Critical Design Review (CDR)
Of
ULTRA VIOLET IMAGING TELESCOPE (UVIT)

(June 17th -18th 2011, ISAC, Bengaluru)

Deviations in Design/ Specifications with Reference to the PDR, and the impact of these on Science Goal

UVIT-CDR-00-001.1

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Compiled by:

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Abbreviations

ASTROSAT	Astronomy Satellite, India
BMU	Bus Management Unit of the satellite
CCD	A solid state imaging device
CDR	Critical Design Review
CFRP	Carbon fibre reinforced plastic
CMOS imager	A solid state imager
CSA	Canadian Space agency
CPU	Camera Proximity Unit; contains the Detector Module, and some electronics, and mounts on focal plane
DHU	Data Handling Unit of ASTROSAT; receives data on images from UVIT
DM	Detector Module; contains photo-cathode, microchannel plate intensifier, and phosphor coupled with fibre taper to CMOS detector
EM	Engineering/qualification model
EU	Electronic Unit for control etc. of detectors
FUV	Far UltraViolet : 130 nm to 180 nm wavelengths
FM	Flight Model, to be launched
FWHM	Full width at half maximum; used here as a measure of image size
HVU	High Voltage Units for detectors
ICD	Interface control document
IISU	ISRO Inertial Systems Unit; a laboratory of ISRO
INSAT 3D	An Indian satellite
ISAC	ISRO Satellite Centre
ISRO	Indian Space Research Organisation
LEOS	Laboratory for Electro-Optics Systems (ISRO)
MFD	Mechanical Fixing Device for mirrors/optics
NUV	Near UltraViolet: 200 nm to 300 nm wavelengths
PDR	Preliminary Design Review
Photek	Contractor for IIA, who supply the DMs
PSF	Point spread function
RFP	Request for Proposals to supply the required material
Routes	Contractor for CSA, who make detector system
P/L	Payload (UVIT)
S/C	Spacecraft
SAC	Satellite Applications Centre; a laboratory of ISRO
STR team	Structural engineering team at ISAC
Star 250	A CMOS imager from Fill Factory, Belgium
TC	Telecommand
TM	Telemetry
UV	Ultraviolet range of electromagnetic spectrum
UVIT	UltraViolet Imaging Telescope
UVITEU	Electronic Unit for detectors in UVIT
VIS	Visible: 320 nm to 550 nm wavelengths

1. Scope of the Document

This document primarily concerns with any critical changes which were made in the design after the PDR and which have some effect on scientific observations possible with the payload.

2. Introduction

Goals of the project are defined in terms of the bands of observations, effective areas or sensitivity, spatial resolution of the images, total field of observations, and simultaneous observations with the other payloads.

The goals are not quantified as percentages, but a high spatial resolution and capacity of simultaneous observations with the other payloads have been considered as the most important. A high spatial resolution, compared to the latest wide-field UV imaging mission Galex (NASA) opens new areas of imaging in UV, and simultaneous observations from UV to hard X-rays promises to lead to a deeper understanding of the physical processes occurring in X-ray sources.

3. Deviations from PDR

The overall specifications of the payload are listed in the table on the next page. The same table also indicates deviations with reference to the PDR. Let us discuss these deviations one by one.

i) Change in the bands

The FUV band had been changed from 120-180 nm to 130-180 nm. This change has been made to avoid geocorona of Lyman-Alpha line. This change mainly decreases the background and in effect improves the performance.

The NUV band has been changed from 180-300 nm to 200-300 nm. This was done because suitable filters could not be acquired for 180-200 nm range. This means that certain kind of observations, e.g. galaxies with break in the spectrum in 180-200 nm range, cannot be made. Further, transmission of the filter for 200-230 nm is very low (~ 15%), and observations in this band would also take more time by a factor ~ 3.

The VIS band has been changed from 300-600 nm to 320 -550 m. This was done as it was not possible to have a beam splitter which transmits from 300 nm while reflecting all < 300 nm., and the photo-cathode with low dark current is loses sensitivity very rapidly for > 500 nm. This change has no significant impact on science goals.

ii) Change in the field of view

The field of view has been reduced from 29’ to 28’. This in effect implies a loss of observation time by ~ 7%.

iii) Sensitivity

Useful aperture and hence sensitivity have been reduced by a small amount (< 2%) due 4 ribs which support the primary baffle.

Sensitivity is enhanced as reflectivity of the mirrors in FUV is > 70%, as compared to 60% agreed by the supplier (LEOS).

iv) Mass

The mass is increased by ~ 20 Kg. We are unable to assess the impact of this increase, but we have taken a clearance for this from the project.

	FUV	NUV	VIS
Detector ***Deviation wrt PDR***	Intensified CMOS Photon counting/ Integration *None*	Intensified CMOS Photon Counting/ Integration *None*	Intensified CMOS Photon Counting/ Integration\ *None*
Telescope Optics **Bandwidth** ***Deviation wrt PDR***	Ritchey-Chretian 2 mirror system. 130-180 nm FUV *120-180 in nm PDR*	Ritchey-Chretian 2 mirror system 200-300 nm *180-300 nm in PDR*	Ritchey-Chretian 2 mirror sysem 320-550 nm *300-600 nm in PDR*
Geometric Area (cm^2)	~ 880	~ 880	~ 880
Effective Area (cm^2) ***Deviation wrt PDR***	>~15 at peak *None*	>~50 at peak *None*	>~ 50 at peak *None*
Field of View ***Deviation wrt PDR***	~ 28' *~ 29' in PDR*	~ 28' *~ 29' in PDR*	~ 28' *~ 29' in PDR*
Spectral resolution ***Deviation wrt PDR***	<1000 A (depends on choice of filters) *None*	< 1000 A (depends on choice of filter) *None*	< 1000 A (depends on choice of filter) *None*
Spatial Resolution ***Deviation wrt PDR***	<1.8 arcsec *None*	< 1.8 arcsec *None*	< 1.8 arcsec *None*
Time resolution ***Deviation wrt PDR*** **Typical observation time per target.**	<10 ms (For partial field) *None* 30 min	<10 ms (For partial field) *None* 0.5 - 1 day	<10 ms (For partial field) *None* 1 - 2 days
Sensitivity (Obs. Time) ***Deviation wrt PDR***	>20^{th} magnitude (5σ) in 2000s *1800 s in PDR*	---	---
Photometric Accuracy ***Deviation wrt PDR***	10% *None*		
Total Mass (kg) ***Deviation wrt PDR***	229 kg *Yes, increase by ~ 20 kg*		

Total Power (Watts) ***Deviation wrt PDR***	85 (peak 117) *None*
Sun-avoidance angle ***Deviation wrt PDR***	45 deg *None*
Responsibility	IIA, in collaboration with IUCAA and TIFR, and CSA. With support in hardware and tests from many centres of ISRO