

Tiny Brown Dwarf's Disk May Form Miniature Solar System

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Using the Spitzer Space Telescope, a team of astronomers led by Kevin Luhman (Harvard-Smithsonian Center for Astrophysics) has discovered a protoplanetary disk around a surprisingly low-mass brown dwarf. This remarkable finding raises the possibility of planet formation around objects that themselves have planetary masses. Moreover, the presence of a disk suggests that terrestrial planets could form and thrive orbiting an object too small to shine via nuclear fusion.

"It's an exciting possibility-one that hasn't been explored extensively because this is the first evidence for the building blocks of planets around such a small object," said Luhman.

The team's findings were presented today in a press conference at the Planet Formation and Detection meeting in Aspen, Colorado, and will be published in the Feb. 10th issue of *The Astrophysical Journal Letters*.

The brown dwarf in question, OTS 44, is located approximately 500 light-years away in the southern constellation Chamaeleon. OTS 44 weighs in at around 15 Jupiter masses, placing it near the dividing line between brown dwarfs (generally defined as objects of 15-70 Jupiter masses) and planets. At a temperature of 3,600° F (2300 Kelvin), OTS 44 is the coolest and least massive brown dwarf known to have a circumstellar disk.

Although the team cannot measure the total mass of the disk, it likely contains enough matter to make one small gas giant or several Earth-

sized planets. "This brown dwarf and its disk could eventually evolve into a miniature version of our solar system," said Luhman.

Due to the brown dwarf's low temperature, an Earth-sized world would have to orbit much closer to the brown dwarf than the Earth from the Sun in order to be as warm as Earth. Theorists estimate that liquid water could exist on the surface of a planet about 1 to 4 million miles from the brown dwarf. The disk of OTS 44 extends beyond both sides of this "habitable zone."

Without nuclear fusion to sustain it, the brown dwarf will gradually cool and dim. If an Earth-sized world forms near the brown dwarf, it will be scorching at first, then grow cooler and more hospitable over time. Since the brown dwarf cools more slowly as it gets older, such a planet could remain in the habitable zone for an extended time, raising the intriguing possibility that life might evolve.

"That is pure speculation, of course. But finding a circumstellar disk around such a small brown dwarf certainly widens the possibilities for planet formation," said Luhman.

The researchers plan to search for similar disks around other nearby brown dwarfs. Spitzer revealed the disk of OTS 44 in only 20 seconds of observing time. Further searches may locate similar disks around even smaller central objects of 10 Jupiter masses or less.

The team detected OTS 44's circumstellar disk using Spitzer's Infrared Array Camera, or IRAC. IRAC data showed an excess of infrared emission at long wavelengths—the signature of a dusty disk that absorbs radiation from the brown dwarf, heats up, and re-radiates the energy in the infrared.

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