# A DETAILED LOOK AT A BROWN DWARF DISK

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Fig. 1

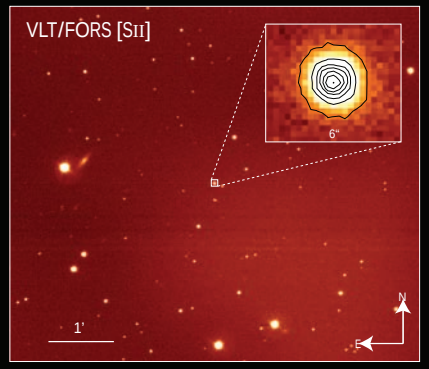



Fig. 2

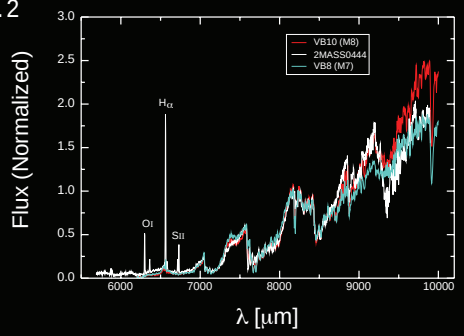



Fig. 3

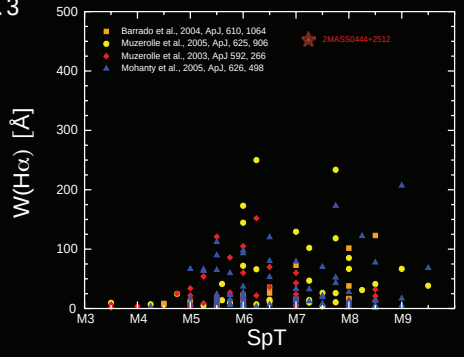
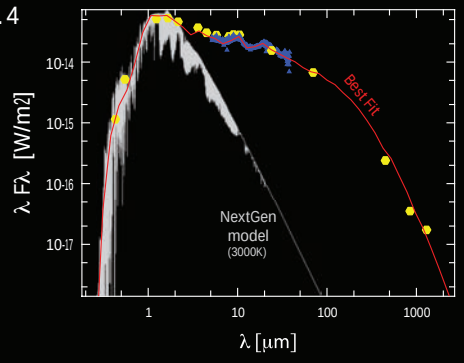



Fig. 4




## Brown Dwarf Formation

Over the last 10 years, a large number of BD has been discovered. One of the most debated questions is whether these substellar objects form the same way as stars, via the fragmentation and collapse of a molecular cloud, or as aborted stellar embryos ejected from their parent proto-stellar cluster. A comparison of stellar and substellar disk properties directly addresses this question.

Combining data from the litterature and new measurements obtained at the Keck (HIRES), VLT (NACO, VISIR and FORS2), Spitzer (IRS spectrum), CAHA (TWIN) and JCMT (SCUBA) observatories, we present one of the most detailed analysis of the properties of a bona-fide BD member of the Taurus association.

## A young brown dwarf in Taurus

2MASS J0444+2512 is a remarkable young BD of the Taurus association. Mid-IR and mm observations have revelead the presence of a disk (Guieu et al. 2007, Scholz et al., 2006).

Our new optical spectrum (Fig. 2) indicates that the object is a M7 dwarf, with Av~0. The presence of Hα as well as forbidden emission lines confims that the object is young and belonging to the Taurus association.

## Intense Accretion and outflow

Our Keck/HIRES spectrum shows one of the strongest Hα emission reported for a late-type object (see Fig. 3) with W(Hα)~450 Å indicating that intense accretion is on-going. The spectrum also shows strong forbidden emission lines (such as OI, SII, see Fig. 2) indicating the presence of a jet and outflow. We obtained a deep VLT/FORS2 [SII] band image (Fig. 1) to try to resolve this jet and outflow, without success (no extended emission detected as shown in the contour zoomed-image).

## Disk Properties

Fitting the SED (Fig. 4) with the latest theoretical models of Pinte et al. (2006), we derive the following major properties:

- the grains are large (~1 mm)
- the total dust mass adds up to $10^{-5}$ Msun
- the 35μm bump in the SED is caracteristic of the presence of crystaline silicates
- the scale height must be large (45 AU) in order to reproduce the high IRS spectrum flux

A more detailed analysis of the SED is on-going. The unprecented wavelength coverage makes of 2MASS J0444+2512 a benchmark object for the study of substellar disks.

## First direct images of a Brown Dwarf disk ?

We used VLT/NACO to obtain deep adaptive optics near-IR images. A reference PSF star was observed after each observation, and we performed a careful PSF subtraction and analysis. Figure 5 shows the results of the PSF subtraction in 3 bands. Unusally strong residuals appear. The scale and level of these residuals could well correspond to adaptive optics artefacts, but the consistency of their shape and level in different filters and at different time intervals suggest that they possibly correspond to some diffused light from the disk. New deeper images are required to confirm this result. These would then be the first direct images of a BD disk.

Direct images provide crucial constraints on the models of disk and would allow to considerably improve our understanding of their properties.

### References:

Apai et al., 2005, Science, 310, 834
Guieu et al., 2007, A&A, 465, 855
Luhman et al., 2003, ApJ, 590, 348
Pinte et al., 2006, A&A, 459, 797
Scholz et al., 2006, ApJ, 645, 1498

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Fig. 5