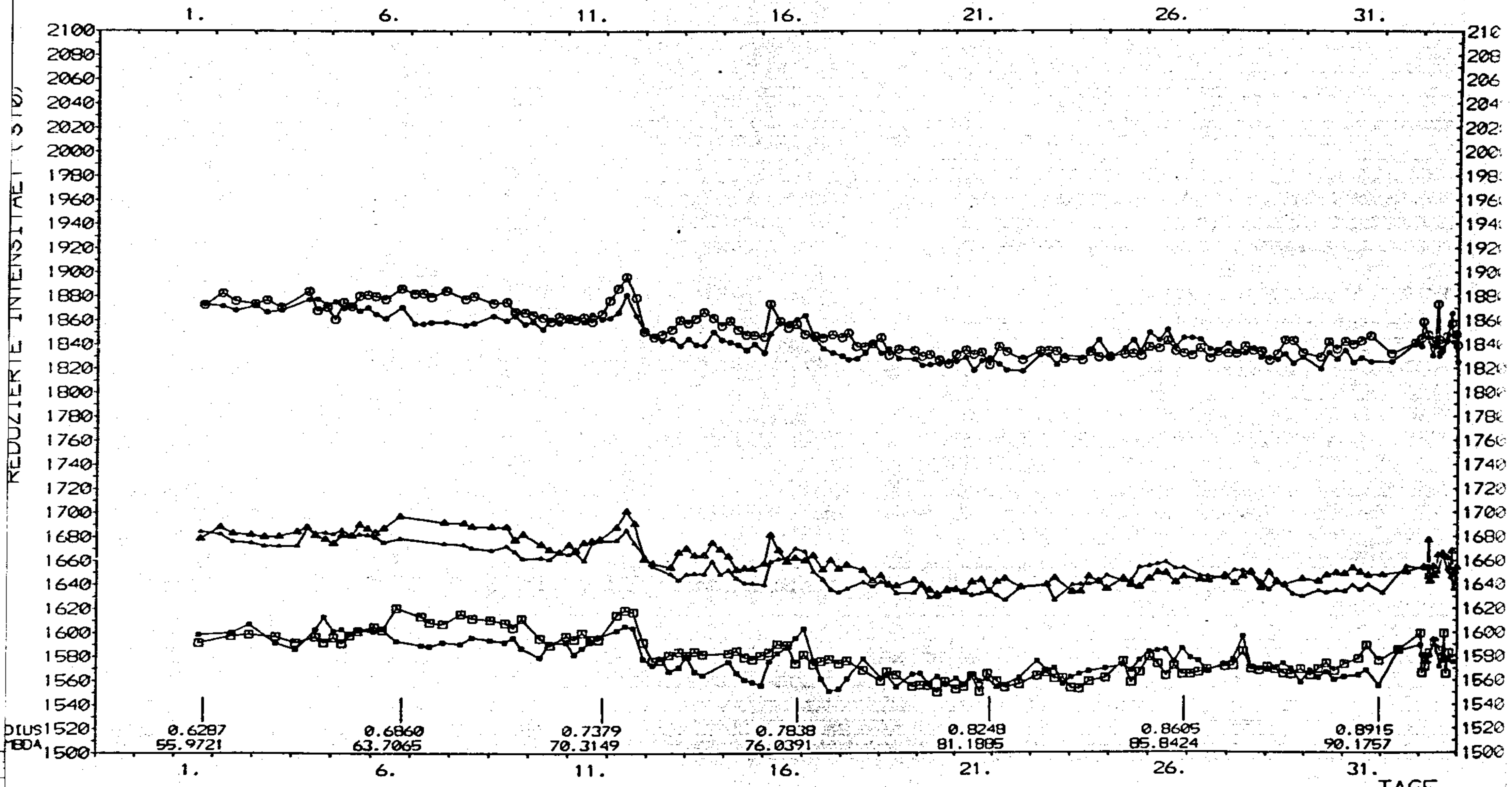
INTENSITAETEN 15 GRAD PHOTOMETER

MONAT: DEZ JAHR: 1979 HELIOS B R= 0.6272- 0.9218

□=UV 15 GRAD ⊙=VIS 15 GRAD △=BLAU 15 GRAD

GEWAEHLTER SEKTOR: 1

KLEINE SYMBOLE: KOMPLEMENTAER-SEKTOR

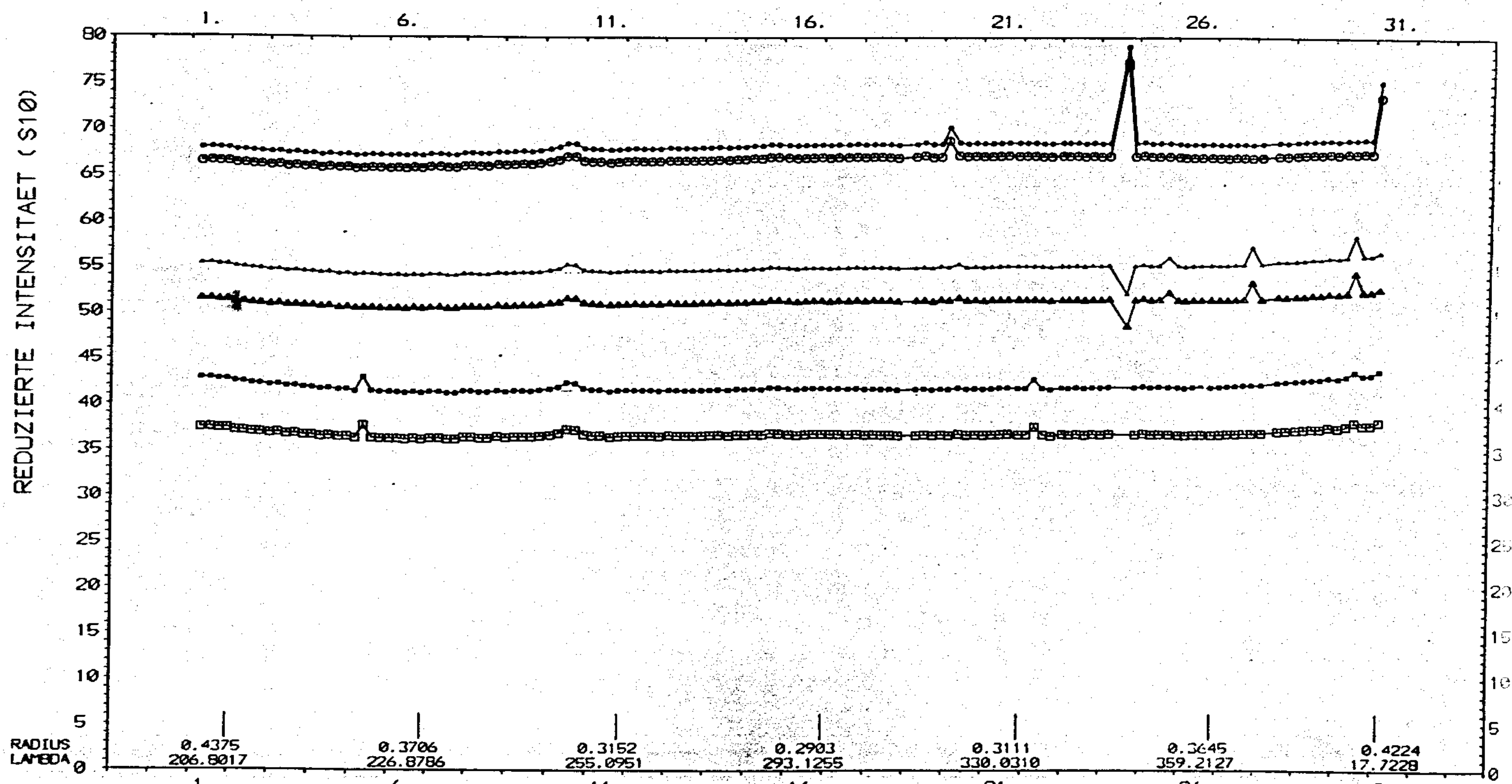


INTENSITAETEN 90 GRAD PHOTOMETER

MONAT: APR JAHR: 1976 HELIOS B R= 0.4465- 0.4224

□ =UV 90 GRAD-10 ○ =VIS 90 GRAD+10 △ =BLAU 90 GRAD

KLEINE SYMBOLE: MIT DURCHLASSKORREKTUR



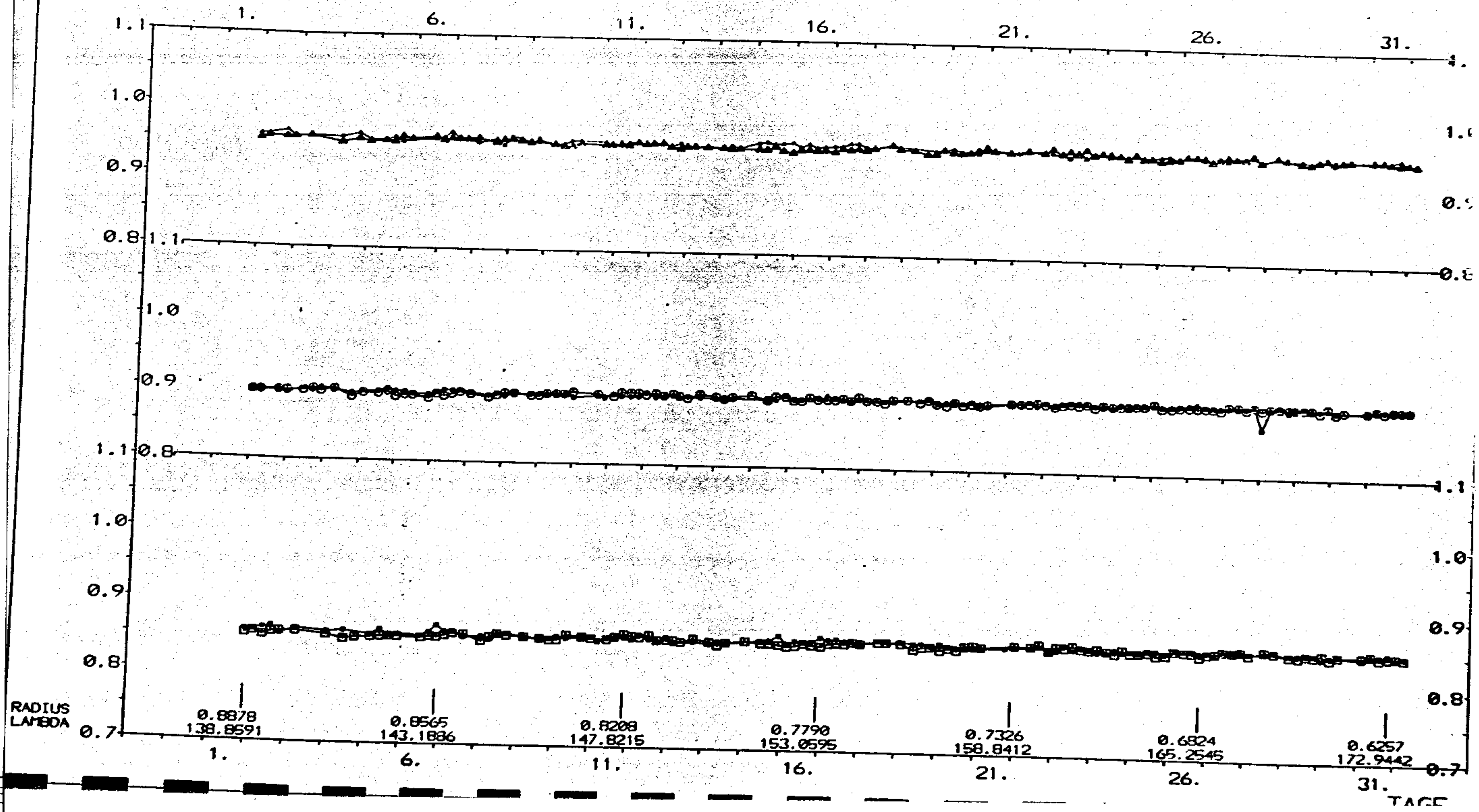
VERHAELTNISSE 15 GRAD PHOTOMETER

MONAT: MAR JAHR: 1978 HELIOS B R= 0.8882 0.6204

□=U/V 15 GRAD ○=R/V 15 GRAD △=U/B 15 GRAD

GEWAEHLTER SEKTOR: 1

KLEINE SYMBOLE: KOMPLEMENTAER-SEKTOR



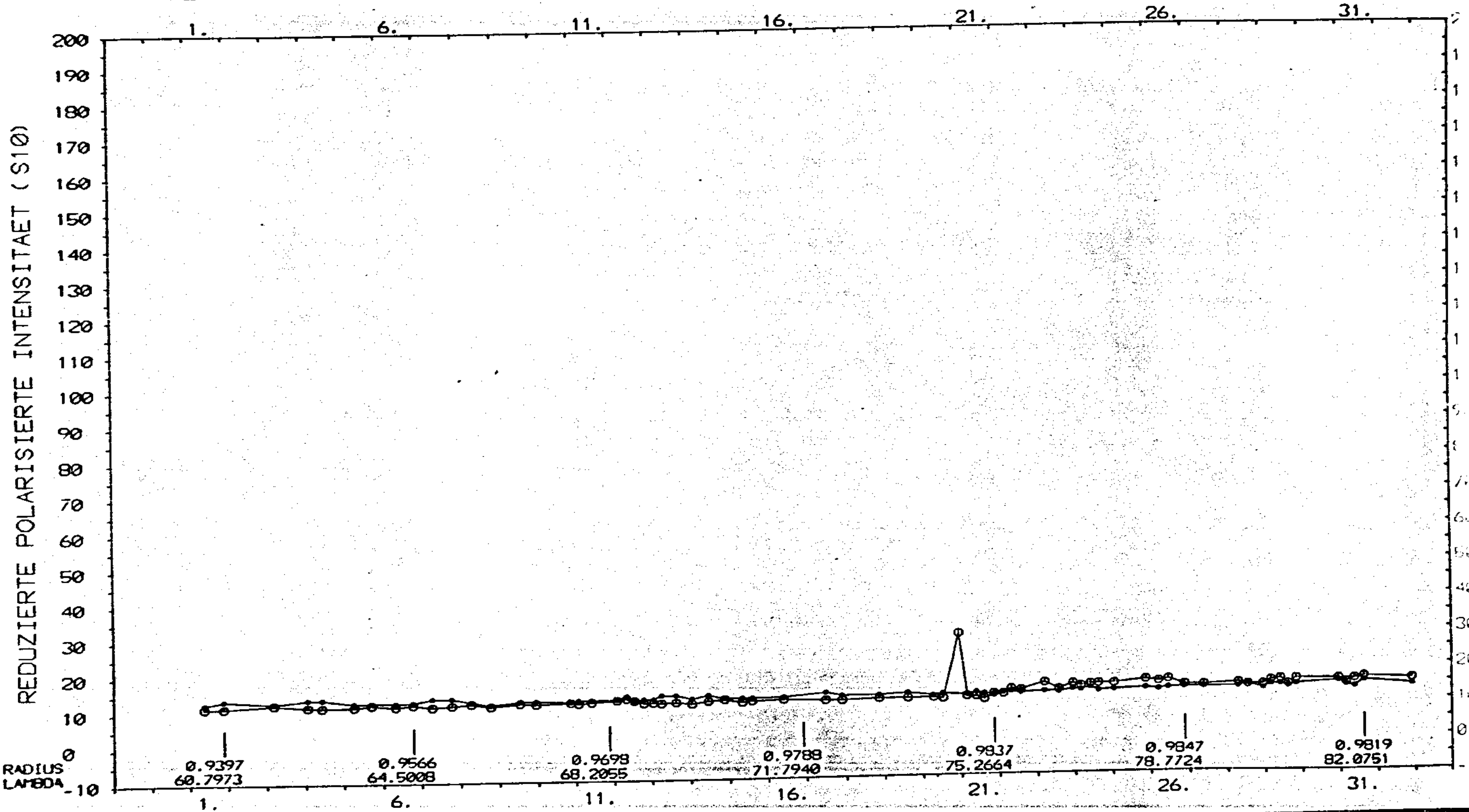
POLARISIERTE INTENSITAETEN 30 GRAD PHOTOMETER

MONAT: DEZ JAHR: 1975 HELIOS A R= 0.9376- 0.9805

□ =UV 30 GRAD+20 ○ =VIS 30 GRAD+10 △ =BLAU 30 GRAD

GEWAEHLTER SEKTOR: 16

KLEINE SYMBOLE: KOMPLEMENTAER-SEKTOR

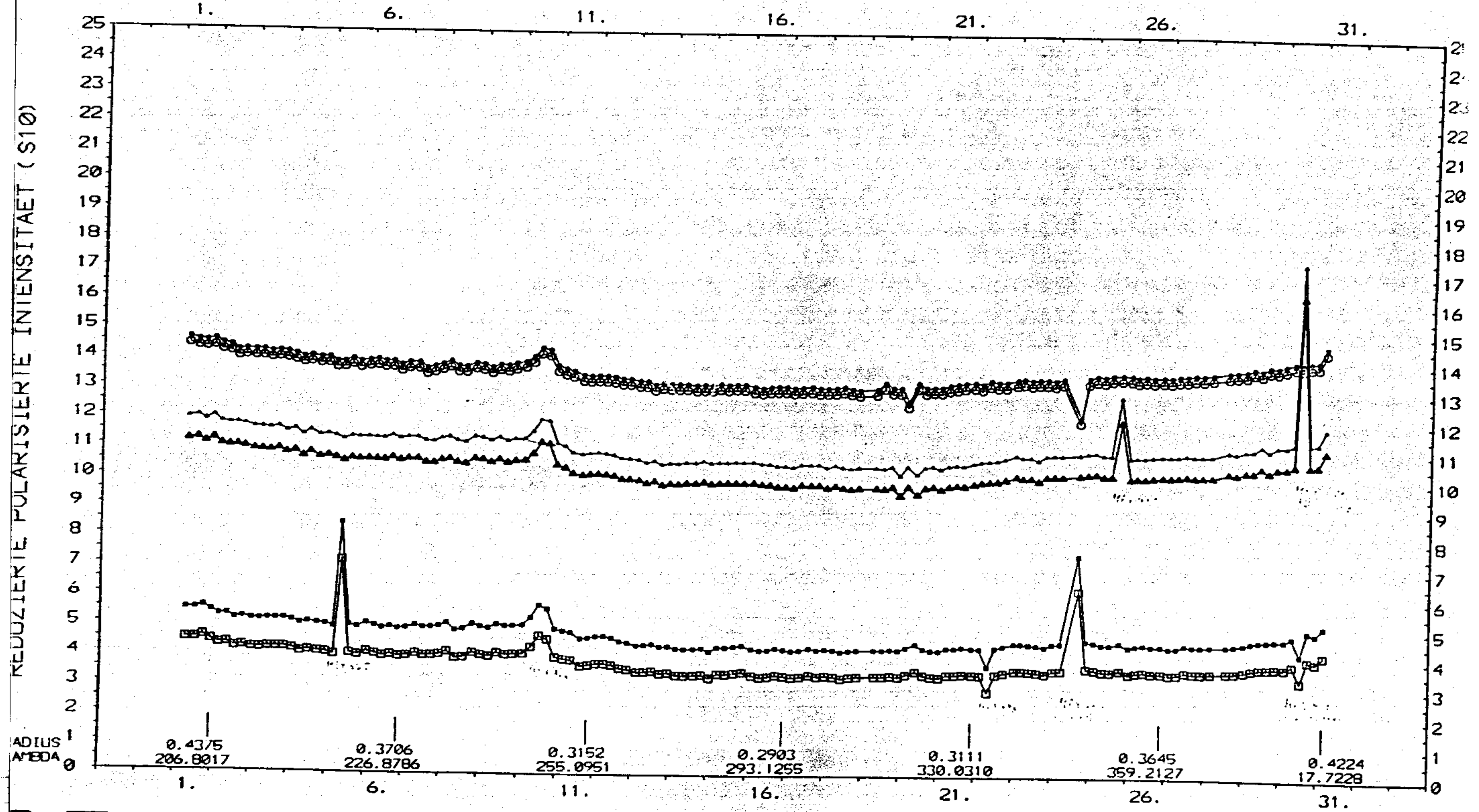


POLARISIERTE INTENSITAETEN 90 GRAD PHOTOMETER

MONAT: APR JAHR: 1976 HELIOS B R= 0.4465- 0.4224

□ =UV 90 GRAD-5 ○ =VIS 90 GRAD+5 △ =BLAU 90 GRAD

KLEINE SYMBOLE:MIT DURCHLASSKORREKTUR



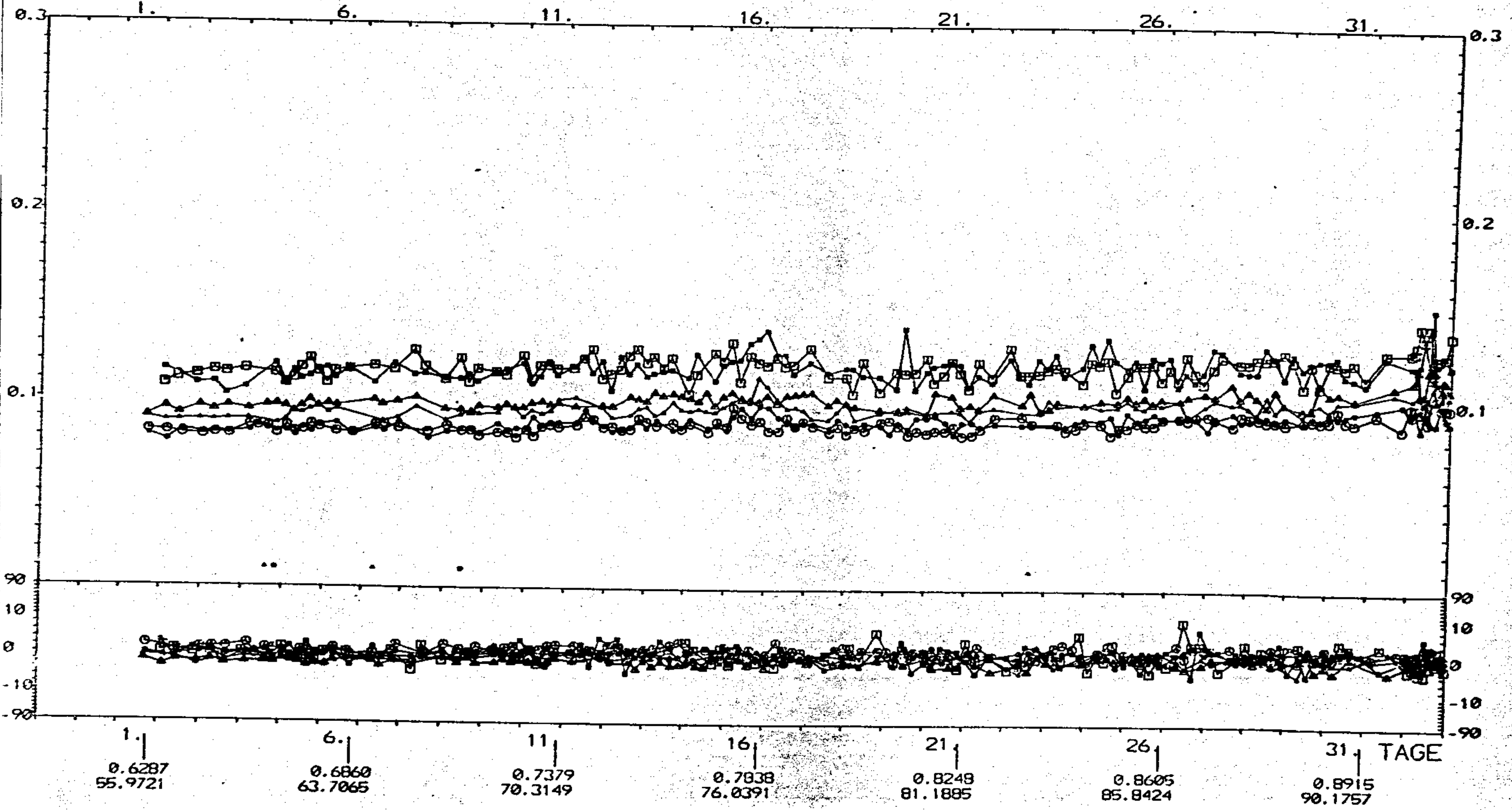
POLARISATION 15 GRAD PHOTOMETER

MONAT: DEZ JAHR: 1979 HELIOS B R= 0.6272- 0.9218

▫ =UV 15 GRAD ○ =VIS 15 GRAD △ =BLAU 15 GRAD

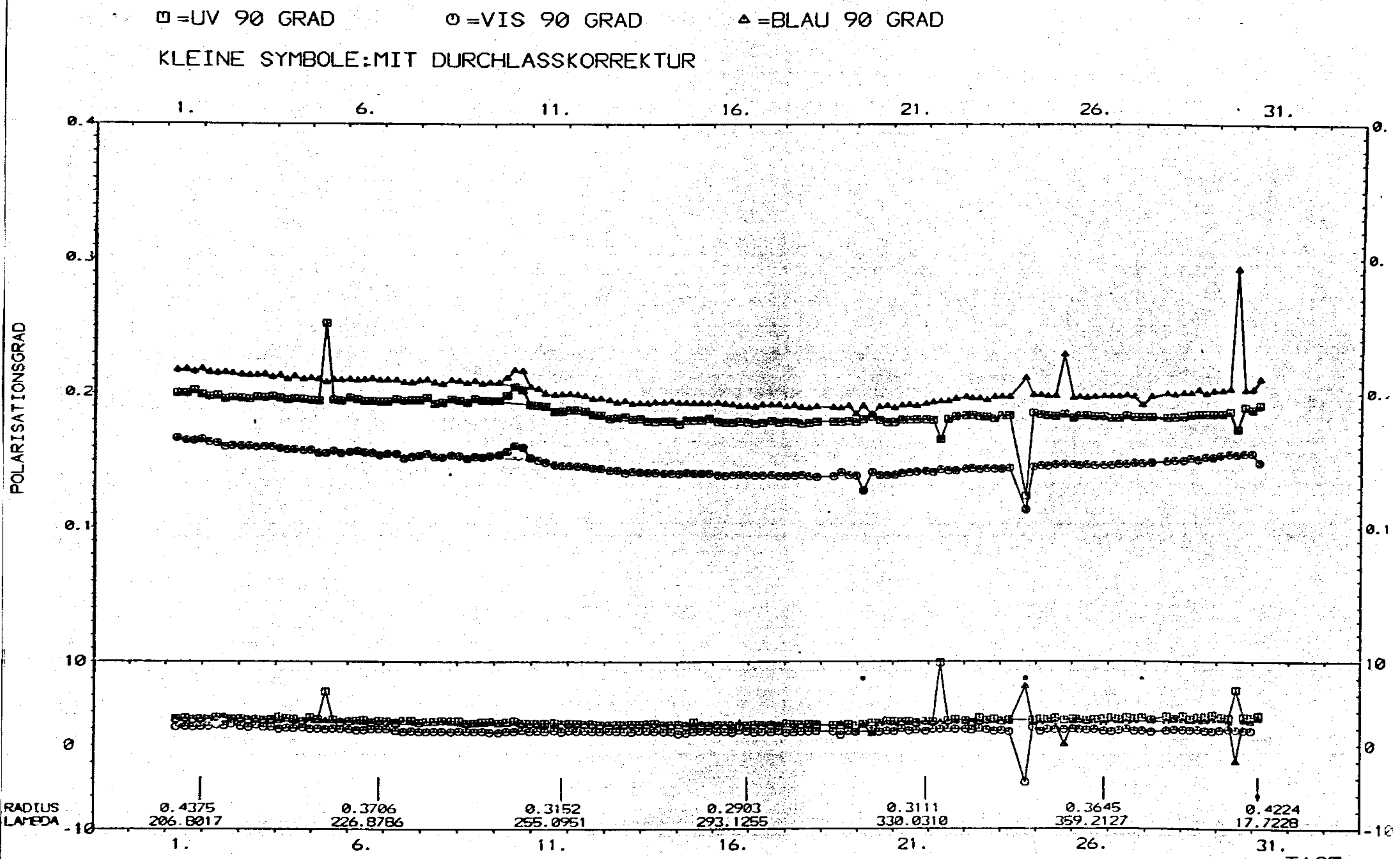
GEWAEHLTER SEKTOR: 1

KLEINE SYMBOLE: KOMPLEMENTAER-SEKTOR



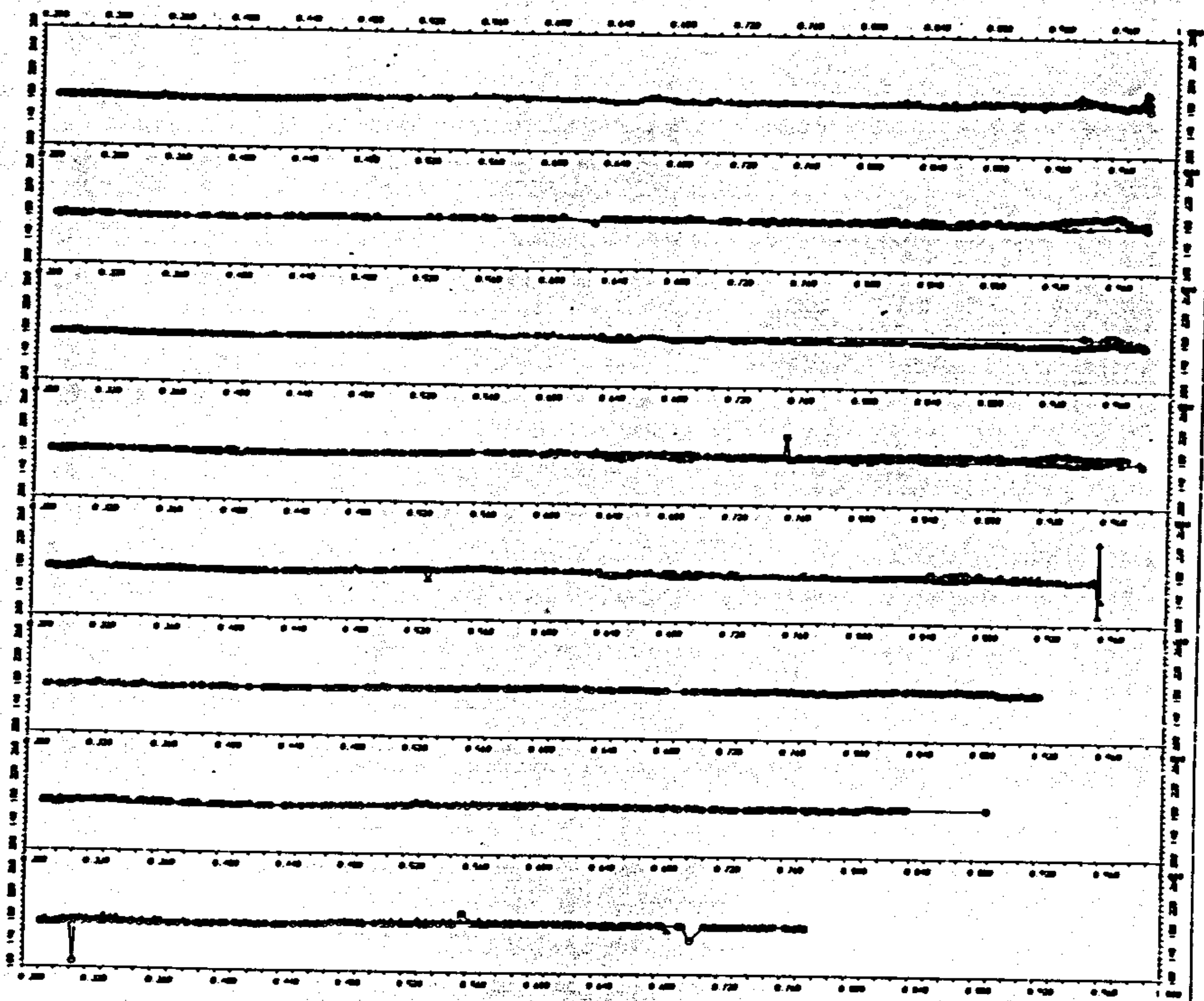
POLARISATION 90 GRAD PHOTOMETER

MONAT: APR JAHR: 1976 HELIOS B R= 0.4465-0.4224



INTENSITAETEN 15 GRAD PHOTOMETER UEBER RADIUS

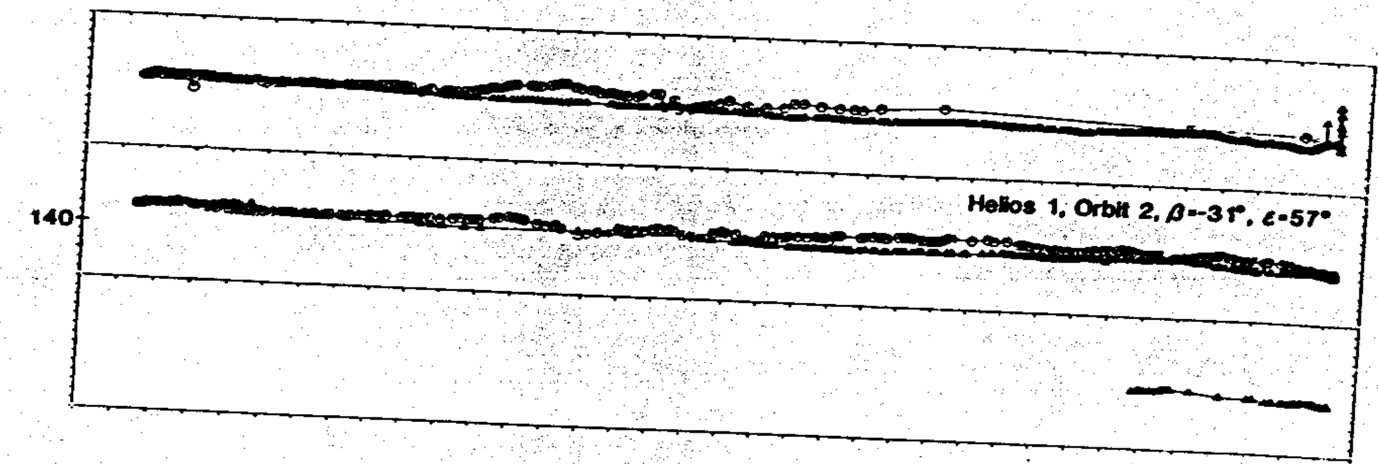
FARBE: BLAU SEKTOR: 10 HELIOS B



HELIOS.A ←AA
DSKC:U1510R.PPP[410,41000]

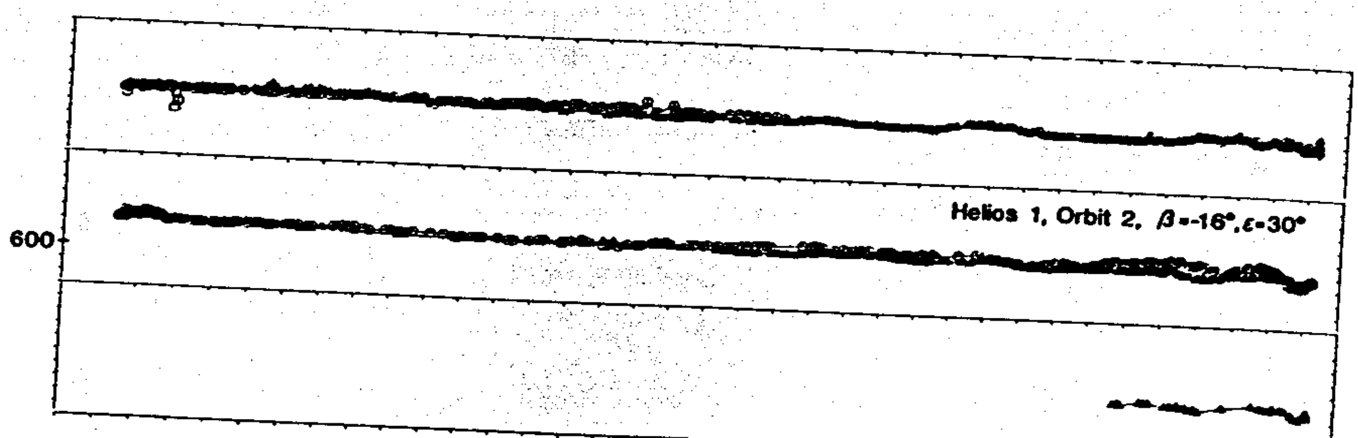
INTENSITAETEN 30 GRAD PHOTOMETER UEBER RADIUS

FARBE: BLAU   SEKTOR: 9   HELIOS A



INTENSITAETEN 15 GRAD PHOTOMETER UEBER RADIUS

FARBE: BLAU   SEKTOR: 5   HELIOS A



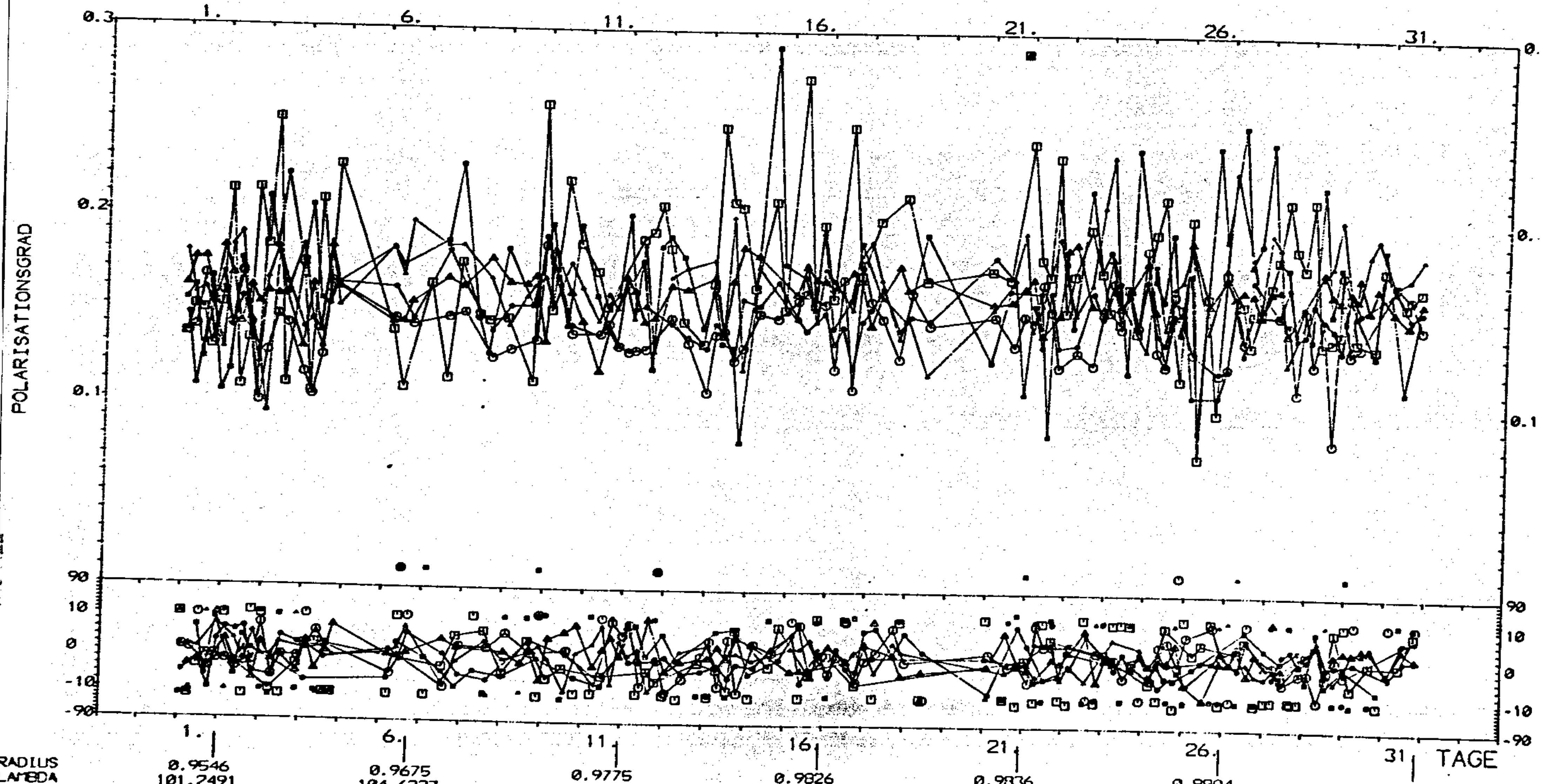
POLARISATION 15 GRAD PHOTOMETER

MONAT: JAN JAHR: 1977 HELIOS B R= 0.9515- 0.9733

□ =UV 15 GRAD ○ =VIS 15 GRAD △ =BLAU 15 GRAD

GEWAEHLTER SEKTOR: 13

KLEINE SYMBOLE: KOMPLEMENTAER-SEKTOR



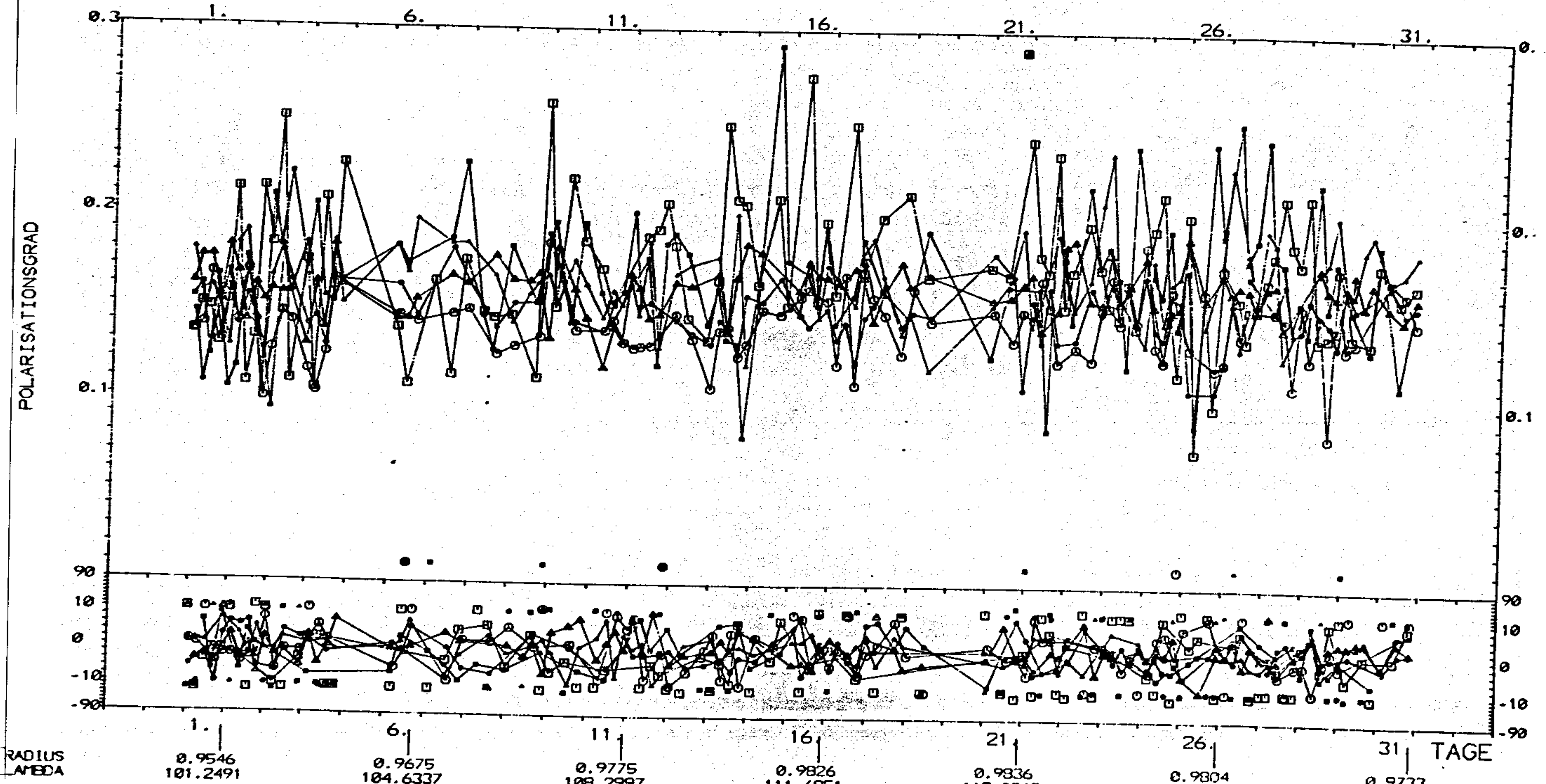
POLARISATION 15 GRAD PHOTOMETER

MONAT: JAN JAHR: 1977 HELIOS B R= 0.9515- 0.9733

□ =UV 15 GRAD ○ =VIS 15 GRAD △ =BLAU 15 GRAD

GEWAEHLTER SEKTOR: 13

KLEINE SYMBOLE: KOMPLEMENTAER-SEKTOR



15. List of events
(Helios A and Helios B, in german)

Stand: 13. 6.1981

Helios A Ereignistabelle

Tag		Zeit	Ereignis
10.12.74	344	8h11:00	Start = 0. Aphel
11.12.74	345	22h10:41	E9 ein, erster EDF
13.12.74	347	05h10	Step II abgeschlossen
14.12.74	348	22h09:00	E9 aus, E7 Integrity Check
		23h19:17	E9 ein, erster EDF
16.12.74	349	0314	Lagekorrektur $\theta = -0.2^{\circ}$
10. 2.75	041	0737	1. Lagemanöver Beginn
		15h27	1. Lagemanöver Ende
4. 3.75	063	7h43	2. Lagemanöver Beginn
			Spin-Up um 0.12 rpm
		16h29	2. Lagemanöver Ende
15. 3.75	074	9h12:15	1. Perihel
21. 3.75	080	7h08:00	3. Lagemanöver Beginn
		10h30	3. Lagemanöver Ende
24. 3.75	083	18h	Alle Experimente aus
			(1. Regulator schalten)
25. 3.75	084	1h01	E9 ein, erster EDF
		11h36	E9 aus
		17h26	E9 ein, erster EDF
12. 4.75	102	7h30	4. Lagemanöver Anfang
		11h47:00	4. Lagemanöver Ende
27. 4.75	117	18h00	1. Blackout Beginn
15. 5.75	135	18h	1. Blackout Ende
17. 6.75	168		1. Aphel
29. 8.75	241	22h00	2. Blackout Beginn
1. 9.75	244	6h	2. Blackout Ende
11. 9.75	254		Spin-Up um 0.12 rpm
18. 9.75	261		Spin-Up um 0.12 rpm
21. 9.75	264	12h16	2. Perihel
25.11.75	329		Erdnächster Punkt

Tag		Zeit	Ereignis
25.12.75	359	14h00	2. Aphel
17. 3.76	077	13h-14h	5. Lagemanöver (Keppler)
29. 3.76	089	15h52	3. Perihel
6.4.76	097		Spin-Down/Spin-Up (Musmann)
22. 6.76	174	04h10:46	Ausschalten durch Überlast (2. Regulator schalten)
29. 6.76	181		E9 an für 10h
2. 7.76	184	18h	3. Aphel
8. 7.76	190		E9 an für 28h
13. 7.76	195		E9 an für 21h
20. 7.76	202		E9 an für 23h
27. 7.76	209		E9 an für 23h
3. 8.76	216		E9 an für 44h
16. 8.76	229	21h10	E9 an
19. 9.76	263	06h40	3. Blackout Beginn
23. 9.76	267	21h05	3. Blackout Ende
1.11.76	306	16h49	M3 bleibt stehen in C3 bei C3→D
5.10.76	279	19h07	4. Perihel
19.11.76	324	16h15	M4 schaltet nicht von C2 nach C3, bleibt stehen
8.12.76	343		Versuch, Motoren wieder zu starten
8. 1.77	008	20h51	4. Aphel
3. 4.77	93	17h16:19	Alle Experimente aus (3. Regulator schalten)
3. 4.77	93	23h55	E9 wieder an
13. 4.77	103	22h31	5. Perihel
11. 7.77	192	23h45	Alle Experimente aus (4. Regulator schalten)
18. 7.77	199	0h25	5. Aphel - E9 aus
11. 8.77	223	10h21:07	E9 wieder eingeschaltet
10.10.77	283	16h48	4. Blackout Beginn
12.10.77	285	23h27	4. Blackout Ende
21.10.77	294	2h20:30	6. Perihel
2. 1.78	002	2h47:09	5. Regulator schalten, E9 aus

Tag		Zeit	Ereignis
8. 1.78	008	2h44	6. Regulator schalten
9. 1.78	009	21h35:50	7. Regulator schalten
10. 1.78	010	18h37:21	8. Regulator schalten
24. 1.78	024	4h16	6. Aphel
20. 2.78	051	14h05	E9 wieder eingeschaltet
29. 4.78	119	6h13:30	7. Perihel
17. 6.78	168	20h25	M1 bleibt stehen in Stellung P1
2. 7.78	183	21h40:00	E9 ausgeschaltet (Aphel)
12. 7.78	193	8h35:00	Heater group 1 ausgeschaltet (E2-E4)
18. 7.78	198		Heater group 2 aus (E9, E10)
23. 7.78	204	1h18	9. Regulatorschalten
2. 8.78	214	8h11	7. Aphel
17. 8.78	229	9h02	Heater group 1 an (E2, E3, E4
2. 9.78	245		Heater group 2 an (E9, E10)
7. 9.78	250	21h05	E9 wieder eingeschaltet
7. 9.78	250	22h50:25	10. Regulatorschalten (E9 aus)
10.10.78	283	7h30:00	E9 wieder eingeschaltet
27.10.78	300	9h00	5. Blackout Anfang
1.11.78	305	20h30	5. Blackout Ende
5.11.78	309	10h11	8. Perihel
11.11.78	315	16h48:25	11. Regulatorschalten (E9 aus)
12.11.78	316	4h30	E9 wieder eingeschaltet
24.11.78	329	11h30	Heater group 3 aus (Zentraltei
15.12.78	349	13h28	M2 bleibt stehen in C2
3. 1.79	003	7h40	Heater group 1 aus (E2, E3, E
8. 1.79	008	8h10	E9 ausgeschaltet (Aphel)
16. 1.79	016	7h02	Heater group 2 aus (E9, E10)
8. 2.79	039	12h00	8. Aphel
9. 4.79	099	9h05	Alle Heizer ein
10. 4.79	100	9h40	E9 ein
ab 10. 4.79	100-125		Signal von Sensor 30° sinkt auf "Null"
14. 5.79	134	12h41	9. Perihel
2. 6.79	153	12h30	12. Regualtorschalten (E9 aus

Tag		Zeit	Ereignis
2. 6.79	153	21h	E9 wieder eingeschaltet
15. 6.79	166	15h50	Heizergruppe 3 aus (Zentralteil)
8. 7.79	189	13h45	13. Regulatorschalten, E9 aus
		23h10	E9 wieder ein
11. 7.79	192	7h00	Heater group 1 aus (E2,E3,E4)
13. 7.79	194	0h00	E9 aus zum Aphel
18. 7.79	199	13h40	Heater group 2 aus (E9,E10)
17. 8.79	229	14h31	9. Aphel
16.10.79	289		Heizer ein
17.10.79	290	6h45	E9 ein
20.11.79	324	16h25	10. Perihel
19.12.79	353	13h43	Heizergruppe 3 aus
10. 1.80	010	17h21	14. Regulator schalten Heizergruppe 1 aus
17. 1.80	017	2h09	15. Regulator schalten Heizergruppe 2 aus, E9 aus
4. 2.80	035	12h17	16. Regulator schalten
9. 2.80	040	12h34	17. Regulator schalten
23. 2.80	054	19h51	10. Aphel
30. 4.80	121	12h48	Heizergruppe 2 an
2. 5.80	123		E9 an
28. 5.80	149	21h50	11. Perihel
12. 7.80	194	6h00	Heizergruppe 2 aus
12. 7.80	194	13h00	E9 aus
31. 8.80	244	23h52	11. Aphel
3.11.80	308		Heizergruppen 1 und 2 an
6.11.80	311		E9 an
2.12.80	337	9h30	E9 aus

Tag		Zeit	Ereignis
5.12.80	340	1h55	12. Perihel
12.12.80	347	12h30	E9 an
18. 1.81	018	9h35:43	18. Regulator schalten.E9 aus
10. 3.81	069	3h33	12. Aphel
13. 6.81		5h05	13. Perihel

Stand: 13. 6.1981

Helios B Ereignistabelle

Tag		Zeit	Ereignis
15. 1.76	015	05h34:00	Start = 0. Aphel
17. 1.76	017	00h47:25	E9 ein, erster EDF
18. 1.76	018	21h54:27	E9 aus, E7 Integrity Check
19. 1.76	019	00h04:05	E9 ein, erster EDF
21. 1.76	021	01h33	Abschluß Lagemanöver
20. 2.76	051	13h30	1. Lagekorrektur
27. 2.76	058	14h12-14h37	2. Lagekorrektur
17. 4.76	108	2h29:00	1. Perihel
14. 5.76	135	11h40	1. Blackout Beginn
19. 5.76	140	11h45	1. Blackout Ende
4. 7.76	186	16h:00	2. Blackout Beginn
16. 7.76	198	8h:00	2. Blackout Ende
18. 7.76	200	22h	1. Aphel
4. 9.76	248		TWT2 verloren
20. 9.76	264	03h07	3. Blackout Beginn
29. 9.76	273	23h59	3. Blackout Ende
19.10.76	293	19h08	2. Perihel
7. 1.77	7	3h36	CMD-Empfänger 1 verloren
20. 1.77	020	16h00	2. Aphel
23. 4.77	113	13h03	3. Perihel
17. 5.77	137	12h38-15h06	Störung Übertragung durch Aktivität
29. 5.77	149		4. Blackout Beginn
29. 6.77	180		4. Blackout Ende
25. 7.77	206	10h49	3. Aphel
4.10.77	277	22h20	5. Blackout Beginn
8.10.77	281		5. Blackout Ende
26.10.77	299	8h34:00	4. Perihel
7.12.77	341	7h30	Beginn Lagemanöver
8.12.77	342	18h30	Ende Lagemanöver
12.12.77	346	16h30	Gas ablassen bis auf 0.25 kg

Tag		Zeit	Ereignis
16. 1.78	016	7h47	Beginn Spin-Down wegen Leck
16. 1.78	016	7h49:41	1. Regulatorschalten - E9 aus
16. 1.78	016	9h29:30	Ende Spin-Down
27. 1.78	027	6h48	4. Aphel
13. 2.78	044	8h15	E9 wieder eingeschaltet
1. 3.78	060		Mit letztem Gas stabilen Punkt eingestellt
30. 4.78	120	5h08	5. Perihel
8. 6.78	159		6. Blackout Beginn
1. 7.78	182		6. Blackout Ende
7. 7.78	188	21h15	2. Regulatorschalten - E9 aus
15. 7.78	196	15h35:00	Heater group 2 aus (E9, E10)
17. 7.78	198	14h00:00	Heater group 1 aus (E2, E3, E4)
1. 8.78	213	3h36	5. Aphel
17. 8.78	229	2h50	Heater group 1 an (E2, E3, E4)
28. 8.78	240	8h	Heater group 2 an (E9, E10)
6.10.78	279	12h30	E9 ein
9.10.78	282		7. Blackout Beginn
20.10.78	293	23h25	7. Blackout Ende
22.12.78	356	7h33	Heater group 3 aus (Zentralteil)
2.11.78	306	2h00	6. Perihel
2. 1.79	002	9h00	Heater group 1 aus (E2, E3, E4)
7. 1.79	007	3h00	E9 aus (Aphel)
11. 1.79	011	7h33	Heater group 2 aus (E9, E10)
3. 2.79	034	1h00	6. Aphel
4. 4.79	094	8h58	Alle Heizer ein
6. 4.79	096	9h10	E9 ein
6. 5.79	126	22h44	7. Perihel
15. 6.79	166		Heizergruppe 3 aus (Zentralteil)
27. 6.79	178	18h12:26	3. Regulatorschalten, E9 aus
28. 6.79	179	8h35	E9 wieder eingeschaltet
30. 6.79	181	14h00	Heizergruppe 1 aus (E2,E3,E4)

Tag		Zeit	Ereignis
1. 7.79	182	16h00	E9 ausgeschaltet
3. 7.79	184	8h40	E9 wieder eingeschaltet
5. 7.79	186	9h30	E9 ausgeschaltet
7. 7.79	188	8h25	Heizergruppe 2 aus (E9,E10)
7. 8.79	219	21h08	7. Aphel
28. 9.79	271	12h20:32	4. Regulatorschalten bei Heizer ein
4.10.79	277	20h50	E9 eingeschaltet
24.10.79	297	20h45:18	8. Blackout Beginn
27.10.79	300	1h33:03	8. Blackout Ende
8.11.79	312	19h34	8. Perihel
	um Tag 300		Sensor 30° verliert an Empfindlichkeit, fällt aus
18.12.79	352	12h30	Heizergruppe 3 aus
23.12.79	357	7h22	5. Regulatorschalten, E9 ausgeschaltet
30.12.79	364	4h50	6. Regulatorschalten Heizergruppe 2 aus
1. 1.80	001	9h00	Heizergruppe 1 aus
15. 1.80	015	6h44:28	7. Regulatorschalten
28. 1.80	028	6h11	8. Regulatorschalten
9. 2.80	040	18h56	8. Aphel (Start +1487 d)
8. 3.80	068	17h45	9. Regulatorschalten S/C-Emergency

- ENDE DER MISSION -

Acknowledgement: The programme for the generation of plots was written by B. Planck. This work was supported by the Bundesministerium für Forschung und Technologie with grant WRS 0 108.

D-43190 1/31/76

DUMP OF TAPE LSOUT1

INPUT TAPE LSOUT1 ON MT2
DATA INPUT H9 NF 71 FL 1 1 0 SR 71 1 1

Helios B · Level# · Exper. id · month of Launch

FILE 1 RECORD 1 LENGTH 640BYTES · 1 · 91 · 4 · 9 · 1 · 20 · Header Label

(0)	00300008	00000000	00010000	00440C00	0000050B	00000000	04000000	00090000	00000100	00000104
(40)	00000000	01000000	000C0000	007B0A00	00000000	00000000	00000000	00000000	00000000	00000000
(80)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(120)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(160)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(200)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(240)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(280)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(320)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(360)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(400)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(440)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(480)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(520)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(560)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(600)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000

Handwritten under row 40: 1 · 12 · 1978

FILE	INPUT RECS.	DATA RECORDS INPUT	MAX. SIZE	READ ERROR SUMMARY PERM	ZERO B	SHORT	UNDEF.	INPUT RETRIES #RECS.	TOTAL#
1	164	164	640	0	3	0	0	3	3

MC HEADER LABEL
Jan 31, 1976

FILE 71 RECORD 1 LENGTH 640BYTES · 2 · 70 · 1976 · 31 · 19 · 47

(0)	00800008	00000000	00020000	00040600	00007B08	00000001	0F000000	01030000	00020F00	00006305
(40)	000007B8	08000000	02000000	00000000	00000200	00000C40	04000000	00000000	00000000	00000000
(80)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(120)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(160)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(200)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(240)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(280)	00000000	00000000	00000000	00000000	00000000	00000000	01000000	00000000	00000000	00000000
(320)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	000000BD	85999909
(360)	BE0A2222	02BD8B33	3303BE20	00000000	00000000	00000000	00457378	000045E4	68000046	5AAE8B0A
(400)	45775200	0045E4DC	0000465A	AC000045	DAEC8509	4AC834AC	0C4A42E8	73094B68	2F900E4A	E0F43A0C
(440)	415C587F	0C415CBD	78B4144	B2270E41	45053600	4B4B114E	054ACFBC	490340F8	A2AE0A4A	C2276B0B
(480)	4A4177BE	0D4140A7	D20E40C0	A1A70C40	C0A1A70C	43FD56BB	0843FD75	4207407A	F4840540	7AE53D0C
(520)	43D92D23	0444C353	FF0842FC	00000042	00000000	43400000	00000000	00000000	00000000	00000000
(560)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(600)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000

Handwritten near row 40: 1976 · 2

FILE	INPUT RECS.	DATA RECORDS INPUT	MAX. SIZE	READ ERROR SUMMARY PERM	ZERO B	SHORT	UNDEF.	INPUT RETRIES #RECS.	TOTAL#
71	98	98	640	0	1	0	0	1	1

EOJ DUMP STOPPED AFTER FILE 71 # OF PERMANENT READ ERRORS 0

START TIME 06/19/81 14:27:55 STOP TIME 06/19/81 14:30:03

DUMP OF TAPE X213

D-46368

03/01/75 – 03/31/75

INPUT TAPE X213 ON MT4
DATA INPUT n/ NF 140 SK 2 1 1 SF 140 1 1

FILE	INPUT RECS.	DATA RECORDS INPUT	MAX. SIZE	READ ERROR SUMMARY PERM	ZERO B	SHORT	UNDEF.	INPUT RETRIES #RECS.	TOTAL#
1	12	12	640	0	0	0	0	0	0

FILE 2 RECORD 1 LENGTH 640BYTES

					year 1975		DAY 60	HR. 1	MIN. 59	
(0)	00800008	00000000	00020000	00160400	00007307	00000003	00000000	00010000	00030800	00088208
(40)	0000007B	07000000	03000000	00000600	00000304	000005DC	09000000	00000000	00000000	00000000
(80)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(120)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(160)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(200)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(240)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(280)	00000000	00000000	00000000	00000000	00000000	00000000	01000000	00000000	00000000	00000000
(320)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000041	DD555506
(360)	42795555	0540C000	000041E8	00000000	00000000	00000000	00456444	150D45D7	68000046	4D600000
(400)	45553400	0045C3CC	000045F7	D2490245	C0355505	00000000	0040C055	F2060000	00000040	C1528100
(440)	00000000	004157E6	88080000	00000000	00000000	00000000	0040C327	B70A0000	00000000	00000000
(480)	40C4B907	03000000	000040C0	20100040	C0201000	4459037B	0B44593E	3F0F3FEE	0F71023F	EDA62B02
(520)	43D9E8A3	0A43D920	440B4378	00000041	40000000	43780000	0041D000	00000000	00000000	00000000
(560)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(600)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000

FILE	INPUT RECS.	DATA RECORDS INPUT	MAX. SIZE	READ ERROR SUMMARY PERM	ZERO B	SHORT	UNDEF.	INPUT RETRIES #RECS.	TOTAL#
2	134	134	640	0	0	0	0	0	0

FILE 140 RECORD 1 LENGTH 640BYTES

					1975		90	19	9	
(0)	00800008	00000000	00020000	001E0E00	00007807	00000005	0A000000	01030000	00000900	0004830C
(40)	0000007B	07000000	05040000	00010700	00000304	00000C48	0E000000	00000000	00000000	00000000
(80)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(120)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(160)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(200)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(240)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(280)	00000000	00000000	00000000	00000000	00000000	00000000	01000000	00000000	00000000	00000000
(320)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000041	C1555505
(360)	42711111	0140C000	000041E0	00000000	00000000	00000000	00456AC6	AA0B45D9	7AAA0B45	51E2AA0B
(400)	4556F400	0045C4E8	000045FB	04000045	C4C00000	40C00CA6	0940C1A9	9C0740C1	05FA0140	C29DF902
(440)	4157E214	084157D4	DC074140	78AF0141	40553705	40C63A43	0340C46F	A10F4141	8FC90840	C493BA0F
(480)	40C5C1ED	0840F5D6	620C40C0	30240240	C0404004	44D616F6	0E44D630	B0083FF5	3255063F	F59D5A00
(520)	43DA4358	054308D8	6C0243DA	00000042	D0000000	43DA0000	0042DC00	00000000	00000000	00000000
(560)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
(600)	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000

FILE	INPUT RECS.	DATA RECORDS INPUT	MAX. SIZE	READ ERROR SUMMARY PERM	ZERO B	SHORT	UNDEF.	INPUT RETRIES #RECS.	TOTAL#
140	134	134	640	0	0	0	0	0	0

EOJ DUMP STOPPED AFTER FILE 140 # OF PERMANENT READ ERRORS 0

START TIME 01/06/82 11:13:06 STOP TIME 01/06/82 11:17:54

$$
$EXE TPDUMP BS