

Young Stellar Objects in Lynds 1641: Disks and Accretion

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Abstract

We investigate the young stellar objects (YSOs) in the Lynds 1641 (L1641) cloud using multi-wavelength data covering ~ 1390 YSOs across a range of evolutionary stages. In addition, we targeted a sub-sample of YSOs for optical spectroscopy. We use this data, along with archival photometric data, to derive spectral types, extinction values, masses, ages, as well as accretion rates, and characterize the disk property of each YSO.

Introduction

The disk dissipation process is neither well understood theoretically, nor well constrained observationally. With the Spitzer Space Telescope our ability to study disk evolution has dramatically increased, both by sharp increase in number of stars and clusters investigated, as well as expansion of samples down to very low mass with accurate measurement in mid-infrared wavelengths. By correlating the disk properties to those of the central stars and the environments, the physical mechanisms that govern the disk dissipation process may be revealed.

YSO distribution

L1641 is located in the Orion complex at a distance of ~ 450 pc. In L1641, two star formation modes (**isolated** vs. **clustered**) exist. The Spitzer observations of this region have yielded excellent samples of thousands of young stars including both substantial numbers of TDs as well as normal T Tauri stars.

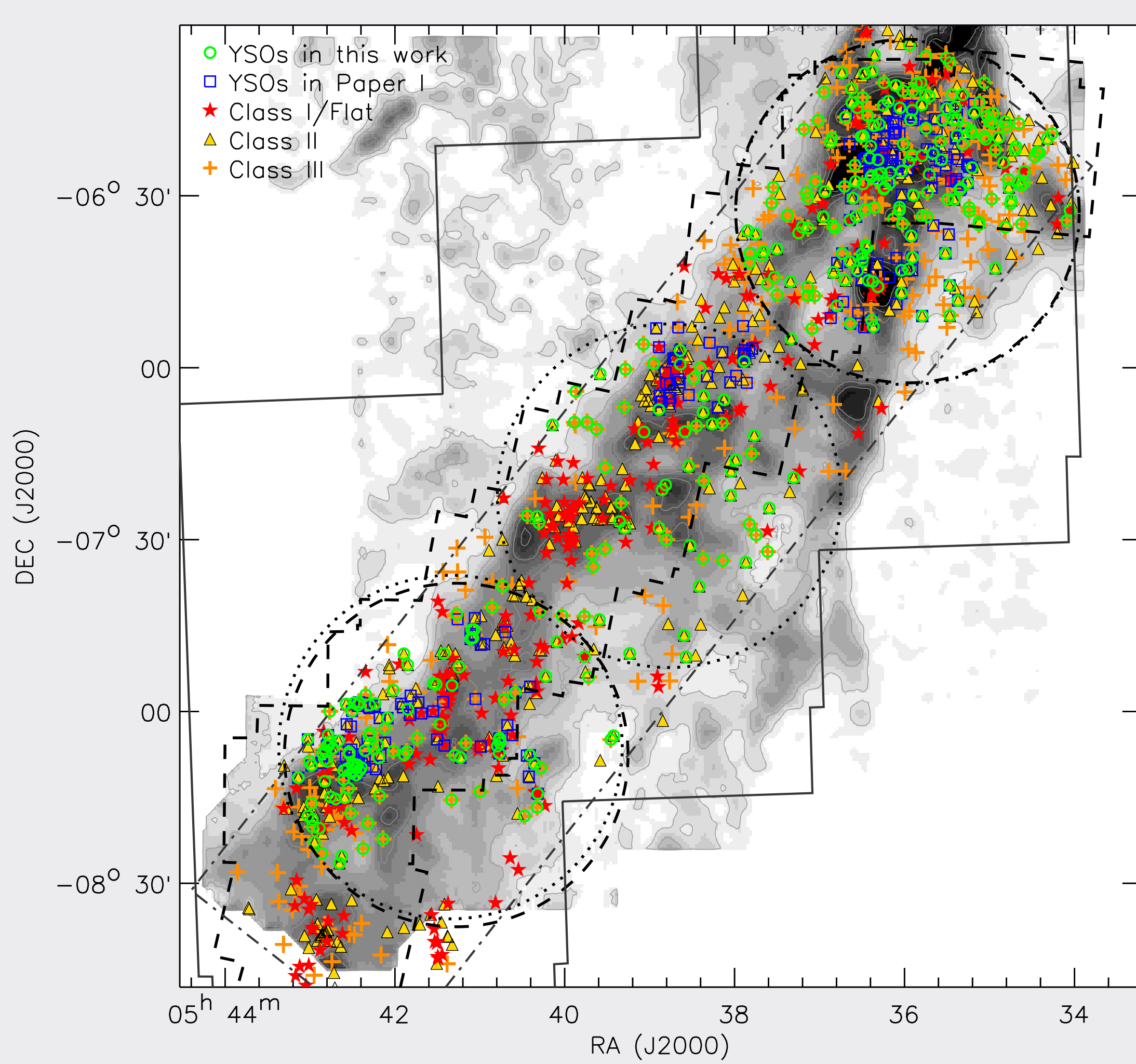


Figure 1. Distribution of YSOs in L1641 overplotted on a ^{13}CO integrated intensity map (Bally et al. 1987). The green open circles mark the YSOs observed with the Hectospec. The big circles show the fields of view (FOV) of our spectroscopic surveys with the Hectospec (dotted lines) and the Hectochelle (dashed lines).

Age distributions

In L1641, the median ages (τ) of the YSOs with optically thick disks, TD objects, and diskless YSOs are ~ 1.1 Myr, ~ 1.5 Myr, and ~ 1.8 Myr, respectively:

$$\tau(\text{Thick}) \lesssim \tau(\text{TD})$$

$$\tau(\text{TD}) \lesssim \tau(\text{Diskless})$$

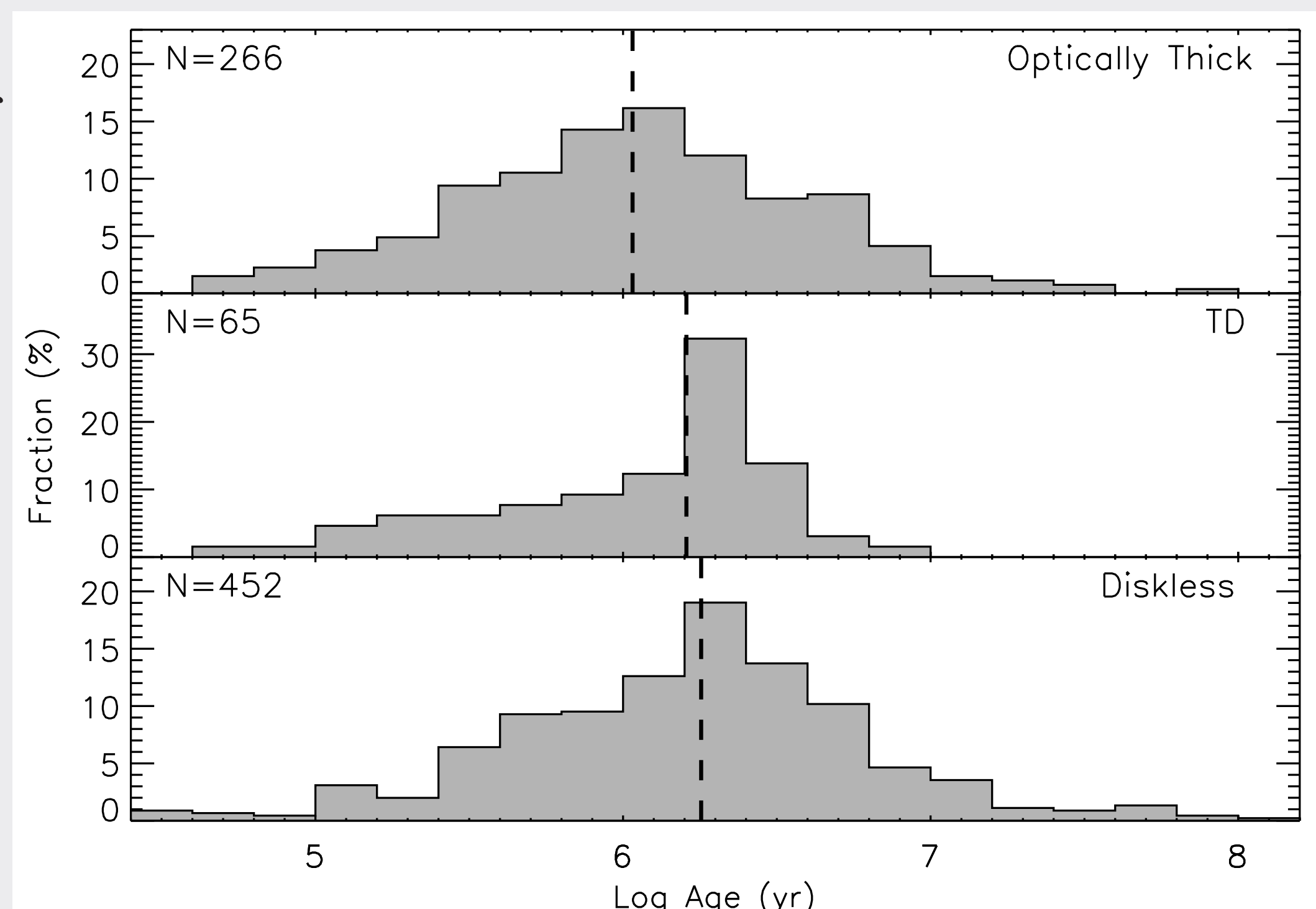


Figure 2. Histograms showing the age distribution for YSOs with optically thick disks, TDs, and without disks, respectively.

Disk frequency vs. stellar mass

We obtain a disk fraction of $\sim 50\%$ in L1641. The disk frequencies are almost constant as a function of stellar masses with a slight peak at $\log(M_*/M_\odot) \approx -0.25$, which is quite different from that seen in IC 348, Cha I, and Taurus (Lada et al. 2006, Luhman et al. 2008, 2010).

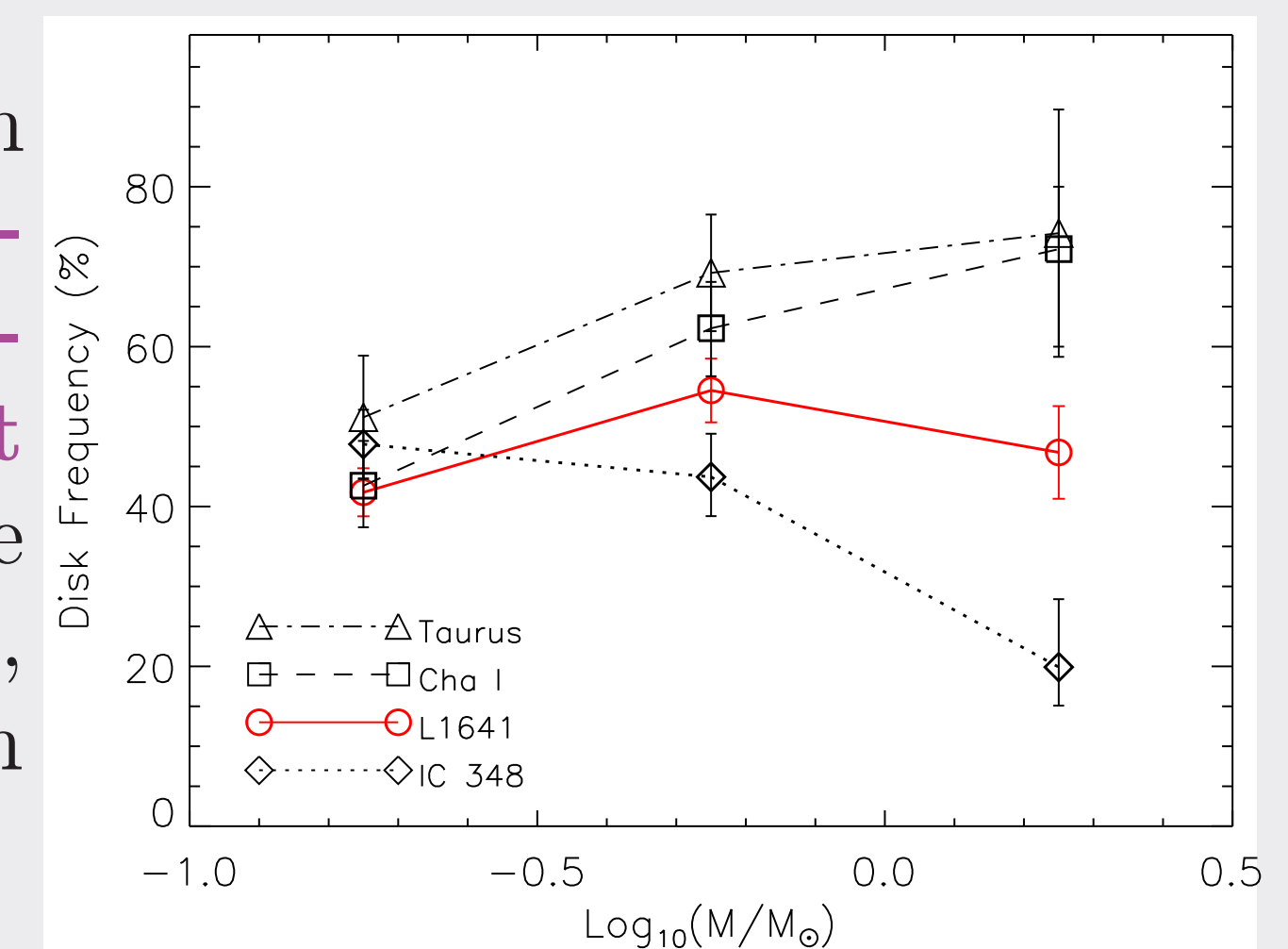


Figure 3. Disk frequency as a function of stellar mass in L1641

Accretion among different types of disks

In L1641, **40%–45%** of TDs are accreting, much lower than the fraction (**77%–79%**) of accretors among optically thick disks. But the accretors among the two populations show **similar** median accretion rates.

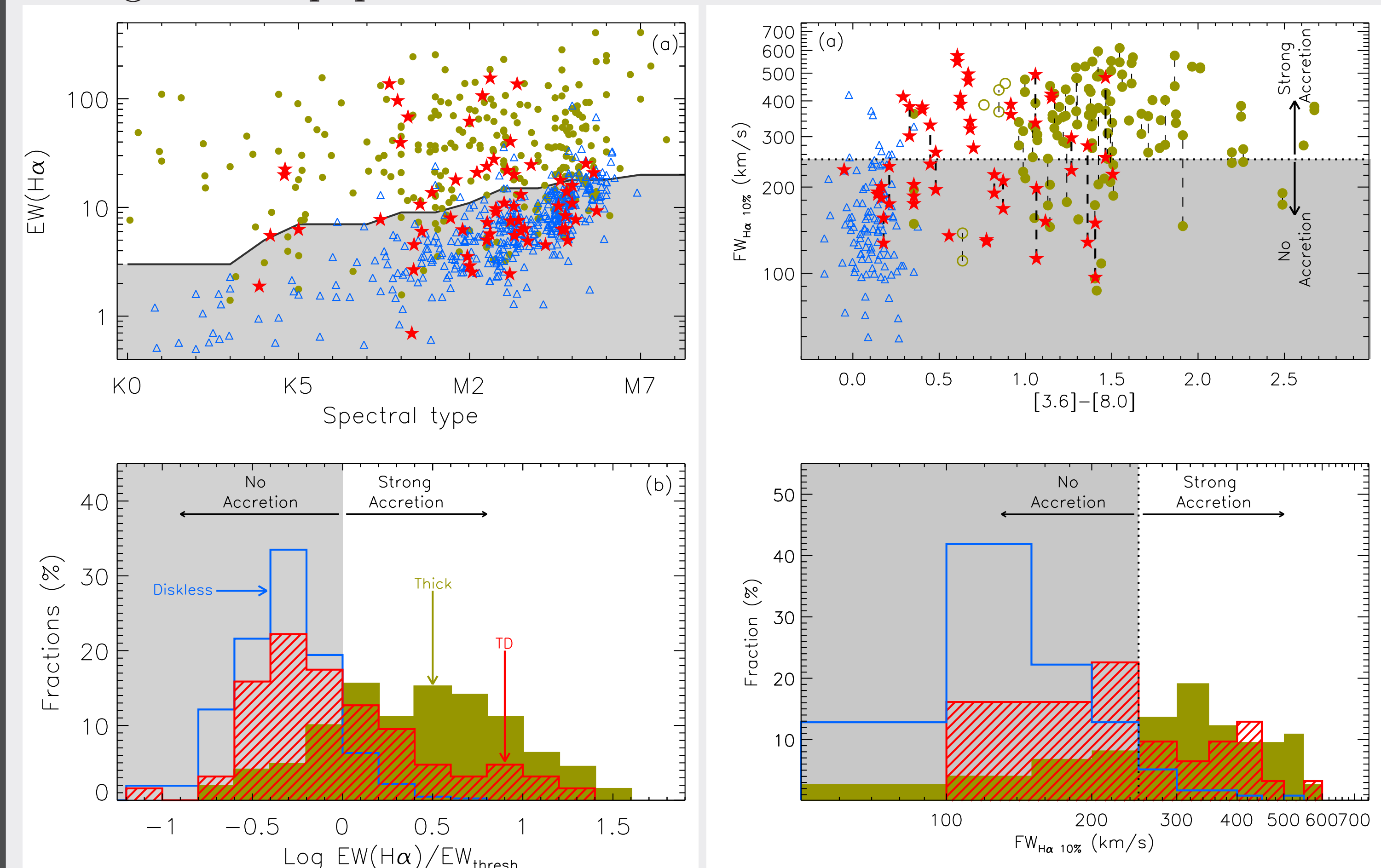


Figure 4. (left) $\text{H}\alpha$ EWs among different types of disks. The optically thick disks, TDs, and diskless YSOs are shown with the filled circles, the triangles, and the star symbols, respectively. Figure 5. (right) $\text{H}\alpha$ $\text{FW}_{\text{H}\alpha,10\%}$ (the full width of $\text{H}\alpha$ at 10%) among different types of disks. The symbols are same as in Figure 4.

Accretion variation

We have monitored the $\text{H}\alpha$ line profiles of several hundred YSOs with the Hectochelle at multiple epochs during 2010–2012. We find typical accretion rate changes of ~ 0.6 dex for both optically thick disks and TDs.

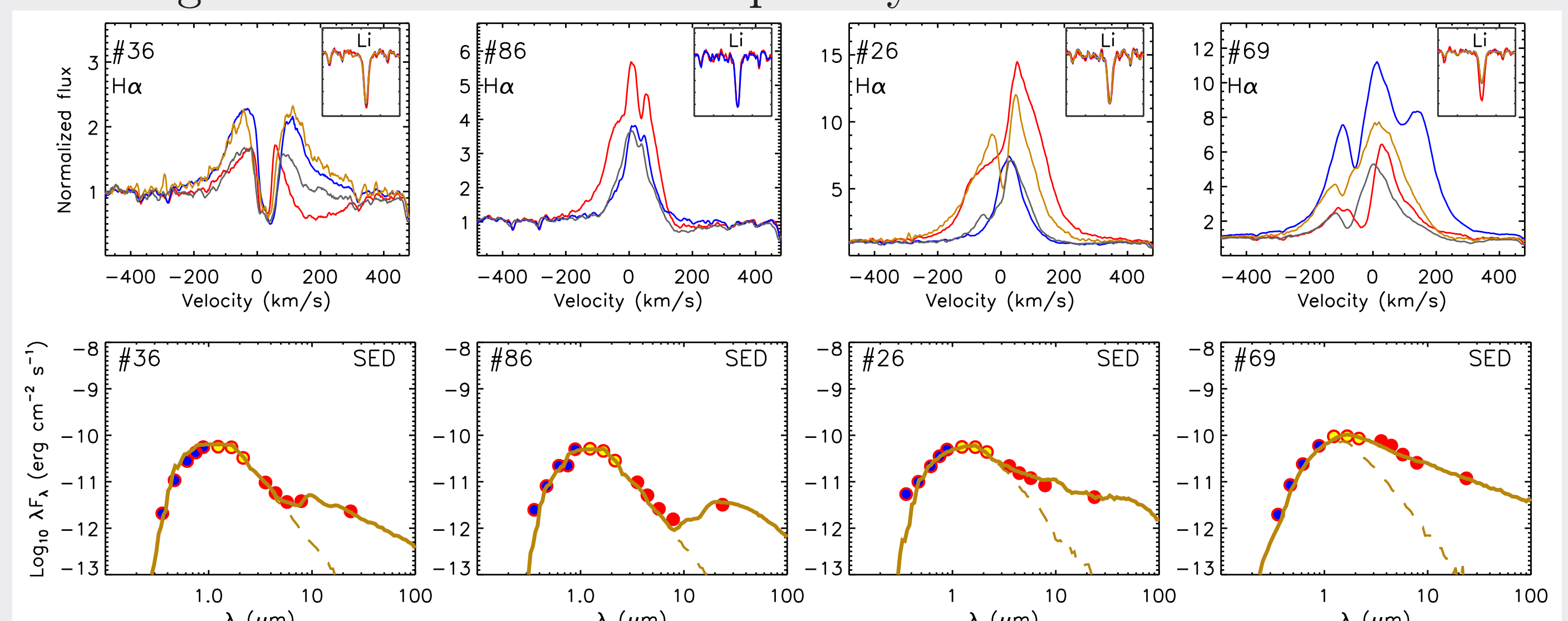


Figure 6. $\text{H}\alpha$ profile at several epochs for 2 TDs and 2 optically thick disks, as well as their SED. The observation dates have been encoded as different colors: red for 2010-Feb-5, blue for 2010-Mar-3, Yellow for 2010-Nov-29, gray for 2012-Dec-1.

Reference



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