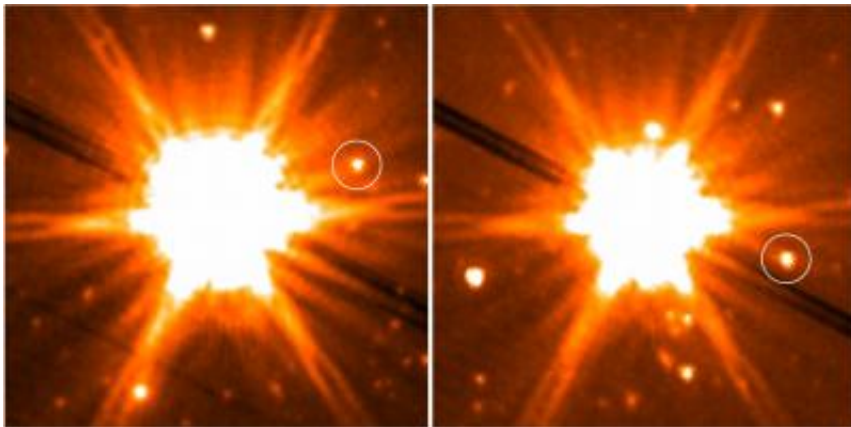


Scientists snap first images of brown dwarf in planetary system

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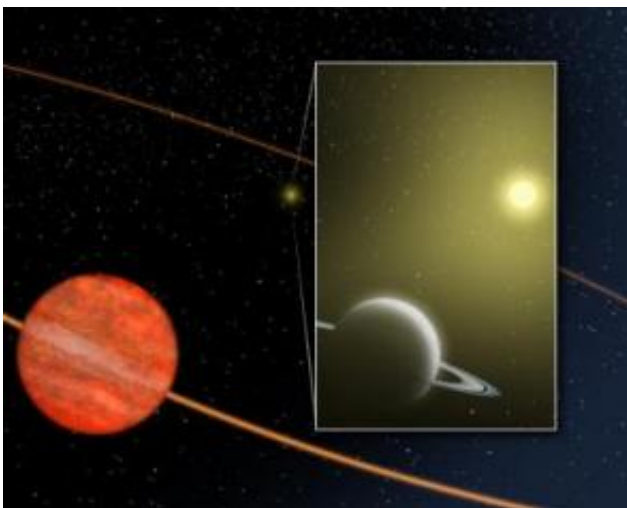
Using infrared photographs obtained with NASA's Spitzer Space Telescope, astronomers have discovered two very cold brown dwarfs orbiting the stars HD 3651 (left) and HN Peg (right). These brown dwarfs have masses of only 20 and 50 times the mass of Jupiter and have orbits that are more than 10 times larger than Pluto's orbit. HD 3651 and HN Peg are in the Sun's neighborhood of the Galaxy, with distances of only 36 and 60 light years from the Sun. Credit: NASA / JPL-Caltech / K. Luhman (Penn State University)

Scientists using NASA's Spitzer Space Telescope have discovered and directly imaged a small brown dwarf star, 50 times the mass of Jupiter, orbiting with a planet around a Sun-like star. Such an arrangement has never before been seen but might be common, the scientists say, leading to solar systems with distorted planetary orbits.

Kevin Luhman of Penn State University is the lead author on a report describing this discovery, which will be published in *The Astrophysical Journal*. The discovery concerns a class of the coldest brown dwarfs, called T dwarfs.

"Over the last ten years, astronomers have been extremely successful in finding planets close to their host stars using indirect detection methods," said Luhman, an assistant professor in the Penn State Department of Astronomy and Astrophysics. "Because of its infrared capabilities, Spitzer is well suited for directly detecting cool T dwarfs, and perhaps even large planets, in the outer parts of planetary systems."

Luhman's team also discovered a second brown dwarf that is smaller yet, about 20 times the mass of Jupiter, orbiting another star. This smaller object could be the youngest T dwarf known, offering scientists a snapshot of early brown-dwarf development. The two T dwarfs are the first to be imaged by Spitzer. Shortly after these companions were found, Spitzer also discovered a T dwarf that is floating through space by itself rather than orbiting a star. The team that discovered that T dwarf is led by Daniel Stern at NASA's Jet Propulsion Laboratory.



This is an artist's concept of the star HD 3651 as it is orbited by a close-in Saturn-mass planetary companion and the distant brown dwarf companion discovered by Spitzer infrared photographs. The Saturn-mass planet was discovered through Doppler observations in 2003. Its orbit is very small, the size of Mercury's, and is highly elliptical. The gravity of the distant brown dwarf companion may be responsible for the distorted shape of the inner planet's orbit. Credit: NASA / JPL-Caltech / T. Pyle (SSC)

Brown dwarfs are small stars that are not massive enough to burn hydrogen, like our Sun does. Their cores are not hot enough to trigger such nuclear fusion. As a result, their surface temperature is only a few thousands of degrees when young, cooling considerably to about the temperature of a planet as they age. Consequently, they are dim and hard to identify and, as a result, the first unambiguous identification came only about ten years ago.

The more massive of the two newly discovered T dwarfs is called HD 3651 B, located in the constellation Pisces. This object is in a solar system containing a star slightly less massive than our Sun that is orbited by a planet slightly smaller than Saturn.

The planet's orbit around the Sun-like star is highly elliptical, which had suggested that the gravity of some unseen object farther away from the star was pulling the planet outward. Sure enough, it was a T dwarf. Many extrasolar planets have been discovered with highly elliptical orbits. The Spitzer discovery is the first evidence to support the theory that small companions such as T dwarfs can hide in such solar systems and can cause the orbits of planets to be extreme.

"The orbit of the planet in this system is similar to Mercury's, but the T dwarf has an orbit over ten times larger than Pluto's," said Brian Patten of the Harvard-Smithsonian Center for Astrophysics (CfA), a co-author.

"Although HD 3651 B would be just beyond naked-eye visibility to an intrepid astronomer living on this system's planet, the T dwarf makes its presence known through gravity."

The other T dwarf is called HN Peg B in the constellation Pegasus. Whereas most brown dwarfs are billions of years old, HN Peg B is relatively young, only about 300 million years old. The scientists determined its age by carefully studying the companion star, which was formed at the same time from the same gas cloud. The system also contains a previously discovered disk of dust and rocks.

"Detectable debris disks and T dwarf companions are fairly rare, so the presence of both around the same star makes this a particularly exciting star system," said Giovanni Fazio of CfA, a co-author.

Source: Penn State

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