

A DETAILED LOOK AT A BROWN DWARF DISK.

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Over the last 10 years, a large number of Brown Dwarfs (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 literature 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.

1 A young brown dwarf in Taurus

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

Our new optical spectrum indicates that the object is a M7 dwarf, with $A_V \sim 0$. The presence of $H\alpha$ as well as forbidden emission lines confirms that the object is young and belonging to the Taurus association.

2 Intense Accretion and outflow

Our Keck/HIRES spectrum shows one of the strongest $H\alpha$ emissions reported for a late-type object with $W(H\alpha) \sim 450\text{\AA}$ indicating that intense accretion is on-going. The spectrum also shows strong forbidden emission lines (such as OI, SII) indicating the presence of a jet and outflow. We obtained a deep VLT/FORS2 [SII] band image to try to resolve this jet and outflow, without success (no extended emission detected).

3 Disk Properties

Fitting the SED with the latest MCFOST theoretical models (Pinte et al. 2006, see Fig. 1), we derive the following major properties:

- the SED indicates the presence of large grains ($\sim 1\text{ mm}$)
- the total dust mass adds up to $10 M_\odot$

- the $35\ \mu\text{m}$ bump in the SED is characteristic of the presence of crystalline 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 unprecedented wavelength coverage makes of 2MASS J0444+2512 a benchmark object for the study of substellar disks.

4 Direct images of a Brown Dwarf disk ?

We used VLT/NACO to obtain deep adaptive optics near-IR images in 3 broad and 2 narrow bands. A reference PSF star was observed after each observation, and we performed a careful PSF subtraction and analysis in each bands. Unusually strong residuals appear. The scale and level of these residuals could well correspond to adaptive optics static aberration artefacts, but the consistency of their shape and level in different filters and in successive exposures suggest that they possibly correspond to some diffused light from the disk. New deeper images are required to confirm this result. Direct images provide crucial constraints on the models of disk and would allow to considerably improve our understanding of their properties.

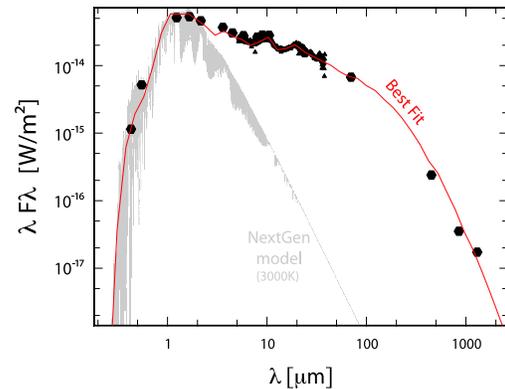


Figure 1: Spectral Energy Distribution of the brown dwarf (black) and best MCFOST model fit (red). A synthetic DUSTY photosphere distribution from Allard et al. (2000) is also overplotted (grey) for comparison.