CRITICAL DESIGN REVIEW

SCIENCE REQUIREMENTS

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PRESENTED BY

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GUVI SCIENCE REQUIREMENTS

- SCIENCE REQUIREMENTS ESTABLISHED AND PRESENTED AT THE PRELIMINARY DESIGN REVIEW (PDR) IN JAN 97 ARE BASED ON TIMED MISSION SCIENCE OBJECTIVES

- ALL ENGINEERING SPECIFICATIONS ARE DERIVED FROM THE FLOWDOWN OF THE SCIENCE REQUIREMENTS. DETAILS ARE DESCRIBED IN GUVI-PDR-01 ACTION ITEM RESPONSE

FLOW DOWN STRUCTURE

Determine Major Species Composition in MLTI	Science Objectives (A)	Measure auroral energy inputs
Coverage Accuracy Spatial Scales Mission Life	Measurement Goals (B)	Auroral Boundary Location Accuracy of Q and E Spatial Scales
Horizontal Resolution Altitude Resolution Pointing Knowledge Calibration accuracy	Instrument Capability Requirements (C)	
Spectral Resolution Spectral Passband Scan Mechanism Performance Data System Requirements	Functional Requirements (D)	
Step size Stray light Integration period	Implementation Requirements (E)	

SCIENCE OBJECTIVES

LEVEL A

A1. Determine seasonal and local solar time variation of the major species composition in the MLTI region in accordance to the TIMED science requirements for accuracy, temporal and spatial scales and coverage.

A1a. Provide a global determination of O, N_2, O_2 and temperature profiles through measurement of spectral radiance of principal atomic and molecular ultraviolet dayglow emission features.

A2. Measure energy inputs in the auroral region to understand the global MLTI energy balance in accordance with TIMED requirements.

A2a. Provide the precipitating auroral particle flux (Q), average energy (E), auroral boundaries and conductivity through measurement of spectral radiance of auroral ultraviolet emission features.

MEASUREMENT GOALS

		LEVEL B	UPLINE LINKS
B.1	Provide Global coverage of HI(121.6), OI(130.4), OI(135.6), and N_2(LBH) Emission		
	B.1.a	Maximize the extent of the local solar time and geographic coverage.	A1
	B.1.b	Provide limb profile capability from 110 to 300 km.	A1
	B.1.c	Accuracy for composition +_ 15% during solar maximum conditions.	A1
	B.1.d	Spatial scales: 1/2 scale height (vertical); 100 km (horizontal).	A1
B.2	Auroral measurement must yield HI(121.6), OI(135.6) and N_2(LBH)		A2
	B.2.a	Auroral oval and boundary detection for a 1 erg $cm^{-2}s^{-1}$ electron aurora	A2
	B.2.b	Accuracy better than +_20% for energy input per spatial element	A2
	B.2.c	Accuracy better than +_25% for average energy per spatial element	A2
	B.2.d	Locate boundary to +_ 10 km	A2
	B.2.e	Spatial scales: Energetic particles ~ 20 km; Conductivity ~ 100 km	A2

INSTRUMENT CAPABILITY REQUIREMENTS

	LEVEL C	UPLINE LINKS
C.1	Contiguous coverage of the Earth dayglow on the disk	B.1.a
C.2	Limb coverage from 60 to 500 tangent altitudes	B.1.b,d
C.3	Maximum intensity levels equivalent to solar max conditions at local noon	B.1.a
C.4	Contrast in signal brightness day to night 1000:1 in Rayleighs	B.1.c,d; B.2.a,b
C.5	Sampling interval on limb equivalent to 15 km at 250 km tangent altitude	B.1.d
C.6	Altitude resolution of an individual limb measurement <= 6 km	B.1.d
C.7	Horizontal resolution dayglow measurements ~ 100 km	B.1.d
C.8	Horizontal resolution auroral ~ 20 km post-processing	B.2.e
C.9	Knowledge of S/C altitude <=1 km; latitude and long. <= 3 km	B.1.b
C.10	Maintain error budgets to meet accuracy requirements	B.1.c
C.11	SYSTEM LEVEL REQUIREMENTS	
C.11.a	Orbital altitude 600 < 900 km	B.1.a, B.2.a
C.11.b	Orbital inclination > 70 degrees	B.2.a

FUNCTIONAL REQUIREMENTS

	LEVEL D	UPLINE LINKS
D.1	**IMAGING SPECTROGRAPH REQUIREMENTS**	
D.1.a	Image spatial and spectral FUV airglow and aurora 115 to 180 nm	B.1,2
D.1.b	Spectral Resolution 1.5 to 5.0 nm FWHM	B.1.c,B.2.b
D.1.c	Spatial pixel size from 0.4 to 1.5 degrees	B.1.b,d
D.1.d	Photon counting system with low dark rate and low stray light	B.1.c; B.2.b,c
D.1.e	Responsivity, scan range, dwell time consistent with accuracy req.	B.1.a,b,c; B.2.a,b,c
D.2	**SCAN MECHANISM REQUIREMENTS**	
D.2.a	Spatial Resolution < 10 km nadir	B.2.d,e
D.2.b	Scan rate and FOV to provide contiguous imaging of disk	B.1.a
D.2.c	Uncertainties in pointing and stability to meet <6 km (Vert) knowledge	B.1.c
D.2.d	Field of Regard: 140 degrees; -60 to + 80 degrees	B.1.a

FUNCTIONAL REQUIREMENTS (CONT)

LEVEL D		UPLINE LINKS
D.3	**DATA SYSTEM REQUIREMENTS**	
D.3.a	Down link wavelength and pointing data	B.1
D.3.b	Support 100% duty cycle	B.1
D.3.c	Support command and control functions	B.1,2
D.3.d	Support "color" definitions up to 5	B.1,2
D.4	**DETECTOR ELECTRONICS**	
D.4.a	Maximum count rates 117 kHz	B.1.c
D.4.b	Control distortions and non-linearities	B.1.c
D.4.c	Intrascene dynamic range 1000:1	B.1,2
D.4.d	Control gain for 2 yr lifetime	A.1
D.5	**ERROR BUDGETS (Maximums)**	
D.5.a	Brightness Measurement Uncertainty: 8%	B.1.c
D.5.b	Pointing Errors: 6%	B.1.c
D.5.c	Calibration Errors: 8%	B.1.c
D.5.d	Inversion/theory: 7%	B.1.c

IMPLEMENTATION REQUIREMENTS

	LEVEL E	UPLINE LINKS
E.1	Scan mechanism repeatability better than 1/4 step	D.5.b
E.2	Integration period = 0.068 s	D.1.e
E.3	Total scan range: 140 degrees, -60 to + 80	D.2.b,c
E.4	Scan step size: 0.4 degrees	D.1.e
E.5	Instrument placement error +_ 0.1 degree all axes	D.2.c
E.6	BRIGHTNESS ERROR BUDGET	
	E.6.a Counting Statistics: 4%	D.5.a
	E.6.b Dark Count: 1%	D.5.a
	E.6.c Stray Light: 2%	D.5.a
	E.6.d Non-linearities: 3%	D.5.a
	E.6.e Data Compression: 2%	D.5.a
E.7	Spectrograph internal straylight performance: <0.1% per spectral pixel	E.6.c
E.8	Off-axis rejection: 6x10(-2) @ 0.8 degrees	E.6.c