PRESS RELEASE

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The coldest brown dwarf ever observed:
Closing the gap between stars and planets

Based on the article "CFBDS J005910.90-011401.3: reaching the T-Y brown dwarf transition?"
by Delorme et al.,

To be published in *Astronomy & Astrophysics*, 2008

An international team of astronomers has discovered the coldest brown dwarf star ever observed. This finding, to be published in *Astronomy & Astrophysics*, is a new step toward filling the gap between stars and planets.

An international team [1] 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 [2]: 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 [3]. Located about 40 light years from our solar system, it is an isolated object, meaning that it does not 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°C, by filling the gap now left in the midrange.

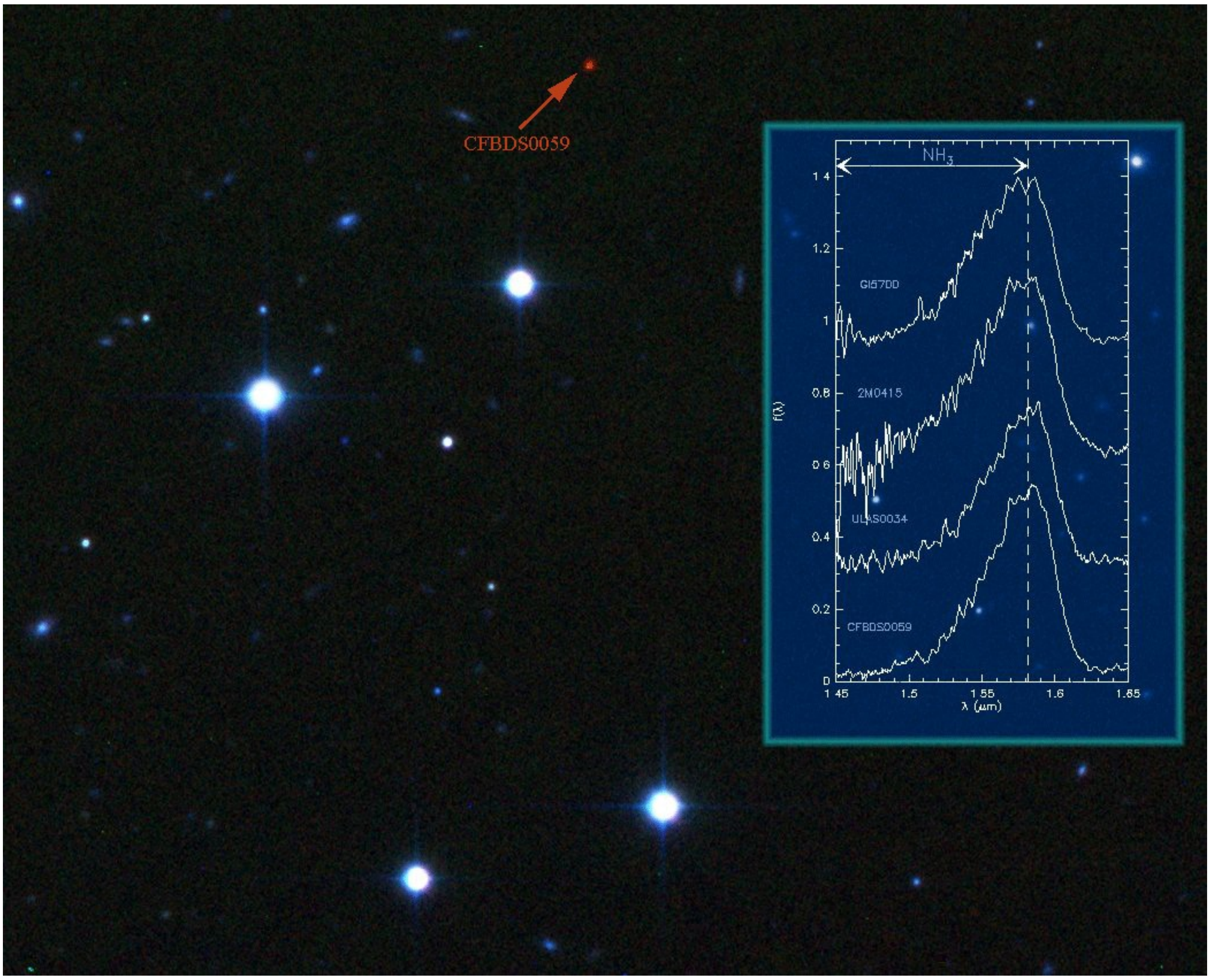

Figure 1. Picture of the brown dwarf CFBDS0059 *(small red dot on the top of the picture) and its near-infrared spectrum (lowest curve) illustrating the presence of ammonia.*

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.

Figure 2. *From left to right: New Technology Telescope (© ESO), Canada France Hawaii Telescope (© J.-C. Cuillandre, CFHT), and Gemini North Telescope (© Gemini Observatory/AURA)*

[1] The team of astronomers includes P. Delorme, X. Delfosse (Observatoire de Grenoble, France), L. Albert (CFHT, Hawaii), E. Artigau (Gemini Observatory, Chile), T. Forveille (Obs. Grenoble/France, IfA/Hawaii), C. Reylé (Observatoire de Besançon, France), F. Allard, A. C. Robin (CRAL, Lyon, France), D. Homeier (Göttingen, Germany), C.J. Willott (University of Ottawa, Canada), M. C. Liu, T. J. Dupuy (IfA, Hawaii).

[2] CFBDS0059 was discovered in the framework of the Canada-France Brown-Dwarfs survey. The object was first identified in pictures from the wide-field camera Megacam installed on the CFHT (Canada France Hawaii Telescope). Infrared pictures were then obtained with the NTT telescope (La Silla, ESO, Chile) and confirmed the low temperature of the object. Finally, the spectrum showing the presence of ammonia was obtained using the Gemini North Telescope (Hawaii).

[3] The mass of Jupiter is about 300 times the Earth's mass and about 1/1000e of the Sun's mass.

CFBDS J005910.90-011401.3: reaching the T-Y brown dwarf transition?, by P. Delorme, X. Delfosse, L. Albert, E. Artigau, T. Forveille, C. Reylé, F. Allard, D. Homeier, A. C. Robin, C.J. Willott, M. C. Liu, and T. J. Dupuy. To be published in *Astronomy & Astrophysics*, 2008.

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Contacts:

- Science:

Dr. Thierry Forveille
Laboratoire d'Astrophysique de Grenoble
414, Rue de la Piscine
Domaine Universitaire
38400 Saint-Martin d'Heres, France
Email: Thierry.Forveille (at) obs.ujf-grenoble.fr
tel : +33 (0)4 76 51 42 06

- Press office:

Dr. Jennifer Martin
Astronomy & Astrophysics
61, avenue de l'Observatoire
75014 Paris, France
Email: aanda.paris (at) obspm.fr
Phone: +33 (0)1 43 29 05 41

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