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ASTRONOMERS IDENTIFY THE COLDEST STAR

Astronomers from the U.S. Naval Observatory (USNO) and UCLA have discovered the coldest and faintest known star, a “brown dwarf” located 19 light-years from the Sun in the constellation Eridanus.

These findings are being presented at the American Astronomical Society's 201st meeting in Seattle, Washington by Dr. Frederick Vrba, who heads a team of astronomers investigating faint stars at USNO's Flagstaff Station, Flagstaff, AZ. This discovery has important implications for the relationship between stars and planets.

The Naval Observatory astronomers were able to deduce the cold temperature of this brown dwarf, known as 2MASS J04151954-0935066, or 2MASS 0415-0935 for short, by determining its distance from the Sun. Using a technique called parallax measurement, they traced its apparent tiny elliptical path against a background of much more distant stars caused by the Earth's annual revolution around the Sun. “By observing this motion over several years,” explained Vrba, “it is possible to triangulate a precise distance to the nearby star.” USNO has long been a leader in this research area, determining the distances of about a thousand nearby stars using visible light parallaxes.

However, brown dwarfs such as 2MASS 0415-0935 are so cold that they emit almost no visible light. Virtually all of their energy emission is in the infrared portion of the electromagnetic spectrum, the same kind of “invisible” light that beams out of television and stereo remote control units. Vrba and his research group used the 1.55-meter (61-inch) Strand Astrometric Telescope at the Flagstaff Station along with a new generation of infrared array detectors to pioneer the technique of parallax determination at these wavelengths.

By using the parallax distance, the apparent brightness of the brown dwarf, and some physics to estimate its size (roughly the same as the planet Jupiter), the astronomers calculated the surface temperature of this object to be a mere 410°C (770°F), not much warmer than a household oven.

While this may not seem chilly to those of us in the middle of winter, for a star, 2MASS 0415-0935 is downright frigid. The Sun's surface is a comparatively searing 5500°C (9940°F). Brown dwarfs can be colder than traditional stars because their low masses, typically less than 8% that of the Sun, inhibit the Hydrogen fusion reactions that power most stars. Without these energy-generating reactions, brown dwarfs radiate away their heat and eventually cool to temperatures much lower than that of any star.

“Because this object is so cold, it emits very little light,” explained UCLA postdoctoral fellow Dr. Adam Burgasser, who originally discovered the brown dwarf in 2001 using the Two Micron All Sky Survey (2MASS). “It would take a half a million of these brown dwarfs to produce the same amount of light as the Sun.” Indeed, the USNO measurements confirm that 2MASS 0415-0935 is both the coldest and faintest star ever found. “While it will take another two years of observations to make a final distance determination, its current place as the dimmest star seems fairly certain.” said Vrba.

Very cool brown dwarfs like 2MASS 0415-0935 are starting to challenge conventional views of what stars and planets are. Astronomers have detected both methane and water vapor in this object, gases that are present in the atmospheres of planets like Jupiter and even the Earth, but not in any normal stars. Furthermore, most brown dwarfs have sizes and masses similar to those of giant planets found orbiting other stars. “Physically, this object looks very much like a planet,” commented Burgasser. “But it doesn't orbit around a star like planets do, and it probably formed like a star in the first place. How do you make the distinction?”

Vrba and his team hope to shed at least some light on that question. This discovery was part of a much larger study to determine the distances of very cool stars recently identified in various sky surveys such as 2MASS.

“2MASS 0415-0935 has certainly helped narrow the gap between stars and planets, but it may not hold its title as the faintest brown dwarf for long,” said Vrba. “As we continue to observe these faint ‘stars’ we will get a better census of what the true population is of dim, cool objects near the Sun. We may yet find dimmer and cooler objects.”



The 2MASS project is headed by the University of Massachusetts in Amherst, MA, and the Infrared Processing and Analysis Center in Pasadena, CA, as part of NASA's Origins Program. 2MASS is funded by NASA's Office of Space Science and the National Science Foundation. Additional 2MASS information and images are available at <http://www.ipac.caltech.edu/2mass>, and at <http://pegasus.phast.umass.edu>.

EDITORS: *This false color optical/near-infrared image of 2MASS 0415195-093506 (left, the red object in the center of the field) can be obtained over the Internet from:*

http://www.usno.navy.mil/pao/press/brown_dwarf_release_image.shtml