UA mirror lab to cast first mirror for giant Magellan telescope

December 15 2004

The University of Arizona Steward Observatory Mirror Laboratory and the Carnegie Observatories of the Carnegie Institution have signed an agreement to produce the first mirror segment for the Giant Magellan Telescope (GMT), a project of the multi-institutional GMT consortium. The Steward Observatory Mirror Lab in Tucson, Ariz., will cast the 27-foot (8.4-meter) mirror next summer, in 2005.

The GMT will be located at the Carnegie Observatories' site at Las Campanas, Chile.

The eight partners in the GMT project consortium are the Carnegie Observatories, the University of Arizona, Harvard University, Smithsonian Astrophysical Observatory, University of Michigan, Massachusetts Institute of Technology, University of Texas at Austin, and Texas A & M University.

"The National Academy of Sciences' astronomy decadal survey has ranked extremely large telescopes as the highest priority for ground-based optical astronomy," Steward Observatory Mirror Laboratory Director and Regents' Professor J. Roger P. Angel said. "The GMT is the first of this next-generation, which is several times larger than the current generation of large telescopes, to begin construction of the primary mirror optics."

The GMT's primary mirror will consist of seven large mirror segments, each 27 feet (8.4 meters) in diameter. The mirror to be cast next summer

will be the first of six identical outer segments that will be arranged in a hexagon around the seventh, central element. Together they will bring light to a focus much as a single mirror 70 feet (21.4 meter) in diameter roughly as wide as the 2004 Christmas tree in New York's Rockefeller Center is tall.

When corrected for atmospheric blurring with adaptive optics, the telescope will make infrared images ten times sharper than the Hubble Space Telescope, the same as a single 83-foot (25.4 meter) mirror in space.

"The GMT builds on concepts and technologies developed for the Large Binocular Telescope (LBT), which is approaching completion on Mount Graham," Steward Observatory Director and Regents' Professor Peter Strittmatter said.

"With its seven 8.4-meter mirrors, the GMT will provide a major advance in light-gathering power along with superb optical properties for high-resolution imaging of very faint objects. The GMT will be a huge advance for astronomy worldwide, and it's great to see the project get under way. We at the UA are proud to be partners in this epoch-making project."

The GMT, scheduled for completion in 2016, will be able to probe the secrets of planets that have formed around other stars in the Milky Way, peer back in time toward the Big Bang with unprecedented clarity, delve into the nature of dark matter and dark energy, and explore the formation of black holes. These rank among the most important questions in astronomy today.

The GMT capitalizes on the technology base that UA Steward Observatory and collaborating institutions have developed for a series of current-generation large telescopes: the MMT in southern Arizona, twin

Magellan telescopes in Chile, and the Large Binocular Telescope on Mount Graham, Ariz.

The GMT will use the lightweight, honeycombed borosilicate primary mirrors for which the Mirror Lab is famous. Six GMT primary mirror segments will be off axis, that is, they'll focus light at an angle so it merges with light focused by the on-axis central mirror.

"The net effect is that the GMT will appear to have a single 26-meter mirror covered with a mask consisting of seven 8.4-meter apertures," Strittmatter said. "Fabricating the off-axis mirrors is the new element in the program, and this first GMT mirror will serve to demonstrate the technology at the 8.4-meter scale."

In preparation for making the GMT mirror, a Mirror Lab team headed by Buddy Martin already is working on a 5.5-foot (1.7 meter) off-axis aspheric primary mirror, a one-fifth scale GMT mirror fabrication demonstration that will be used for the New Solar Telescope at Big Bear Observatory.

The GMT will incorporate other advanced technologies pioneered by Steward Observatory and collaborating researchers in Italy. Its adaptive optics system -- a system that compensates for light blurring in Earth's atmosphere will be directly integrated into the telescope optics. The deformable secondary mirror will make the correction.

The nearly 10-foot (3 meter) diameter secondary mirror will be electro-magnetically gripped by thousands of computer-controlled 'actuators' that tweak the mirror with nanometer precision. The unique system has been pioneered at the MMT and also is being incorporated in the LBT.

Researchers at Steward Observatory also are developing a tomographic system to measure atmospheric blurring.

"The Giant Magellan Telescope will allow an unprecedented view of extrasolar planets, as well as a window out to the largest scales and back to the earliest moments in the universe," Wendy Freeman, director of the Carnegie Observatories, said. "We plan to complete the GMT so that it will work in tandem with the future generation of planned ground- and space-based telescopes.

"The real distinction of GMT, however, is that it is building on a heritage of successful technology," Freeman added. The performance of the twin Magellan telescopes at Las Campanas "has far exceeded our expectations," she said.

Source: University of Arizona