

STELLAR WIND FLOWS IN T TAURI STARS

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ABSTRACT. Following the successful modelling of the wind from RU Lupi using data at moderate and high dispersion we report on similar observations of other T Tauri stars where the general pattern of the wind, as deduced from the widths of the emission lines of the various species, seems to be similar.

T Tauri stars form a class of young (pre-main sequence) variable stars showing strong stellar wind outflows (Kuhi 1964, Penston & Lago 1983) and rather high mass loss rates. One of the most attractive and most completely explored models to provide an explanation for the large proportion of the photospheric energy in these stars being carried by a mechanical rather than a radiative flux invokes driving by hydromagnetic waves (Lago 1979, De Campli 1981, Hartmann et al., 1982). In the extreme T Tauri star RU Lupi, the observational constraints were satisfied by an Alfvén wave driven wind if the (mean) surface magnetic field is ≈ 600 G (Lago 1979, 1982, 1984 and Lago & Penston 1982). The magnetically-driven wind accelerates rapidly reaching its maximum speed very near the stellar surface. Further out and before the flow reaches the escape velocity, the wind decelerates due to gravitational forces.

Being aware that models of "average" T Tauri stars may not be meaningful we are extending Lago's work to several of the brightest T Tauri stars of high emission class. In our spectroscopic observations of RW Aur, DF Tau and V380 Ori a similar pattern to the one found in RU Lupi is suggested but in DI Cep the wind is more solar-like with a continuous acceleration out to the hottest regions (Sá et al., 1986).

In the present paper we report another group of recent observations. The spectra were taken in October 1985 using the 500mm camera of the IDS and IPCS (slit width set to 0.5 arc seconds and dispersion of 17Å mm^{-1}) on the Isaac Newton Telescope at the Observatorio del Roque de los Muchachos on the Island of La Palma. The resolution ($\approx 0.5\text{Å}$) is adequate to study the overall line profiles and, in particular, to measure good values for the line widths. The data were calibrated and sky subtracted using standard SPICA programmes on the Starlink Vax 11/780 at RGO.

The spectra of the stars LkH α 120, LkH α 264 and BP Tau in the blue region are shown in Fig. 1. The spectrum of Lk H α 120 is dominated by FeI and FeII emission lines; no proper identification of HeI can be done above the threshold limit of noise and of resolution. In the Lk H α 264 the absence of strong FeI emission lines is outstanding but the Na D lines and HeI λ 5876 are strongly in emission. BP Tau has no "visible" Fe lines and the outstanding emission lines of the optical spectrum of this star are H, He, SiI, NaID and Ca H and K lines.

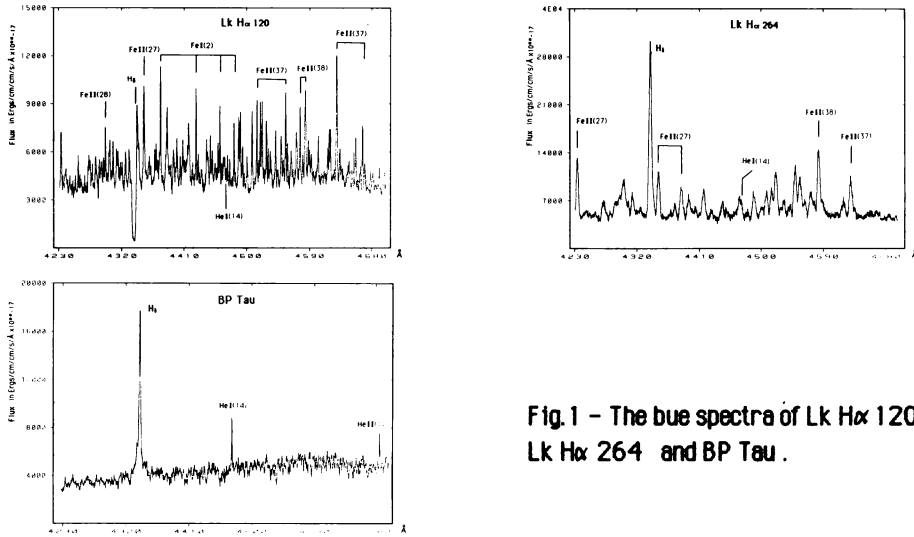
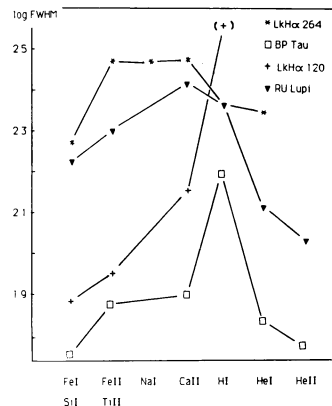


Fig. 1 – The blue spectra of Lk Hx 120, Lk Hx 264 and BP Tau.

For the purpose of this paper the FWHM of the identified emission lines are interpreted as due to a velocity field and the mean widths of each species are used. The data are summarized in Fig. 2.

Fig. 2 – The stars involved are late type stars and we believe that ordering the species by increasing excitation energy of the levels corresponds to an increasing distance from the photosphere. Interpreting the plot as wind velocity against a measure of height above the atmosphere the general trend is similar to the one presented by RU Lupi (shown for comparison): an initial acceleration in the inner chromosphere followed by deceleration in a ballistic zone far from the star.



Although only a very preliminary analysis has been done so far there seems to be some indication of a common behaviour on the runs of the velocity of RU Lupi (the only detailed model so far) and the more recently observed T Tauri stars.

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