IDENTIFICATION AND SPECTRAL DECONVOLUTION OF UNRESOLVED BROWN DWARF BINARIES USING VLT/XSHOOTER

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INTRODUCTION

Spectroscopy is an important tool in identifying unresolved binaries especially for L/T transition objects, as the integrated light of the system results in hybrid, highly peculiar spectra.

Using VLT/Xshooter we have obtained the spectra of 130 L and T dwarfs (Day-Jones et al., in prep.; Marocco et al., in prep.). The brown dwarfs candidates were selected from the UKIDSS LAS DR7, using colour-colour cuts to eliminate contaminants. The sample contains ~250 candidates, and we followed-up and confirmed as brown dwarfs 130 of them. **For more details on the sample selection and the spectroscopic follow-up, see the poster by Day-Jones et al.**

The wavelength range covered by Xshooter (300-2480 nm) combined with its resolution (R~5000) makes it an ideal instrument to identify and deconvolve the spectra of unresolved binaries.

In this contribution we present the 16 unresolved binary candidates identified within our sample.

CANDIDATES SELECTION

The unresolved binary candidates have been selected using combination of spectral indices and the spectral type. The indices and the criteria used are defined in Burgasser et al. (2010). The results are shown in Figure 1. **With this method we identified 24 potential binaries.**

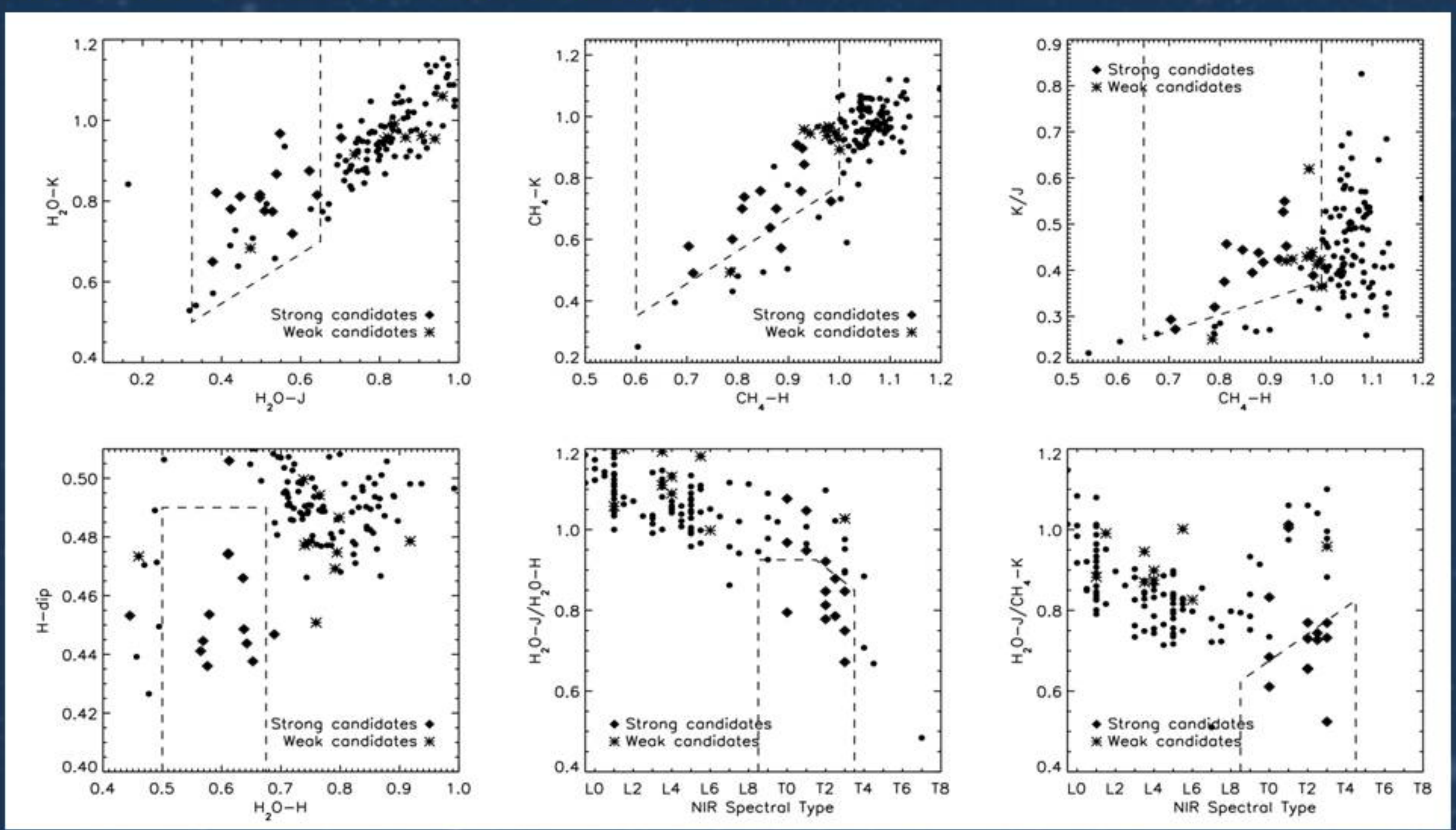

Figure 1: the index-index and index-spectral type criteria used to identify the binary candidates. The dashed line encloses the selection area . Objects that fall into that area in two plots are called "weak candidates". Objects that fall into that area in at least three plots are called "strong candidates".

SPECTRAL DECONVOLUTION

The spectral types of the components were determined via spectral fitting using synthetic unresolved binary templates. The templates were created combining the spectra taken from the SpeX-Prism on-line library (http://pono.ucsd.edu/~adam/browndwarfs/spexprism/), scaling them to the appropriate flux level using the M_J – spectral type relation from Marocco et al. (2010). Two examples are shown in Figure 2.

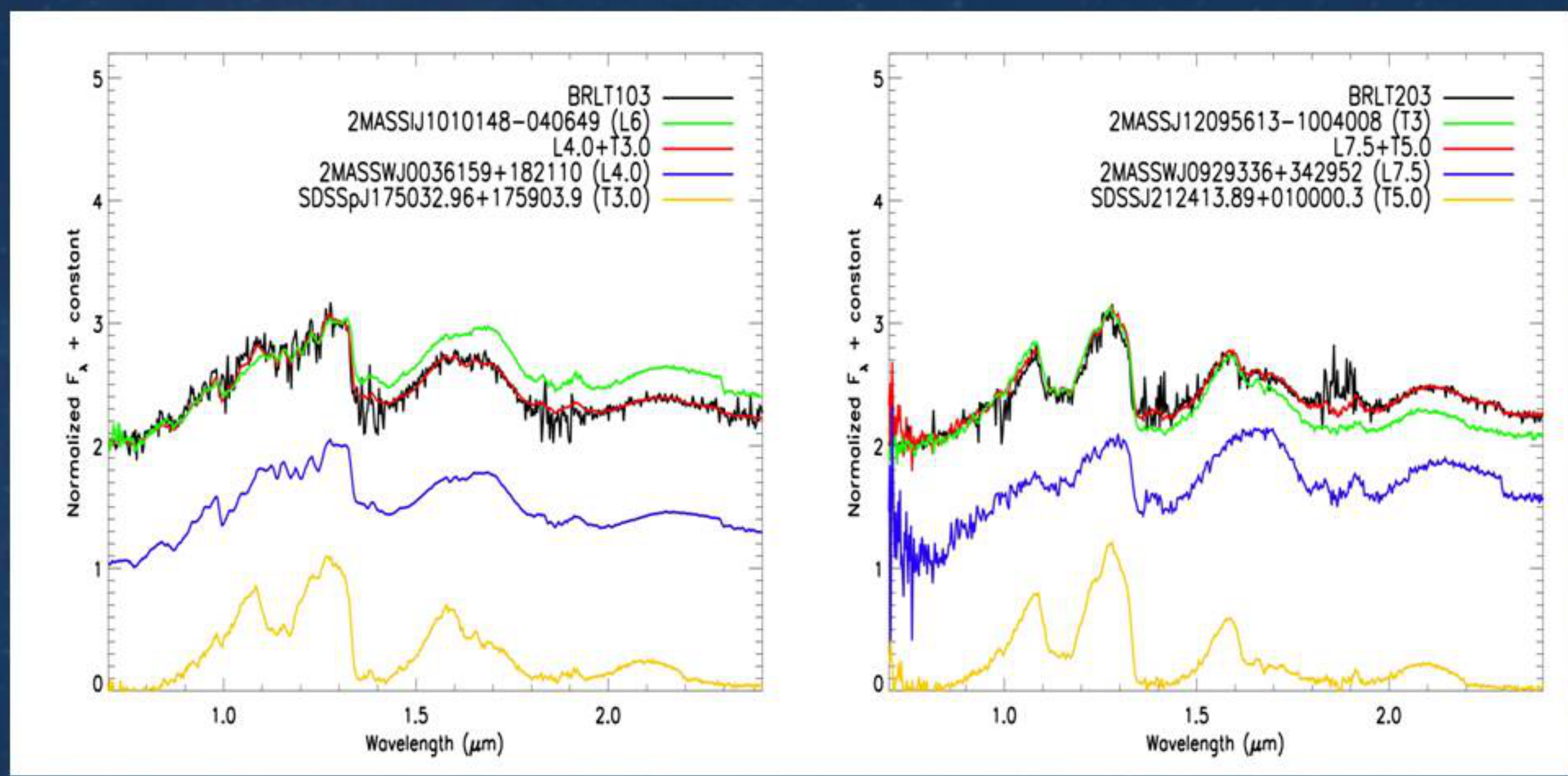

Figure 2: two examples of spectral deconvolution: BRLT103 (left panel) and BRLT203 (right panel). The black line is the Xshooter spectrum of the target; the green line is the best-fit standard template; the red line is the best-fit binary template; the blue and the yellow lines are the two components of the binary template.

The results of the deconvolution were compared with those from the fitting with spectroscopic standards using an F-test (Table 1). **Sixteen objects give a statistical better fit with the combined templates** (η > 1.15). Two of them are previously confirmed binaries: BRLT131 (SDSS1021-0304, Burgasser et al. 2006) and BRLT275 (SDSS1511+0607, Gelino et al., in prep). The spectral types obtained by our deconvolution are in good agreement with those in the literature (±1 subtype).

Target name	Single template best fit (χ^2)	Combined template best fit (χ^2)	F-test η
Strong candidates			
BRLT15	T2.0 (14.83)	L6.0+T4.0 (3.171)	4.68
BRLT45	T1.0 (6.258)	T0.0+T2.0 (6.453)	0.97
BRLT87	T1.0 (4.371)	T0.0+T1.0 (2.949)	1.48
BRLT131	T3.0 (3.071)	T2.0+T6.0 (2.536)	1.21
BRLT197	T2.0 (6.298)	L7.5+T4.0 (3.098)	2.03
BRLT202	T2.5 (5.497)	T0.0+T6.0 (4.332)	1.27
BRLT203	T3.0 (10.64)	L7.5+T5.0 (5.016)	2.12
BRLT232	T2.5 (2.838)	L7.5+T5.0 (3.061)	0.93
BRLT275	T2.0 (4.793)	L7.0+T6.0 (3.337)	1.44
BRLT281	T0.0 (13.27)	L5.0+T3.0 (4.800)	2.76
BRLT311	T3.0 (9.332)	T0.0+T5.0 (7.466)	1.25
BRLT312	T0.0 (6.504)	L5.5+T4.0 (5.121)	1.27
BRLT333	T2.0 (3.595)	L7.0+T3.0 (3.646)	0.98
BRLT344	T0.0 (5.804)	L4.5+T5.5 (1.235)	4.69
Weak candidates			
BRLT16	L3.5 (3.744)	L2.0+T5.0 (3.569)	1.05
BRLT33	L3.5 (6.079)	L3.0+T4.0 (3.370)	1.80
BRLT42	M9.0 (5.236)	M8.0+L2.0 (2.737)	1.91
BRLT60	L1.0 (2.299)	L1.0+L8.5 (2.173)	1.06
BRLT71	L1.5 (2.143)	L0.5+L3.5 (2.489)	0.86
BRLT91	T3.0 (2.830)	T2.0+T4.0 (3.063)	0.92
BRLT103	L6.0 (3.876)	L4.0+T3.0 (2.296)	1.69
BRLT176	L4.0 (3.928)	L4.0+T6.5 (2.357)	1.67
BRLT305	L5.5 (7.029)	L5.0+L7.0 (8.559)	0.82
BRLT335	L4.0 (4.631)	L5.5+T1.0 (2.873)	1.61

Table 1: the results of the spectral deconvolution.

CONCLUSIONS & FUTURE WORK

We found 16 spectroscopic binary candidates (14 new) in our sample of 130 L and T dwarfs.

These binary candidates are selected in a uniform and homogeneous way, from a complete, magnitude limited sample of brown dwarfs. The confirmation of their nature via high-resolution imaging can lead to an estimate of the lower limit of the binary fraction. This limit is required to constrain the IMF and birth rate of brown dwarfs (see poster by Day-Jones et al.).

Further analysis and simulations will be performed to estimate the rate of false positives given by the technique.

The spectra obtained will be made publicly available on-line, shortly after publication.

References:

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