EXTREME M DWARFS AND BROWN DWARFS IN A DEEP CCD SURVEY

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Two years ago, Seitzer and Tyson began a program of 4-meter prime focus CCD observations at CTIO, with the aim to develop techniques for imaging and photometry to the theoretical limit of that telescope and overall 52% efficiency: 26.6 J mag, 26 R mag, 25 I mag. Color-magnitude plots show that the limiting magnitudes for detection are 28 J mag, 27 R mag, and 25.3 I mag. Each of our CCD fields covers about 12 sq. arcmin., with total exposure time about 7000 sec. in each of the three bands (see Boeshaar and Tyson 1985). Processed images are put on a VAX 11/780 and the FOCAS v.3.2 automated detector and classifier is run. In order to determine the probability of detection and photometric errors as a function of magnitude, FOCAS is rerun many times on artificial images made by adding in real star and galaxy images, dimmed many magnitudes, at random locations on the CCD sky frame. Over 2000 objects are detected in every high galactic latitude CCD field, less than 50 of which are classified as stars. Most of the faint galaxies are very blue (due to evolution), making it possible to search for infrared excess stars in the presence of so many galaxies.

An analysis of six CCD fields indicates no evidence for a dynamically significant disk or halo population of extreme M dwarfs. We surveyed 128 pc^3 in the R and I bands for stars of 0.1 $M_\odot$ (M_V=16). If we assume 0.5 to 1.5 times the locally observed mass density (0.1 $M_\odot$ per pc^3) is in the form of these stars (Bahcall 1985), we should have seen 20-60 such red dwarfs. One candidate was found.

We do not wish to address at present the question of evolution effects on the detectability of objects below the end of the hydrogen burning main sequence greater than 2-3 billion years old. There exist some variation in the theoretical estimates of the evolution of "brown dwarfs"; furthermore, great uncertainty exists regarding the observationally determined absolute magnitude vs. mass relation for stars at the very bottom of the main sequence. For stars of 0.08 $M_\odot$ (M_V=18-19 mag), we surveyed 87 pc^3 in the R and I bands, and would have expected to find 20-50 of the intrinsically faintest M dwarfs for a dynamically significant disk population. Possibly one was found.

The I-band stellar number counts reveal 20 times fewer counts than would be expected for a barely dynamically significant halo composed of a distribution of masses (0.15-0.09 $M_\odot$) rather than stars of a single mass and luminosity. Other halo models would predict even more M dwarfs.

Bahcall, J. N., 1985, Bull. Am. Astron. Soc. 17, 581.
Boeshaar, P. C., and Tyson, J. A., 1985, Astron. J. 90, 817.

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