LASER BEACON SHARPENS IMAGES OF EARTH-BOUND ASTRONOMY

Can You Imagine . . .

. . . a laser guide that helps astronomers see the universe with greater clarity from retrofitted terrestrial telescopes.

The science of adaptive optics (AO) is at least as old as the speculations of Sir Isaac Newton on the nature of light scatter. He once observed that good astronomical viewing required a "serene and quiet Air," and for centuries stargazers sought high ground to escape the influence of the earth's atmosphere. Some of the world's most powerful telescopes were built on mountaintops to get a clearer look at the universe and the Hubble Space Telescope represents the latest extension of this quest for clear vision.

In recent years, as defense technology yielded its secrets to the astronomy community at large, the undulations of the air seem more manageable. AO, originally conceived to get a clear view of missile threats and spaceborne weaponry, now provides astronomers with a conjurer's bag of tricks. Shape-changing mirrors, fast digital processors, and powerful lasers help to gather and focus errant light waves. Once indistinct, or even hidden, stars and galaxies will soon be seen with greater clarity from retrofitted terrestrial telescopes.

Lawrence Livermore National Laboratory (LLNL; Livermore, CA) testfired a new sodium laser guide star at Mount Hamilton's Lick Observatory. The guide star is part of an AO system that enables astronomers to sharpen ground-based celestial images to resolutions approaching the quality of Hubble. The LLNL project aims to retrofit some of the world's largest telescopes, including the Keck II telescope on Mauna Kea, Hawaii, with new eyes to see the universe. Its sister, Keck I, has already made significant discoveries about the cosmos. Many expect Keck II to outperform Keck I once it has the high-technology equivalent of corrective lenses.

The U.S. Department of Energy at LLNL originally sponsored the Atomic Vapor Laser Isotope Separation program, whose technology led to the evolution of the high-powered laser. However, BMDO and the U.S. Air Force's pioneering AO research marks the AO system surrounding the laser. Dr. Claire Max, principal investigator, worked on the original concept of laser guide stars in a BMDO-supported AO project in the early 1980s.

A number of AO experts contributed to LLNL's technology development. These experts came from companies such as Xinetics, Inc., Itek, Adaptive Optics Associates, and MIT's Lincoln Laboratory.

A NUMBER OF ADAPTIVE OPTICS EXPERTS CONTRIBUTED TO LLNL'S TECHNOLOGY DEVELOPMENT.

■ A laser guide star is beamed out of the open dome of Lick Observatory. It sharpens ground-based celestial images.

ABOUT THE TECHNOLOGY

The laser guide beams up to a focal point 95 kilometers above the earth. This soldium-rich region of the upper atmosphere fluoresces when the laser beam illuminates it. Knowing the properties of the exciting laser and of the returning sodium light, researchers can map the atmospheric distortions in the signal and compensate for those distortions with AO elements.