WSO-UV Spain

The Imaging and Slitless Spectroscopy Instrument for Surveys (ISSIS) for the World Space Observatory-Ultraviolet (WSO-UV): optical design, performances and verification tests.

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ABSTRACT:
In this work, we present the current ISSIS design and their main characteristics. Also, we present the main performance verification for ISSIS to ensure that the current design of ISSIS fulfils the scientific requirements and to ensure the feasibility of the in flight calibration. We also define the facilities and technical characteristics for realizing the tests.

1. INTRODUCTION:

The WSO-UV is an international project developed to guarantee access to the ultraviolet (UV) range in the post Hubble Space Telescope epoch. This 170 cm space telescope, to be launched in 2017, has been conceived as a multipurpose observatory carrying instrumentation for astronomical imaging and spectroscopy. The WSO-UV spectrographs consist of three different instruments: two high resolution (R~55,000) echelle spectrographs and a long slit spectrograph for low resolution (R~1000) spectroscopy. The camera unit of the WSO-UV is named ISSIS: the Imaging and Slitless Spectroscopy Instrument for Surveys. The baseline for ISSIS design approved in the PDR consists of two acquisition channels, both of them provided with photon counting detectors with Micro-ChanneL Plates (MCP). These two channels are:

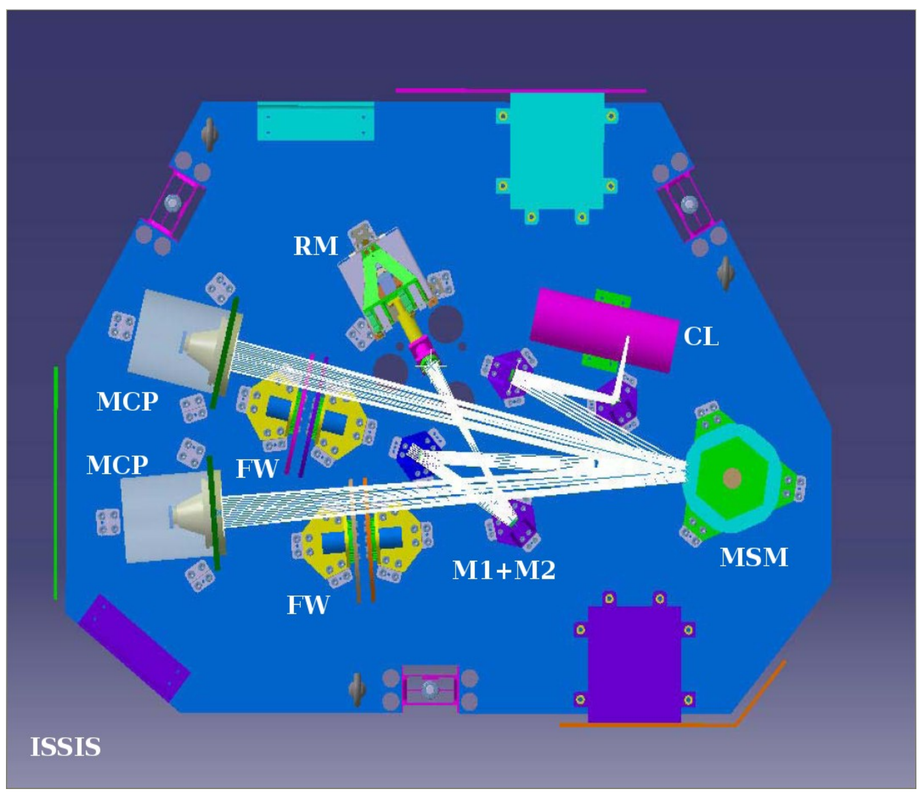
- The Far Ultraviolet (FUV) Channel covering the 1150-1750 Å wavelength range
- The Near Ultraviolet (NUV) Channel in the 1850-3200 Å range.

The WSO-UV Ground Segment [1]

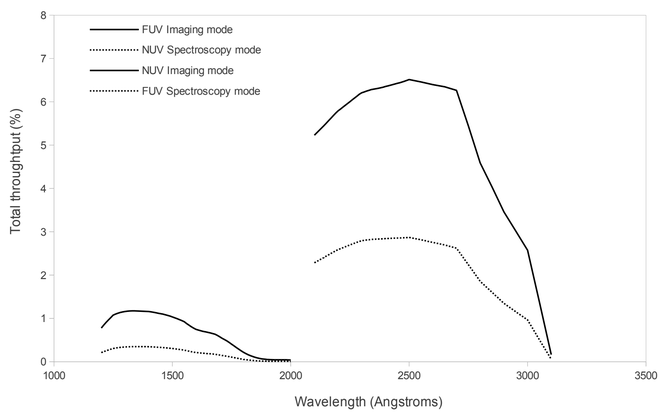
2. SCIENTIFIC REQUIREMENTS:

- High resolution mapping of weak and nebulous sources such as microjets or gravitational lenses.
- The mapping of UV emission lines in extended emission nebulae (H II regions, supernovae remnants, planetary nebulae) and jets (from protostars or from compact objects) .
- Efficient spectroscopy of weak sources: from transiting planets to Active Galactic Nuclei and star forming galaxies at moderate redshifts ($0.5 < z < 1.5$).
- Resolution of R~500 to study the absorption of the stellar radiation by transiting planets or to determine the terminal velocity of radiatively driven winds of O stars in Local Group galaxies.
- Enhancement of the dynamic range with coronographs or masks to map faint emission close to bright sources on sub-arcsec scales: from disks to jets or binary components.
- Time resolution as short as 40 milliseconds to track the evolution of instabilities in disks around compact sources.

3. ISSIS OPTICAL DESIGN AND PERFORMANCES:

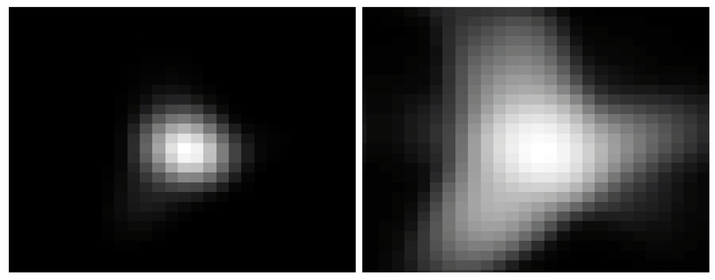


Schematic view of ISSIS instrument [2]. The main elements are refocusing mechanism (RM), optical relay (mirrors M1 and M2), mode selection mechanism (MSM), filter wheels (FW), calibration lamp (CL) and MCP detectors (MCP).

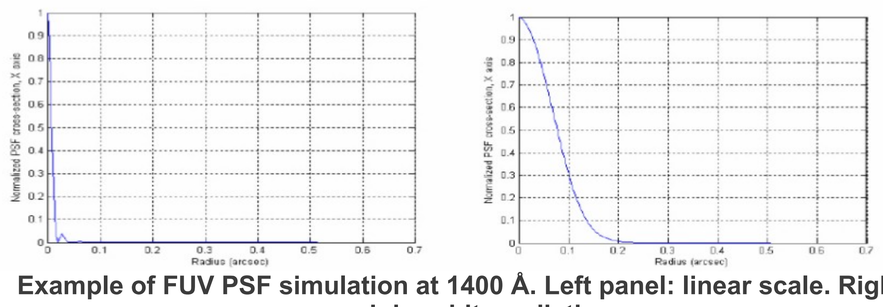


Total throughput for telescope+ISSIS both in imaging (without filter) and in spectroscopy modes.

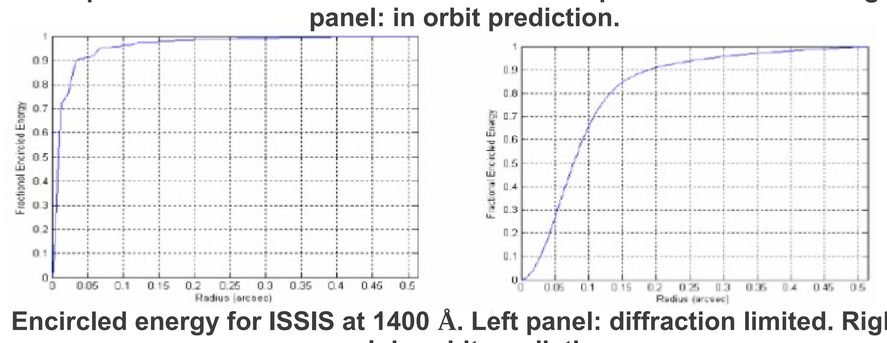
	FUV Channel	NUV Channel
Spectral range	1150 - 1750 Å	1850 - 3200 Å
Peak throughput (imaging)	~1400 Å	~2500 Å
Field of view: imaging	70 arcsec x 75 arcsec	70 arcsec x 75 arcsec
Field of view: spectroscopy	36 arcsec x 65 arcsec	31 arcsec x 61 arcsec
Detector type	CsI MCP	CsTe MCP
Detector diameter	40 mm	40 mm
Detector format (equivalent)	> 2048x2048 pix	> 2048x2048 pix
Pixel scale	0.036 arcsec	0.036 arcsec
Scale ratio	< 7 %	< 7 %
Number of reflections	4	4
Temporal resolution	40 ms	40 ms
Slitless spectroscopy resolution	R = 500	R = 500



Example of FUV PSF simulation at 1400 Å. Left panel: linear scale. Right panel: logarithmic scale.

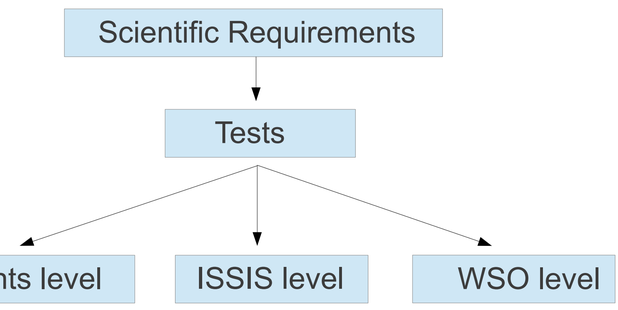


Example of FUV PSF simulation at 1400 Å. Left panel: linear scale. Right panel: in orbit prediction.

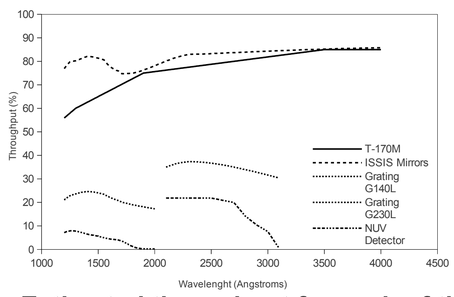


Encircled energy for ISSIS at 1400 Å. Left panel: diffraction limited. Right panel: in orbit prediction.

4. PERFORMANCE VERIFICATION FOR ISSIS:



Components tests:
Detectors
Filters
Mirrors
Gratings
Calibration Lamps



Estimated throughput for each of the optical elements (mirrors, gratings and detectors) of ISSIS.

ISSIS level verification tests:
Geometric Tests
Geometric Distorsion Tests
Image Quality Tests
Radiometric Efficiency
Spectroscopy Tests
Uniformity of the Radiometric response
Exposure Time Repeatability
Straylight Tests
Mechanism Functionality and repeatability

Challenges:
Clean room class ISO5
Vacuum chamber
Telescope simulator for on axis beam

REFERENCES:

[1] Gómez de Castro, Sestito, Sánchez, Yañez, Shustov, Sachkov, Malkov, Lozano, Kazakevich. The WSO-UV space telescope science operations. Proceedings of SpaceOps Conference 2012.
[2] Gómez de Castro, Sánchez, Sestito, Rodriguez, Gómez, Seijas, Lopez-Martinez, Quintana, Ubierna, Muñoz. ISSIS: the Imaging and Slitless Spectroscopy Instrument for Surveys in the World Space Observatory Ultraviolet telescope. Proceedings of the SPIE Conference, 8443. 2012