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RX Cam IS A SPECTROSCOPIC-BINARY CEPHEID

The bright Cepheid variable RX Cam (HD 25361 = BD+58°694) turned out to have a blue companion with the help of IUE spectra quite recently (Evans, 1992). Prior to this discovery the only piece of information on its duplicity was given by the O−C diagram of this Cepheid (Szabados, 1980), for the O−C residuals show a wave-like pattern, as if RX Cam were a component in a long–period binary system (see Figure 1).

Unfortunately this bright Cepheid had long been a neglected object from spectroscopic point of view. In addition to Joy's (1937) classical radial velocity study, only one more series of v_{rad} data (Barnes et al., 1988) had been available before the major radial velocity survey carried out quite recently by Gorynya et al. (1992). Since RX Cam had never been suspected to belong to a spectroscopic binary, the authors of this latter paper did not compare their new data with the earlier ones. As a matter of fact, a simple comparison indicates variability in the γ-velocity of RX Cam, and a closer look at the previously published data also refers to the spectroscopic-binary nature of this Cepheid.

Figure 2 shows all radial velocity data plotted against the phase of the pulsational period. The value of this period (7.912024 days) was taken from Szabados (1980), zero phase was arbitrarily chosen at J.D. 2,440,000. The O−C diagram constructed for RX Cam indicates that there is no phase shift between the older-epoch and the more recent radial velocity data. Thus assuming a constant period gives a correctly phased radial velocity curve. Nevertheless, the scatter is very wide in Figure 2 indicating that the mean radial velocity averaged for one pulsational cycle shows temporal variation. Presumably, this is due to the orbital motion of the Cepheid component in a binary system.

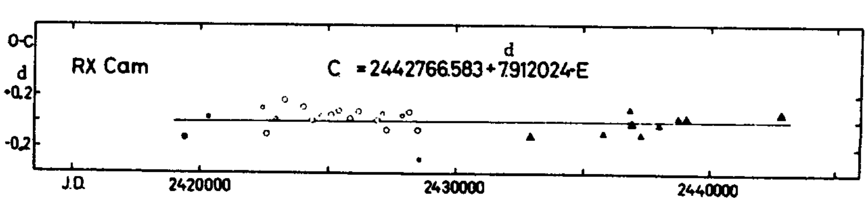

Figure 1. The O−C diagram of RX Cam taken from Szabados (1980).

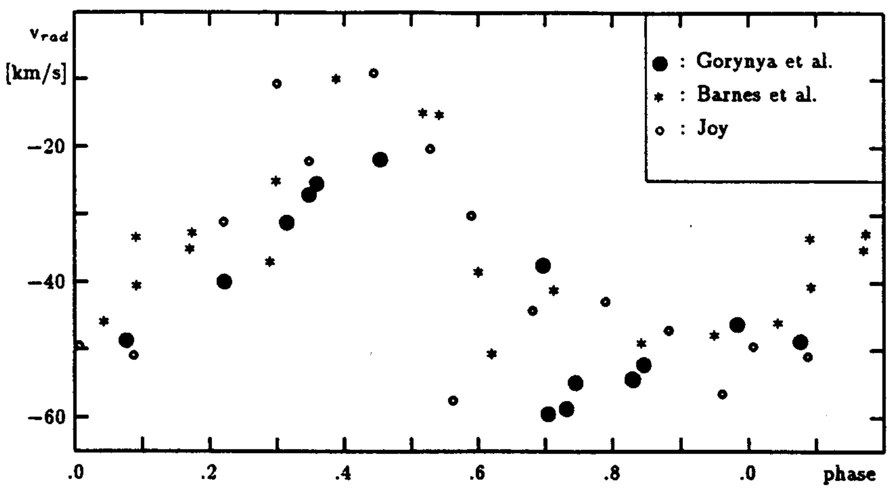

Figure 2. The phase diagram for the radial velocity data of RX Cam based on the whole sample.

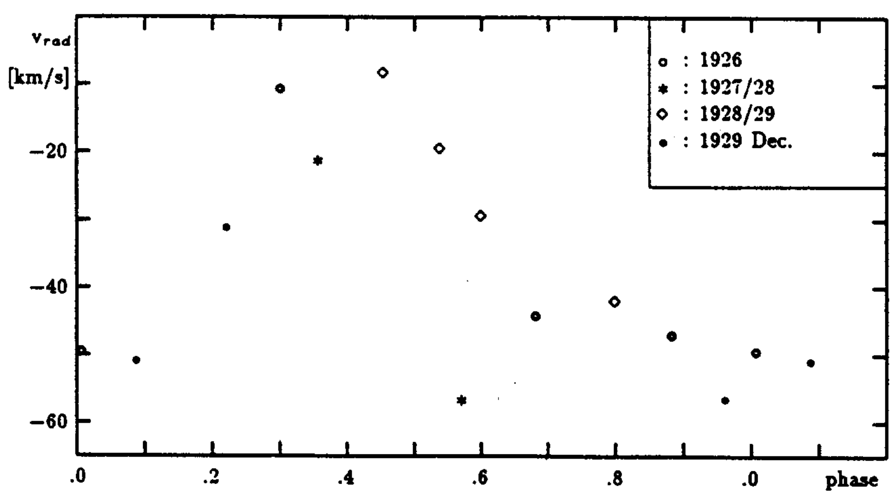

Figure 3. The phase diagram of Joy's (1937) radial velocity data separated into four groups.

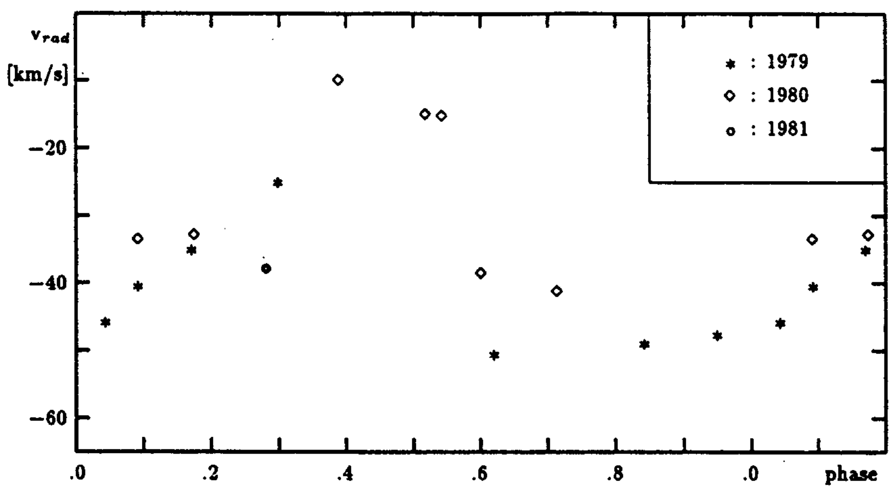

Figure 4. The phase diagram of the radial velocity data obtained by Barnes et al. (1988) separated into three groups.

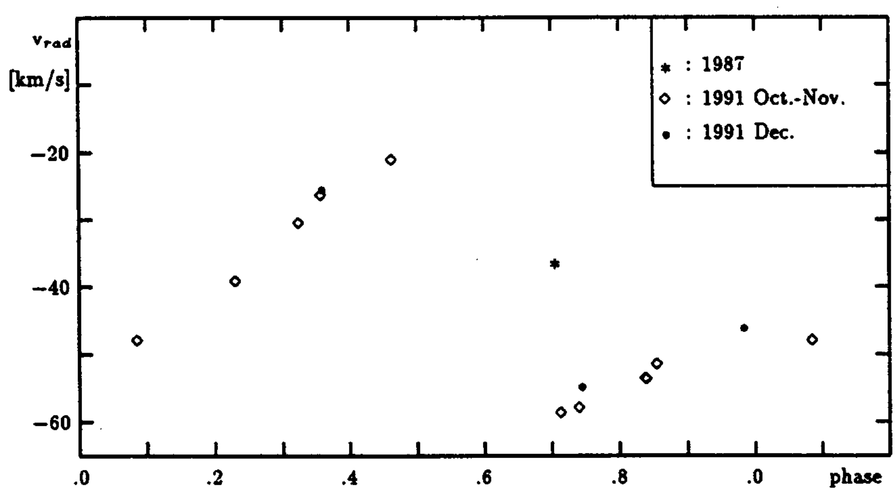

Figure 5. The phase diagram of the radial velocity data obtained by Gorynya et al. (1992) separated into three groups.

A closer look at the individual observational series also gives evidence for variable γ-velocity in each case. Joy's (1937) data were obtained in four consecutive observational seasons, and the radial velocities obtained during the second and the fourth runs are systematically more negative than the data obtained in the other two years. This is clearly seen in Figure 3. Barnes et al. (1988) observed RX Cam in three consecutive years. Their data plotted in Figure 4 clearly indicate that the γ-velocity was largest in 1980, while the single point obtained in 1981 is shifted to an even smaller value of γ-velocity than the 1979 data. Finally, Figure 5 shows the high-precision radial velocity data published recently by Gorynya et al. (1992). The single point obtained in 1987 deviates strongly from the bulk of data. Although the observers made a remark on this anomaly, commenting that the star might have been misidentified, in my opinion it is more probable that this shift also reflects the orbital motion. Moreover, the variation in the γ-velocity can be detected even during a single season: the data obtained in December 1991 are less negative than those observed in October – November 1991.

Rapidity of the change in the γ-velocity can also be suspected on the basis of the data obtained by Barnes et al. (1988). The first point measured in both 1979 and 1980 seasons deviates toward more negative values. These points (near phase 0.6 in Figure 4) are separated in time by more than one month from the other observations carried out in the respective years.

Various methods of period analysis applied to the whole sample (i.e. data plotted in Figure 2) failed to give a reliable single value for the orbital period. For the time being it can only be stated that the total variation in the γ-velocity exceeds 20 km/s and the orbital period is rather short for a binary system containing a classical Cepheid component. It is worthy of note that at present the shortest value of the reliably determined orbital periods for classical Cepheids just exceeds 500 days (S Mus – Evans, 1990). In view of the rapid variations detected in RX Cam, this Cepheid is a promising candidate to be an even closer system. As a consequence, the wave-like pattern in the O−C diagram cannot be explained with the recently discovered spectroscopic-binary nature and, the light-time effect caused by such a short orbital period cannot be pointed out from the photometric observations of typical accuracy. In order to make a more complete description of the system containing RX Cam, further spectroscopic and photometric data are extremely necessary.

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