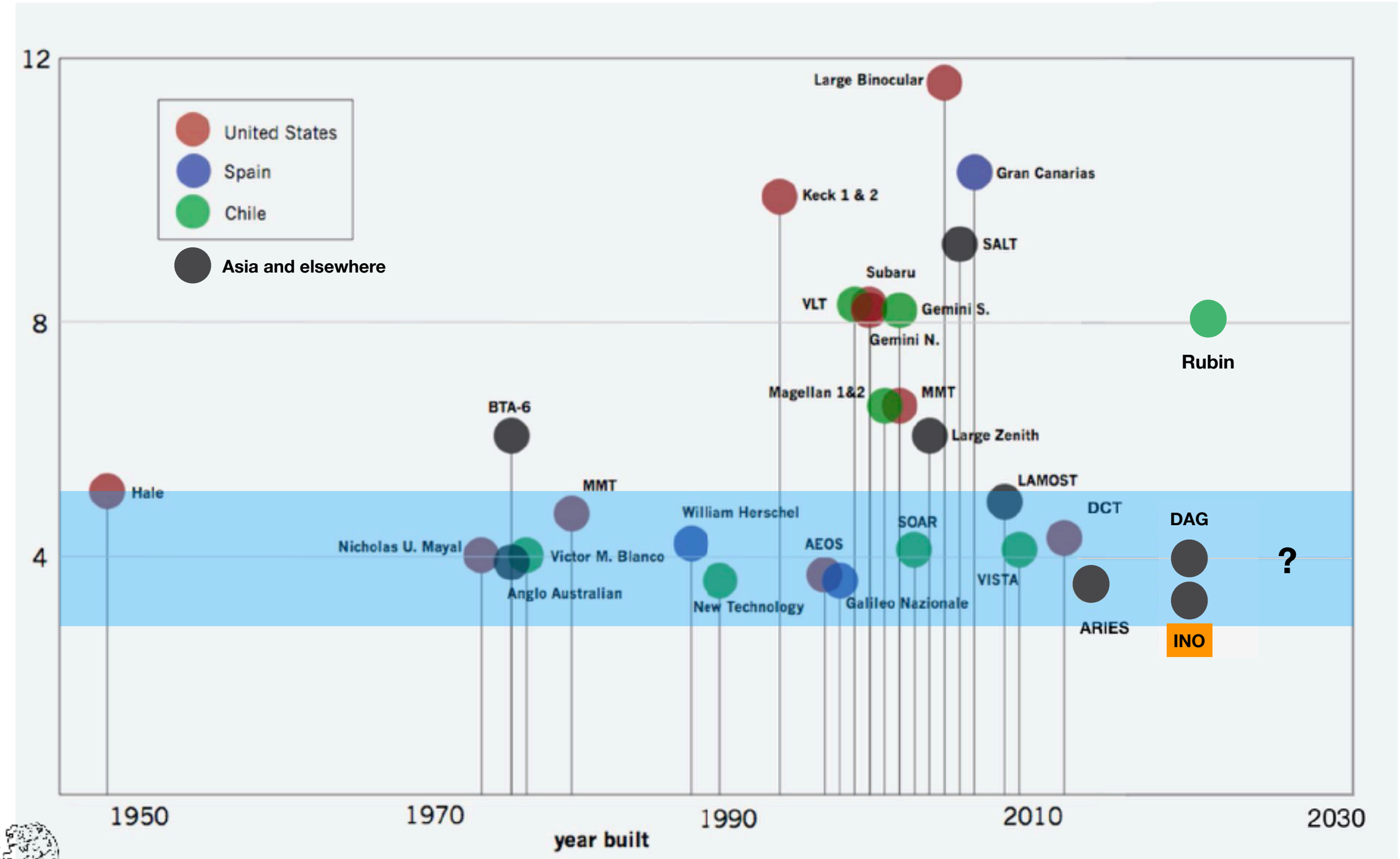
Iranian National Observatory

Habib Khosroshahi

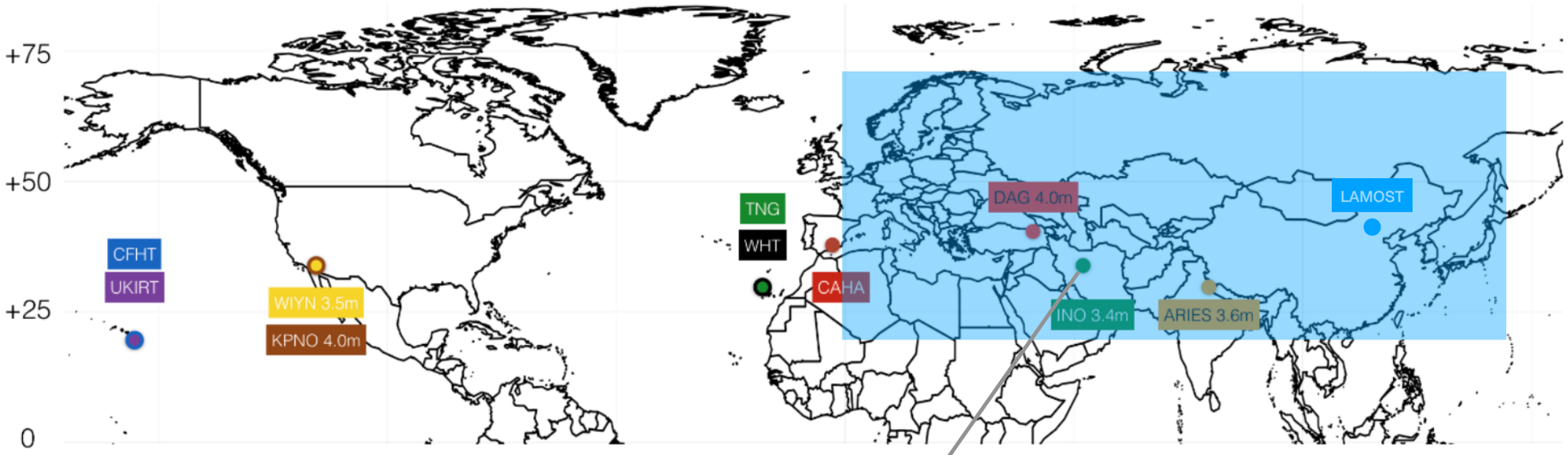
M.Bidar, H.Jenab, R.Ravanmehr, M.Mohajer, S.Saeidifar, F.Ghaderi, A.Jafarzadeh, R.Shomali, A.Javadi, H.Shalchian, Shokatpour, Behnam, A.Mirhaj, Z.Azizi, M.Rostamian, R.Sadeghi, A.Gholami, S.Fatemi, H.Altafi, E.Saremi, N.Nouri, and **many other** present and past colleagues

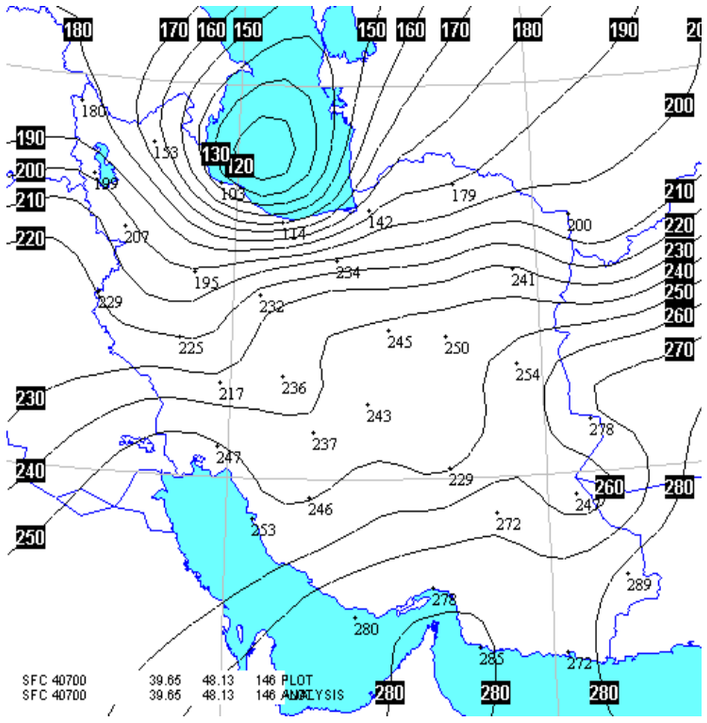
4m telescope race



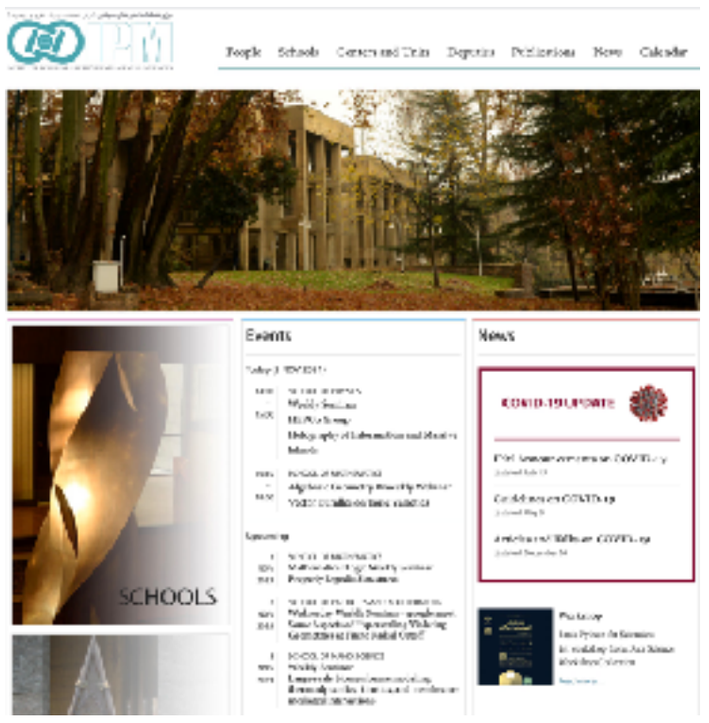
Source: wikipedia

The site





Nasiri, Darudi, Khosroshahi, Sarazin, 2019, MNRAS



INO headquarter @IPM

Science with 4m telescopes

Galactic

Exoplanets

Microlensing

Stars
Magnetism is WDs
Pre-MS stars
ISM
Metalicity

Solar system
Planetary studies to surveys

Extra-galactic

Galaxy
Dwarfs to giants morphology, star formation, metallicity, Kinematics, Environment, Dark matter, LSBs
Gravitational lensing

AGNs & Quasars
Environments and hosts
AGN varibility

INO operation modes

Regular observing time

Astronomers can apply to this in one of the following modes by submission of Phase I (and Phase II) proposals.

Visiting

The visiting mode will allow training of new observers.

Service

Mostly dedicated to programs requiring short exposures over many nights

Large/Survey programs

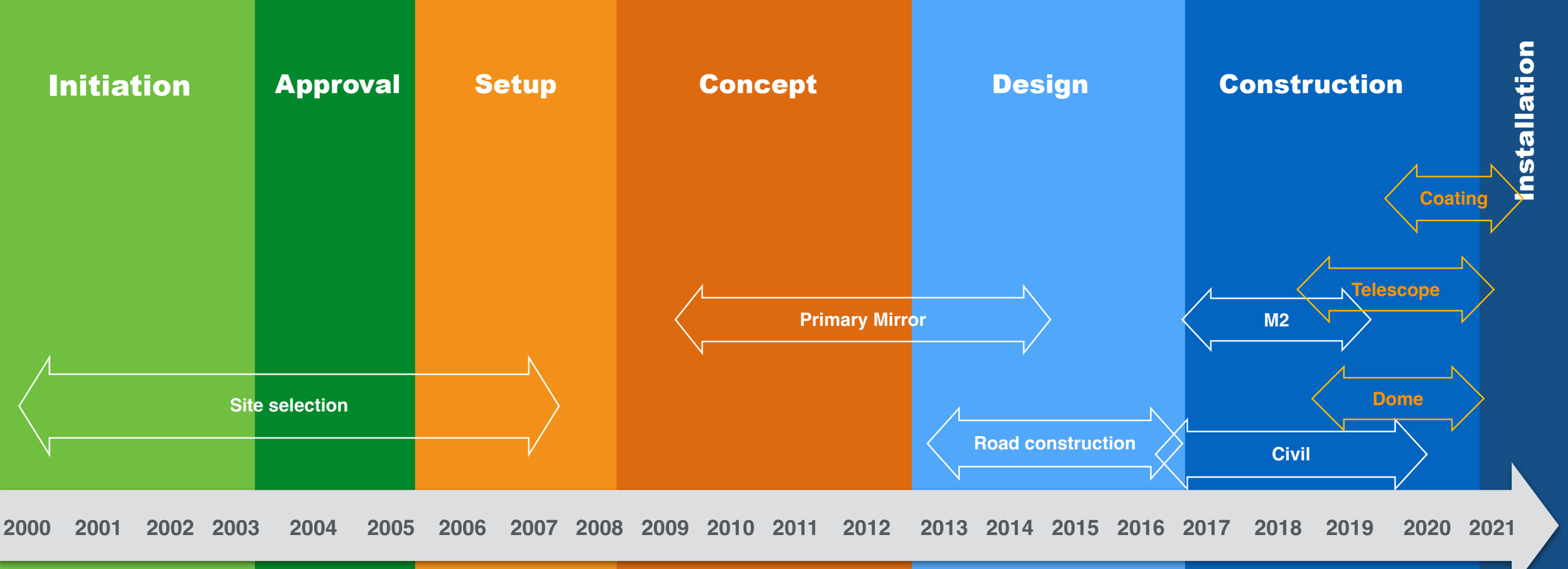
These will be set up by the INO in collaboration with the community of astronomers with international presence.

The surveys will be conducted by students assigned to these programs.

Guaranteed time

Target of opportunity

INO is likely to adopt a conditional “open sky” policy. A condition that engages the local community.



2001: Site selection studies begin

2003: 4 sites selected for long term monitoring

2004: Cabinet approves the project

2004: Parliament allocates budget code

2006: IPM hosts INO project

2007: Site selection concludes with Gargash and Dinava

2008: Site monitoring begins in Gargash and Dinava

2009: Vice-presidency for Science and Technology provides financial support

2009: Primary mirror ordered

2012: Conceptual design approved

2012: Road construction begins

2013: Detail design begins

2014: Primary mirror is delivered to INO

2016: Detail design complete

2016: Secondary mirror ordered

2016: Road construction complete

2017: Science operation begins at the site

2017: Enclosure and site construction begins

2017: Enclosure and site construction begins

2018 Telescope construction begins

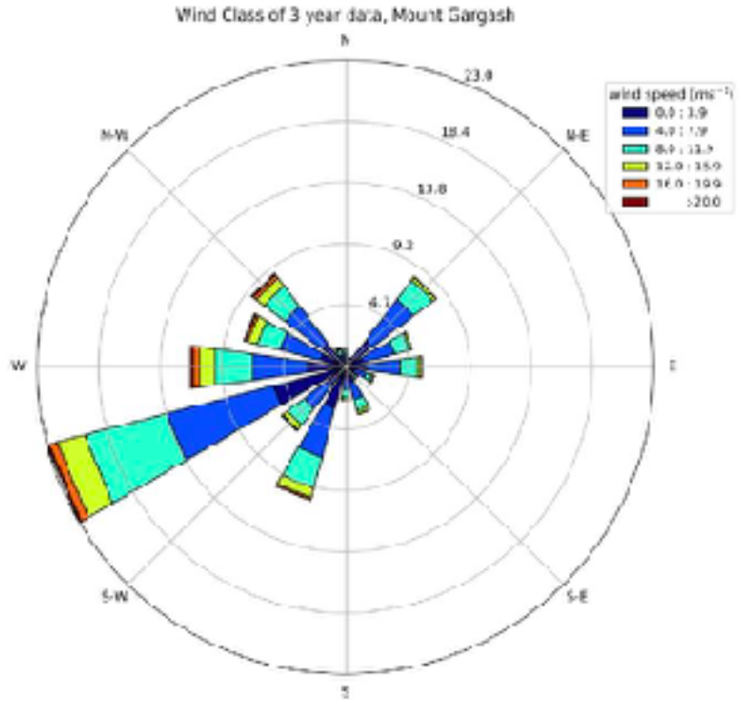
2020 Dome installed

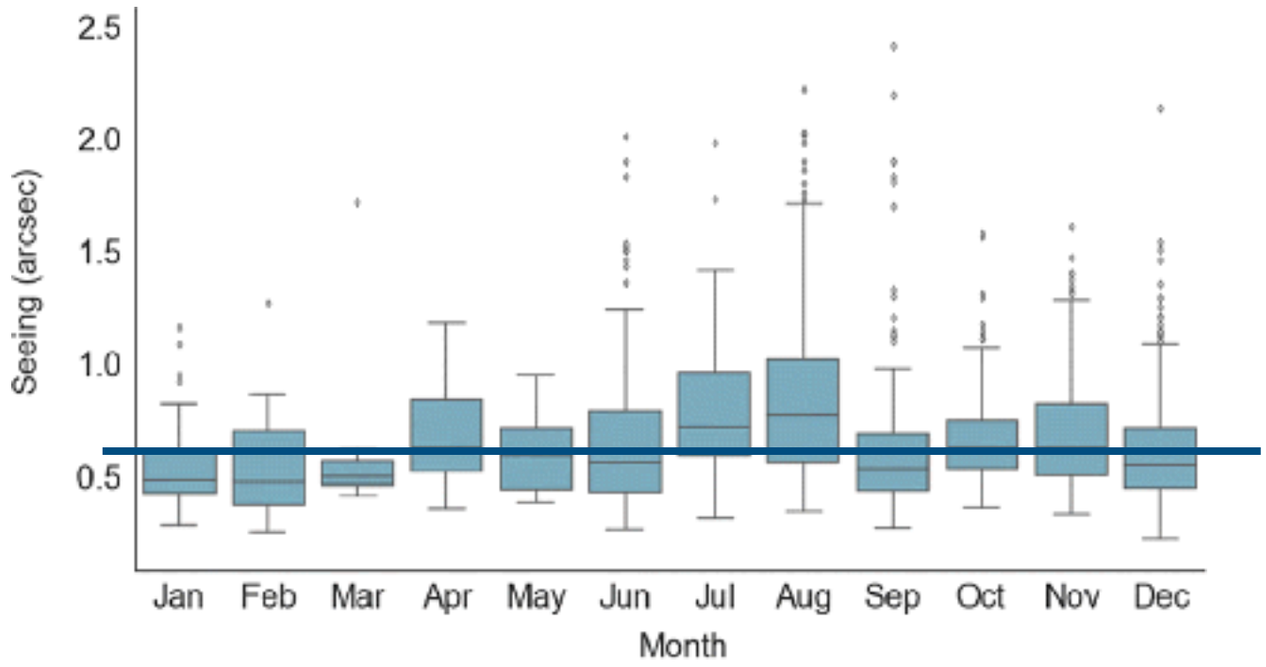
2020 Telescope assembled

2021 Telescope installed at the site

Site properties

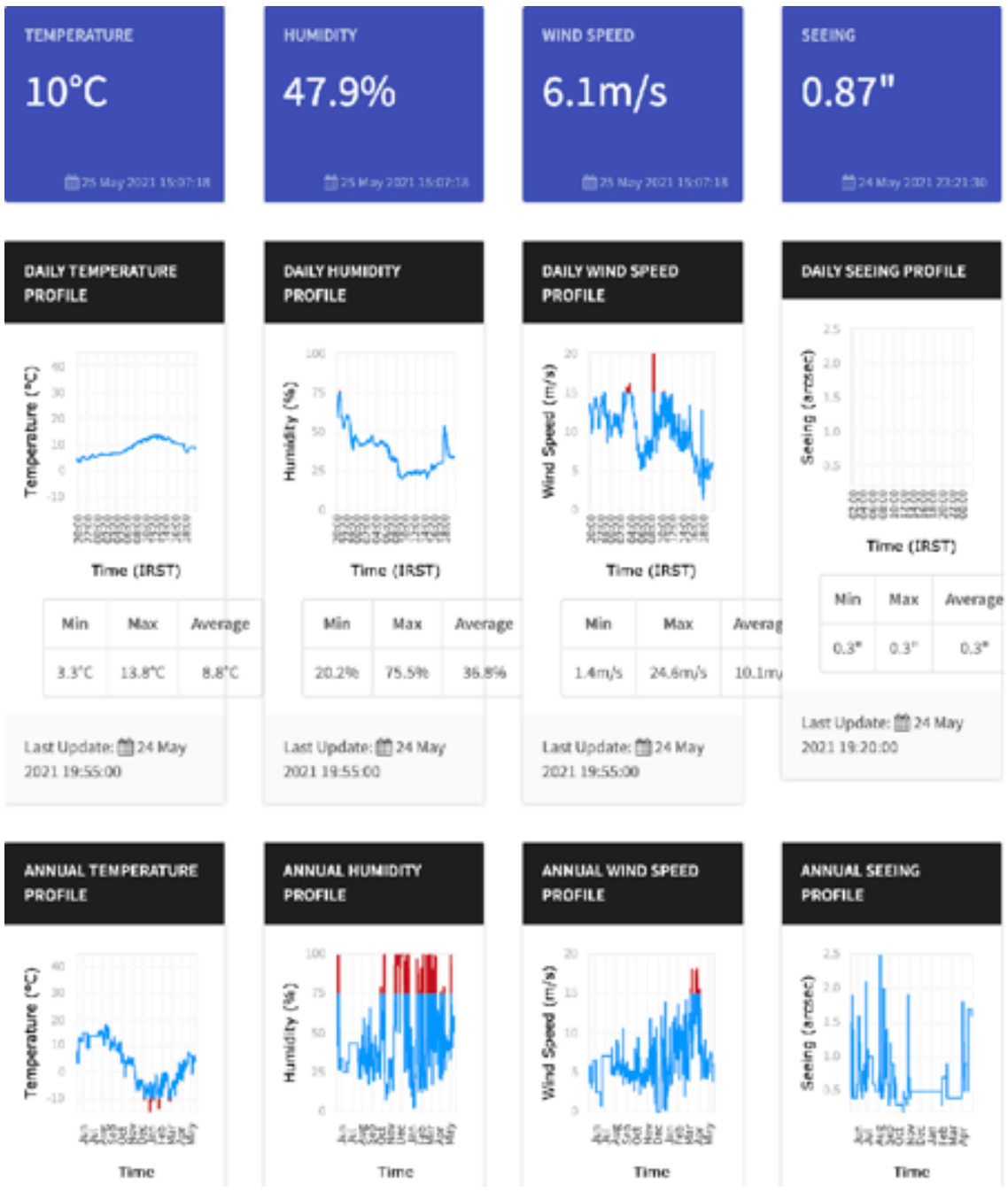
Seeing	25%	50%	75%	Median
Dinava	0.60” (0.09)	0.74” (0.09)	0.91” (0.09)	0.73” (0.09)
Gargash	0.54” (0.04)	0.67” (0.04)	0.89” (0.04)	0.68” (0.04)

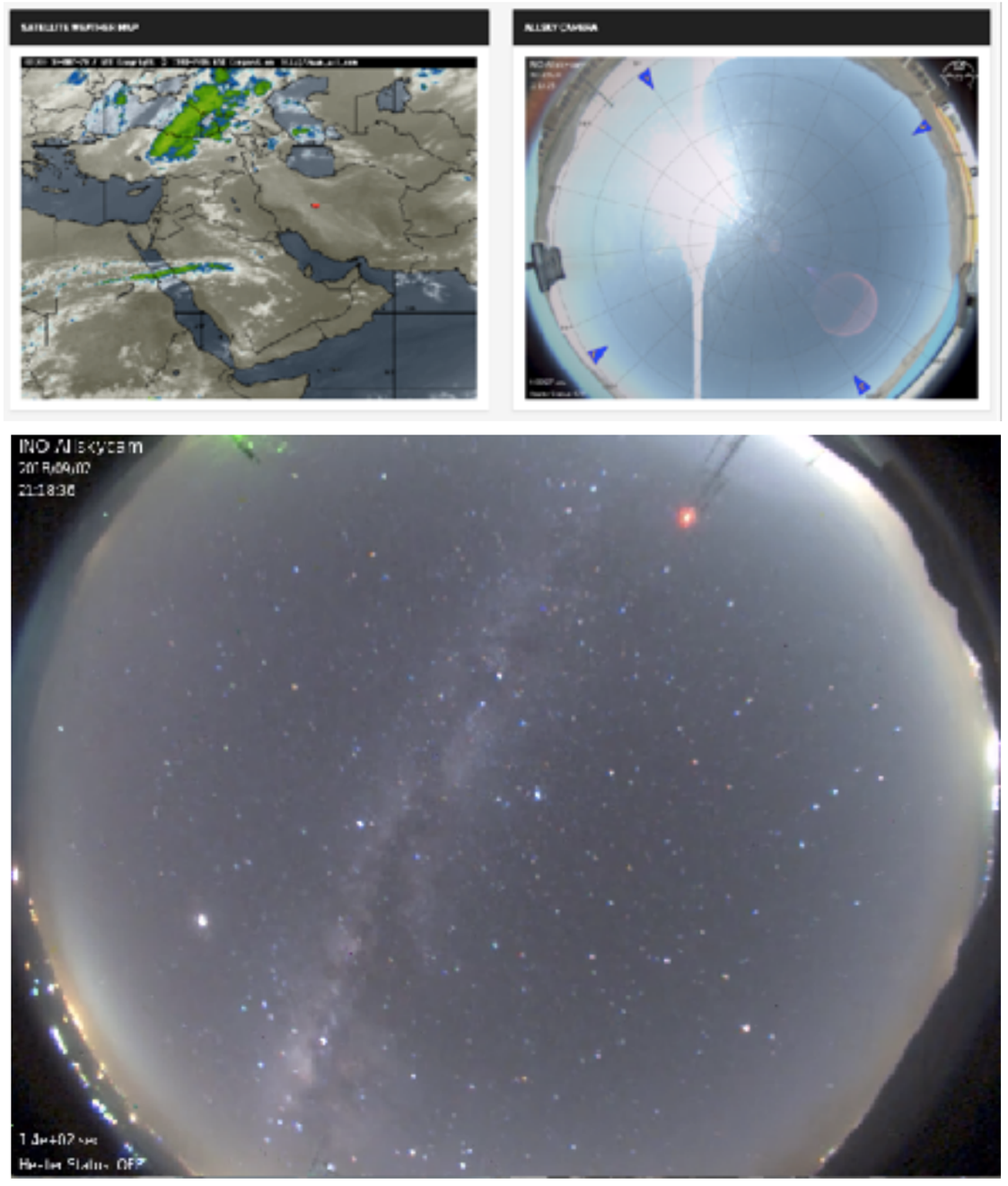




Danesh et al 2019

Online data

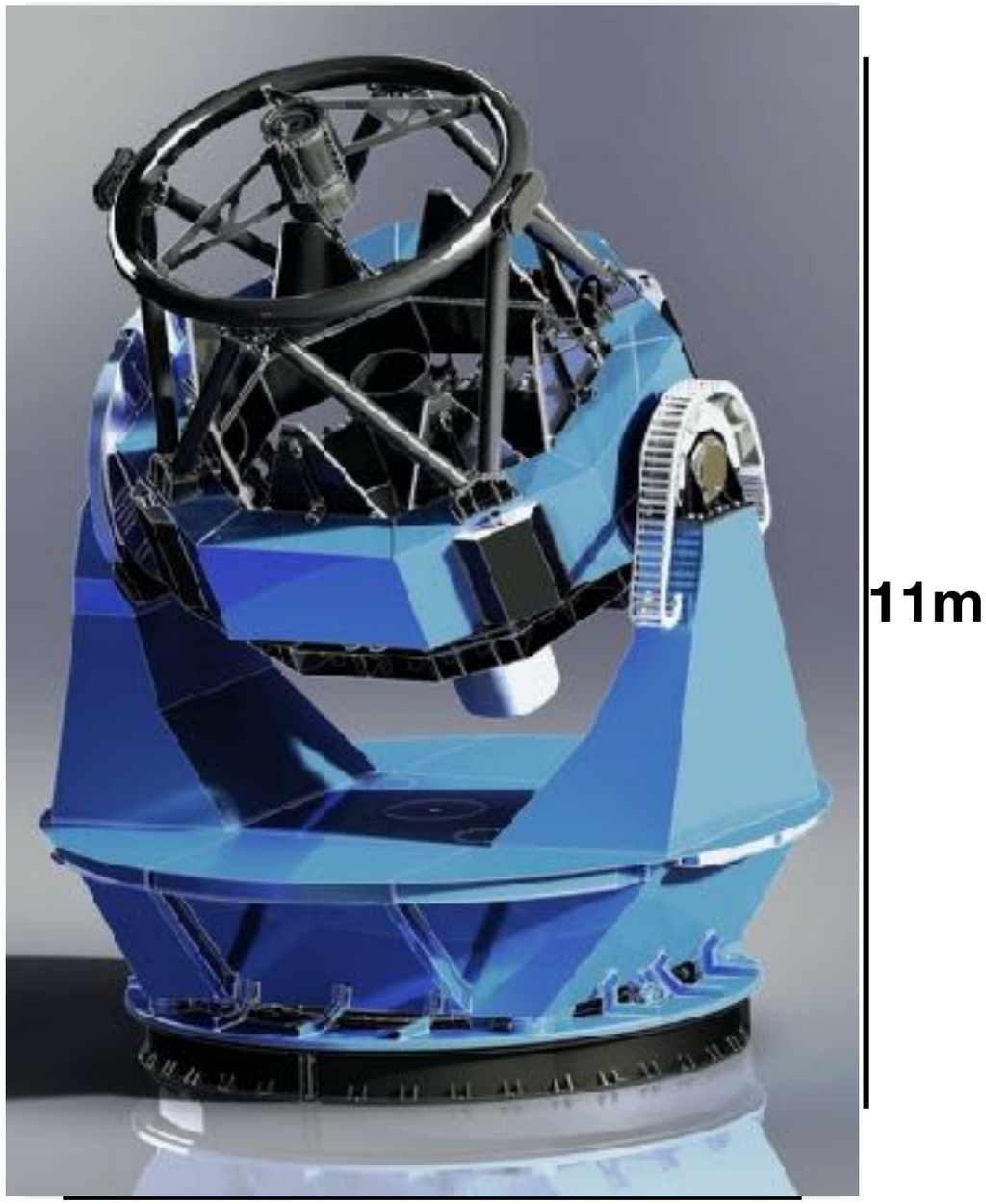




www.ino.org.ir

The telescope

Optics	Ritchey-Chrétien
Wavelength	325-2500 nm
M1 diameter	3400/700 mm
M1 f-ratio	f/1.5
Telescope f-ratio	f/11.36
Mount	Alt-Az
Guided tracking accuracy	0.2 arcsec
Field of view	8-20 arcmin
Structure weight	90 T



Telescope specifications

Mirror Cover

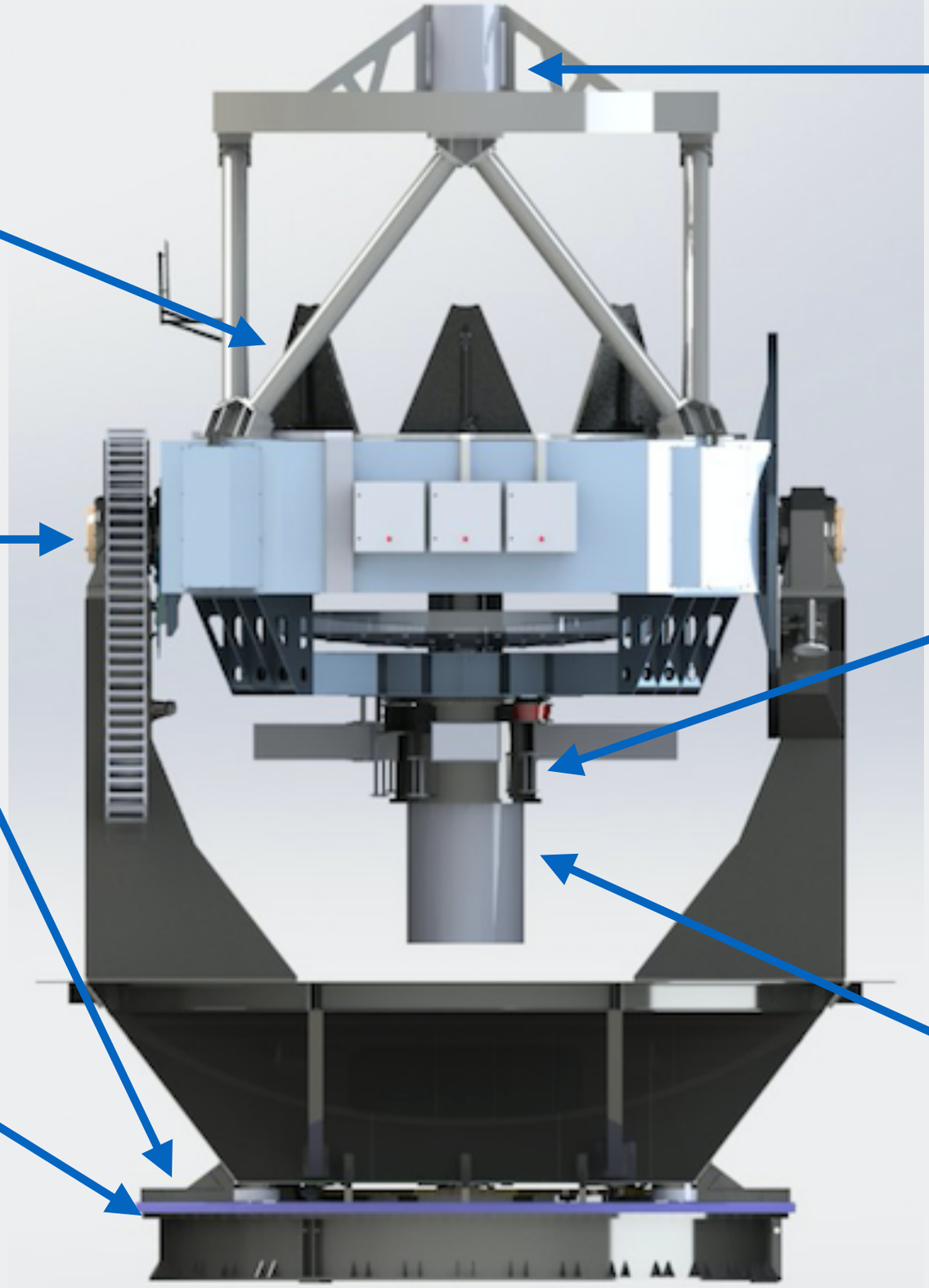
1000 N/m2 load
0-90 deg range

Motor/Gear

AC torque motor
Spur gear
3 °/s altitude speed
3 °/s azimuth speed
<10” RMS blind point
<3” RMS model point
<5” RMS tracking 10min
<0.2” RMS auto-guiding

HSB

80T load
40µ oil film thickness
4 pads
5µ flatness (30cm)
100 µ flatness (total)
Self-aligned
>1e+9 $N.m^{-2}$ stiffness



Hexapod

1 µ relative accuracy
<0.2 µ/0.2” resolution
110 kg payload
6 mm / 10’ Stroke
5.2 kg.m2 Moment of Inertia

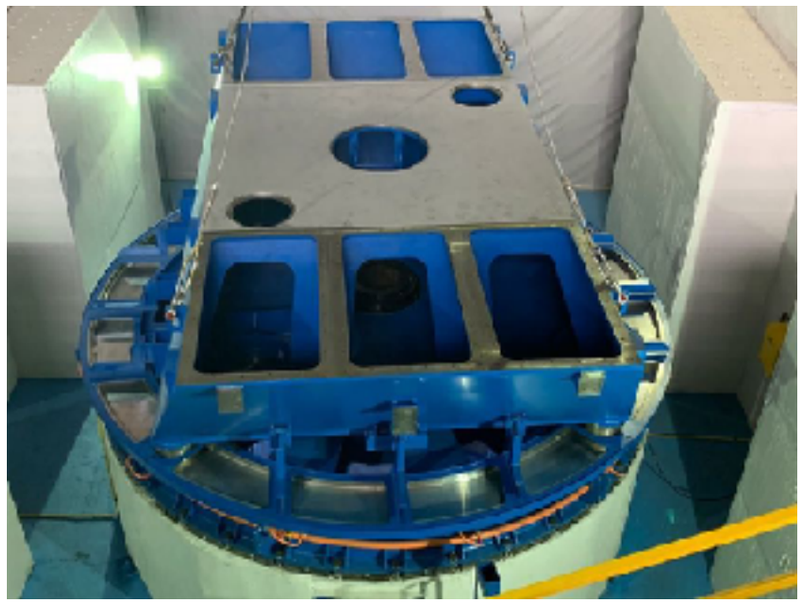
Adapter

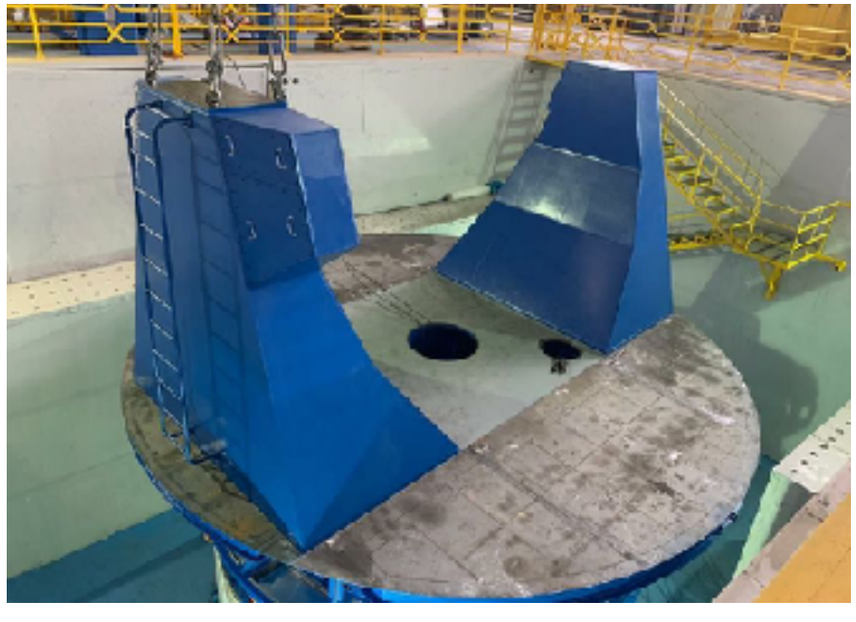
100‘ sq. technical field
Auto-guider unit
WFS unit
ADC unit

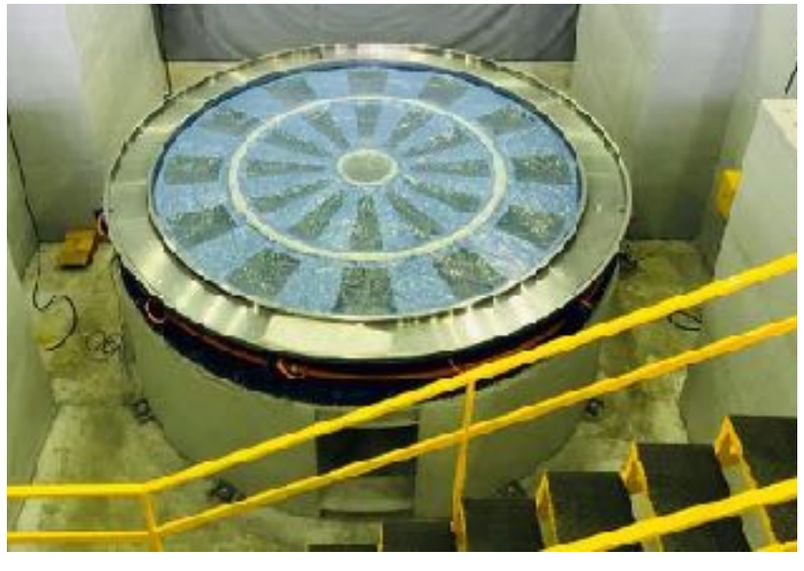
Instruments

1500 kg on-axis
20’ FOV
3 x120 kg side
8’ FOV
Direct imager
low R spectrograph
Multi-obj spectrograph

Manufacturing

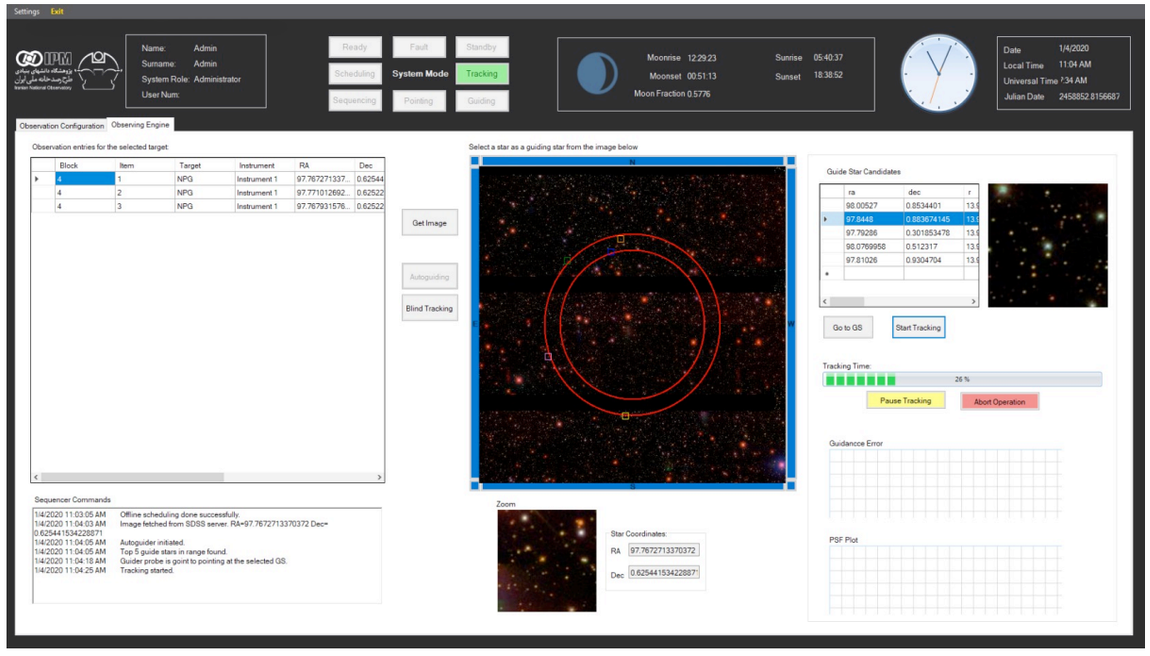






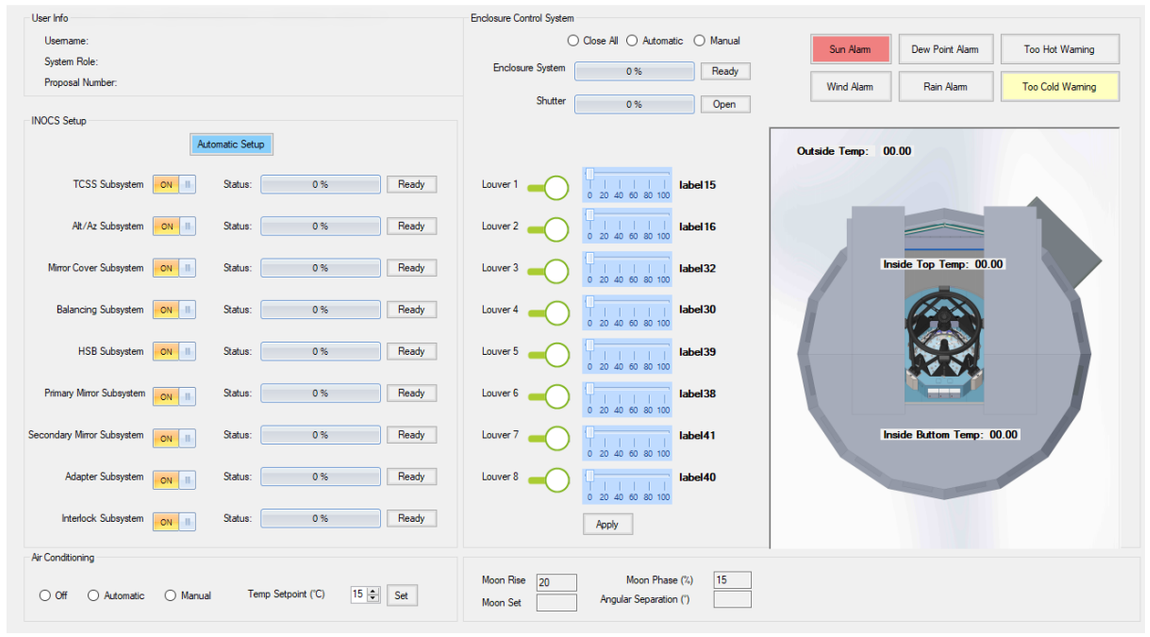
User interface

Observation Application

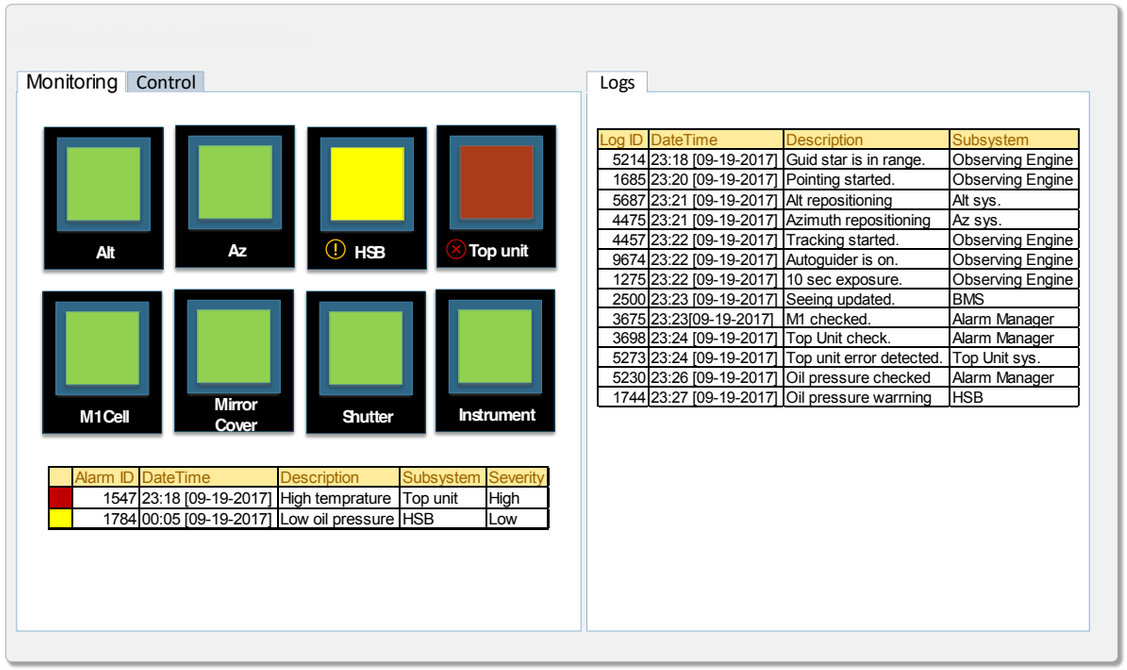


Site Monitoring Application

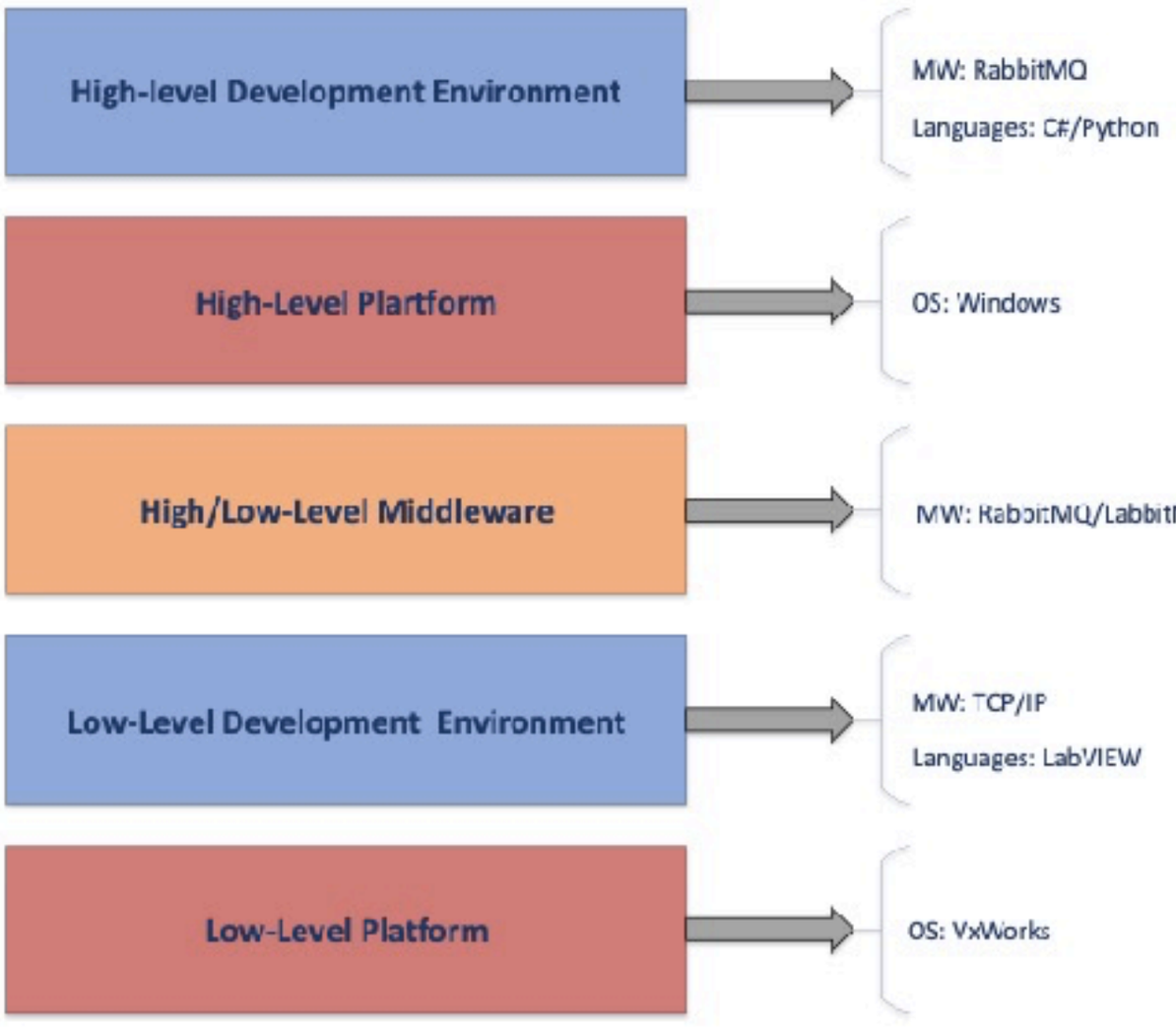
Telescope Operation Application



Alarm/Warning Application



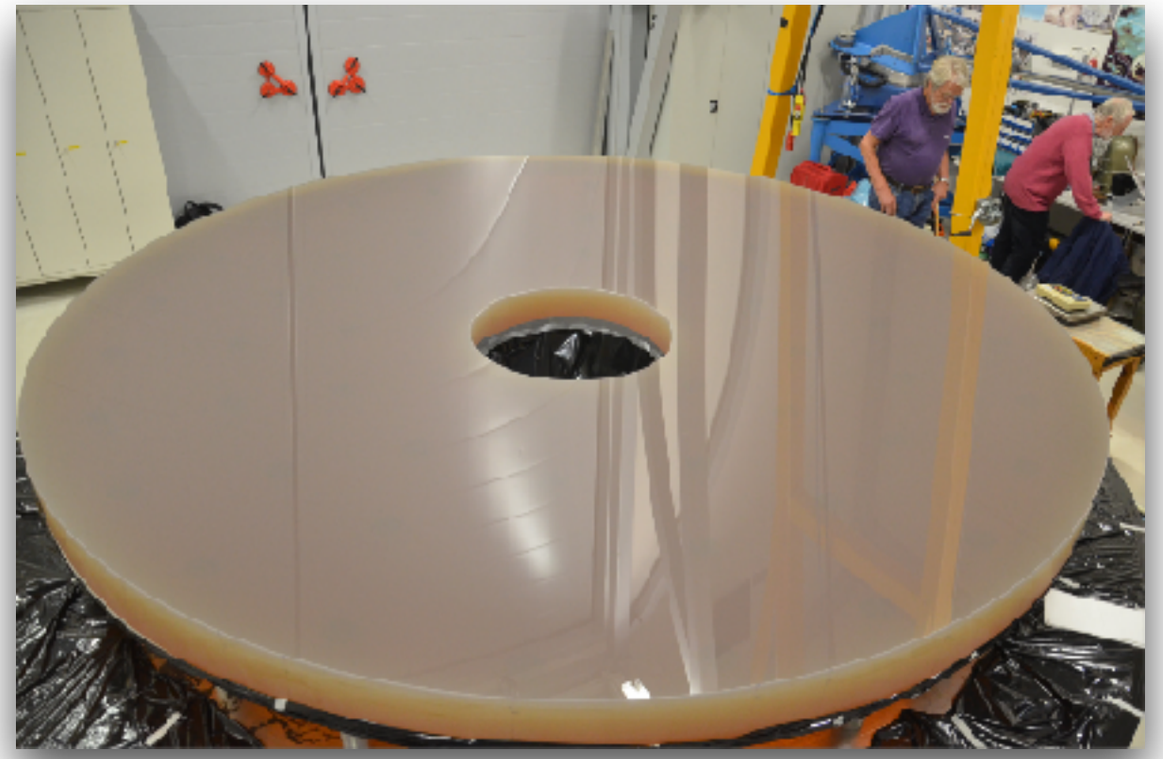
Software development

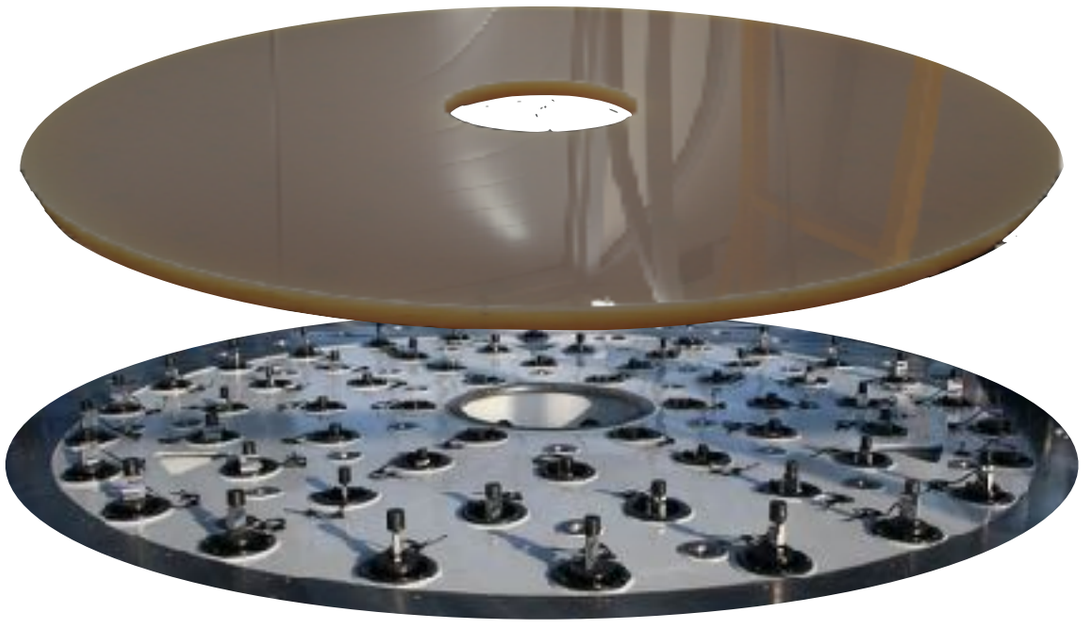


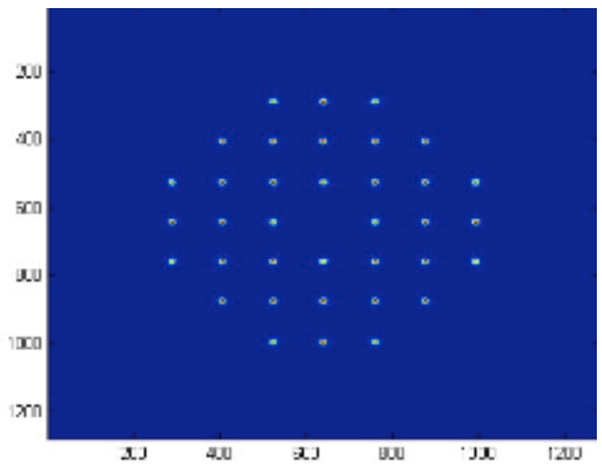
Factory Assembly Test

Primary mirror

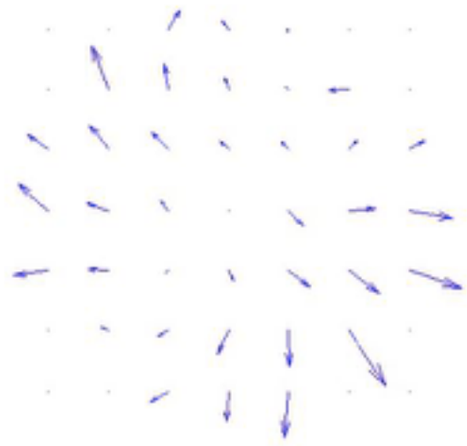
Material:	**ZERODUR®**
Glass Weight:	**~4000 kg**
Diameter:	**3401 mm**
Thickness:	**180 mm ± 10 mm**
Central hole:	**700 ± 1 mm**
Surface roughness:	**< 2 nm RMS**



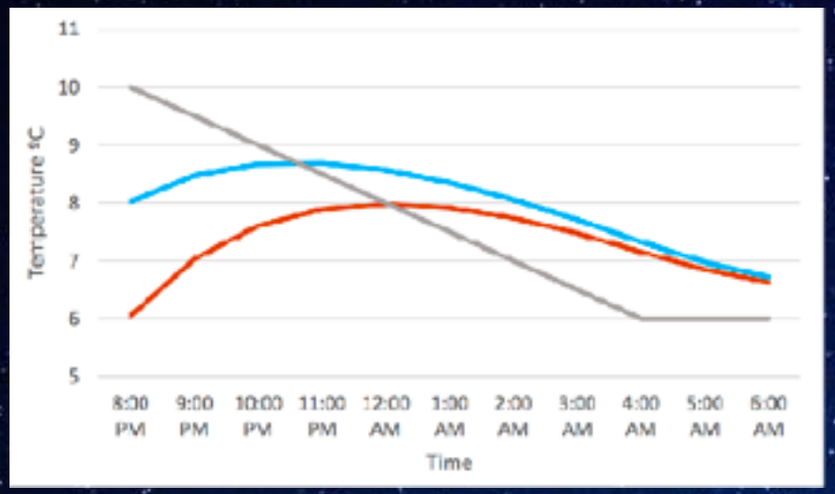


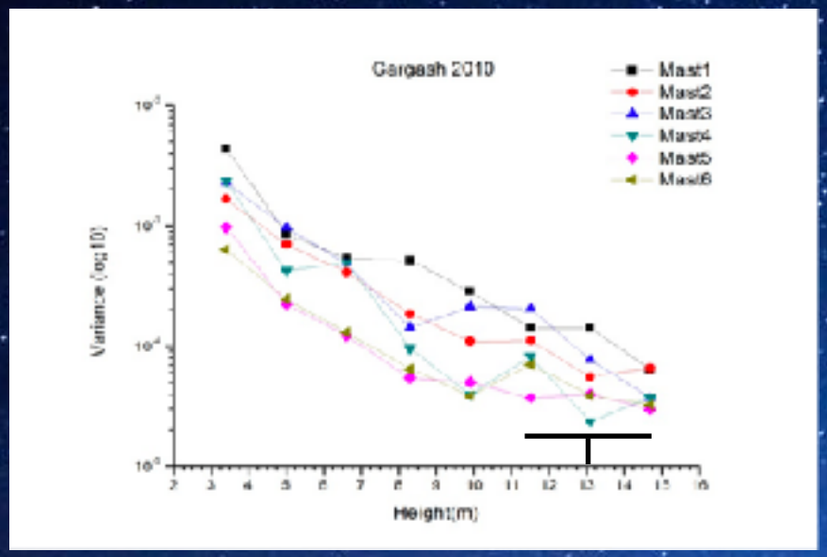


Spot diagram



Centroid displacement


11
10
9
8
7
6
5
Temperature °C
8:00 PM
9:00 PM
10:00 PM
11:00 PM
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
Time


Gargash 2010
Mast1
Mast2
Mast3
Mast4
Mast5
Mast6
Variance (log10)
Height (m)

16m

13m

INO100

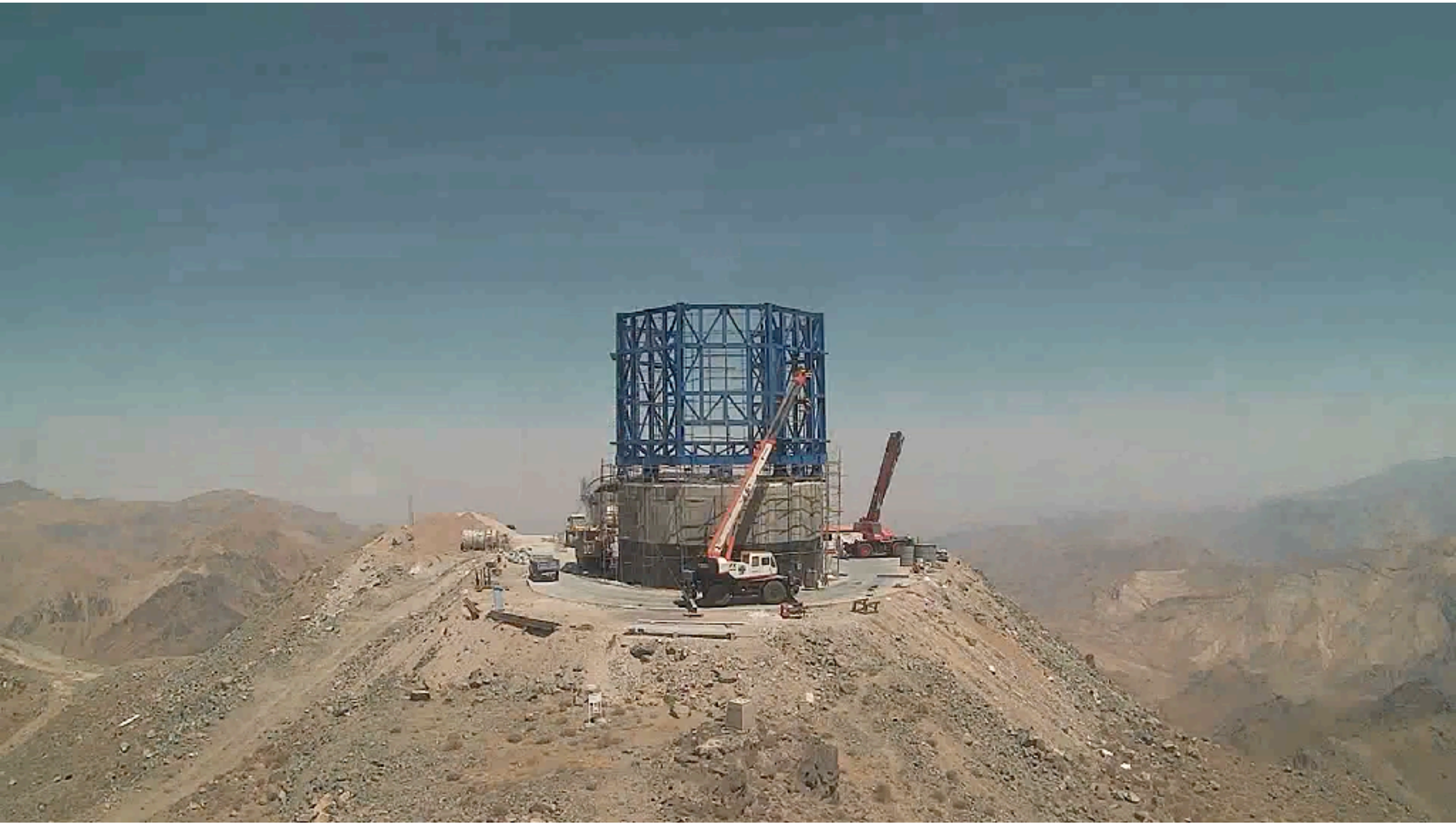
INO LA

INO340

Site monitoring station

Developing the site

Civil construction



May 2020

May 2021
including
telescope
site assembly

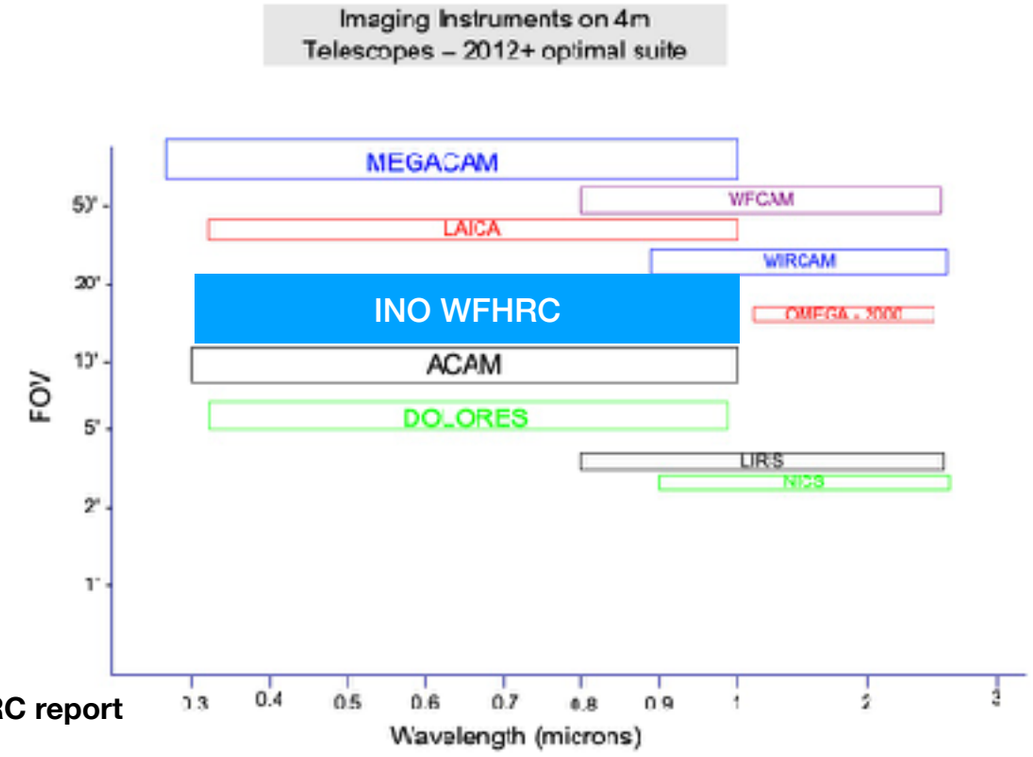
Winter closer
Nov 2020-April 2021

Instrumentation plan

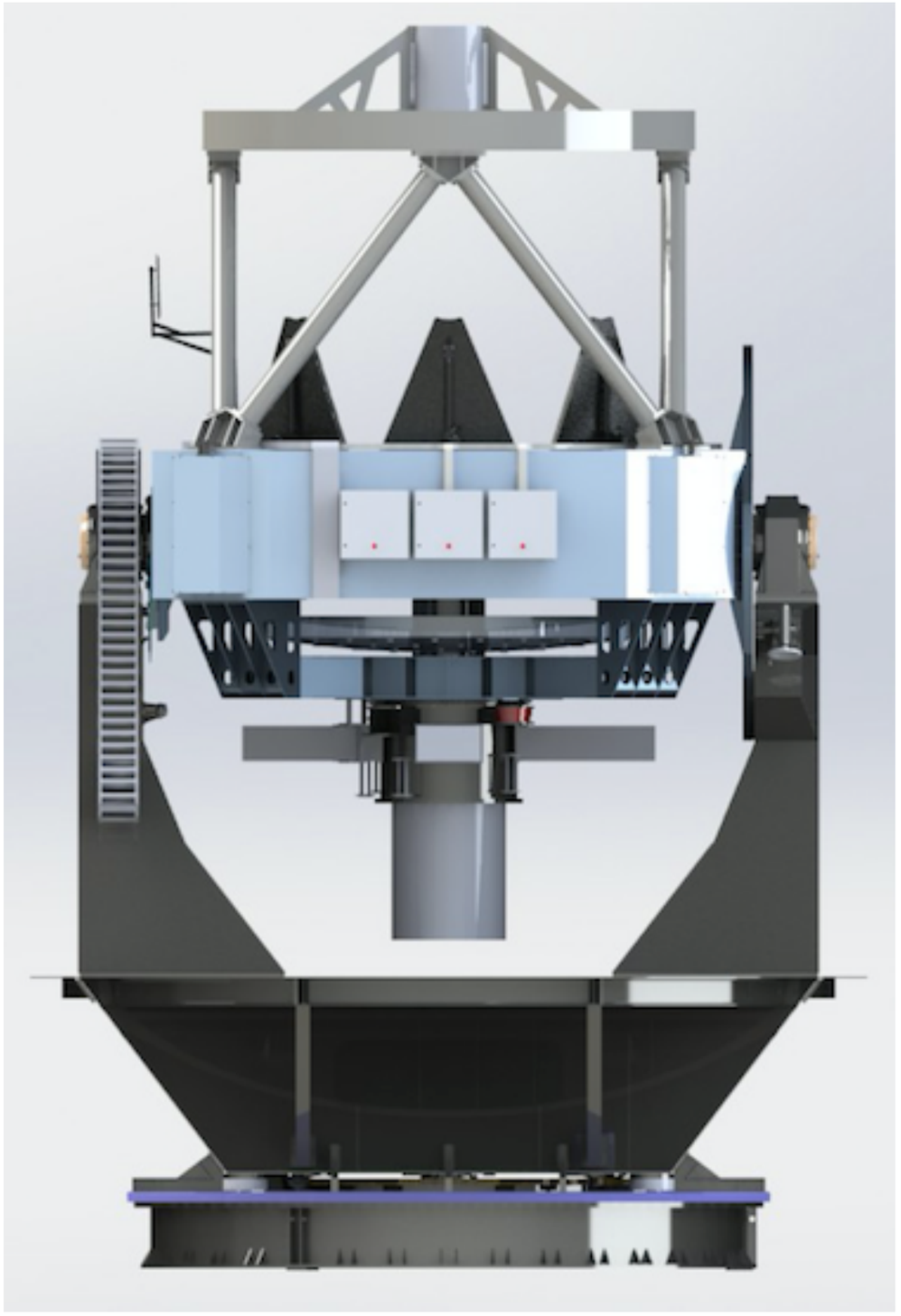
Phase I:
Commissioning Camera

Phase II:
Imaging camera (FoV 4 arcmin)
Medium/Low resolution Slit Spectrograph

Phase III:
Wide field Imaging camera (FoV 20 arcmin)
Multi-object / IFU spectrograph



Opticon/ETSRC report



Lens Array

Ultra-deep imaging of M33: exploring its stellar halo with broadband imaging for the first time (No 1310)

30.06.2021 12:04 - 12:17 Contributed talk
S12b : The Renaissance of the Low Surface Brightness Universe

Zahra Sharbaf[1], Mohammad Akhlaghi[2], Ignacio Trujillo[3], Hamed Altaf[2], Hadi Infante-Sainz[3], Habib Khosroshahi[3], Elham Saremi[1], Alireza Molaeinezhad[4], Surena Fatemi[5], Mohammad Ali Haddad[3]

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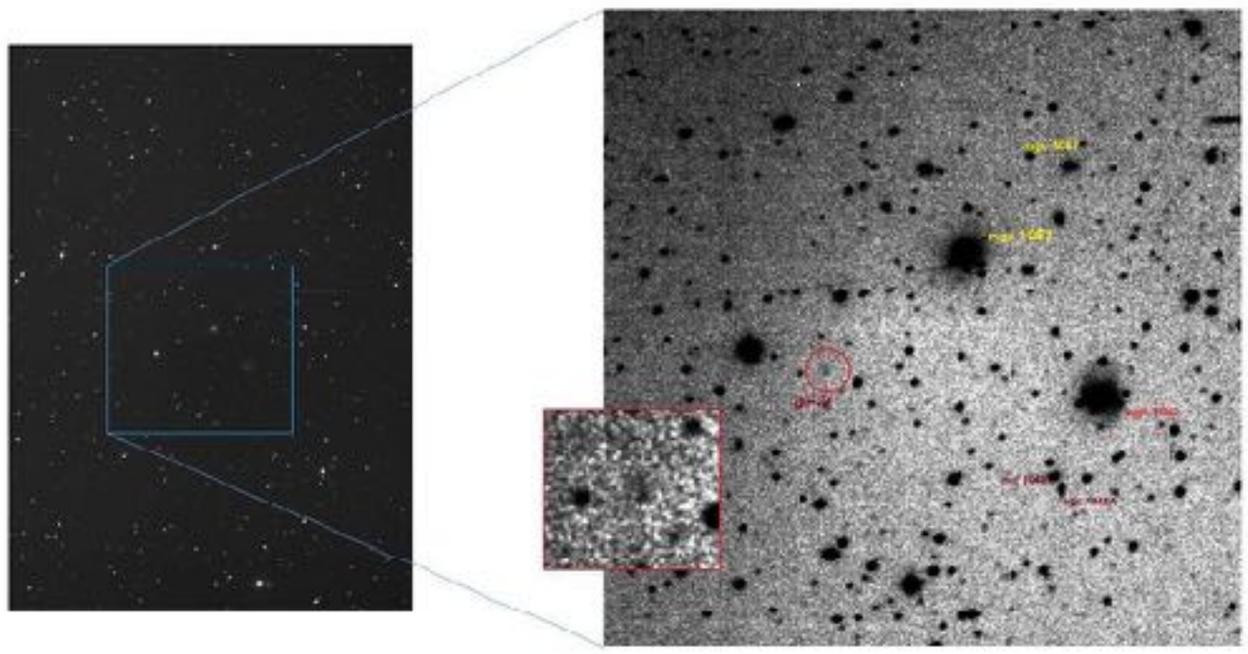
[3] Iranian National Observatory, Institute for Research in Fundamental Sciences (IPM)
[4] Institute of Astronomy, University of Cambridge
[5] Department of physics, Yazd University

We present the first attempt of exploring the stellar halo of M33 using ultra-deep broad-band imaging. Deep images using the star counting technique by the PAndAS survey reveals that M33 is undergoing a tidal interaction with its massive neighbor M31. Due to this interaction, the stellar halo of M33 is currently experiencing a tidal disruption. These features are only visible at extremely low surface brightness levels (i.e. >30 mag/arcsec^2). For this reason, M33 is a perfect test-bed for comparing ultra-deep broadband imaging with the star counting techniques to characterize the faintest surface brightness stellar emission. The outcome of this experiment is, therefore, key for interpreting the low surface brightness information in galactic systems where the stellar population can not be resolved (i.e. >16 Mpc).

Our experiment is conducted using the Iranian National Observatory Lens Array (INOLA). INOLA's field-of-view is 1.9 by 2.5 degrees, with a pixel size of 2.8 arcsec/pixel, easily covering M33 and its halo in one single exposure.

We will present a detailed description of all the technical challenges we have dealt with, including the construction of a very extended non-parametric point spread function (PSF) out to a radius of 45 arcminutes, and a massive scattered light removal of 4400 stars within each exposure for improved sky background estimation before creating the final stack.



First light 2018