The hottest white dwarf in its class

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White dwarfs in the globular cluster M4. In this picture, only the faintest stars are white dwarfs. © NASA and H. Richer (University of British Columbia)

(PhysOrg.com) -- A team of German and American astronomers present far-ultraviolet observations of white dwarf KPD 0005+5106 and reveal that it is among the hottest stars ever known with a temperature of 200 000 K at its surface. *Astronomy & Astrophysics* is publishing this discovery, which was made through spectroscopic observations with NASA's space-based Far-Ultraviolet Spectroscopic Explorer (FUSE).

Astronomy & Astrophysics is publishing spectroscopic observations with NASA's space-based Far-Ultraviolet Spectroscopic Explorer (FUSE) of the white dwarf KPD 0005+5106. The team of German and American astronomers who present these observations show that this white dwarf is among the hottest stars known so far, with a temperature of 200 000 K at its surface. It is so hot that its photosphere exhibits emission lines in the ultraviolet spectrum, a phenomenon that has never been seen before. These emission features stem from extremely ionized calcium (nine-fold ionized, i.e., CaX), which is the highest ionization stage of a chemical element ever discovered in a photospheric stellar spectrum.

Stars of intermediate mass (1-8 solar masses) terminate their life as an Earth-sized white dwarf after the exhaustion of their nuclear fuel. During the transition from a nuclear-burning star to the white dwarf stage, the star becomes very hot. Many such objects with surface temperatures around 100 000 Kelvin are known. Theories of stellar evolution predict that the stars can be much hotter. However, the probability of catching them in such an extremely hot state is low, because this phase is rather short-lived.

Since its discovery as a faint blue star in 1985, KPD 0005+5106 attracted much attention because optical spectra taken with ground-based telescopes suggested that this white dwarf is very hot. In addition, it belongs to a particular class of rare white dwarfs whose atmospheres are dominated by helium. A detailed analysis of these spectra, combined with ultraviolet observations performed with the Hubble Space Telescope (HST), had led to the conclusion that KPD 0005+5106 has a temperature of 120 000 Kelvin, which made it the hottest member of its class. It was, however, rivaled by other similarly hot white dwarfs, discovered a few years ago in the Sloan Digital Sky Survey.

The FUSE observatory performed spectroscopy in the far-ultraviolet wavelength range, which is inaccessible to HST. During its lifetime (1999-2007), FUSE frequently observed KPD 0005+5106 because it was used as a calibration target to track the telescope's performance. The team of astronomers, including K. Werner, T. Rauch, and J.W. Kruk, made use of all accumulated data and obtained a dataset of outstanding quality. Close inspection revealed the presence of two emission lines from calcium, and detailed stellar atmosphere modeling confirmed their photospheric origin. The analysis proves that the temperature must be 200 000 Kelvin, for the presence of these emission lines to be possible.

Although theory predicted the existence of such hot white dwarfs, the star nevertheless represents a challenge to our concepts of stellar evolution because of its composition. The measured calcium abundance (1-10 times the solar value) in combination with the helium-rich nature of its atmosphere represents a chemical surface composition that is not predicted by stellar evolution models.

Citation: Discovery of photospheric CaX emission lines in the far-UV spectrum of the hottest known white dwarf (KPD 0005+5106), by K. Werner, T. Rauch, and J. W. Kruk. *Astronomy & Astrophysics Letters*, 2008, volume 492-3, pp. L43.

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