TSPM Overview and Project Status

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Outline

- Operational concept
- Project organization
- Physical context
- Enclosure
- Optical design & Telescope
- Control system
- Project management & Systems engineering
- Next steps

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TSPM Operational Concept

- A legal entity, say TSPM Observatory, will build and operate the TSPM.
- The TSPMO will not be part of the OAN-SPM, even though it will be located within its premises.
- Presumably, telescope time will be awarded in proportion to the partner contributions, so
  - most or all development, upgrades, and major repairs will take place at the partner institutions
  - the TSPMO will be mostly concerned with building and operating the TSPM and should be staffed to focus on these priorities.

TSPM Operational Concept

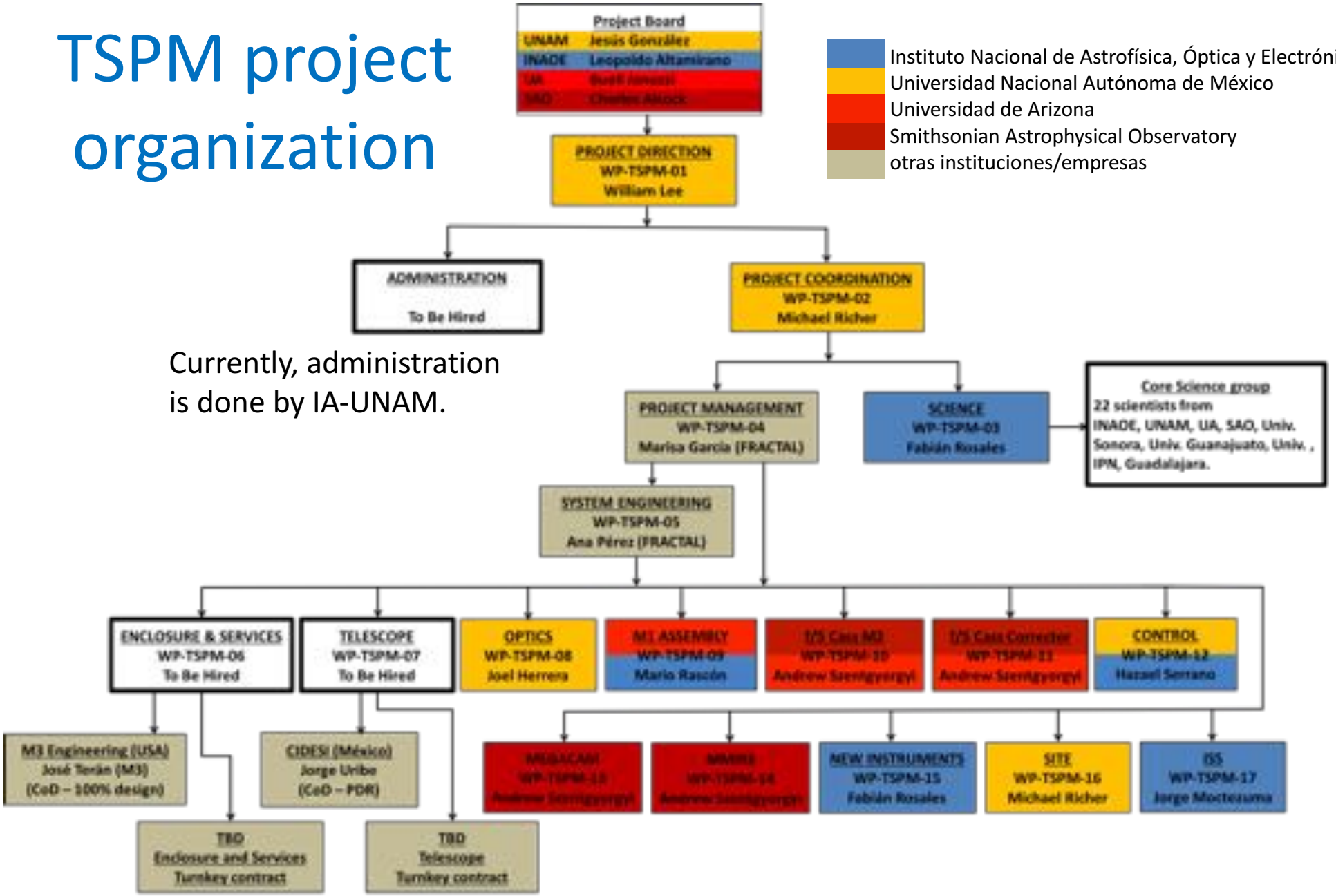
- The TSPMO will require
  - director, responsible to the Project Board and who leads day-to-day operations,
  - an administrative structure as well as
  - technical and scientific staff for its operation
- The TSPMO administrative staff will not be at the OAN-SPM, but ideally in some other single location. Ensenada is the closest sensible location.
- The OAN-SPM is too remote for daily commuting to be reasonable; staff working at the TSPM will have to live on-site during their work periods.
  - Effectively, this implies that, for each person physically required on site at the OAN-SPM, at least two must be hired.

TSPM Operational Concept

- The TSPM's primary operational objective is to provide a facility that permits world-class astronomical research.

- The partners expect the combination of the TSPM the MMT to be a general-purpose observatory, operating in at least the visible and near-infrared.
- In its initial configuration, the TSPM must be functionally equivalent to the f/5 Cassegrain configuration of the MMT.
- Beyond "Day 1", the TSPM should allow the partners to develop other capabilities that will sustain their growth over the next four decades.

TSPM project organization



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Universidad Nacional Autónoma de México
Universidad de Arizona
Smithsonian Astrophysical Observatory
otras instituciones/empresas

Currently, administration is done by IA-UNAM.

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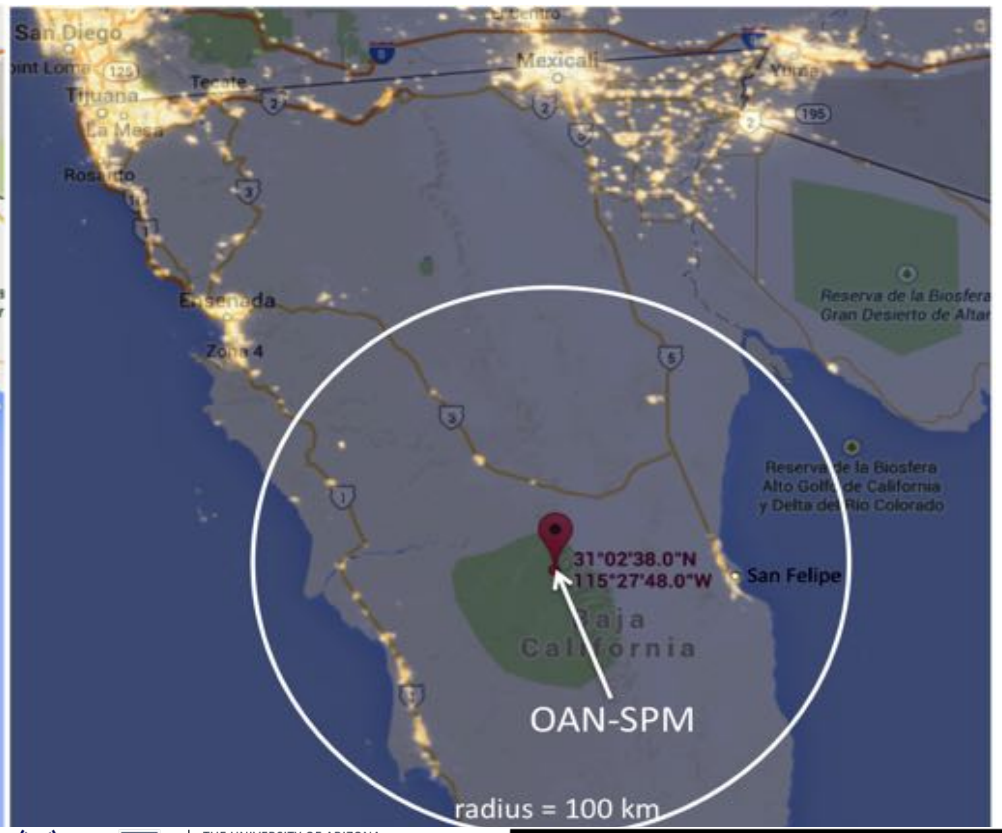
Physical Context: OAN-SPM

- The TSPM will be located at the OAN-SPM in north central Baja California (long. 115˚ W, lat. 31˚ N, alt. 2800m).



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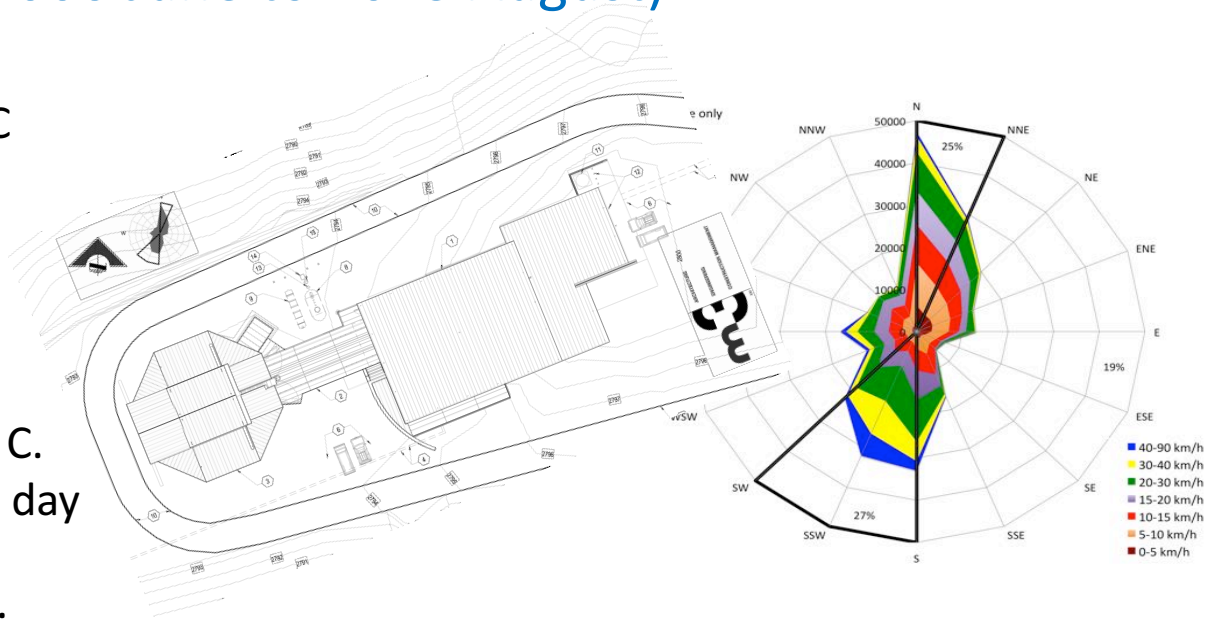
Physical Context: Climate

(statistics: 2006 June to 2013 August)

- The temperature
  - total range: -16.7˚C to +23.9˚C
  - 90% range (frequency): -2˚C to +18˚C
  - 95% range (frequency): -5˚C to +18˚C
  - varies with the seasons.
  - median daily excursion is 5.9˚ C.
  - variation is greater during the day and during the winter.
  - is lowest at dawn, on average.
  - is correlated between sunrise and sunset on the same day: for sunrise temperatures exceeding 0˚C (85% of the time), they differ by less than +1˚±2˚C.



- At night, winds blow primarily from
  - S-SW: dominate Dec.-June (and overall)
  - N-NE: dominate July-Nov.

  } not quite perpendicular to the enclosure orientation
- Winds from the S-SW are stronger.
- Winds are weakest from May to September.

Physical Context: Astroclimate

- The OAN-SPM is a dark site, comparable to other major observatories (B=23.1 mag, V=21.8 mag; Plauchu-Frayn et al. 2017).
- The OAN-SPM is a clear site (1982-2006, Tapia et al. 2007):
  - 80% of nights spectroscopic
  - 65-70% of nights photometric
- Late spring/early summer has the largest fraction of clear nights.
- The median seeing is 0.79" and the 10th percentile is 0.50” (Skidmore et al. 2009; TMT study).
- The seeing (TMT study)
  - is stable from sunset, but degrades somewhat before dawn.
  - has no dependence upon the wind direction, but does degrade as the wind speed increases.
  - improves with height near the ground .

Enclosure design: M3

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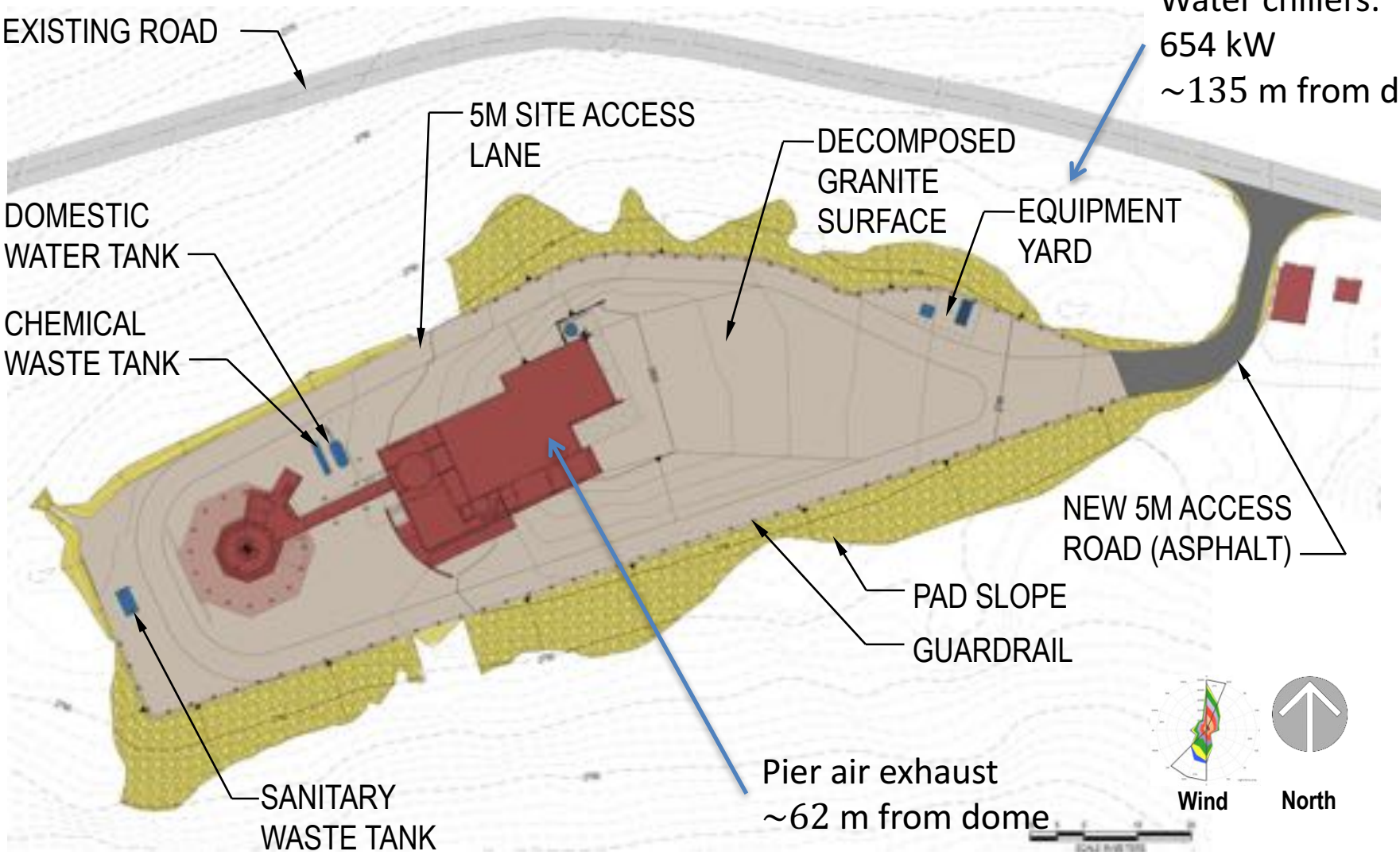
Civil
Site Plan



Water chillers:
654 kW
~135 m from dome

Enclosure design

- The telescope enclosure and pier follow Magellan.
- The handling of the primary mirror follows Magellan.
- All maintenance occurs on a single level (inc. delivery and commissioning).
- Control room, data archiving, etc. on lower level of support building.

Enclosure and fixed base

Support building

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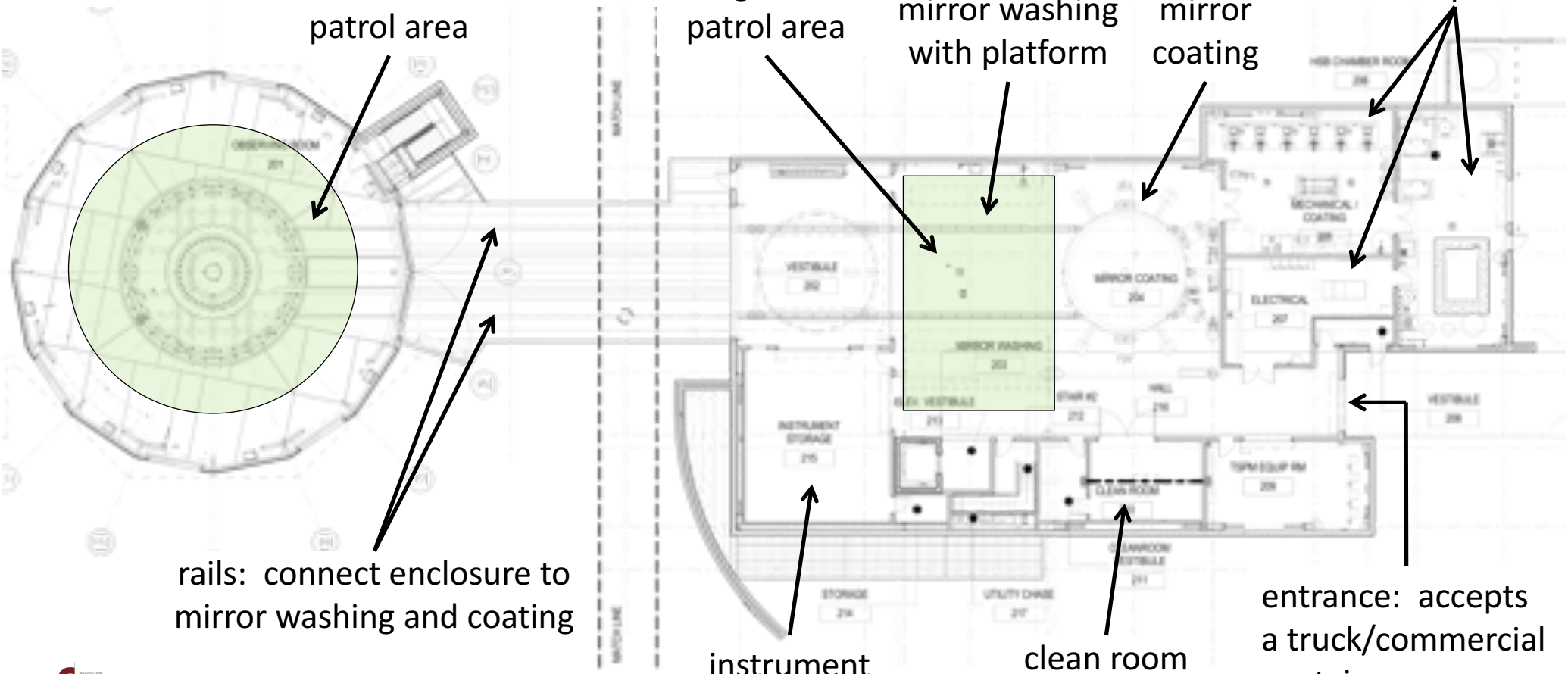
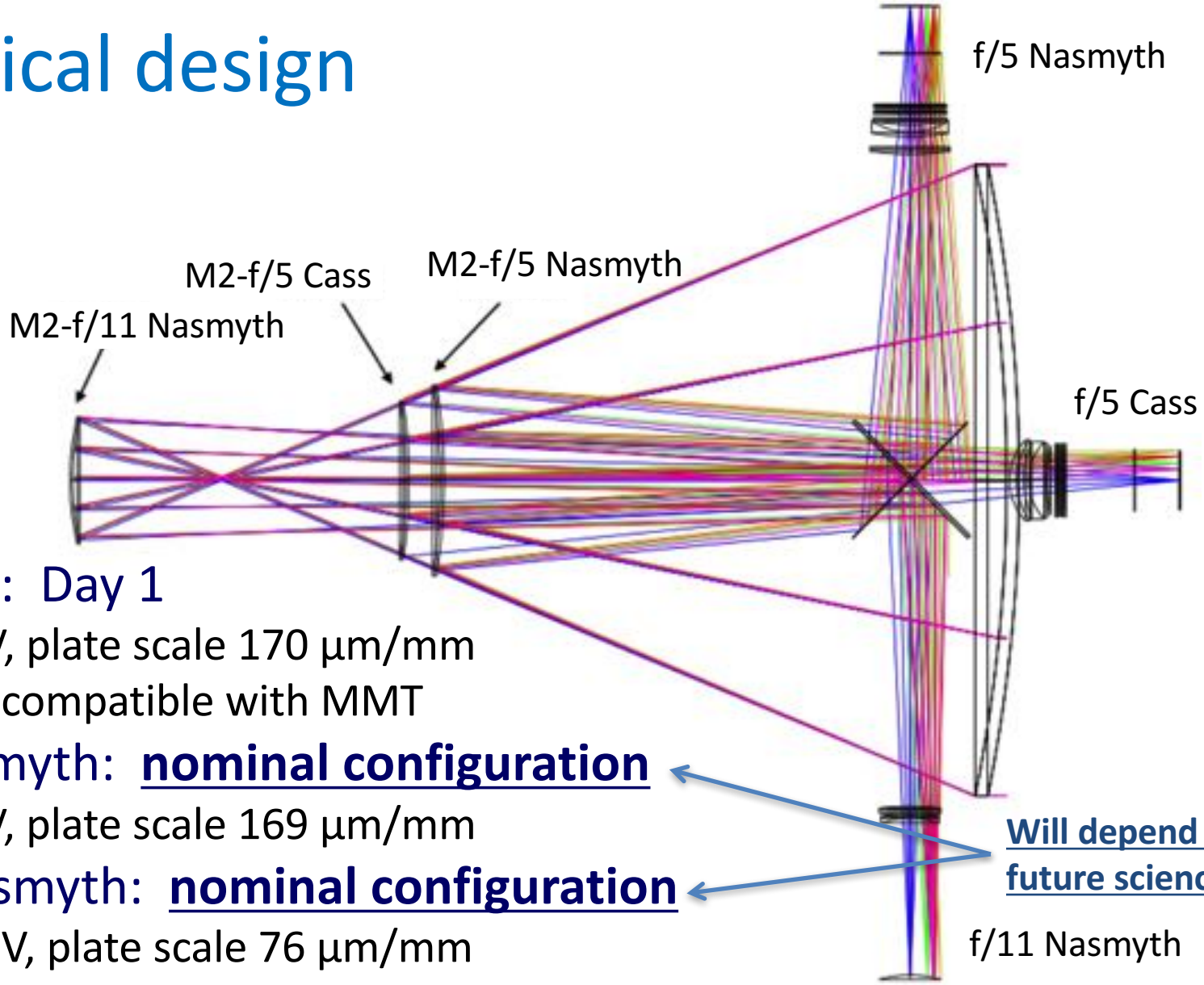
Enclosure design



Optical design



- f/5 Cass: Day 1
  - 1˚ FoV, plate scale 170 µm/mm
  - 100% compatible with MMT
- f/5 Nasmyth: **nominal configuration**
  - 1˚ FoV, plate scale 169 µm/mm
- f/11 Nasmyth: **nominal configuration**
  - 27’ FoV, plate scale 76 µm/mm

Will depend upon future science.

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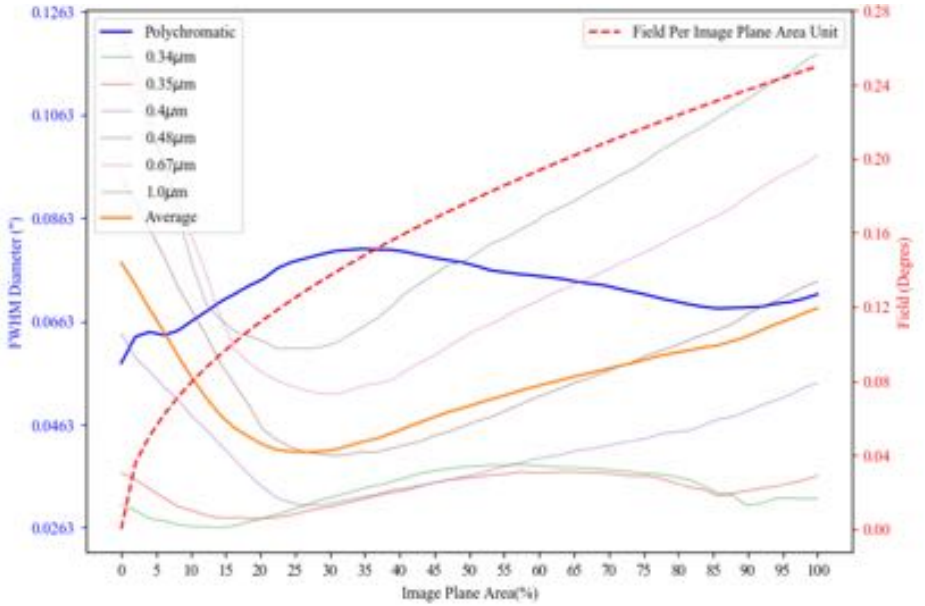
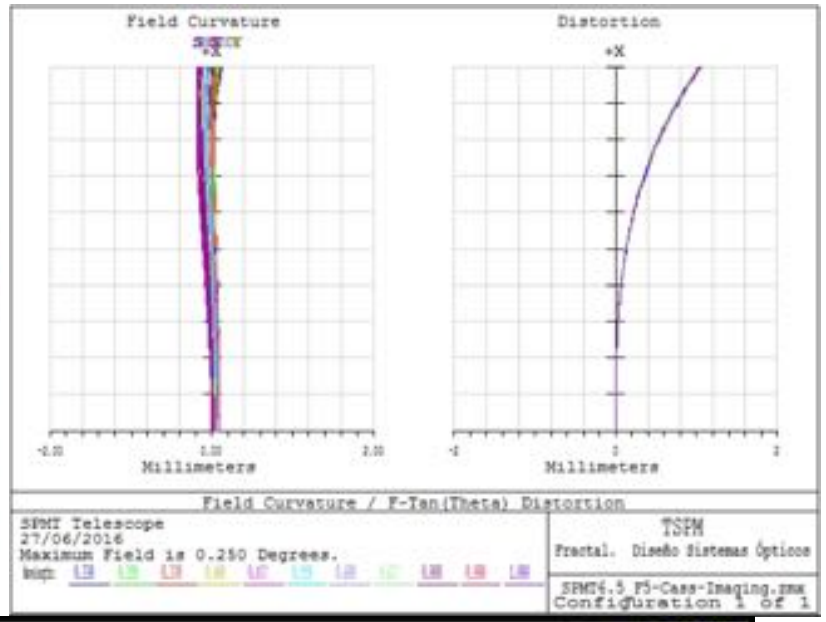
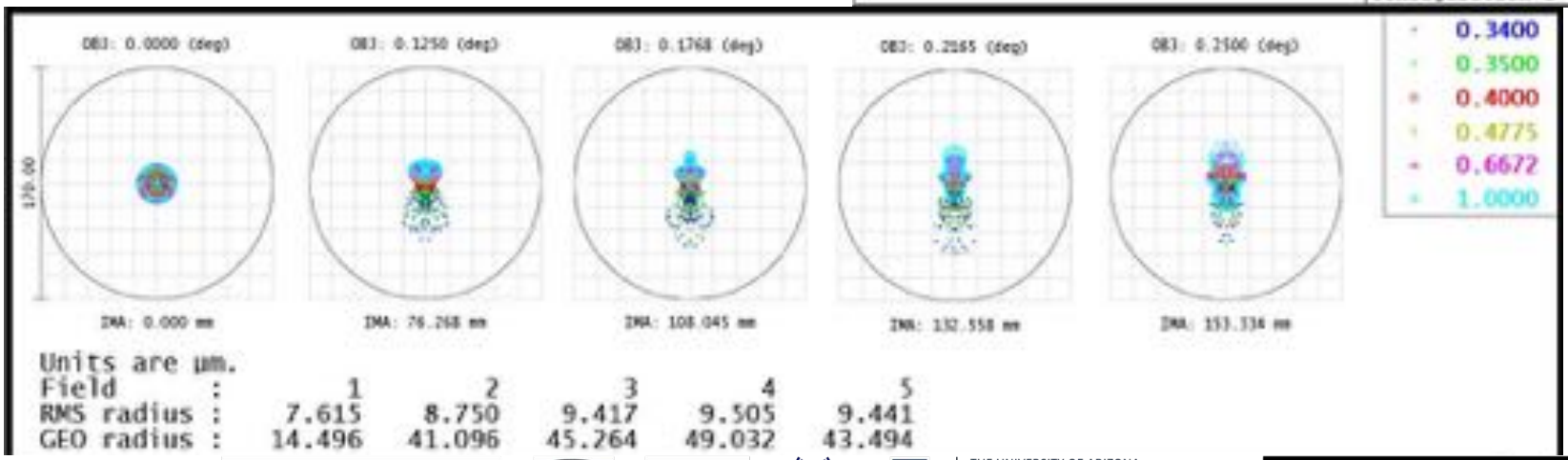
Optical Design: f/5 Cass, imaging







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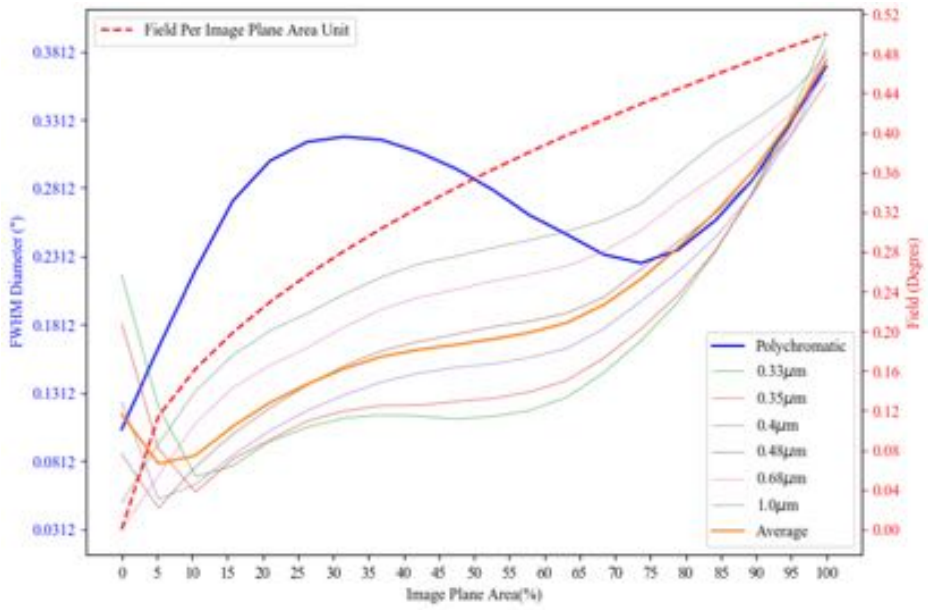
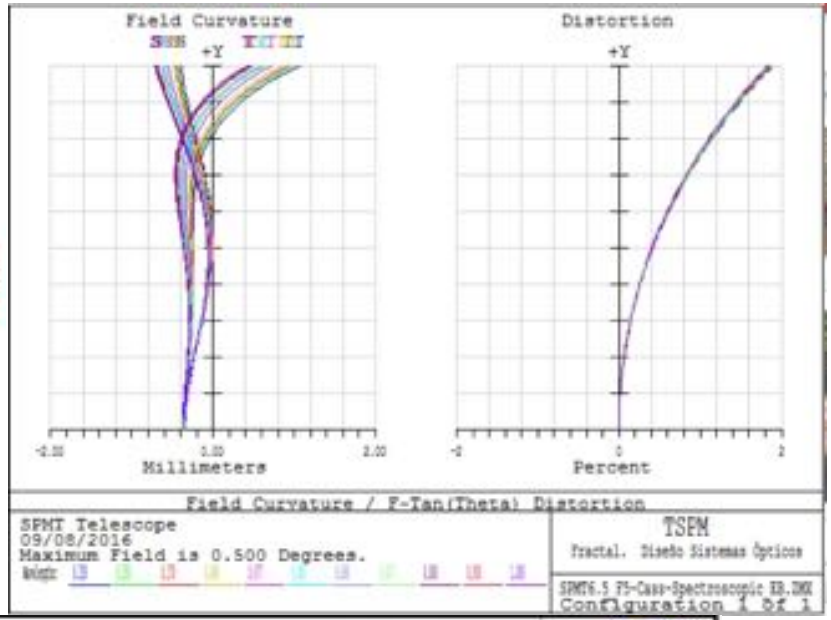
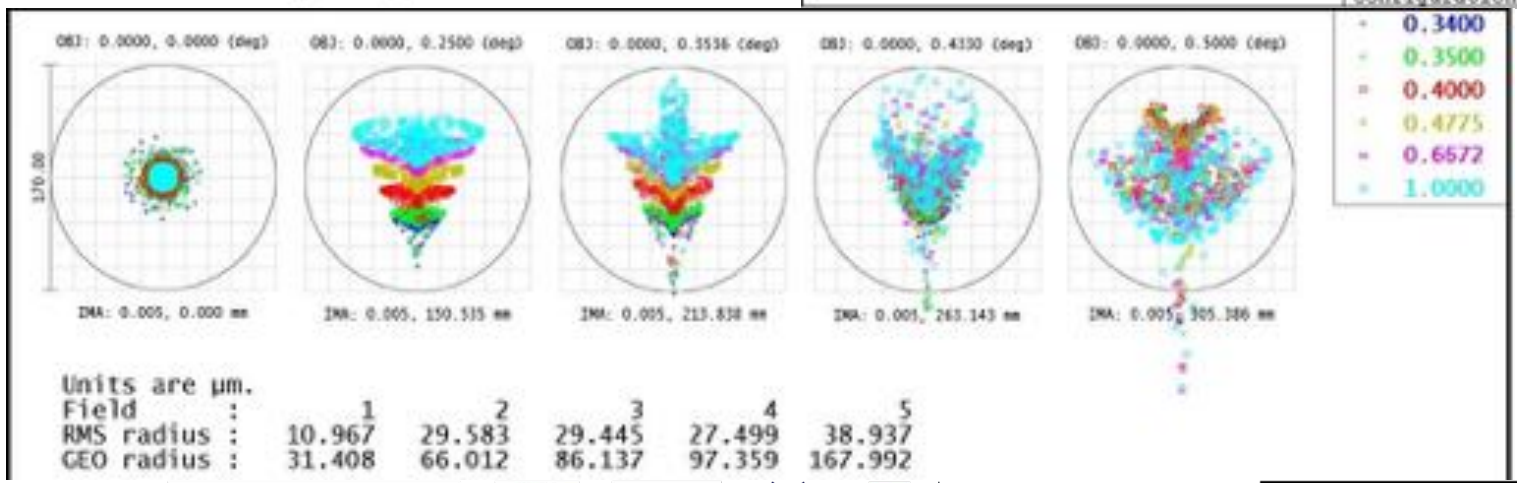
Optical Design, f/5 Cass, spectroscopy







M1, transport box

- The primary mirror system (a list of items, including M1) is a contribution of INAOE and UA.
- The primary mirror is currently in storage at an Air Force base in Tucson, AZ.
- The primary mirror is scheduled to begin polishing in 2019.

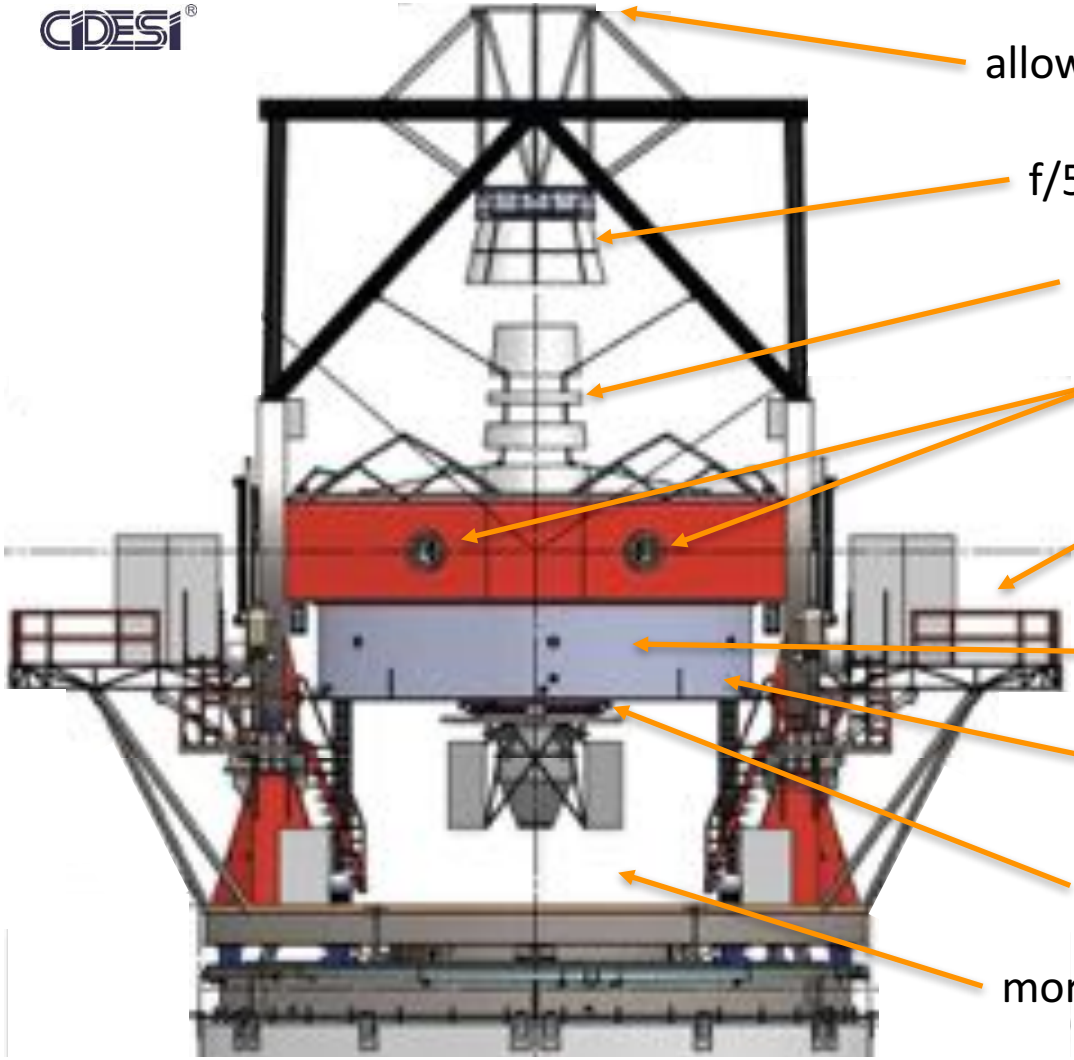
M1 cell fabrication

- The M1 cell is being fabricated and is progressing well.

M2/f/5 Cass corrector: in use @ Magellan2/Baade

It is inserted into the M1 cell.

Telescope design: CIDESI



allows f/11 Gregorian, as at Magellan

f/5 Cass. M2 compatible with MMT and Magellan

baffle design similar to Magellan

4 folded Cassegrain ports

more space/weight on Nasmyth platforms than Magellan

M1 is optically identical to MMT and Magellan

M1 cell with cone (compatible with MMT)

Cass. rotator compatible with MMT (MMIRS shown to scale)

more space at Cass. station than MMT/Magellan

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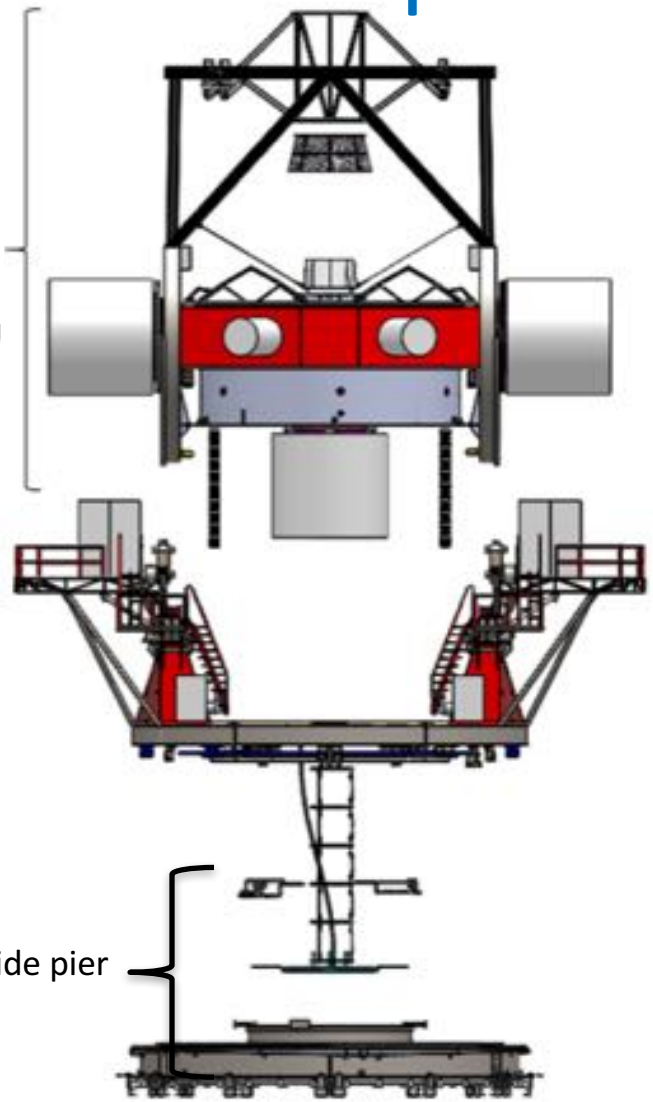
Telescope design: CIDESI

CIDESI

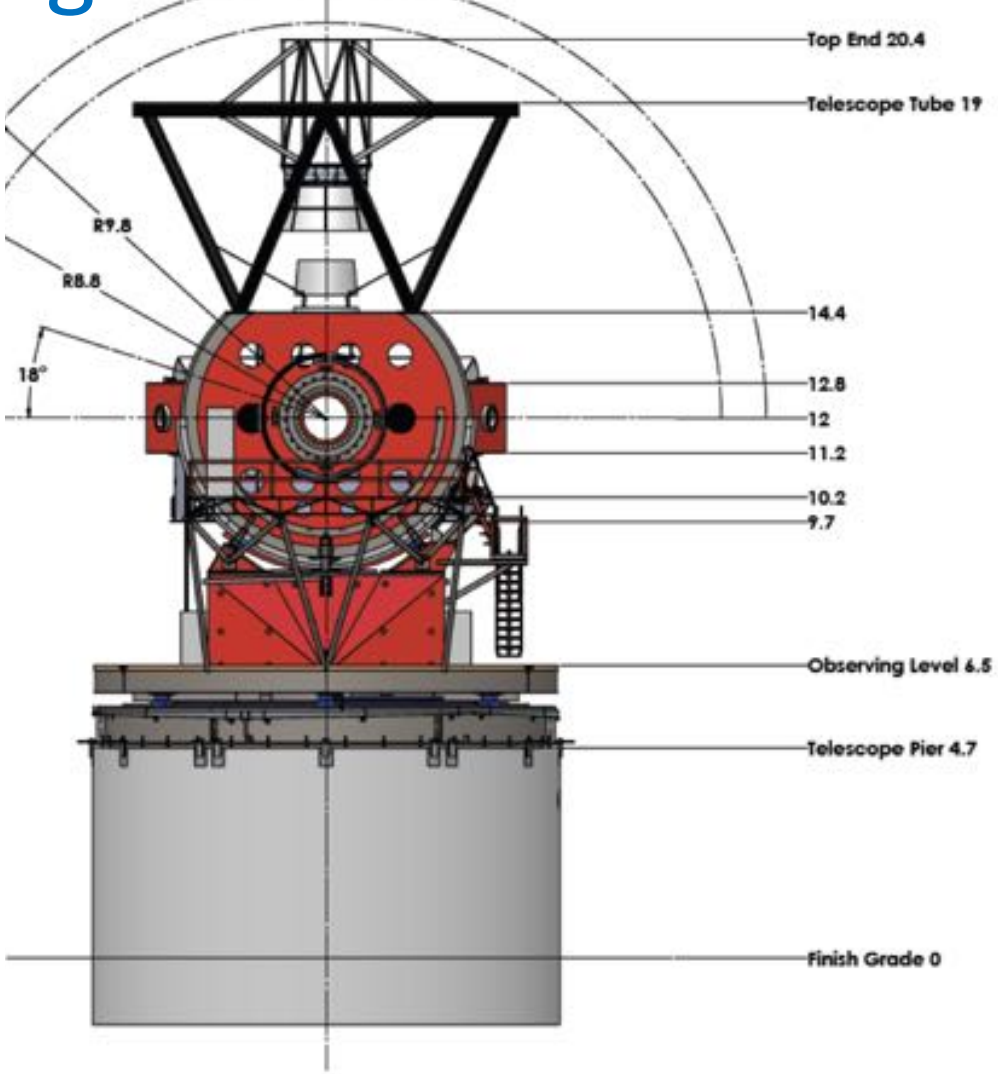
Rotating mass around elevation axis 98.3 tonnes

Rotating mass around azimuth axis 176.2 tonnes

Non-rotating mass 54.2 tonnes



Inside pier



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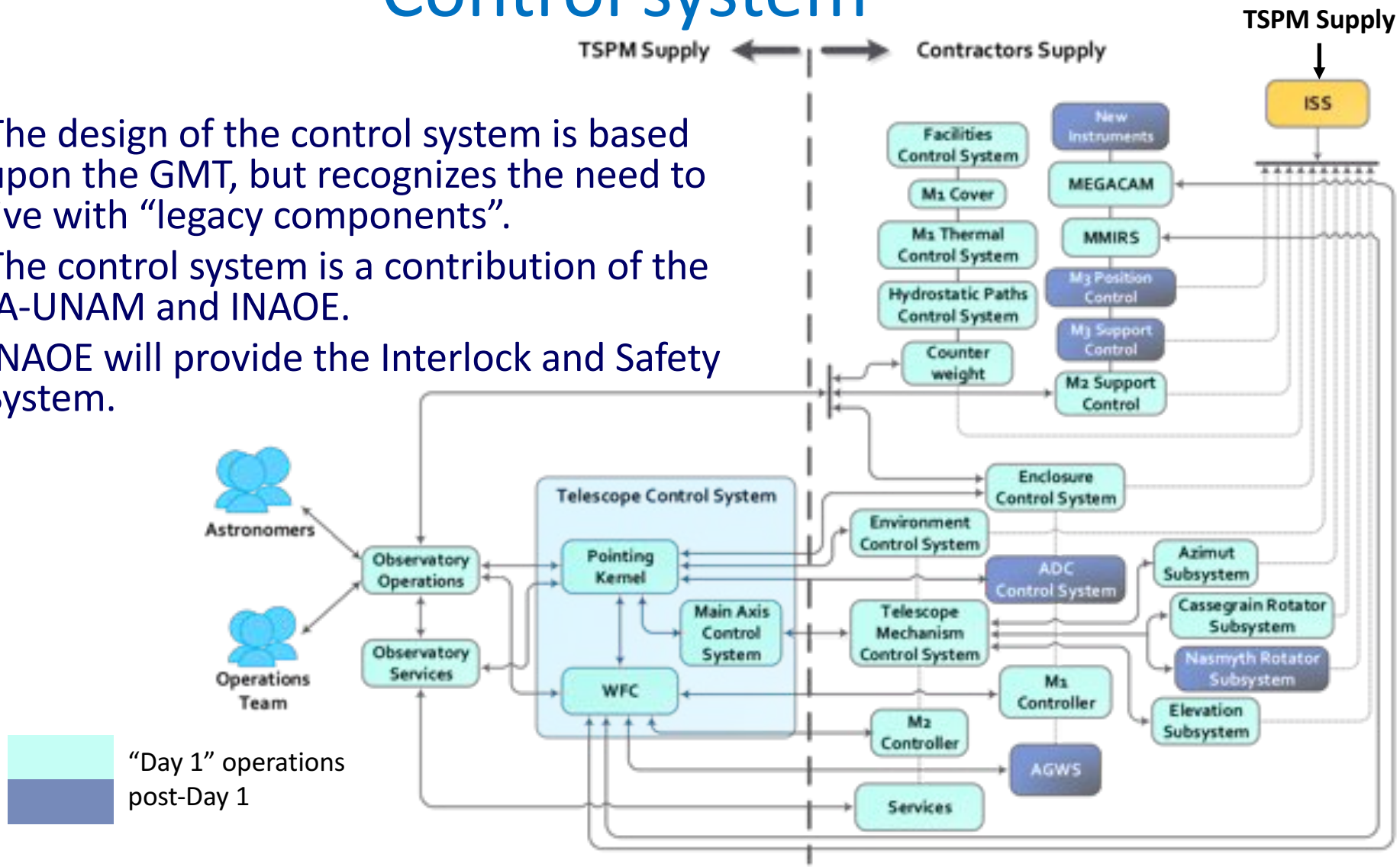
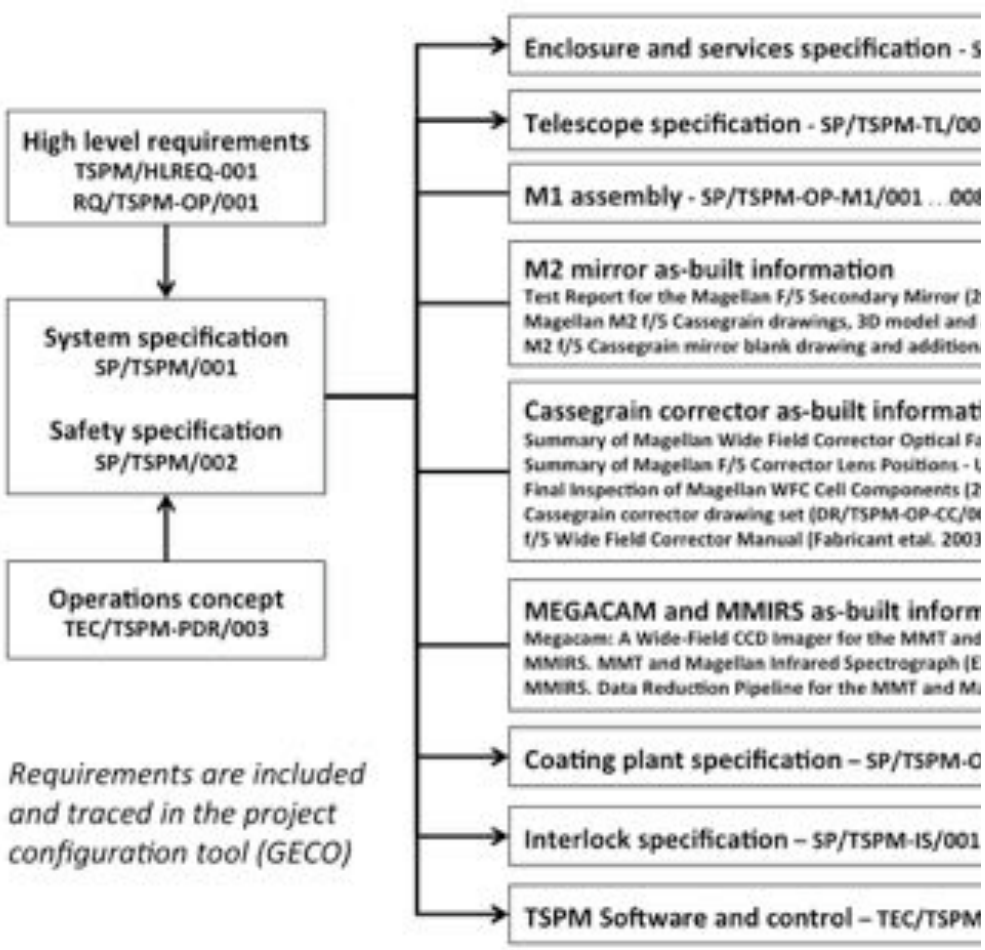
Control system

- The design of the control system is based upon the GMT, but recognizes the need to live with “legacy components”.
- The control system is a contribution of the IA-UNAM and INAOE.
- INAOE will provide the Interlock and Safety System.

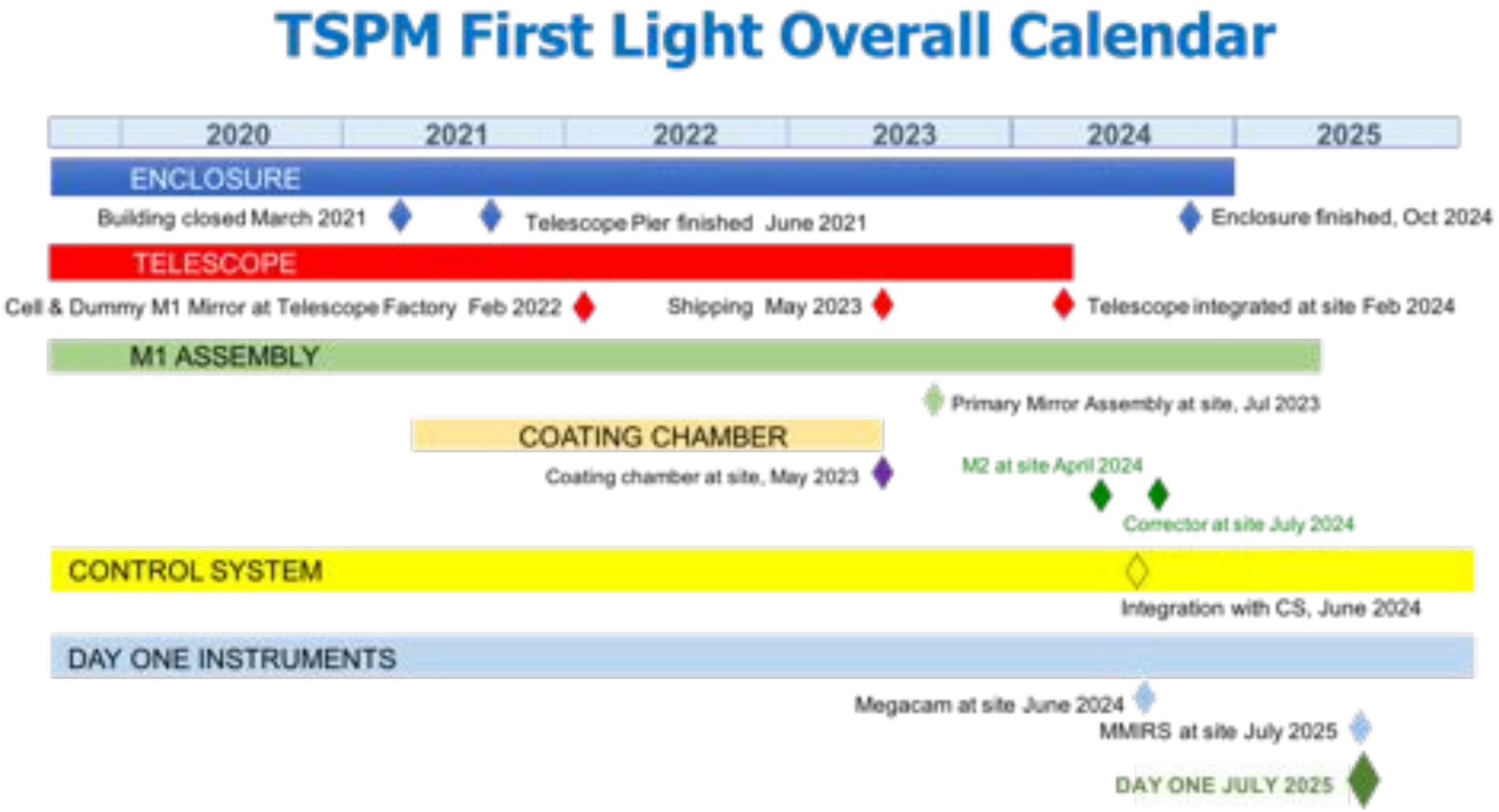


Systems engineering and Project Management



- Systems engineering and project management use tools from Fractal S.L.N.E..
- All subsystem specifications are defined.
- The physical interfaces have been defined, but some operating system and interlock/safety interfaces are pending.
- Error budgets exist (image quality, differential distortion, pointing, tracking, guiding)
- Technical budgets exist (mass, heat dissipation, consumption, RAMS)
- Currently, the project is driven by the budget and associated cash flow.

Systems engineering and Project Management



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Next steps

- Wind tunnel and CFD studies of the enclosure and surroundings are underway in collaboration with UNAM's Instituto de Ingeniería.
- The environmental impact study for the TSPM project has been submitted to the authorities.
- INAOE, IA-UNAM, SAO, and UA/SO are working on a draft Memorandum of Understanding.
  - This will give the TSPM project a firmer legal standing.
  - This will provide more leverage for funding with Mexican funding agencies.
- CIDESI continues to work on the detailed mechanical design of the telescope.
- Work continues on the control system and the interlock and safety system.
- Polishing of M1 will begin in 2019.

Thank you!

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