The Future of Science of Gemini Observatory 2015 continued

Instrument Feasibility Studies (GIFS). While differing in design, all four instruments are driven by the need to investigate transient objects that will be discovered by JWST, LSST, and LIGO. All four teams pointed out that Gemini's locations in Chile and Hawaii combined with Target of Opportunity (ToO) scheduling and a flexible instrument complement are great advantages for carrying out this work. Possible instrument suites constrained by the Gemini four instrument plus adaptive optics (AO) model were topics of discussion.

Many of the presentations can be found in pdf format on the website *http://www.gemini.edu/fsg15/program*.

The 2015 TMT Science Forum

Mark Dickinson

The theme of the third annual Thirty Meter Telescope (TMT) Science Forum, held on 23–25 June 2015 in Washington, DC, was "Maximizing Transformative Science with TMT." That admittedly ungainly and buzzwordy title captures two important foci of the meeting. First, there is the "transformative science" that will be enabled by a telescope whose collecting area will be an order of magnitude larger than that of today's largest optical/infrared telescopes and whose diffraction-limited angular resolution will be nearly five times sharper than that of the James Webb Space Telescope at similar wavelengths. Second, this year's Forum considered how to "maximize" the scientific return from TMT through innovative international collaborations, observatory operations, data management, and instrumentation. One hundred thirty-nine participants gathered at the headquarters of the American Association for the Advancement of Science (AAAS), and at the Mayflower Renaissance Hotel, to review the status of the project, to discuss TMT science, to plan future TMT observing programs, and to consider ways to run the observatory that will yield the best and most science.

Two days of plenary sessions alternated between invited science talks and discussion sessions. The science talks used current forefront research as a springboard to the future potential of TMT for achieving new breakthroughs. Topics spanned a huge range, including small body solar system science (Karen Meech, IfA), exoplanet atmospheres (Jayne Birkby, CfA), star and planet formation (Gregory Herczeg, KIAA-PKU), stellar chemical abundances (Wako Aoki, NAOJ), nearby galaxies and near-field cosmology (Alan McConnachie, NRC-HIA), supermassive black hole demographics (Jenny Greene, Princeton), early galaxy evolution (Shelley Wright, UCSD), and the intergalactic medium (R. Srianand, IUCAA).

The discussion sessions were among the liveliest parts of the meeting. Most addressed topics related to observatory operations. Each featured two short presentations by experts from operating observatories, who highlighted past experiences and potential lessons for TMT, followed by audience discussion. Topics included time allocation and the balance of small and large science programs, observatory operations and scheduling modes, and data management and archives. Another session focused on education, public outreach, and workforce development. There were also presentations on the status of the TMT project and on planning for the next generation of TMT instrumentation. Doug Simons (CFHT) gave an inspiring presentation about astronomy, Mauna Kea, and Hawaii, which was timely and relevant given the complex challenges faced by TMT as it starts construction, including protests by some members of the Hawaiian community.

The middle day of the meeting featured parallel sessions organized by the TMT International Science Development Teams (ISDTs) on topics ranging from the solar system to cosmology. In addition to invited and

Participants at the 2015 TMT Science Forum, held at the AAAS Headquarters in Washington, DC, listen to Wako Aoki (NAOJ) discuss the exploration of galaxy evolution through the fossil history of stellar chemical abundances. (Image credit: Tony Travouillon/ TMT.)

contributed talks, the participants held extensive discussions about possible "key project" science programs for TMT. One lesson from past experience is that a balance of smaller and larger science programs can be important for the scientific health and productivity of an observatory. The TMT partnership has been discussing ways to enable and encourage large science projects that might span its international community, and the ISDTs have been asked to develop ideas for such projects in order to explore their scientific potential and to consider their implications for TMT operations, data management, and future instrumentation. Participants in the parallel sessions brainstormed on key project concepts, and the ISDT organizers summarized these discussions to the full conference audience on the last day of the meeting.

A few messages can be drawn from the plenary discussion sessions and the ISDT working sessions. Unsurprisingly, there were abundant ideas for large science projects with TMT, and it will be important to implement a cross-partnership time allocation mechanism for large and long-term projects. Such projects can achieve transformative science and can also generate valuable, coherent data sets that could be mined by a wider research community if they are properly reduced, archived, and distributed. Well-run data management, including data reduction software or pipelines and a suitable archive, can significantly amplify the scientific output of an observatory and would help more astronomers squeeze the most science out of precious and unique TMT data. Several of the "key projects" discussed at the Forum (and no doubt many smaller programs as well) would benefit from modes of flexible or queue scheduling, implemented for at least part of TMT's observing time. This is particularly

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The 2015 TMT Science Forum continued

true for time-domain science, including some observations of solar system objects, exoplanets, transient events, and temporal monitoring of various sorts, many of which would be difficult to carry out efficiently with purely classical scheduling. Many important TMT science programs also require diffraction-limited observations taken in the best atmospheric conditions; these can also benefit from queue scheduling. A queue is also well-suited for efficient execution of small observing programs. Several ISDTs are looking beyond TMT's first-light instrumentation suite, and they presented projects that would use high-resolution spectroscopy (both at infrared and optical wavelengths), mid-infrared observations, multiplexed integral field spectroscopy, enhanced performance for high-contrast imaging, and spectropolarimetry. Finally, there was widespread recognition that communications, outreach, STEM education, and workforce development are integrally important to TMT's mission and to its success. There was considerable interest in, and expertise about, these issues among the astronomers attending the meeting and valuable dialogue between people who have been part of the TMT project for years and astronomers who were attending a TMT meeting for the first time.

The TMT Forum is also an opportunity to develop and strengthen ties between TMT and US astronomers outside the current TMT partner institutions (Caltech and the University of California, along with international partners Canada, China, India, and Japan). AURA is an associate member of the TMT International Observatory, with representatives on its governing board and Science Advisory Committee. As part of a cooperative agreement between TMT and the National Science Foundation (NSF), NOAO and the US TMT Science Working Group (SWG) serve as liaisons between the broader US astronomical community and TMT and are helping to develop a model for potential NSF partnership in the observatory. Eighty-two participants at this year's TMT Forum (roughly 60% of the total) came from US institutions outside the partnership, including many US members of the TMT ISDTs. Some were TMT habitués who have attended two or even three Forum events, while others were newcomers. It was a valuable occasion for the US TMT SWG to gather more information about the US community's interests and aspirations, which will inform the SWG's report to the NSF.

The TMT Detailed Science Case: 2015 edition
The Detailed Science Case (DSC) is the highest-level statement of the motivations for building the Thirty Meter Telescope. It provides examples of the transformative science that TMT can accomplish, from our solar system to cosmology. The original DSC was written in 2007, and it has now been thoroughly updated in a community-based effort involving the TMT International Science Development Teams (ISDTs). The ISDTs are topical science groups that advise and assist the TMT project and plan ahead for future TMT science programs. They are one of the best ways for US community astronomers to get involved in TMT, with annual calls for membership. More than 140 scientists worldwide contributed to DSC-2015, including about 40 from US institutions other than the current TMT partners. You can read DSC-2015 at *http://arxiv.org/abs/1505.01195*.

Phoenix Moves to Gemini South

Ken Hinkle, Dick Joyce & Verne V. Smith

On the morning of June 8, Caty Pilachowski (Indiana University) took the last observation using the Phoenix near-IR spectrograph combined with the Kitt Peak Mayall 4-m telescope. This observation marks the end of Phoenix use at Kitt Peak. Phoenix was the last f/16 instrument on the Mayall, so this was also likely the last use of the f/16 secondary. The decommissioning of Phoenix at the 4-m is part of the planned move to lower-cost operations as the Mayall transitions toward DESI.

The Phoenix-Gemini interface and Phoenix handling fixtures stored outside the Gemini South dome. (Image credit: Steve Margheim/Gemini.)

Phoenix, however, remains a popular instrument with long-slit, high-resolution capabilities over the entire 1–5 micron region that are not otherwise available. The need for a high-resolution near-IR spectrograph is particularly acute in the Southern Hemisphere since the ESO/VLT equivalent instrument CRIRES is out of commission for a few years as part of an upgrade. To fill this lack of capability in the south, NOAO and Gemini have agreed to offer Phoenix as a visitor instrument at the Gemini South telescope. Phoenix was last offered at Gemini South as a queue instrument in 2010B. Potential users should note that as a visitor instrument, observations will be blocked into a single run each semester.

Currently, Phoenix is in the Tucson lab being refitted to the Gemini instrument interface. When Phoenix was shipped to Kitt Peak in 2011, there was no plan to return it to Gemini. We believed that the Gemini interface would never again be used. Some months ago we started searching for the parts needed to prepare the instrument to go back to Gemini. Fortunately, the interface was found outside the Gemini South dome. The budget for moving Phoenix to Gemini does not include funding for upgrades, and the move will not go forward if there are major problems. However, so far all is going well, and we anticipate shipping Phoenix to Gemini South in the last quarter of 2015. The tentative plan is to schedule a block of Phoenix time in the second half (May–July) of the 2016A semester.