A LOW-RESOLUTION SPECTROSCOPIC SURVEY OF POST-T TAURO CANDIDATES

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ABSTRACT We report the results of a spectroscopic survey at low-resolution (≈ 1-2 Å) of Post-T Tauri candidates. The program stars were taken from the list of Lindroos (1986) and consist of late-type secondaries of visual binaries with early-type primaries. The observations were carried out at ESO using different telescopes and instruments. From our data we conclude that only a fraction of Lindroos' stars show evidence of being pre-main sequence objects, while the others are more likely optical pairs.

Keywords: Post-T-Tauri; Lithium Abundances; CaII Emission; PMS Stars

INTRODUCTION

Post-T Tauri (PTT) stars –as defined by Herbig (1978)– are low-mass pre-main sequence stars that are older and more evolved than Classical T-Tauri (CTT) stars. According to Herbig, the number of PTT's should be larger than that of CTT's, since the CTT stage is relatively short and represents only a small fraction of the pre-main sequence lifetime of a low-mass star. However, PTT's do not show the extreme properties of CTT's (e.g. strong Hα emission and infrared excess) and therefore are difficult to detect by conventional optical methods.

X-ray observations of star forming regions (e.g. Walter et al. 1988) have revealed hundreds of strong X-ray sources that are not CTT's. Given their weak Hα emission and lack of IR excess and continuum veiling, they have been termed Weak-lined T-Tauri (WTT) stars or Naked-T Tauri (NTT) stars. Many of these X-ray selected PMS stars, however, appear to be coeval with CTT's, and thus cannot be PTT's in the sense of Herbig.

Gahm et al. (1983) suggested an alternative method for finding PTT stars. This consists of searching for visual binaries with early-type primaries and late-type secondaries. If the binaries are physical and not just optical pairs, their late-type secondaries should still be contracting towards the ZAMS. In this way Lindroos was able to identify 78 systems with likely PTT secondaries.

In order to discriminate between physical and optical pairs we have carried out a spectroscopic survey of these PTT candidates: if the late-type companion is a genuine PMS star it should show signatures of youth, like a strong Li 6708
A absorption line, as well as strong CaII H and K emission lines and a filled-in Hα.

OBSERVATIONS

45 of the 78 binaries in Lindroos' list have secondaries later than F0. In total, we observed 37 of them in the red and 32 of these also in the blue. Two additional stars that were in Gahm et al., but not in Lindroos were also observed.

The observations were carried out at the European Southern Observatory (ESO) at La Silla, Chile, using a variety of telescopes and instruments as shown in Table I. Additional high-resolution observations using larger telescopes are now in progress.

Table I: Summary of Observations.

<table>
<thead>
<tr>
<th>Telescope</th>
<th>Instrument</th>
<th>Range</th>
<th>Res.</th>
<th>lines</th>
<th>Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2m MPI</td>
<td>B&amp;C + CCD</td>
<td>5900 - 6900 Å</td>
<td>1.9 Å</td>
<td>Hα and Li</td>
<td>17</td>
</tr>
<tr>
<td>1.5m ESO</td>
<td>B&amp;C + CCD</td>
<td>5900 - 6900 Å</td>
<td>2.2 Å</td>
<td>Hα and Li</td>
<td>22</td>
</tr>
<tr>
<td>1.5m ESO</td>
<td>B&amp;C + CCD</td>
<td>3800 - 4300 Å</td>
<td>1.0 Å</td>
<td>Ca II H&amp;K</td>
<td>32</td>
</tr>
<tr>
<td>1.4m CAT</td>
<td>CES + CCD</td>
<td>6680 - 6730 Å</td>
<td>0.1 Å</td>
<td>Li</td>
<td>5</td>
</tr>
<tr>
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<td>CES + CCD</td>
<td>6538 - 6588 Å</td>
<td>0.1 Å</td>
<td>Hα</td>
<td>4</td>
</tr>
</tbody>
</table>

RESULTS

The main results emerging from our survey are the following: i) We have detected a very strong Li line in only 13 secondaries (plus one in Gahm et al. but not in Lindroos), and weak Li in 5 additional objects. For the same stars Hα is seen in emission or filled-in in only 6 cases out of 39. ii) We have detected CaII H&K emission, at our resolution, in only 8 of the 32 stars observed in the blue, i.e. in a somewhat larger percentage than for stars showing filled-in Hα profiles. In 3 cases we were not able to establish whether Ca was in emission or not (two of them correspond to stars having a strong Li, while no Li is present in the spectrum of the third object).

We have used a few stars observed at both high and low resolution to determine the accuracy of our determinations of Li equivalent widths. For those stars for which no Li was detected, the derived upper limits are typically ≤ 50mÅ. We have used comparison stars with well-known CaII K fluxes –observed at the same resolution as the stars in our sample– to estimate the chromospheric emission of our stars and/or to puts limits on the detectability of CaII in our spectra. From this analysis we conclude that only a fraction (≤ 40%) of the
late-type secondaries in Lindroos' list are likely to be PMS objects, while the other stars in the sample (≥ 60%) lack both a strong Li absorption and CaII emission.

In Fig. 1 we show an HR diagram of the observed objects. Filled symbols represent stars with CaII H&K in emission and/or strong Li. All of them are very close to the ZAMS, thus confirming the hypothesis that they are genuine PTT's. Other stars from Lindroos which -if physical pairs- would be located well above the ZAMS (open symbols in the figure) do not show any evidence of youth. These are more likely optical pairs.

![HR diagram of the sample objects](image)

**Fig. 1:** HR diagram of the sample objects. Filled circles represent stars with strong Li and strong CaII H & K; filled squares represent stars with strong Li, but no CaII emission; empty squares represent stars with weak Li and weak or absent CaII H & K; empty circles represent stars which lack both Li absorption and CaII emission.

**REFERENCES**


