Astronomers find evidence of water clouds in brown dwarf atmosphere

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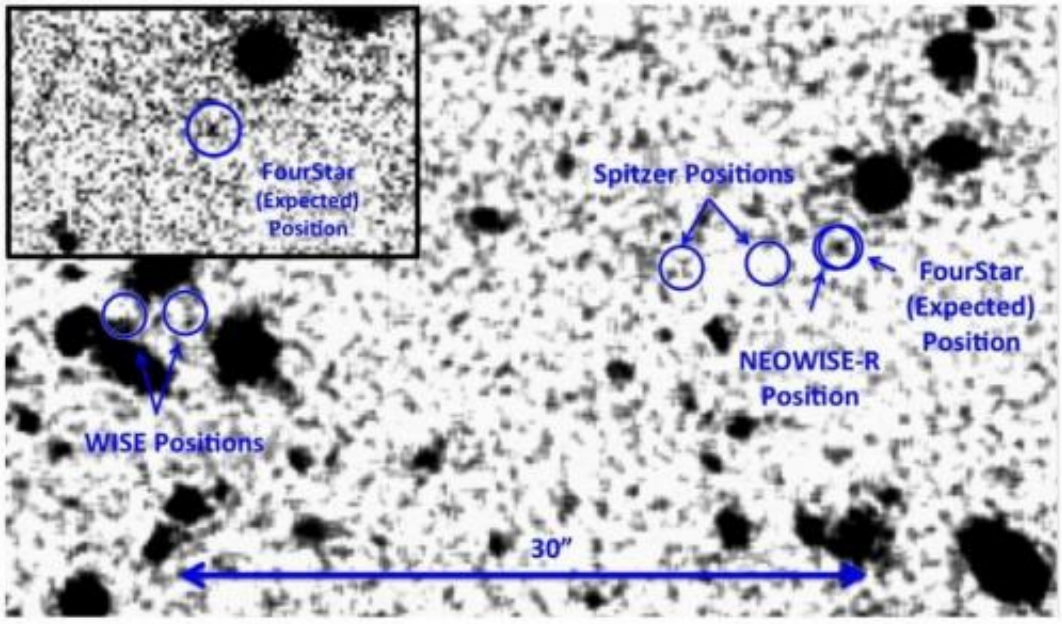

A ~ 45″ x 25″ region of the final mosaic image at J3 created from three nights of observing the source W0855 with the FourStar imager. Credit: arXiv:1408.4671 [astro-ph.SR]

(Phys.org) —A team of researchers, led by space scientist Jacqueline Faherty, has found evidence of water clouds in the atmosphere of a brown dwarf situated just 7.3 light years away. In their paper to be published in *The Astrophysical Journal Letters*, the team describes how they found evidence of the water clouds and where the research is headed next.

WISE J0855-0714, a brown dwarf was first spotted by astronomer Kevin Luhman after studying pictures taken by NASA's WISE telescope over the period 2010-2011. A brown dwarf is a star that failed to progress to a point where it could sustain nuclear reactions. Instead of growing, such stars fade and grow colder. WISE J0855-0714's atmosphere is believed to be just below the freezing point.

Since the discovery of the brown dwarf, scientists have been studying it to learn more about such objects—in some respects they are easier to study then exoplanets because they don't have a nearby star and its associated emissions. In this latest effort, the researchers pored over infrared images taken by Chile's Magellan Baade telescope over three nights this past May. Colors observed in the images matched those of models developed to show what a brown dwarf would look like if it had water clouds in its atmosphere. If further evidence can prove conclusively that the finding is truly water clouds, it would mark the first such instance in a body outside of our solar system.

WISE J0855-0714 is approximately the size of Jupiter, but has three times its mass—it's also the coldest known brown dwarf. The infrared images also indicate that it's only partly cloudy, which is a relatively new phenomenon, at least from a known perspective, and offers astronomers a unique opportunity to study how it occurs on other celestial bodies. In our solar system, only Earth and Mars have water clouds. And while some exoplanets have been found to have water vapor in their atmosphere, none have been found to have water clouds.

Space scientists won't know for sure if the evidence from the infrared images really shows water clouds until researchers with the James Webb space telescope can get a good look at WISE J0855-0714 sometime within the next ten years.

More information: Indications of Water Clouds in the Coldest Known

Brown Dwarf, arXiv:1408.4671 [astro-ph.SR] arxiv.org/abs/1408.4671

Abstract

We present a deep near-infrared image of the newly discovered brown dwarf WISE J085510.83-071442.5 (W0855) using the FourStar imager at Las Campanas Observatory. Our detection of J3=24.8+0.33 -0.53 (J_MKO=25.0+0.33-0.53) at 2.6sigma—or equivalently an upper limit of J3 > 23.8 (J_MKO > 24.0) at 5sigma makes W0855 the reddest brown dwarf ever categorized (J_MKO - W2 = 10.984+0.33 - 0.53 at 2.6sigma—or equivalently an upper limit of J_MKO - W2 > 9.984 at 5sigma) and refines its position on color magnitude diagrams. Comparing the new photometry with chemical equilibrium model atmosphere predictions, we demonstrate that W0855 is 4.5sigma from models using a cloudless atmosphere and well reproduced by partly cloudy models (50%) containing sulfide and water ice clouds. Non-equilibrium chemistry or non-solar metallicity may change predictions, however using currently available model approaches, this is the first candidate outside our own solar system to have direct evidence for water clouds.