IUE OBSERVATIONS OF SYMBIOTIC STARS

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ABSTRACT

The IUE observations suggest that the symbiotic stars can be placed in two broad groups. One of the groups is characterized by strong, narrow emissions arising from a wide range of excitation energies, while the other one typically shows a strong continuum with absorption lines and very few or no emissions at all. Both broad groups appear to suggest that we are dealing with binary systems and that they probably differ in the characteristics and extent of the chromosphere-corona formation that is present in the system.

Twenty stars that are listed among the symbiotic stars were observed with the IUE in December, 1978/January, 1979 and in July, 1979, mostly in the low dispersion arrangement, except for 17 Leporis and AX Monocerotis, which were also observed with high dispersion.

The aim of the program was to ascertain:

1) whether or not the belief that all symbiotic stars are binaries is sustained by the UV observations;

2) whether or not the behavior of the whole group is similar in the UV;

3) whether or not there were any detectable changes in the UV spectra between the two observing epochs.

The stars that were observed are:

R Aquarii [1]
Z Andromedae [1]
T Coronae Borealis* [1]
BF Cygni# [1]
CH Cygni [2]
CI Cygni# [1]
V1016 Cygni# [1]
WY Geminorum# [2]
RW Hydrae [1]
17 Leporis* [2]
AX Monocerotis*# [2]
BX Monocerotis# [2]
RS Ophiuchi# [2]
AR Pavonis*# [1]
AG Pegasi* [1]
AX Persei [1]
RX Puppis# [1]
RR Telescopii# [1]
WY Velorum [2]
HD 4174 [1]

The five objects definitely known to be binaries are indicated on the list with an asterisk, while the symbol # stands for observations made only on one of the two epochs.

The examination of the UV spectra of the twenty stars disclosed that they can be placed in two broad groups. The first group is characterized by the presence of numerous narrow emission lines that arise from a wide range of excitation energies, from 6000°K (Mg II) to 10^5 °K (N V). The strong emissions in the short wavelength range are of resonance and intercombination lines and of transitions that correspond to higher excitation, like He II 1640. The lines normally present are

C III]	1909
Si III	1892
N III]	1749
O III]	1666
He II	1640
C IV	1548, 1551
N IV]	1486
Si IV	1394, 1403
C II	1335
N V	1239, 1243

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but, of course, the relative intensities are not the same on all the stars that we would place in our first group.

The SWP images were secured with exposure times short enough so that the emission lines would not become saturated. Therefore, our material in the short wavelength mode is not suitable for the detection of a hot continuum, if present; however, such a continuum is clearly visible in the case of AR Pav.

In the IUE long-wavelength range, the group normally displays strong Mg II in emission; however, in the case of AG Peg, no Mg II is observed on our images. The Mg II resonance doublet appears to be variable in Z And and in WY Vel, and, in the context of this fact, we should mention here that in the spectroscopic binary μ^1 Scorpii Sahade and van der Hucht (ref. 1) found that Mg II is also strongly variable and concluded that the variation may perhaps be correlated with variations in Balmer emission.

The second <u>broad</u> group shows typically no emissions except of Mg II in WY Vel and in CH Cyg, and of O I 1303 in CH Cyg. The images secured for the stars in this group show a continuum spectrum which does not correspond to a late type star. In the cases of WY Vel and WY Gem the resonance lines that are present in emission in the first group, appear in absorption, reminding us of the behavior of Be stars in the ultraviolet.

If we consider the first <u>broad</u> group, we can conclude that

1) the resonance lines must be formed in a region of low density where collisional excitation is at work and is characterized by a large range in excitation temperatures; this suggests that the objects have some sort of a chromosphere-corona formation that may perhaps be linked to the late-type star;

2) although our SWP material, except in the case of AR Pav, does not show evidence for an early-type continuum, the presence of high-excitation lines, like He II 1640, and the presence of a continuum on the LWR images point towards the existence of a hot source and, thus, support the hypothesis that we are dealing with binary systems.

The behavior of our second group appears to support the same conclusion and, therefore, the validity of the binary hypothesis for the symbiotic stars is generally valid for our large sample. The difference in spectral behavior in the two groups should then be related to the characteristics and extent of the chromosphere-corona formation.

On the list of the observed objects which is given ut supra, we have indicated with number "1" those that belong in our group 1, and with number "2" those that belong in our group 2.

No correlation is possible to establish between what we have learned from the IUE material and what we know about the symbiotic stars from investigations made in other wavelengths. Only simultaneous photometric and spectral observations in a wide range of wavelengths, taken at appropriate times, could help us understand whether or not the two broad groups are actually related to the phase in the nova-like behavior, and, therefore, to arrive to a more definite picture of the structure -and evolution- of the extended envelopes in the symbiotic stars. The whole thing may even have a bearing on Linsky and Haisch's (ref. 2) finding of solar and non-solar type stars.

The analysis of the low-dispersion spectra will be published in detail elsewhere, and the results from the high dispersion material will form a subsequent paper.

REFERENCES

1. Sahade, J. and van der Hucht, K.A.: Ultraviolet Observations of β Persei, μ^1 Scorpii and γ_2 Velorum. Astrophysics and Space Science, in press, 1980.
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