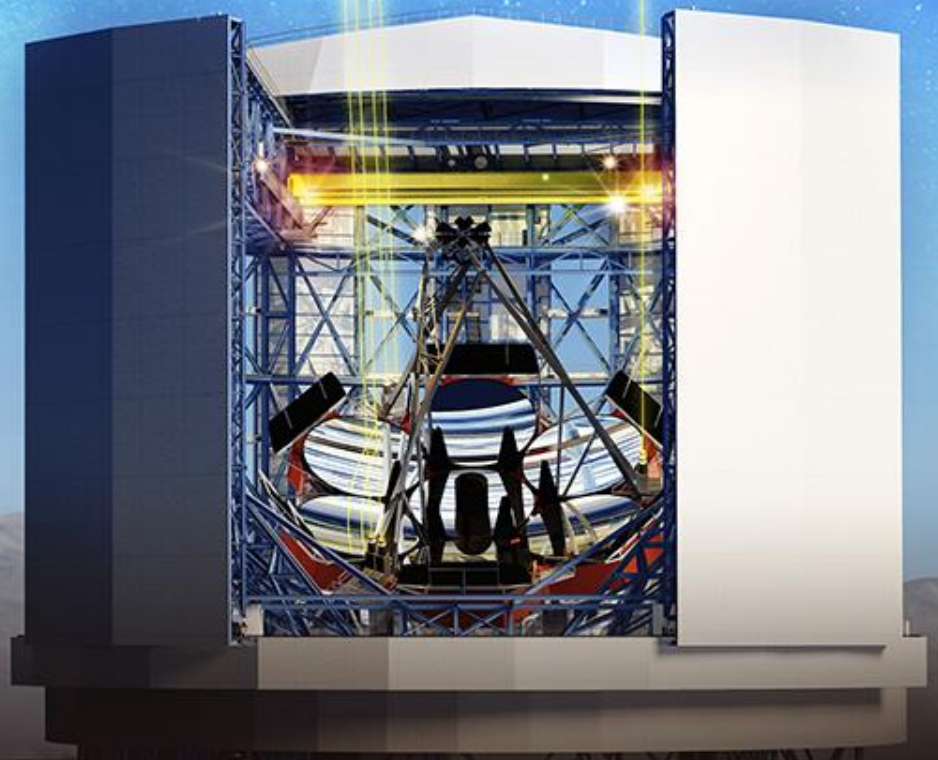
GMT Project Status

Astro2010 Midterm Assessment



Patrick J. McCarthy
Project Director and Interim President
Taft Armandroff
Chair, GMTO Board of Directors

Topics for Today

Topics for Today's Presentation:

- Founders and funding commitments
- Project Status
  - *Science Drivers, Management, Construction Activities*
- Options for Community Participation through Public Funding
- Outreach and Community Building

Three Questions from the Committee:

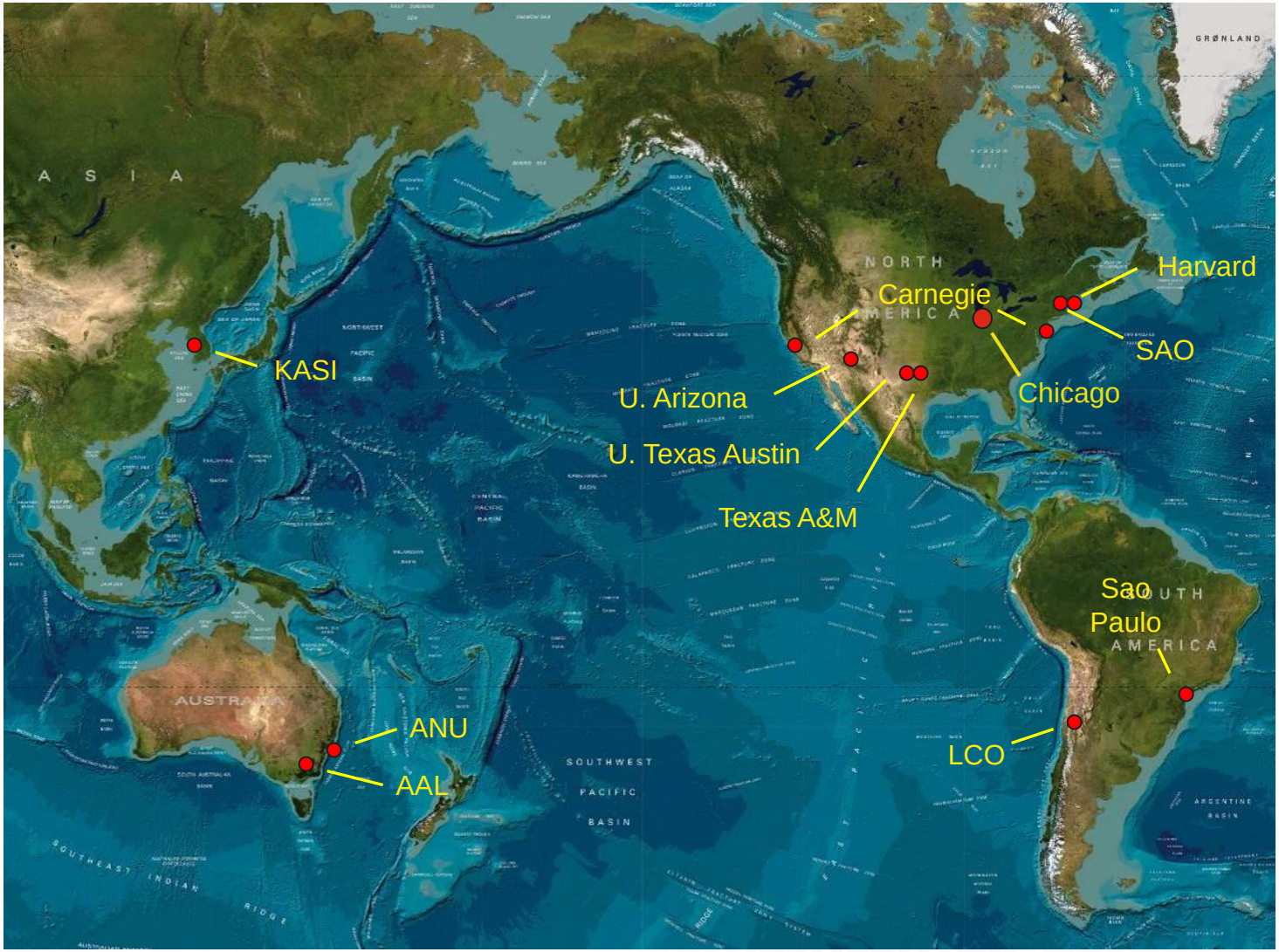
1. How does GMT address the priorities in NWNH?
2. What is the status of Design/Construction and funding?
3. Will the project seek funds from the NSF?
   3a. If so, in what form? (Construction, instruments, operations, archiving)

Giant Magellan Telescope Organization

GMTO is a US non-profit formed to construct and operate the GMT

- Founders contribute cash to GMTO
  - Project is executed on a *cash-basis*
    - *In-kind contributions are less than 2% of the total budget*
    - Contracts are bid competitively world-wide
- 50% of the full budget pledged by the Founders
  - *Irrevocable cash commitments*
- 70% of the full budget covered by Founders' stated intentions
- Active fundraising and new partner recruitment underway

GMT Founder Institutions



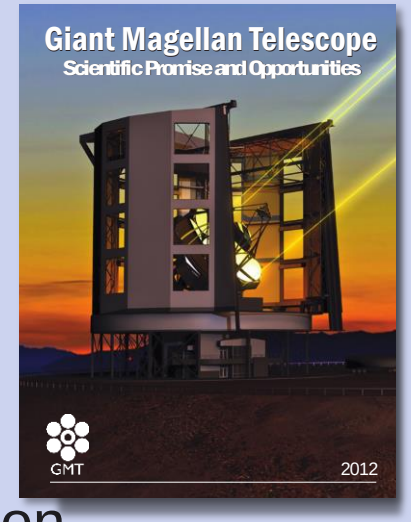
GMTO in Chile

- GMTO in an “Organization Internationale” in Chile
  - Recognized by Presidential Decree
    - *Tax exempt, legally immune*
    - Chilean institutions receive 10% of the observing time
    - Similar to the status of Carnegie, AURA, and AUI
- Carnegie owns Las Campanas – The GMT Site
  - Long term lease of GMT site to GMTO

Scientific Motivation

Top-Level Science Areas

- Extra-solar planets
- Stellar Populations and Chemistry
- Galaxy Building
- Black Hole Growth
- Cosmological Physics
- First-Light & Reionization



2nd edition of GMT Science Book: 2012

Three Legs of the GMT Science Case:

- Discovery Space

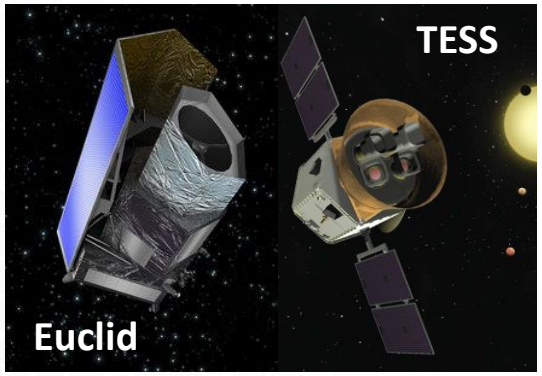
-Contemporary Science Goals

- Synergy

Scientific Synergy

GMT will play a major role in leveraging the potential of US and world-wide astronomy facilities in 2020 and beyond

- Spectroscopy in the visible & IR ***- High spatial resolution*** ***- High sensitivity***



Design and Cost Reviews

System Level PDR

Project Managers from:
E-ELT, DKIST, LSST, SKA, Gemini, VLT

Cost Review

Same team that reviewed the E-ELT Cost and Organization

Technical and Programmatic Leadership

James Fanson, Ph.D.

Joined GMT as Project Manager, October 2015

30 years at NASA JPL

- WFPC2
- Spitzer
- GALEX
- Kepler
- WFIRST

Reinvigorating our project management and technical team for the construction phase

Primary Mirror Status

Seven 8.4m diameter primary mirror segments
Six are off-axis – 14mm aspheric departure!

- S1 Complete – meets all contract specifications
- S2 Front surface processing
- S3 Rear surface processing
- S4 Cast Sept 18 - furnace will be opened in January
- S5 Glass in hand, mold material on order
- S6 Glass on order

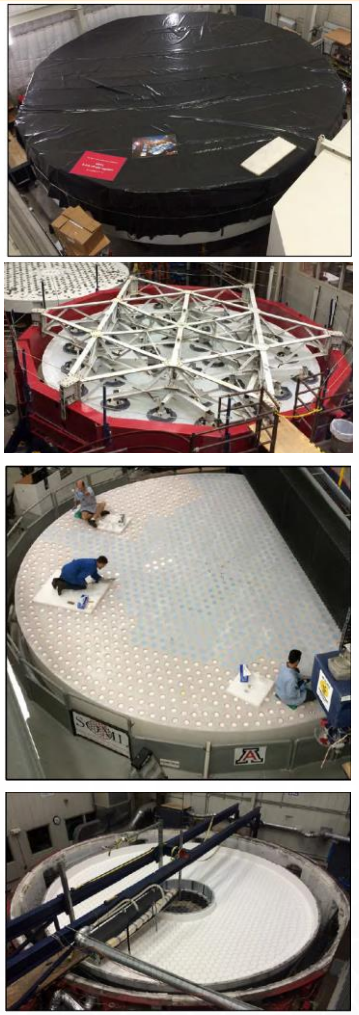
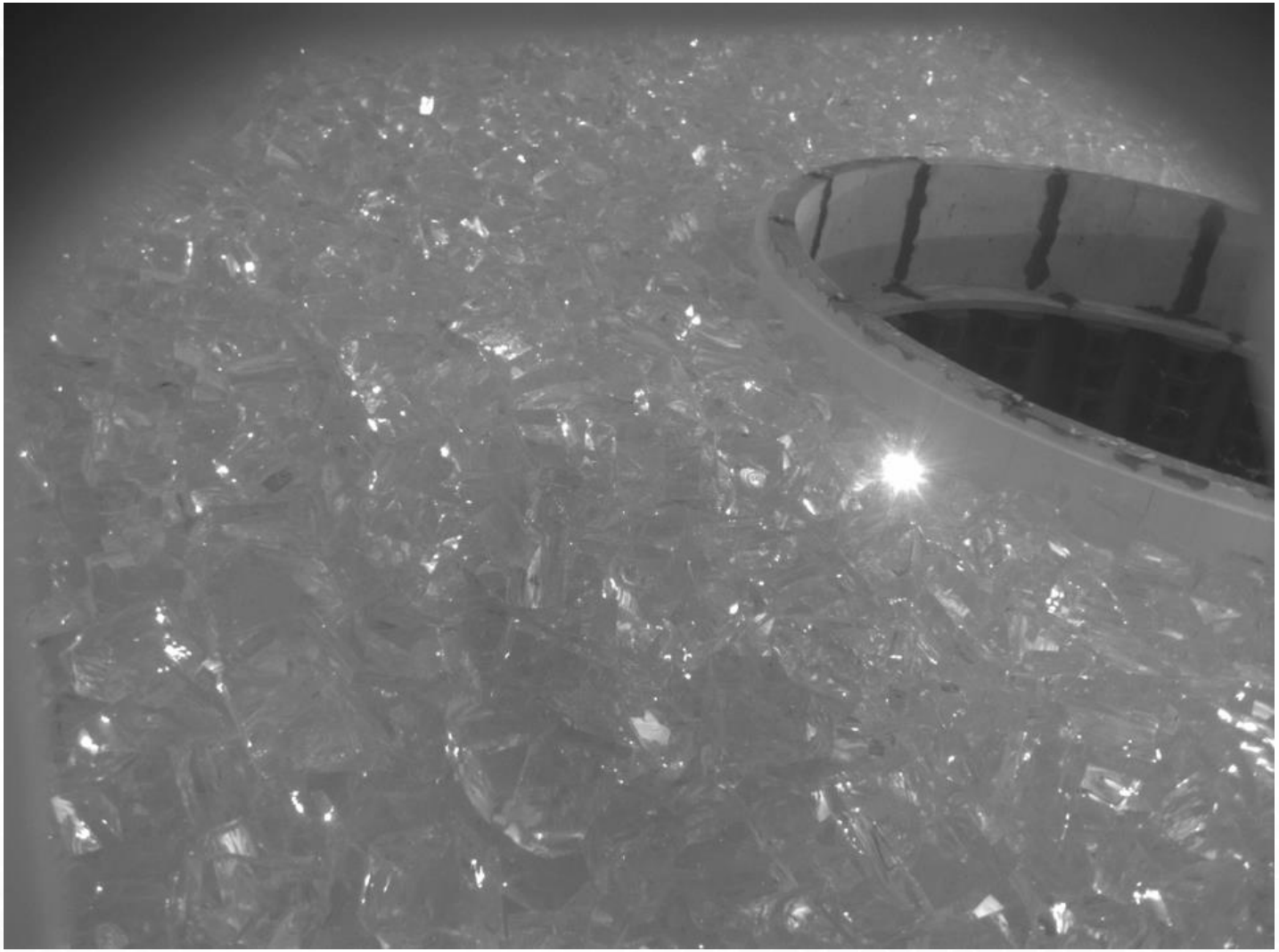
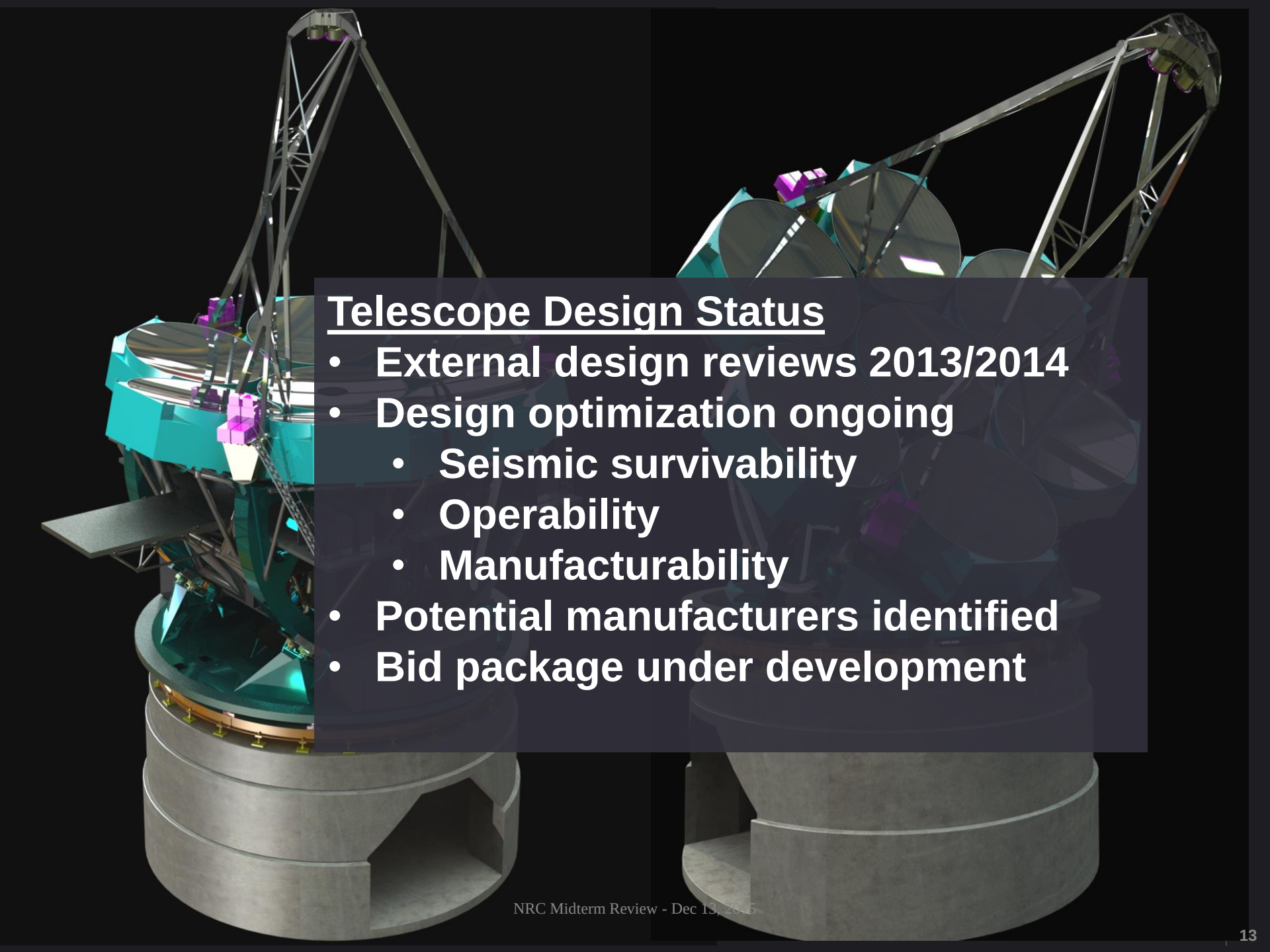


Photo by Ray Bertram

Center Segment Casting – Sept 18

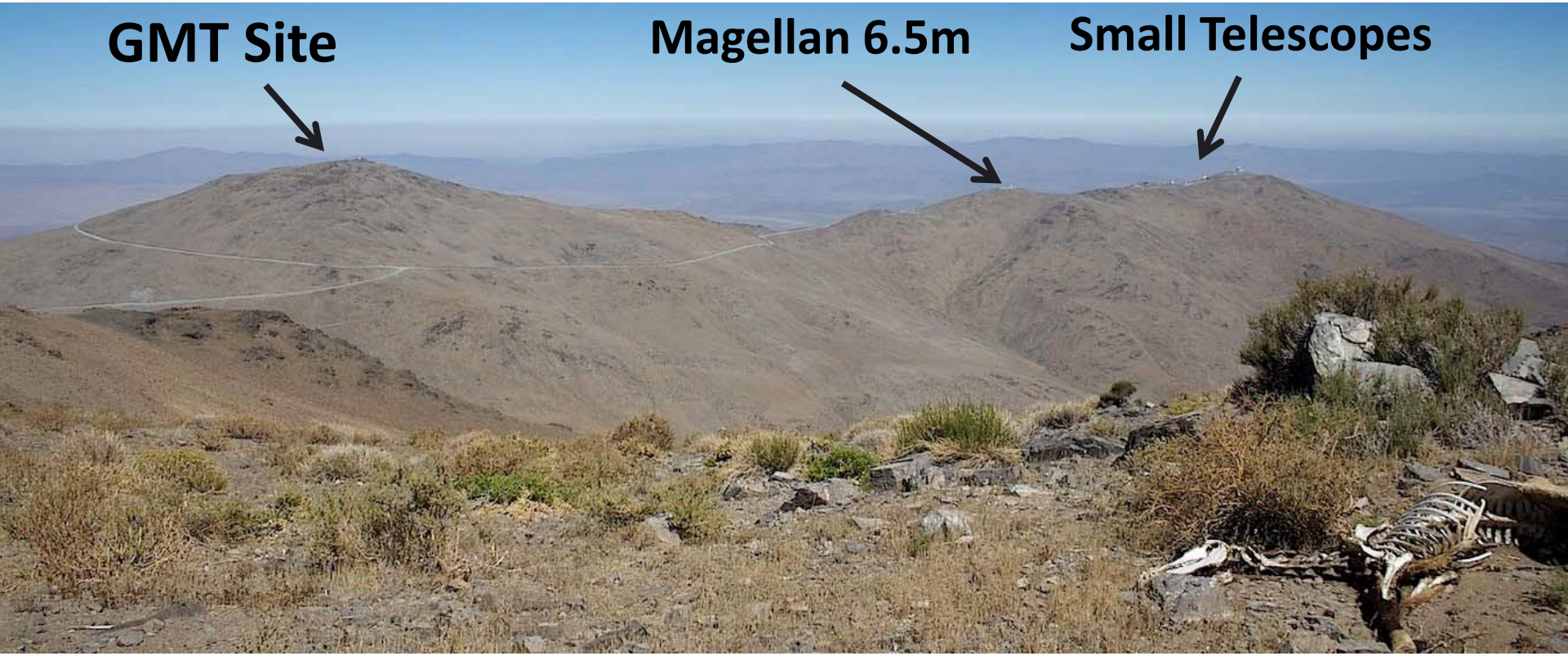




Telescope Design Status

- External design reviews 2013/2014
- Design optimization ongoing
  - Seismic survivability
  - Operability
  - Manufacturability
- Potential manufacturers identified
- Bid package under development

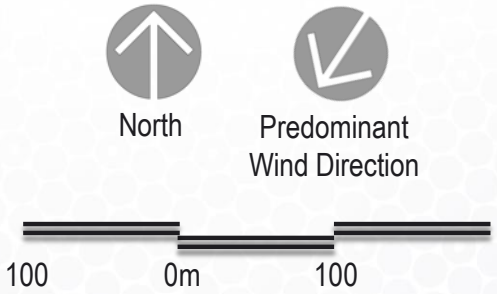
GMT Site at Las Campanas



Carnegie purchased 100 sq. miles in 1968 ($60,000!). The GMT site was tested in 1990's for Magellan and again in 2000's for GMT

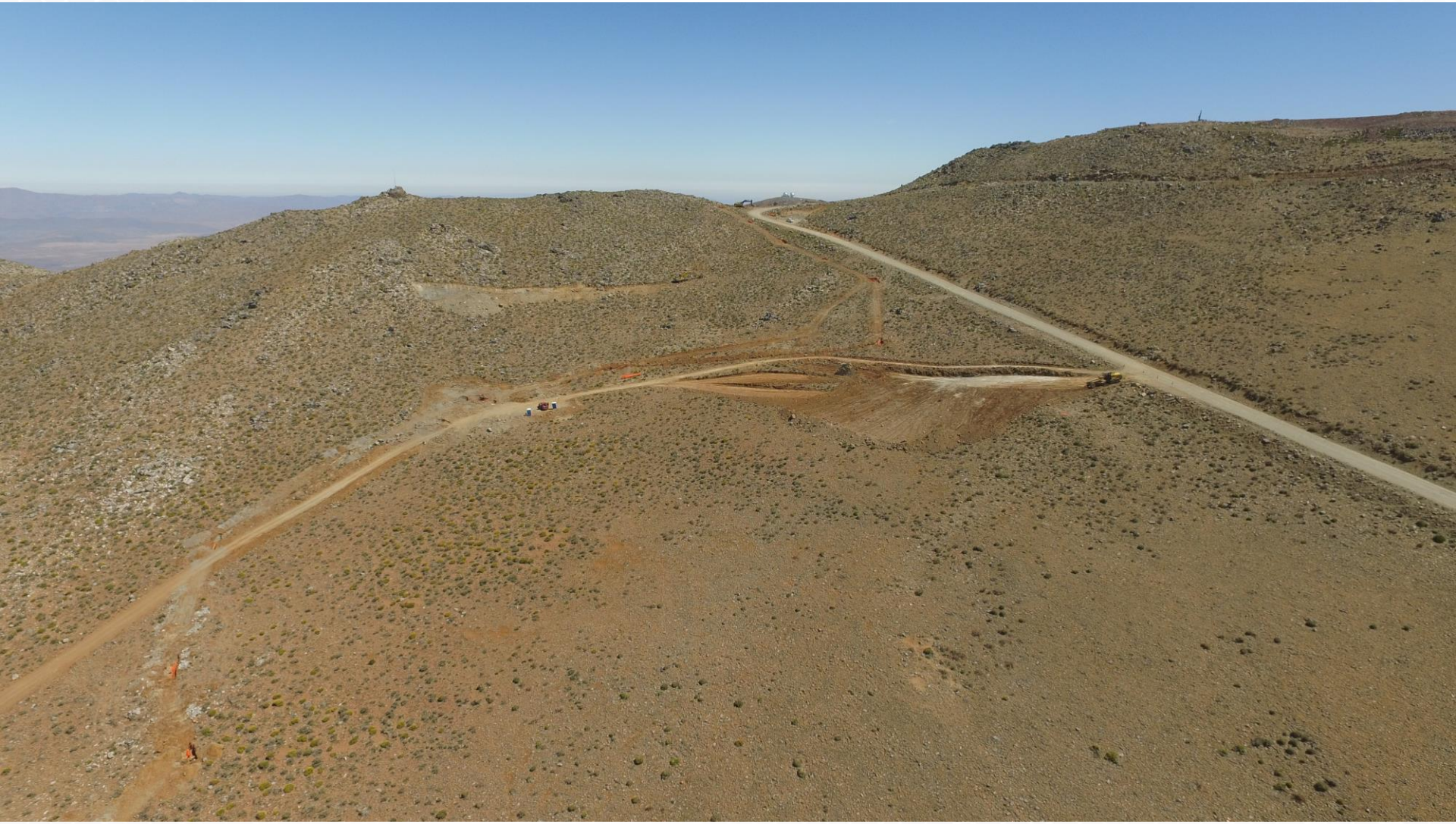
Site Master Plan

1. Enclosure
2. Summit Utility Building
3. Construction Offices & First Aid (During Const.)
4. Warehouse / M1 Factory / M2 Metrology
5. Utilities / Shop Building
6. Construction Camp / Future Lodge



Power and Data to the Site

Construction Work on Site



Construction Work on Site

Lodging for GMT Staff and Contractors

Constructing lodging being built for 200+ on-site construction workers

77 people on site last week!

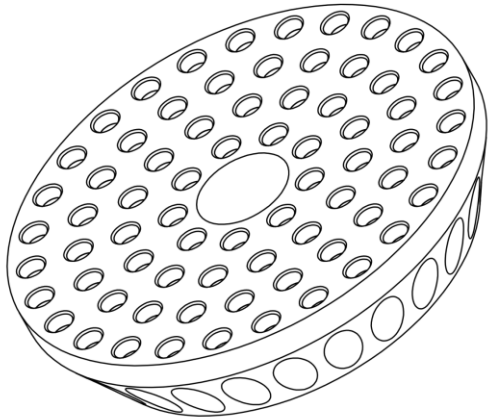
ALMA construction veterans now working for GMT in Chile

AO System: Adaptive Secondary Mirrors

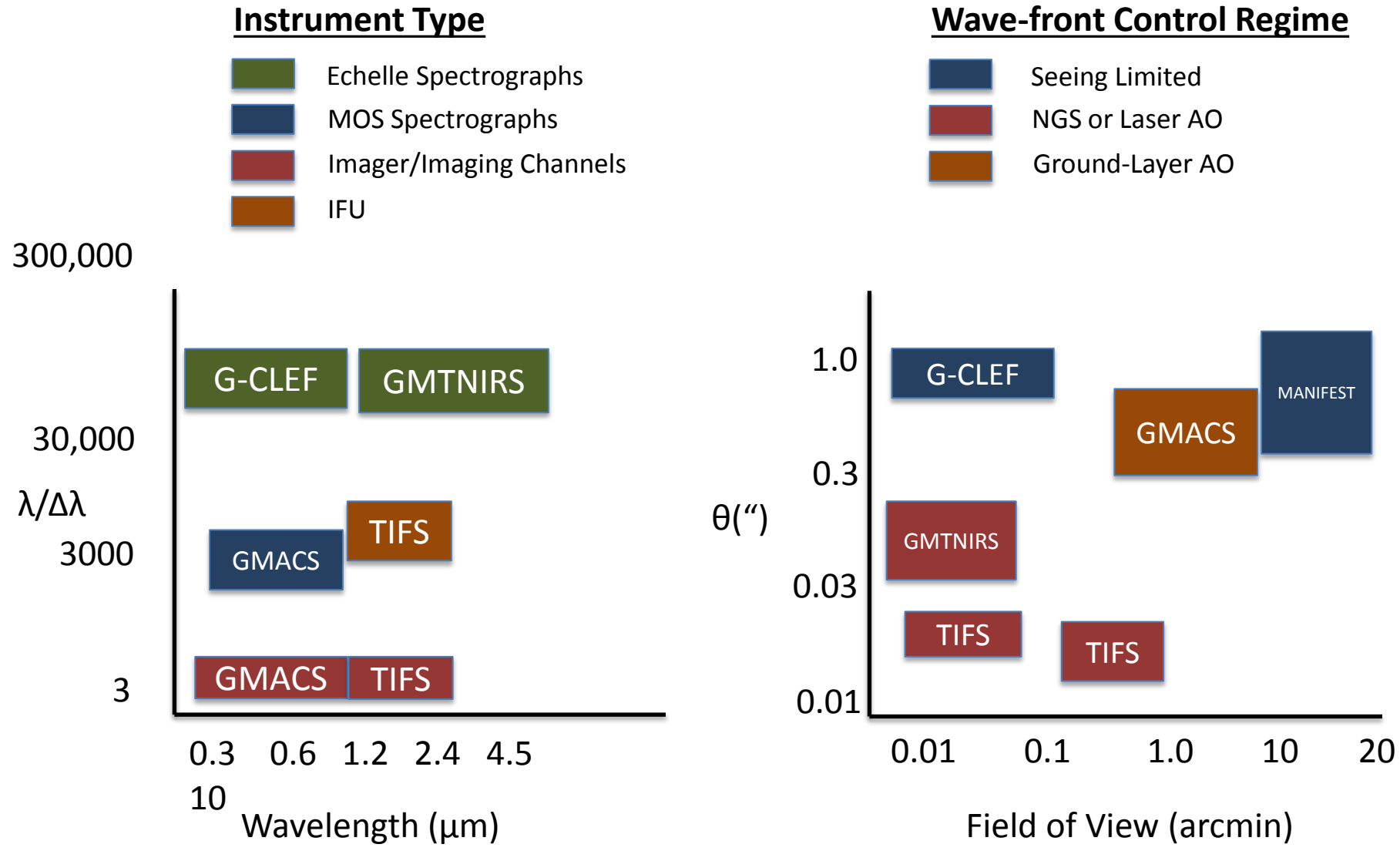
- Segments are 1.05 m, highly aspheric (conjugate 1:1 with M1)
- Builds on MMT, LBT, Magellan, VLT heritage
- Conjugate to layer 160m above ground: enables wide field GLAO
- Currently developing a subscale prototype – crucial to procurement plan

P72

P72 Facesheet
R = 4,147 mm
D = 354 mm
Thickness = 2 mm



First Generation Science Instruments



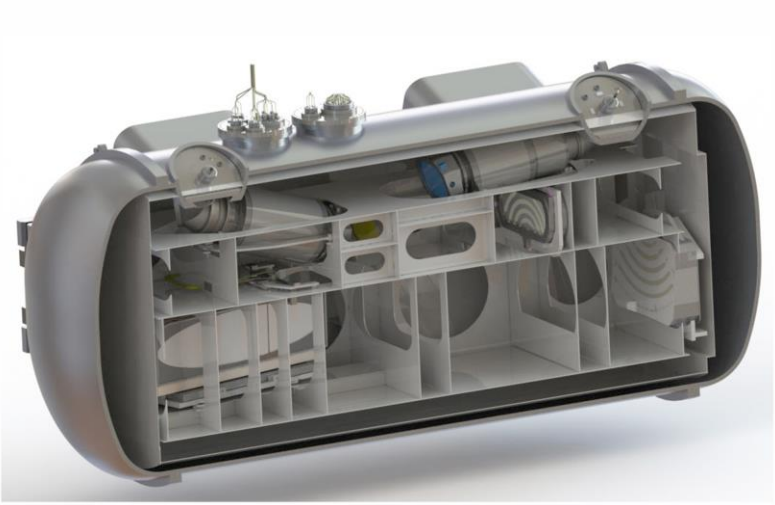
G-CLEF High Resolution Spectrograph

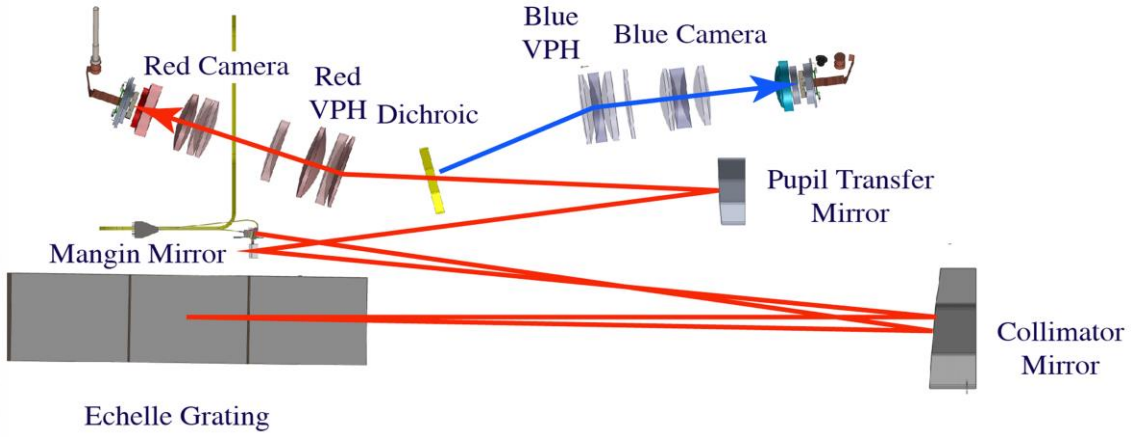
High Resolution Spectrograph and Precision Doppler Speedometer

External PDR passed in June 2015

Ready to move into critical design phase

R = 50,000 – 100,000
Spectrograph
Core Science:
PRV, Exoplanet Spectra,
Abundances, IGM/ICM

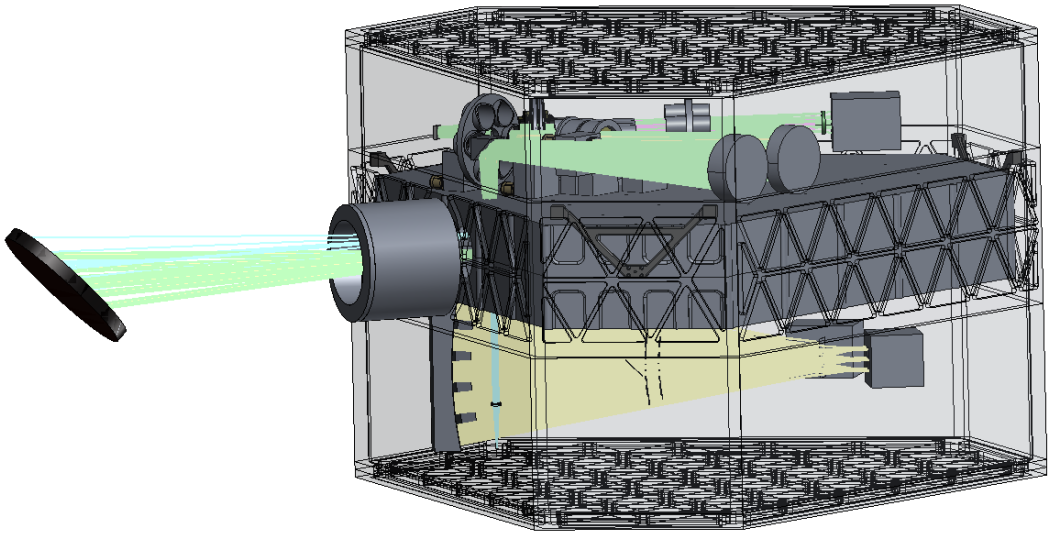


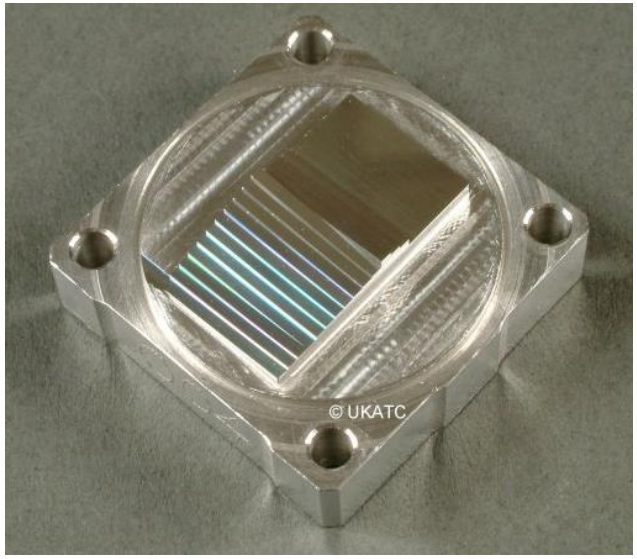


Smithsonian Astrophysical Observatory

MSIP Proposal Pending

GMTIFS – AO IFU Spectrograph/Imager





Micro-mirror image slicer

Builds on successful NIFS and GSAOI instruments on Gemini

R = 5,000
IFU Spectrograph

Core Science:
First-light, Galaxy Dynamics, Black Holes/AGN, Outflows

PDR Planned for late 2016

GMACS: Visible Multi-Object Spectrograph

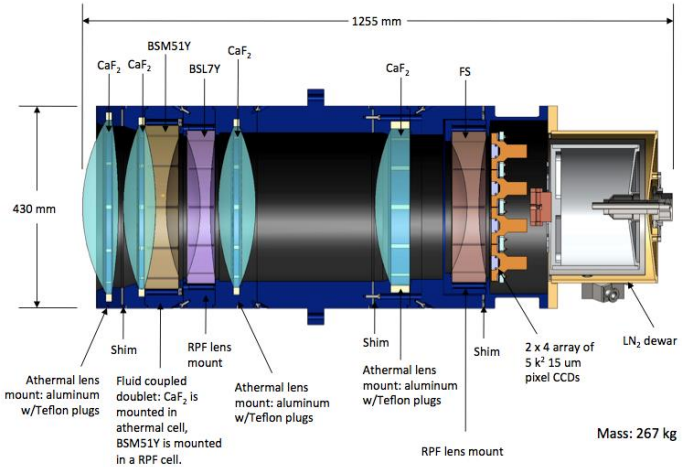


Figure 9-46. Detailed optical layout for the blue camera. The final element (labeled FS, for fused silica) serves as the window to the CCD Dewar.

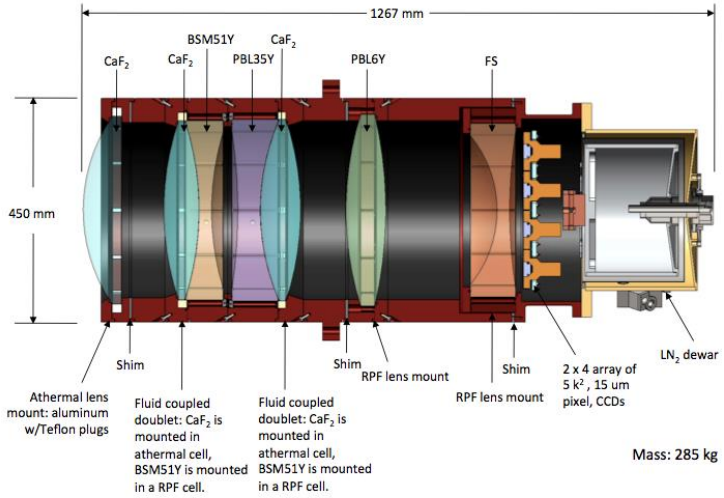
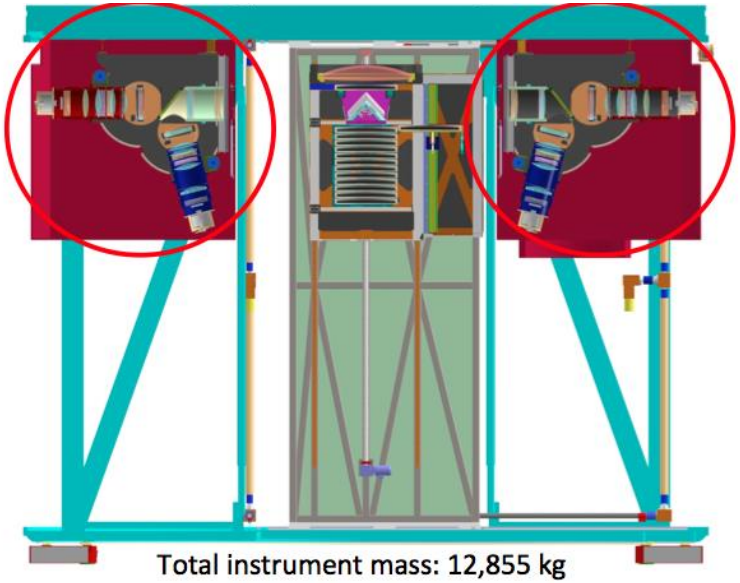


Figure 9-47. Detailed layout for the red camera. As in the blue camera, the final element (FS) is also the Dewar window.



R = 1,000 – 5,000
Multi-Object Spectrograph

Core Science:
Galaxy evolution, First-light, Transient Sources, IGM/ICM, Dwarf Galaxy Dynamics

MSIP Proposal Pending

Responsiveness to NWNH Science Priorities

= Strong Synergy with GMT First Generation

Astro2010 Science Area/Priority	GMT Core Functionality/Contribution		GMT Instrument					
Astro2010 Question	Technique	Science	GCLEF	GMTIFS	GMACS	GMTNIRS	MANIFEST	AO
Cosmology								
1 How did the Universe Begin	-	-						
2 Why is the Universe Accelerating	Near-IR Spectroscopy	SNIa Spectroscopy		■				
3 What is Dark Matter	Multi-Object Spectroscopy	Dwarf galaxy dynamics			■		■	■
4 Neutrino properties	-	-						
Galactic Neighborhood								
1 Circumgalactic Medium	Near-IR & Visible Spec.	ICM Abs and emission	■	■	■	■		■
2 Energy Flows in Galaxies	IFU Spectroscopy	Outflows, ISM dynamics		■	■			■
3 Fossil Record	UV/Visible Spectroscopy	Abundances, dynamics	■		■		■	
4 Dark and Luminous matter connection	IFU & Multi-Object Spect.	Cluster dynamics/lensing		■	■		■	■
Galaxies								
1 Cosmic structure formation	Redshift Surveys	Structure formation			■		■	
2 Baryon cycle	IFU Spectroscopy	ISM energetics	■	■				■
3 Black hole growth	IFU Spectroscopy	Dynamics, infall/outflow		■				■
4 First light	Near-IR Spectroscopy	First galaxies		■	■			■
Planets and Star Formation								
1 Star formation	Near-IR Spectroscopy	Pre-main sequence stars		■		■		■
2 Circumstellar disks	IFU Spectroscopy	Disc dynamics, abundances		■		■		■
3 Diversity of planetary systems	Near-IR Imaging, PRV	Planetary orbits, masses	■			■		■
4 Habitable worlds	Transmission Spectra	Atmospheric composition	■			■		■
Stars and Stellar Evolution								
1 Rotation and magnetic fields	IR Spectroscopy	Zeeman splitting				■		■
2 Type 1A progenitors	UV to IR Spectroscopy	Stellar winds				■		■
3 End points for massive stars	UV to IR Spectroscopy	Zeeman splitting						
4 Physics of compact stellar remnants	-	-						

Project Stages

Stages map to *Scope and Budget Authorization*

Milestones map to *Schedule and Spending*

Stage 3 – 12%

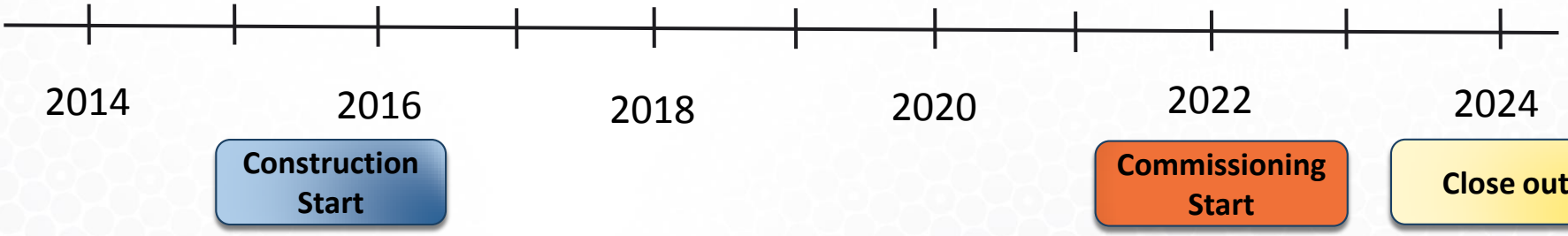
- Remaining Adaptive Secondary Mirrors
- Second AO Instrument
- Facility Fiber Optic Feed

Stage 2 – 26%

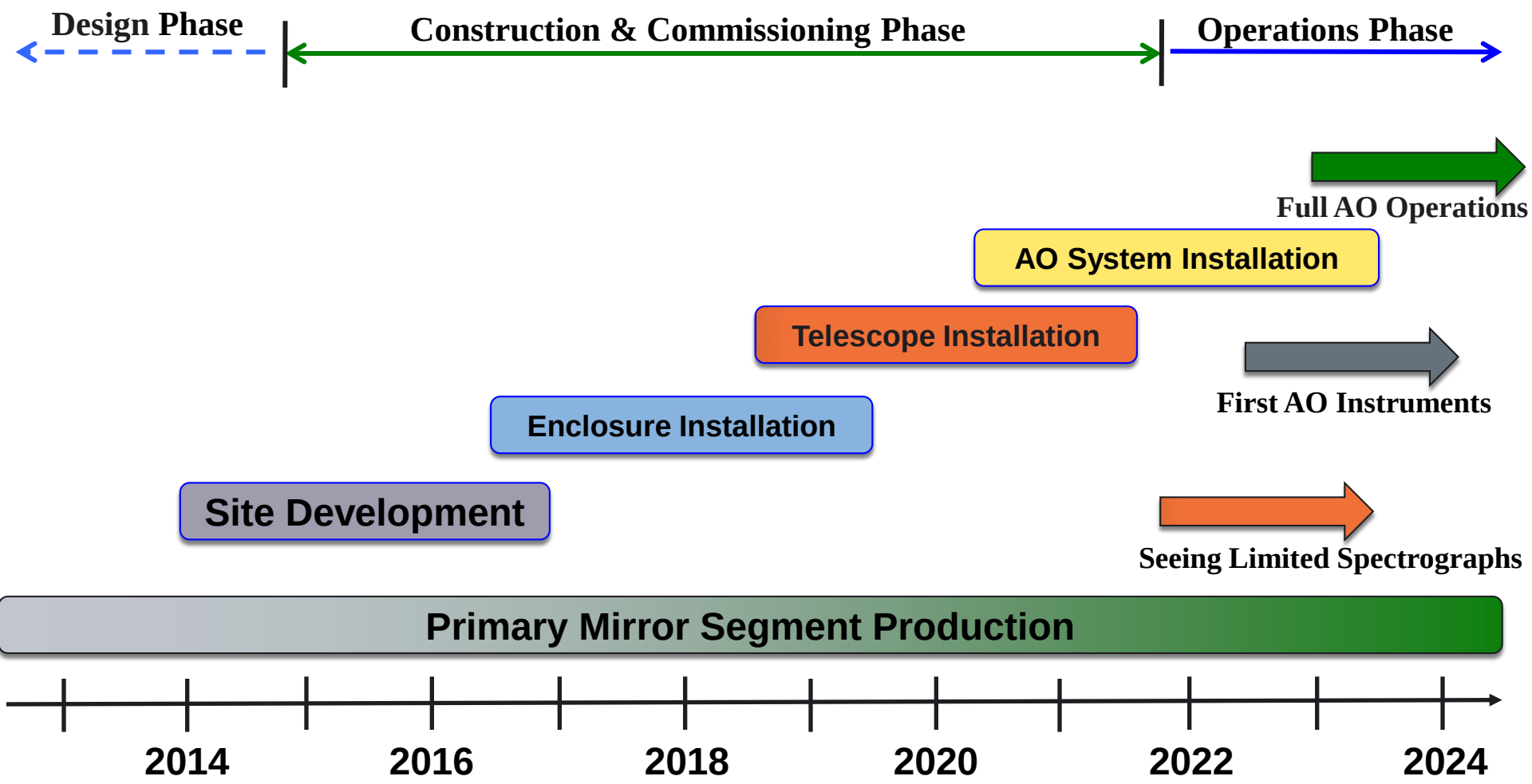
- Primary Mirrors 5 - 8
- First Adaptive Secondary Mirrors
- First AO Instrument

Stage 1 – 62% of total budget

- Essential Infrastructure
- Enclosure
- Support Buildings
- Telescope Mount
- 4 Primary/Secondary Mirrors
- 2 Science Instruments



Schematic Schedule



Opportunities for Federal Investment

Instrumentation:

Project operations budget: $32-35M in today's dollars

$20M base operations

$8M Instrument development

$5M Infrastructure renewal

MSIP and similar programs could support public access

Two proposals in the MSIP pool in the current round

Operations:

Founders' Agreement allows participation in operations by non-founder entities – NSF or other organizations can secure nights through operations support

Construction:

Large scientific infrastructure (e.g. AO) could be funded by NSF, NASA or other agencies through capital budgets or special initiatives

Community Engagement

GMTO Board pledge to match NSF investment in GSMT community engagement with its own funds

- Annual GMT Community Science Conferences
  - Current science topics
  - Focused on *science*, not GMT
  - > 50% SOC, speakers and attendees outside GMT community
  - Full travel support for students, postdocs
  - 120-150 attendees, lots of fun and good science!

2013: Galaxies Evolution	Chicago
2014: Transient Phenomena	Washington DC
2015: Resolved Galaxies	Monterrey Bay, CA
2016: Exoplanets	North/Northwest
2017: TBD….	

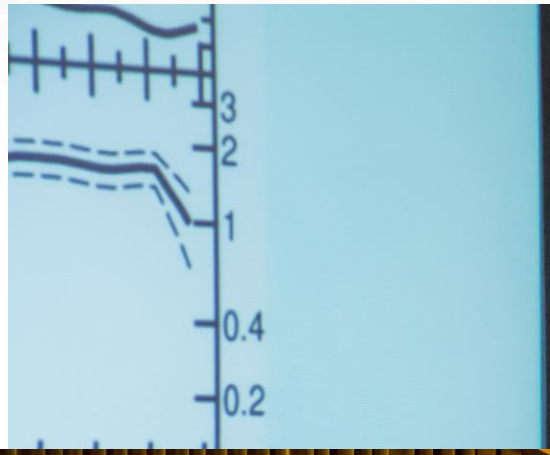
- Technical Workshops: AO4ELT4, Detector workshop, etc.

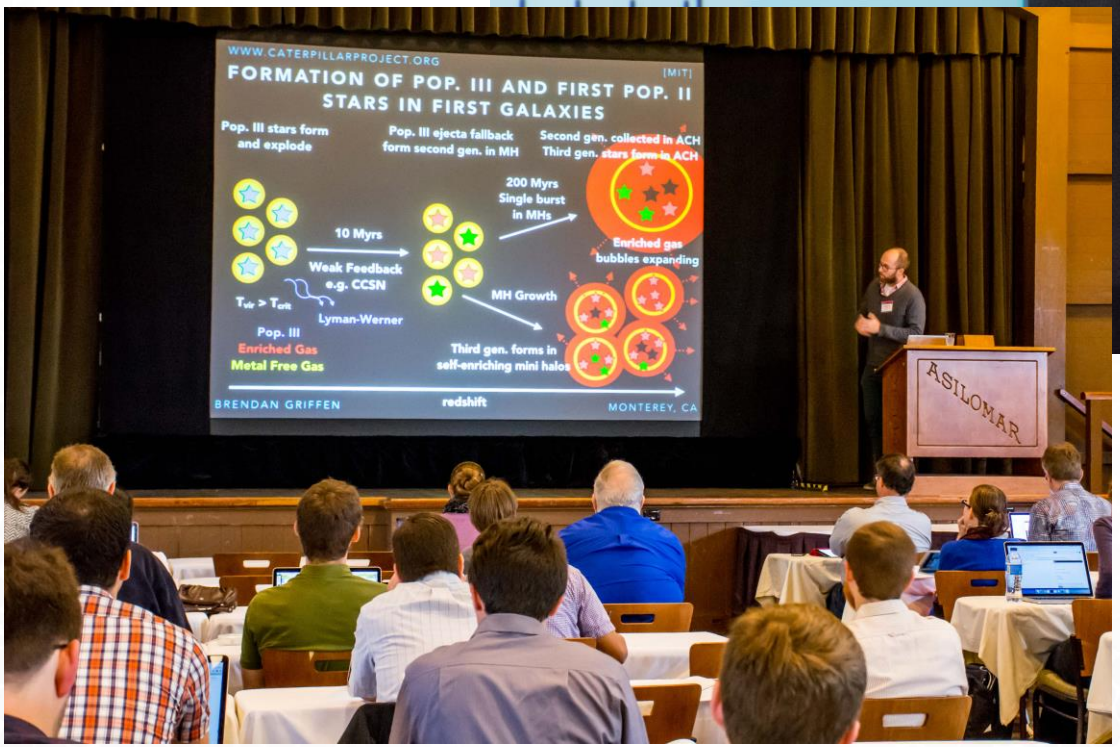
ELT Detector Workshop sponsored by GMTO

GMT, TMT and E-ELT Groups meet with Detector Vendors

GMTO hosting technical discussions among the three projects where natural opportunities for collaboration exist. We are eager for more dialog

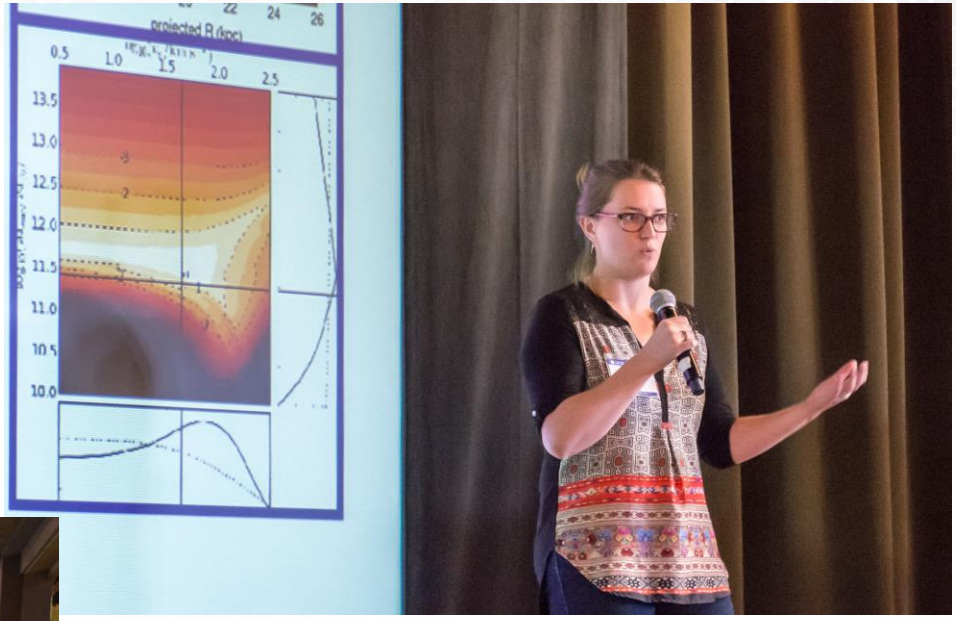
2015 Science Meeting at Asilomar





Speakers from US, Europe, Asia, Latin America, Australia

2015 Science Meeting at Asilomar



Ground Breaking!

Ground Breaking!

Groundbreaking!

Wrap up

Three Questions from the Committee:

1. How does GMT address the priorities in NWNH?

   Very well! – 80% of NWNH priorities addressed by GMT

2. What is the status of Design/Construction and funding?

   Well into construction, well funded, but still fundraising

3. Will the project seek funds from the NSF?
   3a. If so, in what form? (Construction, instruments, operations, archiving)

   We will be flexible and responsive to community needs as we work towards realizing the NWNH goals and look ahead to the 2020 survey