INTRODUCTORY REPORT ON SYMBIOTIC STARS

A. A. Boyarchuk
Crimean Astrophysical Observatory
U.S.S.R. Academy of Science

The term "Symbiotic Star" was first introduced by P.W. Merrill (1958) and now is used for designation of astronomical objects, whose spectra represent a combination of absorption features of a low temperature star with emission lines of high excitation. At first the group of these objects contained four stars: Z And, BF Cyg, CI Cyg and AX Per (Merrill 1933). Many symbiotic stars were discovered as results of different sky surveys in the last decade. The infrared observations have confermed the presence of a cool component in many emission line objects even if the visual observations do not give evidence for the latter. In the catalogue published by Boyarchuk in 1969 the number of symbiotic stars was 21 as well as 16 probable ones. Recently, Allen (1979) has published a catalogue containing more than 100 objects with complex spectra.

More than ten reviews of Symbiotic Stars were published. The problmes of symbiotic stars were discussed during several colloquia. All of this means that symbiotic stars are important objects of astronomical investigations. Many reports on different problems of Symbiotic Stars will be made at this Colloquium, and I should like to point out only a few aspects, which are rather new and I suppose are important for the understanding of Symbiotic Stars.

New observations give more support for a binary hypothesis of the nature of Symbiotic Stars. Here one should note that infrared observations have shown the presence of cool components in many cases. The observation of several stars in the spectral region 1200-3200 A, which were carried out with IUE, shows that hot components of Symbiotic Stars have a temperature of more than 40000°K.
It was known that many Symbiotic Stars show periodic variations of radial velocities. Recently, eclipses were discovered for at least two stars: AR Pav (Mayall 1937) and CI Cyg (Belyakina 1976).

M. Friedjung and R. Viotti (eds.), The Nature of Symbiotic Stars, 11–14.

Of course the direct or indirect evidence of binary nature cannot be given by us for each Symbiotic Star. They need more careful observation.

The IUE observations give more information on the nebula. The semi-forbidden lines give a possibility to determine the physical conditions in the dense parts of the nebula. The electron density varies from 10^{11} to 10^6 cm^{-3} and at the same time the temperature varies from 40000°K to 15000°K. The spectral index of the radio emission means that the density of the nebula varies as r^{-2}. All of this means that the nebulae of Symbiotic Stars are very inhomogeneous.

Some progress has been made in the theory. The accretion in the binary system has been investigated. Bath (1977) considered accretion-heated white dwarfs or main sequence stars. In these cases a mass transfer of 10^{-3} to 10^{-6} $M_{\odot}yr^{-1}$ is needed in order to explain the light curves. Tutukov and Yungelson (1976) and Paczynski and Rudak (1980) have studied the model of a binary consisting of a red giant and of an accreting hot degenerate CO-dwarf. In this case nuclear reactions are the main source of the energy. A mass transfer of 10^{-7} $M_{\odot}yr^{-1}$ is needed for an explanation of light curves of Symbiotic Stars. In both cases the high temperature must be deep in an accretion disk. The observations of soft X-ray radiation seem to confirm this. The temperature of the X-ray radiation is of the order of a few hundred thousand degrees.
Unfortunately single star models of Symbiotic Stars have not been investigated enough. Especially the relative intensities of emission lines and absorption features have not been considered in any single star model.

Thus Symbiotic Stars are very complicated objects where different physical processes exist. The explanation of the nature of Symbiotic Stars will help us to understand the nature of other types of non-stable stars. I hope that this Colloquium will be important for the investigation of Symbiotic Stars.

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DISCUSSION FOLLOWING BOYARCHUK

Hack: I have a question about the stars for which you have presented a binary model. What is the evidence for binarity? Are orbital radial velocity curves available? Or is there good evidence of eclipses? How reliable is the observational evidence for binarity?

Boyarchuk: The orbital radial velocity curves were published for BF Cyg, RW Hya, AG Peg and R Aqr. The light curve of CI Cyg shows eclipses. The energy distribution over wide spectral regions for BF Cyg, CI Cyg, AG Peg, Z And and AG Dra also gives arguments in favour of the binarity of these stars.

Friedjung: Though I believe that symbiotic stars are binary, there is a major problem in the interpretation of the radial velocity variations of some of them. A few cases agree very well with a binary conception, but others are harder to interpret in this framework.

Nussbaumer: You gave radial velocities for some symbiotic stars. There seemed to be more or less periodic changes when lines of NIII and HeII were measured, whereas the radial velocities appeared rather constant in the FeII lines. Have you further comments on these differences?

Boyarchuk: I believe that the FeII lines are formed in the outer parts of the cool giant's atmosphere, and therefore the displacements represent the cool component's motion. If the cool component is a normal red giant, its mass is equal to 3-5 $M_{\odot}$. In this case we shall expect orbital velocities of less than 10 km s^{-1}, for typical periods of about two years. It is necessary to have very accurate measurements of radial velocities in order to obtain a conclusion about the periodic variation in the case of FeII lines.

Slovak: Recent VLA observations at 6 cm by Ghigo and Cohen (1981, Ap.J. 245, 998) resolved an asymmetric nebula around AG Peg of size 0.2-0.3 arcsec. This size is 2-3 times larger than predicted by a spherically symmetric single component wind model (Wright and Barlow 1975, M.N. 170, 41) and indicates the complexity of the wind(s) interacting in the system.

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Viotti: Let me express a number of "desiderata". I believe that important points necessary for understanding the nature of the symbiotic stars are:

(1) the luminosity classification of the cool spectrum component,
(2) the radii of the M I-II-III ... stars,
(3) radial velocity measurements for long time scales (i.e. many 'periods'),
(4) search for "regular" variability of the cool spectral component, expecially near the energy maximum (~ 1 μ),
(5) what is the meaning of the radial velocity curves derived from the emission lines? do they reflect an orbital motion or something else?

McCarthy: I have a comment on item 4 of your list of desiderata. I agree that this field is most important for future photometric and spectroscopic studies. I wish to recall that J. Stebbins and G. Kron stated that in their experience all M giants showed variations of at least 0.1 or 0.2 magnitudes, and that we must suppose M stars to be variable until proven not variable.

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