# Be BINARY SYSTEMS WITH A COOL COMPANION ARE THEY INTERACTING?

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Abstract. High resolution spectrograms of the two well known Be binary systems ζ Tau and KX And were obtained , in the IR ( 2-2.5μ ), with the Fourier Transform Spectrometer of the CFHT. They do not reveal evidence of a cool giant companion.

Some Be stars are currently proposed as interacting binary systems, with a cool companion. We have tried to detect the presumed secondary component ( cool giant ) associated to the well known binary Be stars ζ Tau (HD37202) and KX And (HD218393).

The presumed companions would be a G8 III-II star for ζ Tau (B2-1e)(Harmanec, 1984) and a K1 III-II star for KX And (B3e)(Polidan, 1976). Taking into account the period ,mass functions of these systems, and the presumed spectral types of the secondaries , we have estimated that the two components of the systems would have comparable magnitudes in the IR region 2-2.5μ (K filter). So we observed these stars with the Fourier Transform Spectrometer of the Canada-France-Hawaii 3.60m telescope in August 1985. We obtained several interferograms of both Be stars and comparison stars , with the following characteristics:

- R= 26500 ; S/N= 25 for ζ Tau ( V= 3.03 ; K= 3.01 )
- R= 16400 ; S/N= 20 for KX And ( V= 6.8 ; K= 5.2 )
- R= 42500 ; S/N= 34 for α Lyr ( V= 0.03 ; K= 0.02 )
- R= 16400 ; S/N= 44 for HD202109 ( V= 3.2 ; K= 1.2 )
- R= 26000 ; S/N= 32 " "

α Lyr (A0V) was observed for telluric lines , and HD202109 (G8III) for specific cool giant stellar lines (CO, neutral elements like Na, Si). We observe each Be star near or at their primary minimum of orbital velocity We adopt , for ζ Tau , the new ephemeris given by Harmanec (1984) with P= 132.9735d, and for KX And ,the ephemeris given by Štefl (1985) with P= 38.908d .

After analysis of the spectrum of ζ Tau and KX And , as we can see on the figures , no neutral elements like Fe, Al, Si (cf fig.), Na (cf fig.), Ca or molecular lines like CO (cf fig.), specific of a late type star , are detectable above the noise . This result ,which is a direct test of detection of the presumed secondary component of a binary Be star in the infrared region ,with a high spectral resolution and very good observational conditions , casts a serious doubt about the formation of the Be star envelope from an accretion disk.

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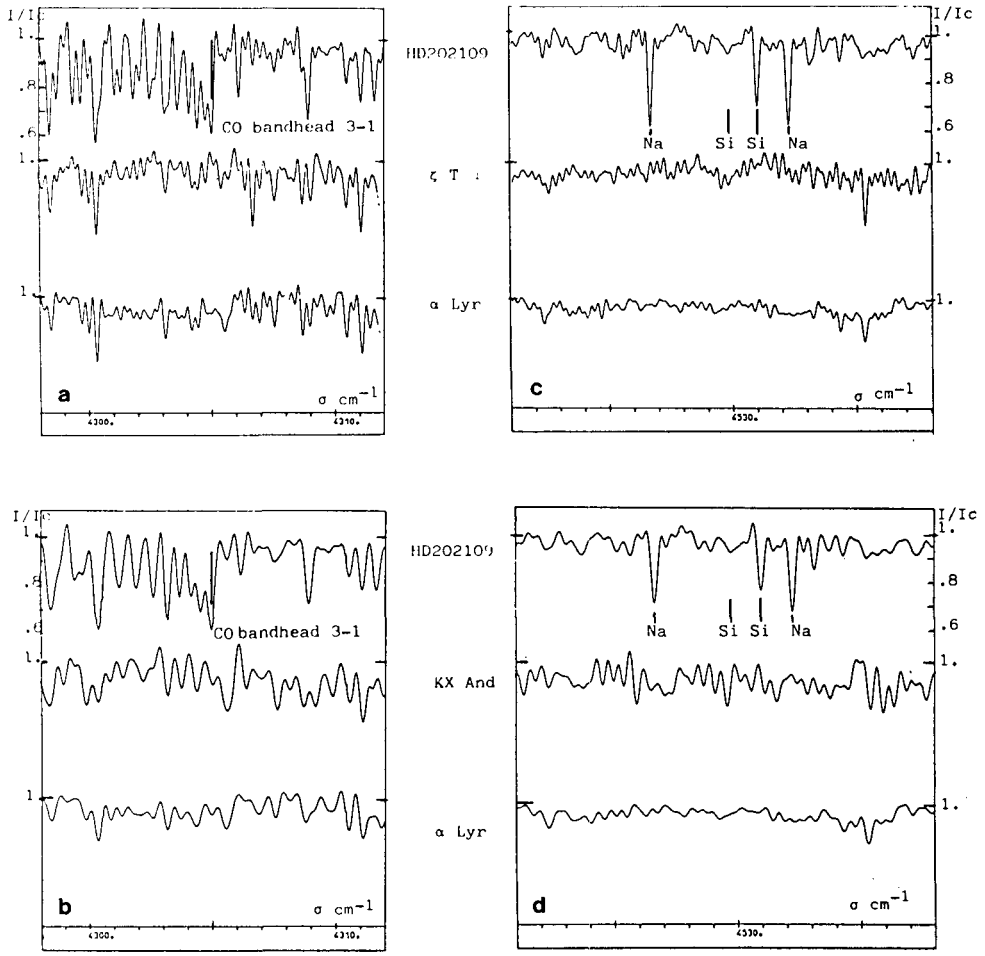
Search of specific cool giant stellar lines: (1) molecular bandhead 3-1 of CO ( $\sigma$ = 4305.21 $cm^{-1}$ ) in the spectrum of $\zeta$ Tau (a) and KX And (b) (2) neutral elements lines of NaI ( $\sigma$ = 4527.02 and 4532.65 $cm^{-1}$ ) and SiI ( $\sigma$ = 4529.40 and 4531.60 $cm^{-1}$ ) in the spectrum of $\zeta$ Tau (c) and KX And (d). All these lines which are well observed in the G8III star are absent in the Be spectra . The interferogram of $\alpha$ Lyr has been degraded to the respective resolutions of $\zeta$ Tau and KX And. Humidity rate was about 12%. The importance of telluric lines in the spectrum of KX And is due to the longer exposure.

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## DISCUSSION FOLLOWING FLOQUET

Polidan:

There is a not well understood phenomenon that is observed in the spectrum of many secondary stars in interacting binaries. The strong absorption lines expected from the late type stellar atmosphere are either quite weak or absent. A good representative case is CX Dra. We clearly see weak lines from the F companion in the red ($\sim$ 6000-7000 Å) but in the near IR ($\sim$ 8500 Å) we find no evidence of the IR Ca II lines. No satisfactory explanation of this phenomenon of normal weak lines and absent strong lines has been produced but filling emission from enhanced active regions and irradiation by the intense radiation field of the B star are likely explanations.

Underhill:

There is a strong free-free infrared excess associated with the H$\alpha$ emission in $\zeta$ Tau. It is possible that the lines you looked for are submerged in the IR excess continuum.

Snow:

Circumstellar molecules such as CO and neutral atoms in a binary system containing a B star might be destroyed by the ultraviolet flux. Therefore, the failure to detect these species may not rule out the presence of a late-type giant.

Smith:

In some cataclysmic variables with faint red components the near infrared spectra show no sign of the red star spectral features, but the red star can still be detected by calculating the correlation function with a suitable comparison star. Did you attempt to correlate your spectrum with your G8 III companion star?

Floquet:

No, we did not.

Harmanec:

I would consider it very important to repeat your observations in those wavelength regions where Polidan saw the secondary lines for KX And, and Malanuschenks and Scherbakov for $\zeta$ Tau.

Floquet:

Unfortunately, for KX And there are no published data of R/V of secondary lines observed by Polidan, and we have some doubt about the detection of the companion of $\zeta$ Tau by Malanuschenks and Scherbakov because of the low dispersion used (4.8 Å/mm) and the very unprecise identification of the presumed secondary line. But we plan to repeat these observations in the near IR and between 2 and 2.5 $\mu$.

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