The McDonald Observatory Planet Search Projects

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Abstract. Presently every telescope at McDonald Observatory is utilized for the search for extrasolar planets. Here we give an overview of the precision Doppler surveys currently in progress at the 9.2 m Hobby-Eberly Telescope (HET) and the Harlan J. Smith 2.7 m telescope. Other planet search programs at McDonald Observatory include a transit search at the 0.8 m telescope (Baliber & Cochran 2003) and a project to detect planets orbiting stable pulsating white dwarfs (Mullally et al. 2003).

1. The McDonald Observatory Doppler Surveys

1.1. The HET programs

For two years now we have carried out two specialized radial velocity (RV) programs using the 9.2 m HET (Ramsey et al. 1998) and its HRS spectrometer (Tull 1998): 1.) a dedicated M-dwarf planet search to explore the frequency of planetary systems in the low-mass regime of the Hertzsprung Russel diagram (see Endl et al. 2003 for the results of the first year), and 2.) a search for very low-mass short period planets around brighter solar type stars. For the magnitude range of the M-dwarf survey of $V = 9$ to 12 we obtain an RV precision of $\approx 6 \text{ m s}^{-1}$ and for brighter F,G and K-type stars ($V < 8$) of $\approx 3 \text{ m s}^{-1}$ (Cochran et al. 2003). These values are not best case values but represent the peaks of the respective RV-scatter distributions (which of course means that for some stars we attain $\approx 1 \text{ m s}^{-1}$ RV precision). This kind of precision level opens up the possibility to detect planets with masses down to a few Earth masses in short period orbits (i.e., “Hot Neptunes”).

1.2. The 2.7 m telescope program

The planet search program at the 2.7 m telescope was already started in 1987 as a small survey of $\approx 30$ solar type stars. This program led to the discoveries of the planetary companions to 16 Cygni B (Cochran et al. 1997), $\epsilon$ Eridani (Hatzes et al. 2000) and $\gamma$ Cephei A (Hatzes et al. 2003). In 1997 the target sample was increased to include 150 stars and has now grown to more than 200 stars.
We are especially interested in finding Jupiter analogs, i.e. giant planets in long period and low eccentricity orbits, so that their presence does not disrupt the orbital stability of possible terrestrial planets inside the habitable zone (Solar System analogs). We have identified several good candidates which exhibit long term, low amplitude and non-linear RV variations, which could indicate planets at larger orbital separations. Fig. 1 shows 3 of these candidates, as well as our most recent discovery: a rare brown dwarf companion ($m \sin i = 26 \, M_{\text{Jup}}$) to the G0IV star HR 5740 (Endl et al. in prep).

References