American Astronomers Lobby For the Next Big Thing

With a successor to the Hubble Space Telescope seemingly assured, U.S. researchers state their case for a complementary mammoth telescope on the ground

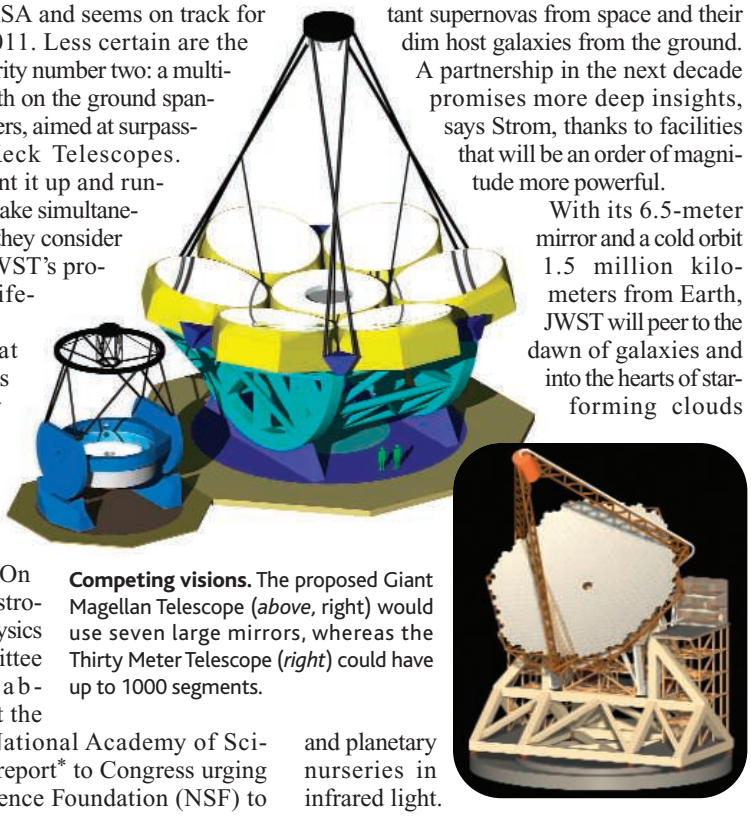
Astronomers like to view the heavens through as many eyes as possible: some on Earth, some in orbit, some tuned to every reach of the electromagnetic spectrum. Soaring costs for next-generation telescopes, however, are forcing researchers in the United States to make hard choices—or vigorous arguments. The top item on their wish list—the $1.6 billion James Webb Space Telescope (JWST), successor to the Hubble Space Telescope—enjoys steady support from NASA and seems on track for launch in late 2011. Less certain are the prospects for priority number two: a multi-mirrored behemoth on the ground spanning 20 to 30 meters, aimed at surpassing Hawaii's Keck Telescopes. Astronomers want it up and running by 2015 to make simultaneous observations they consider crucial during JWST's projected 10-year lifetime.

Fearful that funding shortfalls might narrow that window, U.S. astronomers have sharpened their case for the giant ground-based telescope. On 15 March, the Astronomy and Astrophysics Advisory Committee (AAAC)—established in 2002 at the request of the National Academy of Sciences—issued a report* to Congress urging the National Science Foundation (NSF) to boost its early funding of technology research for the telescope, which to date has relied almost entirely on private grants. What's more, the next-generation ground and space science working groups—usually isolated—are finishing a novel white paper titled, in part, *The Power of Two*. The document claims that the field's central questions are within reach of JWST and an earthbound partner.

Both reports raise the specter of foreign competition. "We felt that if we did not have a large enough telescope in place during the JWST era and our European colleagues did, then our competitiveness at the frontier would be diminished significantly," says *Power of Two* co-author Stephen Strom of the National Optical Astronomy Observatory (NOAO) in Tucson, Arizona.

To set the scene, the reports cite major advances from the pairing of Hubble and the 10-meter Keck Telescopes, such as the discovery of "dark energy" by observing distant supernovas from space and their dim host galaxies from the ground. A partnership in the next decade promises more deep insights, says Strom, thanks to facilities that will be an order of magnitude more powerful.

With its 6.5-meter mirror and a cold orbit 1.5 million kilometers from Earth, JWST will peer to the dawn of galaxies and into the hearts of star-forming clouds and planetary nurseries in infrared light. A ground telescope will examine the same objects in near-infrared and optical light, but five times more crisply than JWST because the vast mirror will collect so much light. Spectrographic analysis of that light should yield exquisite details about motions and compositions of gas that will elude JWST, says astronomer Alan Dressler of the Carnegie Observatories in Pasadena, California. "JWST's sensitivity will be fantastic, and its images will be untouchable," he says. But the ground spectra will show how the first galaxies actually assembled their gas. The spectra also may shed light on worlds like our own in the innermost zones of planetary systems around nearby stars, which JWST won't see, Dressler says.



Competing visions. The proposed Giant Magellan Telescope (*above*, right) would use seven large mirrors, whereas the Thirty Meter Telescope (*right*) could have up to 1000 segments.

The space telescope's designers won't duplicate those strengths. "We're very strict about that," says JWST senior project scientist John Mather of NASA's Goddard Space Flight Center in Greenbelt, Maryland. "If anybody's ever going to do it on the ground, we don't do it."

How the terrestrial telescope will work its magic is hotly debated. Two teams have devised distinct ideas for a Giant Segmented Mirror Telescope (GSMT), and each is convinced its approach is superior. One consortium of more than a half-dozen institutions, led by the Carnegie Observatories, proposes seven 8.4-meter mirrors in a tight floral pattern. The other group—the California Institute of Technology, the University of California, NOAO, and Canada—wants to scale up the 36-mirror honeycomb of the twin Keck Telescopes to a huge surface made of 800 to 1000 segments. Both designs require rapidly flexible optics and a daunting array of laser beams pointed at the sky to detect and erase the blurring of Earth's atmosphere.

The technology challenges are steep, with price tags to match: $500 million and $800 million for the respective designs. Both teams expect more than half of the money to come from universities and private U.S. donors, but even that may not be enough. "For the next-generation facilities … it would be very advantageous to have international partnerships," says astronomer Rolf-Peter Kudritzki of the University of Hawaii, Manoa, chair of the GSMT science working group.

Ideally, those ties should include European astronomers, the AAAC report urges. Current plans in Europe call for a 60-meter to 100-meter "Overwhelmingly Large Telescope," which many researchers view as overly ambitious. If U.S. agencies keep channels open with European colleagues, the world community might sustain two 30-meter-class telescopes—one in the north and one in the south—the report states.

Meanwhile, AAAC urges NSF to up the ante for the technology development needed to explore both U.S.-led designs. A $35 million proposal is pending at NSF, but this year's bleak budget outlook means the two teams probably will get some small fraction of that, according to an astronomer familiar with the deliberations. Even so, NSF is likely to support as much as 50% of one project when resources permit, says Wayne Van Citters, director of the agency's division of astronomical sciences.

But further slippage of up-front funding might push the completion date for a huge ground telescope uncomfortably deep into JWST's limited life span. It's time to make progress toward the best design, says NASA's Mather: "We just want somebody to build one."

—ROBERT IRION

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* www.aas.org/aaac/2005AR.pdf

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