An international partnership for operating TMT
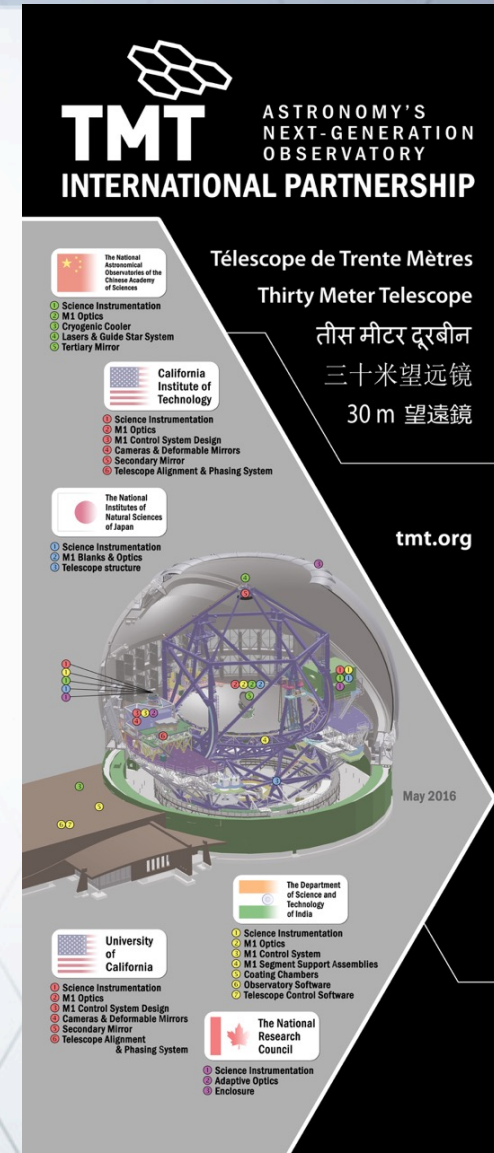
TMT Science Forum
May 25, 2016

Christophe Dumas
& DEOPS team

- Partnership is already in action at all stages of TMT development, construction, instruments design . . .
- Continued collaboration throughout operations is paramount for making TMT a success
  - ◇ Science partners have different needs & expertise
  - ◇ Science partners are geographically diverse
    - Operations support must address the range of user profiles and needs across TIO partnership

TMT Global Participants – First Light Science Instruments

USTC, Beijing (WFOS AGWFS)

NAOJ/Canon, Tokyo (IRIS imager, WFOS cameras)

HIA, Victoria (IRIS OIWFS)

DI, Toronto (IRIS Science, NSCU)

TIPC, Beijing (Cooling)

CSEM, Neuchatel (IRMS CSU)

IUCAA, Pune (IR readout electronics)

UCSC, Santa Cruz (WFOS)

IIA, Bangalore (IR-GSC)

NIAOT, Nanjing (WFOS AGWFS)

UH IfA, Hawaii (WFOS detector readout electronics)

UCLA/CIT (IRIS, IRMS)
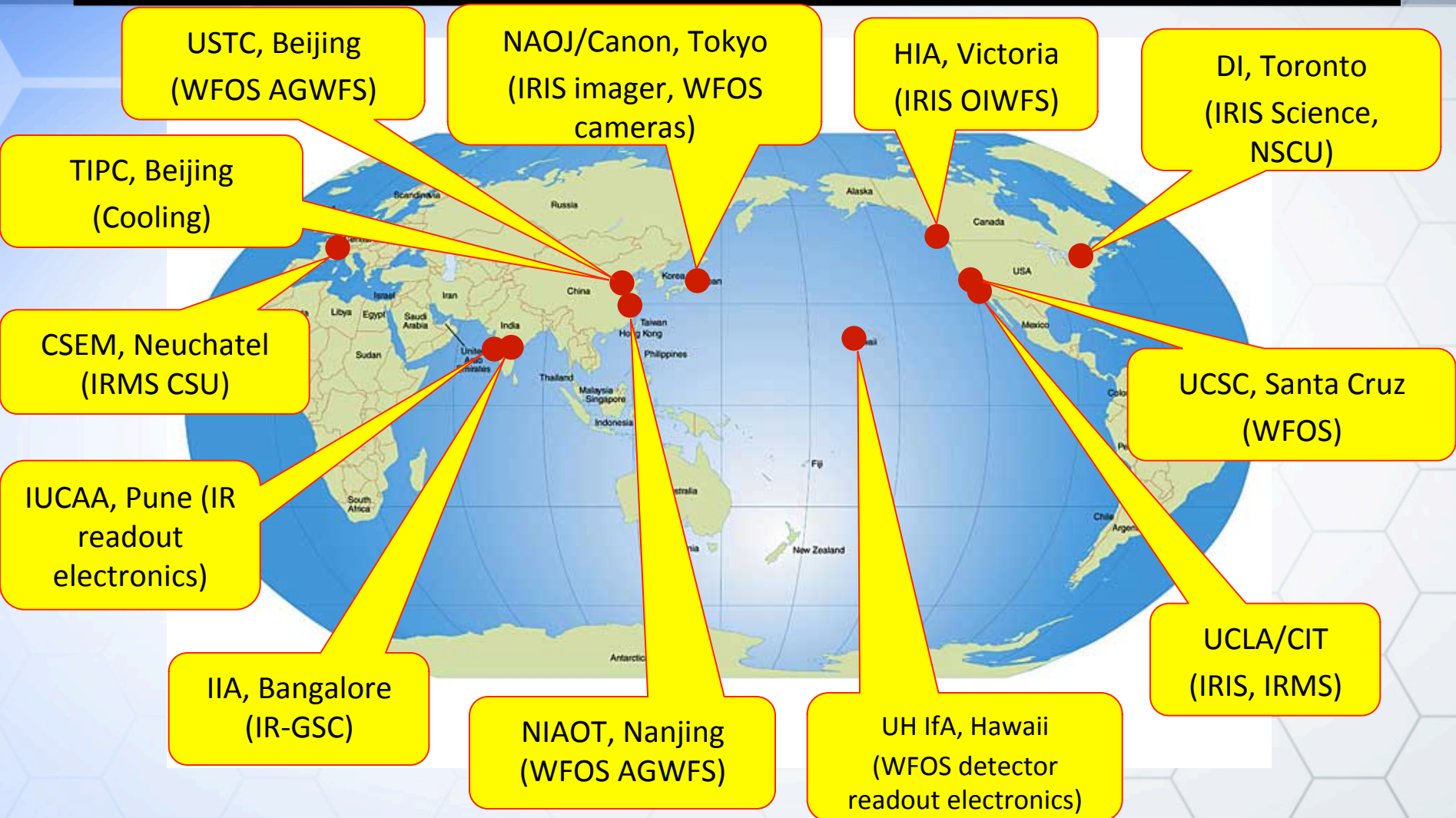
TMT Global AO Participants
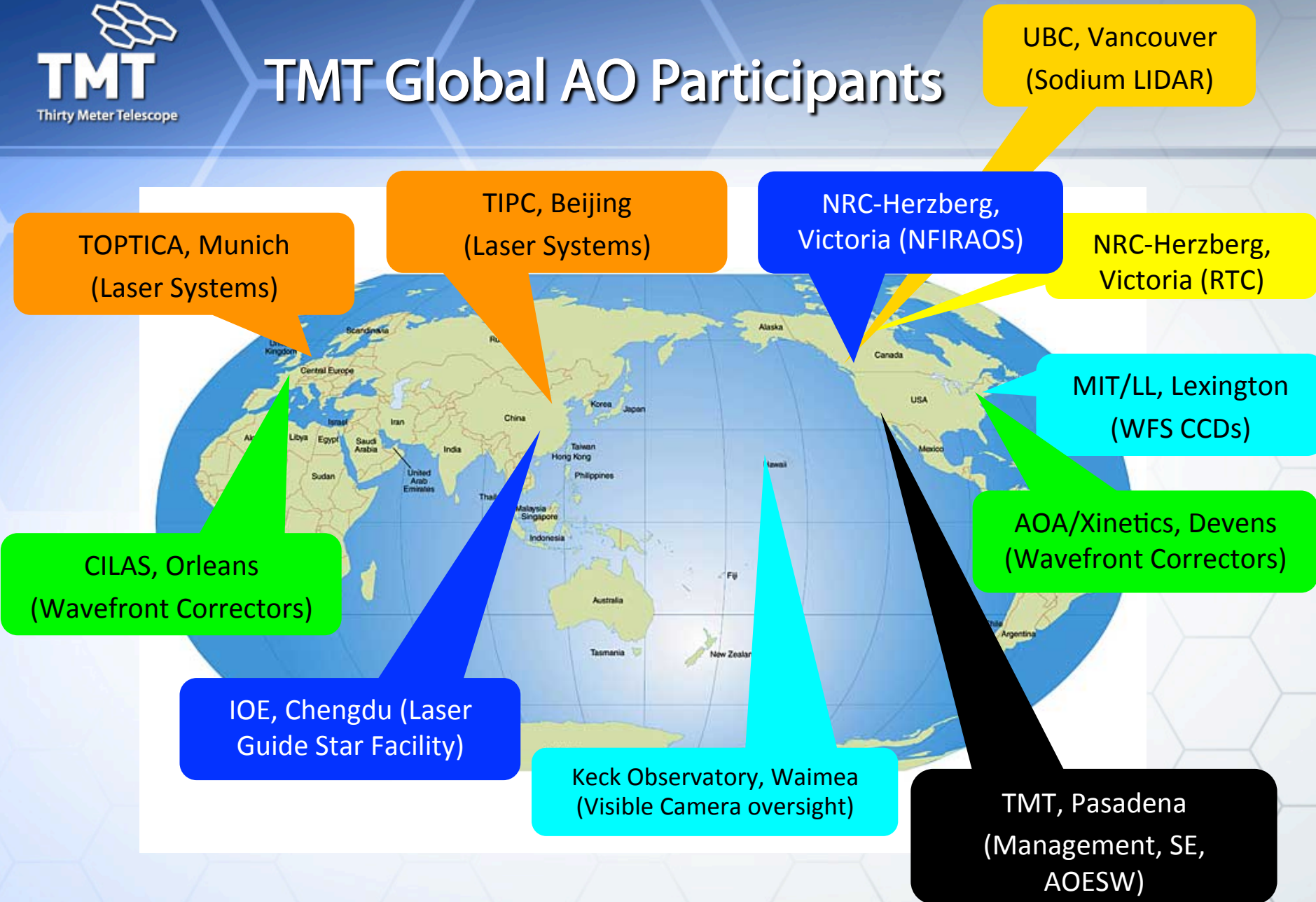
UBC, Vancouver (Sodium LIDAR)

TIPC, Beijing (Laser Systems)

NRC-Herzberg, Victoria (NFIRAOS)

NRC-Herzberg, Victoria (RTC)

TOPTICA, Munich (Laser Systems)

MIT/LL, Lexington (WFS CCDs)

CILAS, Orleans (Wavefront Correctors)

AOA/Xinetics, Devens (Wavefront Correctors)

IOE, Chengdu (Laser Guide Star Facility)

Keck Observatory, Waimea (Visible Camera oversight)

TMT, Pasadena (Management, SE, AOESW)

Planned staffing and operations cost

- Baseline: 119 staff, Yearly budget of ~40M$
- Staffing plan fully comparable with any other modern astronomical facilities

Description	Cost (2011 K$)
Staff salaries & benefits	12,240
Routine operations cost (non-staff)	12,125
Hawaii community benefits	*(3,624)*
Total running cost	**27,989**
New instrument development fund	**12,000**
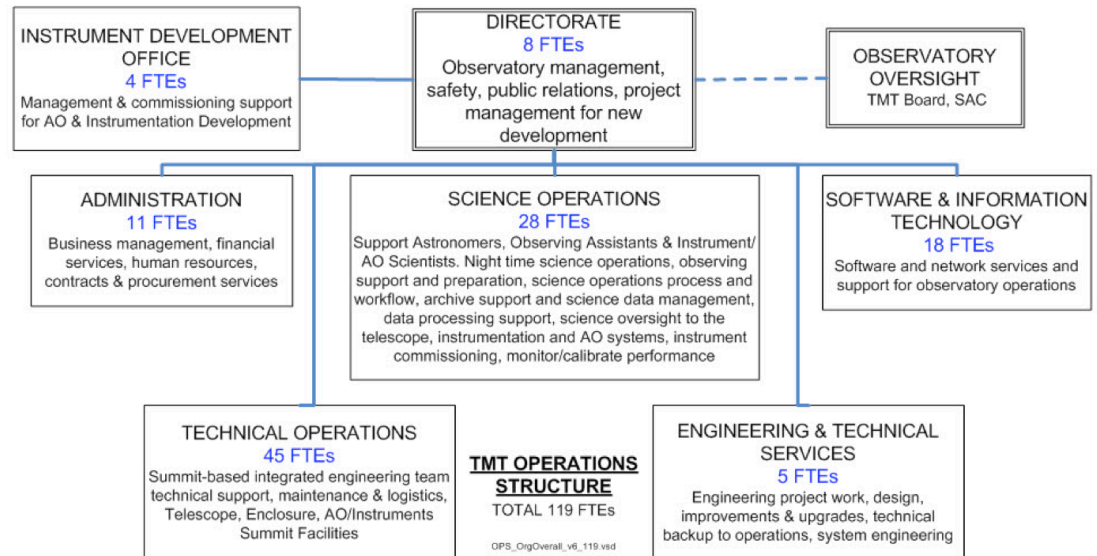
Figure 1 - Operations Organization Chart

Himalayas, India & China

Canary Islands, Spain

Baja California, Mexico

Chile
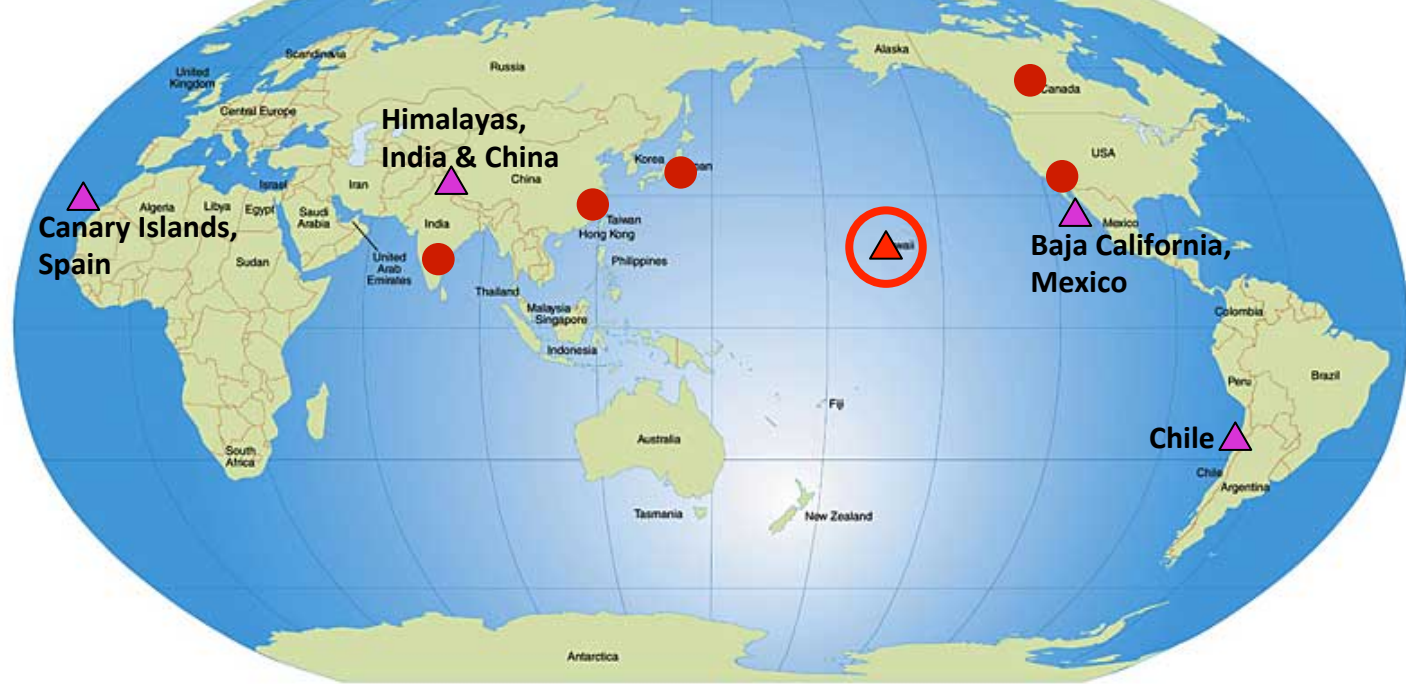
● : TMT partners

▲ : Potential alternate sites
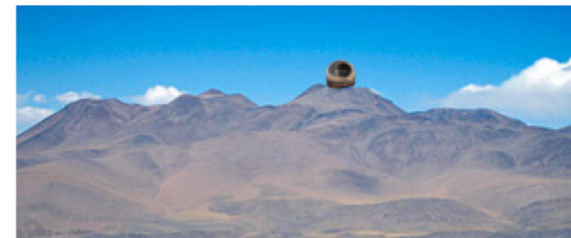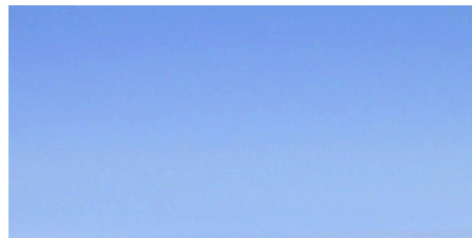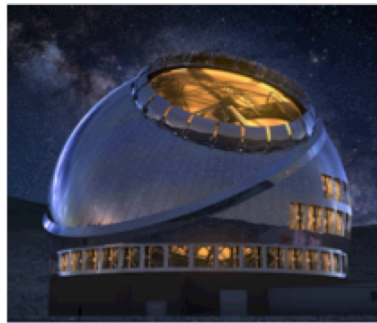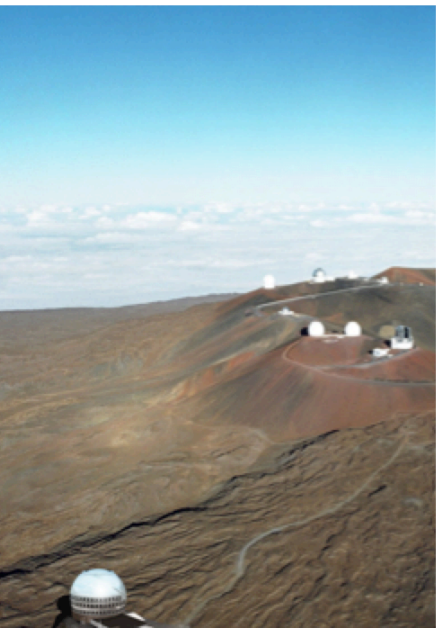
Operation models

- Details of Ops model depends on final site selected, e.g.:
  - Work-schedule
  - Physical location of various operations groups
  - FTE numbers
  - Overall cost

Operations: Organization

INSTRUMENT DEVELOPMENT OFFICE
4 FTEs
Management & commissioning support for AO & Instrumentation Development

DIRECTORATE
8 FTEs
Observatory management, safety, public relations, project management for new development

OBSERVATORY OVERSIGHT
TMT Board, SAC

ADMINISTRATION
11 FTEs
Business management, financial services, human resources, contracts & procurement services

SCIENCE OPERATIONS
28 FTEs
Support Astronomers, Observing Assistants & Instrument/AO Scientists. Night time science operations, observing support and preparation, science operations process and workflow, archive support and science data management, data processing support, science oversight to the telescope, instrumentation and AO systems, instrument commissioning, monitor/calibrate performance

SOFTWARE & INFORMATION TECHNOLOGY
18 FTEs
Software and network services and support for observatory operations

TECHNICAL OPERATIONS
45 FTEs
Summit-based integrated engineering team technical support, maintenance & logistics, Telescope, Enclosure, AO/Instruments Summit Facilities

TMT OPERATIONS STRUCTURE
TOTAL 119 FTEs

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ENGINEERING & TECHNICAL SERVICES
5 FTEs
Engineering project work, design, improvements & upgrades, technical backup to operations, system engineering

Technical center is part of Operations HQ if TMT is located in Hawai`i

TAC

: At Ops. HQ

Operation models *(Cont'd)*

- Still, main model components are site-independent:
  - Technical center (day-to-day support of operations) must be located at easy commuting distance from observatory (i.e. no more than 1h – can be much less depending on site)
  - Operations headquarters hosts:
    - observatory management, admin, outreach, etc
    - science operations (incl. helpdesk tasks)
    - instrument development
    - System (incl. software) engineering

Operation models *(Cont'd)*

- Science operations are done remotely:
  - I.e. no immediate proximity of Science Operations staff near observatory (Keck style) – except for nighttime science operations support staff (e.g. telescope operators, safety)
  - Support of classical (visitor) and queue (service) mode observations, and anything in between (i.e. eavesdropping)
    - Classical observations carried out both at main operation headquarter and distributed operations centers
      - Make use of distributed operation sites to minimize travel
    - Time-domain (time-critical) programs supported adequately to address higher-level risk of observations (e.g. eavesdropping, classical, 'flexible-classical')
    - Selection of observing mode must flexible to be best adapted to program and user needs
      - ESO-VLT studies shows that classical programs lead to higher science-impact → involvement of user/PI in program execution

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Science Operations Staffing & Tasks

- **Support astronomers**
  - Support day and night activities, including user support and software/pipeline improvement/development, improvement of operations, instrument scientists, calibrations, planning, documentation, technical-feasibility of science programs, quality control, troubleshooting, etc

- **System Scientists (Telescope, AO, Instruments, Operations)**
  - Assist in troubleshooting, investigating problems to maintain top-performances of sub-systems and instruments, assist (re-)commissioning activities, work closely with Technical and Science operations staff, Operations procedures/efficiency/metrics/software, calibrations

- **Observing Assistants**
  - Day & night activities related to calibration, queue observing, QA/QC, documentation, planning

Pipelines and archives

- Archives:
  - Archive will be automatically populated by
    - Raw data and associated files, calibrations, basic master calib files
  - Search engine will be developed to ease data-mining and data-association
  - Add-ons: To be funded via (new?) partner(s) contribution?
    - Enhanced calibrations files
      - Tuned to partners & program needs
    - Reduced science-files (science-graded)
      - Removed from instrumental + sky signatures, target-signal extracted & calibrated (photom, wavelengths)

Pipelines and archives *(Cont'd)*

- Pipelines
  - Instrument pipeline delivered to Operations by Instrument Team
  - SciOps responsible to maintain and enhance such pipelines
  - Add-ons: To be funded via (new?) partner(s) contribution?
    - Enhanced pipelines to produce science-ready data-sets
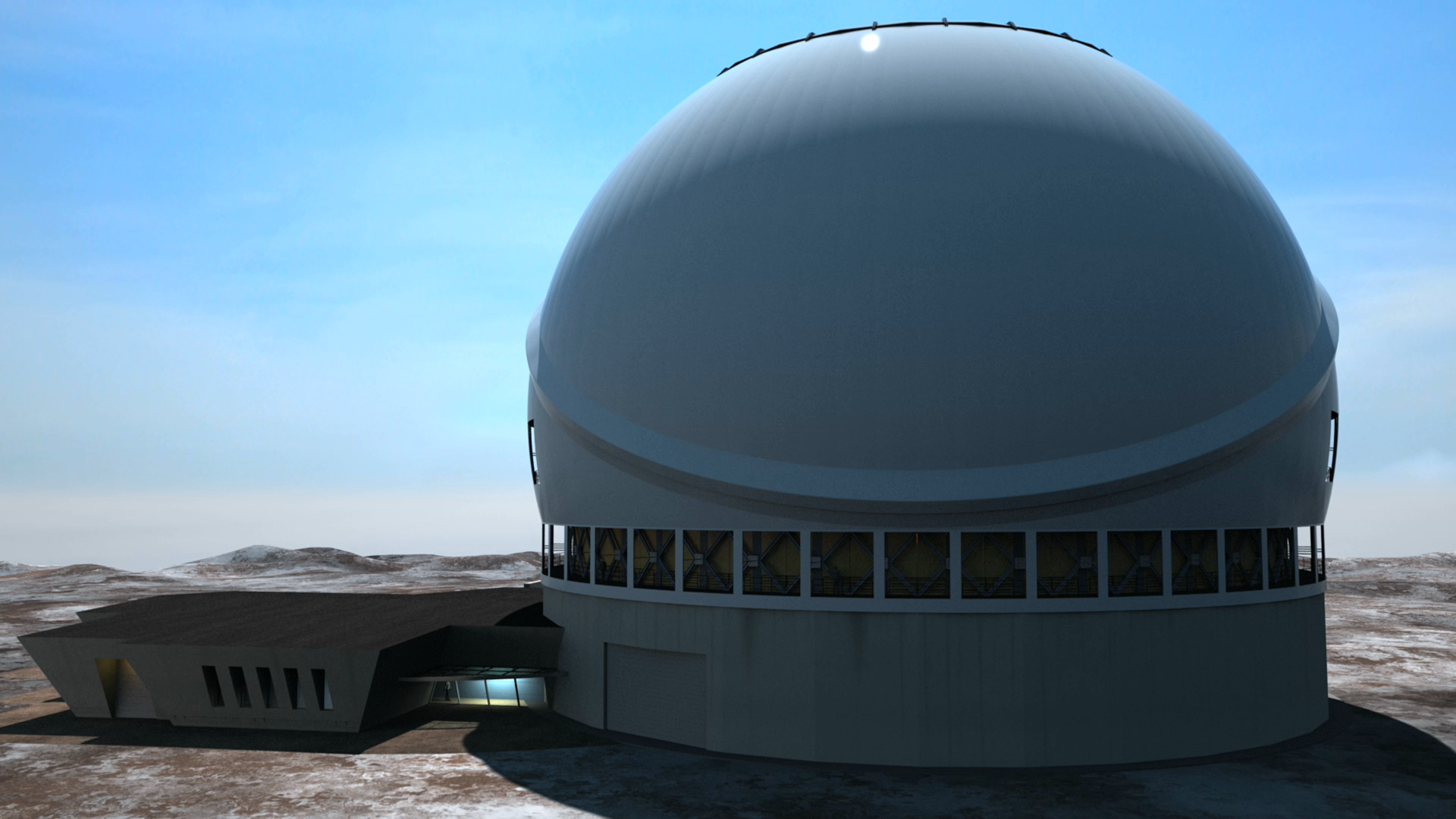
Distributed Operations Centers

- **Remote operation sites should ideally be located throughout partnership**

- The role of such 'TMT Operations Poles' (TOP) will be to attract and concentrate 'local' TMT operations expertize for:

  - Preparation, execution of science programs

  - Support *wrt* reduction of science data immediately after program execution (classical or queue, or anything in between)

  - Archiving and maintaining local copies of TMT data

  - Enhancing archive content with science-graded data

Distributed Operations Centers *(Cont'd)*

- The TOPs would be used to <u>grow expertise</u> in TMT operations and observing techniques <u>across the partnership</u>
  - Each center could be assigned a <u>scientific expertise</u> (e.g. Multi-Object Spectroscopy, High-Contrast observations, Integra-Field Spectroscopy, Polarization, Burst Mode imaging, etc)
- <u>Cross-training</u> of operations staff will be an essential part of TOP programs
  - Regular visits of TOP staff to TMT-HQ (and reversely HQ→ TOPs) for maintaining knowledge up-to-date
  - Goal is to reach homogeneous expertise across TOPs within 'a few years' of TMT operations (realistically ~5 years?)
  - Common 'TOP Mission Statement' must adopted across centers
    - Homogeneous processes, usage of tools, standards, etc

Final comments

- Adaptive queues *(i.e. real-time decision is software based and takes weather conditions into account)* will be needed *(currently not part of the baseline plan)*
  - ○ Will be even more needed to enhance TMT science output in case a low-altitude site is selected *(to benefit from windows when conditions are ideal for a specific program)*
- Some features of the proposed plan are not yet part of TMT budget
  - ○ This leaves opportunities for increased partners contribution, and for new partners

Thank you! ありがとう