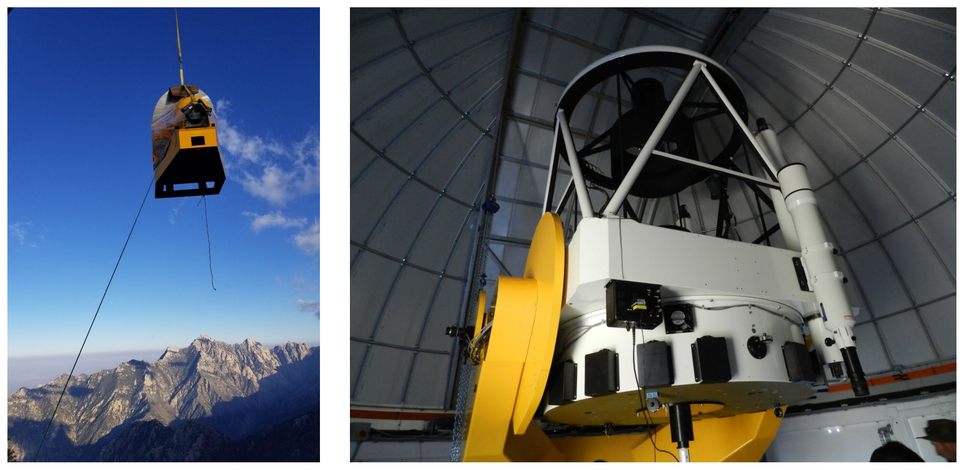
Transneptunian Automated Occultation Survey (TAOS II)

TAOS II is a next generation occultation survey with a goal of measuring the size distribution of the small end (diameters between 0.5 and 30 km) of the Kuiper Belt. The project is a collaboration between the Academia Sinica Institute of Astronomy and Astrophysics, the Universidad Nacional Autónoma de México, and the Harvard-Smithsonian Center for Astrophysics, The survey will operate three telescopes at San Pedro Mártir Observatory in Baja California, México. Each telescope will be equipped with a custom camera comprising a focal plane array of CMOS imagers. The cameras will be capable of reading out image data from 10,000 stars at a cadence of 20 Hz. The telescopes will monitor the same set of stars simultaneously to search for coincident occultation events while minimizing the false positive rate. This poster describes the project and reports on the progress of the development of the survey infrastructure.

Telescopes

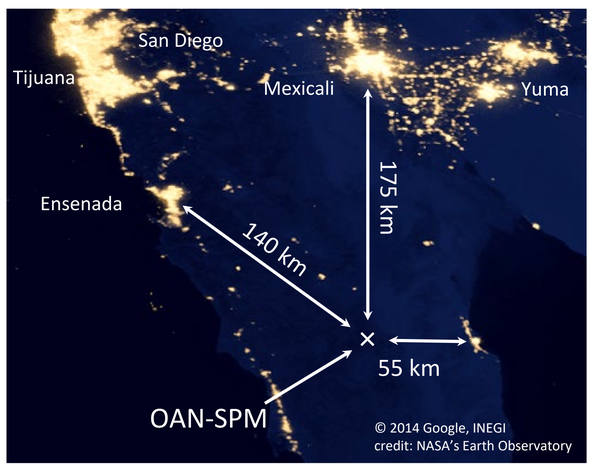
- Three telescopes manufactured by DFM Engineering
- F/4 modified Ritchey–Chrétien design, 1.3 m primary mirror, Single Schmidt corrector plate.
- 1.7 degree field of view onto a 154 mm diameter circle at focal plane.
- 80% of the enclosed energy in a circle of 0.8” on axis, 1.0” at the edge of FOV.
- Telescopes delivered 2013 November, installed 2017 September.

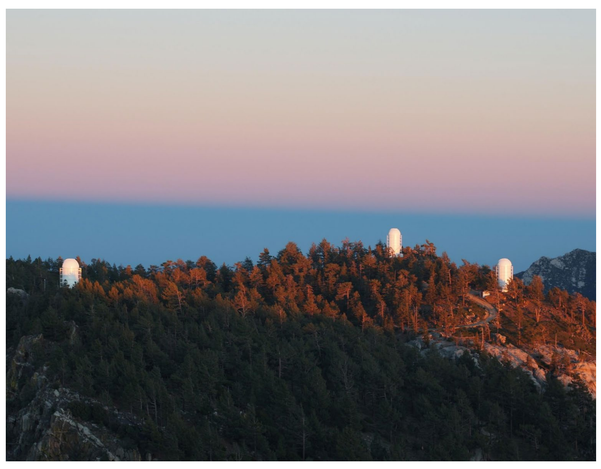


Left: Installation of telescope pedestal at Site #2. Right: Telescope at Site #2 after installation completed.

Site

- San Pedro Mártir Observatory (SPM) in Baja California, México (31.0439˚ N, 115.4637˚ W, 2900m elevation).
- Nominal seeing 0.6”, sky brightness of V = 21.5 mag/arcsec^2 at new moon.
- Light pollution ordinance now in effect for Baja California, so the site will remain dark.
- 270 clear nights per year.





Left: Sky brightness map of SPM (center cross). Right: Three TAOS II enclosures at SPM after completion of construction.

- Telescopes installed on a previously undeveloped ridge at SPM.
- Telescopes separated by 266 meters, 129 meters, and 323 meters.
- Separations large enough scintillation will not affect all telescopes simultaneously, limiting false detections.

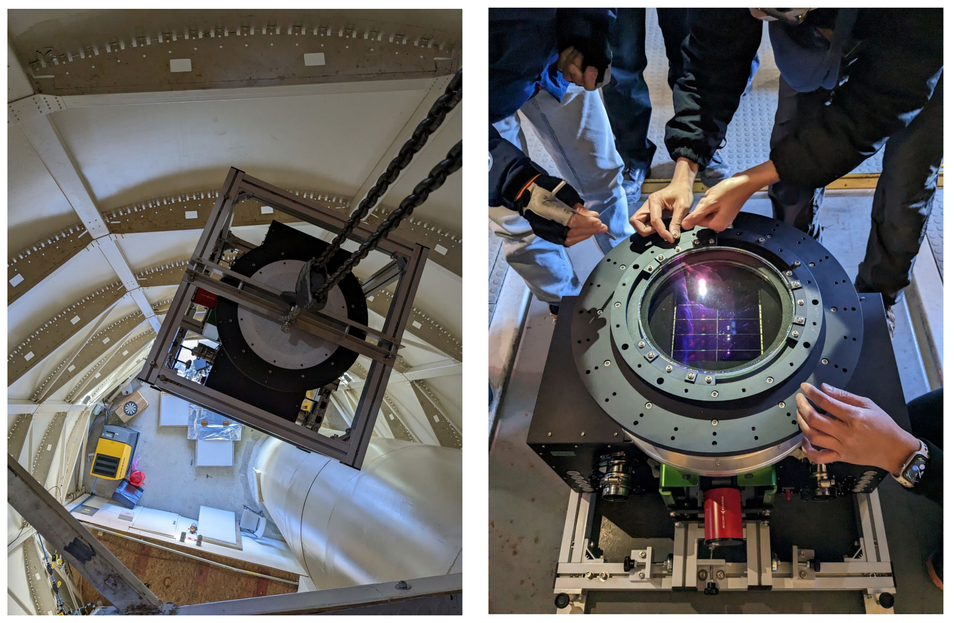
Left: Ring beam installation on enclosure at site #2 on 2016 September 15. Center: Installation of dome at Site #2 2017 August 8. Right: Enclosure at Site #1 after construction complete.

Site development timeline:

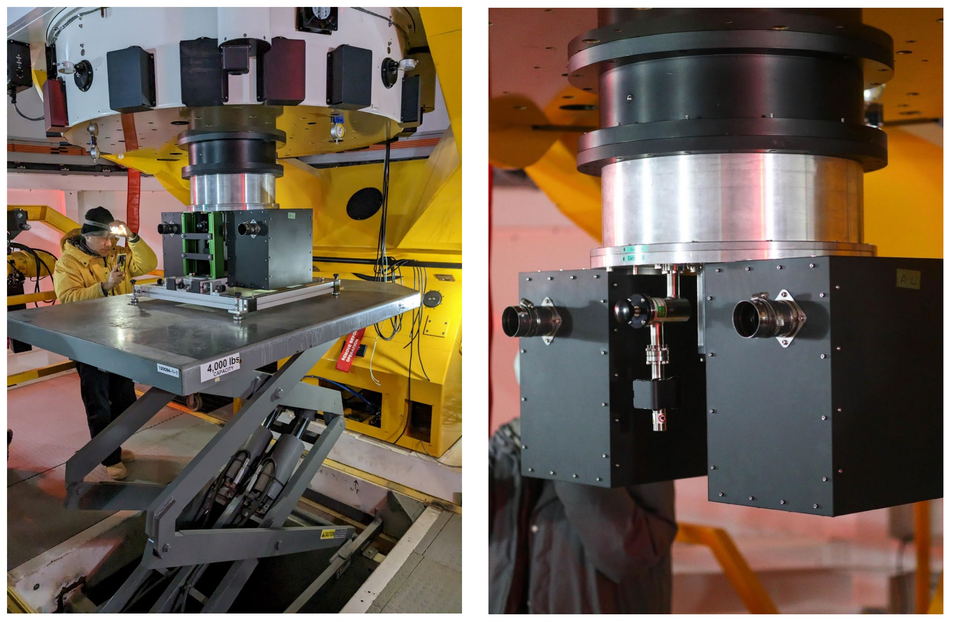
- Groundbreaking at SPM on 2013 May 2.
- Construction of the access roads and installation of electrical and networking lines commenced on 2013 September 23.
- Foundations completed 2015 October.
- Telescope piers installed 2015 November.
- Enclosure construction began 2016 September, completed 2017 April.
- Enclosures topped with 7.4m Ash domes in 2017 August.
- Telescopes installed 2017 September.

Cameras

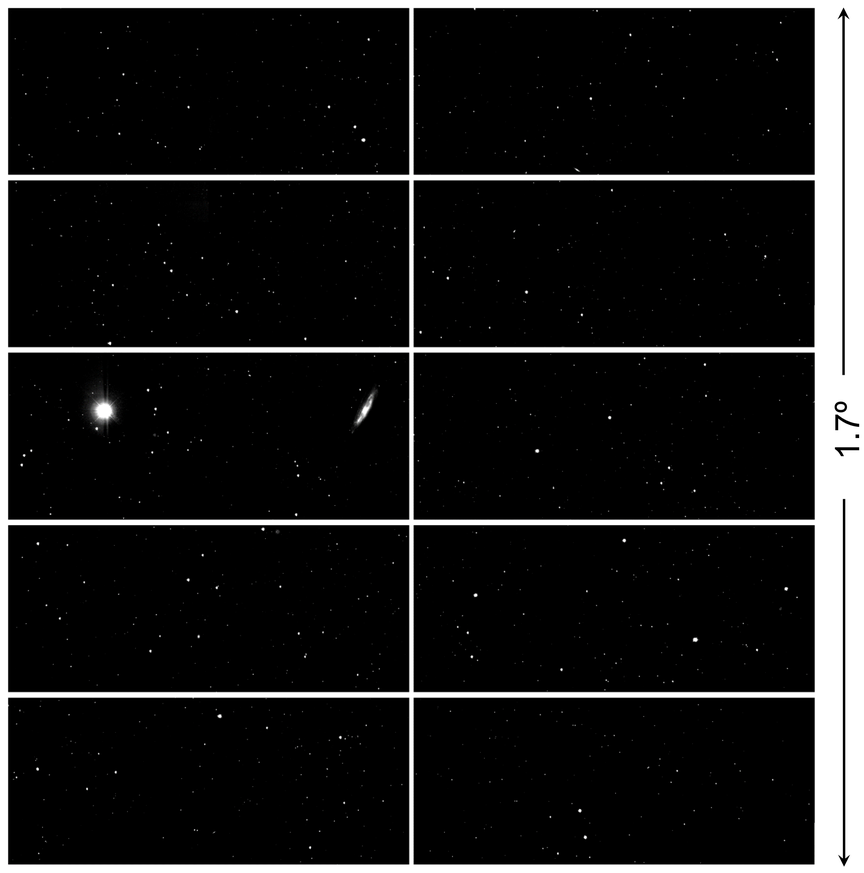
- Readout on >10,000 stars at 20 Hz. Only achievable by reading out small windows around each star.
- Custom CMOS imagers from e2v.
- Focal plane a 2×5 array (3-edge buttable) of 1920×4608 pixel imagers with 16μm pixels (31mm×74mm)
- Back illuminated (entire pixel photo-sensitive)
- QE as good as science grade CCDs
- On-board correlated double sampling (read noise 2.7 e$^-$)
- Cameras installed 2023 March



Left: Site #1 camera being lifted to observing floor. Right: Preparing to mount camera at Site #1.



Left: Installation of camera at Site #1. Right: Camera at Site 1 after installation completed.



Test image of M98 from Site #3.

Remaining tasks:

- Recharge coolant lines.
- Recoat mirrors.
- Maintenance of mirror supports, telescope drive systems and domes.
- Finish software for automated observations.
- Survey projected to start Spring 2024.

中央研究院
天文及天文物理研究所
ACADEMIA SINICA
Institute of Astronomy and Astrophysics

Universidad Nacional
Autónoma de México

Center for Astrophysics |
Harvard & Smithsonian