

**Ministry of Digital Development, Innovation and Aerospace
Industry of the Republic of Kazakhstan
Aerospace Committee**

**Fesenkov Astrophysical
Institute**

Current state of SSA development in Kazakhstan

**COPUOS 2025
Vienna**

A few facts from FAI history on NEO research



Near-Earth surveys
since the launch of
Sputnik in 1957



1978 – 1990 – building of new optical
Observatory Assy-Turgen



The comet
67P/Churyumov-
Gerasimenko (the target of
Rosetta mission) was
discovered at FAI



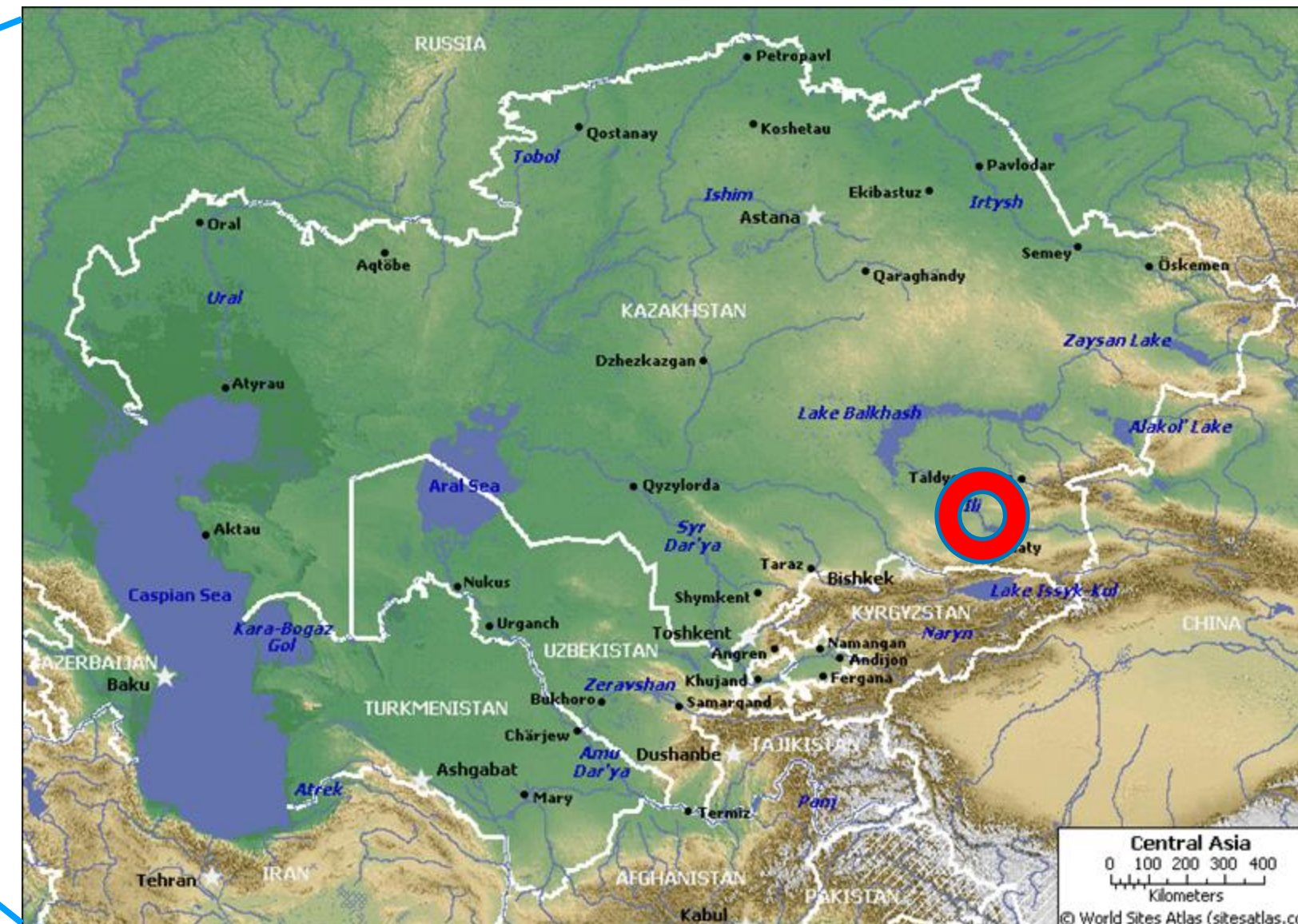
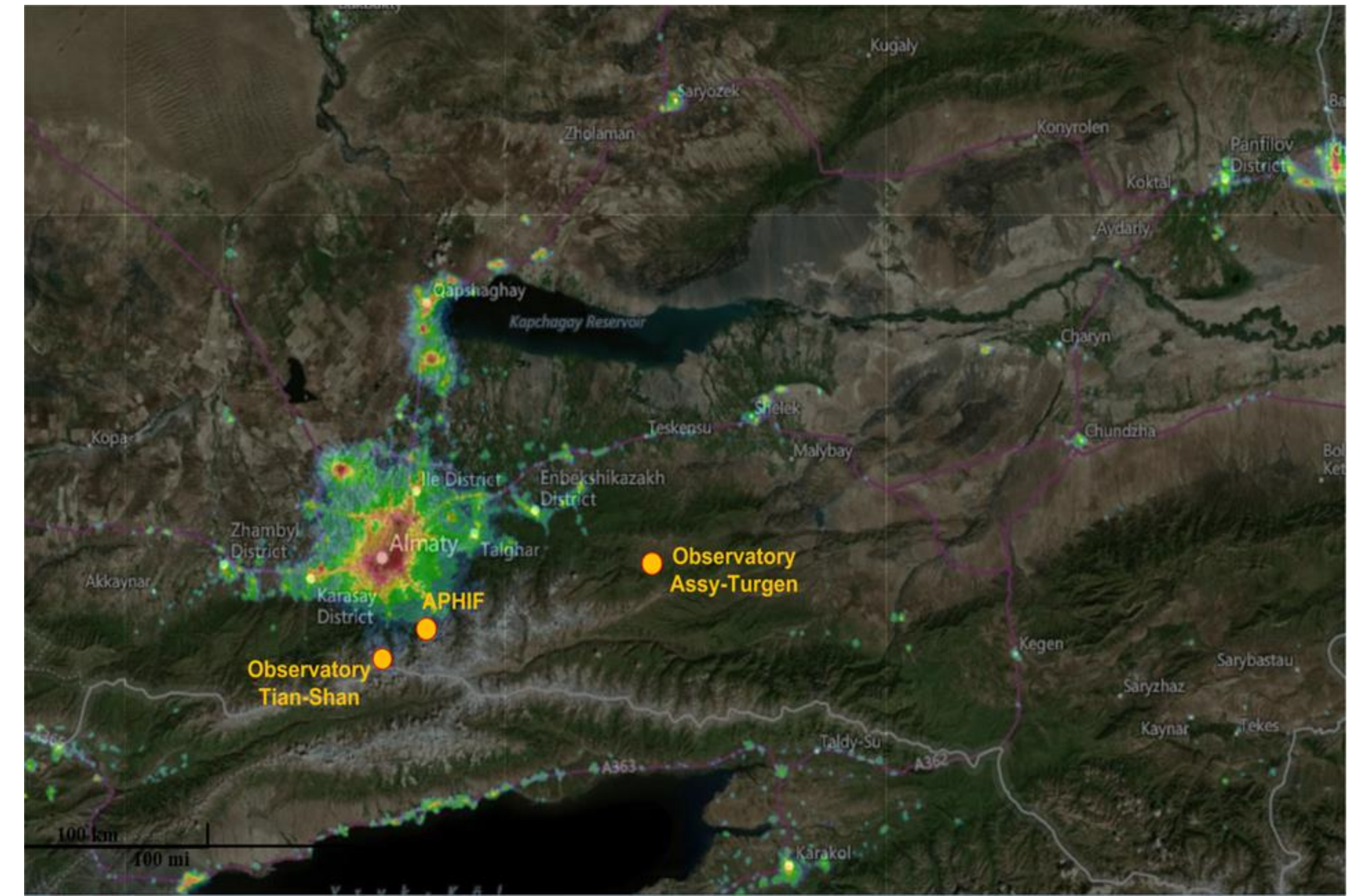
Churyumov & Gerasimenko



Assy-Turgen observatory

Why it is key location for SST

- **Location:** 43°13'31" N, 77°52'18" E, Alt. = 2700 meters
- **Astroclimate:** 1500 h/year, wind speed ~2 m/s, median temperature in summer +9.5C, in winter -10.5, seeing~0".80, limit mag. 21^m.6 (510-700 nm), 22^m.6 (370-510 nm), $P_B = 0.74$, $P_V=0.85$, $P_R=0.91$



Assy-Turgen observatory

SSA development initiated in 2021

Instruments for SST:

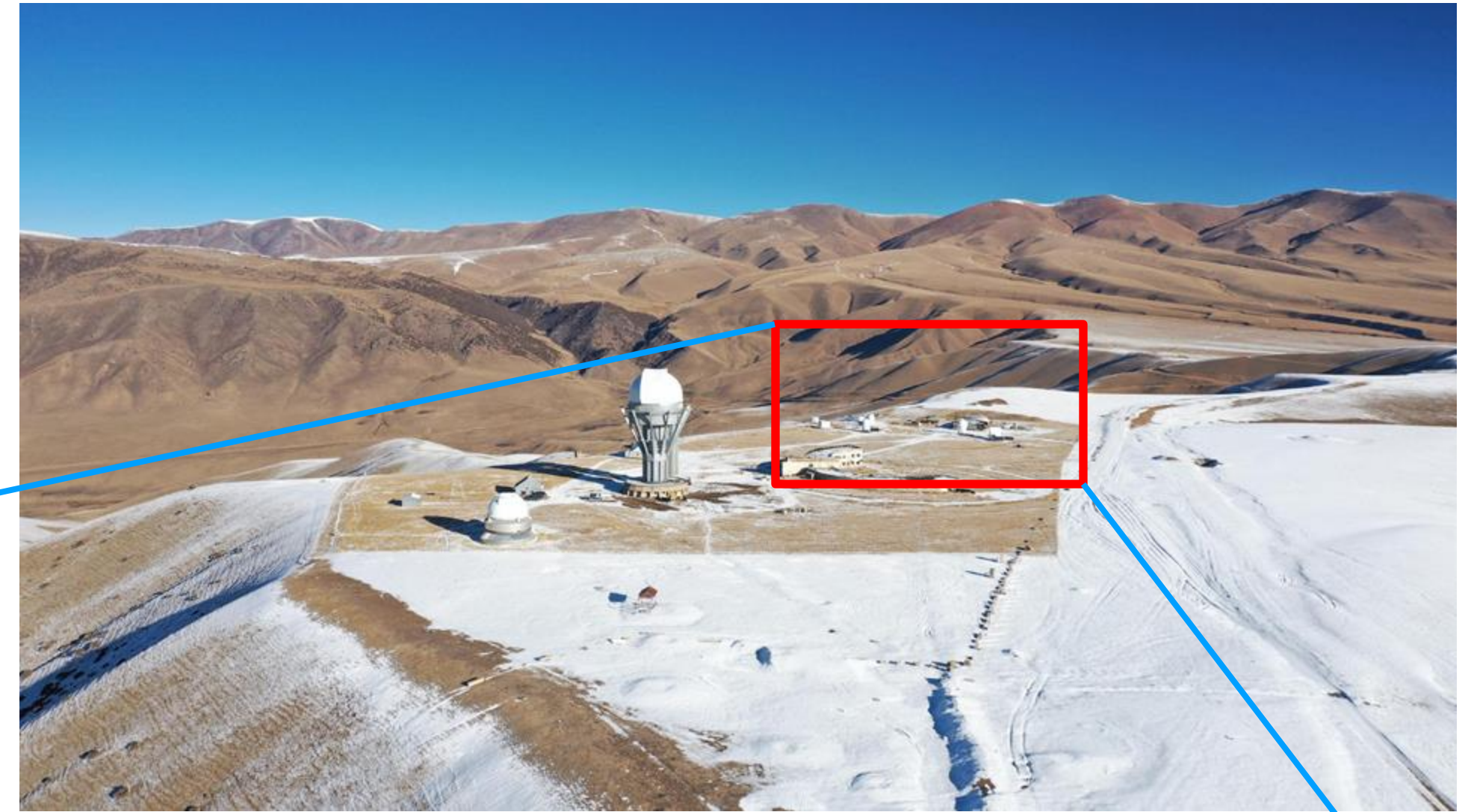
Installed - AZT-20, RC500, WFOS-40, Zeiss-800

Under development and installation - WFOS-70, telescopes of partners, relocation of two Zeiss-1000.



Assy-Turgen observatory

General view and development



North-East view



2020



2025

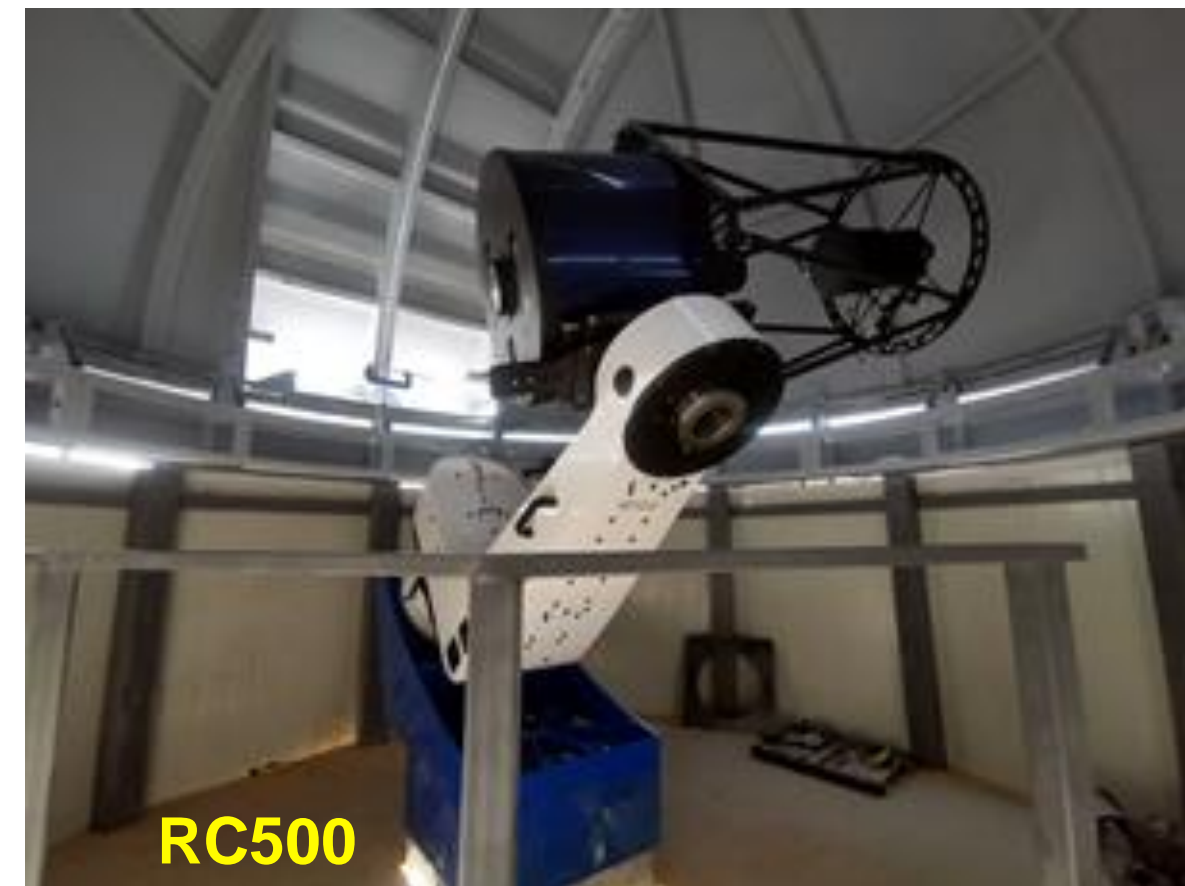
Current SST capabilities

Instruments for Near-Earth Objects survey

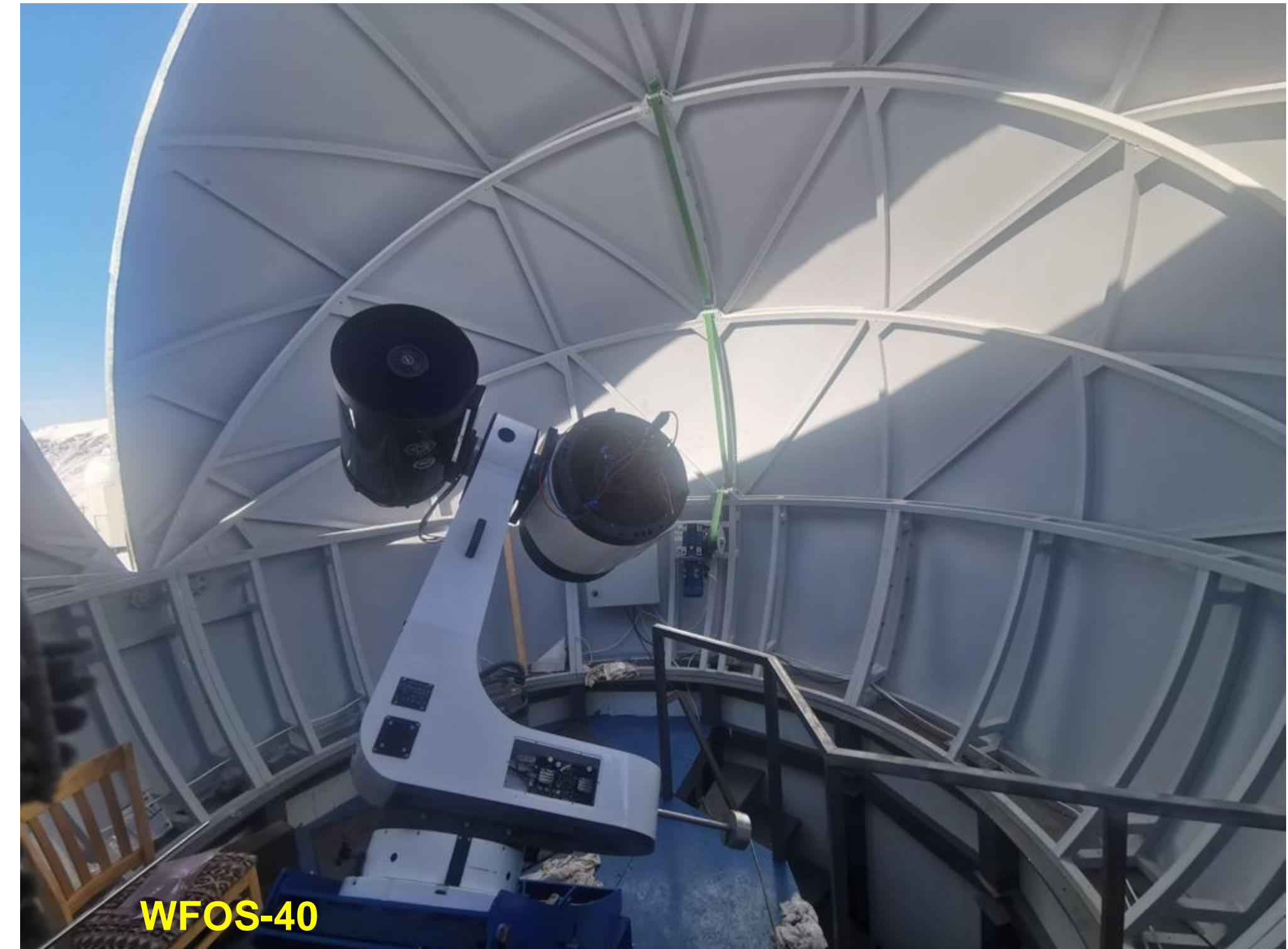
- RSO catalog support: Wide-Field Optical Systems (RC500, WFOS-40)
- LEO survey: WFOS-40 (several Gb of data per night), (WFOS-70 under development)
- Follow-up observations of asteroids: Phaethon, DART and HERA missions



AZT-20
D=1560 mm, $f = 1/3.8$, modified to operate in prime focus with 4-lenses quartz reducer
D=280 mm, transparent in $\lambda = 300 - 2500$ nm, FOV = 60×60 arcmin, $0.38''/\text{pix}$, BVR "Astrodon". Remote control.



RC500
C500: D=508 mm, modified to operate in prime focus $f = 1/2.8$,
FOV = 1.5×2.0 deg



WFOS-40
D=400 mm, FOV $\sim 2.5^\circ \times 3.5^\circ$, designed for Near-Earth Objects surveys

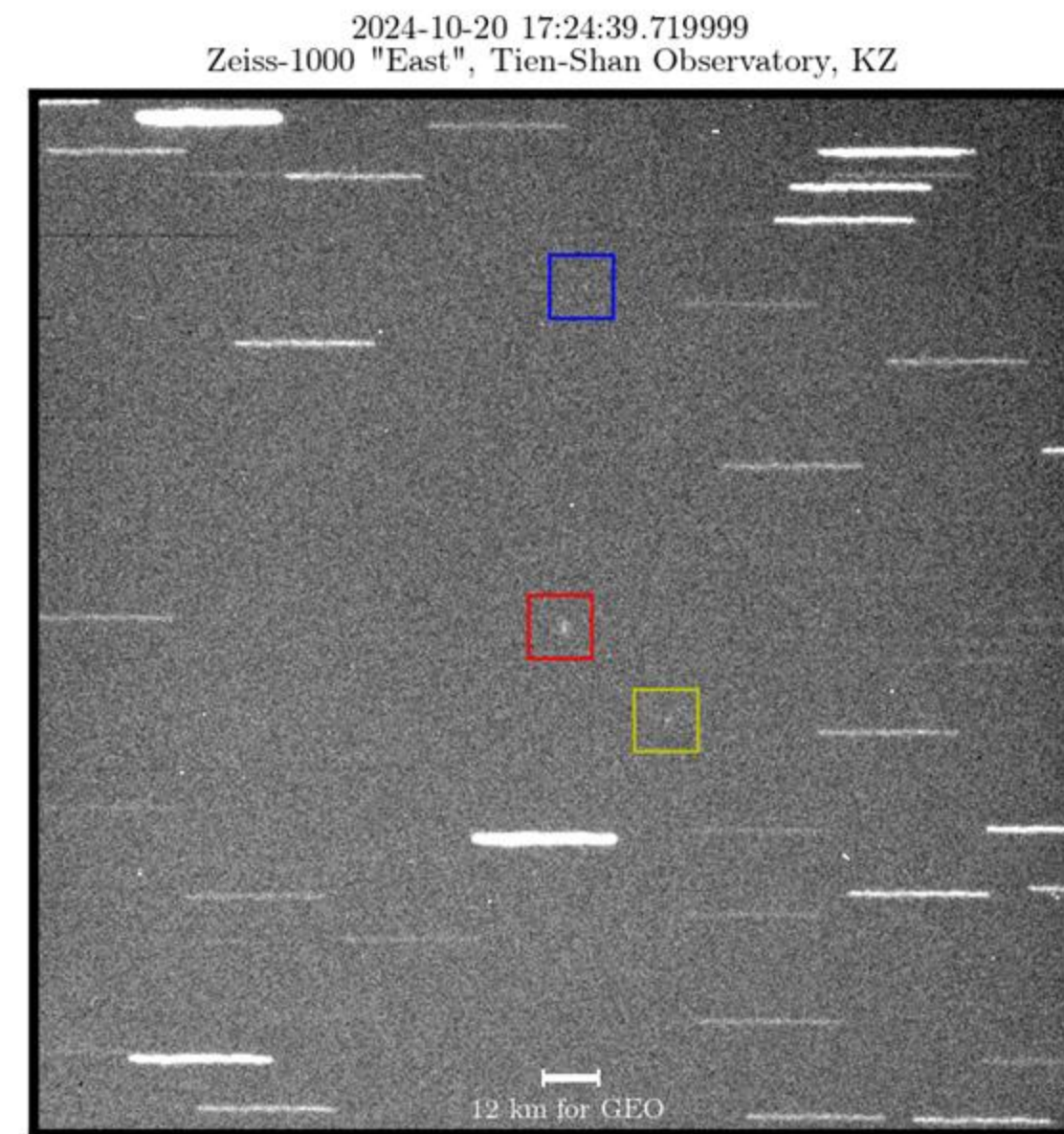
Current SST capabilities & Meteoroid impact

Deep Miss Events

- NME forecast for all GEO in catalog starting at 10 days before the event & observations

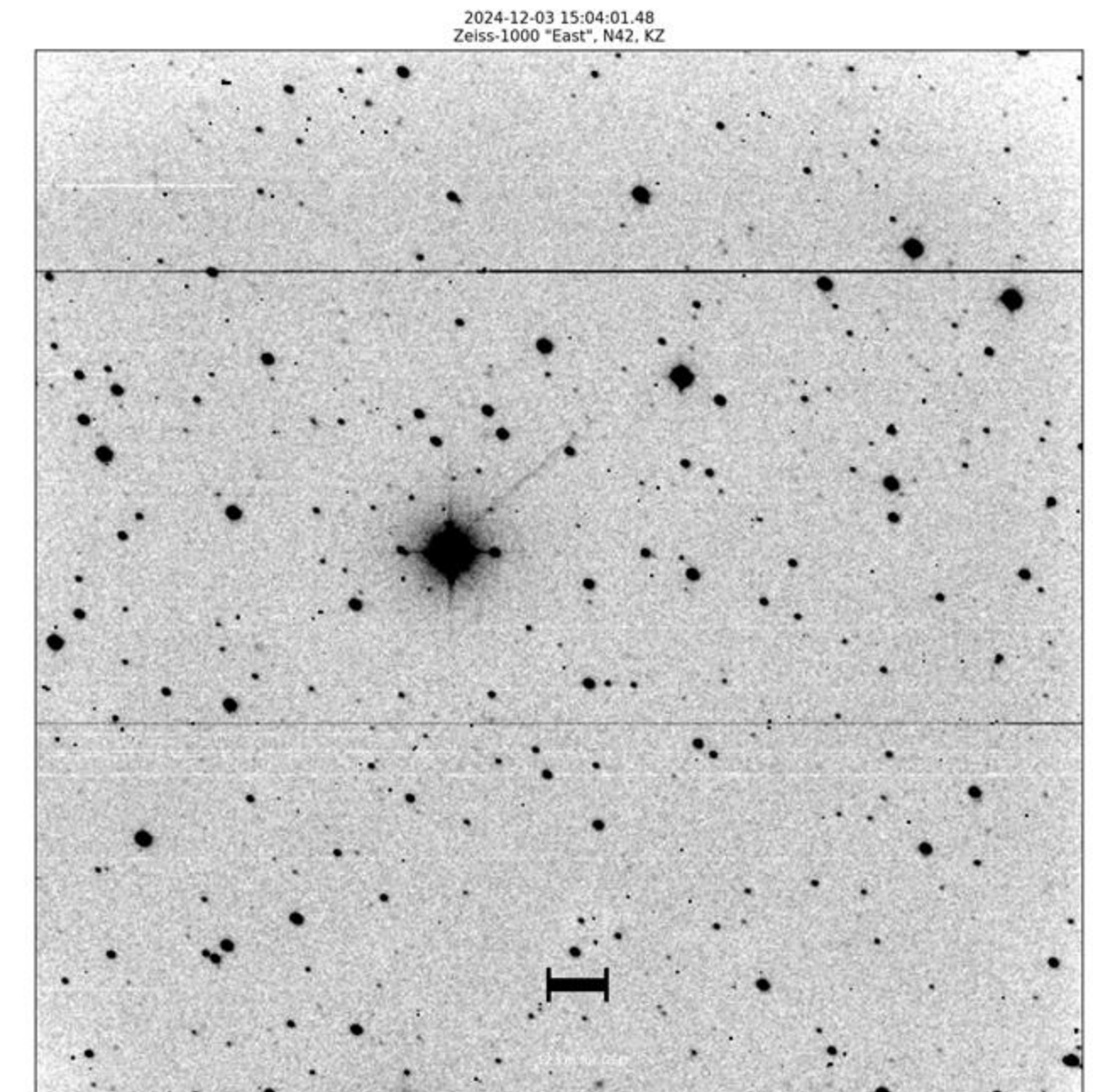


GORIZONT 2 (red) & INTELSAT 9 (PAS 9) (blue)
and unidentified space debris (yellow)
on Dec. 22, 2024



Intelsat 33e (red) and space debris (yellow, blue)
on Oct. 20, 2024 at ~17:25
(Destroyed 19 October 2024, ~04:30 UTC)

Observation of meteorite 2024 XA₁ (C0WEPC5) in collaboration with NEO Coordination Centre at ESA's Planetary Defence Office: 1 hour before the disintegration over eastern Siberia near the city of Olekminsk on 3 December 2024.

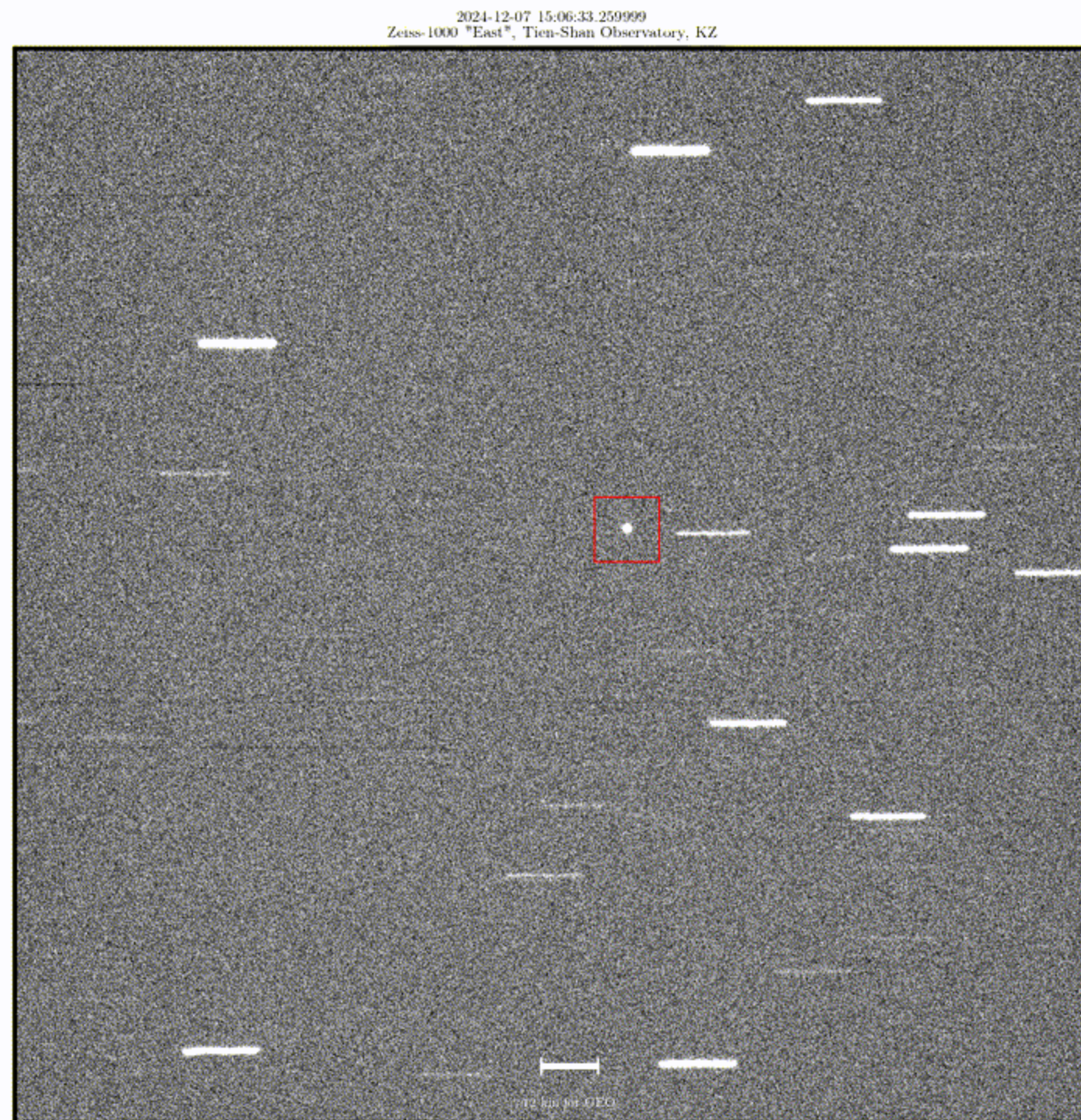


Current SST capabilities

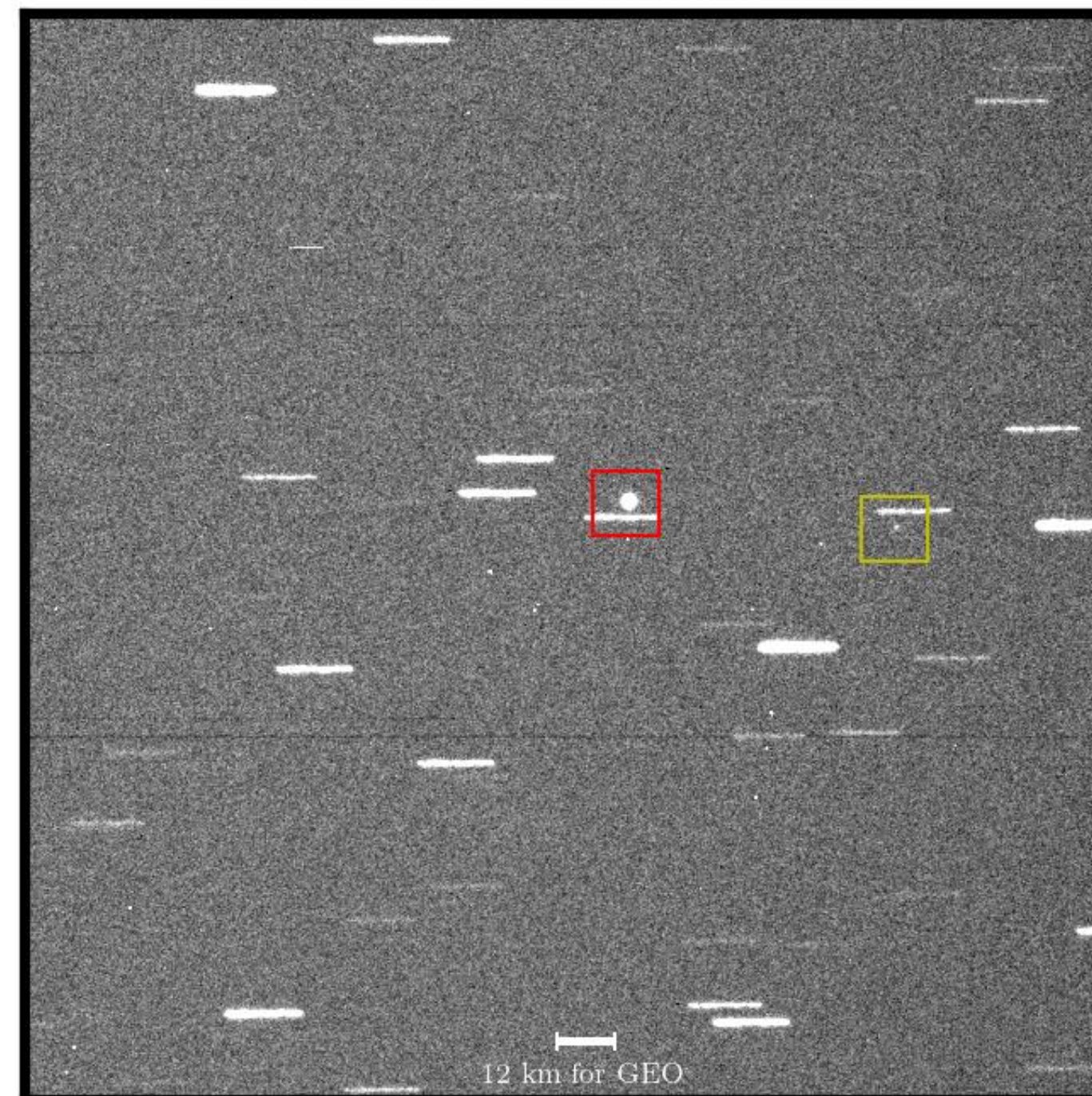
Deep Miss Events (KAZSAT case)

- Use RCSC data for KAZSAT satellites and TLE+FAI catalogs for other objects
- 10-days forecast with orbit propagation and RCSC data. In collaboration with Republican Center of Space Communication

KAZSAT-3 (red) & SL-12 R/B(2)



2024-11-03 17:19:48.789999
Zeiss-1000 "East", Tien-Shan Observatory, KZ

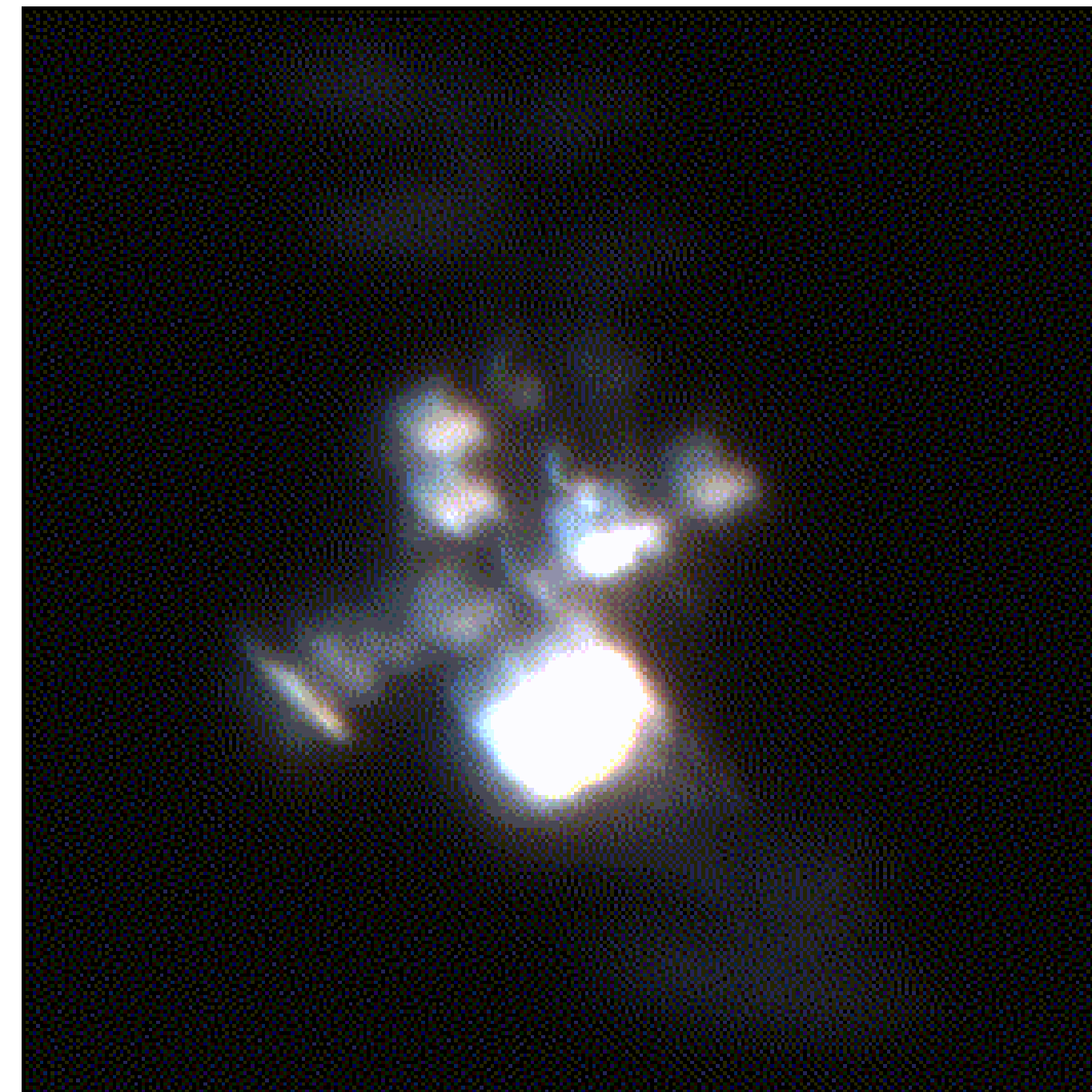


KAZSAT-3 (red) & unidentified space debris (after disintegration of Intelsat 33e) on Nov.3, 2024

Current SST capabilities



WFOS-40 on direct drive high-speed slewing (up to 50 deg/sec) with high-precision positioning and LEO monitoring

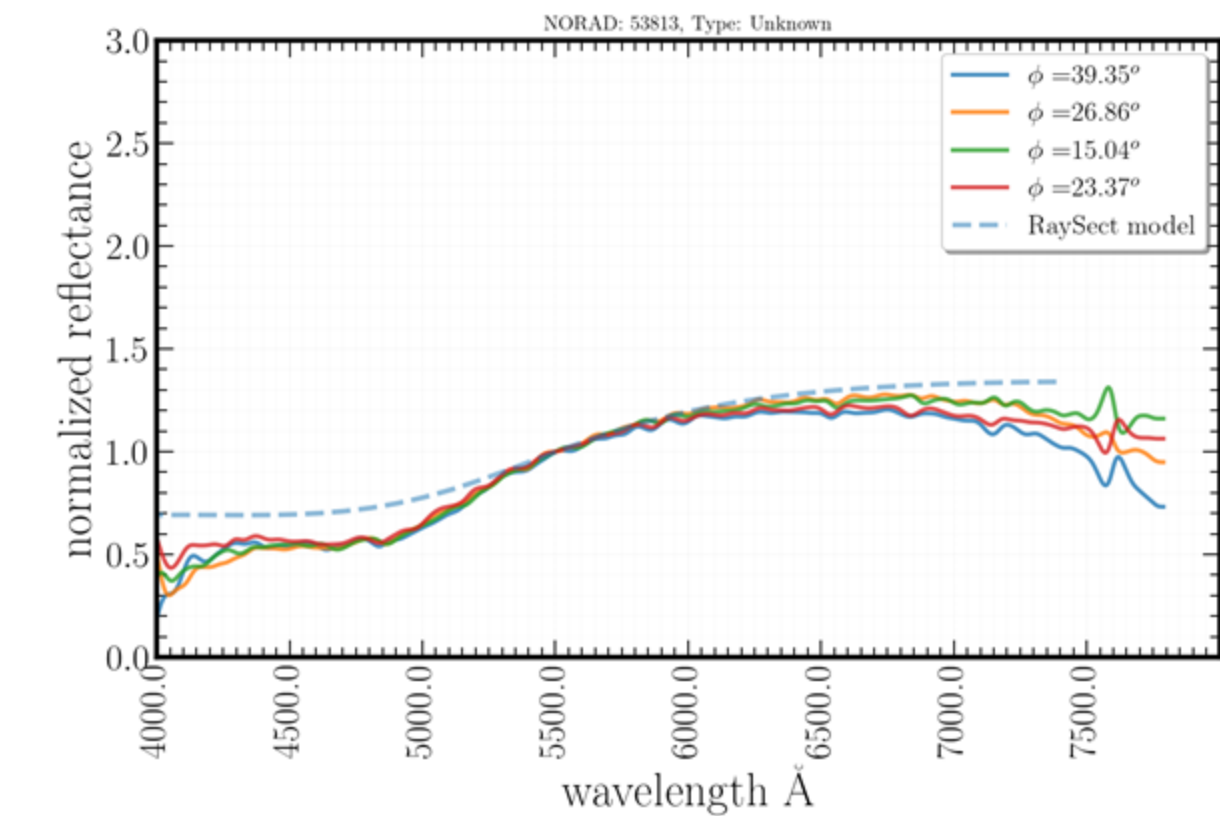
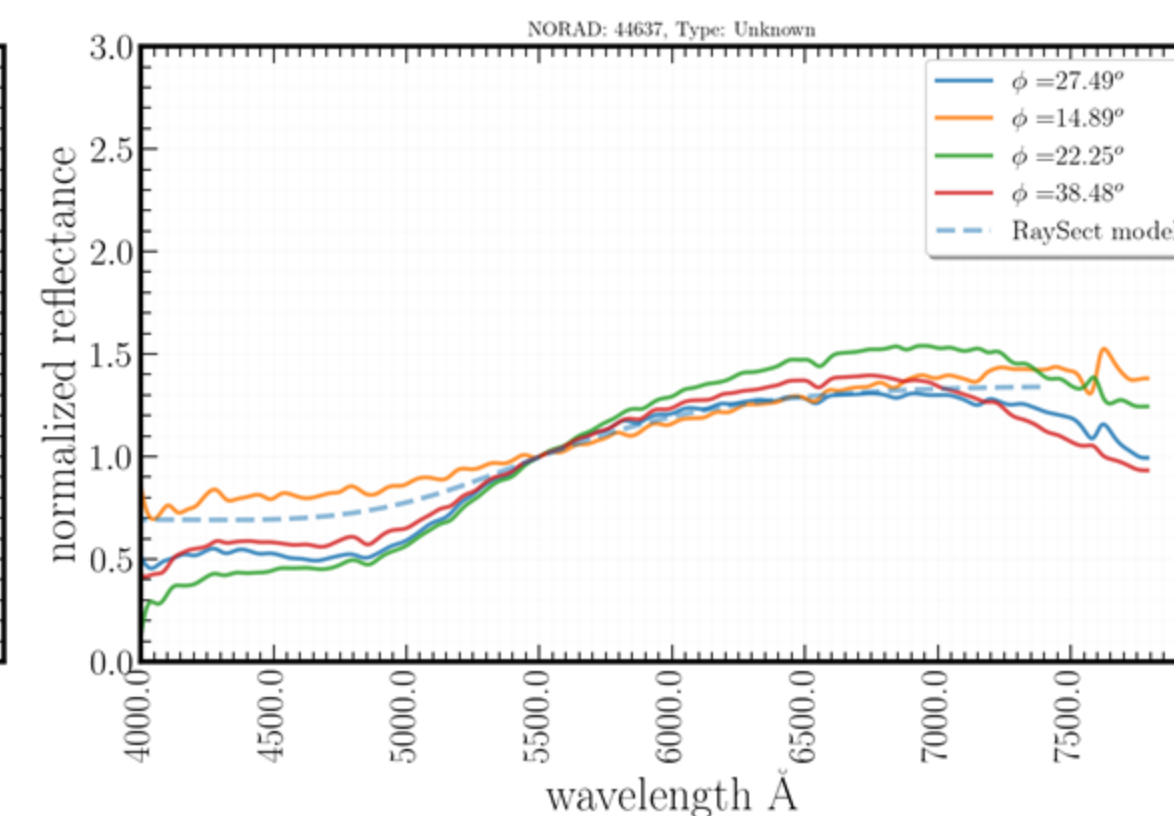
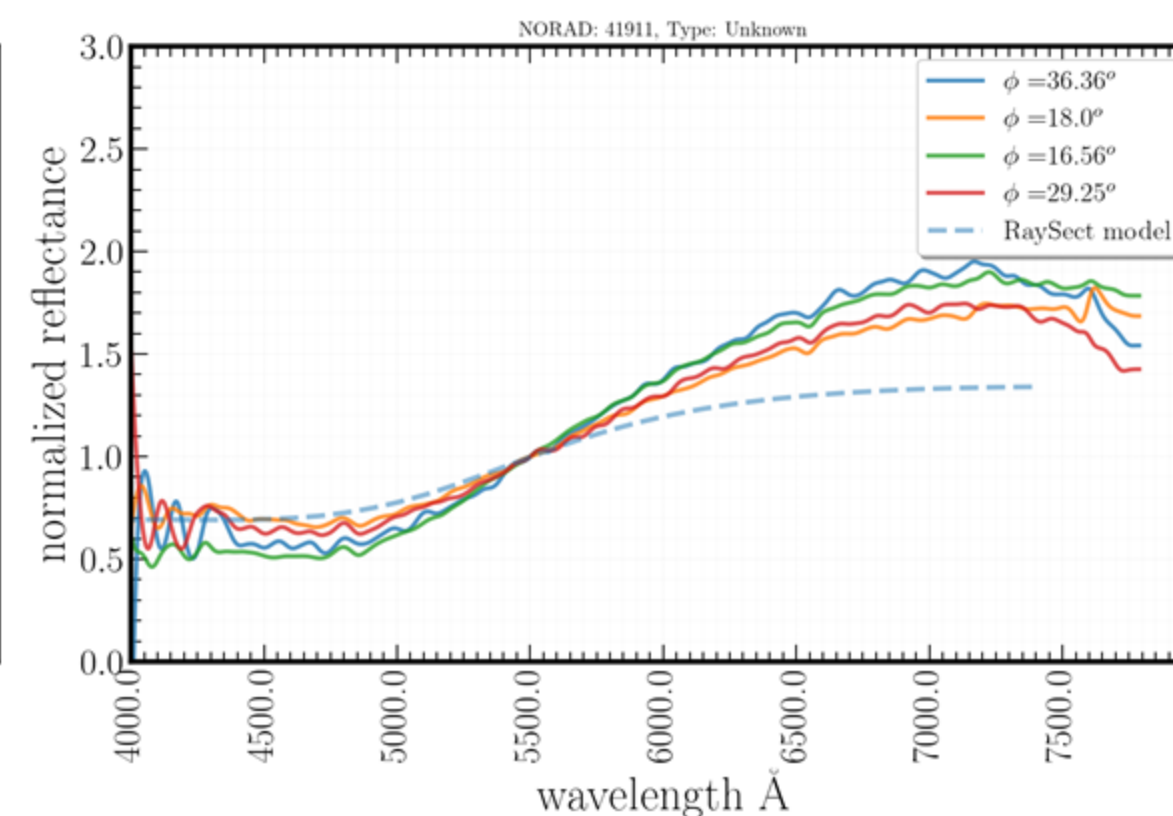
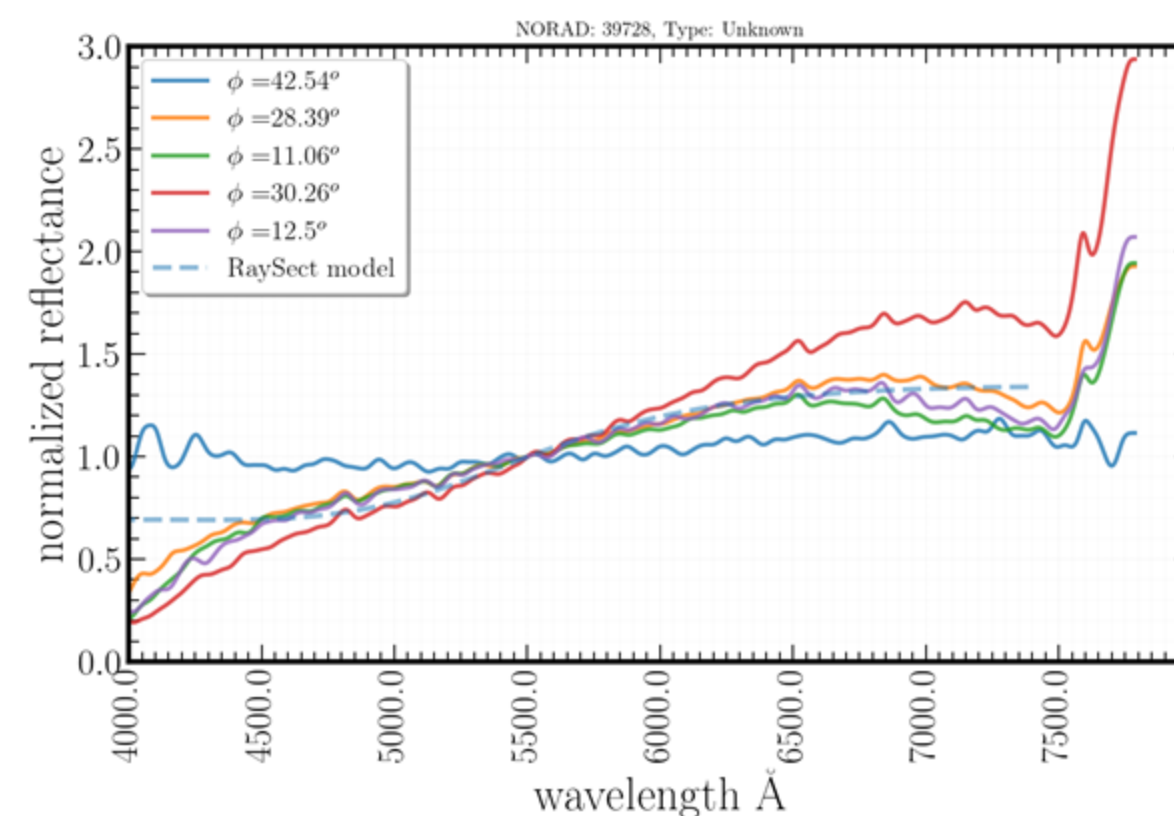


ISS observations on WFOS-40 at Assy-Turgen Observatory

Current SST capabilities

Satellite and asteroid spectroscopy

- Follow-up observations of asteroids: photometry (Zeiss-1000) and spectroscopy (AZT-20)
- Spectroscopy of GEO: identification, material science (AZT-20 spectroscopy)



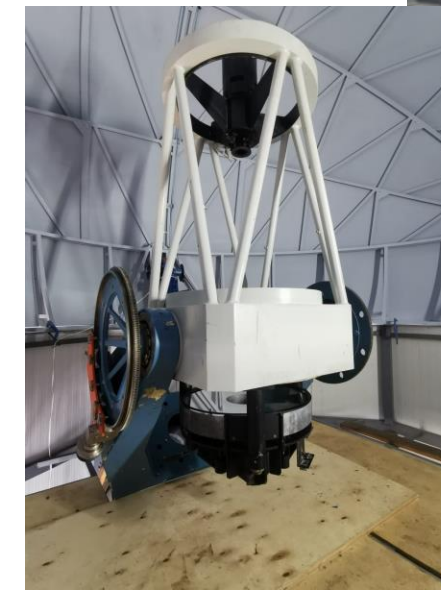
Reflection spectra - spectra of GEO satellites normalized by solar-like star spectra and flux at 550 nm

Ongoing projects

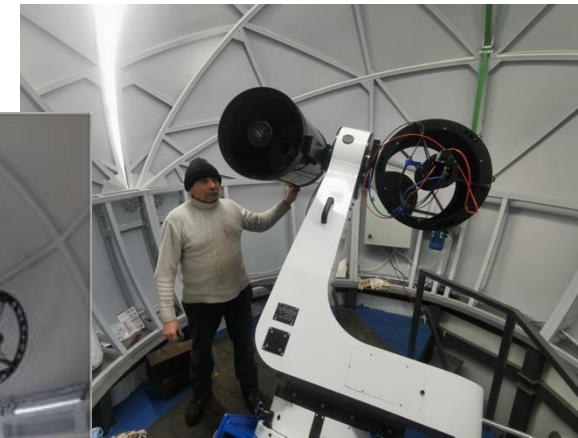
AstroHub

International collaboration on SSA and astrophysics

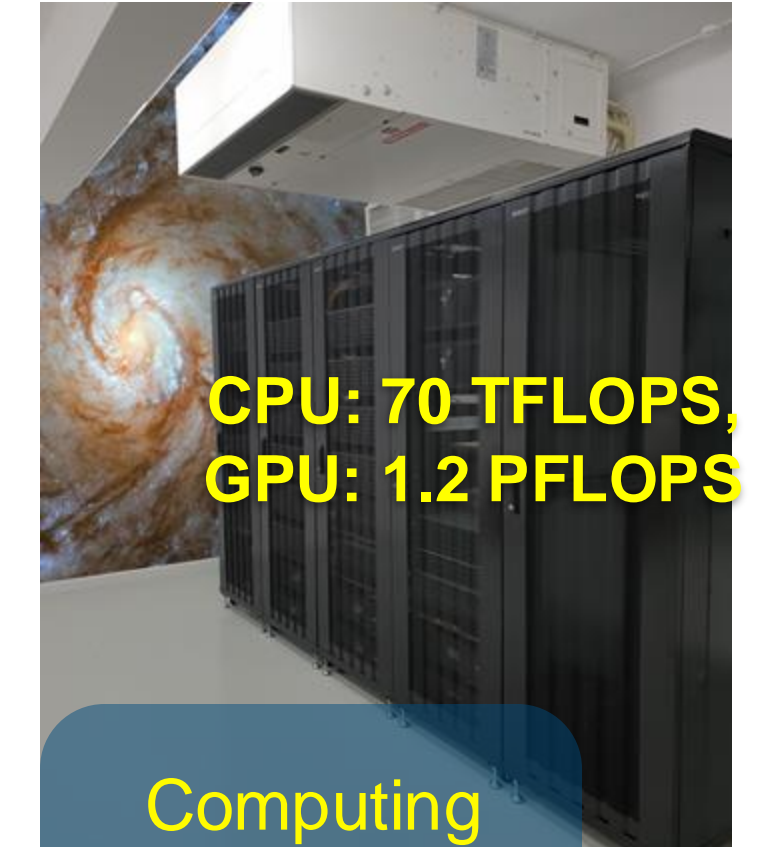
- One, unified ecosystem for small-aperture telescopes
- The opportunities for students and young researchers
- **Participation in international Campaigns:** IAWN, IOTA, APAON



SST: WFOS-40, WFOS-70, Zeiss-800, RC500



VO capabilities



CPU: 70 TFLOPS,
GPU: 1.2 PFLOPS

Computing power: ATO server, FAI cluster



Telescopes of AstroHub partners

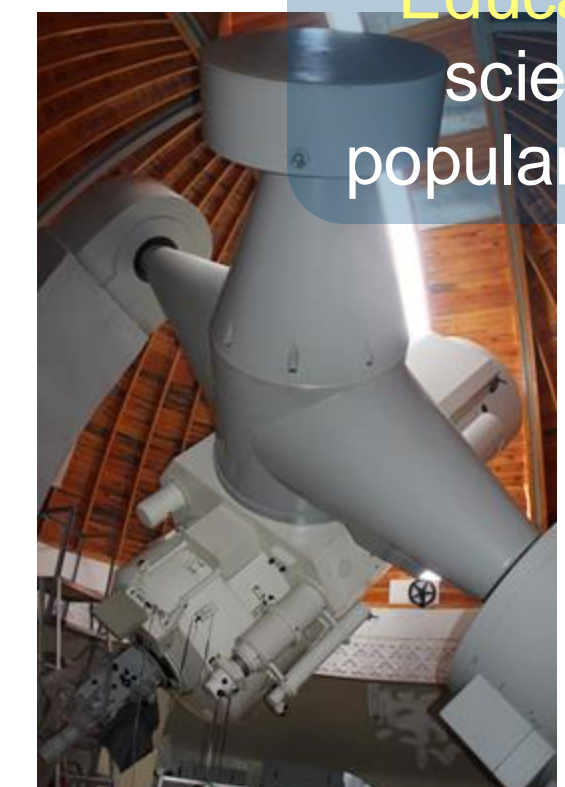
AstroHub
Data and knowledge sharing

Instruments developing, domes, automation

Education, science popularization



Assy-Turgen facilities:
control rooms, accommodation, labs, warehouse



Network of telescopes

Enhance the SSA capabilities

- Use **AstroHub** solutions, **SSA** knowhow on WFOS and **VO** capabilities
- Unfold **worldwide network** of optical sensors
- Use the network for **SSA**, **NEO** and observations



Pavilion and columns for new telescopes at the Assy-Turgen observatory



Column and pavilion for the WFOS-70 telescope at the Assy-Turgen observatory

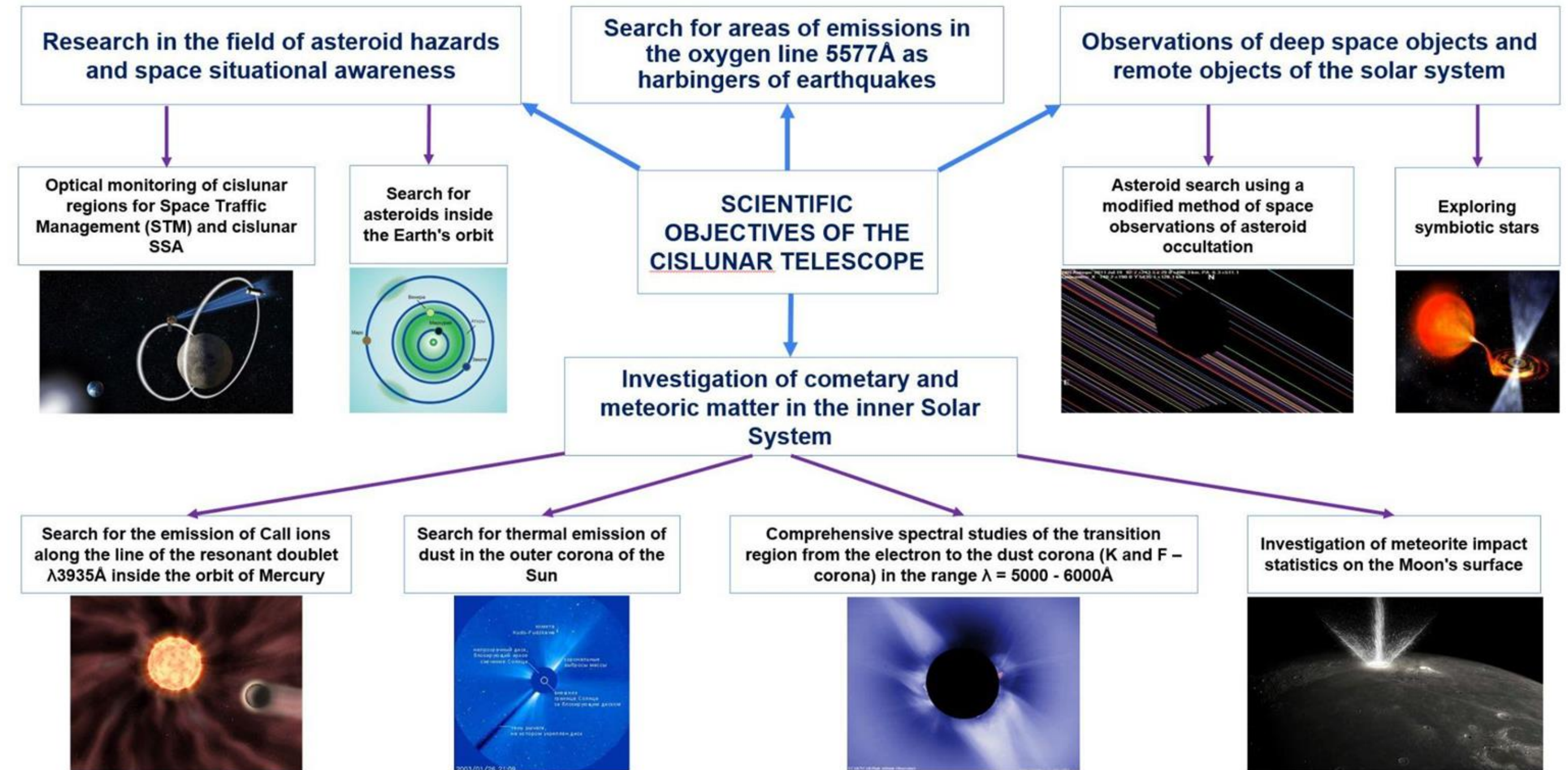
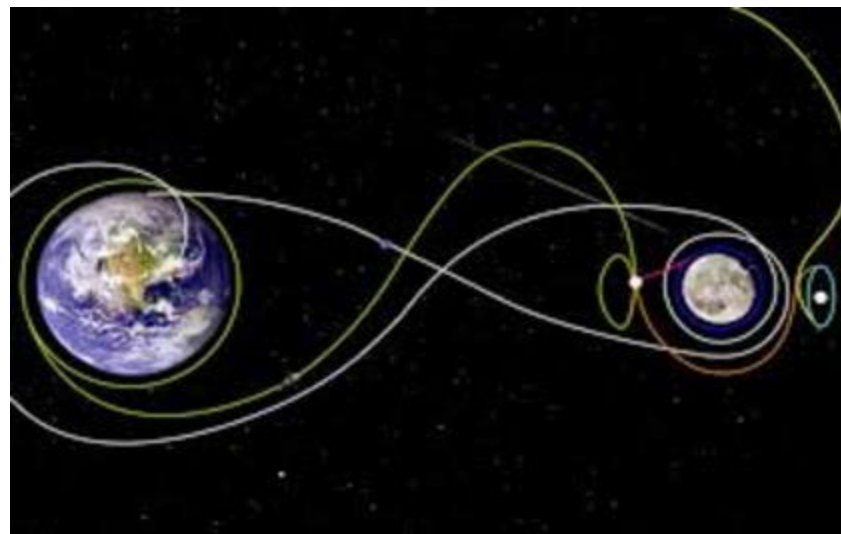


Prospects: up to 90 small telescopes up to 70 cm in diameter and up to 10 medium telescopes up to 1.2 m in diameter



The grinding process of the full-aperture field corrector for WFOS-70

The orbiting Cislunar Telescope



Thank you!

