



516

PIONEER 11

STARLIGHT/ZODIACAL LIGHT EXPERIMENT

73-019A-15A



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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 This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system.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

PIONEER 11

STARLIGHT/ZODIACAL LIGHT TAPE

73-019A-15A PSSB-00043

Tape Format

This dataset has been restored. It consists of 1 tape. The DS tape is 9-track, 6250 bpi. The DR tape is a 3480 cartridge. The data were originally written in UNIVAC 1100 36-bit words. They have been converted to ASCII. The DR and DS numbers along with the corresponding D numbers and time spans are as follows:

<u>DR #</u>	<u>DS#</u>	<u>DD#</u>	<u>FILES</u>	<u>TIME SPAN</u>
DR004404	DS004404	DD046760	7	02/26/74 - 09/24/74

TAPE FORMAT

File 1 of the tape is a header file, containing two records. The rest of the files are data files and contain one header record, followed by data records.

The header records are fixed length and contain ASCII zero values for any unused space. Each data record is divided into four sectors. Each sector contains 16 header words (items 1-16 on format below), and a variable number of 14-word elements, one for each star in the sector (the number of stars is contained in item 6 of the sector header).

Following is a more detailed description of each part of the tape.

Header file

Record 1:

<u>Item #</u>	<u>Format</u>	<u>Description</u>
1	I5	# of data files on tape (directory file not included)
2	I5	# of days on tape
3	I5	Spacecraft - Pioneer (10 or 11)
4	A6	Day of year map was made DAY/YR
5	A6	Number of this tape
6	A6	Input tape number (ignore)
7	A6	Is input tape corrected (ignore)
8	I5	# of <u>sections</u> for day
9-243		Repeat items 4-8 for each remaining day

Record 2:

<u>Item #</u>	<u>Format</u>	<u>Description</u>
1	A6	Day of year map was made
2	I5	File # where data is located (directory file not included)
3	I5	Section #
4	F6.2	First look angle in section
5	F6.2	Last look angle in section
6	F6.2	Minimum elongation
7	F6.2	Maximum elongation
8-336		Repeat of items 1-7 for each section of every day

Data File

Record 1: (header record)

<u>Item #</u>	<u>Format</u>	<u>Description</u>
1	A6	Day of year map was made
2	A6	Input tape # (ignore)
3	I5	Section #
4	I5	Start time of observations for this section, hours (GMT)
5	I5	Start time of observations for this section, minutes (GMT)
6	I5	Start time of observations for this section, seconds (GMT)
7	I5	Stop time of observations for this section, hours (GMT)
8	I5	Stop time of observations for this section, minutes (GMT)
9	I5	Stop time of observations for this section, seconds (GMT)
10	A6	Element name containing position data (ignore)
11	F7.2	Right ascension of +z spin axis
12	F7.2	Declination of +z spin axis
13	F7.2	Correction for look angle
14	F7.2	Correction for sector
15	F7.2	Clock angle of equator
16	F7.2	Clock angle of sun
17	F7.2	Cone angle of sun
18	I6	# of stars used to get pointing correction
19	F7.2	Standard deviation of correction for look angle
20	F7.2	Standard deviation of correction fo sector.
21	I5	# of look angles included in this section
22-111	F7.2	Look angles included in this section

Data Records (records 2-n):

<u>Item #</u>	<u>Format</u>	<u>Description</u>
---------------	---------------	--------------------

Sector Header (written once for each of four sectors in record)

1	F10.2	Right ascension of center of field of view
2	F10.2	Declination of center of field of view
3	F10.2	Elongation angle of sun
4	I6	Sector - azimuthal angle label of field of view
5	F10.2	Look angle - polar angle label of field of view
6	I6	# of stars in field of view
7	F10.2	BP - Blue brightness (Parallel channel) in EDR units.
8	F10.2	RP - Red brightness (Parallel channel) in EDR units.
9	F10.2	BS - Blue brightness (Senkrecht channel) in EDR units.
10	F10.2	RS - Red brightness (Senkrecht channel) in EDR units.
11	F10.2	BPc
12	F10.2	RPc
13	F10.2	BSc
14	F10.2	RSc
15	F10.2	BCTOT = BPc + BSc
16	F10.2	RCTOT = RPc + RSc

} Brightness after star subtraction and corrected
for secular decay in units of $S_{10}(V)$

The individual stars that were subtracted (written once for each star in sector)

17a	I6	Declination of star * 1000
17b	I6	Right ascension of star * 100
18a	I6	BS of star * 1000
18b	I6	BP of star * 1000
18c	I6	IF1 - Flag denoting stellar anomalies (see section 3)
19a	I6	RS of star * 1000
19b	I6	RP of star * 1000
19c	I6	IF2 - Flag denoting spectral type (see section 3)
20	F10.2	Dwell time
21	F10.2	Vignetting correction for BP channel
22	F10.2	Vignetting correction for RP channel
23	F10.2	Vignetting correction for BS channel
24	F10.2	Vignetting correction for RS channel

REQ. AGENT

RAND NO.

ACQ. AGENT

LSM

V0108

WSC

PIONEER 11

73-019A-15A

STARLIGHT/ZODIACAL LIGHT EXPERIMENT

This data set catalog consists of one tape. The tape is 9 Track, 1600 BPI, Odd Parity, Binary, and 7 files. The tape was created on the Univac 1110 computer. The time span with 'D' and 'C' numbers follow:

<u>D#</u>	<u>C#</u>	<u>Time Span</u>
D-46760	C-21877	5/28/74-9/24/74

PIONEER 10/11 BACKGROUND SKY TAPE (BST)

USER'S GUIDE

Experiment: Pioneer 10/11 Starlight/Zodiacal Light

NSSDC Experiment #'s: Pioneer 10-72-012A-14
Pioneer 11-73-019A-15

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The Background Sky Tape (BST) contains the reduced data of photopolarimetric measurements of the brightness of the sky as viewed from the deep-space probes Pioneer 10 and 11. The NSSDC will provide the user with the first two papers of a series of articles dealing with the Pioneer 10/11 Starlight/Zodiacal Light Experiment. The first of these defines the scope of the investigation and describes the instrument; the second explains the reduction process leading to the creation of BST. They are referred to in this guide as Paper I and Paper II, respectively.

PIONEER BACKGROUND SKY TAPE

1. TAPE SPECIFICATIONS AND FORMAT

Tape specifications: 9 Track, ⁶²⁵⁰~~1500~~ BPI, Odd Parity, unformatted 36 bit words binary tape created on the Univac 1110.

FILE 1: Directory File - A printed copy of the Directory file is provided with each tape.

RECORD 1:

Computer Word	Format	Description
1	I	# of data files on tape (directory file not included)
2	I	# of days on tape
3	I	Spacecraft - Pioneer (10 or 11)
4	A	Day of year map was made DAY/YR
5	A	Number of this tape
6	A	Input tape # (ignore)
7	A	Is input tape corrected (ignore)
8	I	# of <u>sections</u> for day
9-13		Repeat computer words 4-8 for each remaining day.
14-18		" " " " " " " "
19-23		" " " " " " " "
24-28		" " " " " " " "
29-33		" " " " " " " "
.		" " " " " " " "
.		" " " " " " " "
.		" " " " " " " "
239-243		" " " " " " " "

(maximum of 48 days)

RECORD 2:

1	A	Day of year map was made
2	I	File # where data is located (directory file not included)
3	I	Section #
4	F	First <u>look angle</u> in section
5	F	Last look angle in section
6	F	Minimum <u>elongation</u>
7	F	Maximum elongation
8-14		Repeat words 1-7 for each section of every day.
15-21		" " " " " " " "
22-28		" " " " " " " "
29-35		" " " " " " " "
36-42		" " " " " " " "
43-49		" " " " " " " "
50-56		" " " " " " " "
57-63		" " " " " " " "
.		" " " " " " " "
30-336		To a maximum of 48 sections

Note: Words that are underlined are defined in section 2 of this REPORT.

FILE 2: Data File

RECORD 1: Header Information

Computer Word	Format	Description
1	A	Day of year map was made.
2	A	Input tape # (ignore).
3	I	Section #.
4	I	Start time of observations for this section, hours (GMT).
5	I	" " " " " " " minutes "
6	I	" " " " " " " seconds "
7	I	Stop time of observations for this section, hours (GMT).
8	I	" " " " " " " minutes "
9	I	" " " " " " " seconds "
10	A	Element name containing position data (ignore).
11	F	Right ascension of <u>+z spin axis</u> .
12	F	Declination of <u>+z spin axis</u> .
13	F	Correction for look angle.
14	F	Correction for <u>sector</u> .
15	F	<u>Clock angle</u> of equator.
16	F	<u>Clock angle</u> of sun.
17	F	<u>Cone angle</u> of sun.
18	I	# of stars used to get pointing correction.
19	F	Standard deviation of correction for look angle. } See note 1,
20	F	Standard deviation of correction for sector. } page 8.
21	I	# of look angles included in this section.
22-111	F	Look angles included in this section.

RECORD 2: 4 Sectors per record

1	F	Right ascension of center of field of view.
2	F	Declination of center of field of view.
3	F	Elongation angle of sun.
4	I	Sector - azimuthal angle label of field of view.
5	F	Look angle - polar angle label of field of view.
6	I	# of stars in field of view.
7	F	<u>BP</u> - Blue brightness (<u>Parallel</u> channel) in EDR units.
8	F	<u>RP</u> - Red brightness (<u>Parallel</u> channel) in EDR units.
9	F	<u>BS</u> - Blue brightness (<u>Senkrecht</u> channel) in EDR units.
10	F	<u>RS</u> - Red brightness (<u>Senkrecht</u> channel) in EDR units.
11	F	<u>BPc</u>
12	F	<u>RPc</u>
13	F	<u>BSc</u>
14	F	<u>RSc</u>
15	F	BCTOT = BPc + BSc.
16	F	RCTOT = RPc + RSc.
The individual stars that were subtracted		
17	BIT 0-17	Declination of star * 1000 - if 0 bit is set then declination is negative.
18	BIT 18-35	Right ascension of star * 100.
	BIT 0-15	BS of star * 1000
	16-31	BP of star * 1000
	32-35	IF1 - Flag denoting stellar anomalies (see section 6).
19	BIT 0-15	BS of star * 1000
	16-31	BP of star * 1000
	32-35	IF2 - Flag denoting spectral type (see section 6).

Computer Word	Format	Description
20	F	<u>Dwell time.</u>
21	F	<u>Vignetting correction</u> for BP channel.
22	F	<u>Vignetting correction</u> for RP channel.
23	F	<u>Vignetting correction</u> for BS channel.
24	F	<u>Vignetting correction</u> for RS channel.
25-32	F	Repeat computer words 17-24 for second star.
.	F	Repeat computer words 17-24 for each remaining
.	.	star in field of view (8 computer words are
.	F	required per star).
.	F	Repeat computer words 1-16 for sector 2.
.	.	Repeat computer words 17-24 for each star in
.	F	this field of view.
.	F	Repeat computer words 1-16 for sector 3.
.	.	Repeat computer words 17-24 for each star in
.	F	this field of view.
.	F	Repeat computer words 1-16 for sector 4.
.	.	Repeat computer words 17-24 for each star in
.	F	this field of view.

Variable
length,
Maximum
1664 words.

RECORD 3: Repeat record 2 for sectors 5, 6, 7, 8

. Repeat record 2 for sectors

. Repeat record 2 for sectors

. Repeat record 2 for sectors

RECORD 17: Repeat record 2 for sectors 61, 62, 63, 64

RECORD 18-33: Repeat records 2-17 for next look angle.

RECORD 34-N: Repeat records 2-17 for each remaining (L) look angle in section #1.
N = 16L + 1.

FILE 3: Repeat FILE 2 for section 2.

FILE 4-(M+1): Repeat FILE 2 for each remaining (up to M) section of day.

Repeat files 2-(M+1) for each day.

This tape has a maximum of 49 files, including the directory file.

2. PARAMETER DEFINITIONS

section	Each day's observations of the sky may be broken up into a number of sections (up to 8). The sections are delineated by look angle. Pointing corrections are determined for each section (Paper I - the need for sectioning; Paper II - the pointing of sections).
look angle	The polar angle between the +z spin axis and the pointing direction of the instrument as determined by telemetry (Papers I and II).
elongation	The angle between pointing direction and the sun.
+ z spin axis	That end of the spacecraft spin axis which points toward the earth. If one's thumb points toward + z, the spacecraft spins according to a right-hand rule.
sector	One spacecraft spin is divided into 64 sectors (Paper I).
clock angle	The true azimuthal angle swept out by the spin of the spacecraft. The clock angle is zero at that node of the ecliptic at which the instrument is rotating into the northern hemisphere (Paper II).
cone angle	True polar angle between + z spin axis and pointing of instrument (Paper II).
BP, RP, BS, RS Parallel Senkrecht	The radiance reading (in relative or EDR units) as given by the four channels of the imaging photopolarimeter (IPP). The B designation stands for blue, the R for red. The S and P designations represent orthogonal directions of polarization. Define an "instrumental" coordinate system based on a Senkrecht (S) direction, which is parallel to the IPP rotation axis and perpendicular to the spacecraft spin axis, and a direction Parallel (P) to the spacecraft spin axis; i.e., the S vector is along the longer side of the effective field-of-view and the P vector is along the shorter. Assume the light source observed with the IPP is partially plane-polarized. This light can be divided into an unpolarized part, I_u , and a completely plane polarized component, I_{pol} . Let the amplitude of the polarized component be $\vec{E}_{pol}$ where $ \vec{E}_{pol} ^2 = I_{pol}$. If θ is the angle between the S direction and the plane of polarization, the component of $\vec{E}_{pol}$ in the S direction is $ \vec{E}_{pol} \cos \theta$, and the component in the P direction is $ \vec{E}_{pol} \sin \theta$. The intensities seen by the S

Note: The EDR (Experiment Data Record) unit is a unit of relative instrument response. All reduction is performed in these units, including star subtraction. Absolute calibration is to be applied to the final results BY THE USER.

and P channels are therefore

$$I_s = \frac{1}{2} I_u + I_{pol} \cos^2 \theta$$

$$I_p = \frac{1}{2} I_u + I_{pol} \sin^2 \theta$$

where I_s corresponds to absolutely calibrated BS or RS readings and I_p corresponds to absolutely calibrated BP or RP readings.

BPc, RPc, BSc, RSc

P
r
i
m
a
r
y

R
e
s
u
l
t
s

Stand for corrected values of BP, RP, BS, and RS, respectively. The corrections applied (see Paper II) are:

- 1) foreground stars have been subtracted,
- 2) the secular decay of the instrument sensitivity is accounted for.

ABSOLUTE CALIBRATION MUST BE APPLIED BY THE USER. THE CONVERSION TO $S_{10}(V)$ OR CGS UNITS IS GIVEN IN SECTIONS 3 AND 4 OF THIS GUIDE.

BP of star
RP of star
BS of star
RS of star

The values that the IPP would read if the star was scanned at a cone angle of 90° (Paper II).

dwelt time

That fraction of $1/64$ of the spacecraft spin period for which the star is in the instrumental field of view (Paper II).

vignetting correction

This term, on the average, is near 1. It corrects for the fact that the instrument response varies depending on the position of the stars in the field of view (Paper II).

(B-V) calculated

For some stars, a B-V color index is not available. This index is needed to determine the IPP response to any given star. B-V was therefore calculated from spectral type information as described in Paper II.

3. PIONEER 10 ABSOLUTE CALIBRATION

The effective wavelength (λ_{eff}) is defined as the average over wavelength weighted by the channel spectral transmission, $T(\lambda)$. The equivalent bandpass ($\Delta\lambda$) is defined by $\Delta\lambda T_{\text{max}} = \int T(\lambda) d\lambda$. The brightnesses listed in the BST (BPc, RPc, BSc, RSc) are in EDR or relative units. To convert them to $S_{10}(V)$'s - the equivalent number of 10th visual magnitude stars of solar color per square degree - they must be multiplied by the calibration constants (C) given below:

<u>Channel</u>	<u>λ_{eff}</u>	<u>$\Delta\lambda$</u>	<u>C</u>
BP	4392A	829A	0.619
RP	6390A	936A	0.648
BS	4363A	818A	0.697
RS	6508A	1038A	0.761

The total blue (red) brightness in $S_{10}(V)$ units is the sum of the two blue (red) channels:

TOTAL BLUE BRIGHTNESS IN $S_{10}(V)$ UNITS = 0.619 BPc + 0.697 BSc,

TOTAL RED BRIGHTNESS IN $S_{10}(V)$ UNITS = 0.648 RPc + 0.761 RSc.

The $S_{10}(V)$ unit contains the solar spectral distribution; i.e., a source of solar color has the same $S_{10}(V)$ value at all wavelengths. The conversion to absolute units therefore depends on the effective wavelength of each Pioneer channel. The conversion of $S_{10}(V)$ units to absolute units for each channel of Pioneer 11 is listed below:

<u>Channel</u>	<u>Conversion</u>
Bp	1 $S_{10}(V)$ = 1.17×10^{-9} ergs $\text{cm}^{-2} \text{s}^{-1} \text{sr}^{-1} \text{A}^{-1}$
Rp	1 $S_{10}(V)$ = 1.08×10^{-9} ergs $\text{cm}^{-2} \text{s}^{-1} \text{sr}^{-1} \text{A}^{-1}$
Bs	1 $S_{10}(V)$ = 1.15×10^{-9} ergs $\text{cm}^{-2} \text{s}^{-1} \text{sr}^{-1} \text{A}^{-1}$
Rs	1 $S_{10}(V)$ = 1.06×10^{-9} ergs $\text{cm}^{-2} \text{s}^{-1} \text{sr}^{-1} \text{A}^{-1}$

5. NOTES AND USER PRECAUTIONS

- 1) The uncertainty (1 standard deviation) in the corrections for look angle and sector significantly influences the quality of the data. If the instrument pointing is not determined accurately, the star subtraction process can introduce large errors. Nominal values for computer words 19 and 20, File 2, Record 1, are 0.15 and 0.40, respectively.
- 2) The foreground star subtraction process, while greatly reducing the effect of stars brighter than about 6.5 mag, nevertheless introduces its own set of errors. These are mainly caused by two effects: 1) stars very near the edge of the field may be subtracted from the wrong FOV; 2) the color corrections for the 12,500 foreground stars are based on the statistics of only a few hundred standard stars. There exists a natural scatter in this calibration which may contribute large errors to FOV's containing stars brighter than about 2nd magnitude.

The above errors are recognized as an abnormally high or low reading in one FOV with respect to the neighboring fields. For Pioneer 10, the number of FOV's which have this defect is much less than 10% for the blue channels and greater than 10% for the red channels. The RS channel is inherently very "noisy", and this also contributes, along with the color statistics, to the higher number of erroneous red channel FOV's.

- 3) FOV's with elongation angles smaller than about 45° contain some stray light contributions. To analyze these data, the user should contact the experimenter directly.

4. PIONEER 11 ABSOLUTE CALIBRATION

The effective wavelength (λ_{eff}) is defined as the average over wavelength weighted by the channel spectral transmission, $T(\lambda)$. The equivalent band-pass ($\Delta\lambda$) is defined by $\Delta\lambda T_{\text{max}} = \int T(\lambda) d\lambda$. THE BRIGHTNESSES LISTED IN THE BST (BPc, RPc, BSc, RSc) ARE IN EDR OR RELATIVE UNITS. TO CONVERT THEM TO $S_{10}(V)$'s - the equivalent number of 10th visual magnitude stars of solar color per square degree - THEY MUST BE MULTIPLIED BY THE CALIBRATION CONSTANTS (C) GIVEN BELOW:

Channel	λ_{eff}	$\Delta\lambda$	C
BP	4445A	844A	0.674
RP	6508A	889A	0.810
BS	4388A	790A	0.624
RS	6453A	978A	0.903

The total blue (red) brightness in $S_{10}(V)$ units is the sum of the sum of the two blue (red) channels:

$$\text{TOTAL BLUE BRIGHTNESS IN } S_{10}(V) \text{ UNITS} = 0.674\text{BPc} + 0.624 \text{ BSc},$$

$$\text{TOTAL RED BRIGHTNESS IN } S_{10}(V) \text{ UNITS} = 0.810 \text{ RPc} + 0.903 \text{ RSc}.$$

The $S_{10}(V)$ unit contains the solar spectral distribution; i.e., a source of solar color has the same $S_{10}(V)$ value at all wavelengths. The conversion to absolute units therefore depends on the effective wavelength of each Pioneer channel. The conversion of $S_{10}(V)$ units to absolute units for each channel of Pioneer 11 is listed below:

Channel	Conversion
Bp	$1 S_{10}(V) = 1.20 \times 10^{-9} \text{ ergs cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1} \text{ A}^{-1}$
Rp	$1 S_{10}(V) = 1.06 \times 10^{-9} \text{ ergs cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1} \text{ A}^{-1}$
Bs	$1 S_{10}(V) = 1.18 \times 10^{-9} \text{ ergs cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1} \text{ A}^{-1}$
Rs	$1 S_{10}(V) = 1.07 \times 10^{-9} \text{ ergs cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1} \text{ A}^{-1}$

6. CODING OF FLAGS DESIGNATING SPECTRAL TYPE

<u>IF1</u>		<u>IF2</u>	
0	Normal star	0	
1	Moderately reddened	1	Type O
2	Marginal variable	2	B
3	Very reddened	3	A
4	Lum class I	4	F
5	Probable significant variable	5	G
6	Significant variable	6	K
7	Sig. variable + class I	7	M
8	Sig. variable + very reddened <u>or</u> Very reddened + class I + sig. var.	8	Very late
9	Sig. variable + moderately reddened <u>or</u> Moderately reddened + class I + sig. var.	9	Type O + (B-V) calculated *
10	Probably sig. var. + class I	10	B + (B-V) calculated
11	Prob. sig. var. + very reddened <u>or</u> Very reddened + class I + prob. sig. var.	11	A + (B-V) calculated
12	Prob. sig. var. + moderately reddened <u>or</u> Mod. reddened + class I + prob. sig. var.	12	F + (B-V) calculated
13	Moderately reddened + class I <u>or</u> Moderately reddened + class I + mar. var.	13	G + (B-V) calculated
14	Marginal variable + class I	14	K + (B-V) calculated
15	Very reddened + class I <u>or</u> Very reddened + class I + mar. var.	15	M + (B-V) calculated

*See (B-V) calculated, page 5.

7. EXPERIMENT BIBLIOGRAPHY

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40. D. W. Schuerman, The Brightness/Unit Volume of the Zodiacal Light as Determined from Pioneer 10, to be presented to Cosmic Dust Panel, COSPAR 1978, Innsbruck.
41. J. L. Weinberg and D. W. Schuerman, Pioneer 10 Observations of Changes in Zodiacal Light Polarization with Heliocentric Distance, to be presented to Cosmic Dust Panel, COSPAR 1978, Innsbruck.

Selected topics of other papers in earlier stages of preparation:

The Calibration and Use of Diffuse Sources (Planetary and Space Science); Weinberg, Sparrow, and Beeson

The Light of the Night Sky Revisited (Sky and Telescope); Weinberg

Polarization Reversal in the Zodiacal Light (Astronomy and Astrophysics); Weinberg, Sparrow, and Hahn

An Observational Model of the Brightness and Polarization of the Zodiacal Light (Astronomy and Astrophysics); Weinberg and Misconi

A Search for Diffuse Optical Radiation associated with the Magellanic Stream; Weinberg, Schuerman, Toller, Giovane, Beeson

Zodiacal Light and the Asteroid Belt: the View from Pioneer 11; Schuerman, Weinberg, Toller, Giovane, Beeson

Pioneer 10 Observations of the Shape of the Zodiacal Cloud; Schuerman, Toller, Misconi, Weinberg, Giovane, Beeson

March 1978

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ASCII LIST OF DS004404

[illegible]

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