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A T TAURI PHASE IN BROWN DWARFS & THE ROLE OF GTC

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The discovery of the first brown dwarfs (Rebolo et al. 1995, Nakajima et al. 1995) has posed an important problem to theoretical and observational astronomers: the formation mechanism. Reipurth & Clark (2001) have proposed that they form as stellar embryos, which gravitationally interact in multiple systems, are rapidly expelled and, therefore, are unable to accrete enough matter to become low mass stars. On the contrary, Padoan & Norlund (2002) argue that they are formed by collapse and fragmentation of a cloud (i.e., as stars do). These scenarios can be tested from the observational point of view, since kinematics, the statistics of circum(sub)stellar disks and their properties should be different. Then, the firs step is to identify such disks and study their properties. In other words, if brown dwarfs experience a phase similar to Classical T Tauri stars, this fact would be a strong evidence that the formation mechanism is similar.

Some clues: Infrared excesses

If the alleged disks surrounding brown dwarfs have properties similar to Classical T Tauri stars, they should have infrared excesses due to the disk contribution to the total continuum. Sometimes this is seen as a excess in the K band (Figure 1). In other cases, the disk might be so cold that the excess is only prominent at longer wavelength. In this case, mid-IR photometry is required. Since brown dwarfs are intrinsically faint and the closest star forming regions (SFR) are not in the solar neighborhood, a large aperture is needed. GTC/CanariCam will be a very powerful machine in orther to discover a significant sample of them.

The first evidence: low and medium resolution spectroscopy

One of the consequences when there is active accretion is the presence of strong Hα emission (other lines, such as CaII IR triplet, HeI6678 Å, etc, might be present). A low resolution spectrum suffices to show this. In fact, in few cases, several forbidden lines can be detected, which are indicative of mass ejection. Medium resolution spectroscopy can be helpful to refine the spectral classification, improve the measurement of the continuum veiling and study the evolutionary status with HR or similar diagrams (Figure 1). GTC/ELMER and GTC/Osiris are needed at this stage, if this kind of investigations are to be conducted. Moreover, Hα and lithium equivalent widths are important quantities which further advance the knowledge of the nature of these objects.

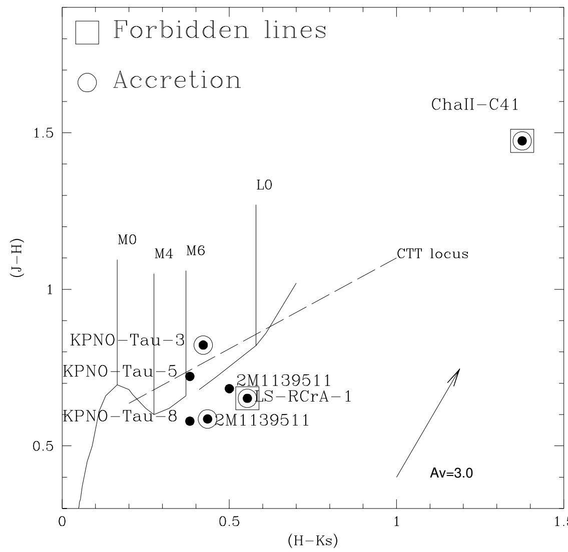

Fig. 1. Infrared Color-Color diagram displaying data corresponding to several brown dwarfs with broad Hα profiles (big circles) and the presence of forbidden lines (big squares) in their spectrum.

Revealed: high resolution spectroscopy

The final prove about the presence of accretion is provided by high resolution spectroscopy, by studying the line profiles. Figure 3a shows several broad, permitted lines in LS-RCrA 1, arising from the magnetically channeled accretion and/or the shock in the object surface. Additional Hα profiles can be seen in panel a of Figure 3b, corresponding to Taurus members with masses at or below the substellar limit ($\sim$0.072 M$_\odot$).

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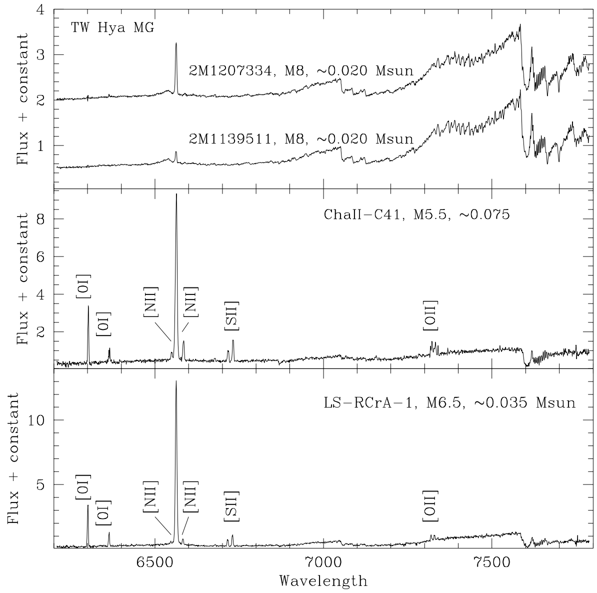

Fig. 2. Medium resolution spectra. **Top panel.** Two brown dwarfs belonging to the 10 Myr TW Hydrae Association. Only 2M1207334 presents accretion (Mohanty et al. 2003). **Medium panel.** ChaII-C41, a member of Chamaeleon II (Barrado y Navascués & Jayawardhana 2004). **Bottom panel.** LS-RCrA 1, part of RCrA cloud (Barrado y Navascués et al. 2004). Note the strong forbidden lines in the last two cases.

The fingerprint: Imaging the disks and jets

So far, there is neither imaging of a disks surrounding a brown dwarf nor of a jet. Again, intrinsic faintness make this very challenging. GTC/CanariCam and its coronograph will be a cornerstone for the understanding of these objects. GTC/Osiris, with is imaging capability in narrowband filters, can also be essential to obtain images similar to those observed in low-mass stars.

Related works can be found in Natta & Testi (2001), Barrado y Navascués & Martín (2003), Jayawardhana et al. (2002), Muhanty & Basri (2003) and Muzerolle et al. (2003).

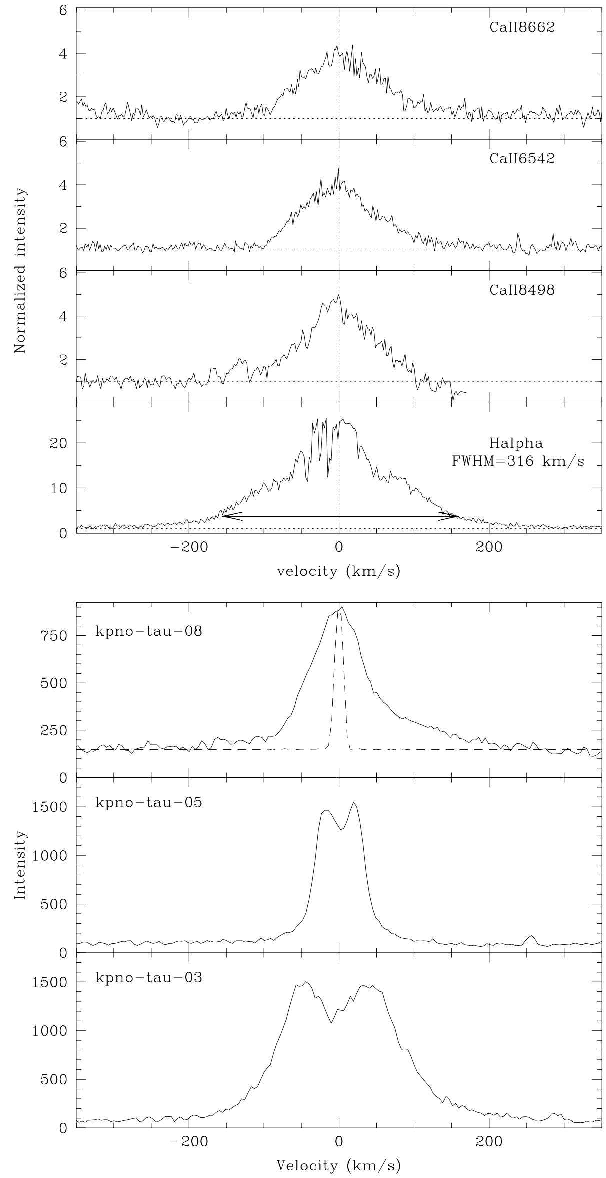

Fig. 3. **(a)**Profiles of permitted, broad lines for LS-RCrA 1 (Barrado y Navascués et al. 2004). **(b)** Hα profiles of three Taurus members. Tau-KPNO-3 is clearly accreting, since the width at 10% of the maximum intensity is larger than 200 km/s (Jayawardhana et al. 2003). The spectral resolution is shown as a dashed line (see Barrado y Navascués 2004).

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