Bull. Astr. Soc. India (2003) 31, 479–482

The Ultra Violet Imaging Telescope: Mechanical Design

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Abstract. The Ultra Violet Imaging Telescope (UVIT) is one of the major scientific instruments on the proposed ASTROSAT mission of the Indian Space Research Organisation. The design of a telescope to meet the scientific requirements within the weight and volume constraints of the satellite bus has been a major challenge. The design has also to meet the qualification levels for launch into orbit as well as the thermal environment in orbit. Here we present the overall design of the UVIT mechanical structure with details of some critical aspects.

Keywords : Telescope , mechanical, space, thermal, structure

1. Introduction

The Ultraviolet Imaging Telescope is a part of the proposed Indian ASTROSAT mission. The principal scientific objectives of the UVIT are: High resolution, multi-band imaging survey of the sky in the ultraviolet (100 - 300 nm), simultaneous UV imaging with the X-ray instruments, & deep imaging studies in the UV for targetted programs.

The initial concept for the UVIT telescope involved a single telescope of 50 cm aperture using beam splitters to obtain separate channels for the near UV (120-220 nm) and far UV (200-300 nm) (Pati & Rao 1998, Pati 1999). The current design has been optimised to a configuration using twin telescopes of smaller aperture (38 cm primary mirror), one for the FUV and the other employing a beamsplitter to cover the NUV and optical.

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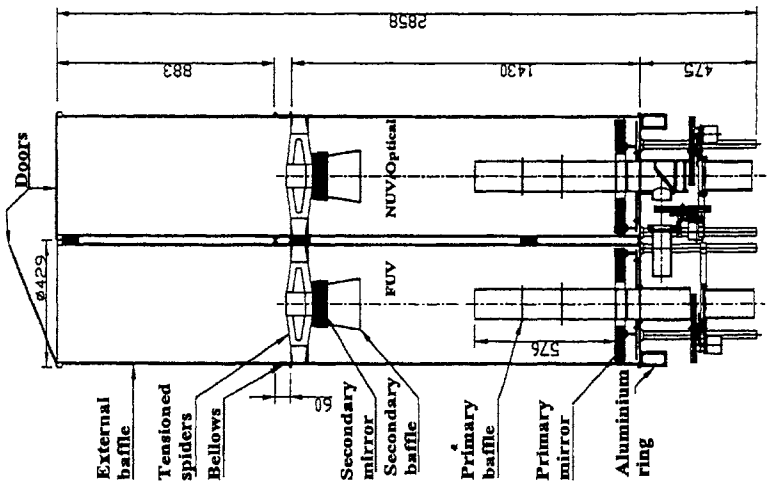

Figure 2. Sectional elevation of UVIT showing principal elements.

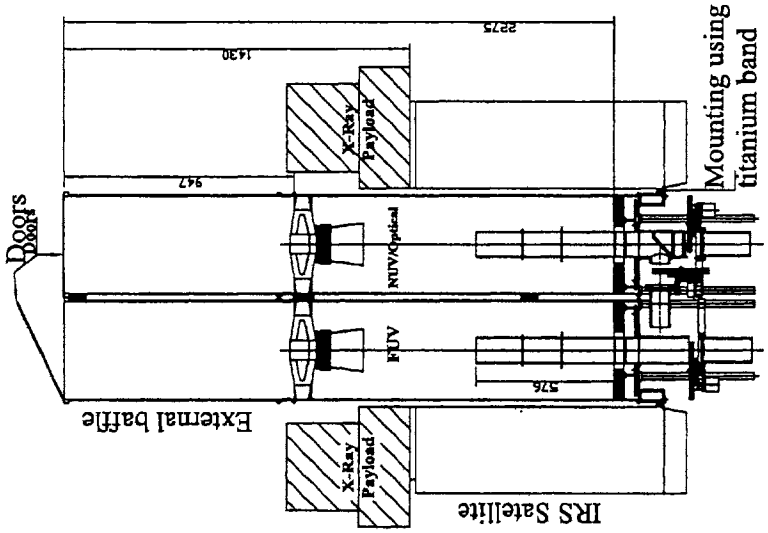

Figure 1. UVIT as mounted in IRS (sectional elevation).

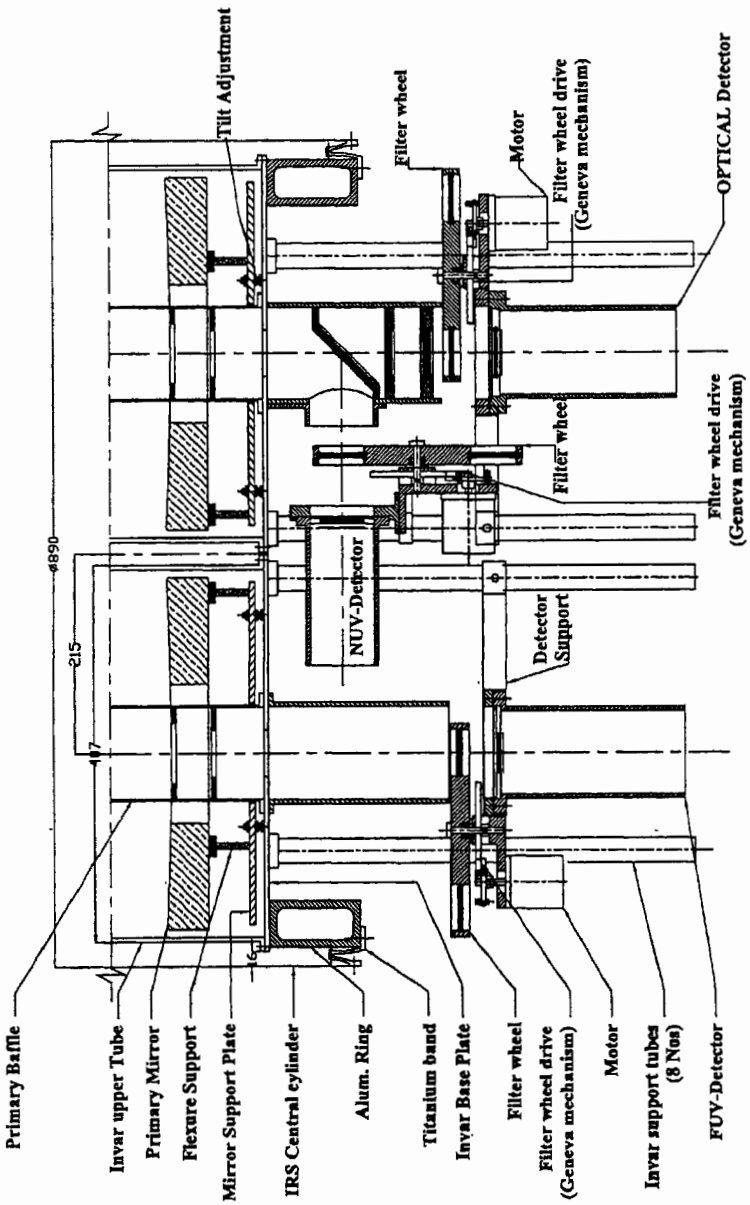

Figure 3. Focal plane area details of UVIT.

2. Mechanical Design Considerations

The various payloads of ASTROSAT are to be mounted on the Indian Remote Sensing satellite bus. Figure 1 shows a sectional elevation of the UVIT mounted within the central cylinder of the IRS satellite bus. The mechanical structure of the UVIT is designed with the following requirements: to serve as an optical metering structure during integration & alignment of the telescope, to maintain the relative positions of the optical components as per optical design specifications through testing, payload integration and launch, to seal the telescope against dust/contaminants. The design must also take account of constraints imposed by thermal expansion, contamination caused by outgassing (in orbit) from the payloads & satellite.

The UVIT field of view (FOV) must be co-aligned with the other scientific instruments to within 1-2 minutes of arc. The two UVIT telescopes would be co-aligned to 30 seconds of arc. The temperature gradient between the primary and secondary mirrors should not exceed 4°C degrees.

3. The UVIT Mechanical Structure

Figure 2 shows the sectional elevation of the twin telescopes with the principal elements marked. Most of the structural elements that serve as the metering structure are made of low expansion Invar. The twin telescopes are fixed on a ring-like structure made from lightweight aluminium alloy which in turn is fixed onto the central cylinder of the satellite.

Figure 3 shows a cross section of the UVIT below the primary mirrors. The two telescopes have a different configuration in this area: the FUV telescopes has a single filter wheel and detector. The NUV telescope has a beamsplitter giving the NUV and optical channels, each of which has a filter wheel and detector. The entire lower assembly seen in the figure has to be enclosed within cover plates to seal against contamination.

Initial design analysis of UVIT structure has been done to check integrity of the structure with static analysis under 6g loading, dynamic sine vibration and random vibration. The analysis reveals that the design adopted is adequate as far as clearances between telescope tubes and the satellite structure are concerned in both static and dynamic cases. Stresses on the mechanical interfaces as well as on the mirrors are all at safe levels. The first frequency of the structure is ~50 Hz. It is possible to incorporate modifications to raise this to ~70 Hz.

References

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Pati A. K. 1999, *Bull. Astr. Soc. India*, **27**, 295