

The University of Arizona Mirror Lab is a one-of-a-kind assembly line



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It took seven years and \$27 million to create the first of seven mirrors for the Giant Magellan Telescope (GMT), but now UA astronomers and optical scientists are gearing up to crank them out much more quickly and cheaply.

Cheap, of course, is a relative term, and it's not exactly an assembly line at the University of Arizona Steward Observatory Mirror Lab.

Five astronomical mirrors are in some stage of production in the concrete cavern beneath the east bleachers of Arizona Stadium.

The lab is polishing the 8.4-meter mirror of the Large Synoptic Survey Telescope and preparing to polish a 6.5-meter mirror for a Mexican project on Baja California.

Two of the Giant Magellan Telescope's giant petals are already cast. One is polished and the other is awaiting that process.

A third 8.4-meter (27 feet) mirror for the GMT spun in a furnace Saturday as the projects' donors and partners toured the facility that pioneered the process of spin-casting astronomical mirrors.

Making such large mirrors and polishing them to astronomical specifications is a five-to-six-year process that requires having several mirrors at various stages, said **Jeff Kingsley**, associate director of the mirror lab.

On Saturday, the furnace, filled with 20 tons of melting glass, spun at just under five revolutions per minute, about merry-go-round speed.

It will heat up and speed up in the coming hours and then cool down for weeks in an annealing process that should be over by Thanksgiving.

Spin-casting allows the glass to evenly flow into a honeycomb of molds, and forms a "dished" parabolic surface that makes the grinding and polishing process easier.

The Giant Magellan Telescope will be built on a peak in Chile's Atacama Desert at Carnegie's Las Campanas Observatory.

A pad has been blasted and cleared at the site, though construction of an enclosure has not

begun.

The Giant Magellan, with its seven 8.4-meter mirrors, would dwarf any telescope in existence today, though Europe and the California universities are leading projects for even bigger ones.

The first mirror for the GMT took so long because the lab's optical scientists had to invent ways to measure it before and after polishing.

Because six of the instrument's petals will be arrayed around a center mirror, they do not have the even, parabolic shape of mirrors previously made by the lab. Kingsley compared them to the shape of a Pringles chip.

New polishing methods had to be invented, along with the measurements.

Kingsley said the lab will complete polishing the second GMT mirror by summer of 2017.

The mirror being cast now will be done by summer of 2018. The center mirror will be completed the following year. Glass has already been ordered for that.

The UA, a partner in the Giant Magellan Telescope Organization, has contributed money and time to the project and has also netted about \$45 million in contracts for its mirror lab.

Total cost of the eight mirrors (counting one spare) will be \$150 million to \$170 million, said **Buell Jannuzi**, director of Steward Observatory and the department of astronomy.

Partners in the project include the UA, Astronomy Australia, The Australian National University, Carnegie Institution for Science, Harvard University/Smithsonian Institution, Korea Astronomy and Space Science Institute, University of Texas at Austin, Texas A&M University and the University of Chicago.