

Thirty Meter Telescope (TMT) Open House

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TMT Status

- ◊ Location, location, location
 - ◆ Hawai'i
 - ◆ La Palma as primary alternative site
- ◊ Schedule
- ◆ US community engagement and the NSF-TMT cooperative agreement
- ◆ Q&A

TMT Overview

- ◆ 30-meter diameter primary composed of 492 1.44m hexagonal segments
- ◆ R-C design produces 20 arcmin field at Nasmyth platforms
- ◆ Three planned first-light instruments
- ◆ 173-page Detailed Science Case
<http://adsabs.harvard.edu/abs/2015RAA....15.1945S>
- ◆ <http://www.tmt.org>

TMT Partnership

◆ Members

- ◇ Canada, National Research Council
- ◇ California Institute of Technology
- ◇ China, Chinese Academy of Sciences
- ◇ India, Department of Science and Technology and Department of Atomic Energy
- ◇ Japan, National Institutes of Natural Sciences
- ◇ University of California

◆ Associate

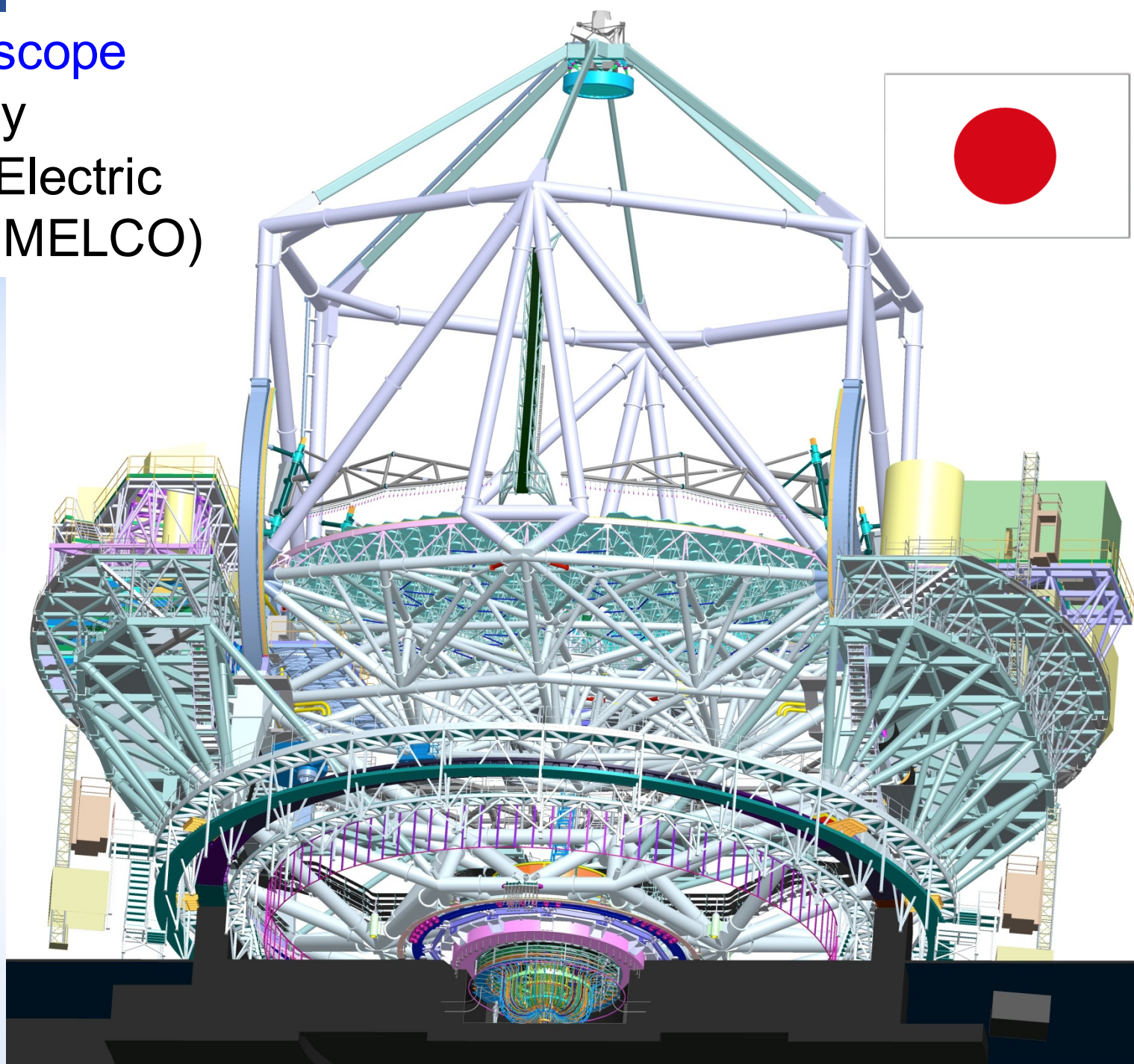
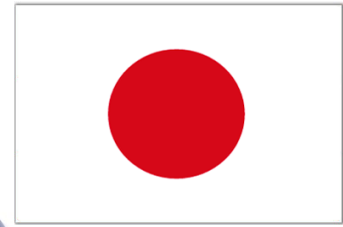
- ◇ NOAO/AURA consistent with the US NSF Cooperative Agreement

◆ Observers

- ◇ University of Hawaii, Gordon and Betty Moore Foundation

◆ Partners formed a limited liability company in 2014 (TMT International Observatory, LLC) in order to construct and operate the TMT Observatory

- TMT Telescope
Structure by
Mitsubishi Electric
Company (MELCO)



TMT Telescope Structure Main Structural Node



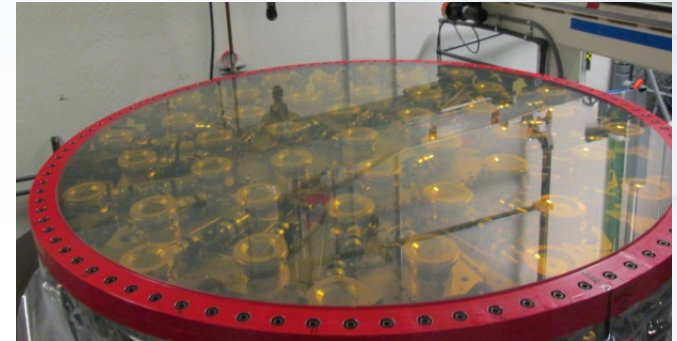
Primary Mirror (M1) Segment Blank Production



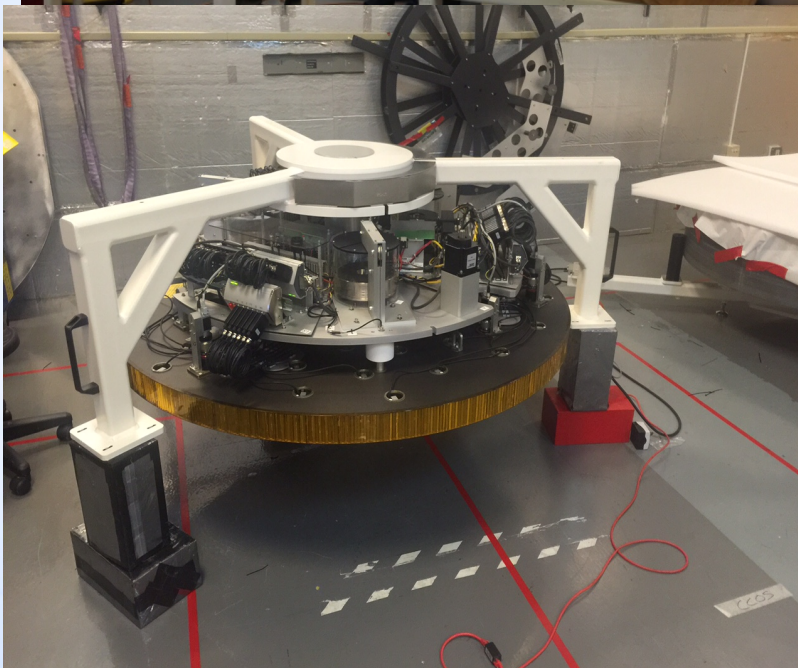
- ◆ Ohara is producing blanks that meet all our requirements



Segment Polishing - Tinsley



Stressing Fixture



Polishing the stressed segment with a spherical tool

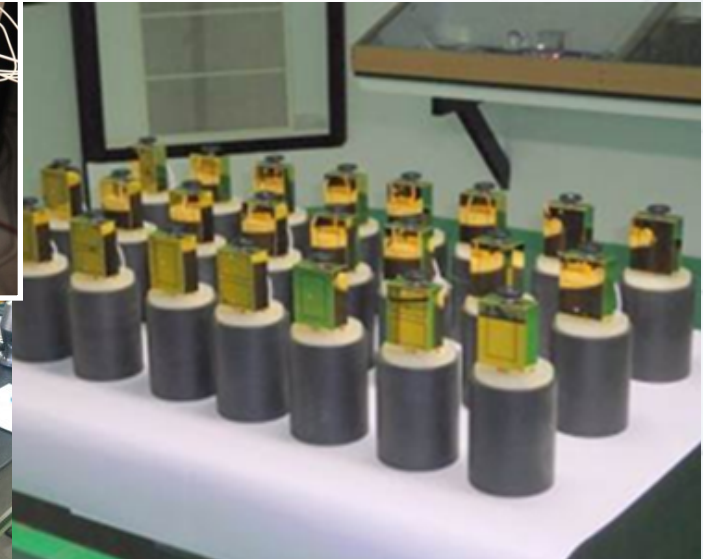
Primary Mirror Control System JPL, TMT-India



- ◆ Jet Propulsion Laboratory is responsible for the system design
- ◆ India is responsible for production of actuators, sensors, electronic

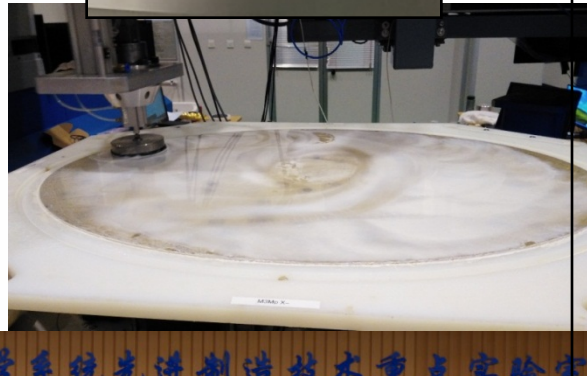
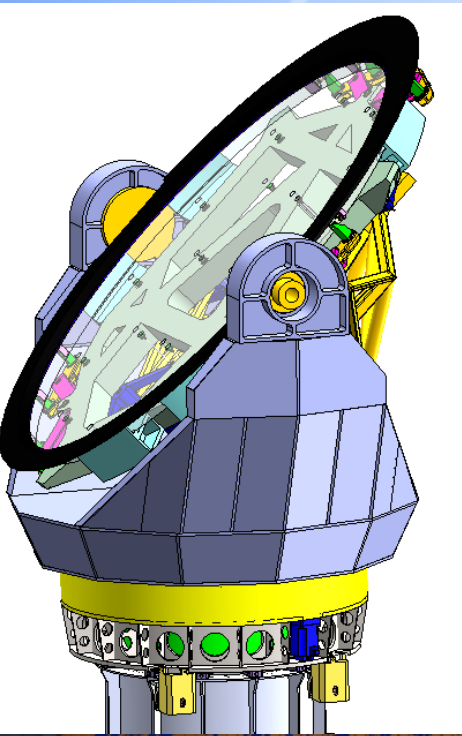


Actuator components



Edge sensors

M3 System at CIOMP, Changchun (1/4 scale functional prototype underway)



Positioner CAD model and parts



Tilt Axis Brake Disks



Parts for Cradle Assembly



Stationary Base



Rotator Bearing Races



Cablewrap Pinon Gears



Yoke Assembly



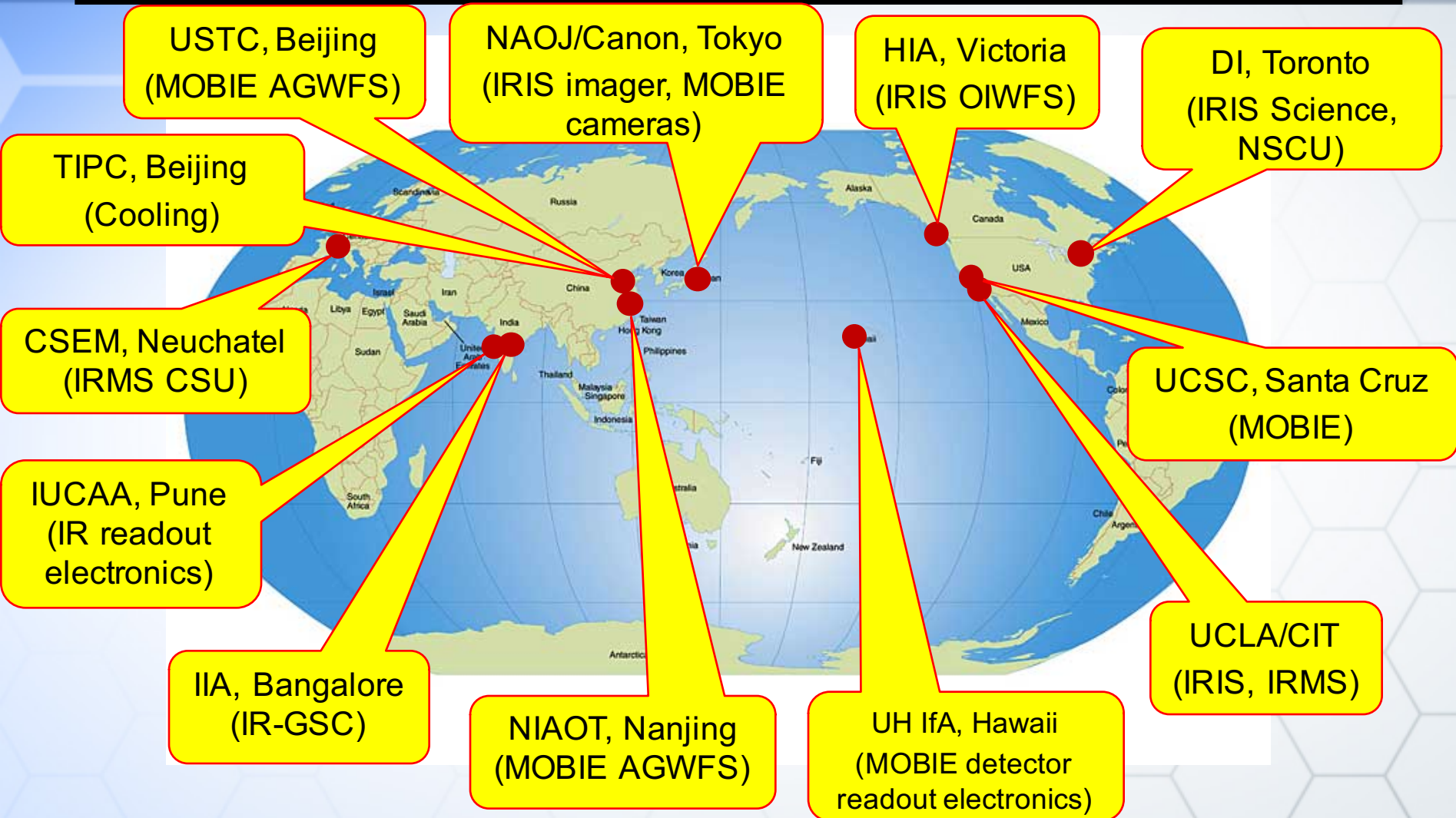
Stationary Middle Base



Tilt Axis Spindle




TMT Global Participants – First Light Science Instruments



Hawaii: short version of a long story

- Mauna Kea holds a special place in Hawaiian culture
- Started the permitting process in 2007 with many trips and talking to many people. Major issues: environmental stewardship, coexistence with cultural practices, shared economic benefits. New way of doing business.
- Final approval of all legal steps: July 23, 2014



Hawaii cont

- With permit and sublease in place, construction was to be initiated in Spring 2015
- Protests stopped construction vehicles on three different occasions
- December 2, 2015 Hawaii Supreme Court vacated the permit on procedural grounds
- A second Contested Case hearing and a second vote by the State of Hawaii Land Board is required to get new permit
- If new permit is issued, it will likely be challenged in court and go directly to the Hawaii Supreme Court

TMT Contested Case II

- Contested Case Hearing was started on Oct 2016 and so far there have been 23 days of testimony and cross examination.
- Eleven of 83 witnesses have completed testimony
- You can watch every minute here:

<http://www.naleo.tv/vod/>

Because of uncertainties in the outcome and pacing of the CCH and likely legal appeals that would follow, it was decided to evaluate potential alternative sites and select one as the single alternative site



Video player interface showing a man speaking at a table with a microphone and laptop. The video title is "BLNR CDUA Contested Case Hearing - Thirty Meter Telescope". The player includes a play button, a progress bar (46:59 / 160:23), and controls for share and resize.

Maunakea remains the preferred site and all efforts are being made to regain access



Alternative Site Studies

- ◆ In February 2016 started investigation of two sites in Chile, Ali in China, Hanle in India, San Pedro Martir in Baja and Roque de Los Muchachos Observatory in the Canary Islands.
- ◆ Criteria for alternative site are many
 - ◇ Science reach
 - ◇ Feasibility of building TMT at site
 - ◇ Cost of construction and operations
 - ◇ Schedule for initiating construction
 - ◇ Low risk in obtain permits
 - ◇ Legal status of TIO to carry out construction and operations

Alternative Sites cont.

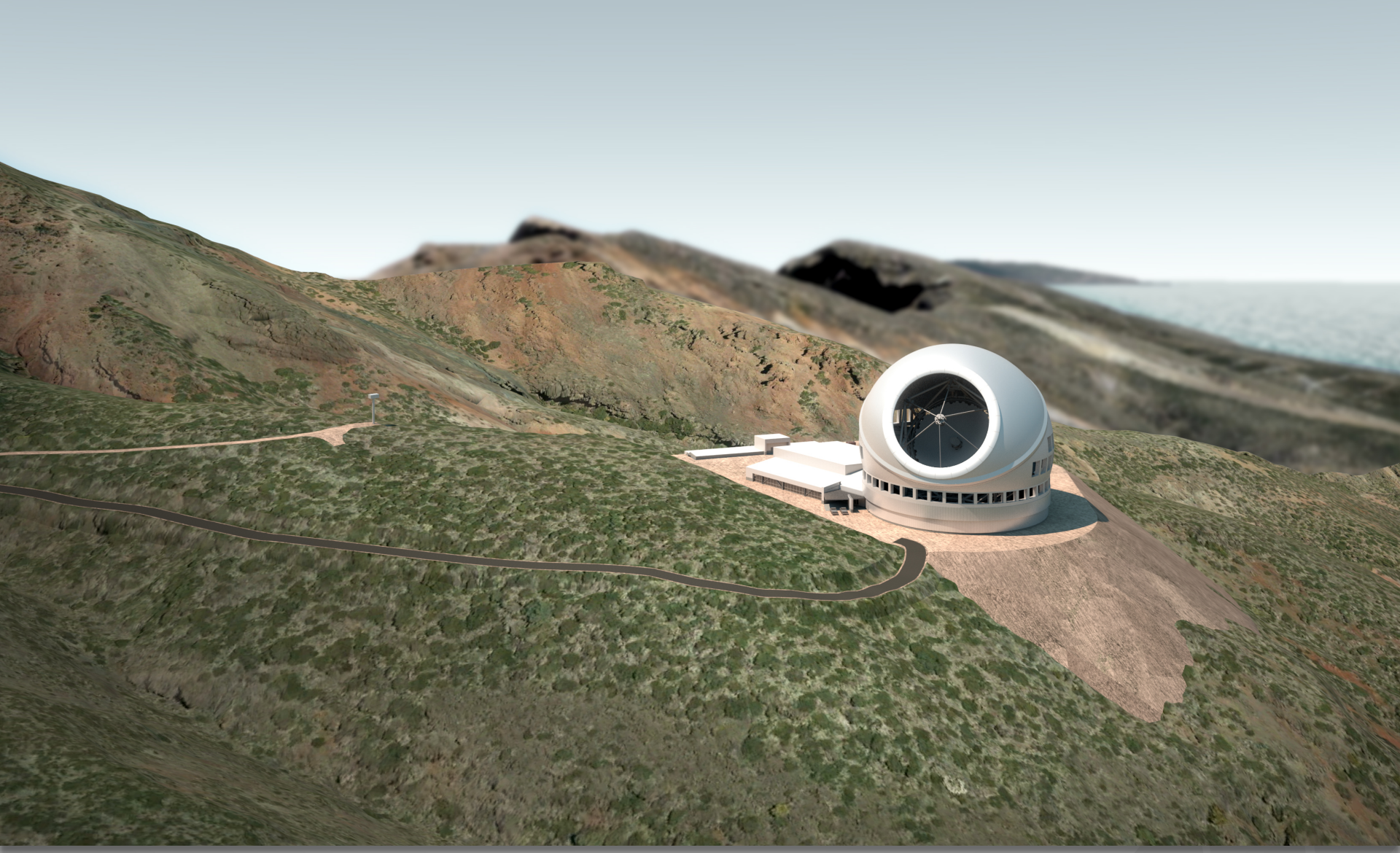
- All sites considered were excellent in terms of science capabilities for the TMT and the potential host countries were welcoming and very easy to work with
- Multiple trips to Spain, Mexico and Chile by Board-level delegations and technical teams
- After 10 months of intense activity, ORM in the Canaries was selected as the single alternative site



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TMT Alternate Site Investigations

Observatorio del Roque de los Muchachos

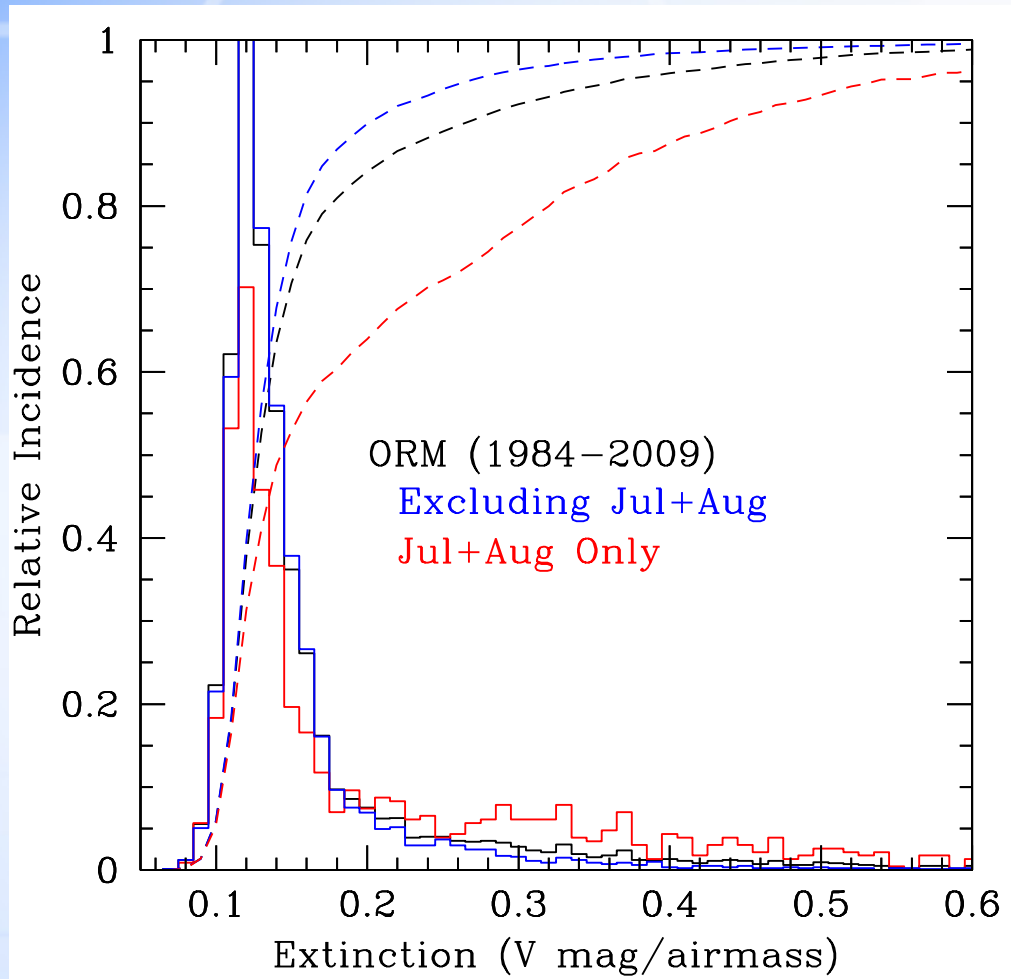


ORM on La Palma

- ◆ Similar CN^2 profile and τ_0 values as Maunakea (relevant to AO correction)
- ◆ Similar fraction of clear nights as Maunakea
- ◆ Lower elevation (2400m vs 3960m)
- ◆ Higher mean temperature
- ◆ Higher declination (28.9° vs 19.8°)

Observations are compromised for longer wavelengths because of the lower elevation and higher temperature

ORM – Effect of Dust on Science



Carlsberg Meridian Telescope at ORM measurements over the past 25 years :

Median, IQR Extinction (mags)

0.132 ± 0.020 (total)

0.130 ± 0.017 (Excl. Jul/Aug)

0.150 ± 0.084 (July+Aug)

Cf. 0.115 (MK); 0.130 (Paranal);
 0.141 (CTIO); 0.145 (SPM)

ORM

- ORM is operated by the Instituto de Astrofísica de Canarias and is the home to nine telescopes including the 10.2-meter Gran Telescopio de Canarias.
- It was recently selected as one of the sites for the Cherenkov Telescope Array
- ORM is the site for which it is most feasible to undertake a quick start for the case Hawaii does not work out and it has the shortest projected construction schedule. This is due in large part to the accessibility of ORM and the existing infrastructure in Tenerife and Santa Cruz de La Palma.

Where is this heading?

- ◆ Completing a Hosting Agreement for ORM and initiating detailed construction replan and permitting processes
- ◆ Full participation in Hawaii Contested Case Hearing and any legal proceedings that follow assuming a new permit is issued
- ◆ Need to have “reasonably assured access” to a site by Fall of 2017 for proposals for 2018 budget
- ◆ Firm goal to initiate construction in April 2018

US Community & TMT

- ◆ Caty Pilachowski (Indiana University) & Dave Silva (NOAO) are AURA representatives to the TIO Board
- ◆ SAC Representatives
 - ◇ Mark Dickinson (NOAO)
 - ◇ Ian Dell'Antonio (Brown)
 - ◇ Karen Meech (Hawaii/IFA)

- ◆ Your TMT SAC and TIO Board representatives participated in discussions of alternate sites
- ◆ Maunakea remains the preferred choice
- ◆ Why is ORM the best alternative?
 - ◇ most expedient path to construction and first light
 - ◇ Need for access to the northern sky
 - ◇ Best AO performance among northern alternate sites
 - ◇ But reduced efficiency for mid-IR and near-UV science desired by the US community

US Participation Plan

- ◆ Draft delivered to NSF in May 2016 - review on hold until the TMT site situation is clarified
- ◆ Three main documents:
 - ◇ Report of the US TMT Science Working Group (SWG)
 - ◆ Science case for US national participation
 - ◆ Maximize benefits to the US community
 - ◇ Business and governance options
 - ◇ Workforce, EPO, & communication plan

- $\geq 20\%$ TMT participation share (60 nights/year), with a minimum of 10%
- Cross-partnership TMT large / key projects
- Ensure use and re-use of TMT data
- A mix of classical and condition-adaptive queue scheduling

- ◆ Consistent, long-term, open access
 - ◇ Create & lead observing programs
 - ◇ Remain competitive in the worldwide GSMT era
- ◆ Full participation in TIO governance and scientific planning
- ◆ Access to TMT data archive
- ◆ Participation in international TMT key projects
- ◆ Enhanced opportunity to participate in developing TMT instrumentation

Annual call for ISDT membership now open!

Applications due *20 January 2017*

Information and instructions at:

<http://www.tmt.org/about-tmt/international-science-development-teams>

(Google: "TMT ISDT")

US community members welcome!

Fundamental Physics & Cosmology
Early Universe, Galaxy Evolution, and the IGM
Milky Way and Nearby Galaxies
Supermassive Black Holes
Stars, stellar physics, and the ISM

Formation of Stars & Planets
Exoplanets
Our Solar System
Time Domain Science

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