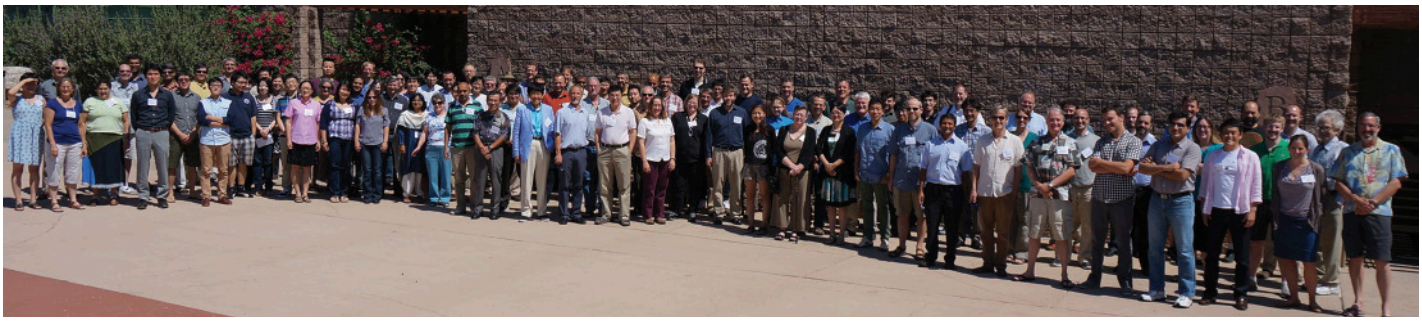
The 2014 TMT Science Forum in Tucson

Mark Dickinson



Attendees of the second annual TMT Science Forum, which was held 17–19 July 2014, at Loews Ventana Canyon Resort in Tucson. (Image credit: Michael Bolte, UC Santa Cruz.)

NOAO and the Thirty Meter Telescope (TMT) Project hosted the second annual TMT Science Forum, 17–19 July 2014 at Loews Ventana Canyon Resort in Tucson. More than 150 scientists and educators attended the meeting. Many came from the TMT partners (India, China, Japan, Canada, Caltech, and the University of California), but more than half of the participants were from US institutions outside the current TMT partners. The NSF provided generous funding to support attendance by members of the US-at-large community, as part of its cooperative agreement with TMT to develop a plan for possible future US federal participation in TMT. The Forum is an opportunity for US astronomers to learn about TMT and to become involved in planning for future science and instrumentation.

The theme of this year's meeting was "TMT in the Astronomical Landscape of the 2020s." On the first day, NOAO Director David Silva opened the meeting with an overview of that landscape, both scientific and programmatic, and discussed the potential for (and the challenges facing) future US federal investment in TMT. Gary Sanders, the TMT Project Manager, reviewed the status of the project as it moves into its construction phase (see sidebar). Thirteen invited speakers then discussed other forefront astronomical facilities, ground- and space-based, present and future, and their scientific synergies with TMT. There were talks about space-based observatories (JWST, WFIRST and Euclid, future X-ray missions such as eROSITA, Astro-H and ATHENA, space exoplanet explorers like TESS and PLATO), radio/millimeter facilities (ALMA, CCAT, the VLA, and SKA), and next-generation ground-based O/IR facilities, including the Subaru HyperSuprimeCam and Prime Focus Spectrograph, PanSTARRS, LSST, and the other two giant telescope projects, the Giant Magellan Telescope and the European Extremely Large Telescope.

An instrumentation workshop on the second day thoroughly reviewed the design and status of TMT's first-light instrument suite and adaptive optics system, TMT system engineering, and the process of planning and development for future-generation instrumentation. In the afternoon, there were parallel topical science sessions organized around the themes of the TMT International Science Development Teams (ISDTs): fundamental physics and cosmology, galaxy formation and the intergalactic medium, the Milky Way and nearby galaxies, supermassive black holes, the formation of stars and planets, extrasolar planets, our solar system, and time domain science. There were about 30 contributed science talks in these sessions, as well as lively discussions. In particular, the ISDT members were asked to start developing ideas for potential TMT key programs—high-impact science projects that might use substantial allocations of TMT time, coordinating teams that could span the TMT partnership. The ISDTs are a growing community of astronomers focused on TMT science. They are open to participation by all PhD scientists, and there will be annual calls for new ISDT members.

In the morning of the third day, the parallel session organizers reported on scientific highlights from their discussions, including these key program ideas, as well as the ISDTs' work on updating the Detailed Science Case, a document that describes at a high level the fundamental scientific problems and projects that motivate the design and construction of TMT. Gordon Squires gave a presentation on TMT's efforts in workforce development, education, and public outreach. The meeting concluded with a lively panel and audience discussion session. Posters were displayed throughout the conference. The presentations are available at the TMT Science Forum website, *conference.ipac.caltech.edu/tmtsf2014*, under "Program."

Many exciting ideas for key-program science were discussed in the parallel sessions, and there was widespread support for such projects in the panel discussion at the end of the meeting. Some US community astronomers viewed this as an effective way to maximize scientific return from an NSF-funded share of the observatory, likely to yield large, coherent scientific data sets with high re-use values. One of the panelists in the closing discussion, Dr. Shude Mao (National Astronomical Observatories, Chinese Academy of Sciences), noted that large, partnership-spanning programs are a good opportunity for astronomers from China and India to engage in forefront international science collaborations. There was general support for investment in data reduction software and archives in order to facilitate use and maximize re-use of TMT data. Some participants stressed the importance of flexible scheduling modes, especially to enable time-critical observations that might otherwise be impossible if time were allocated to each TMT partner in strictly defined blocks. There was interest in finding ways to take advantage of complementary instrumentation on the three extremely large telescopes, such as time trades between the observatories.

Finally, there was widespread enthusiasm for possible future US/NSF participation in TMT, not only from the US participants but from the international TMT partners as well. Of course, the astronomers who

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attended the TMT Forum are perhaps already inclined toward an interest in science with giant telescopes! However, the US TMT Science Working Group (SWG) is surveying the broader US astronomical community to understand its interests, aspirations, and concerns regarding national participation in TMT. The US TMT SWG is organized by NOAO (see *ast.noao.edu/system/us-tmt-liaison*) and consists of astronomers from institutions across the country and outside the current TMT partners (UC and Caltech). The NSF has asked the SWG to develop a model for potential US partnership in TMT. Please stay tuned to the NOAO electronic newsletter, *Currents*, for information about the TMT SWG's survey and its other activities as well as for future announcements about new opportunities to join the TMT International Science Development Teams. NOAO thanks everyone who attended this TMT Forum for making it such a success. We look forward to seeing you again at next year's meeting!

TMT Enters Its Construction Phase

The Thirty Meter Telescope (TMT) project has passed several critical milestones in the past few months and has transformed from a "project" into an observatory in the making.

In May, the financial authorities from the National Institutes of Natural Sciences in Japan, the National Observatories of the Chinese Academy of Sciences, the California Institute of Technology, and the University of California signed their commitments to fund construction of TMT, and the partnership formally incorporated as the TMT International Observatory, LLC (or TIO). The Indian Institute for Astrophysics and the Association of Canadian Universities for Research in Astronomy (ACURA) joined TIO as associate members and are aiming for full membership within the next year. AURA is also an associate member representing the US astronomical community. NOAO is charged with executing the responsibilities, privileges, and participation activities of AURA in TMT. The Gordon & Betty Moore Foundation has provided substantial funding to support the development of the observatory.

At the first meeting of the new TIO Board on 22 May 2014, the members voted to proceed with construction of TMT, contingent on the final approval of a sublease for TMT on Mauna Kea. That approval, by the Hawaii Board of Land and Natural Resources, was granted on 25 July 2014, launching the official start of the TMT construction phase.

The first construction activity in Hawaii will be a ground-breaking and blessing ceremony in October. In Japan, contracts have been signed for the final design of the telescope and for mirror segment blank fabrication. More than 60 mirror segment blanks (out of nearly 500 total) have already been manufactured. Design of the articulated tertiary steering mirror system, as well as the laser guide star system, is proceeding in China. India is prototyping the primary mirror segment assemblies, mirror actuators, edge sensors, and support systems. The adaptive optics facility is nearing its final design stage in Canada, and the TMT enclosure design is ready for construction by a Canadian industrial company. Three first-light instruments are under development by consortia that include contributions from all of the TMT partners.

"It has been an amazing journey for TMT, from idea to shovel-ready project," said Henry Yang, TIO Board Chair and Chancellor of the University of California Santa Barbara. "We are grateful to the Gordon and Betty Moore Foundation, the State of Hawaii, its citizens, and our project partners in bringing this important astronomical science effort to fruition. It is also my rewarding experience to work with so many community friends, University of Hawaii colleagues, and officials in both the Big Island and Oahu in this journey."

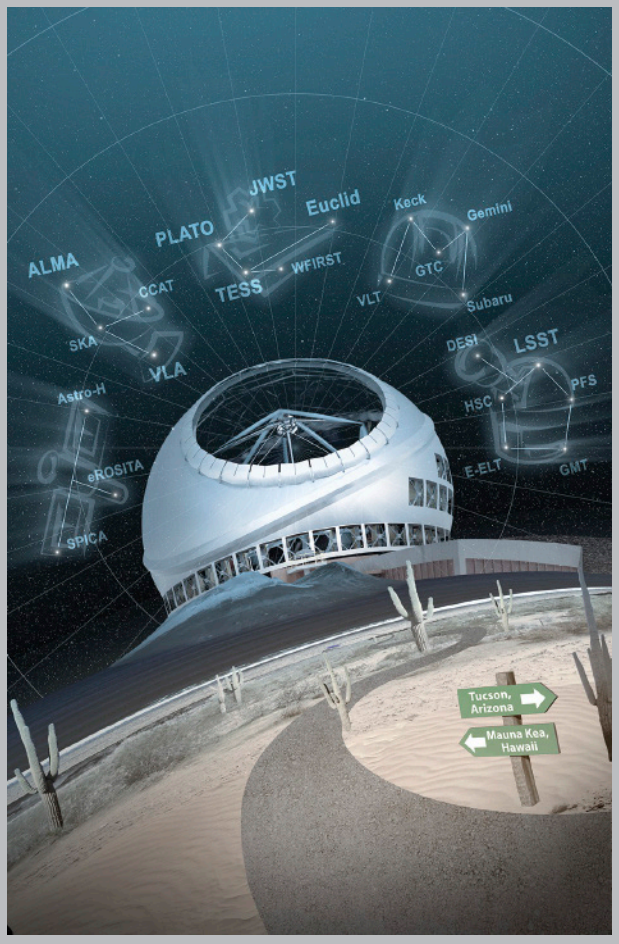

Image credit: Tim Pyle, IPAC