SEARCHING FOR GAS TRACERS IN SPITZER IRS SPECTRA OF YOUNG STARS IN TAURUS

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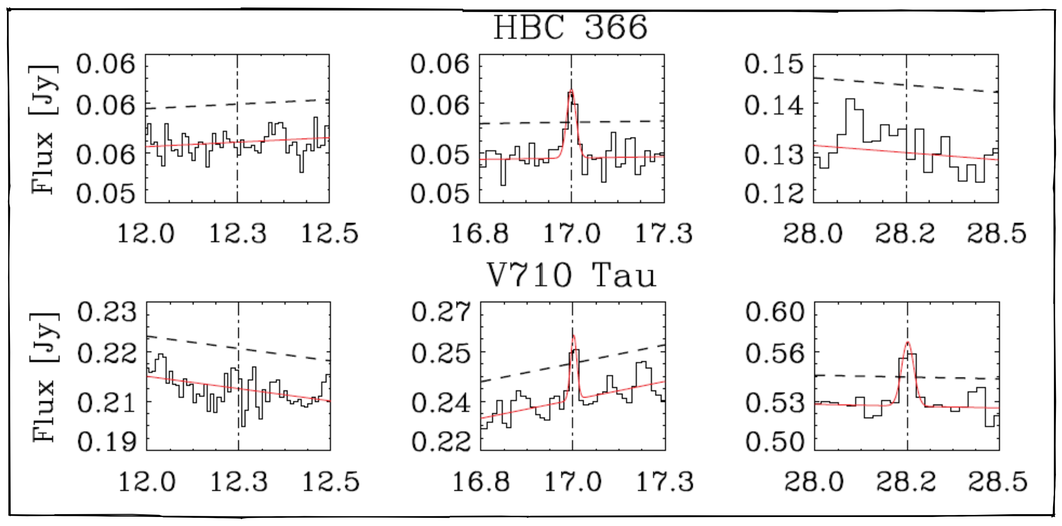
context

Mid-infrared gas emission lines are detected in the environment of young stars (e.g., van den Ancker et al. 1999, Lahuis et al. 2007., Bitner et al. 2008). Their origin might be in shocks, outflows, infalling material or due to irradiation of the disk by high-energy photons.

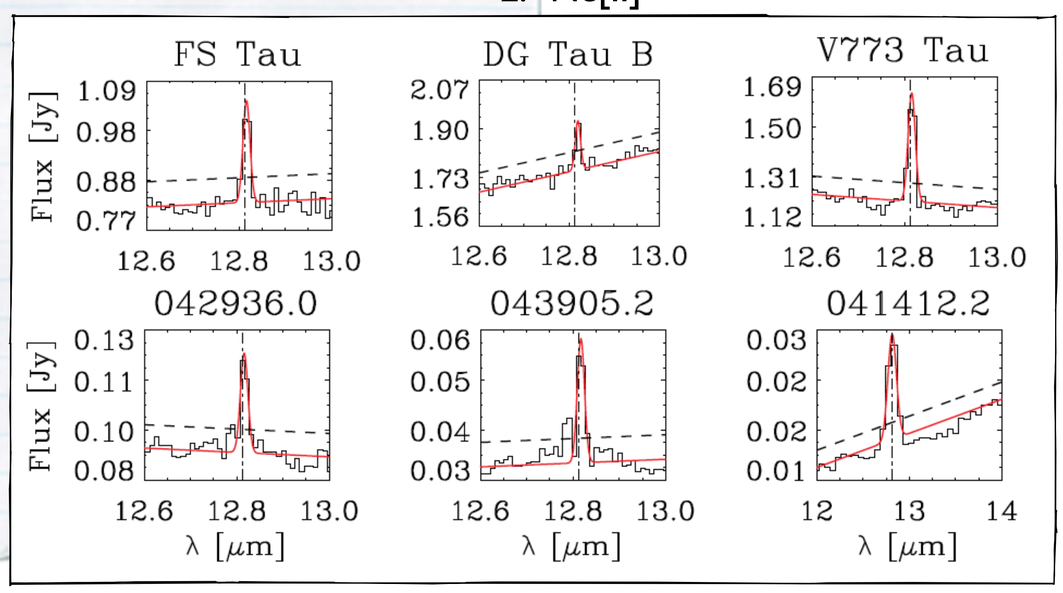
method

We have studied the gas emission in 64 pre-main-sequence stars in the Taurus Molecular Cloud (d~137 pc). Our study is based on Spitzer observations using the IRS spectrograph (R ~ 600). Our sample contains objects in different evolutionary states: Class I (11), II (43) and III (4). We have included also Herbig stars (6).
Line luminosities or 3-sigma upper limits have been obtained by fitting Gaussian profiles to the spectra for the following molecular and atomic species: H_2 (12.28, 17.03, 28.22 μm), [Ne II] (12.81 μm), [Ne III] (15.55 μm), [Fe II] (17.93, 25.99 μm), [S III] (18.71, 33.48 μm). We have detected H_2 in 6 objects, [Ne II] in 18 objects, and [Fe II] in 7 objects. Figures 1, 2, and 3 show some of the detected emission lines.

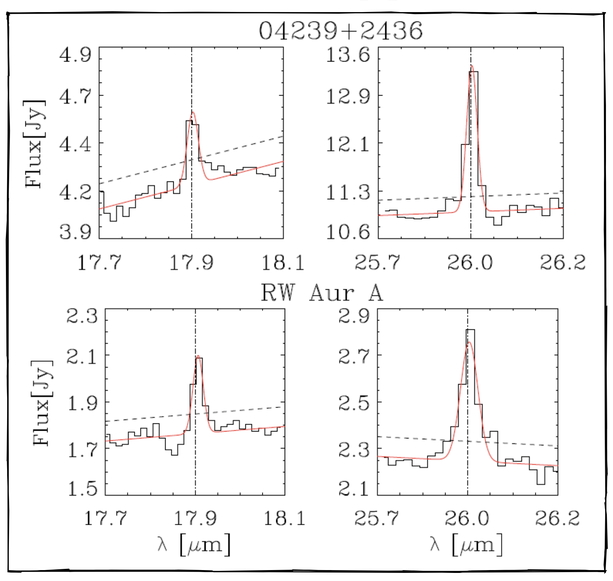
1.- H_2



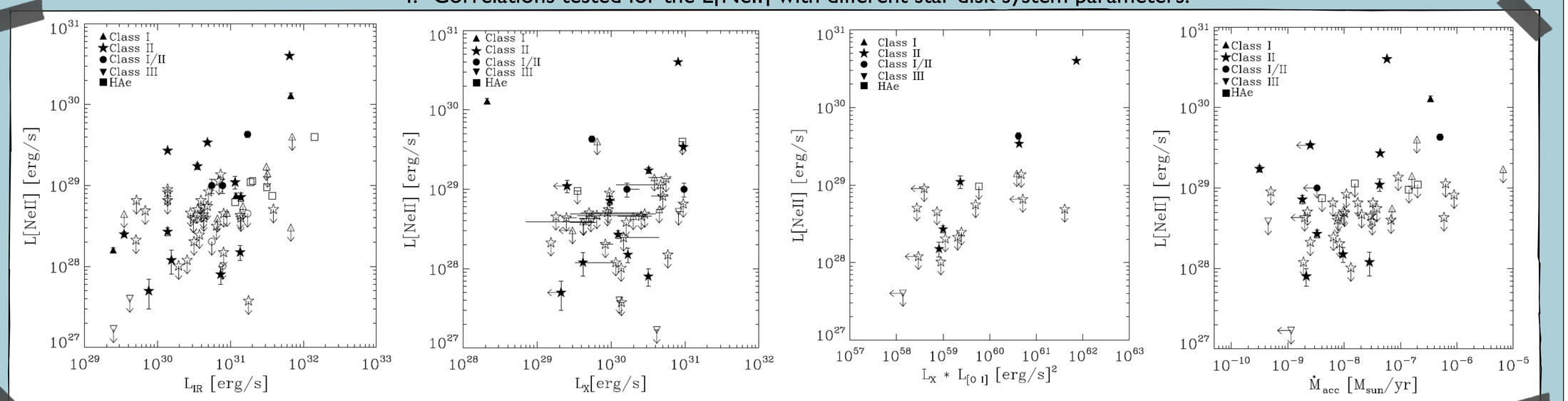
2.- Ne[II]



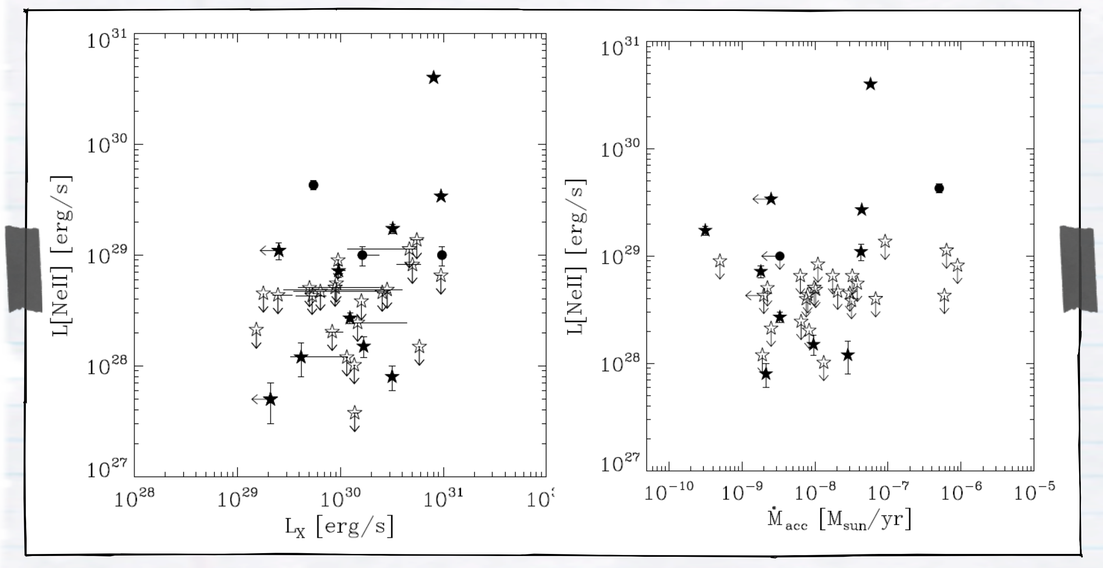
3.- Fe[II]



4.- Correlations tested for the L[NeII] with different star-disk system parameters.



5.- Correlations for the [Ne II] line for Class II objects



correlations

Previous authors have attempted to establish correlations between the luminosity of the emission lines and different stellar and disk parameters (see Pascucci et al. 2007, Flaccomio et al. 2009, Güdel et al 2010).

	H_2	[NE II]	[NE II] CLASS II	[FE II]
M_*	no	no	no	no
L_*	no	no	no	no
L_X	no	no	yes	no
L_{IR}	no	yes	yes	no
M_{acc}	no	no	no	yes
$M_{acc\text{-}high}$		no	yes	
$M_{acc\text{-}low}$		no	yes	
$L_{[OI]}$	no	yes	yes	no
$L_X M_{wind}$		no	no	
$L_{[FeII]}$		no	no	

The table summarizes our results for the correlations tested using survival analysis. In the case of [Ne II] we have created a sub-sample with only Class II sources.

conclusions

We observe a general trend with accretion-related phenomena as the origin of the gas emission lines. Shocks in jets and outflowing material are likely to play a significant role more than shocks in infalling material. The role of X-ray irradiation is present for [Ne II], in particular in Class II sources. The lack of correlation between [Ne II] and [Fe II] points toward different emitting mechanisms. The luminosity of [Fe II] is dependent on the mass accretion rate indicating a link with outflow phenomena. No correlation was found for the H_2 line with any of the tested parameters.

REFERENCES:
Bitner et al. 2008, ApJ 688,1326
Flaccomio et al. 2009, A&A 505, 695
Güdel et al. 2010 arXiv:1006.2848
Lahuis et al. 2007, ApJ 665, 492
Pascucci et al. 2007, ApJ 663, 383
van den Ancker et al. 1999, A&A 348, 877

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