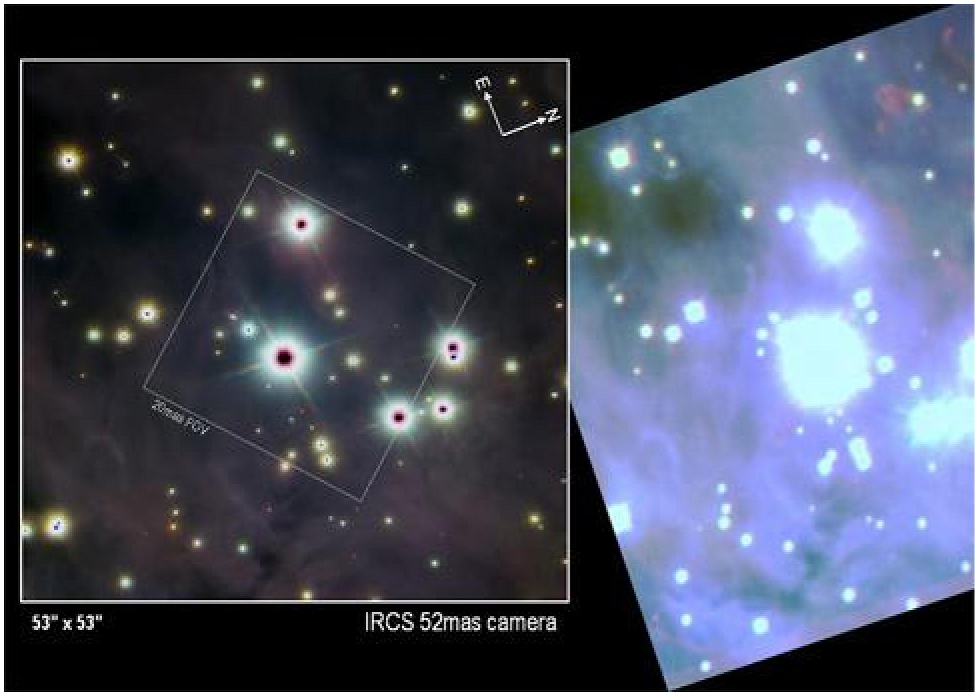
Subaru's eye improves

The instrument atop Mauna Kea, Hawaii, improves its optics by a factor of 10.

Provided by Subaru Telescope



An image of the trapezium region in the Orion Nebula with and without adaptive optics. The image on the right has a resolution of 0.6 arcseconds and was obtained with Subaru's CISCO camera in 1999 without the use of adaptive optics. The image on the left has a resolution of 0.06 arcseconds and was obtained in October 2006 using Subaru's IRCS camera and the new adaptive optics system. *Subaru Telescope* **[larger image]**

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On October 9, 2006 the Subaru Telescope researchers used a new adaptive optics system to obtain an image of the Trapezium region of the Orion Nebula. A comparison of this new image with a first light image taken when the Subaru telescope first began observing in 1999, shows a dramatic increase in contrast and detail in the higher-resolution image. With the new system in place, including a newly installed laser guide star system, to measure and correct for the effect of turbulence in real-time, Subaru's eyesight has been improved by a factor of ten, giving astronomers a clearer view of the universe.

Adaptive optics and laser guide star technology are important to astronomers because a ground-based telescope's ability to resolve spatial detail is limited by turbulence in Earth's atmosphere. If the Subaru Telescope were in space (without atmospheric interference) it could achieve an angular resolution of 0.06 arc-seconds for light with a wavelength of 2 microns.

In practice, even with the excellent observing conditions on Mauna Kea, the typical resolution Subaru can obtain is 0.6 arc-seconds because of the atmospheric turbulence that causes light traveling from stars and other objects to twinkle and blur. Fortunately, adaptive optics technology removes the twinkle and eliminates the blur. This allows astronomers to see greater detail in the objects they observe. Subaru's adaptive optics development team has been working on replacing its older 36-element adaptive optics system with an improved 188-element system for the past five years. At the same time, the team also developed and installed a new laser guide star system that allows astronomers to create an artificial star anywhere in the sky. They use light from the artificial star to measure the twinkle brought on by the atmosphere. That information is then used by the adaptive optics system to deform a special mirror that removes the twinkle and clarifies the view.

On October 12, 2006, researchers projected a laser beam into the sky to produce an artificial star in the sodium layer of Earth's atmosphere, at an altitude of about 90 kilometers. Subaru's laser guide star system is the 4th system to be completed in the world for 8-10m telescopes, and its use of unique solid-state laser and optical fiber technology, both developed in Japan, represents a new and original contribution to the field.

Together, both systems open up a larger portion of the sky to observations with adaptive optics and allow Subaru to reach its theoretical performance limit. With the addition of these new systems, the Subaru telescope will enable astronomers to study objects that were previously unobservable, such as the detailed structure of faint distant galaxies and stellar populations of nearby galaxies. They will also be able to do more detailed imaging and spectroscopy of quasars and gamma-ray bursters.

The research and development of the new systems was supported by a grant from MEXT, the Japanese Ministry of Education, Culture, Sports, Science and Technology.

Subaru is an 8.2-meter optical-infrared telescope on Mauna Kea, Hawaii, operated by the National Astronomical Observatory of Japan, a member institute of Japan's National Institutes of Natural Science.