Ulrike Heiter
2006-10-11

Central stars of planetary systems: red dwarfs

This is an example for a specific research project dealing with planetary systems. The purpose of this project is to characterize planetary host stars at the cool end of the stellar temperature range. Stars with and without planets in the same temperature range will be studied to find out if the correlation of stellar metallicity with exoplanet frequency extends to cool stars.

Background

The vast majority of the so far detected planetary host stars are of intermediate temperature (F to G type). For those, it has been found that stars with high metallicity are more likely to be orbited by gas giant planets than stars with low metallicity (e.g. Heiter & Luck 2003; Fischer & Valenti 2005). However, most stars in our Galaxy (about 75%) are cool and faint "red dwarfs" (M dwarfs). Several groups have started dedicated searches for planets around M dwarfs (e.g. Endl et al. 2003; Bonfils et al. 2004). Up to now, planets have been detected orbiting four M dwarfs (Bonfils et al. 2005b; Butler et al. 2006). The existence of a correlation between stellar metallicity and exoplanet frequency for M dwarfs remains an open question to date.

Most extrasolar planets have been detected indirectly, by their effect on the motion of their host stars. Not much is known about their physical properties. At some point in the future, it will be possible to observe spectra of planets directly, which will consist of the spectra of the host stars reflected or transmitted by the planetary atmosphere. Planets around M dwarfs are the best candidates for such studies, because the contrast between light coming directly from the central star and reflected by the planet is smallest. A good understanding of the stellar atmosphere is crucial for interpreting the planetary spectra. Earth-mass planets to be detected circling M dwarfs may be good locations to search for evidence for life (Segura et al. 2005). But the interpretation of planetary spectra will only be possible if we have good knowledge of the central star.

Project description (abridged)

By comparing high spectral resolution observations to synthetic spectra calculated with improved molecular data, the fundamental parameters of the M dwarfs with and without planets will be determined.

The results will be compared to those of Zboril & Byrne (1998), who analysed a lower resolution spectrum of one of the stars studied within this project. Furthermore, some of the program stars are the cooler components in binary star systems, for which the hotter components have been analysed by Bonfils et al. (2005a). Assuming that a binary system is characterized by one metallicity value, this gives the possibility for another check of the results of this project.

References

Bonfils, X., Delfosse, X., Udry, S., et al. 2004, in ASP Conf. Ser. 321: Extrasolar Planets: Today and Tomorrow, ed. J. Beaulieu, A. Lecavelier Des Etangs, & C. Terquem, p. 101

Bonfils, X., Delfosse, X., Udry, S., et al. 2005a, A&A, 442, 635

Bonfils, X., Forveille, T., Delfosse, X., et al. 2005b, A&A, 443, L15

Butler, R. P., Johnson, J. A., Marcy, G. W., et al. 2006, PASP, in press

Endl, M., Cochran, W. D., Tull, R. G., & MacQueen, P. J. 2003, AJ, 126, 3099

Fischer, D. A. & Valenti, J. 2005, ApJ, 622, 1102

Heiter, U. & Luck, R. E. 2003, AJ, 126, 2015

Segura, A., Kasting, J. F., Meadows, V., et al. 2005, Astrobiology, 5, 706

Zboril, M. & Byrne, P. B. 1998, MNRAS, 299, 753