

## OBSERVATIONS OF LATE-TYPE STARS WITH 'HOT' COMPANIONS

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## ABSTRACT

IUE and ANS observations of the 'hot' companions of  $\alpha$  Ceti,  $\epsilon$  Aur, and  $\pi$  Pup are briefly discussed. Observations of HD 62001, the central star of the nebula VV 1-7 are also reported. The nebula VV 1-7 which is present on the Palomar blue print is not present on the ESO blue prints.

Hot Companions, Late-Type Stars, IUE, UV.

## I. INTRODUCTION

Late-type stars radiate very little energy in the ultraviolet. If they have any companions which are hotter but less luminous, then such companions become relatively more conspicuous in the ultraviolet. We (Gilra and Wesselius 1980, ref. 1) have observed more than two dozen late-type stars with hot companions in UV with ANS. In about half of these cases the spectral types of the companions were known from ground-based observations and our UV observations confirm these. In about one fourth of the cases we have determined the spectral types and luminosity classes of the companions from the UV observations; from ground-based observations they were known only as single-lined spectroscopic binaries and/or unresolved astrometric binaries. In the remaining we have discovered hitherto unknown 'hot' companions.

Out of all these binaries the three most outstanding binaries were proposed for observations with the IUE:  $\alpha$  Ceti,  $\epsilon$  Aur, and  $\pi$  Pup. A fourth - HD 62001 - was added to this group since ANS observations (Gilra et al. 1978, ref. 2) revealed photometric variability and a hotter companion was suspected. Brief summary of the observations is given below, details will be published elsewhere.

## II. OBSERVATIONS

1.  $\alpha$  Ceti - The ANS ultraviolet observations showed the "blue" companion to have the most unusual photometric properties of all the stars observed with ANS. The IUE observations have resolved the mystery (Cassatella et al. 1980, ref. 3) and a model will be presented elsewhere.

2.  $\epsilon$  Aur - The ANS observations indicated that at 1550 Å and 1800 Å there was an excess which we attributed to the previously very enigmatic companion. The companion was identified as an A3 Ib star. The IUE observations support this conclusion. However, in the short-wavelength IUE observations the question of the grating scattered light makes analysis of shorter wavelength observations ( $\lambda < 1400$  Å) very difficult. Compared to the ANS observations, the IUE observations show much higher level of radiation. If the instrumental scattering problem in the IUE is not responsible for this increased brightness then one has to conclude that either the companion is a variable, or, during the ANS observations the system was passing through the secondary eclipse. If it was indeed the secondary eclipse then the orbital eccentricity turns out to be about 0.4. In the meantime Hack and Selvelli (ref. 4) have published their IUE observations. Their conclusion that the companion is a B star is not supported by the IUE data - neither on spectroscopic grounds nor on photometric grounds.

3.  $\pi$  Pup - This is one of the cases in which a hitherto unknown hot companion was discovered (ref. 1). The IUE observations have confirmed the ANS discovery. The companion is B2-B3 with total luminosity of about 5  $L_{\odot}$  and  $M_V \approx +4.5$ . The high-resolution IUE observations show asymmetric absorption lines. The resonance lines have a central emission component. The matter coming from the primary (K4 III) has formed a ring/disc around the subluminescent star. The radial velocity of the primary star does not vary. This fact combined with the high-resolution IUE observations suggests that the orbit is probably in the plane of the sky.

4. HD 62001 - The ANS observations (ref. 2) showed that this "central star" of the nebula VV 1-7 was a UV variable. It appeared that there might be a hotter companion with this A0-A1 V star. The IUE observations do not show the existence of a hotter star. However, CII, MgII lines show P Cygni profiles suggesting mass transfer. The ground-based observations show photometric and radial velocity variations

bility. A comparison of the ESO blue prints with the Palomar blue prints shows that the nebula VV 1-7 is not visible on the ESO prints which have a higher sensitivity. A nova-like outburst was probably responsible for the shell and it has faded in 25 years. Details will be reported elsewhere by Rao and Gilra.

### III. CONCLUSION

IUE observations (which were motivated by ANS observations) have provided valuable information on the companions of  $\alpha$  Ceti,  $\epsilon$  Aur, and  $\pi$  Pup. In all these cases and HD 62001 the processes of mass loss, mass transfer, and evolutionary effects can be investigated in detail.

### IV. REFERENCES

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