





Planetary First Family (left)

Astronomers using the Gemini North telescope and W.M. Keck Observatory on Hawaii's Mauna Kea have obtained the first-ever direct images identifying a multi-planet system around a normal star.

The planets (indicated by b, c and d on reverse) formed about sixty million years ago and are young enough that they are still glowing from heat released as they contracted. Analysis of the brightness and colors of the objects shows that the objects range from about 7 to 10 times the mass of Jupiter. As in our solar system, these giant planets orbit in the outer regions of this system – at roughly 25, 40, and 70 times the Earth-Sun separation. The furthest planet orbits just inside a disk of dusty debris, similar to that produced by objects in the Kuiper Belt of our solar system (just beyond the orbit of Neptune at 30 times the Earth-Sun distance). In some ways, this planetary system seems to be a scaled-up version of our solar system with a larger and brighter star.

The host star (a young, massive star called HR 8799) is about 130 light years away from Earth. Comparison of data from different times show that the three planets are all moving with, and orbiting around, the star. This proves that they are associated with it rather than just being unrelated background objects coincidentally aligned in the image. HR 8799 is faintly visible to the naked eye, but only to those who live well away from bright city lights or have a small telescope or even binoculars.

The Gemini images allowed the international team to make the initial discovery of two of the planets in the confirmed planetary system with data obtained on October 17, 2007. Then, on October 25, 2007, and in the summer of 2008, the team, led by Christian Marois of the National Research Council of Canada's Herzberg Institute of Astrophysics and members from the U.S. and U.K., confirmed this discovery and found a third planet orbiting even closer to the star with images obtained at the Keck II telescope. In both cases, adaptive optics technology was used to correct in real-time for atmospheric turbulence.

This discovery is the first time we have directly imaged a family of planets around a normal star outside of our solar system. Team member Bruce Macintosh of the Lawrence Livermore National Laboratories adds, "Until now, when astronomers discover new planets around a star, all we see are wiggly lines on a graph of the star's velocity or brightness. Now we have an actual picture showing the planets themselves, and that makes things very interesting."

See press release at: www.gemini.edu/threeplanetspr

First Picture of Likely Planet around Sun-like Star (right)

First reported in September 2008 by a team led by David Lafrenière (then at the University of Toronto, now at the University of Montreal and Center for Research in Astrophysics of Quebec), the suspected planetary system (shown at right on reverse image montage) required further observations over time to confirm that the planet and star were indeed moving through space together. "Back in 2008 what we knew for sure was that there was this young planetary mass object sitting right next to a young Sun-like star on the sky," says Lafrenière. The extremely close proximity of the two objects strongly suggested that they were associated with each other but it was still possible (but unlikely) that they were unrelated and only aligned by chance in the sky. According to Lafrenière, "Our new observations rule out this chance alignment possibility, and thus confirms that the planet and the star are related to each other."

The system, known as 1RXS J160929.1-210524 (or 1RXS 1609 for short), provides scientists with a unique specimen that challenges planetary formation theories due to its extreme separation from the star. "The unlikely locale of this alien world could be telling us that nature has more than one way of making planets," says co-author Ray Jayawardhana of the University of Toronto. "Or, it could be hinting at a violent youth when close encounters between newborn planets hurl some siblings out to the hinterlands," he adds.

With its initial detection by the team using the Gemini Observatory in April of 2008 this object became the first likely planet known to orbit a sun-like star that was revealed by direct imaging. At the time of its discovery the team also obtained a spectrum of the planet and was able to determine many of its characteristics, which are confirmed in this new work. "In retrospect, this makes our initial data the first spectrum of a confirmed exoplanet ever!" says Lafrenière. The spectrum shows absorption features due to water vapor, carbon monoxide, and molecular hydrogen in the planet's atmosphere.

Since the initial observations several other worlds have been discovered using direct imaging, including a system of three planets around the star HR 8799 also discovered with Gemini (also shown on this montage). However, the planets around HR 8799 orbit much closer to their host star.

The host star is located about 500 light-years away in a group of young stars called the Upper Scorpius association that formed about five million years ago. The observations used the Near-Infrared Imager (NIRI) and the Altair adaptive optics system on the Gemini North telescope. Adaptive optics allows scientists to remove much of the distortions caused by our atmosphere and dramatically sharpen views of space.

See press release at: www.gemini.edu/sunstarplanet