Keck Telescopes Take Deeper Look at Planetary Nurseries

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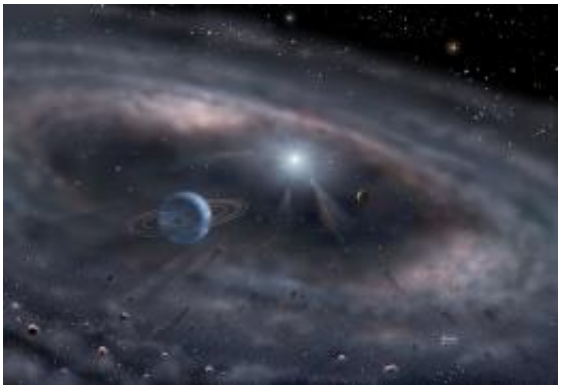

This artist's concept shows the development of planets within a dust disk around a young star. The Keck Interferometer probed the temperature and density of the dust disk around MWC 419 to within a fraction of an astronomical unit from the star. Credit: David A. Hardy

(PhysOrg.com) -- Astronomers using the W. M. Keck Observatory have peered far into a young planetary system, giving an unprecedented view of dust and gas that might eventually form planets similar to Jupiter, Venus, or even Earth. The researchers used the Keck Interferometer, which combines the light-gathering power of both 10-meter Keck telescopes to act as an 85-meter telescopemuch larger than any existing or planned telescope.

“Because the gas, dust and debris that orbit young stars provide the raw materials for planets, probing the inner regions of those stars lets us learn

about how Earth-like planets form," said astronomer Sam Ragland of Keck Observatory. He and his collaborators recently measured the properties of a young planetary system at distances closer to the star than Venus is to the Sun.

MWC 419, also known as V594 Cas, is a young, blue variable star located 2,100 light years away in the constellation Cassiopeia. Credit: DSS/STScI/AURUA

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"Nothing else in the world provides us with the types of measurements the Keck Interferometer does," said Wesley Traub of Caltech's Jet Propulsion Laboratory. "In effect, it's a zoom lens for the Keck telescopes."

The "zoom lens" allowed the researchers to probe MWC 419, a blue, B-type star that has several times the mass of the Sun and lies about 2,100 light-years away in the constellation Cassiopeia. With an age less than

ten million years, MWC 419 ranks as a stellar kindergartener.

W. M. Keck Observatory operates two 10-meter optical/infrared telescopes on the summit of Mauna Kea. Credit: Joey Stein/ WMKO

With the interferometer and the increased ability to observe fine detail, the team measured temperatures in the planet-forming disk to within about 50 million miles of the star. “That’s about half of Earth’s distance from the Sun, and well within the orbit of Venus,” said team member William Danchi of NASA’s Goddard Space Flight Center in Greenbelt, Md.

For comparison, astronomers using a single telescope have directly observed HR 8799, Fomalhaut and GJ 758 and their orbiting planets, which are 40 to 100 times farther away from their stars.

The interferometry results were taken in near-infrared light (3.5 to 4.1 micrometers), which is a wavelength slightly longer than red light and is invisible to the human eye. The researchers used a newly implemented

infrared camera, which is the only one of its kind on Earth, to make the first “L-band” interferometric observations of MWC 419.

“This unique infrared capability adds a new dimension to the Keck Interferometer in probing the density and temperature of planet-forming regions around young stars. This wavelength region is relatively unexplored,” Ragland said. “Basically, anything we see through this camera is brand new information.”

With the data, Ragland and his collaborators measured the temperature of dust at various regions throughout MWC 419’s inner disk. Temperature differences throughout the disk may indicate that the dust has different chemical compositions and physical properties that may affect how planets form. For example, in the Solar System, conditions were just right to allow rocky worlds to form closer to the Sun, while gas giants and icy moons assembled farther our in the system. The team reported their findings in the Sept. 20 issue of the Astrophysical Journal.

The observations are an “important first step” in a larger program to collect data on young stars that span the lower-mass T Tauri stars, which are the progenitors of Sun-like stars, to their more massive counterparts, like MWC 419, explained John Monnier, an interferometry scientist at the University of Michigan who was not involved with the study.

The astronomers want to study the range of developing stars because their mass, size and luminosity might affect the composition and physical characteristics of the surrounding disk. Ragland and his collaborators are continuing to collect data on young stars and will combine their infrared observations with new data from the Keck Interferometer’s “nulling” mode, a technique which will block out the light from the central star in a young planetary system.

Provided by W. M. Keck Observatory