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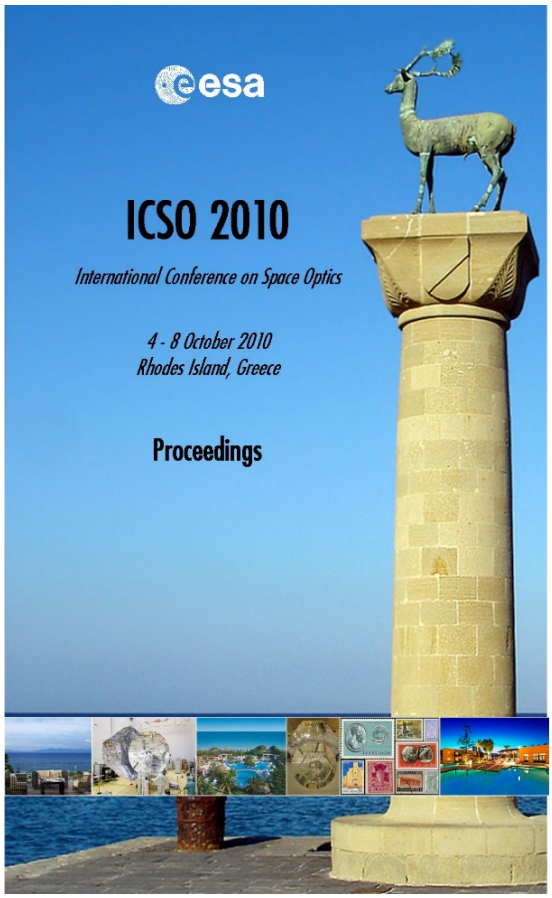

Edited by Errico Armandillo, Bruno Cugny, and Nikos Karafolas

OPSys: optical payload systems facility

S. Fineschi, G. Capobianco, G. Crescenòio, G. Massone, et al.

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OPSys: Optical Payload Systems Facility

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Abstract

The Turin Astronomical Observatory recently completed construction in Altec, Turin, of, Italy, a new Optical Payload System (OPSys) facility for tests of contamination sensitive optical space flight instruments. The facility is specially tailored for tests on solar instruments like coronagraphs. The test facility includes a clean room for instrument assembly and a relatively large (4.e+3 liters) optical test and calibration vacuum chamber. After vacuum conditioning, the chamber will hace an ultimate pressure of 1.e-7 torr.

The Space Optics Calibration Chamber (SPOCC) consists of a test section with a vacuum-compatible motorized optical bench, and of a pipeline section with a solar simulator at the opposite end of the optical bench hosting the instrumentation under tests. The solar simulator is an off-axis parabolic mirror collimating the light from the source with the solar angular divergence.

This presentation will describe the SPOCC's vacuum system and optical design, and the post-flight stray-light tests to be carried out on the Sounding-rocket Experiment (SCORE). This sub-orbital coronagraph is the prototype of the METIS coronagraph for the ESA Solar Orbital mission. Solar Orbiter closest perihelion is one-third the Sun-Earth distances. The plans will be illustrated for testing METIS simulating in SPOCC the coronagraph observing conditions from the Solar Orbiter perihelion.

The Space Optics Calibration Chamber - SPOCC

Figure 1. *The vacuum pumping system (third module)*

Table 1. *Clean room technical data*

Description	Unit	Contamination controlled area
Volume	m^3	58.6
Class	ISO	6
Flux	m^3/h	7260
Air Recycle	n°/h	123.9

Table 2. *Optical Bench's Articulation Specification*

Translation

	minimum	goal
•Vertically (y-axis):	± 2 cm	-2 cm; +4 cm
•Laterally (x-axis):	± 2 cm	± 5 cm

Tilt in yaw (x-z plane): ± 2°
Tolerances in the translation
•Resolution: 25 µm
•Stability (over 1 hour): 125 µm
•Accuracy: 125 µm
•Repetability: 50 µm
Tolerances in the angular motion
•Resolution: 0.3 arcmin
•Stability (over 1 hour): 20 arcsec
•Accuracy: 1 arcmin
•Repeatability: 0.6 arcmin

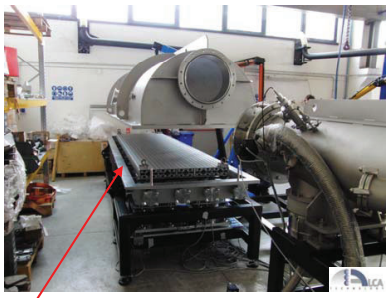

Figure 2. *The test section and optical table*

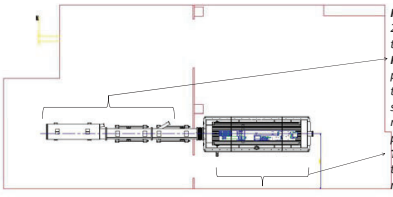

Figure 3. *SPOCC facility is composed of 2 part: The pipeline tube section an the test section*
Pipeline tube section *is composed of 3 parts:*
the first tube for the optics location a second module removable, and a third module containing the vacuum pumping system.
Test section *is equipped with an optical table. The optical table has 4 stepper motor that allow tilts and translations on the table plane see Table2.*

The payloads to be tested in the OPSys facility

Figure 4. The Sounding-rocket Coronagraphic Experiment – SCORE to be calibrated in the OPSys facility

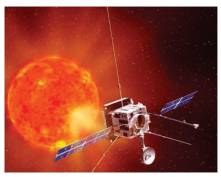

Figure 5. *Artistic impression of the ESA Solar Orbiter mission whose payload includes the METIS coronagraph to be tested and calibrated in the OPSys facility.*

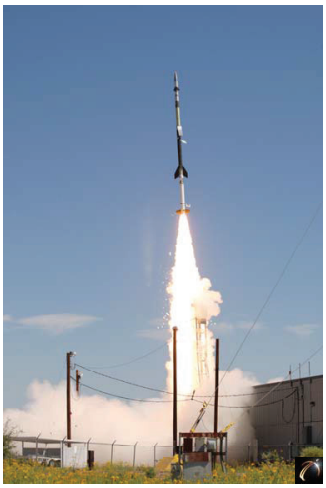

Figure 6. *The Sounding-rocket HERSCHEL with SCORE was launched on September 14th 2009.*

Collimating system Optical Design

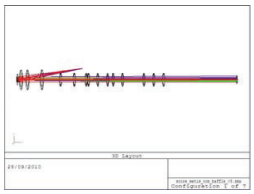

Figure 7. *Optical system in "collimated mode". for the SCORE stray light measurements*

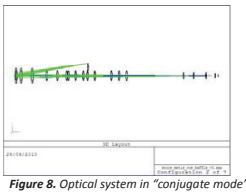

Figure 8. *Optical system in "conjugate mode" for the METIS stray light measurements An annular source is focussed on the edge of the METIS external occulter.*

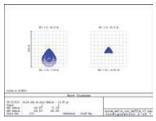

Figure 9. *The spots for 2 points from the annular source for the METIS tests. Visible coma aberration is due to the use of a non paraxial source and an off axis parabolic mirror.*

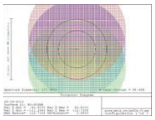

Figure 10. *For the stray-light tests, the collimator ensures that the SCORE front aperture is uniformly illuminated by a solar divergent, collimated beam*

Stray Light Suppression Optimization via Numerical Ray-trace

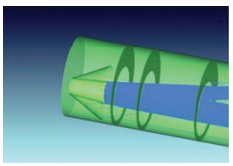

Figure 11. *The light trap is designed to ensure at least three bounces for the entering rays. The trap's surface is covered with VEL-BLACK® with an absorption of 99.95% in the visible range. From numerical ray-trace simulations the emerging-to-entering ratio of the scattered rays into the SCORE field of view (±1°) is 3e-10*

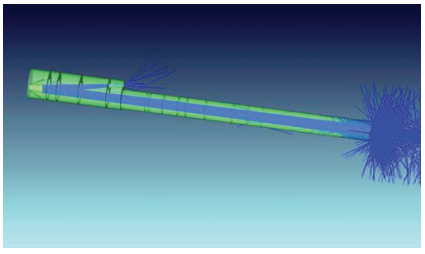

Figure 12 *Additional baffles along the beamline further suppress the scattering from the collimator*

Results
Numerical ray-trace simulations (one million rays) indicate an upper limit of ***5e-12 stray-light level*** *from the SPOCC set-up to be used for the SCORE tests.*

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