

# First Brown Dwarfs from the UKIRT Infrared Deep Sky Survey (UKIDSS)

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## Introduction

UKIDSS began in May 2005 and will survey 7500 square degrees of the northern sky, extending over both high and low galactic latitudes, in JHK to K=18.3. This depth is three magnitudes deeper than 2MASS. Four of the principal quarry of UKIDSS are: the coolest and nearest brown dwarfs, high-redshift dusty starburst galaxies, elliptical galaxies and galaxy clusters at redshifts  $1 < z < 2$ , and the highest-redshift quasars, at  $z=7$ . UKIDSS aims to discover the nearest object to the Sun (outside the solar system) as well as some of the farthest known objects in the Universe.

UKIDSS searches for the nearest and smallest objects in the solar neighborhood. This survey is deep enough to detect brown dwarfs and young free floating planets with as little as 5 Jupiter masses within a distance of a few tens of parsecs. The UKIDSS should find brown dwarfs even cooler than T dwarfs, Te <700K, a new spectral class tentatively named Y dwarfs (Leggett et al 2005). The combination of IR and optical colors, and large expected proper motions will allow the UKIDSS to find halo brown dwarfs if they exist, testing the universality of star formation processes and the formation history of the Milky Way.

## Aim

- To obtain spectral classification of the BD candidates selected from the Large Area Survey of the UKIDSS.
  - To improve photometry and measure proper motions of the first UKIDSS L, T, and Y dwarf candidates using ISPI at the Blanco 4m telescope.
- The discovery of the first Y dwarfs would be an obvious high profile result, but more importantly we will be able to rapidly and efficiently mine the UKIDSS database for larger samples of these objects. The knowledge of actual Y dwarf colors will allow us to employ optimal color-magnitude criteria, as the observing strategy of UKIDSS is still flexible. The first Y dwarfs may provide the key to modify exposure times so as to maximize Y dwarf sensitivities.

## Observations and Data Reduction

The survey instrument is WFCAM on the UK Infrared Telescope (UKIRT) in Hawaii. WFCAM has four 2048x2048 Rockwell devices.

UKIDSS is a set of five surveys. The areas are as follows:

1. Large Area Survey (LAS) 4000° sq extraGalactic
2. Galactic Plane Survey (GPS) 1800° sq Galactic
3. Galactic Clusters Survey (GCS) 1400° sq Galactic
4. Deep Extragalactic Survey (DXS) 35° sq
5. Ultra Deep Survey (UDS) 0.77° sq extraGalactic

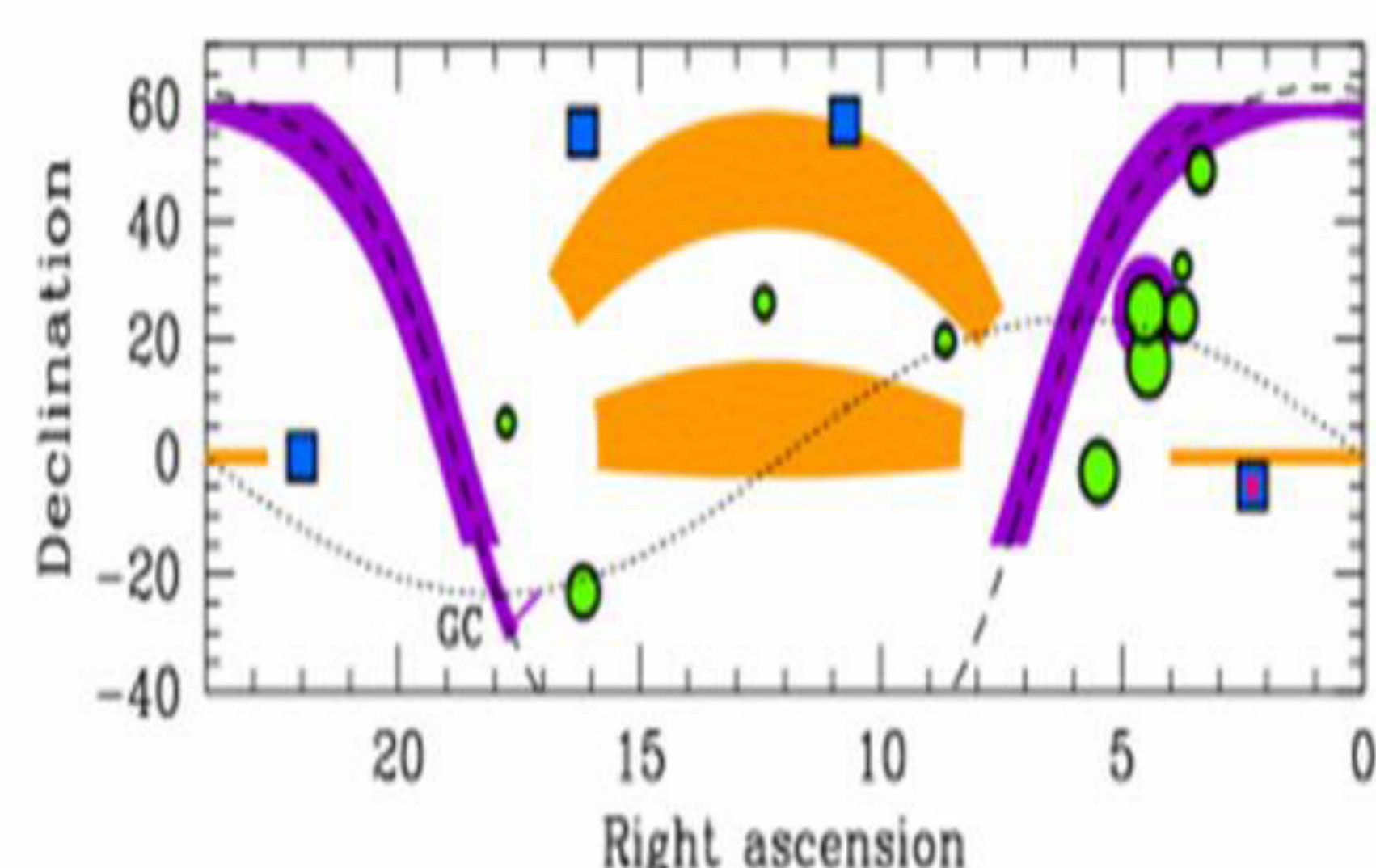


Figure 1. Planned final UKIDSS sky coverage. The color coding is given by the symbols in the table above. Details of the fields are given in the individual survey pages. The dashed line marks the galactic plane, and the dotted line marks the ecliptic. Note that UKIRT lies at latitude +20.

The brown dwarf candidates were selected based on their YJHK colors.

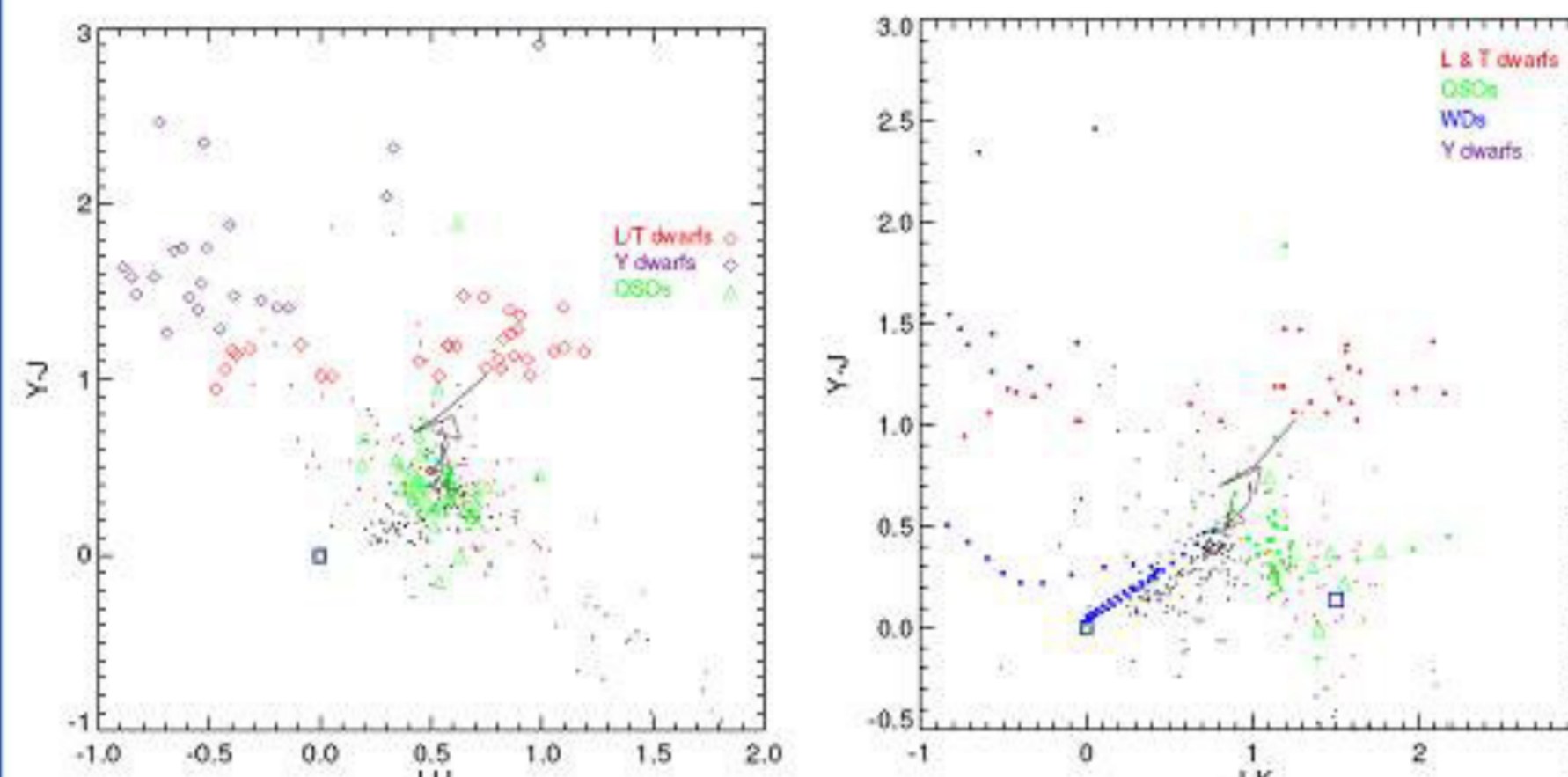


Figure 2. (Y-J,J-H & Y-J,J-K) Color-Color diagrams for one of the WFCAM tiles.

To obtain photometry and proper motions, selected candidates were observed using the ISPI instrument mounted on CTIO 4m-Blanco Telescope. The data was reduced using the CIRRED package available through CTIO web pages. The images were flat corrected and sky subtracted and all the images for a single target were stacked using imalign task in IRAF. WCSTools package was used to obtain astrometry for the stacked images.

The spectra for selected candidates was obtained using the 4.2m William Herschel Telescope with LIRIS and the 3.5m Galileo Telescope with DOLORES. The data was reduced using standard tasks in IRAF.

## Results and Conclusions

Table 1. J magnitudes and proper motion measurements of a representative set of program objects using UKIDSS astrometry and CTIO 4m observations

Name	J Mag	Proper Motion RA (mas/yr)	Proper Motion Dec (mas/yr)
UBD1	19.24±0.13	+1 ± 10	-139 ± 10
UBD2	17.53±0.03	-21 ± 10	+80 ± 10
UBD3	18.68±0.08	-23 ± 10	-29 ± 10
UBD4	19.19±0.10	+27 ± 10	-54 ± 10

We have obtained proper motions and photometry for 15 UKIDSS BD candidates with the ISPI on CTIO 4m telescope.

We have also obtained optical spectra for 1 BD candidate using the 3.5m Galileo Telescope with DOLORES confirming it as an L dwarf. The near IR spectra obtained using the 4.2m William Herschel Telescope with LIRIS confirms 2 L dwarfs and 1 T dwarf.

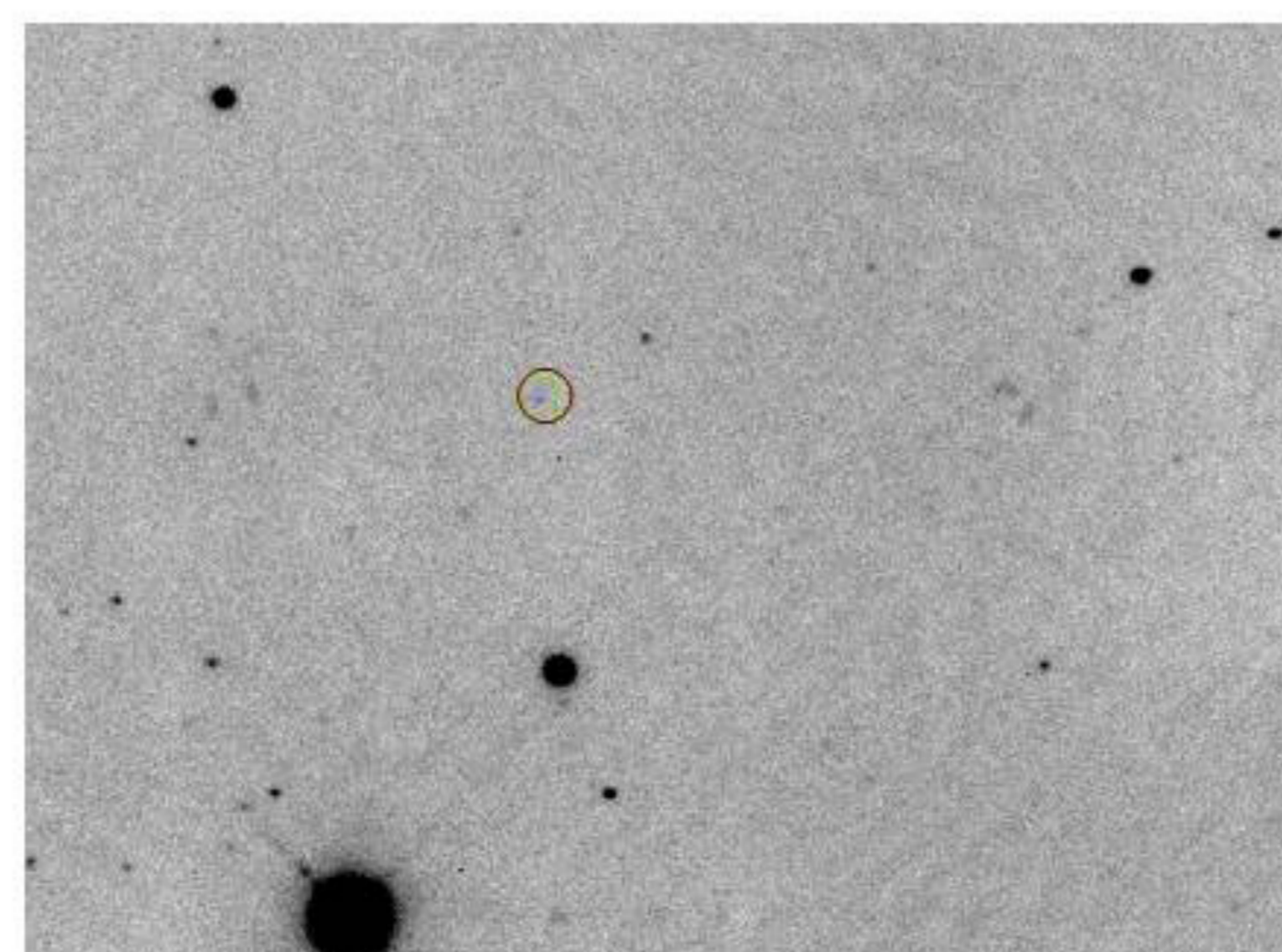


Figure 3. ISPI Image of one of a BD candidate (object is circled in red)

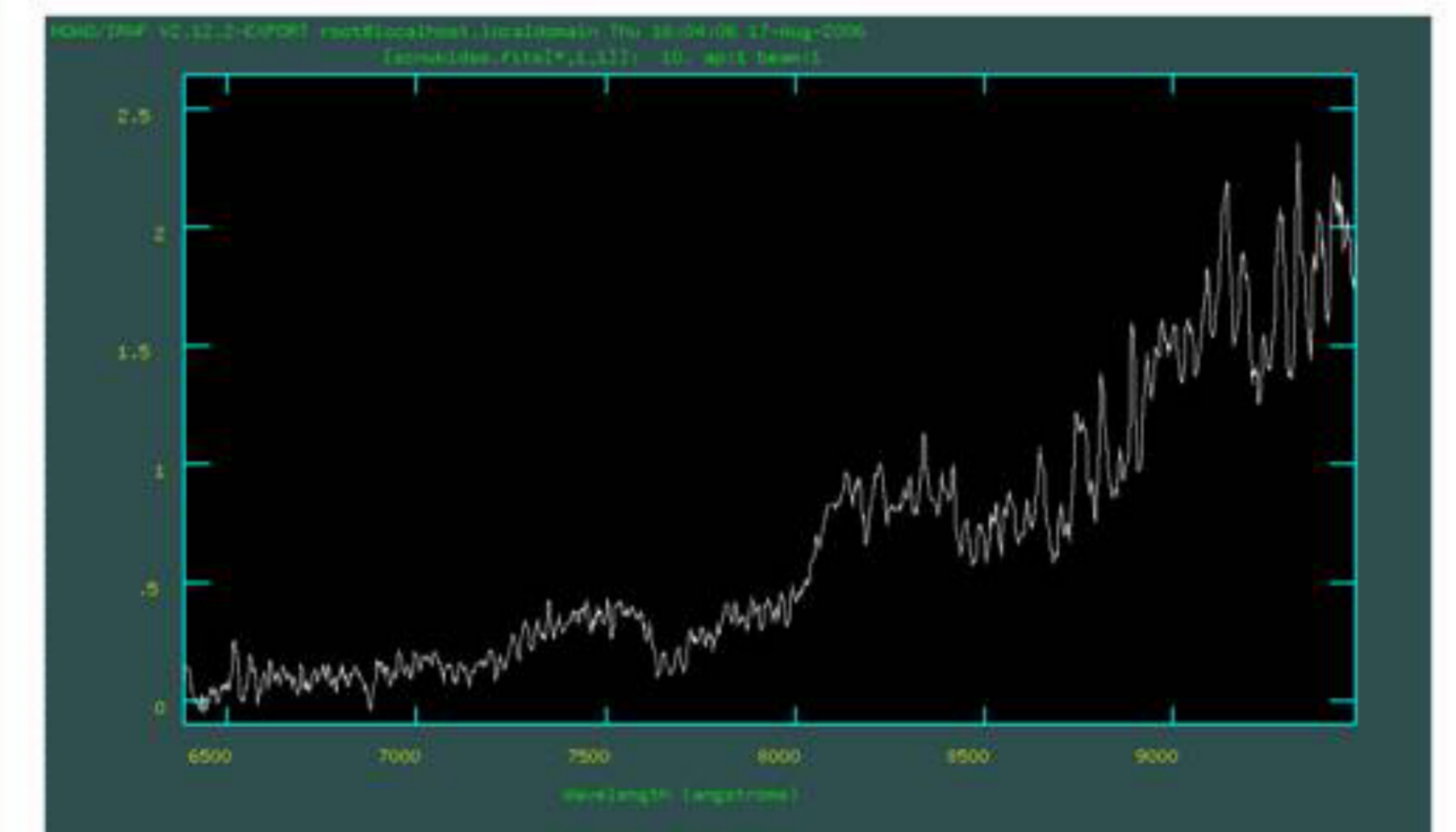


Figure 4. TNG/Dolores Optical spectra of a BD candidate

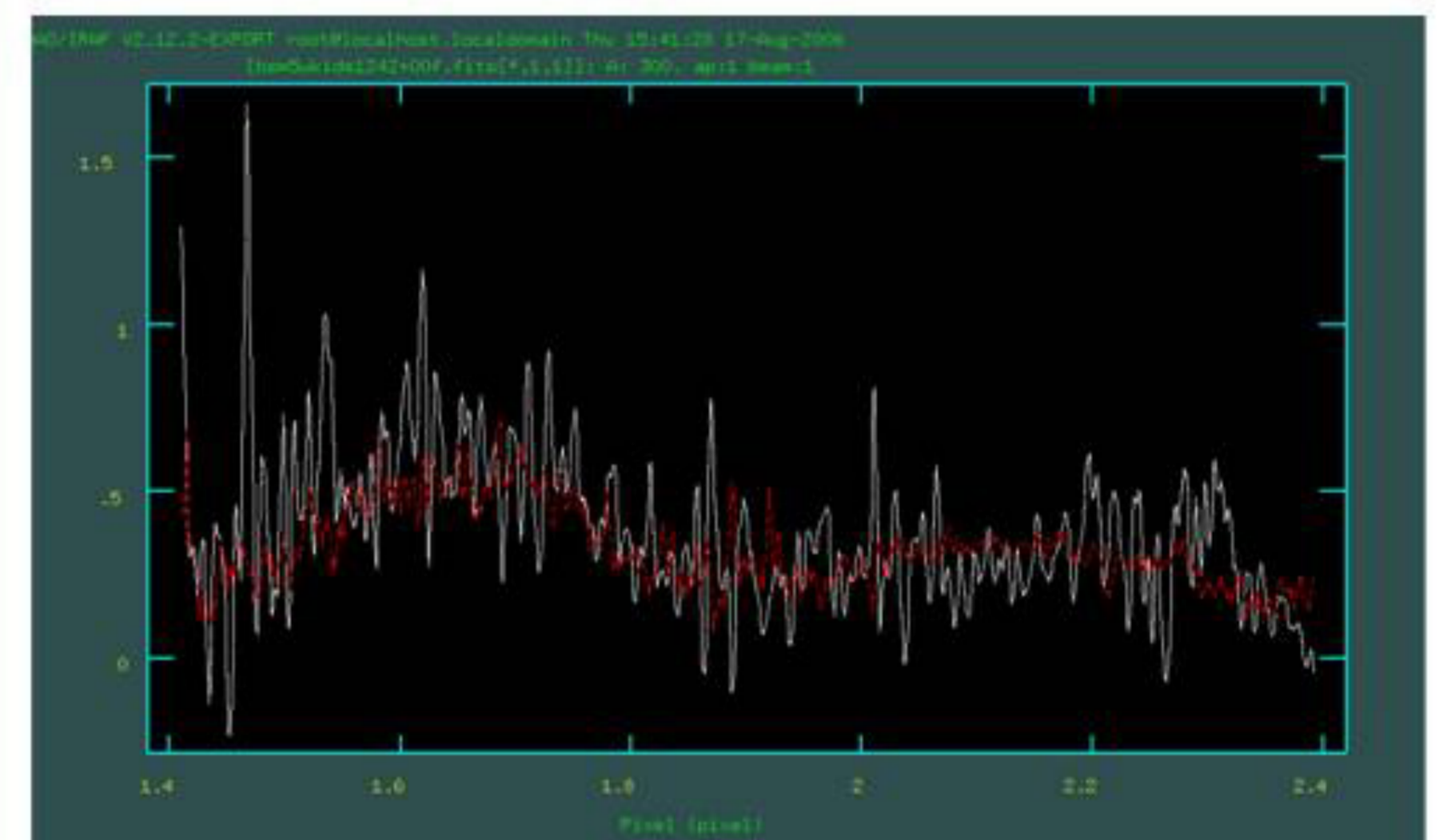


Figure 4. WHT/LIRIS Near IR spectra of a BD candidate plotted over a known BD from SDSS which was observed with the same set-up. (SDSS object's spectra is in red)

The spectral classes of the confirmed BD's from this survey are in good agreement with the estimated spectral types from the colors obtained.

The proper motions could shed more light on multiplicity and velocities which in turn could tell more about any cluster membership or formation mechanism once we have an estimate of the distance.

## References

1. Hewett et al 2005
2. Leggett et al 2005
3. Astrogrid UKIDSS pages

## Acknowledgements

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