

## Optical Spectroscopy of Young Brown Dwarfs in Orion

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**Abstract.** Red spectra of a sample of low-mass stars and brown dwarfs in the Orion Trapezium cluster are discussed. They show late-type spectral characteristics confirming cluster membership and some show evidence of circumstellar activity.

### 1. Observations

Optical spectra of substellar objects in Orion were obtained at the Anglo-Australian Telescope on 20th January 2002 using the Taurus Tunable Filter (TTF) with a red volume phase holographic grating and slit masks. The instrument was operated in Nod and Shuffle mode (Glazebrook & Bland-Hawthorn 2001) nodding by 4 arcsec along 7 arcsec slitlets. This gives good correction for sky airglow emission but residual nebular emission is present, appearing as either positive or negative lines, depending on the local gradient. Each mask contained approximately 30 object slits. The objects were selected from the near-infrared photometry of Lucas & Roche (2000) and are all to the west of the Trapezium where the nebular emission is weaker than in the bright core.

The spectra of six objects are shown in Figure 1, from 600-1000nm, in order of increasing H magnitude. With assumed ages of 1 Myr, these correspond to objects ranging from stars just above the H-burning limit to brown dwarfs with masses of about  $0.06M_{\odot}$ . The spectra have not yet been corrected for atmospheric absorption or interstellar extinction; the apparent strong absorptions near 750nm and 940nm have substantial telluric components.

### 2. Spectra

The spectra show the expected mid to late M-type signatures, with strong TiO edges near 700, 760, 840 and 880nm, confirming that they are cluster members. Preliminary analysis has not revealed any L-type signatures in these relatively massive brown dwarfs and careful correction of the nebular emission will be required to search for species such as KI and CsI. The region around the LiI line at 671nm is masked by [SII] nebular emission. It is immediately obvious that some of the objects (e.g. 035-333) display prominent emission in the CaII

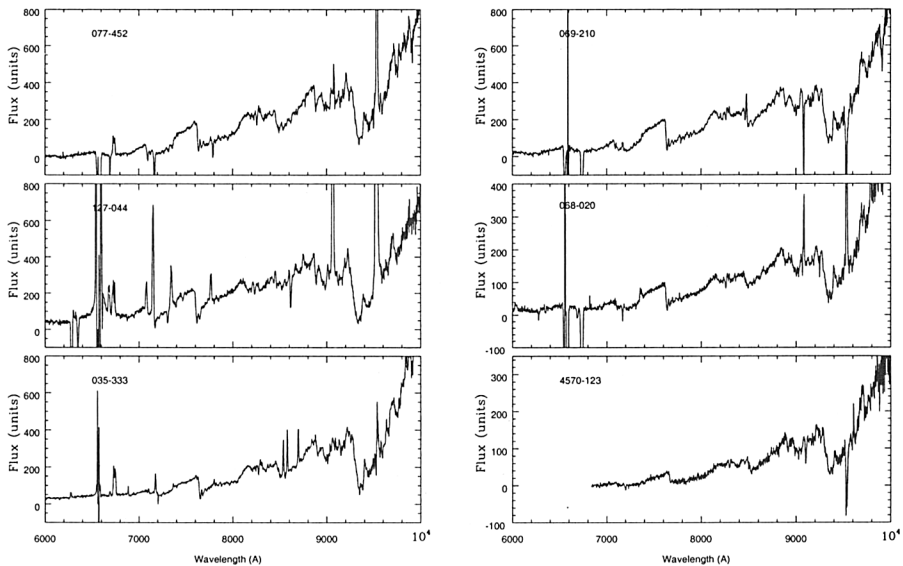


Figure 1. Preliminary spectra of 6 objects near the H-burning limit

triplet lines at 850-866nm and probably also have circumstellar contributions to low-excitation nebular lines. The spectrum of 035-333 is similar to that of LS-RCrA1, an M7 star in the Corona Australis star-forming region (Fernández & Comerón 2001), but with higher equivalent width emission lines, suggesting a very active circumstellar environment.

Further analysis of these data and also of spectra obtained with GMOS at Gemini-N is underway. We hope to survey a significant number of brown dwarfs and extend the spectroscopy to fainter and lower mass objects, spanning the whole mass range down to the deuterium-burning limit and below if possible. The aim is to develop spectroscopic diagnostics of temperature (and possibly gravity) by reference to models under development by Allard et al. This will complement the photometric data and begin to establish the HR diagram for the young low mass objects in the Orion Trapezium cluster.

## References

- Fernández, M. & Comerón, F. 2001 *A&A*, 380, 264  
 Glazebrook, K & Bland-Hawthorn, J. 2001 *PASP*, 113, 197  
 Lucas, P. W. & Roche, P. F. 2000 *MNRAS*, 326, 695