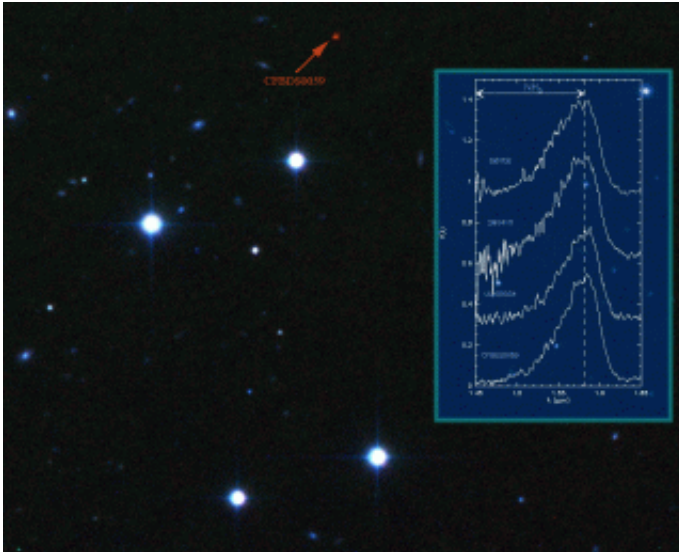


# The coldest brown dwarf ever observed

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Picture of the brown dwarf CFBDS0059 (small red dot on the top of the picture) and its near-infrared spectrum (lowest curve) illustrating the presence of ammonia. Credit: A&A

An international team led by French and Canadian astronomers has just discovered the coldest brown dwarf ever observed. Their results will soon be published in *Astronomy & Astrophysics*. This new finding was made possible by the performance of telescopes worldwide: Canada France Hawaii Telescope (CFHT) and Gemini North Telescope, both located in Hawaii, and the ESO/NTT located in Chile.

The brown dwarf is named CFBDS J005910.83-011401.3 (it will be called CFBDS0059 in the following). Its temperature is about 350°C and

its mass about 15-30 times the mass of Jupiter, the largest planet of our solar system. Located about 40 light years from our solar system, it is an isolated object, meaning that it doesn't orbit another star.

Brown dwarfs are intermediate bodies between stars and giant planets (like Jupiter). The mass of brown dwarfs is usually less than 70 Jupiter masses. Because of their low mass, their central temperature is not high enough to maintain thermonuclear fusion reactions over a long time. In contrast to a star like our Sun, which spends most of its lifetime burning hydrogen, hence keeping a constant internal temperature, a brown dwarf spends its lifetime getting colder and colder after its formation.

The first brown dwarfs were detected in 1995. Since then, this type of stellar object has been found to share common properties with giant planets, even though differences remain. For example, clouds of dust and aerosols, as well as large amounts of methane, were detected in their atmosphere (for the coldest ones), just as in the atmosphere of Jupiter and Saturn. However, there were still two major differences.

In the brown dwarf atmospheres, water is always in gaseous state, while it condenses into water ice in giant planets; and ammonia has never been detected in the brown dwarf near-infrared spectra, while it is a major component of Jupiter's atmosphere. CFBDS0059, the newly-discovered brown dwarf, looks much more like a giant planet than the known classes of brown dwarfs, both because of its low temperature and because of the presence of ammonia.

To date, two classes of brown dwarfs have been known: the L dwarfs (temperature of 1200-2000°C), which have clouds of dust and aerosols in their high atmosphere; and the T dwarfs (temperature lower than 1200°C), which have a very different spectrum because of methane forming in their atmospheres. Because it contains ammonia and has a much lower temperature than do L and T dwarfs, CFBDS0059 might be

the prototype of a new class of brown dwarfs to be called the Y dwarfs. This new class would then become the missing link in the sequence from the hottest stars to giant planets of less than  $-100^{\circ}\text{C}$ , by filling the gap now left in the midrange.

This discovery also has important implications in the study of extrasolar planets. The atmosphere of brown dwarfs looks very much like that of giant planets, therefore the same models are used to reproduce their physical conditions.

Such modeling needs to be tested against observations. Observing the atmospheres of extrasolar planets is indeed very hard because the light from the planets is embedded in the much stronger light from their parent stars. Because brown dwarfs are isolated bodies, they are much easier to observe. Thus, looking to brown dwarfs with a temperature close to that of the giant planets will help in testing the models of extrasolar planets' atmospheres.

Source: Astronomy & Astrophysics

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