Thirty Meter Telescope (TMT) Project Status

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Project Manager (Acting)

NSF's National Optical-Infrared Astronomy Research Laboratory

TMT
THIRTY METER TELESCOPE

GIANT MAGELLAN TELESCOPE

TMT-System Architect

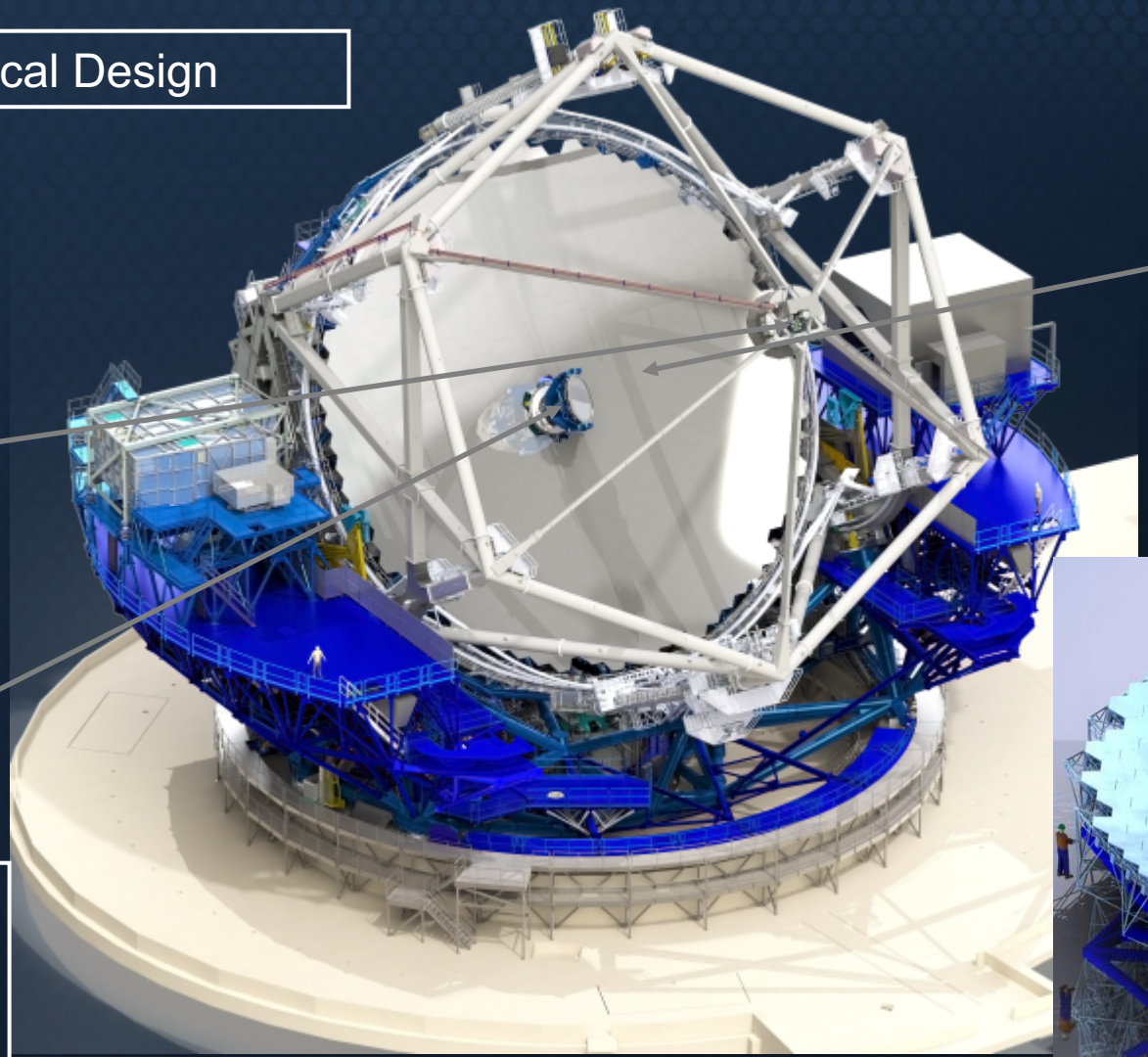
Ritchey-Chrétien Optical Design

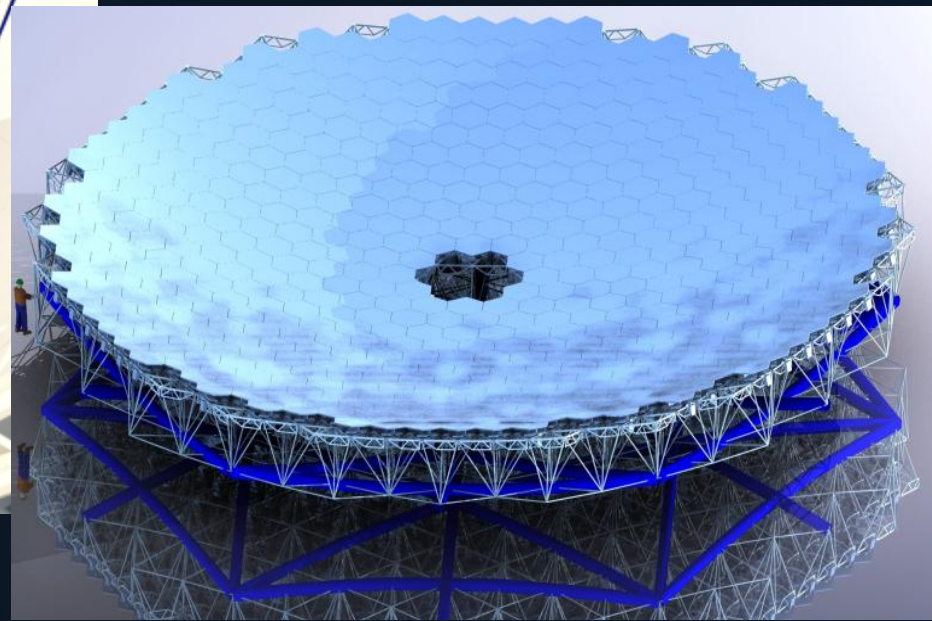
30m hyperboloidal f/1 primary mirror (492 segments)

3.1m convex hyperboloidal secondary mirror

Flat 2.5m x 3.5m tertiary mirror

Aplanatic configuration with 20 arcmin field of view 2.62 m diameter (15 arcmin unvignetted)

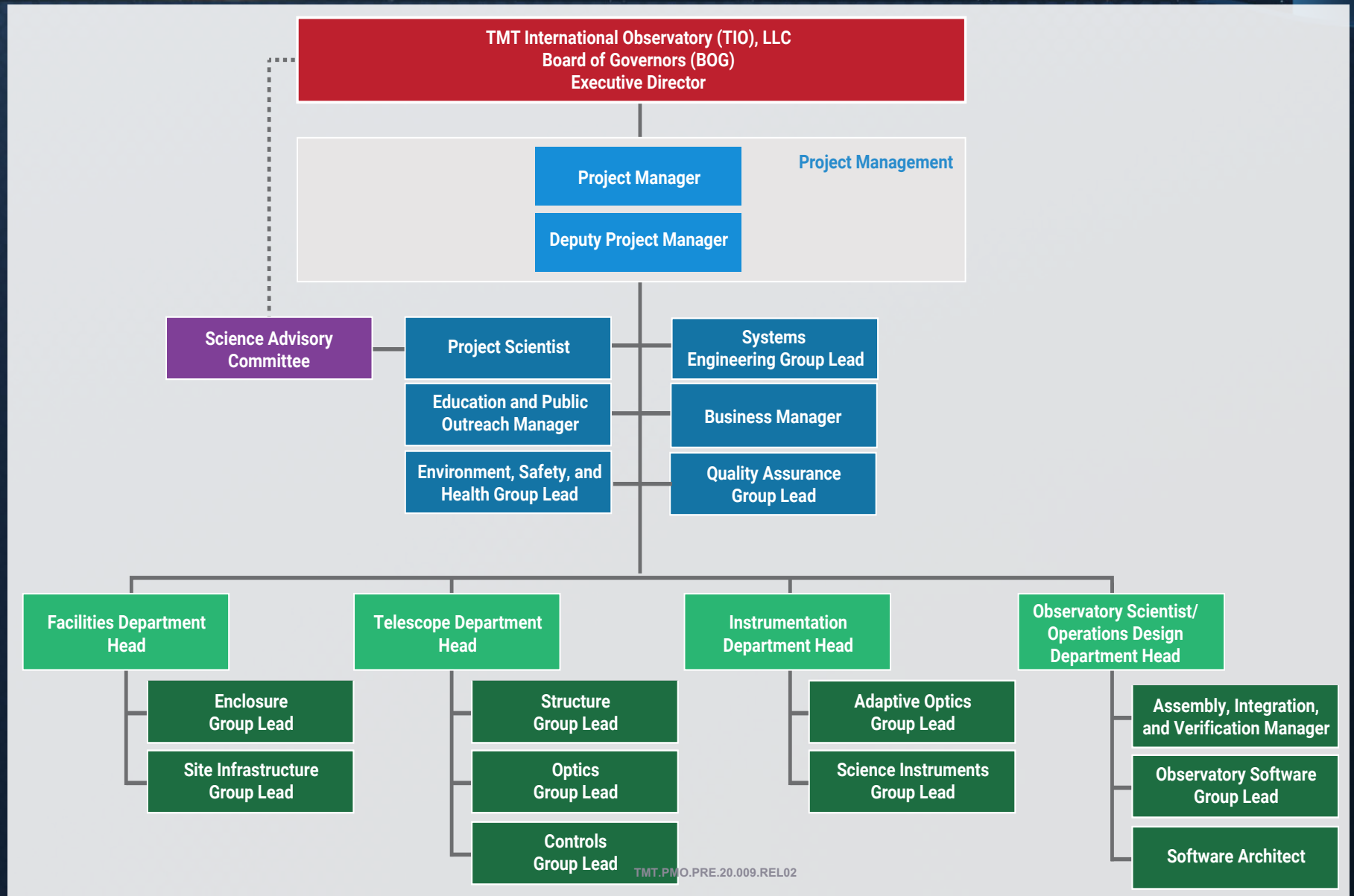




TMT is funded by a global public-private partnership

- Private: all-cash partners
  - Caltech, U. of California System (thanks to contributions from the Gordon & Betty Moore Foundation)
- Public: in-kind and cash government contributions
  - Japan's NINS/NAOJ;
  - India's DST/DAE;
  - Canada's NRC
  - China: NAOC, CAS Institutes, Universities
- US: NSF/AURA (TBD) potential all-cash partner in USELTP

Project Organization: Experienced Team Members



Project Control Using Signed Work Packages and Earned-Value Management

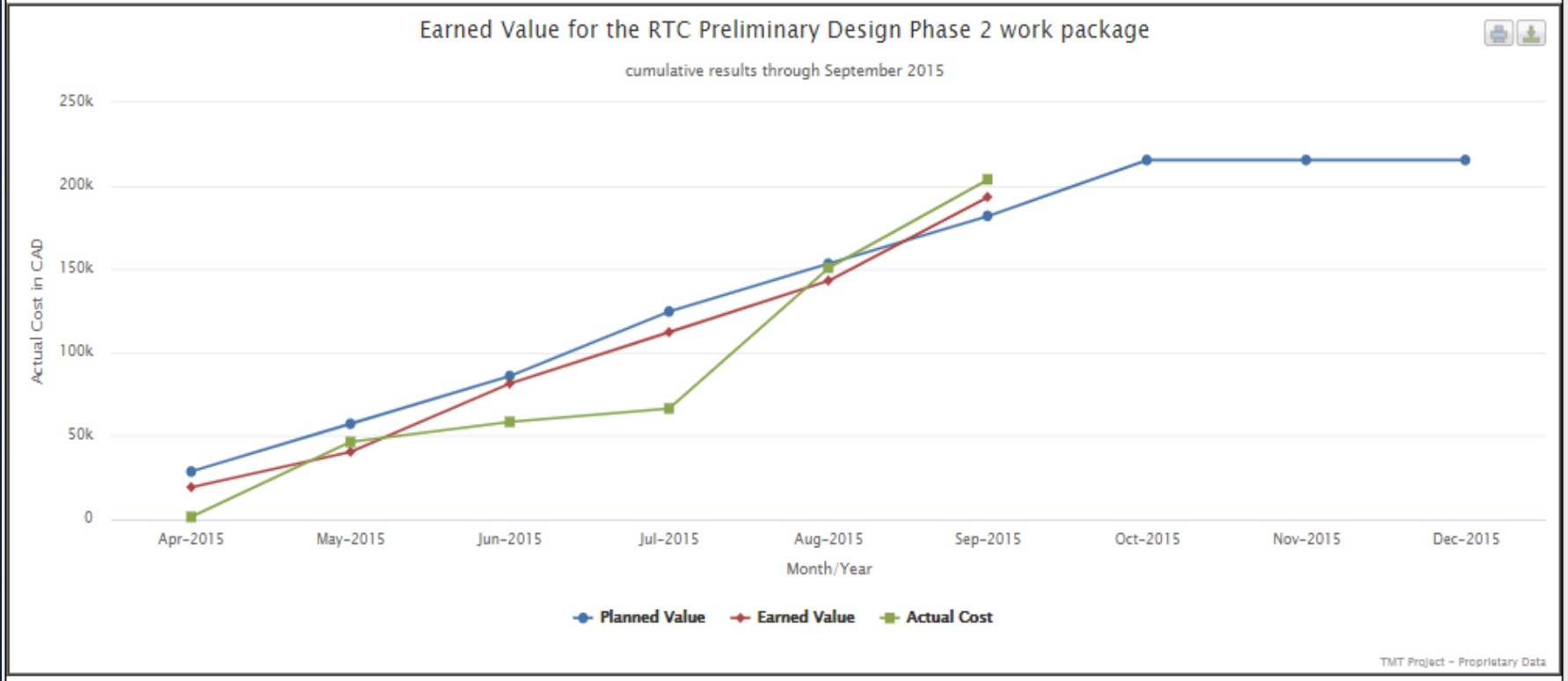
- Signed written Work Package (WP) Agreements define and agree to all tasks in construction phase;
- Earned-Value management to measure performance, to identify issues early

Cost Performance Report - Earned Value - Current Year Budget in CAD

Sep 2015 Monthly Results					Cumulative Results through Sep 2015					At Completion		
Work Scheduled	Work Performed	Actual Cost	Schedule Variance	Cost Variance	Work Scheduled	Work Performed	Actual Cost	Schedule Variance	Cost Variance	Budget at Completion	Estimate at Completion	Variance
$28,632	$50,126	$52,969	$21,493	$-2,843	$181,795	$193,152	$203,721	$11,358	$-10,568	$215,292	$227,071	$11,779

Cost Performance Index (CPI): 0.95

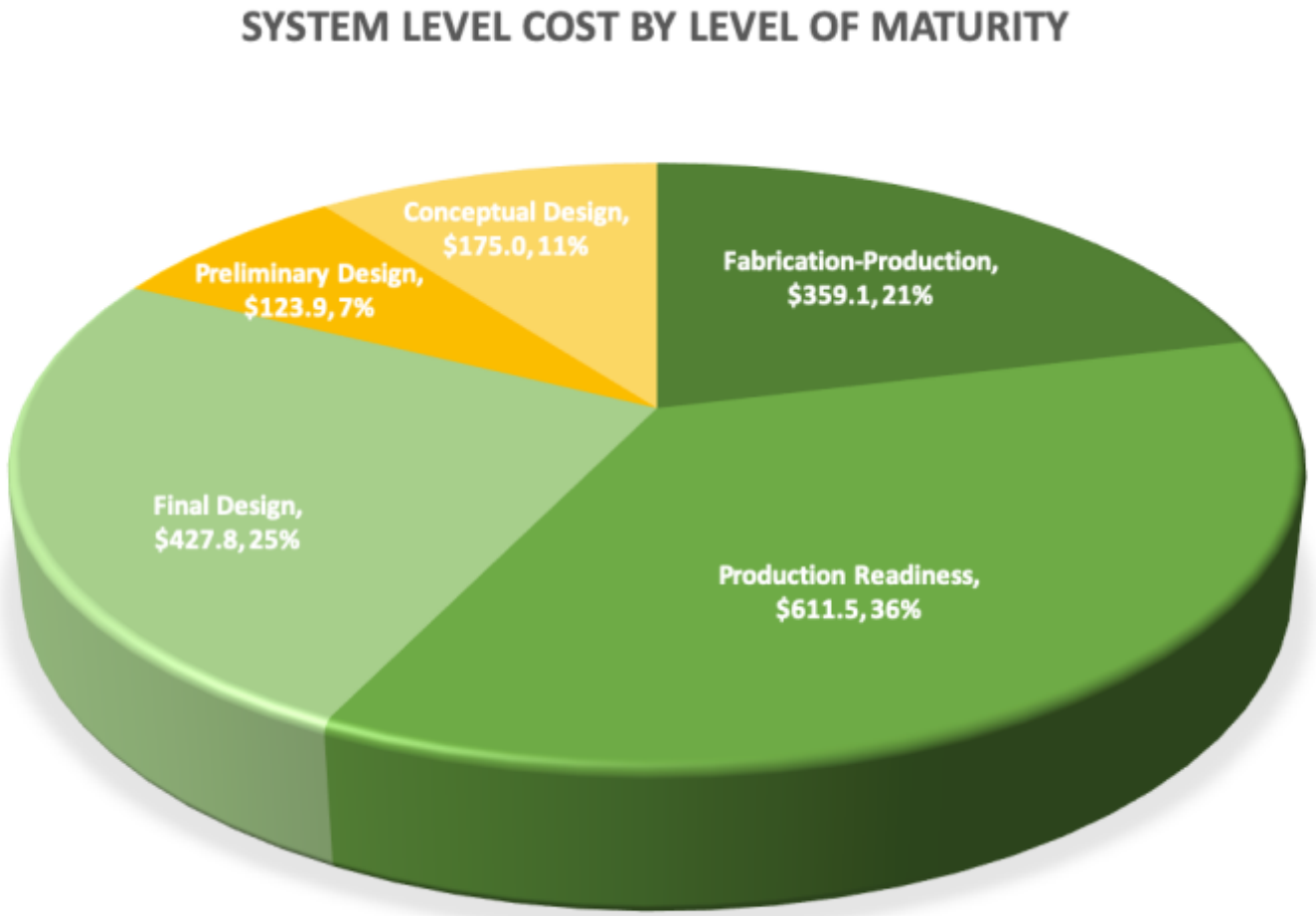
Schedule Performance Index (SPI): 1.06



All Enabling Technologies Are In Hand

- Segmented Primary Mirror System architecture
  - Keck heritage with TMT improvements
- Alignment and Phasing System
  - Keck heritage with TMT improvements implemented at Keck
- NFIRAOS Multi-Conjugate AO system architecture
  - led by experienced individuals from prior large telescope AO systems,
  - NFIRAOS deformable mirrors already in production
  - NFIRAOS Real Time Controller (RTC) is in fabrication
  - NFIRAOS VCAM high-order detectors are commercial off the shelf Sony detectors
  - Sodium lasers—commercial from TOPTICA/MPBC: superior performance/proven reliability

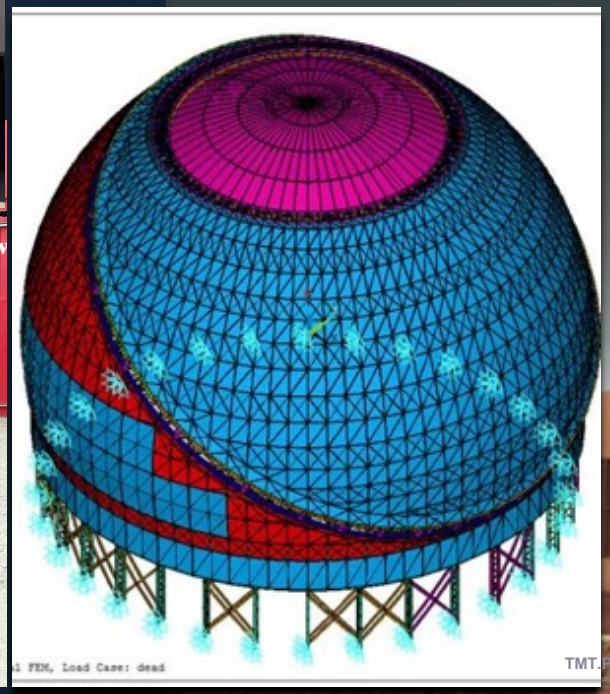
Design Is Mature



82% of the Total System is in Final Design, Production Readiness or Production as measured by Cost

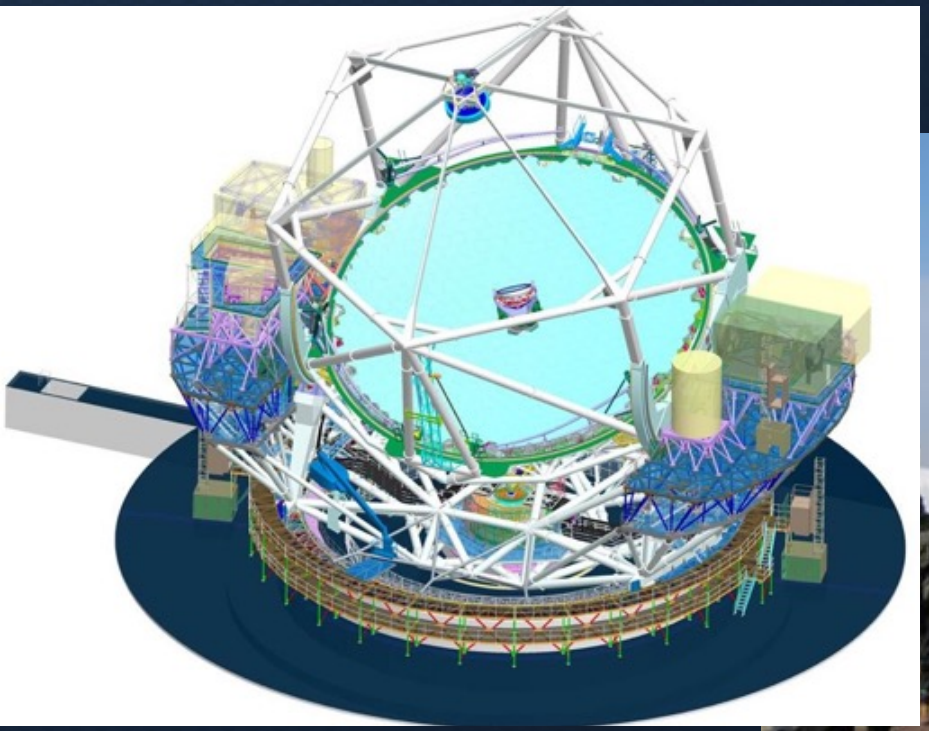
Enclosure Is Ready For Fabrication (Dynamic Structures Inc.)

- Passed Production Readiness Review (PRR-1) on 1/30/2020; PRR-2 (2/18/2020) on Safety
- Extensive analysis, modeling, simulation and prototyping; technical risks addressed for MK, lower seismic risk for ORM

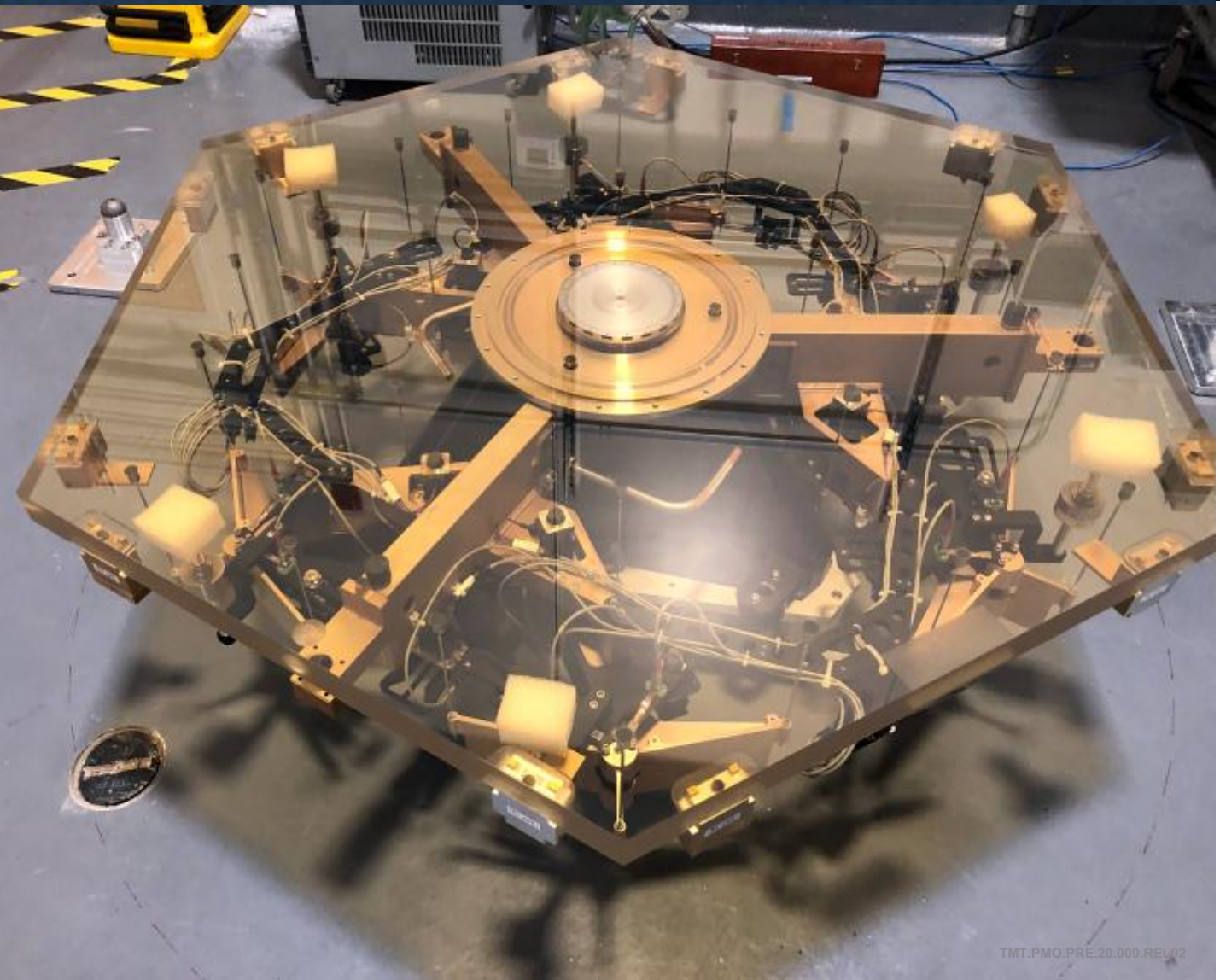


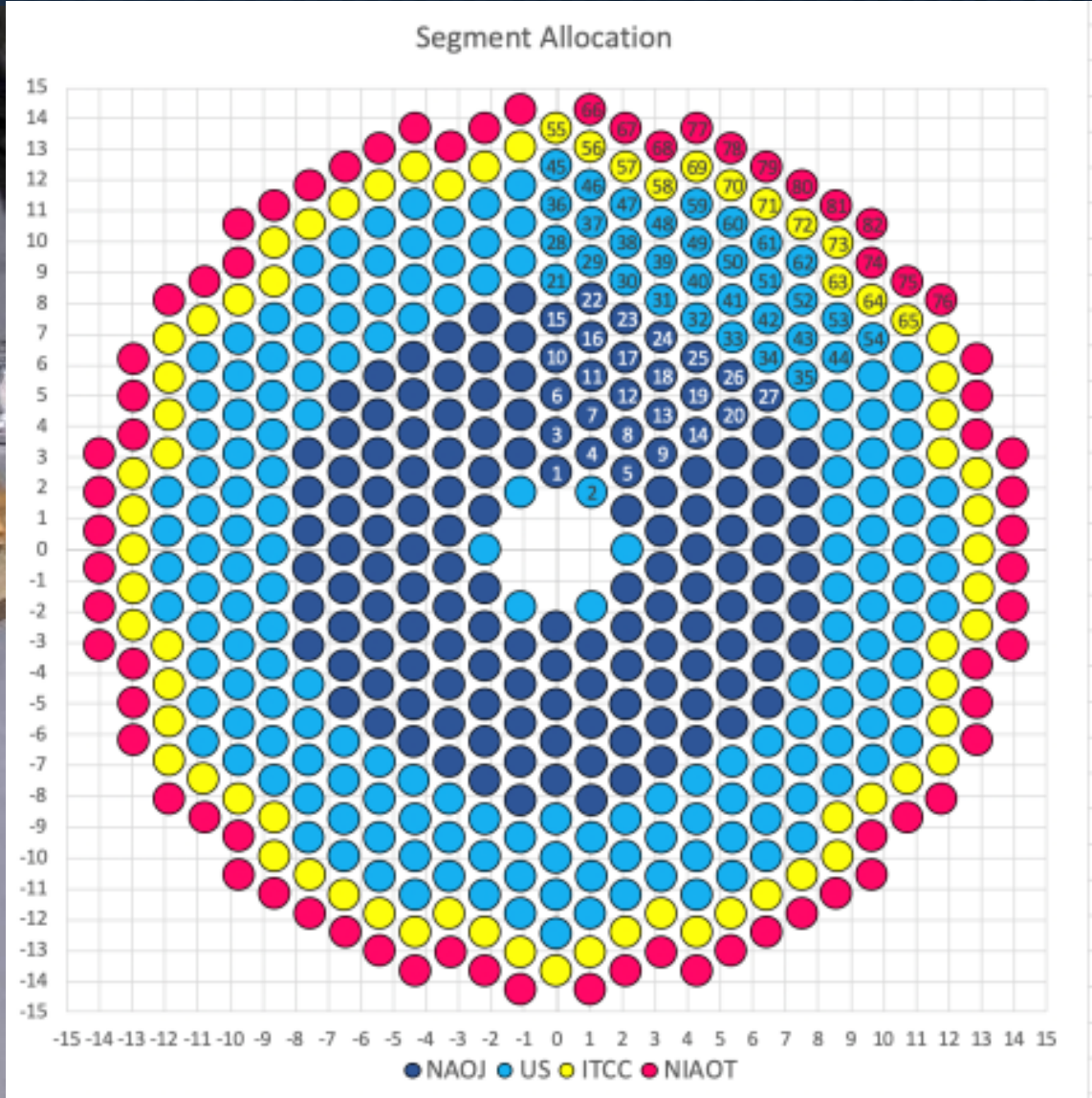
Telescope Structure Is Ready for Fabrication

- Passed Final Design Review (FDR) on 11/15/2019; PRR-1 (long-lead elements) on 3/11/2020
- Extensive analysis, modeling, prototyping; technical risks addressed for MK, lower seismic risk for ORM



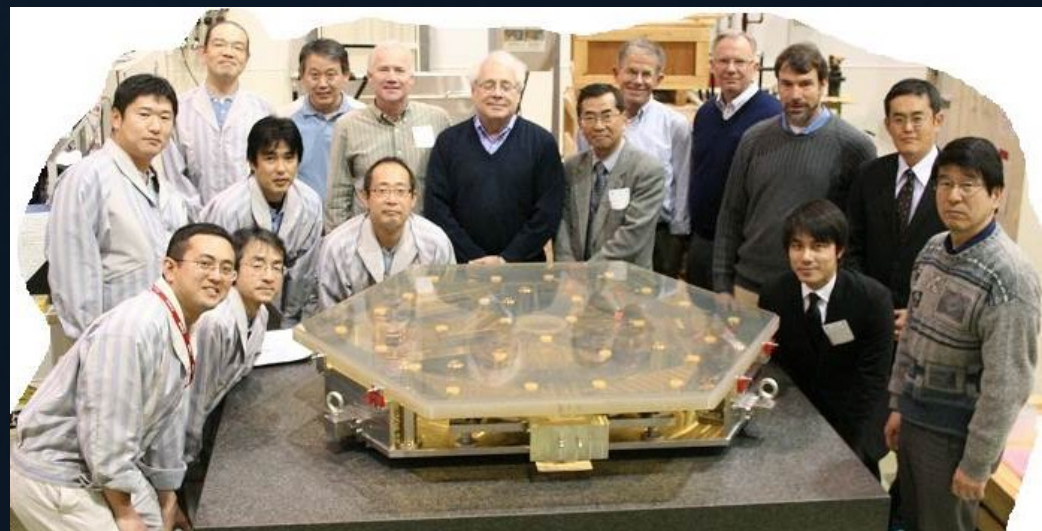
Primary Mirror Segments Are In Production





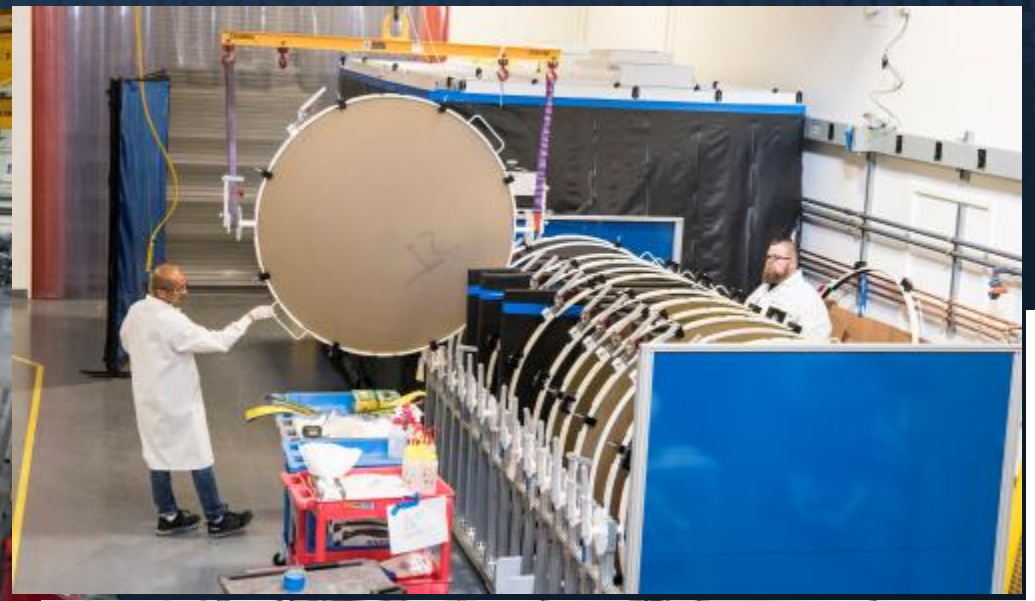
356 Ohara Blanks (62%) Are Delivered / In Processing
(~4 year polishing supply, or filling 24m with spares)

- Canon polished 30 roundels;
- Shiba started hex-cutting;

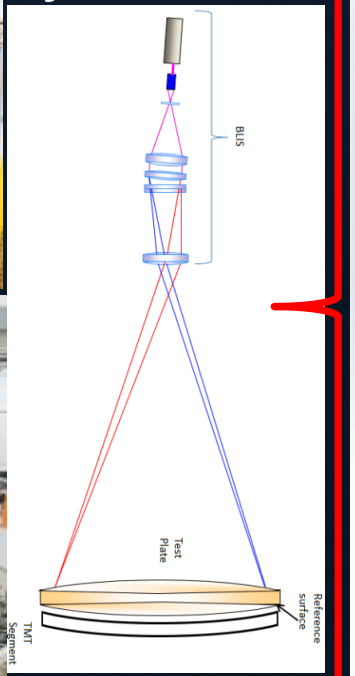


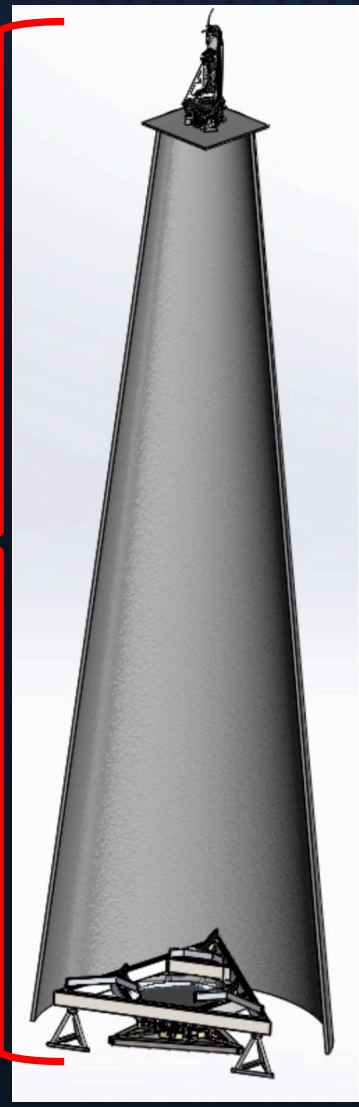
COHERENT is under fixed-price contract for polishing, Hex-cutting

USELTP



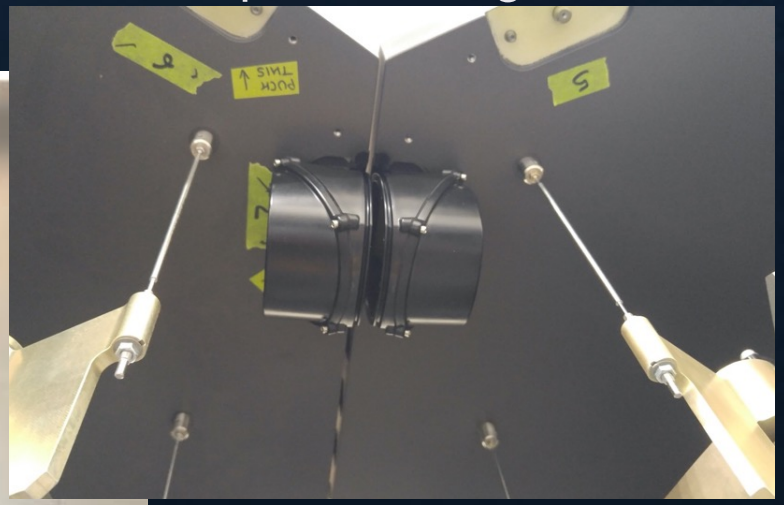
Arizona Optical Systems (AOS) final metrology system





Multi-Segment Integration and Test Facility (MSIT)

- In TIO laboratory to test assembly and installation procedures, control elements for risk reduction;
- Shown are seven segments (production SSAs + Al dummy mirrors) installed, capacitive edge sensor housings across gap.



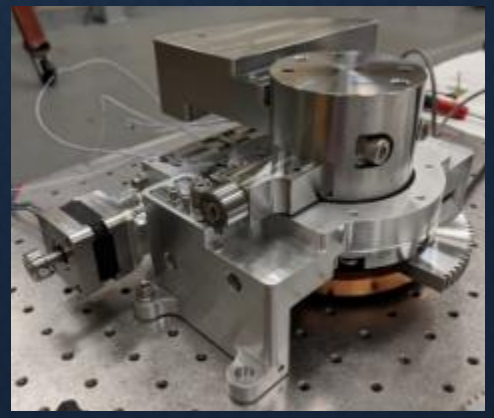
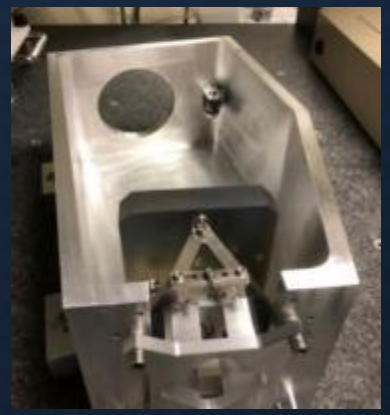
Facility MCAO System NFIRAOS Is Ready for Fabrication at NRC

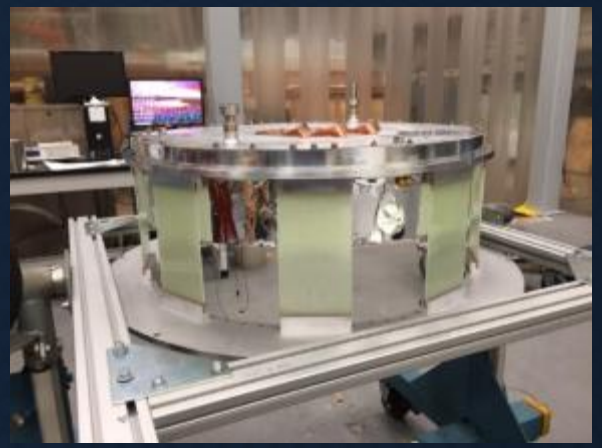
- Passed FDR in 2018; Passed Optics Fabrication Readiness Review (FRR) in 2019;
- Large performance margins supported by extensive analysis, modeling, simulation and prototyping;

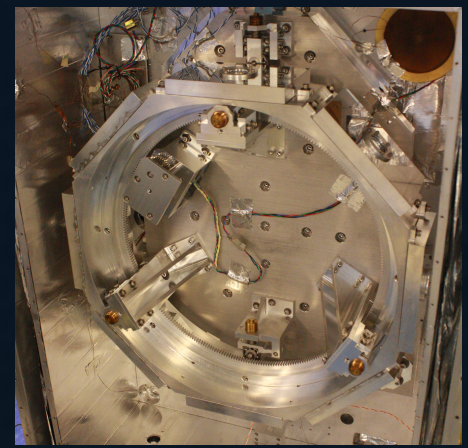
Canada-NRC completed a large I&T facility for NFIRAOS (investment outside of TMT cost book)

First-Light Science Instrument
IRIS is completing Final Design in May, 2021

- Completed PDR in late 2017; UCLA+Caltech+NAOJ+China+Canada
- Risk addressed with large performance margin, extensive analysis, modeling, simulation, prototyping
- To be integrated and tested with NFIRAOS at NRC before shipping to the site.

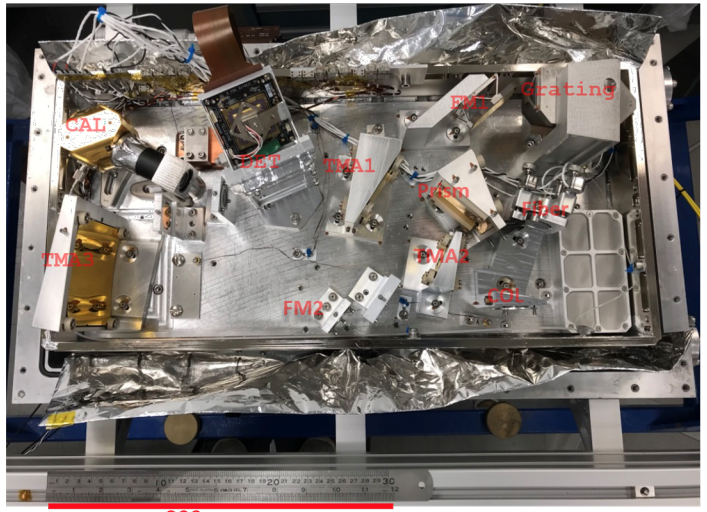



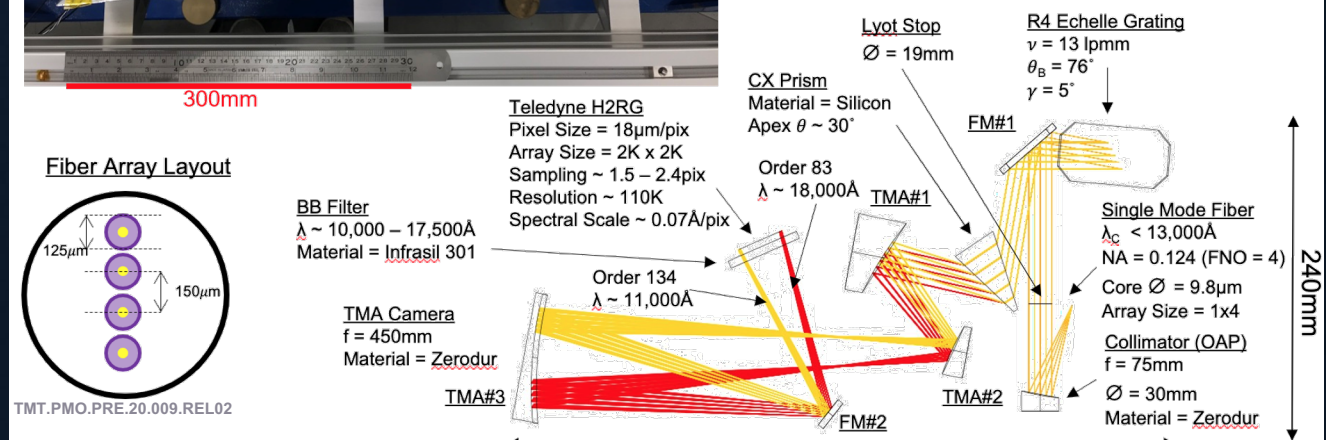



First-Light Science Instrument MODHIS in Conceptual Design

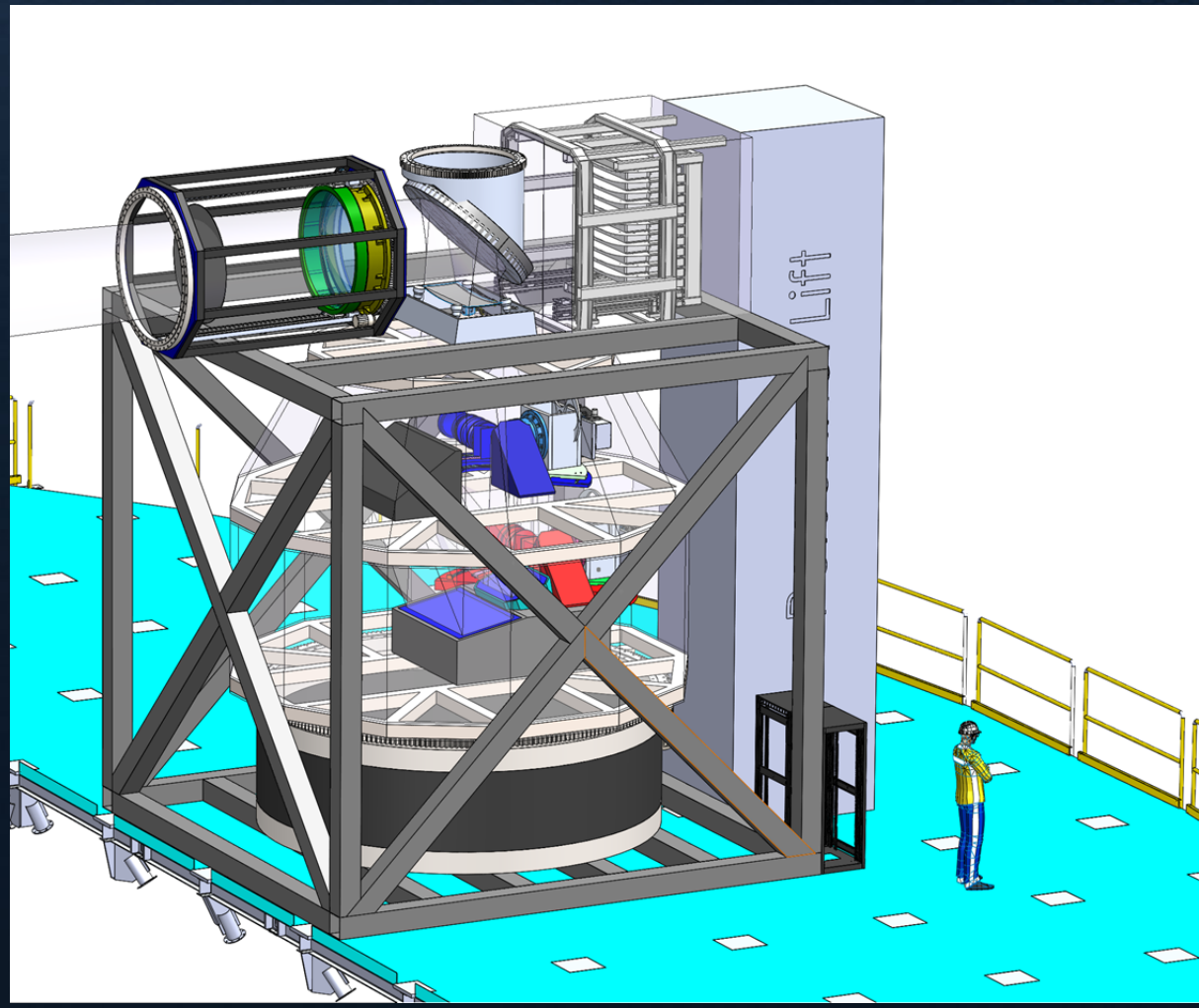
- Selected in 2019 to enhance TMT's exoplanet capability; Caltech+UCSD+UCLA+Canada+Japan;
- Single mode fiber fed, diffraction-limited spectrograph, size independent of telescope aperture;
- Heritage from similar PARVI instrument operating on Palomar, with an upgraded instrument under consideration for Keck





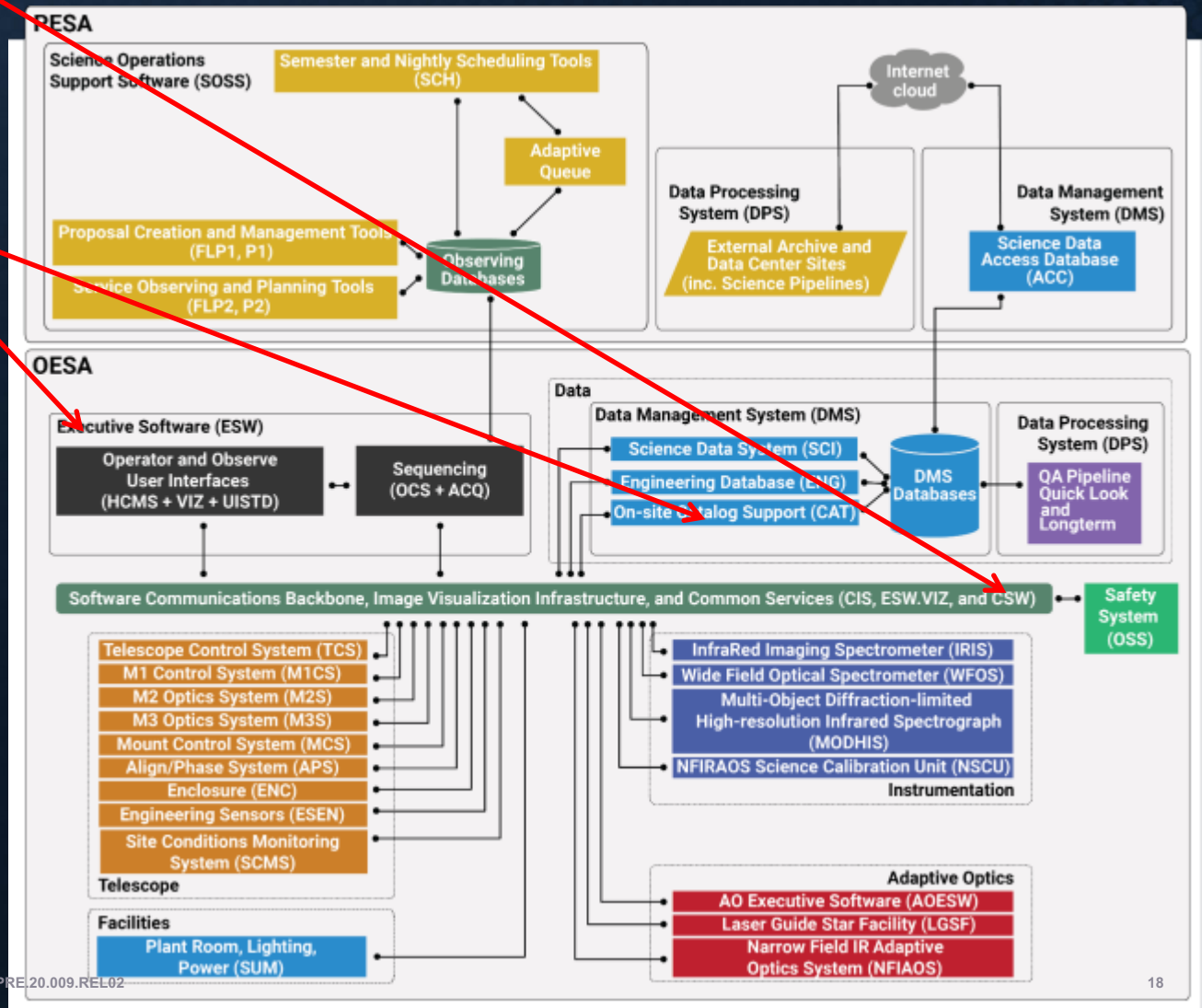
First-Light Science Instrument WFOS is Completing Conceptual Design in May 2021

- UCSC+Caltech+China+India+Japan;
- Completed a thorough design optimization in 2018; with on-axis FOV, efficient layout, gravity invariant configuration and reduced complexity
- Completed Optomechanical, Requirements, Operational Concepts Conceptual Design Review (CoDR) in 5/2020;
- Final CoDR in May, 2021.

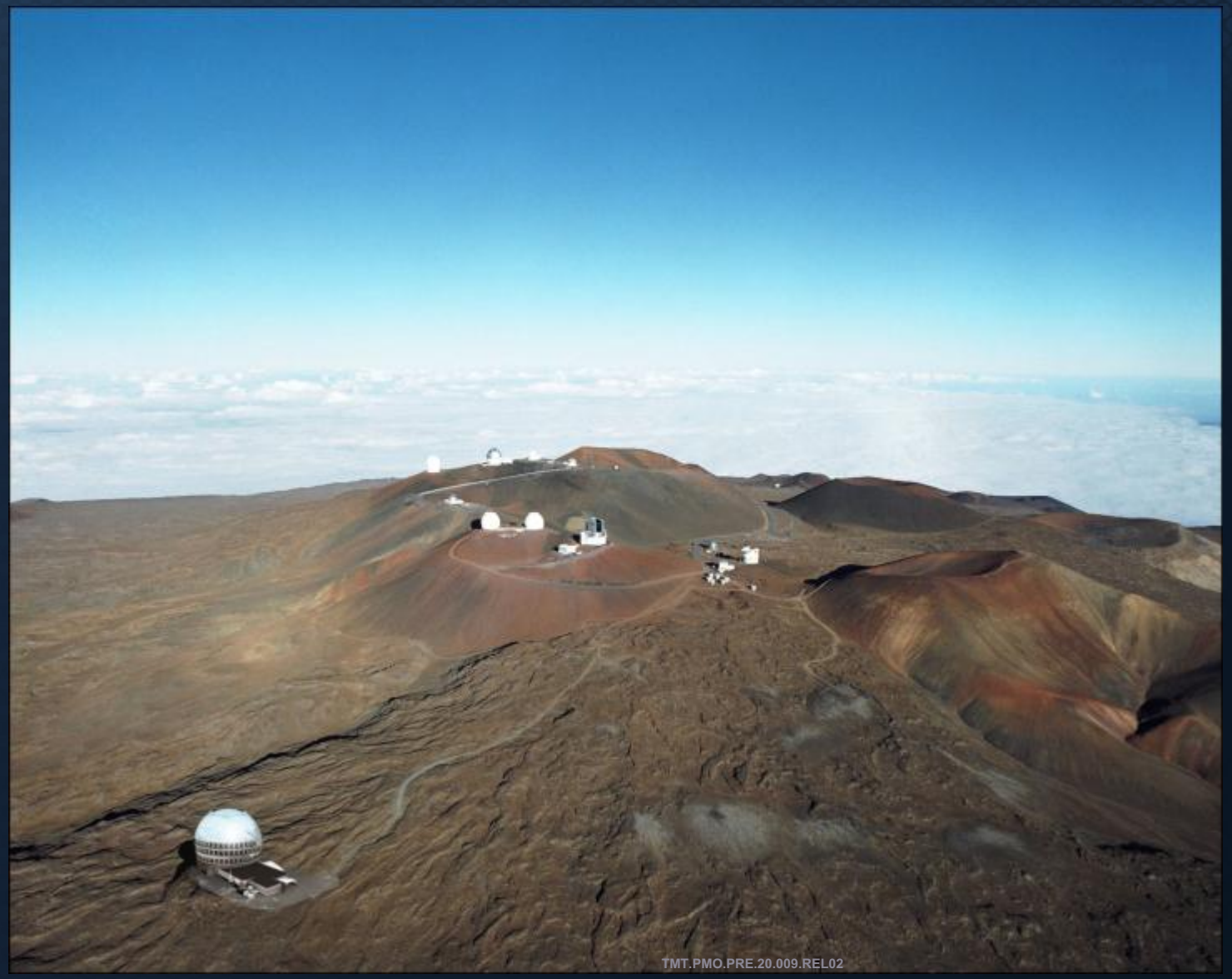


Already Delivering Observatory Software Subsystems

- Common Software (CSW) subsystem already delivered; backbone for all TMT software
- Executive Software (ESW) subsystem passed PDR May 2019; FDR in 2021
- Data Management Software (DMS) Guide Star Catalog is being prototyped now
- Software Test and Integration Laboratory (STIL) running for all TMT software test/verification.



TMT Mauna Kea Site Preferred



THIRTY METER TELESCOPE

CIVIL PACKAGE

CONSTRUCTION DOCUMENTS

MAUNA KEA, HAWAII

NOVEMBER 30, 20
TMT.SUM.DWG.14.001.REL

PROJECT LOCATION:	MAUNA KEA LOOP ROAD
TAX MAP KEY AND DISTRICT:	3-4-4-15:9, HĀMĀKUA DISTRICT
LEGAL PROPERTY OWNER:	STATE OF HAWAI'I
TENANT NAME:	TMT INTERNATIONAL OBSERVATORY, LLC
TENANT MAILING ADDRESS:	100 W. WALNUT ST. SUITE 300 PASADENA, CA 91105
TENANT PHONE NUMBER:	(626)395-1602

TMT is under contract and shovel ready

THIRTY METER TELESCOPE

Project Manual

for the

THIRTY METER TELESCOPE

Mauna Kea, Hawaii

Civil Package

TMT.SUM.SPE.13.001.DRF01

November 30, 2018
Revision 2

DANIEL H. NEFF
REGISTERED PROFESSIONAL ENGINEER
NO. C-7714
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION AND CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION.

SIGNATURE

M3-PN07131

M3 Engineering & Technology Corporation ❖ 2051 W. Sunset Road, Ste. 101 ❖ Tucson, Arizona 85704 ❖ 520-293-1488

Roque de los Muchachos Observatory (ORM): TMT Alternate Site

THIRTY METER TELESCOPE

CIVIL, ENCLOSURE FIXED BASE, SUMMIT FACILITY AND UTILITY BUILDING

DESIGN DEVELOPMENT SUBMITTAL

OBSERVATORIO DEL ROQUE DE LOS MUCHACHOS, ISLAS CANARIAS, ESPANA

LEGAL PROPERTY OWNER:	OBSERVATORIO DEL ROQUE DE LOS MUCHACHOS
TENANT NAME:	THIRTY METER TELESCOPE OBSERVATORY CORPORATION
TENANT MAILING ADDRESS:	100 W. WALNUT ST. SUITE 300 PASADENA, CA 91125, USA
TENANT PHONE NUMBER:	(626) 395-1602

TMT stands ready for geotechnical study on-site, followed by full civil work.

Technical Specifications, Design Development

TMT.SUM.SPE.17.001.DRF01

Thirty Meter Telescope Facilities at Observatorio del Roque de los Muchachos

TMT International Observatory, LLC (TIO)

M3-PN160051 : Issued August 25, 2017 : Revision 0

Prepared by:
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Closing Remarks

- TMT technical maturity is high, shovel-ready pending site access;
- The partnership is working hard to advance design and fabrication;
- TMT is excited to be part of USELT: leveraging international public-private partnership to offer the US astronomy community all sky access to an extraordinary next generation optical/infrared astronomy.


https://noirlab.edu/public/projects/useltp/
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