WORLD SPACE OBSERVATORY - ULTRAVIOLET STATUS in RUSSIA

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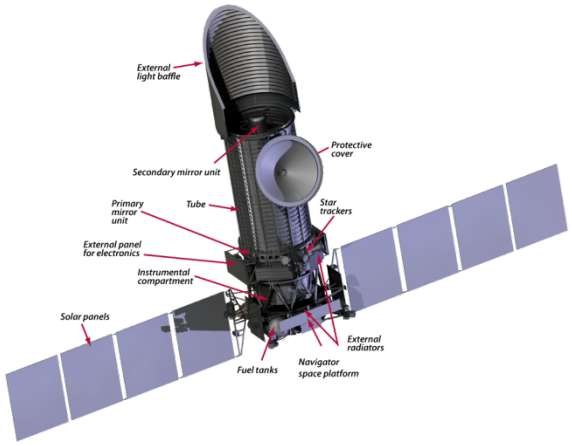
“Spektr” SERIE in the Russian Federal Space Program

SPECTR – R (RADIOASTRON) on orbit since 2011

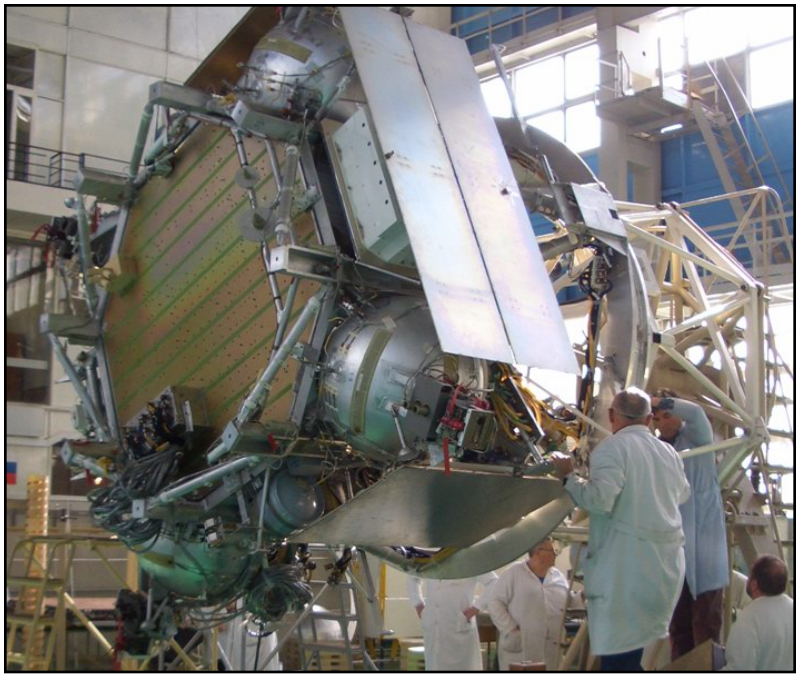
SPECTR – RG (ROENTGEN (x-RAY) GAMMA, WITH E-ROSITA) 2018

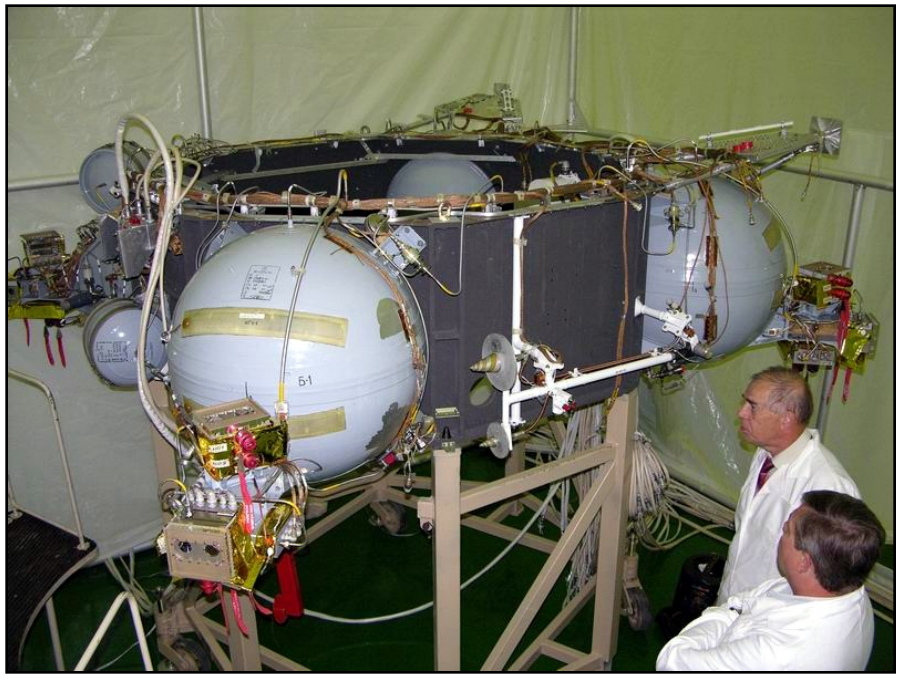
SPECTR – UF (ULTRAVIOLET), WSO-UV 2023



SPECTR – M (MILLIMETRON) after 2025

Unified space platform NAVIGATOR for “Spektr” SERIE





Flight models of the platform Navigator for meteorological ELECTRO Project.

There are NO technical or political problems right now!!!!!!!

WSO-UV is still the only large UV telescope on orbit during the period 2023-2030

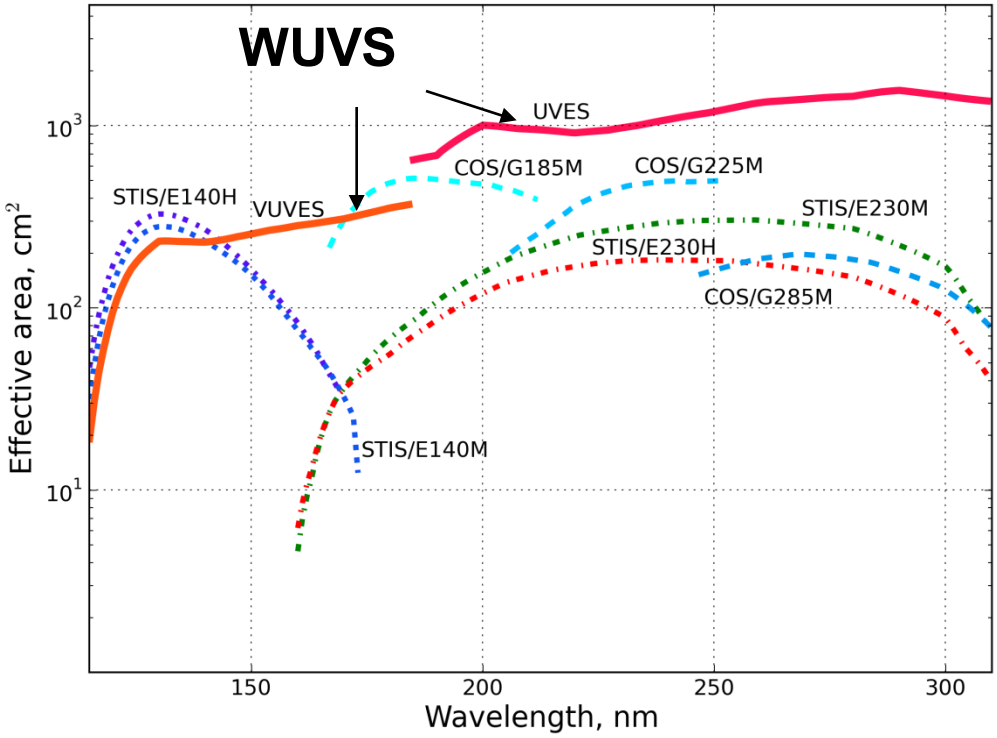
NASA flagship project LUVOIR is an idea to be realised after 2030

WSO-UV as the HST "successor" should has larger aperture but
HST – 2.4 m
WSO-UV – 1.7 m

1. Efficient optical system

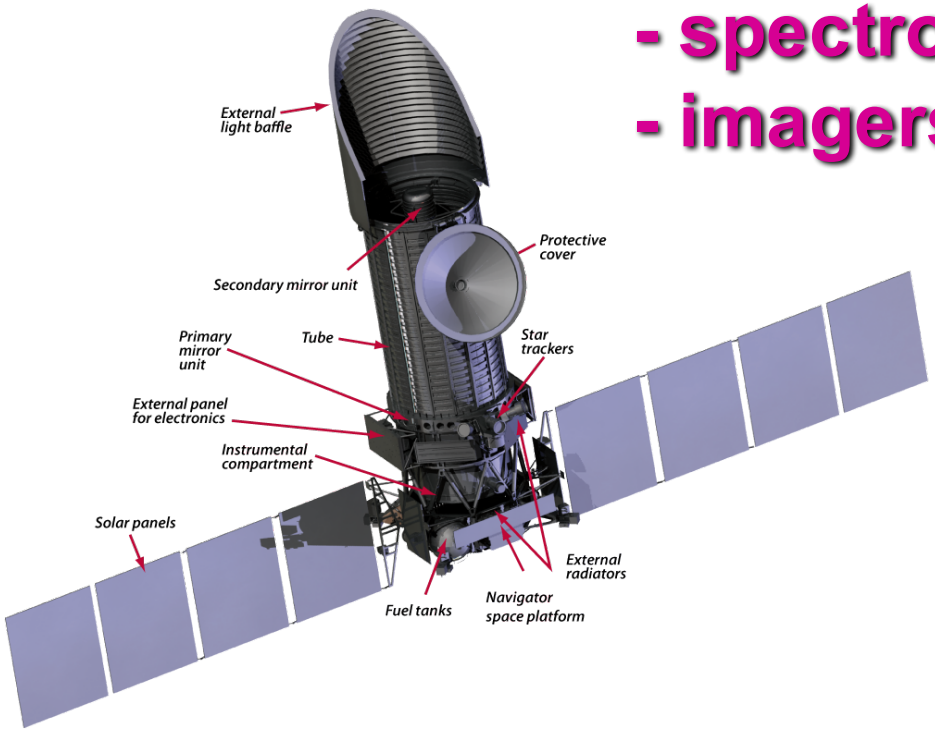
2. Geosynchronouse orbit

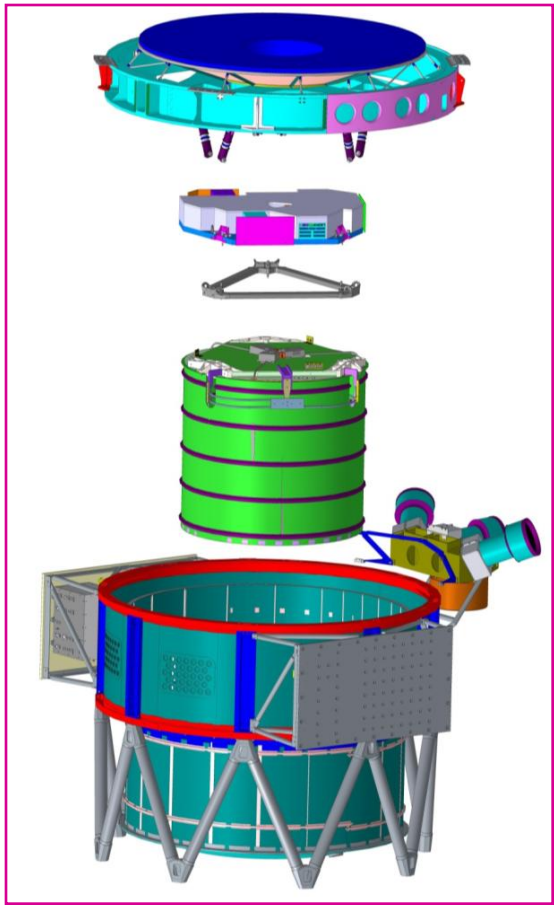
3. Modern detectors



Efficiency of WSO-UV Spectrographs

WSO-UV instrumentation:
- single telescope
- spectrographs
- imagers





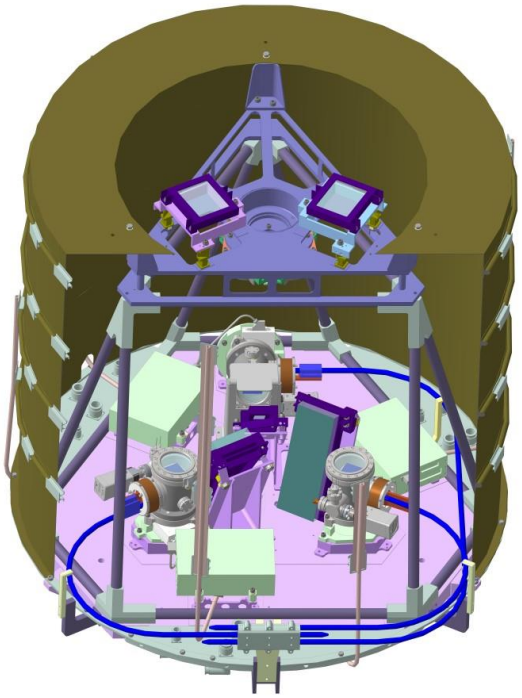
WUVS (WSO-UV Spectrograph)

Three channels (spectrographs) of the WUVS :

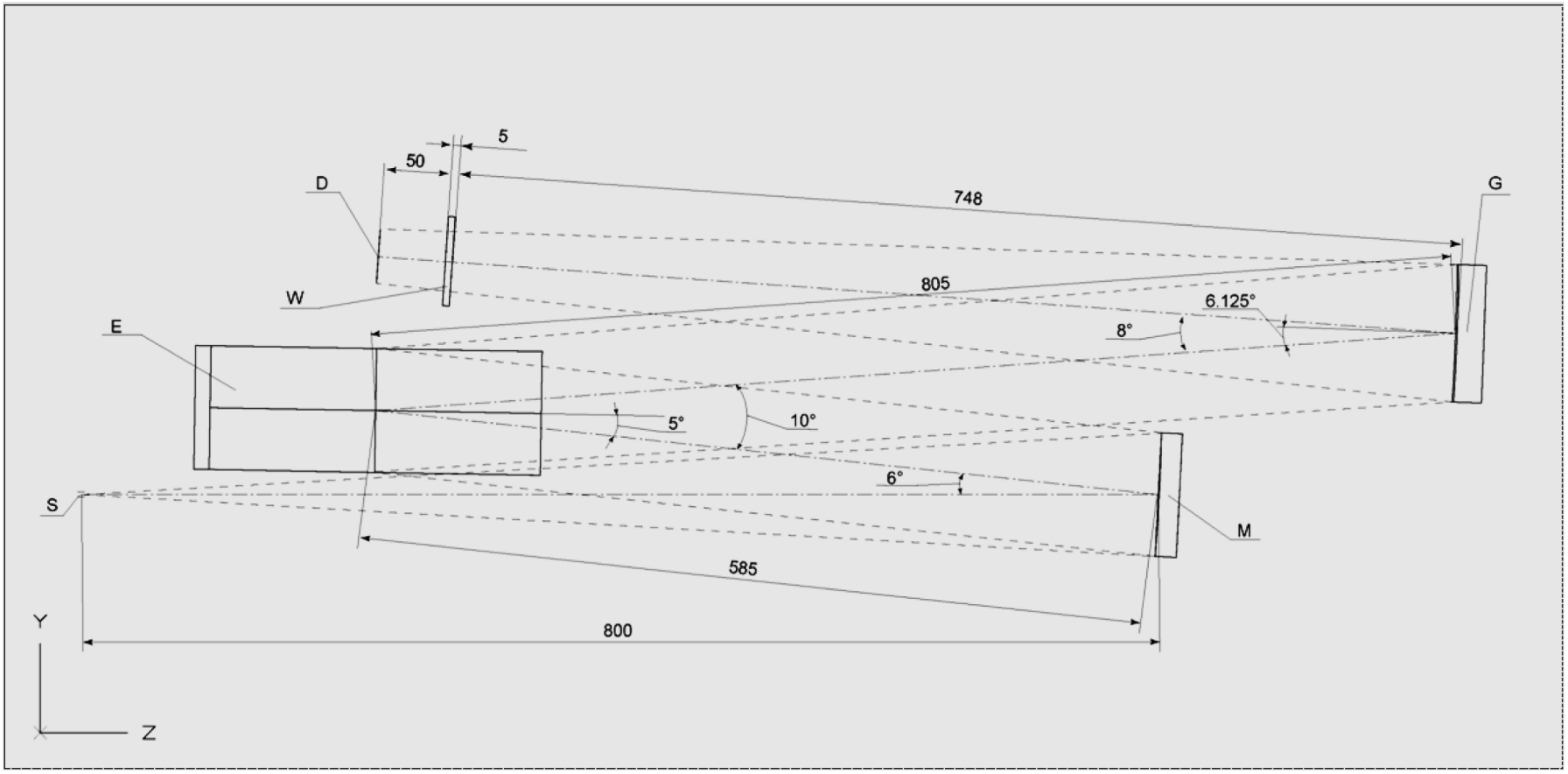
Vacuum **U**ltra**v**iolet **E**chele **S**pectrograph
VUVES - 115-176 nm, R ≥ 50 000

Ultra**v**iolet **E**chele **S**pectrograph
UVES - 174-310 nm, R ≥ 50 000

Long **S**lit **S**pectrograph
LSS - 115-305 nm, R=1000

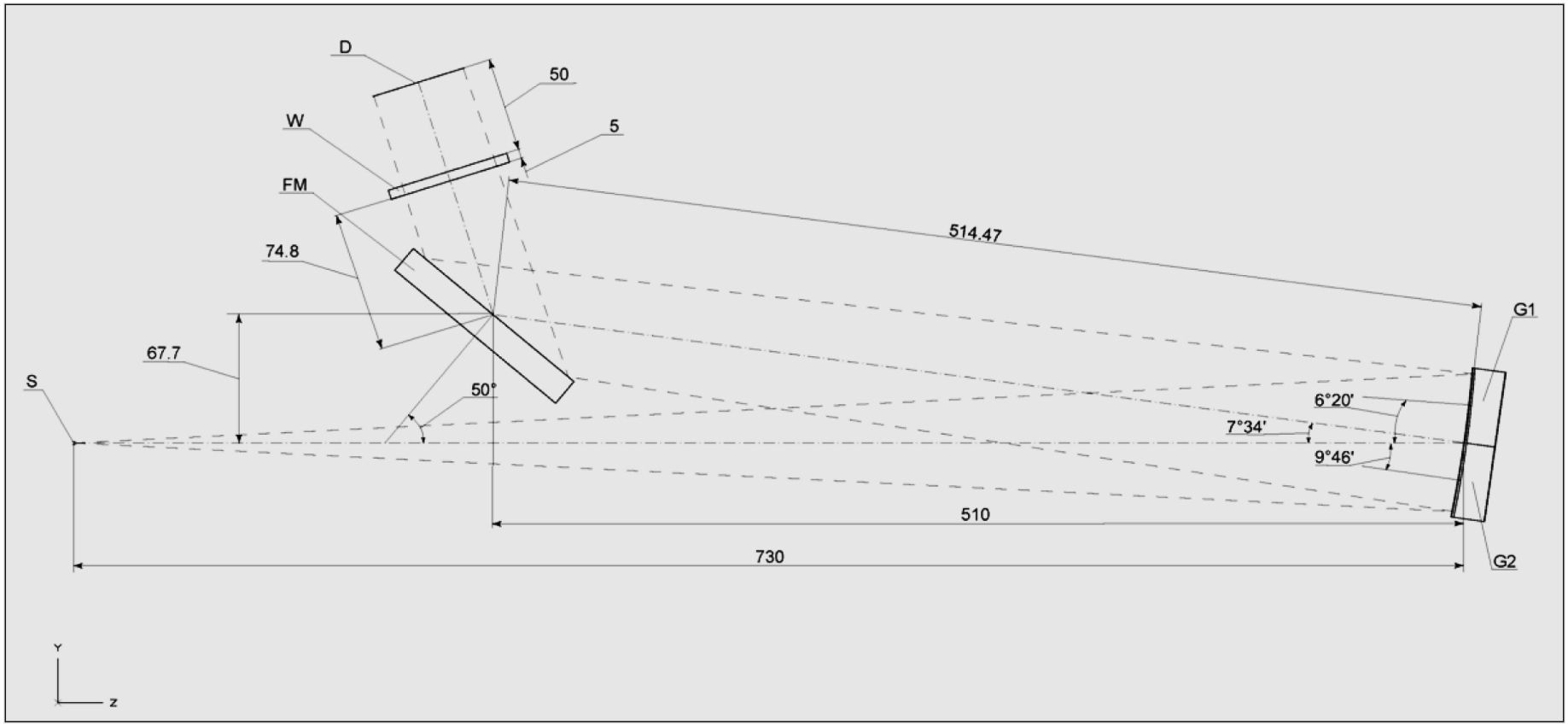


WSO-UV high-resolution channel optical layout (Panchuk et al.)



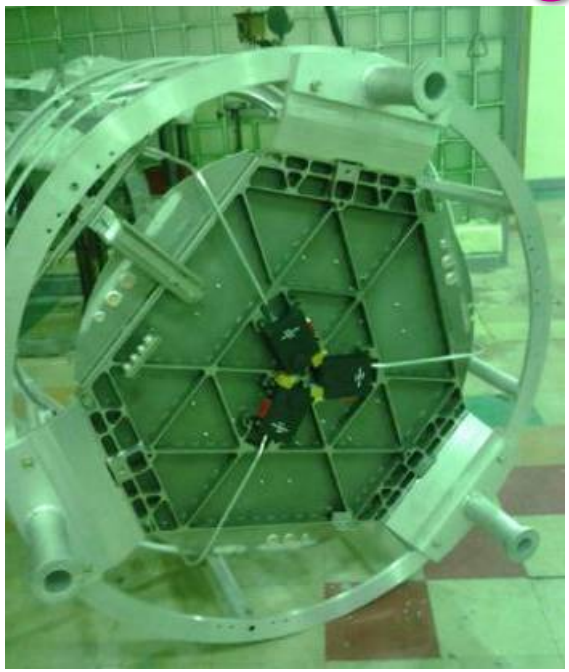
S - entrance slit, M - collimator mirror, E - echelle grating, G - cross-dispersion grating, W - entrance window of CCD, D - CCD surface, dashed lines - border of the light beam

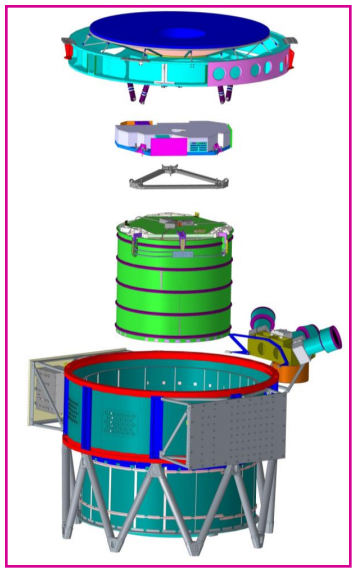
WSO-UV long slit channel optical layout (Panchuk et al.)

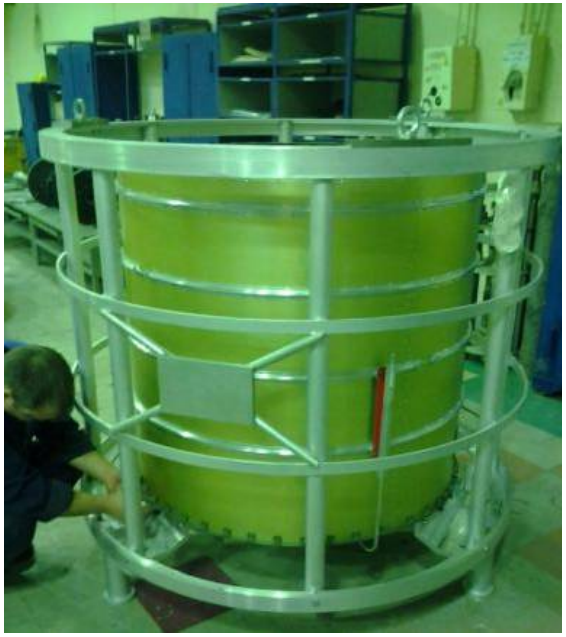


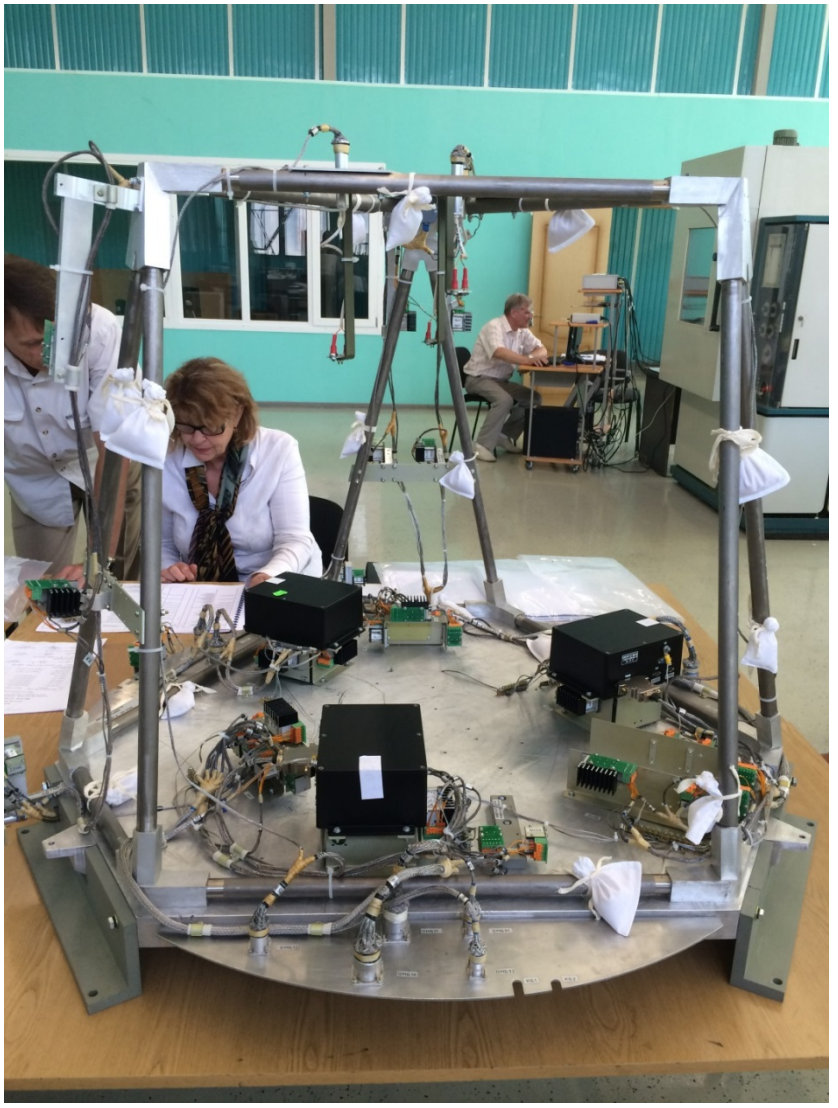
S - entrance slit, G1 - toroidal grating of near UV branch, G2 - toroidal grating of far UV branch, FM - flat mirror, W - entrance window of CCD, D - CCD surface.

Spectrograph mock-ups

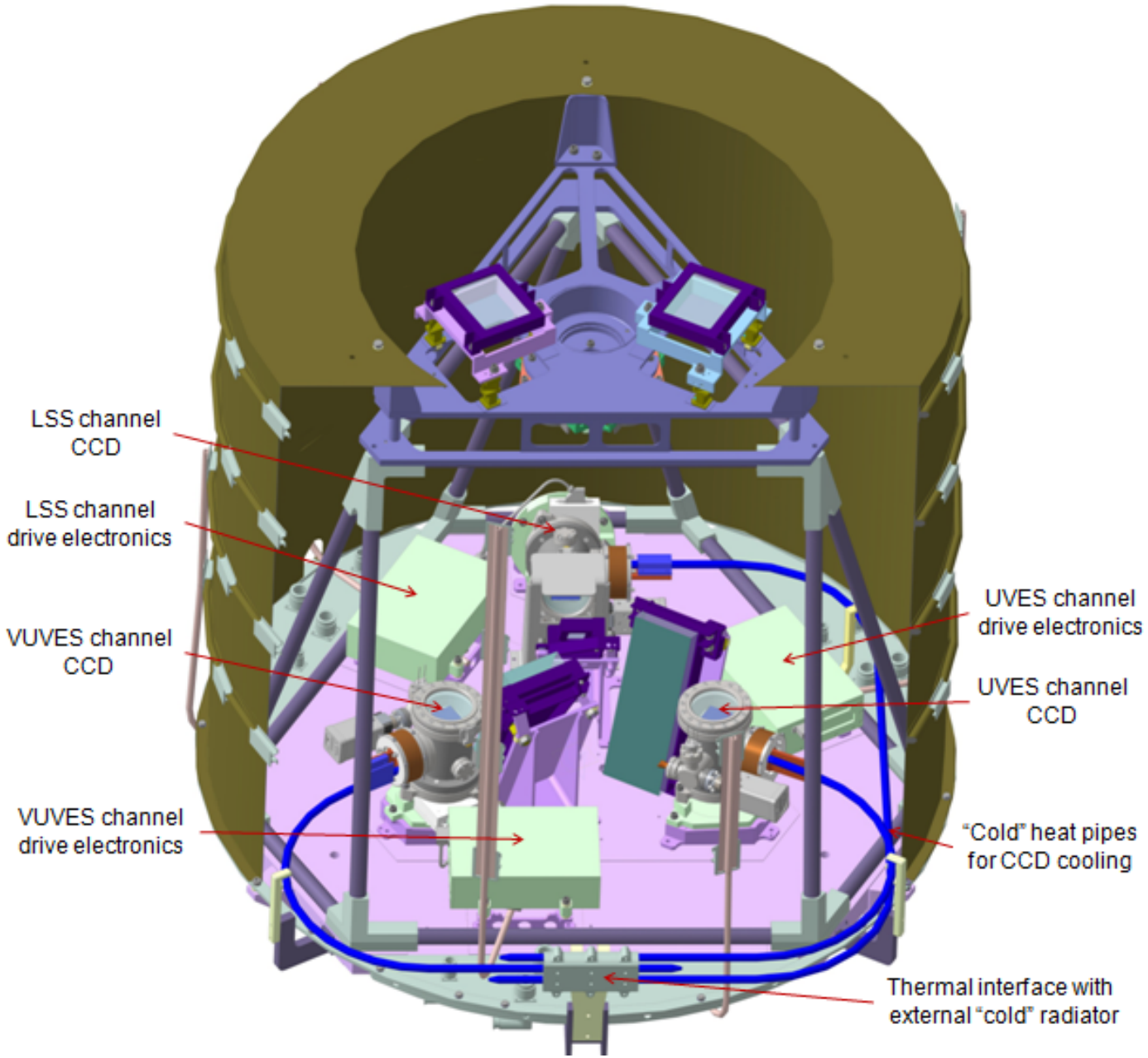




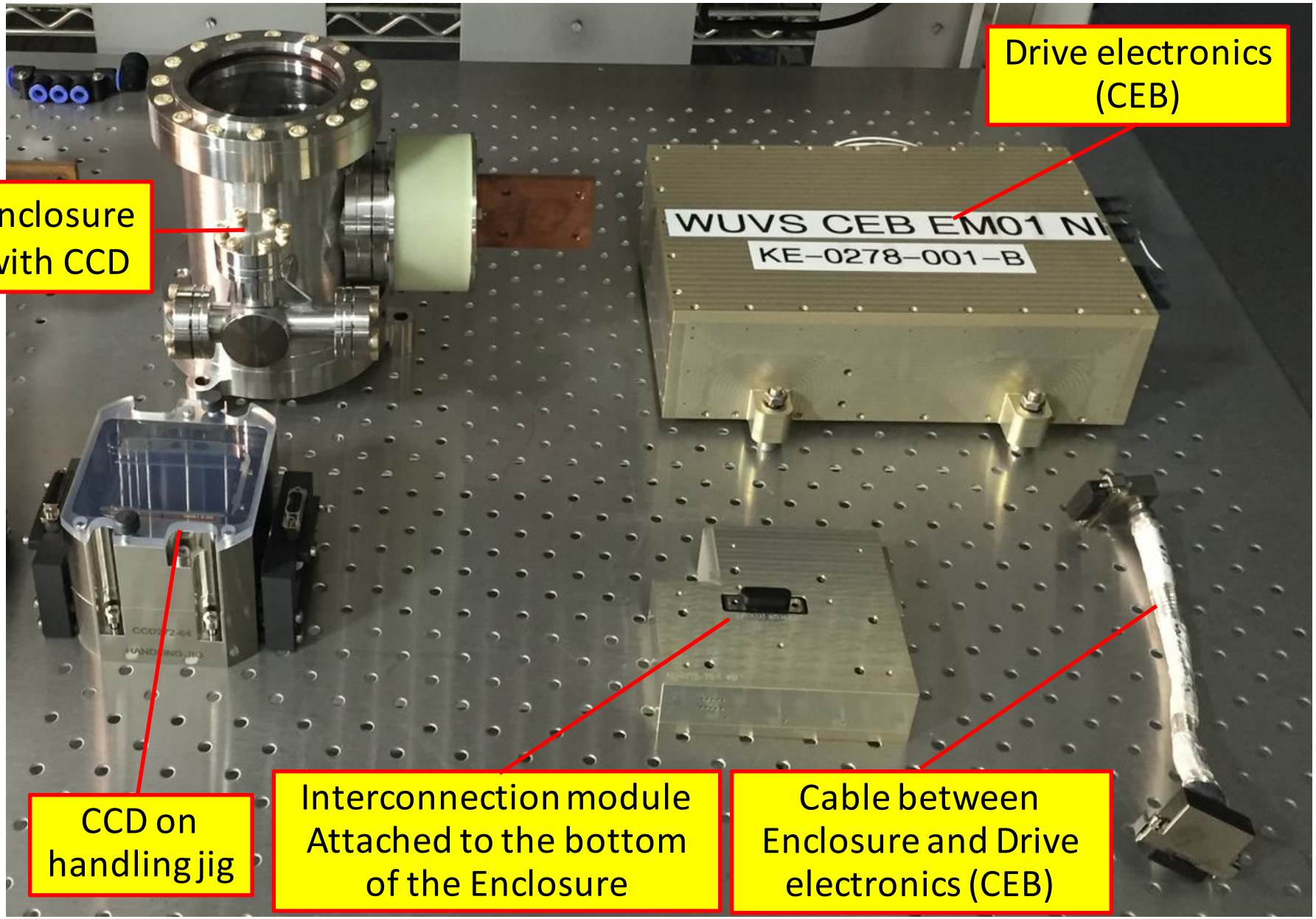




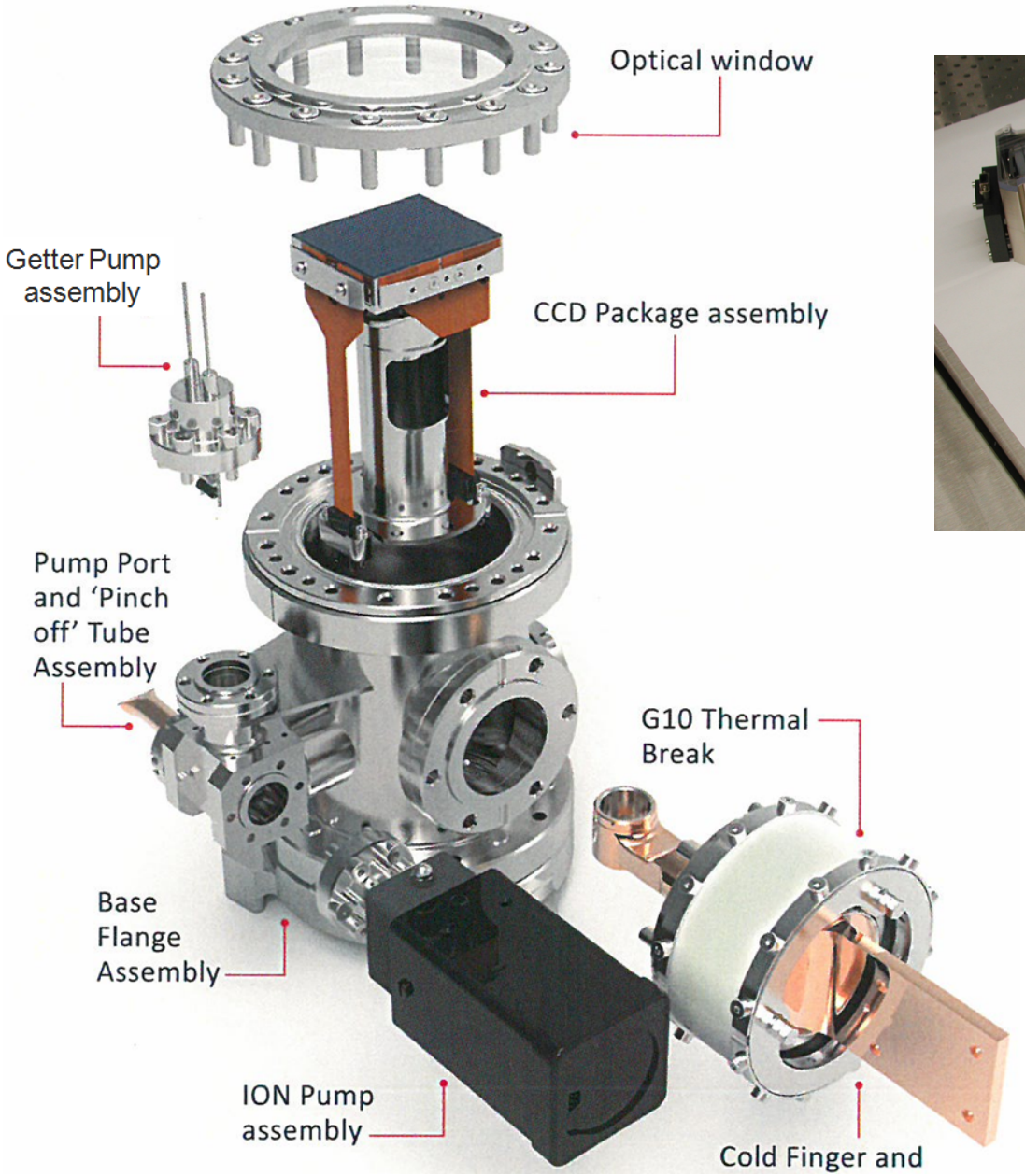
Detector location inside WUVS

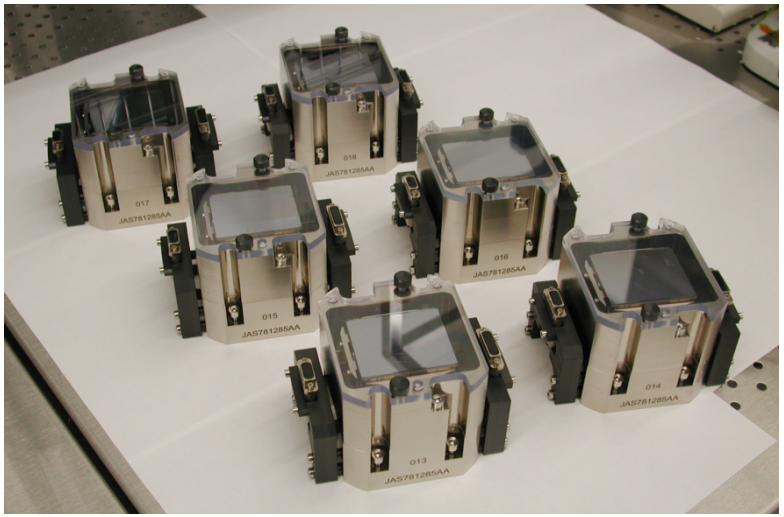


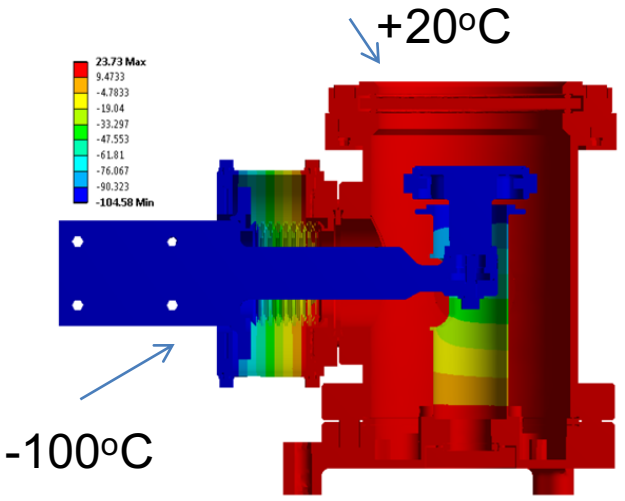
WUVS detector main components



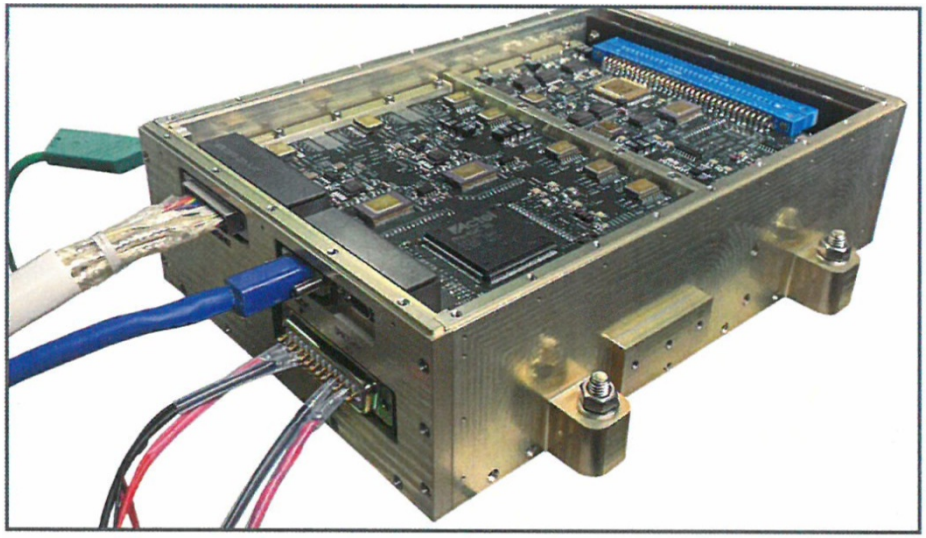
CCD custom design cryostat (Enclosure)

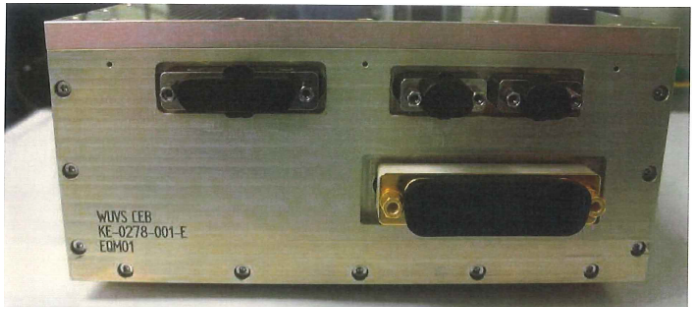


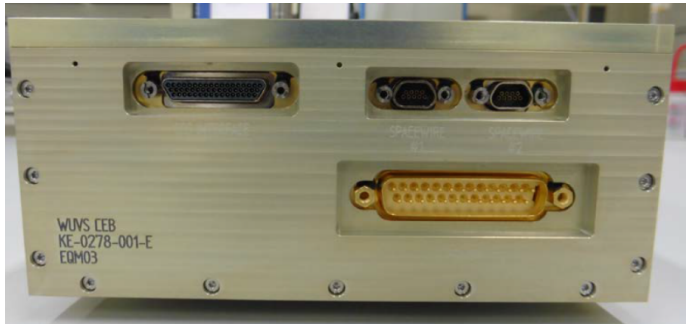


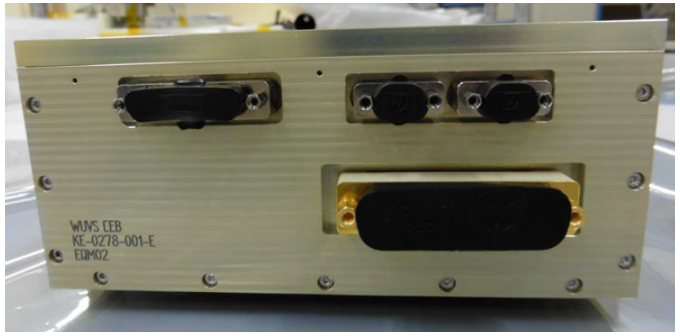


ITAR-free custom design of Camera Electronics Box (CEB)





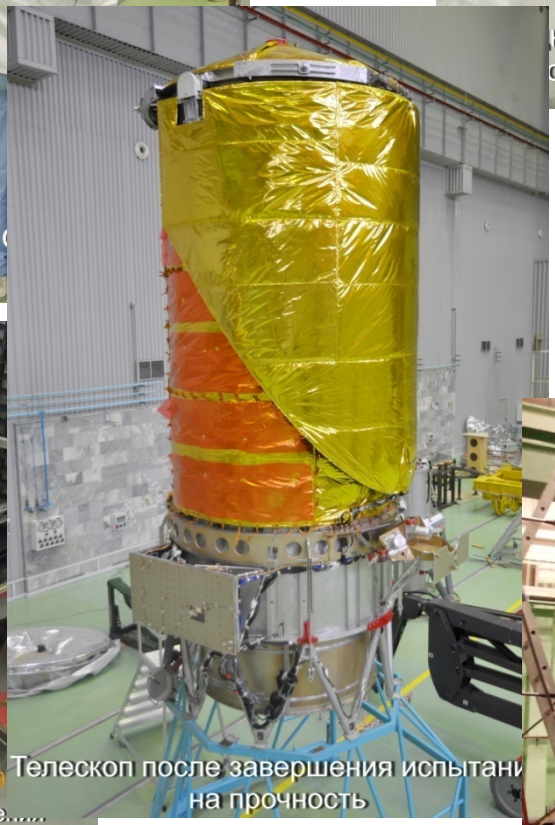


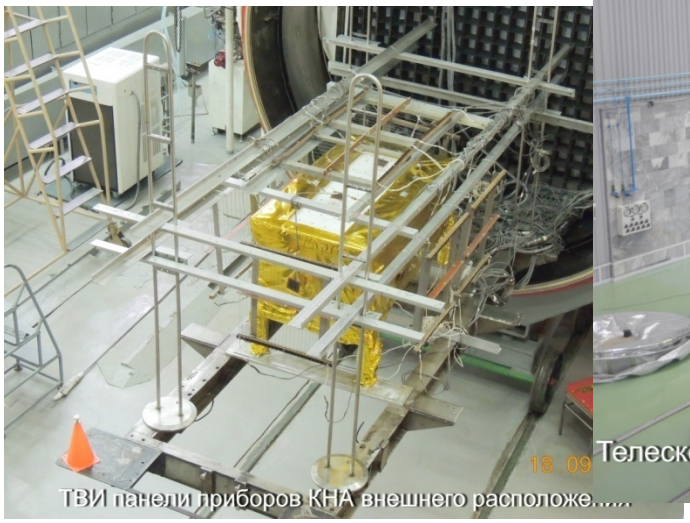


CEB EQMs were delivered to Russia in October 2017.

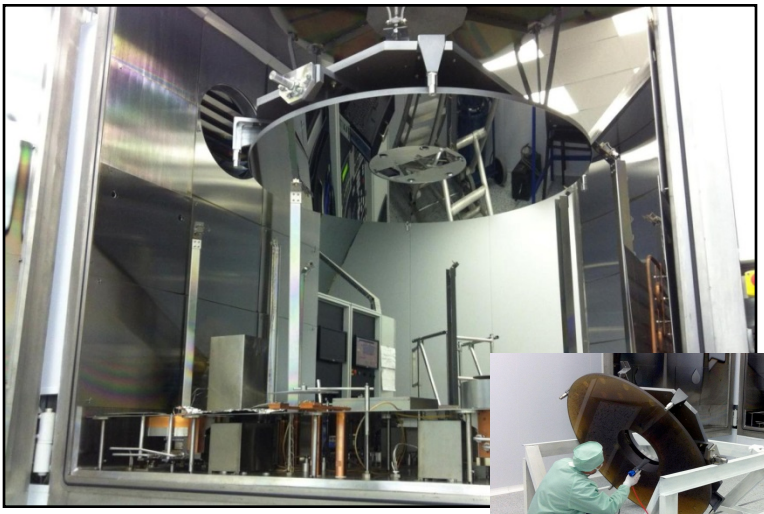
Enclosure EQM, Teledyne e2v (UK), 2017

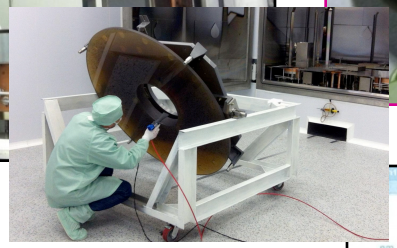
The T-170M telescope

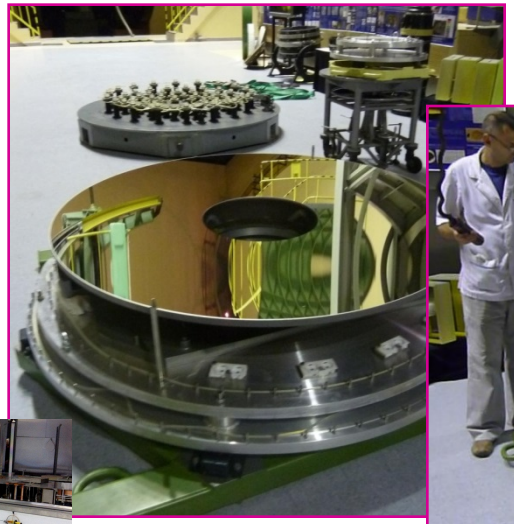


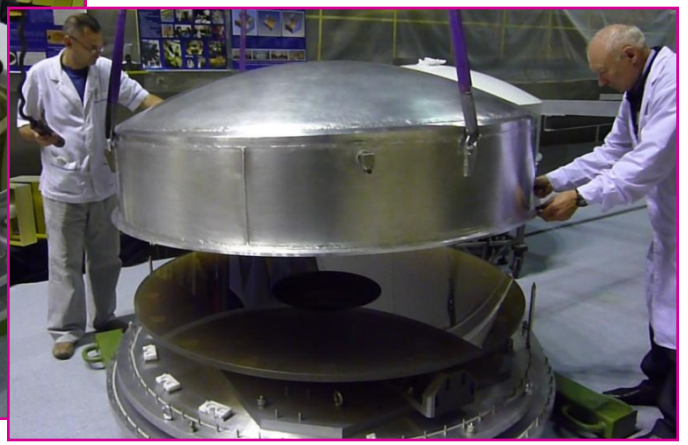


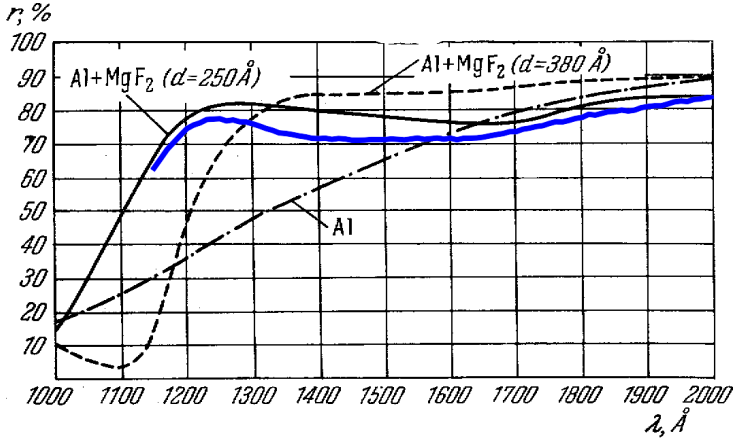
Optics (LZOS, Russia) + coating (LUCH company, Russia)

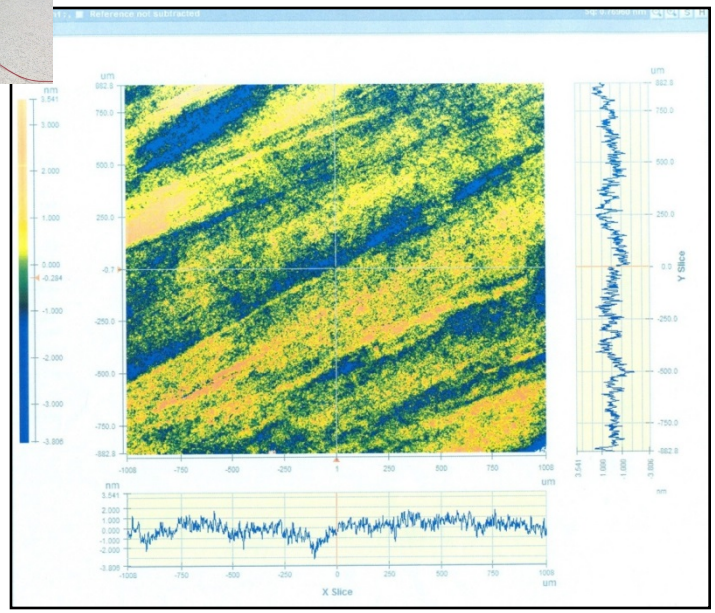










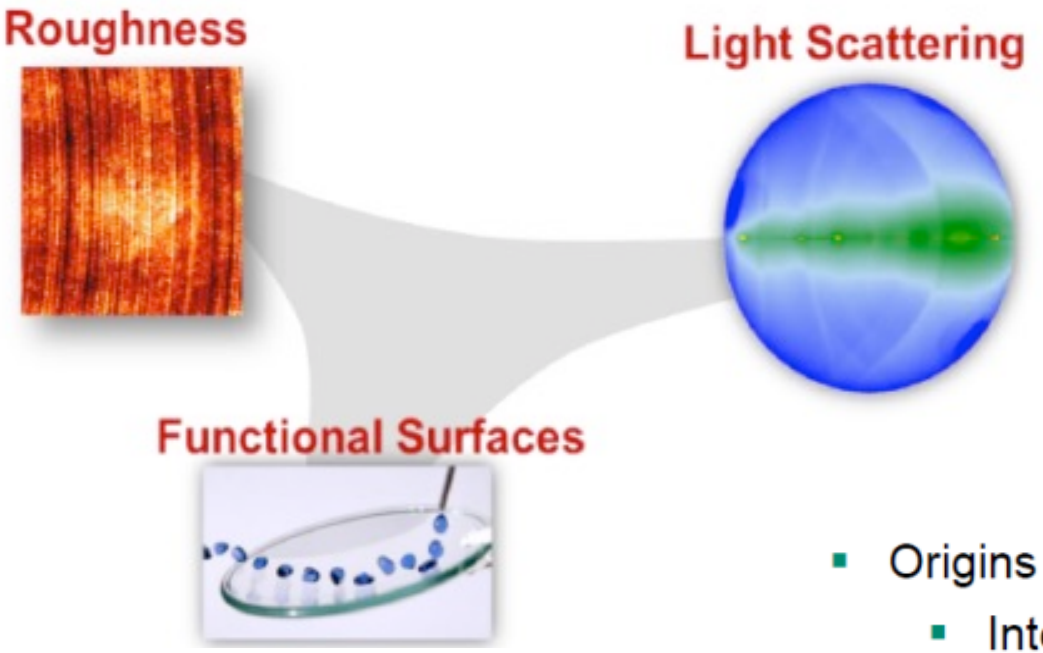


rms = 0.75 nm

1 mm

Current work:

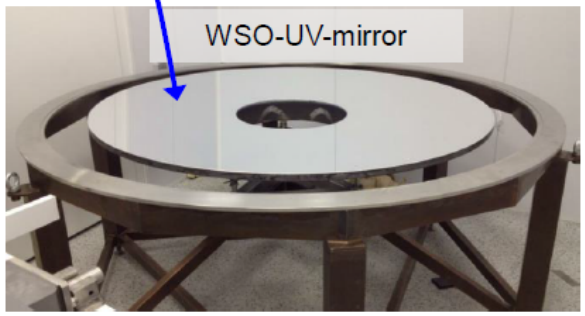
Surface and Thin Film Characterization



- Origins of scattering:
  - Interface roughness, but also:
  - Defects, bulk inhomogeneities, Sub-Surface-Damage, Coatings, …

+ CONTAMINATION OF THE SURFACE

New in 2016: High-end scatter sensor for INASAN

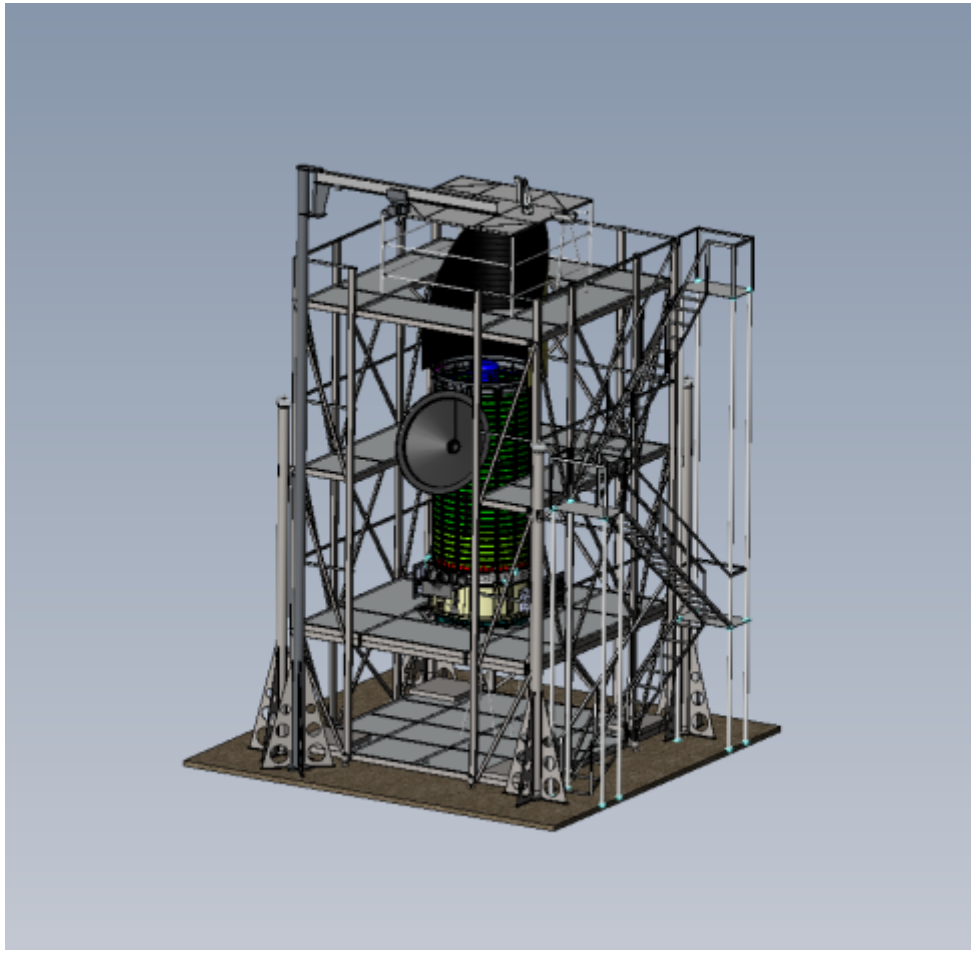


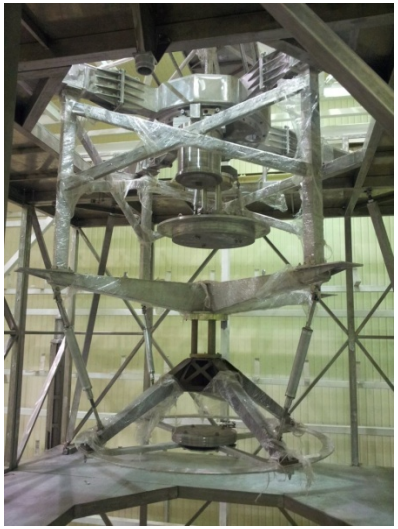
Special version with new features:

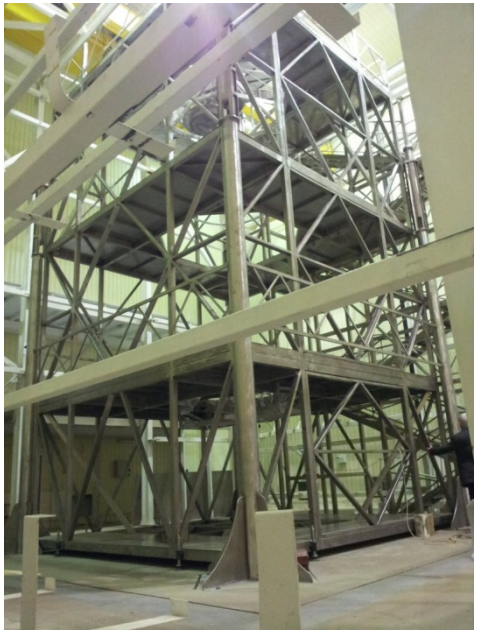
- Illumination wavelength 405 nm
- Enhanced dynamic range and sensitivity
- Integrated refocussing unit and distance sensor
- Manual swivel arm for positioning sensor over large mirror

Only instrument world-wide to measure low-level BRDF on meter scale optical surfaces

Telescope AIV facilities

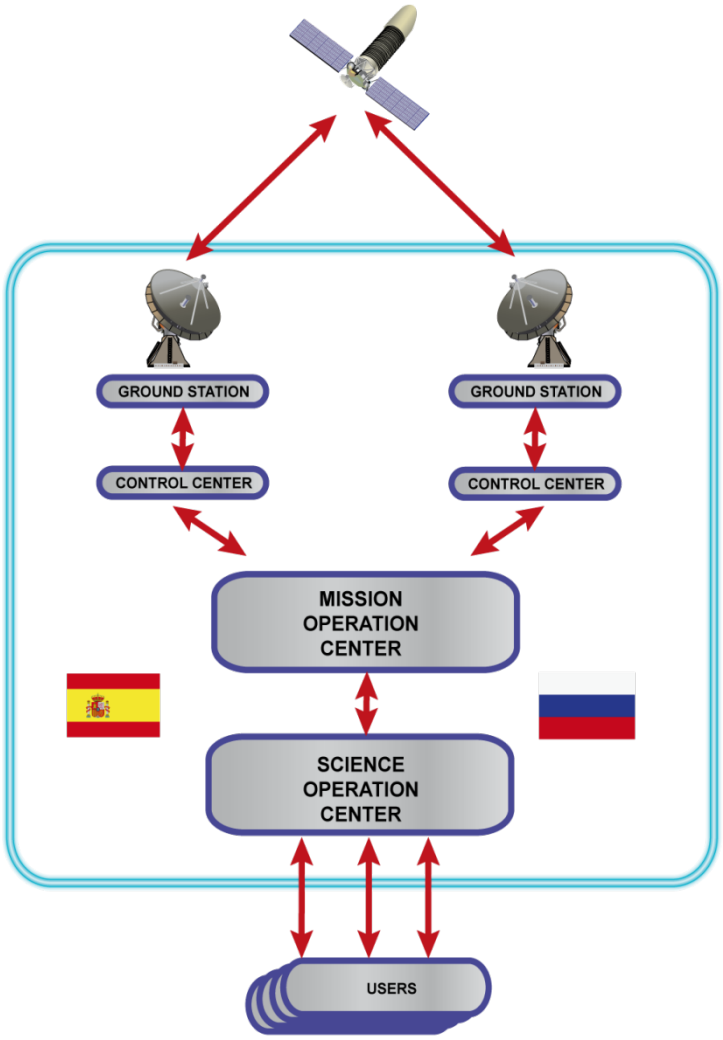






Groung Segment

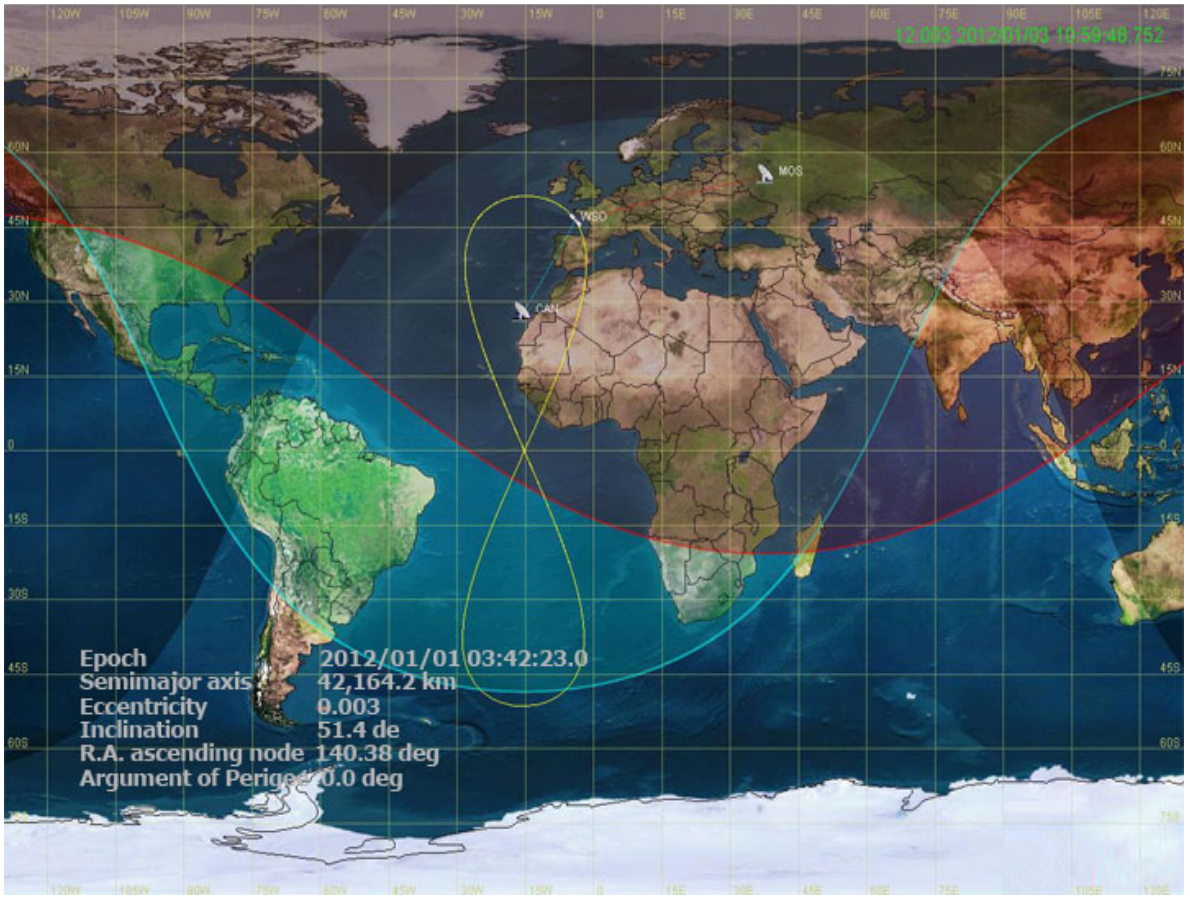
SPAIN-RUSSIA
SHARED OPERATIONS
Science Operation Centers:
Russia: INASAN, Moscow
Spain: UCM, Madrid



Orbit

ZENITH = > PROTON launcher

WSO-UV geosynchronous orbit, i=51.6^{o} = > 14^{o} = > 40^{o}



Groung Segment

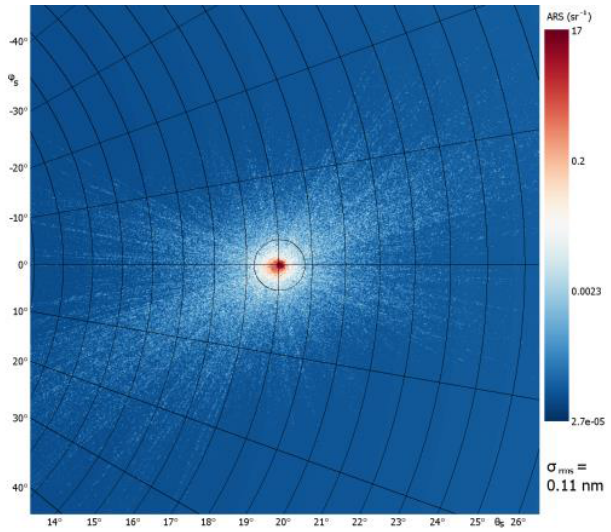
Because of the fact that preparatory observations may be required

Core Programme Call to be released in 2018!!!

Tomorrow we will officially start SPAIN-RUSSIA SHARED OPERATIONS of SOC

Very recent results

φs

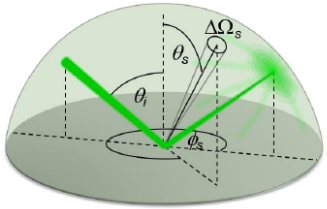


Polar scattering angle θs

Standard (Black glass GL10000)

Angle Resolved Scattering

$$ARS(\theta_s) = \frac{\Delta P_s(\theta_s)}{\Delta\Omega_s P_i} = BSDF(\theta_s)\cos\theta_s$$

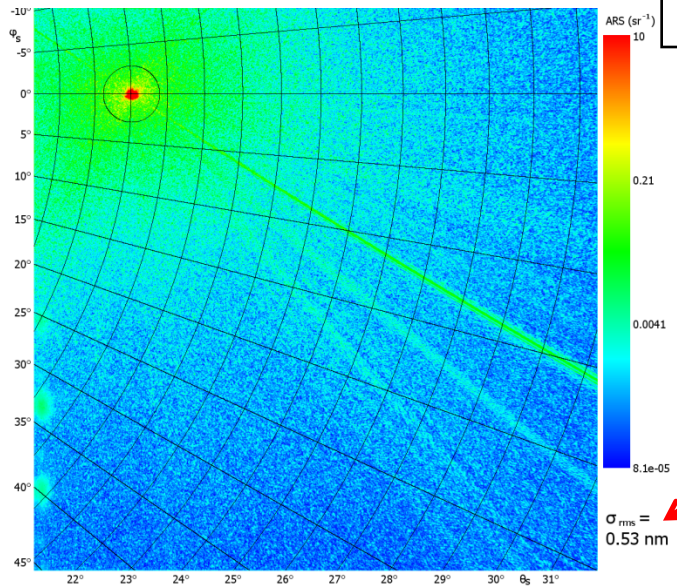


θ_S … polar scatter angle
P_s … scattered power
P_i … incident power
$\Delta\Omega_S$ … detector solid angle
BSDF… Bidirectional Scattering Distribution Function

Total Scattering

$$TS = \frac{P_s}{P_i} = \int ARS \, d\Omega_s$$

International Standard ISO 13696 established after series of round-robin experiments



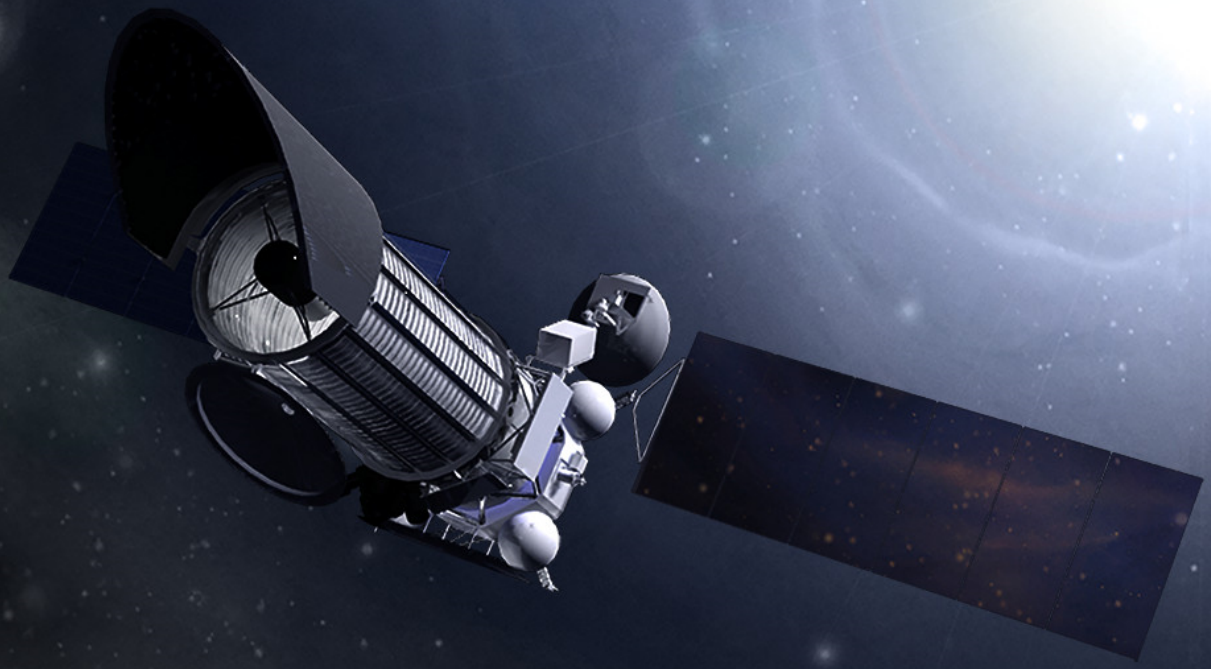
0.53nm

Al+MgF2

INASAN

WSO-UV

World Space Observatory – Ultraviolet



Thank you for your attention!