Accretion and winds in transitional disks

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Transitional disks have significantly dust depleted cavities (e.g., Espaillat et al. 2014). These cavities are also gas depleted (e.g., van der Marel et al. 2015).

However, **there are transitional disks accreting** at the same rate as full disks with similar stellar properties and located in the same regions (Fig. 1). In the context of magnetospheric accretion models, this implies that their inner disk (r~0.1 AU) is still as rich.

We are using high-resolution (R~70,000) VLT/UVES spectra to address the following questions:

- What kind of wind is traced by forbidden lines in transitional disks?
- Where is the gas traced by these lines located in these objects?
- Is the magnetospheric accretion scenario valid also for transitional disks?

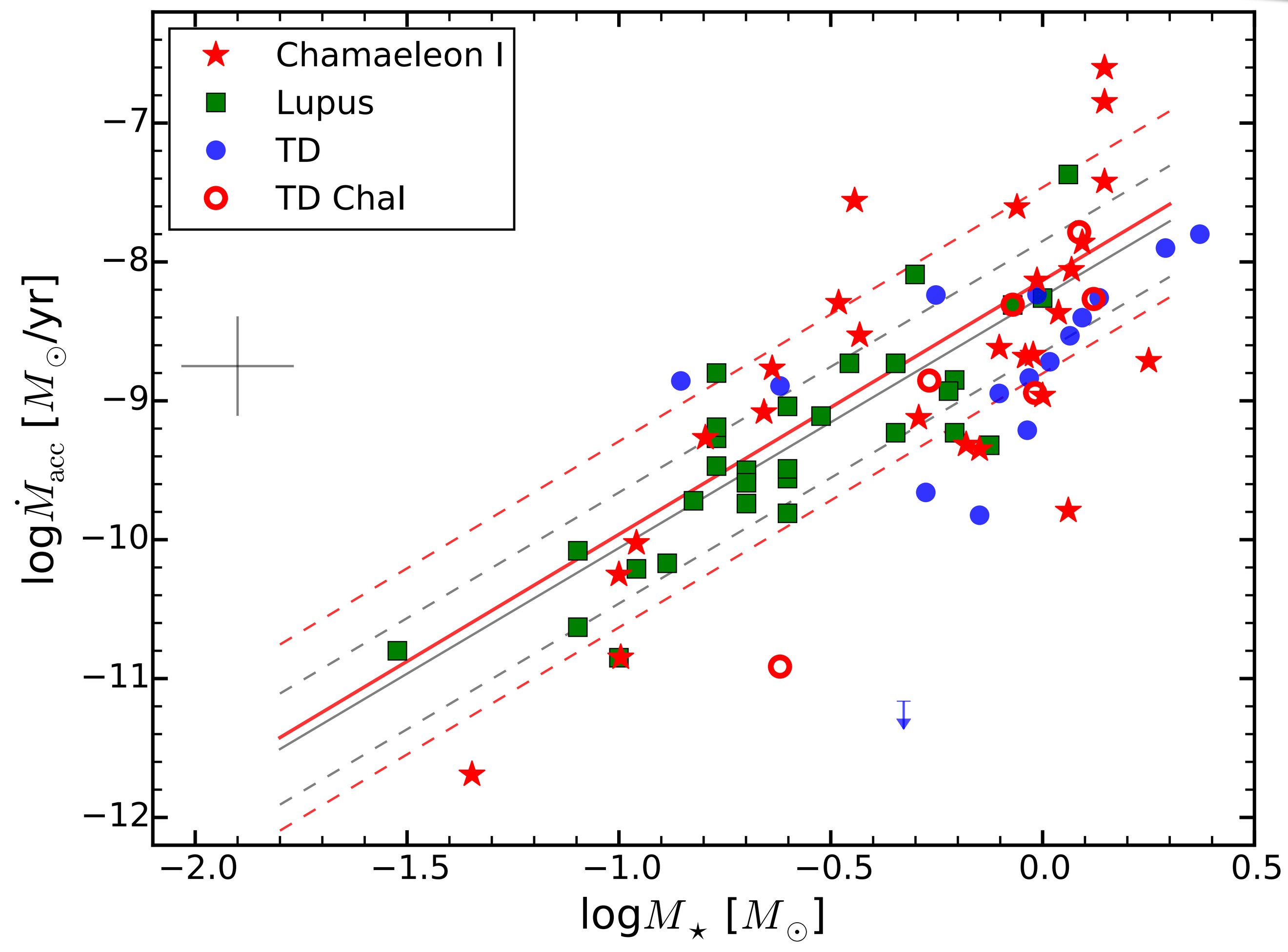
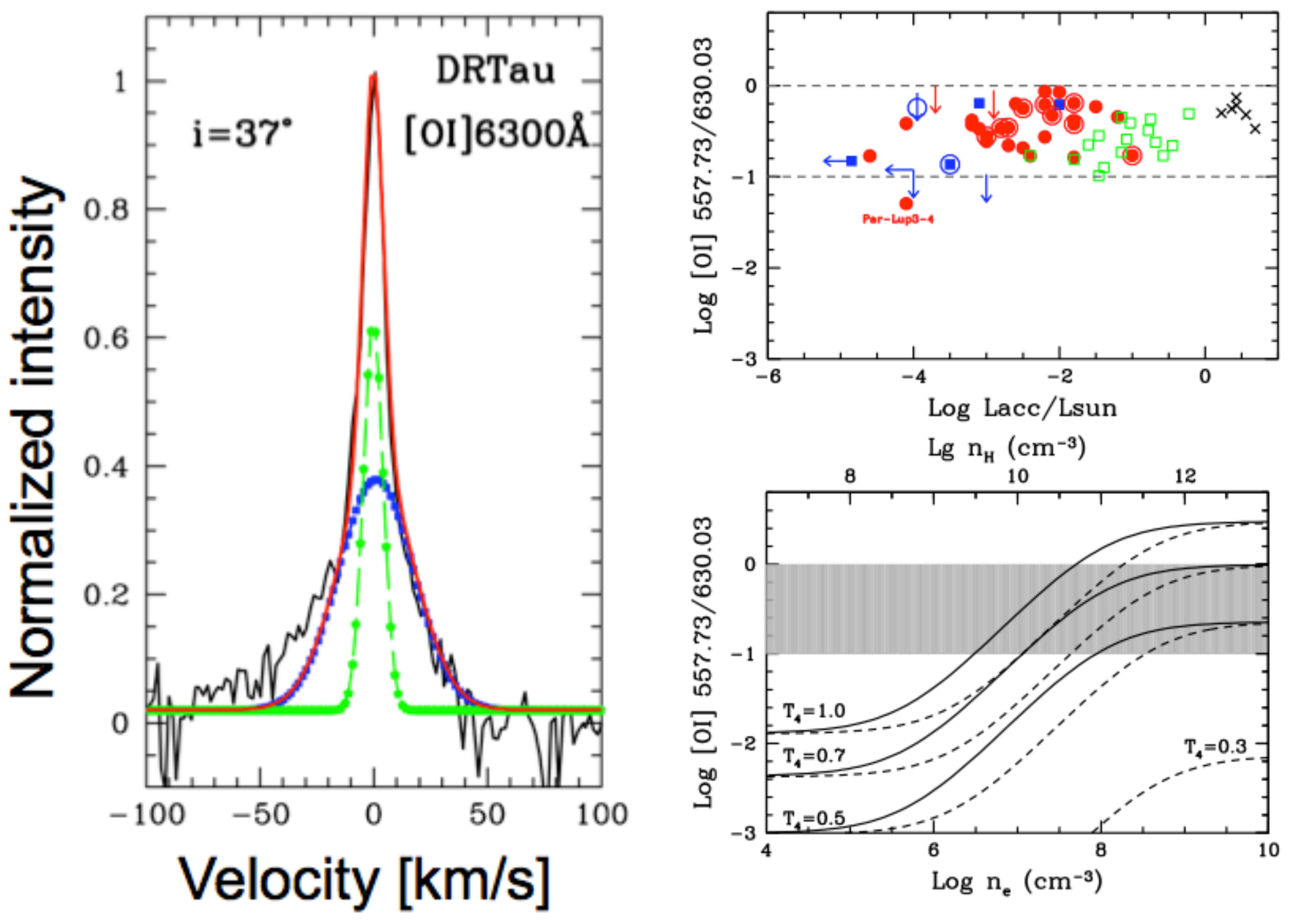


Fig. 1: Mass accretion rate vs stellar mass measured with VLT/X-Shooter from UV-excess for accreting full disks in Lupus (Alcala et al. 2014), in Chamaeleon I (Manara et al. 2015b), and in a sample of transitional disks in various regions, including Chamaeleon I (Manara et al. 2014). Figure adapted from Manara et al. (2015b).

Forbidden [OI] lines in cTTs



The high-velocity component (**HVC**) of forbidden emission lines in young stellar objects is a tracer of **jets** (Hartigan et al. 1995), while the origin of the low-velocity component (LVC) is still under debate. Recently, Rigliaco et al. (2013) studied high-resolution spectra of [OI] lines and suggested that the **LVC** of the [OI]6300AA and [OI]5577AA lines is composed by **two components**: a **narrow component tracing a photoevaporative wind**, and a **broad component tracing bound gas** in keplerian rotation in the disk (Fig. 2a). Natta et al. (2014) have then shown, using medium-resolution spectra, that the wind traced by the LVC of forbidden lines is slow (v_{peak} < 20 km/s), warm (T ~ 5000-10000 K), and mostly neutral, thus consistent with a disk origin (Fig. 2b).

Fig. 2: On the left, the fit with a broad component and a narrow component of the [OI]6300AA line (Rigliaco et al. 2013); on the right, the top panel shows the measured ratio between the [OI]5577AA and [OI]6300AA line fluxes for the sample by Natta et al. (2014), while the bottom panel shows the corresponding model predictions for collisions with electrons (solid curves) and with hydrogen atoms (dashed curves).

Forbidden [OI] lines in transitional disks

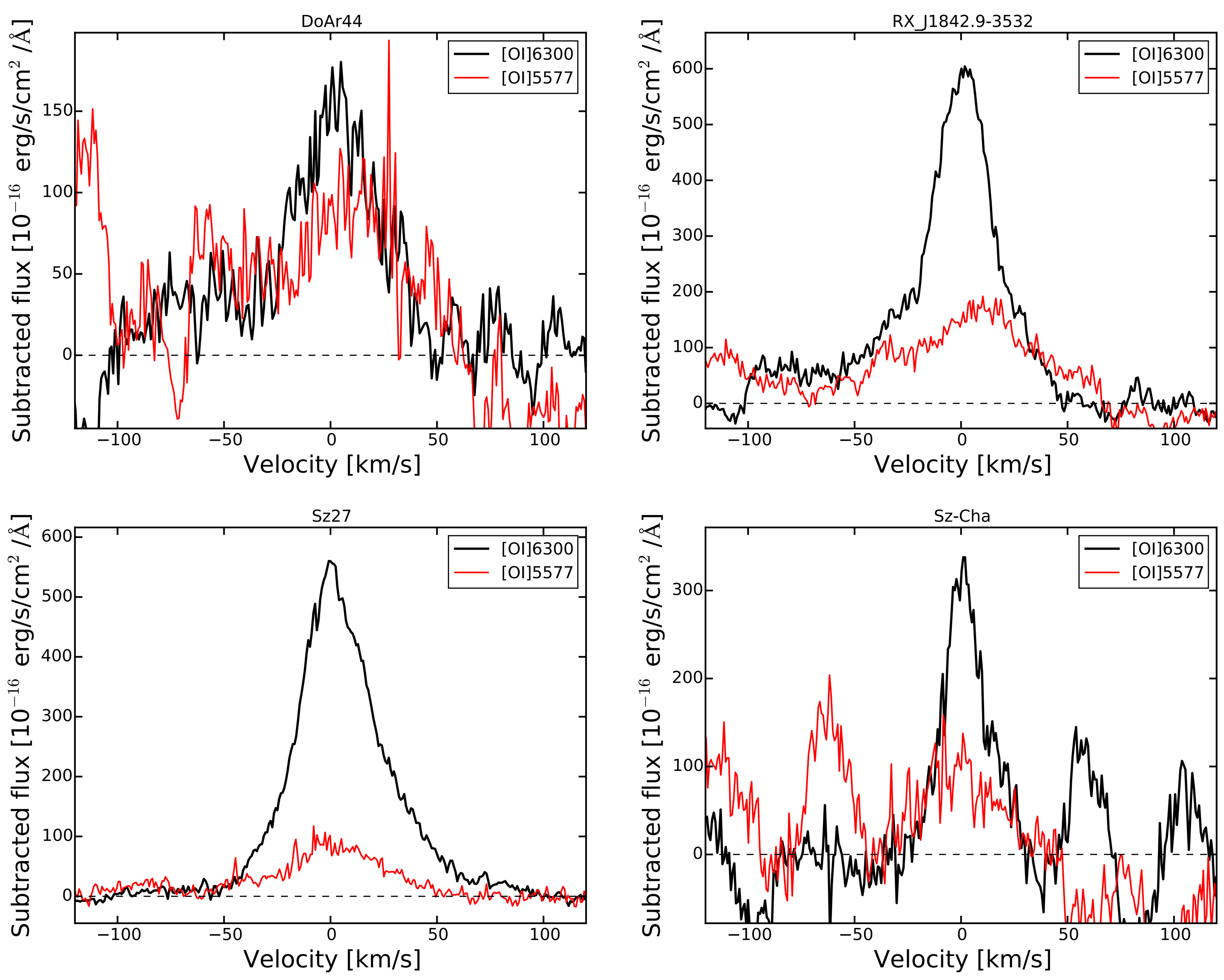


Fig. 3: Example of residual profile for the [OI]6300AA and [OI]5577 lines in our spectra of transitional disks.

In our spectra of accreting transitional disks, we never see a narrow component in the profile of the LVC of the [OI]5577AA. On the other hand, both a broad and a narrow components are present in the LVC of the [OI]6300AA line also for our sample of transitional disks.
We never observe any HVC (v>100 km/s) in these lines in our sample, which suggests that there are **no jets** in these objects.
The BC of the two lines seem to extend up to ~±50 km/s, which suggests gas in keplerian rotation down to r_{in} ~ 0.35 AU.

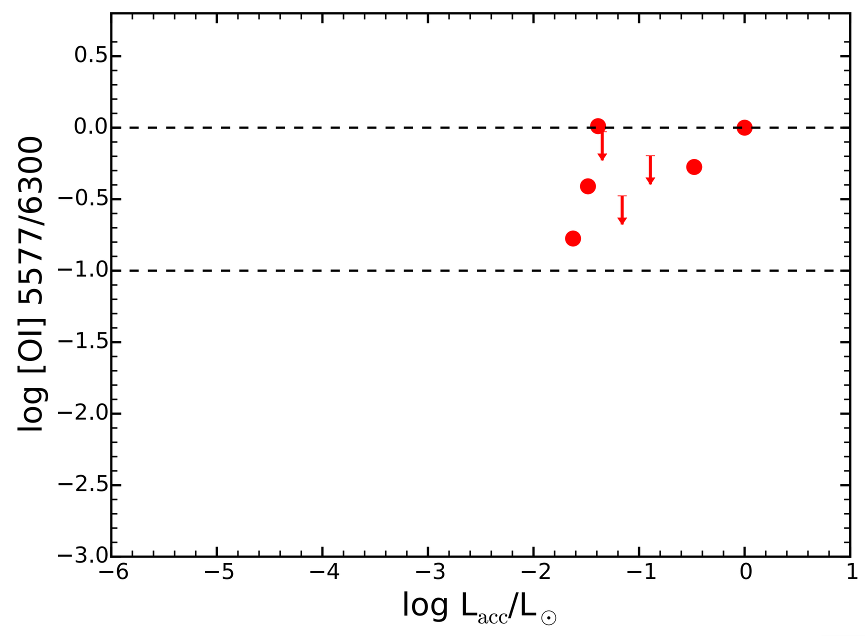
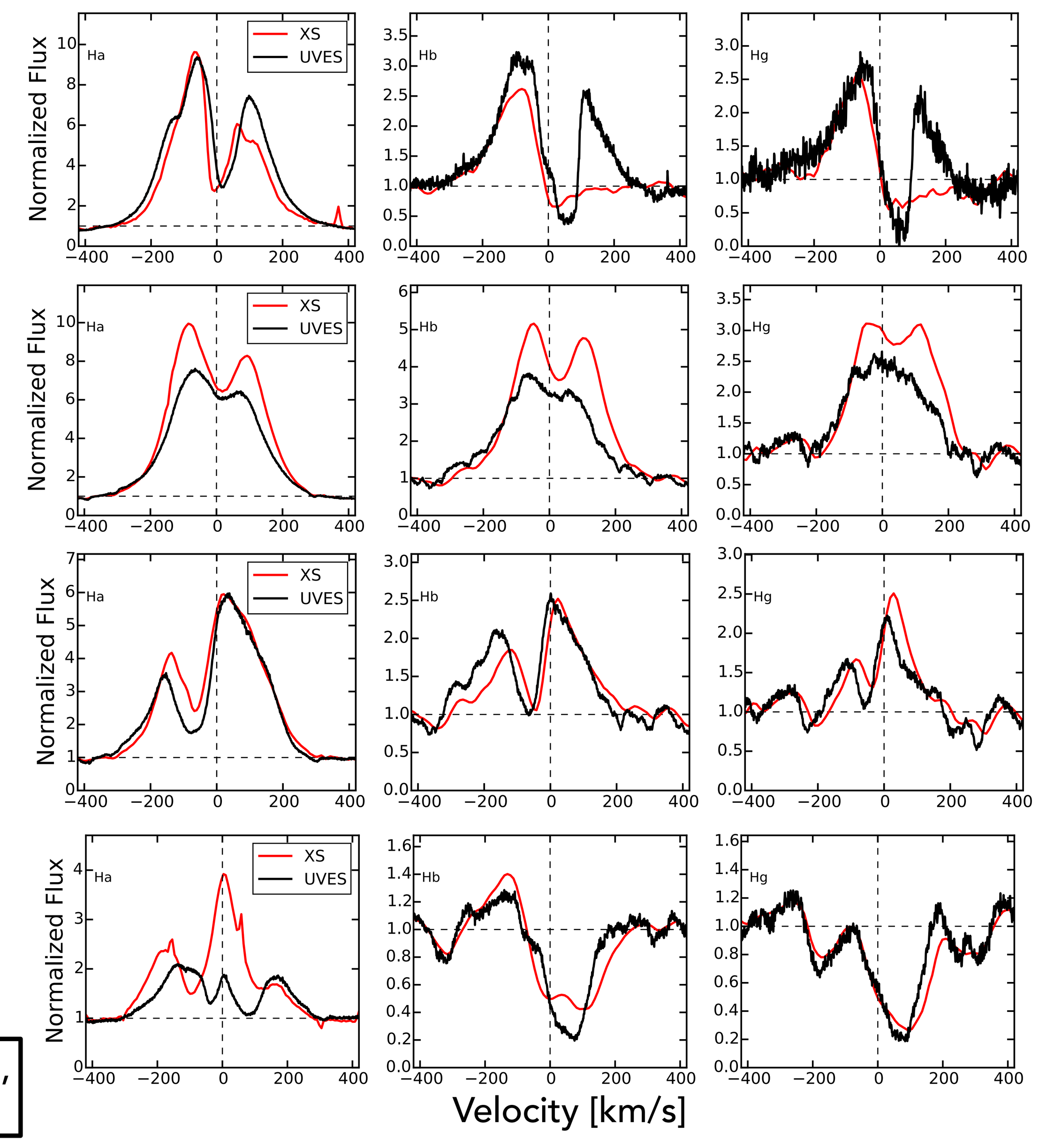


Fig. 4: The ratio of the two [OI] lines is similar as the one in full disks (Fig. 2) when measuring the whole flux of the LVC of the two lines. Similarly, the luminosity of the [OI]6300 AA line has a similar dependence with Lacc as the one found by Natta et al. (2014) for full disks.

Fig. 5: Examples of permitted emission line profiles for some transitional disks in our sample. The three lines shown are, from left to right, Hα, Hβ, Hγ. The four objects are, from top to bottom, Sz27, DoAr44, RX J1842.9-3532, and Sz Cha



What is going on in transitional disks?

There are transitional disks with mass accretion rates similar to full disks with the same stellar mass and located in the same region. All these **accreting transitional disks** that we observed with high-resolution spectroscopy **do not show evidence of high-velocity jets**.
More statistics is needed to infer these findings to the whole class of transitional disk objects.
In our sample, the LVC of the [OI]5577AA line never shows a narrow component, which possibly traces a photoevaporative wind.
Is the **magnetospheric accretion** scenario valid also in transitional disks? Some permitted lines show redshifted absorption features (Fig. 5), and also HeI line has similar properties as full disks (see poster by M. Vincenzi). However, the lack of jets (in our sample) poses strong questions on the accretion process in these objects.

References: Alcala et al. 2014, A&A, 561, A2; Espaillat et al. 2014, PPVI, 497; Hartigan et al. 1995, ApJ, 452, 736; Manara et al. 2014, A&A, 568, AA18; 2015b, A&A, in press; Natta et al. 2014, A&A, 569, AA5; Rigliaco et al. 2013, ApJ, 772, 60; van der Marel et al. 2015, A&A, 579, A106.