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UA MIRROR LAB TO CAST TWO MIRRORS IN ONE FOR THE LSST

The University of Arizona's Steward Observatory Mirror Laboratory is about to cast a new kind of giant optic for a unique wide-field survey telescope, the Large Synoptic Survey Telescope.

The telescope will be the widest, fastest, deepest eye of the new digital age.

Mirror Lab workers will begin loading 51,900 pounds of glass into the mirror mold early today.

The Mirror Lab will cast two mirrors as a single piece of glass for the telescope, known as the LSST, this month. The lab will cast an outer 27-foot-diameter (8.4 meter) primary mirror and an inner 16.5-foot-diameter (5-meter) third mirror in one mold. It is the first time a combined primary and tertiary mirror will be produced on such a large scale.

The LSST will be the world's largest, most powerful wide-angle survey telescope. It will provide time-lapse digital imaging across the entire available night sky every three days, enabling astronomers anywhere simultaneous access to study supernovae, planet-approaching asteroids or comets and other dynamic celestial chance events, and explore the nature of dark matter and dark energy.

Normally, big telescopes see a patch of sky the size of a tiny piece of Earth's moon. The LSST will see a section of sky roughly 40 times the size of the full moon. Each image will be recorded at high resolution by a 3.2 billion-pixel camera arrayed in a 2-foot (64 centimeter) detector, the world's largest.

The LSST will be built on Cerro Pachón, an 8,800-foot, or nearly 2,700-meter, mountain peak in northern Chile. Private and public partners, collaborating as the LSST Corp., plan to begin the survey in 2014 or 2015.

The LSST will use three mirrors. The outer region of the 27-foot primary mirror will collect celestial light and reflect it up to the separate 11-foot (3.4-meter) secondary mirror. The secondary mirror bounces light back down to the telescope's 16-foot tertiary mirror, which then sends it up again into a camera at the center of the secondary mirror. This complex down-up, down-up optical light path is needed to acquire the wide field-of-view.

The conservative approach would have been to cast the first and third LSST mirrors separately, Mirror Lab Director and Regents' Professor of Astronomy Roger Angel said. Ten years ago, he proposed the telescope design that has evolved into the LSST.

"But it costs almost as much to cast a 5-meter third mirror as it does to cast an 8-meter primary," Angel said. "If we put these in the same piece of glass, that saves how much glass you have to use all together, as well as the time it takes to cast two mirrors."

Another, possibly greater, advantage is that by making the two mirrors in one, the two mirrors can be precisely aligned once and for all in the laboratory, Angel said. "So we'll save money both in the manufacture of the mirrors and also over the lifetime of the telescope because of the simplicity of permanently holding the mirrors in proper alignment."

FURNACE STARTS HEATING MARCH 23, SPINNING MARCH 28

Steward Observatory Mirror Lab workers will load 51,900 pounds of E6 borosilicate glass, made by the Ohara Corp. of Japan, into the giant rotating furnace March 17 and 18. Of this total, 9,800 pounds will be loaded over the tertiary mirror, which has a more steeply curved radius than the primary mirror.

Mirror Lab "oven pilots" will start heating the furnace at around 4 p.m. on March 23, so the glass will be sufficiently soft at 1,380 degrees Fahrenheit for furnace rotation to begin at about 10:30 p.m. on March 28.

The 39-foot-diameter furnace will spin at almost 7 rotations per minute for just over three days. Spinning at this speed, molten glass will by centrifugal force take on the curve of the primary mirror. Because the tertiary mirror has a deeper curvature, extra glass in the tertiary mold will be eventually ground away later in the mirror-making process.

As the furnace spins, liquid glass will flow between 1,650 hexagonal aluminum silicate cores. The cores create the honeycomb glass structure that is the hallmark of mirrors made at the Steward Observatory Mirror Lab, which is famous for making stiff, lightweight, thermally stable, giant "honeycomb" telescope mirrors.

Furnace temperatures will peak at 2,150 degrees Fahrenheit on March 29. LSST partners will mark the occasion with a day's worth of activities celebrating this "high fire" event.

The LSST casting cycle is about four months long. After high fire, the Mirror Lab begins the carefully controlled cooling process. About 100 days later, the cooled mirror blank and cores, which together weigh 85,000 pounds, will be lifted from the furnace and turned on end so cores can be removed. A total 16,000 pounds of glass will be removed from the faceplate and backplate of the mirror during grinding and polishing. The finished mirror will weigh about 35,900 pounds.

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Institutional members of the LSST Corp. are:

Brookhaven National Laboratory, California Institute of Technology, Carnegie Mellon University, Columbia University, Google Inc., Harvard-Smithsonian Center for Astrophysics, Johns Hopkins University, Stanford University's Kavli Institute for Particle Astrophysics and Cosmology, Las Cumbres Observatory Global Telescope Network Inc., Lawrence Livermore National Laboratory, National Optical Astronomy Observatory, Princeton University, Purdue University, Research Corporation, Stanford Linear Accelerator Center, Pennsylvania State University, The University of Arizona; the University of California at Davis, the University of California at Irvine, the University of Illinois at Urbana-Champaign, the University of Pennsylvania, the University of Pittsburgh and the University of Washington.

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LSST project, http://www.lsst.org