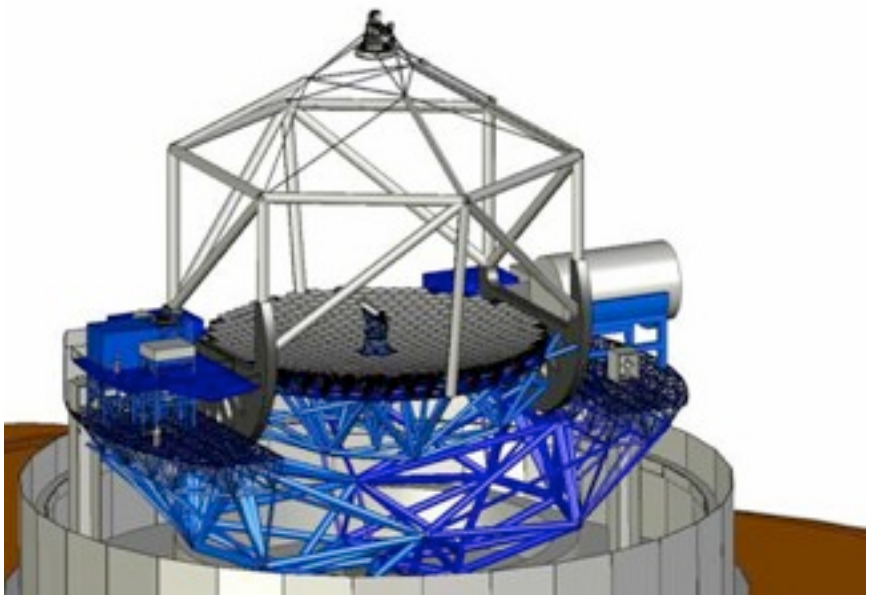
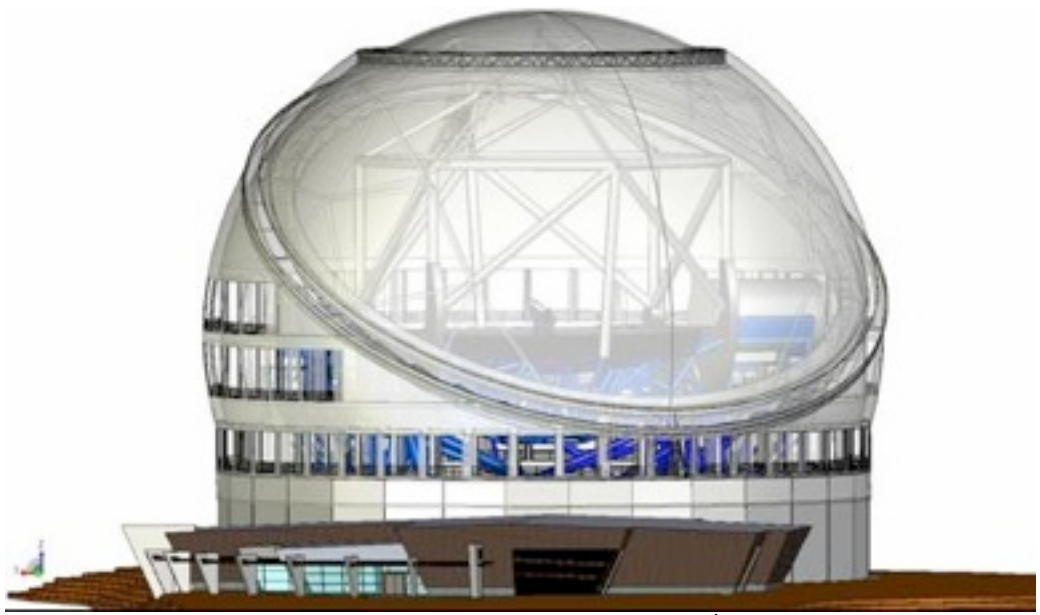
TMT-China opportunities & challenges

Suijian Xue
CTMT Project Office
Nov. 8, 2011





TMT
Thirty Meter Telescope

Outline

- Current status
- Ongoing technical activities
- Summary

Why joining TMT?

- **Golden era for astronomy ...**
- **Currently Chinese optical/IR facilities lag significantly behind**
  - 2.4m versus 10m (general-purpose telescopes)
  - no good seeing and weather sites (Dome-A, Antarctica)
- **China has built up infrastructures in the last decade**
  - e.g., LAMOST has built up the technology know-how for constructing segmented mirrors, spectrographs etc; AO technology development
- **Chinese Astrophysics Strategy Committee recommended joining TMT as the highest priority, in equal footing with Dome-A**
- **In the US, the Astro2010 report**
  - ranks GSMT (TMT/GMT) as the third highest priority for ground-based astronomy (but number one by the optical/IR panel.)
  - recommends NSF immediately down-selects either TMT or GMT and participate at the 25% level.

Progress and Status

- May. 2009 TMT-China consortium formed among CAS institutes
  NAOC, NIAOT, IOE, CIOMP, TIPC
- Nov. 2009 TMT-China obtains “observer” status
- Nov. 2010 MoU signed TMT-China upgrades participation stage
- Sept. 2011 LOI signed among partners, NAOC becomes a member of TMT collaborative board
- Oct. 2011 First official evaluation meeting on TMT by MOST

  Panel recommends:

  - China should participate TMT at no less than 10% level, with in-kind contribution at no less than 70% level;

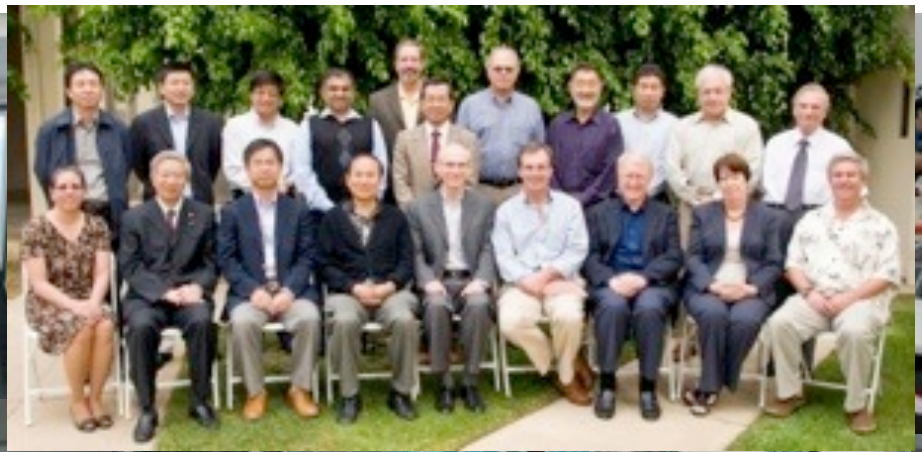
  - TMT-China should be endorsed with initial R&D funding ASAP

TMT-C Consortium Institutes

TMT

THIRTY METER TELESCOPE

Exchange visits & negotiation





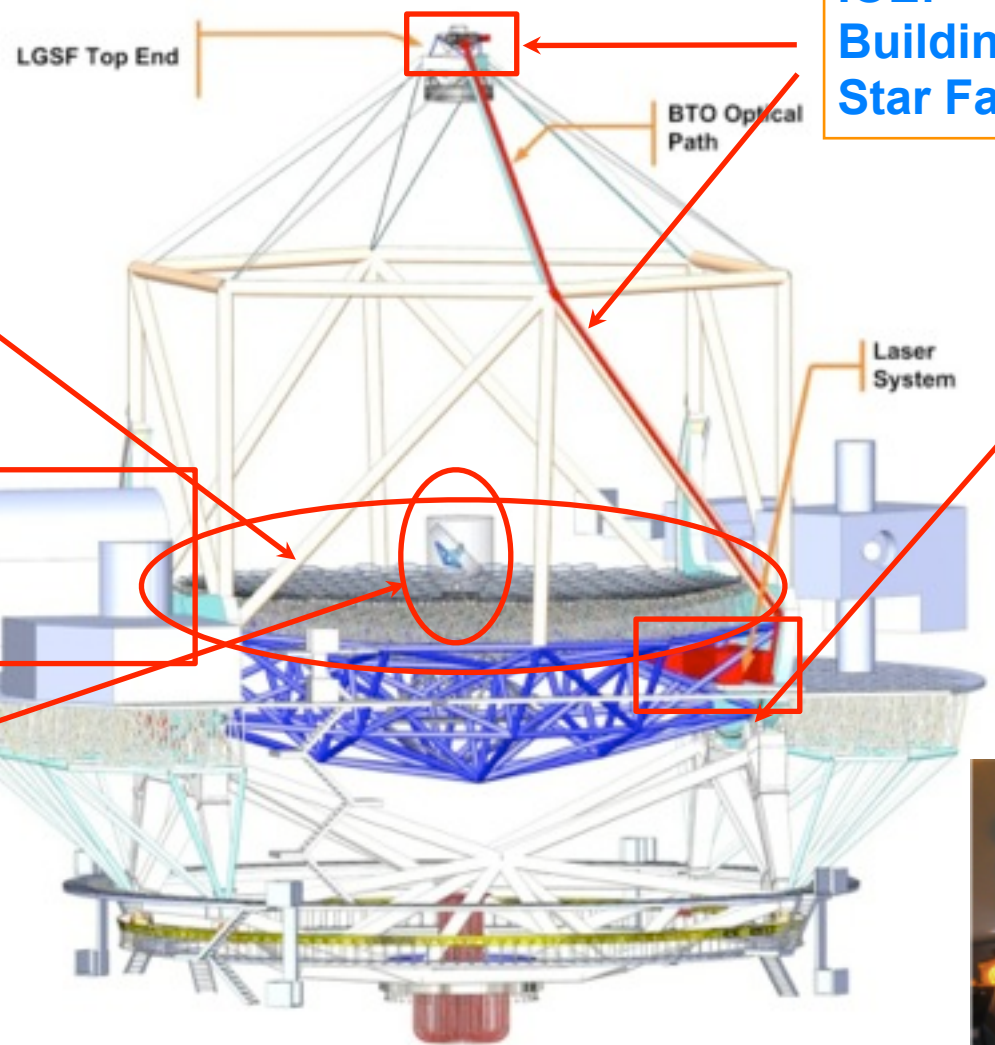

2011 International Symposium on Photoelectronic Detection a
International Colloquium on Thirty-Meter Telescope
International Colloquium on Thirty-Meter Telescope
May 24-26, Beijing China

China's In-kind Technical Contributions

NIAOT: M1 stress mirror polishing and mass production

NIAOT & USTC : preliminary design WFOS/ AGWFS

CIMOP: Polishing and fabricating M3CA & M3PA



IOE: Building Laser Guider Star Facility

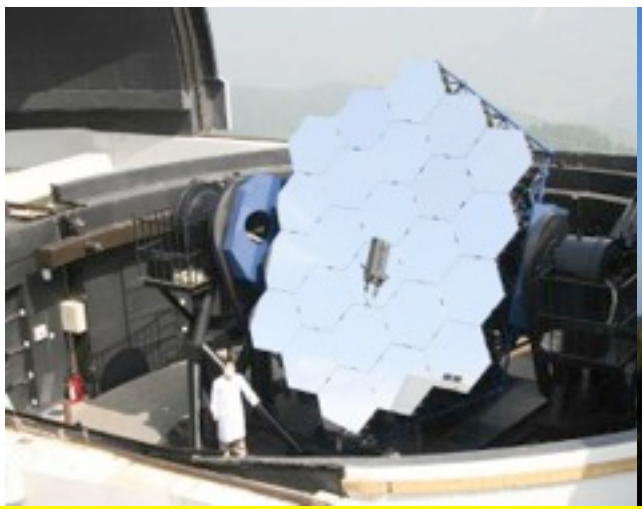
TIPC: 20W prototype of Sodium Laser

on-sky test of LGSF

On going technical activities

- Work Packages signed
  - 1) NIAOT SMP demonstration on 3 mirror blanks
  - 2) IOE LGSF(BTO/LLT) update and preliminary design
  - 3) TIPC 20W pulsed sodium laser prototype demonstration
  - 4） NIAOT&USTC Feasibility and Conceptual Design Studies for the WFOS/MOBIE Acquisition, Guiding, and Wavefront Sensing (AGWFS) Subsystem
  - 5) CIMOP Preliminary design for M3 cell assembling and positioner assembling
- Work Packages in developing
  - TIPC Cryogenic systems design for all instruments
  - M2 mirror polishing?

Works been done at NIAOT



LAMOST Segmented mirror system 61（24 planner +37 spherical）

TMT technical goal： **toward to a mass production of aspherical SMP**

30cm stress mirror polishing and hex-cutting

Annual Polishing machine

20m vertical testing tower

CIMOP kicked off the project on M3CA, M3PA

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  - CIM
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Mirror Cell Team

Mirror Fab Team

Electronics & Controls Team

Positioner Team

CIMOP kicked off the project on M3CA, M3PA

Thirty Meter Te

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19	**M3PA**
20	M3PA Conceptual Design Start
21	M3PA Conceptual Design Review
22	M3PA Preliminary Design Start
23	M3PA Preliminary Design Review
24	M3PA Final Design Start
25	M3PA Final Design Review
26	M3PA Fab, Assembly and Test Start
27	M3PA Pre-Ship Review
28	M3PA Received at TMT Summit

Mirror Cell Team

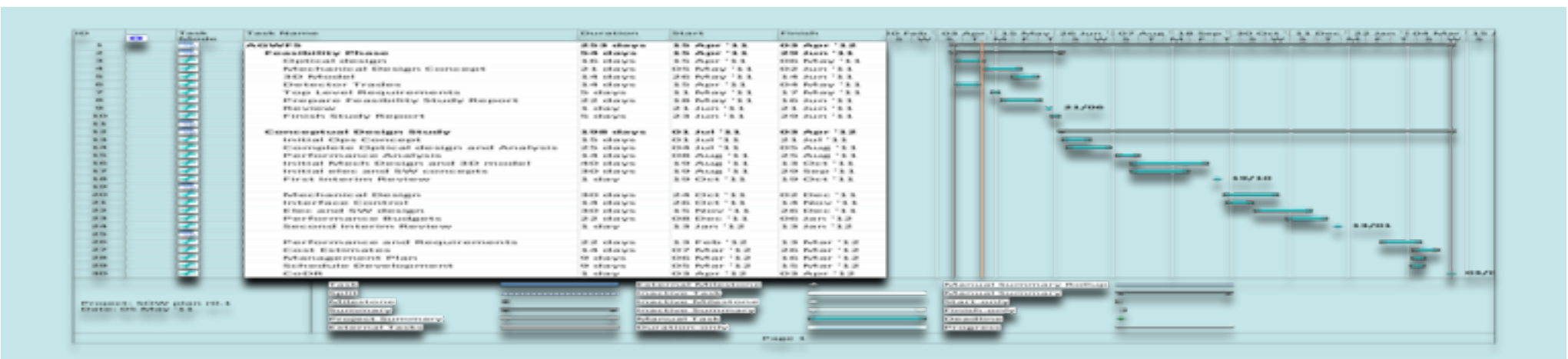
Mirror Fab Team

Electronics & Controls Team

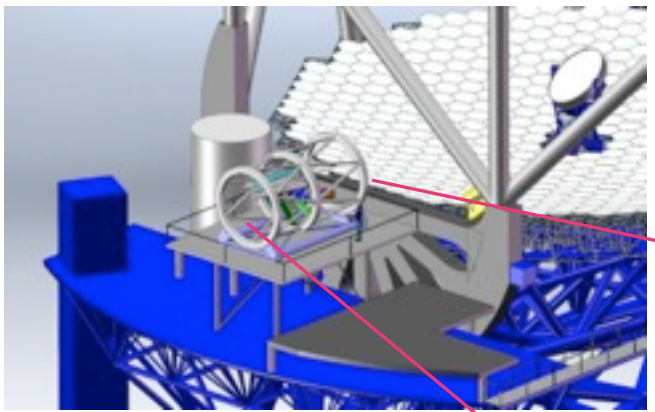
Positioner Team

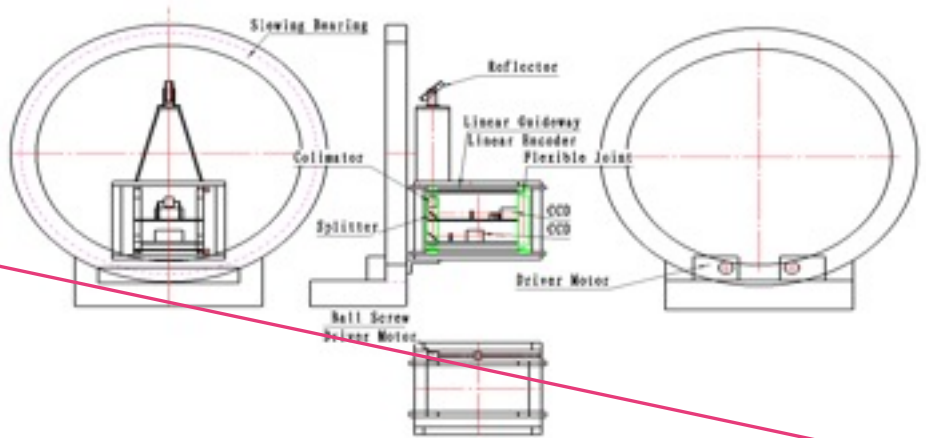
Works on Science Instrument-WFOS

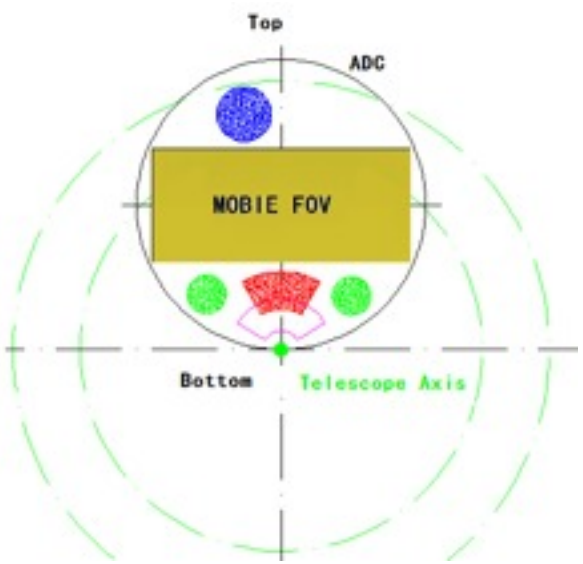
- The AGWFS team at NIAOT&USTC completed a comprehensive Feasibility Study, including
  - The optical design of the AGWFS,
  - The mechanical concept for the AGWFS,
  - Detector choices for the AGWFS detectors,
  - A list of remaining top-level design choices facing the conceptual design phase, and
  - The cost estimate for the AGWFS
- The conceptual study and the support of MOBIE concept study will be carried out in 2011.07-2012.03

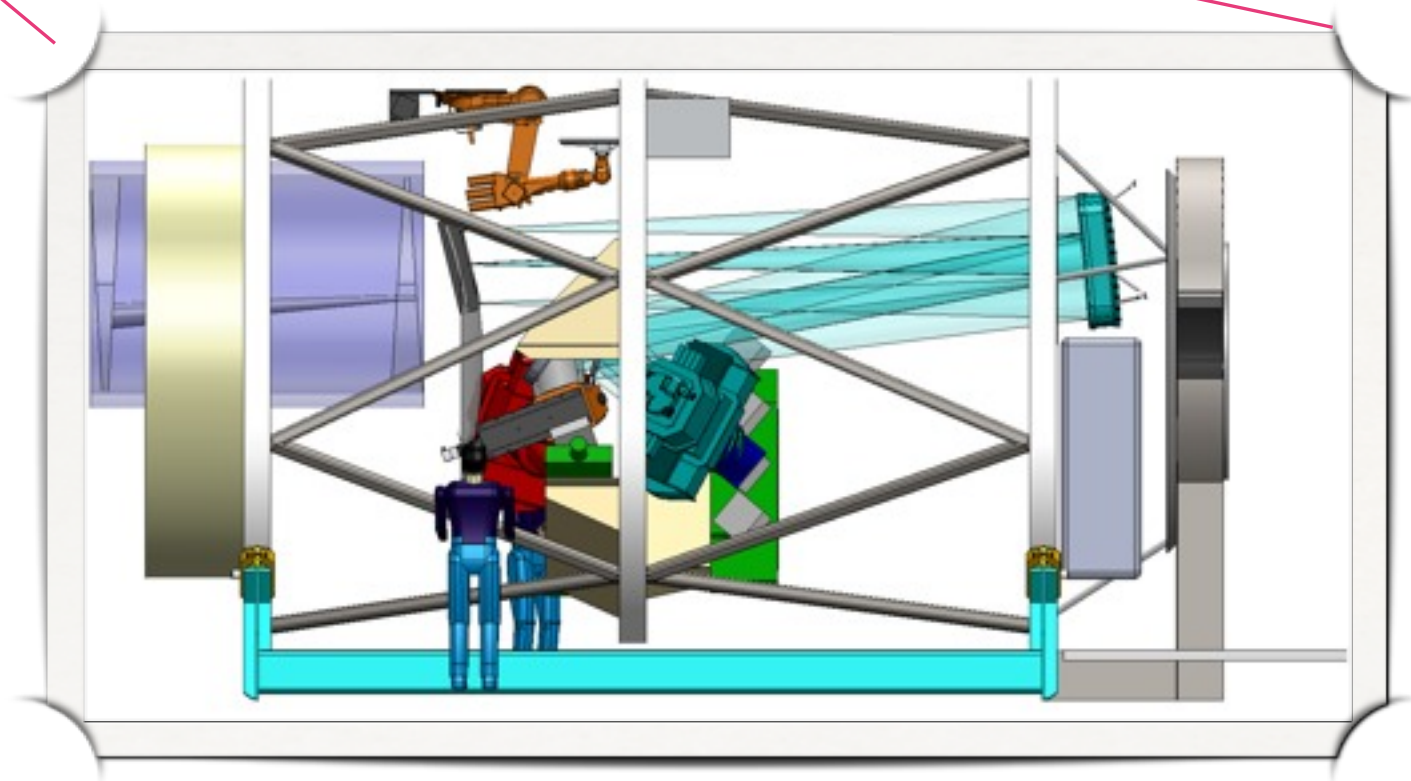


AGWFS—Where it is ?

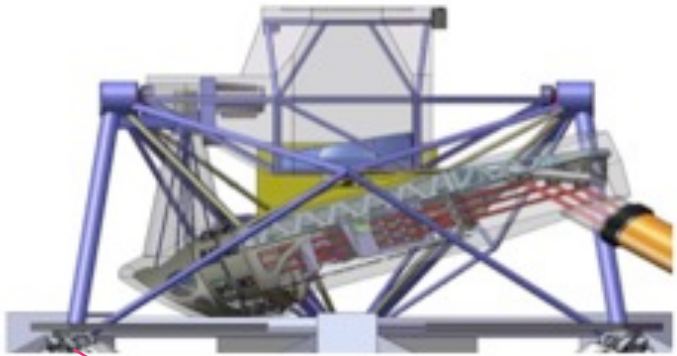


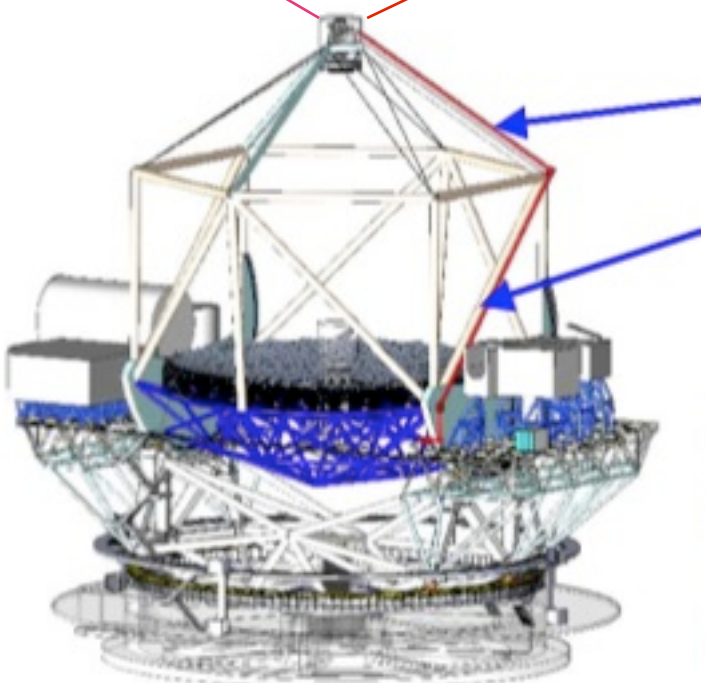


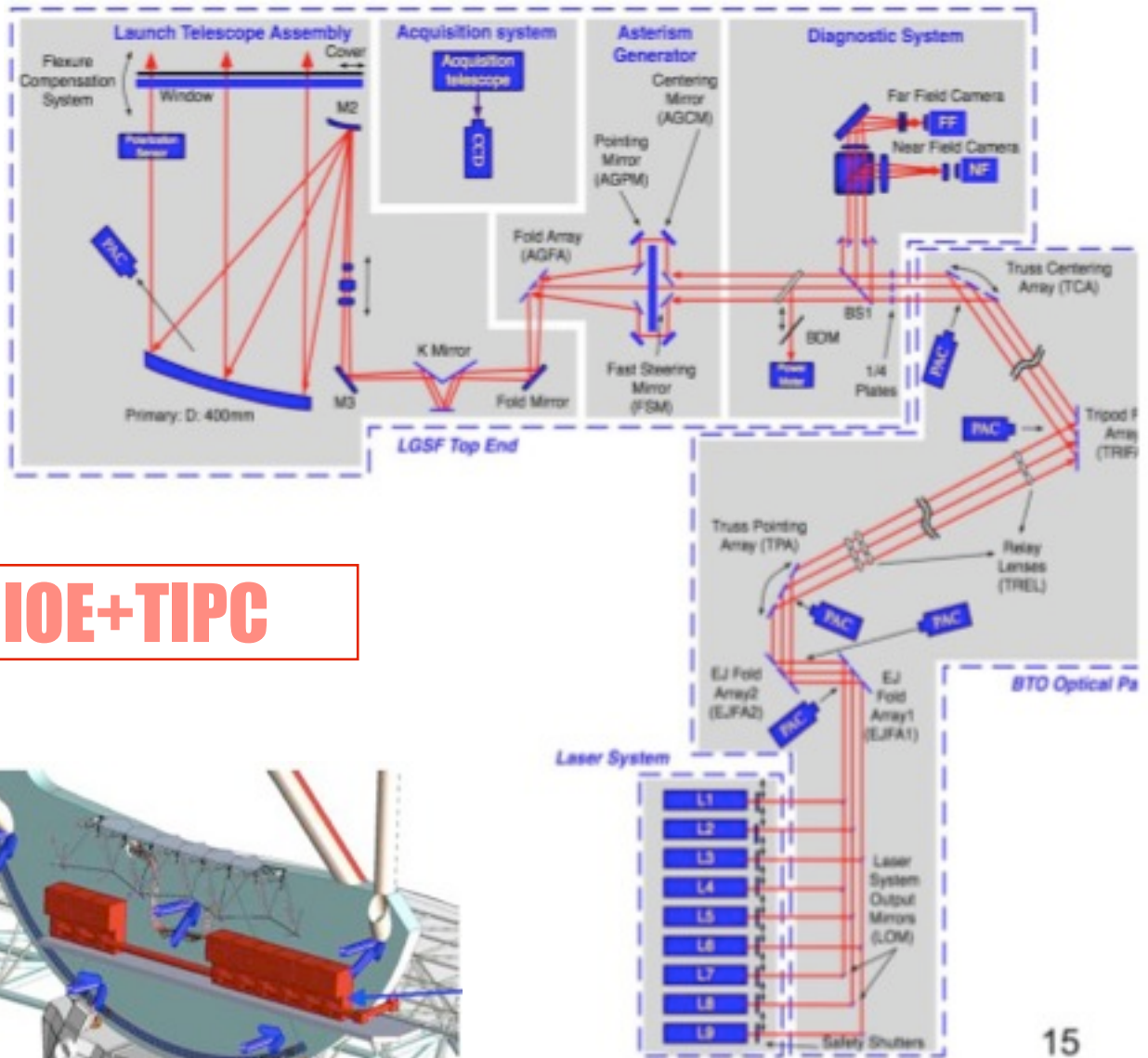




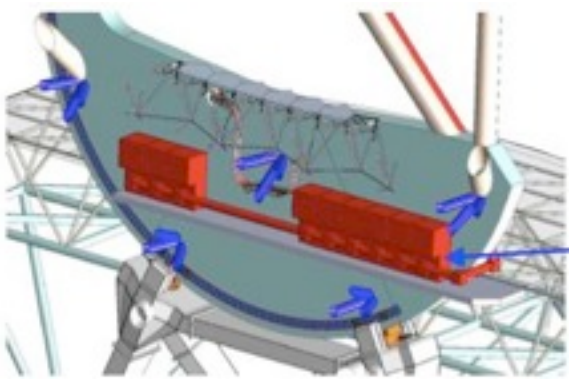
TMT LGSF & Laser reference design





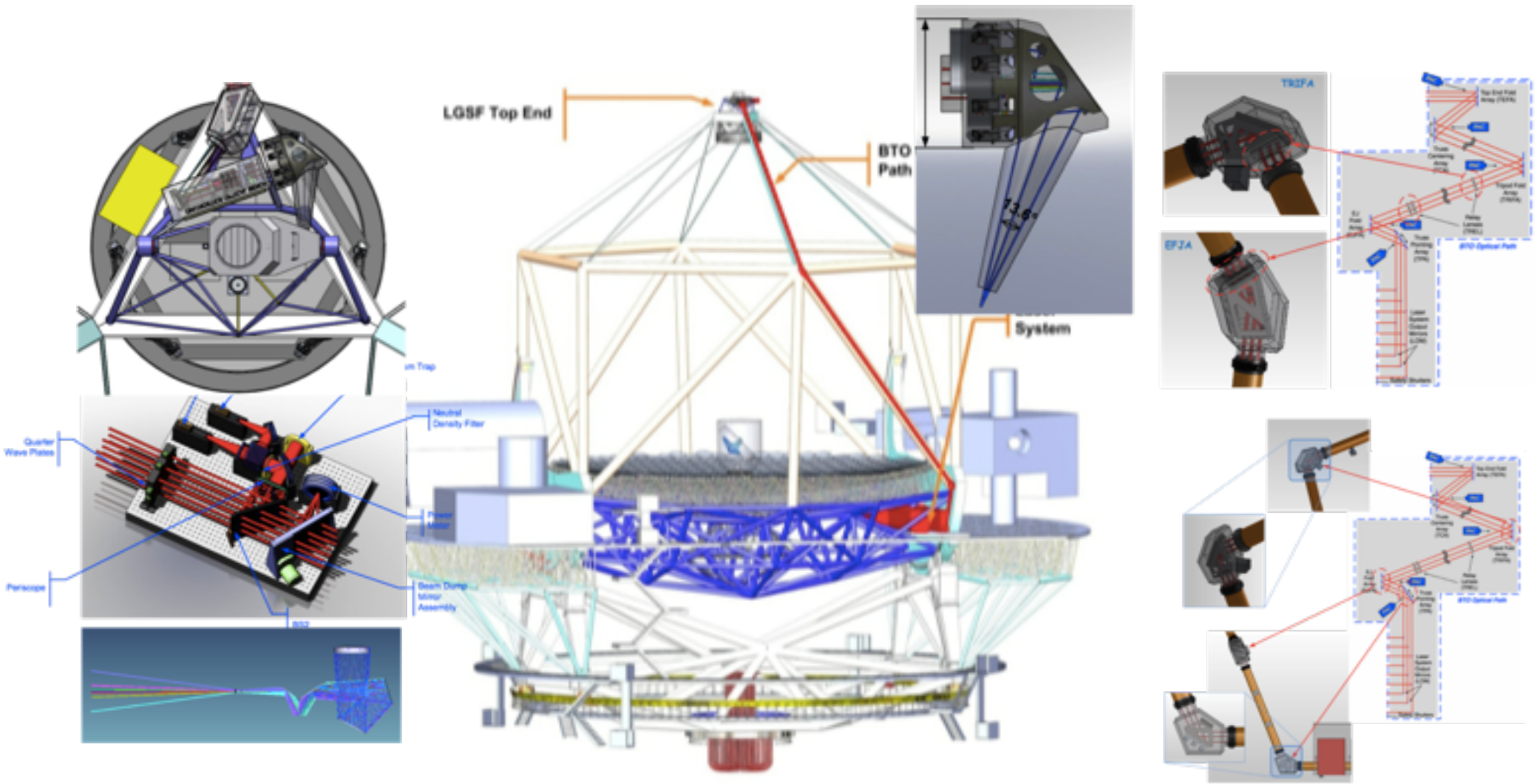


IOE+TIPC



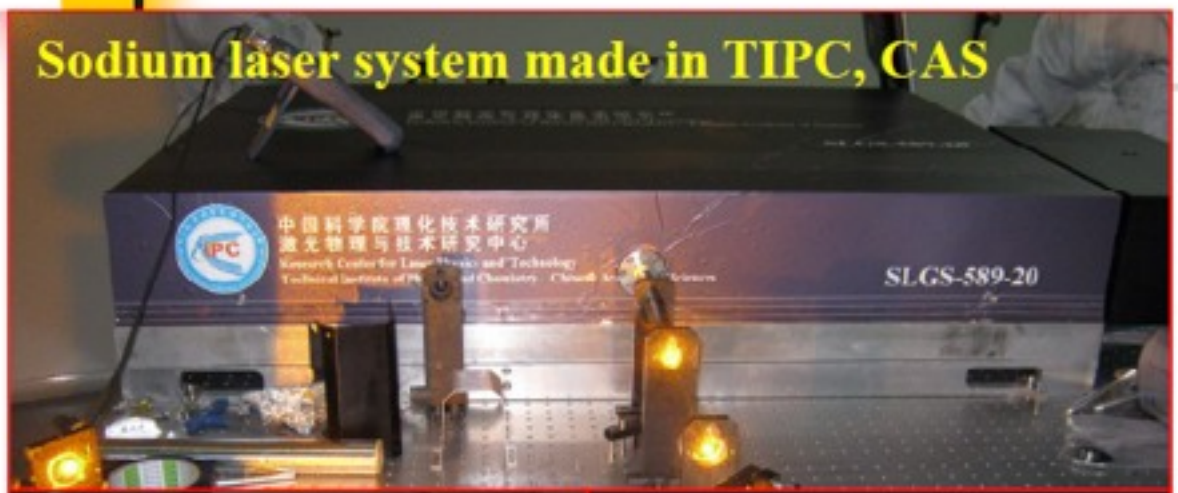
LGSF design improvement carrying out at IOE

- 2010年初，完成20W钠激光导星发射装置，成功得到图像
- 改进了TMT 激光导星系统（LGSF）初期概念设计



3. Development of our sodium laser system

Field experiment for the LGS system



20W output to generate 8.7 magnitude

2011 Oct 21

3. Development of our sodium laser system

Field experiment for the LGS system

Significantly less photon return than required, data analysis now well understood, improvements underway

20W output to generate 8.7 magnitude

UBC LIDAR Test Facility
Site of Na Layer Photon Return Tests

- Next version of TIPC laser to be tested in China and at UBC facility in 2012
- ESO Toptica/MPB laser prototype planned for UBC test in 2013 following tests in Europe and Chile

New test building to house TIPC laser system at UBC LIDAR test facility

TMT
Thirty Meter Telescope

Summary

- TMT offers China a unique opportunity to leapfrog in observational astronomy
  - Complementary with other efforts
- China has the capability to contribute in many areas
  - Stress Mirror Polishing of M1, for mass production
  - Lasers and laser guide star facility
  - Polishing and fabricating 4m-class optics & fine-mechanics i.e., M3 mirrors system
  - Advanced cryogenic technology application
  - WFOS (Wide-field Optical Spectrometer)
- Much remains to be done!

Much remains to be done!

- **What do we need to improve in TMT-China?**
  - Management? Organisation? Transparency?
  - Community involvement? CAS & University …….
- **How do we build up scientifically competitive teams?**
  - Observer base? Summer school/workshop; small telescope training. Obtain international telescope time through open competitions. Utilize the domestic facilities well - through student training, in observing and technology, undergraduates.
  - Theoretical simulations? Integration between obs. And theo.; already leading in GPU/super-computing in some areas.
  - How do we involve all astronomers in China?
  - How do we get involved in TMT science programs? Volunteers in TMT working groups?
- **Telescope Access Program**
  - How do we run it fairly for the whole Chinese community?
- **Second-generation instruments**
  - How and what can we propose? Multi-object fiber spectrographs,HROS

TMT
Thirty Meter Telescope

Thanks!

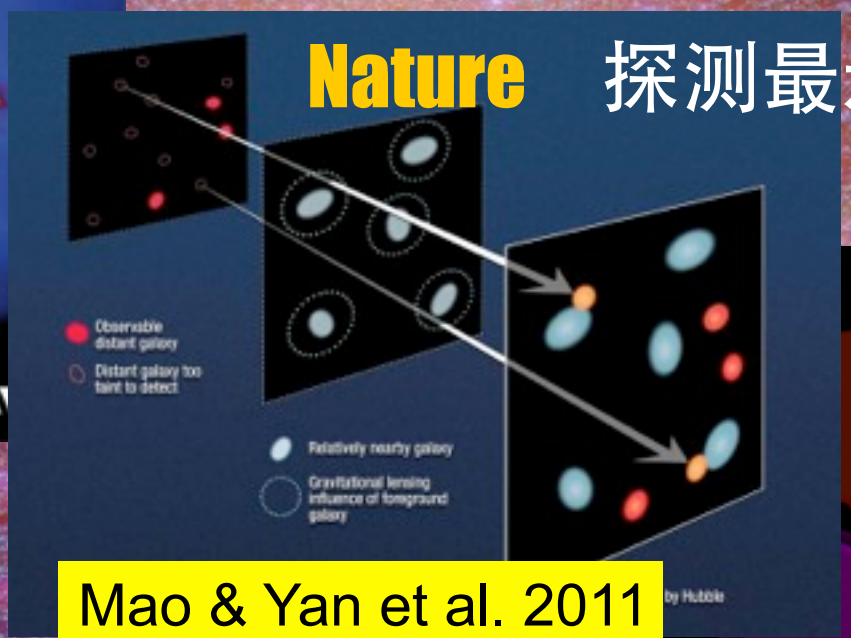
中国科学家的科学期望

一流的科学研究需要一流的设备

TMT
Thirty Meter Telescope

宇宙早期暗物质

Gao et al. 2007



探测最远和最早天体

Mao & Yan et al. 2011

系外行星系统

Li & Lin et al. 2010

合作与竞争：中印分别加入TMT

2009年，国务委员刘延东会见TMT高层管理代表，表态支持中国科研机构参与TMT的合作

2010年，印度总理辛格会见TMT高层管理代表，表态支持印度政府参与TMT的合作

CTMT budget outline

- based on Workshare Scenario Z-1(Nov. 2010)

Description	Subtotal	Annual Budget（MillionCNY）			
		2012	2013-2015	2016-2018	2019
Technical System					
M1 Polishing	272.7	80.0	83.0	83.0	26.7
M2 System	216.9	6.9	90.0	90.0	30.0
M3 System	32.0	2.0	12.0	12.0	6.0
Lasers	47.6	8.0	18.0	18.0	3.6
LGSF	76.2	17.2	27.0	27.0	5.0
WFOS	105.4	20.0	36.6	36.6	12.2
Contingency	71.4			41.4	30.0
Construction Cost for the Science Operation Center of CTMT	6.0	2.0	2.0	1.0	1.0
Subtotal of Technical System Cost	**828.1**	**136.1**	**268.6**	**309.0**	**114.5**
Common Fund	**147.7**	**36.2**	**46.5**	**46.5**	**18.5**
Infrastructure	**91.0**	**51.0**	**40.0**		
Subtotal of Construction Period Cost（2012-2019）	**1066.8**	**359.4**	**623.7**	**664.5**	**247.5**
Operation Cost（2020-2039）	**459.7**				
Total	**1526.5**				

Total for construction ~164M US$, ～71M US$ for 10% share operation