PHOTOMETRIC OBSERVATIONS OF THE R AQUARII SYSTEM

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ABSTRACT. Photometric BVRIJHK observations of the symbiotic star R Aqr are presented. The data were obtained at Byurakan Station of the St.Petersburg University Astronomical Observatory during the interval 1971–1991, using AFM–6 photometer (C–8 type photocatode) at the 48 cm telescope (BV), the IKAF–1 photometer (S1 type photocatode) at the 48 cm and 62 cm telescopes (RI), IKAF–2 PlS photometer at the 62 cm telescope (JHK). The photometry was made and reduced to Johnson system in the usual manner for broad–band photometry. The main part of the data were obtained in red and near infrared, and my report will concern the cold component.

Key words: R Aqr – long–period variables – symbiotic binaries

The primary [cold] component of the R Aqr system is LPV with a period of 387 days, a spectral type of M3e – M8.5e + pec and amplitude of variations between V(max) of 5.8 mag and V(min) of 12.4 mag (Kholopov et al. 1985). The double star is surrounded by an extended emission nebula with a diameter of outer ring of about 2'. Most of the nebula is concentrated into an inner core about 30" across.

The stellar spectrum shows a variable blue component (a secondary), which presumably is linked with the ionization nebula. The hot component is probably a white dwarf or a subdwarf.

The orbital period of the system is not known exactly. It appears to be greater than 20 years: 27 (Merrill 1950) or 44 years (Wallerstein 1984). This is supported by our polarimetric data as well. The distance to the object is 260 pc, and the interstellar extinction is small E(B–V)=0.03 (Eggen 1970).

The hot component was not photometrically active during the period of the observations. The light curve of R Aqr shows two kinds of the brightness changes: variations of the cold component brightness and much more slow variations of the average brightness. We have separated these changes and obtained the mean light curve for RIJHK bands. Unfortunately, we have not enough data to do that in BV.

We have found the ephemeris for Mira variations:

$$\mathrm{JD}_{min} I = 2442454 + 384.4 \cdot E \qquad (1)$$

In red and near infrared, R Aqr satisfies to all the criteria for normal LPV:

- shape and phase of light curve,
- wavelength dependence of amplitude,
- time of maximum light is progressively
- delayed with increasing wavelength, and
- the star's position in the near infrared two–color diagrams.

The depression of the Mira maximum can be interpreted as a result of the eclipse of the cool component by an extended disk or cloud around secondary (Willson et al. 1981). The total duration of the eclipse is 7–8 cycles of Mira. There appears to be no plateau in the minimum. In visual region the brightness of the star falls down to B=V=13.2 mag which corresponds to the hot sources' (nebula+hot secondary component) intensity level. A loss of light in a central phase of the eclipse is 2.8, 2.8, 2.1, 1.9, 1.6 mag in R, I, J, H, K bands, respectively. The eclipsing object must be a large, non–luminous body. But at present we cannot definitely say what it is.

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BM ORI: SEARCH FOR SECONDARY SPECTRAL LINES

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ABSTRACT. The search for the secondary spectral lines was made by using special high signal/noise ratio emulsion A700u. The four spectra (two near elongations and two near conjunctions) were obtained with 6-m telescope (BTA), dispersion is 26 Å/mm. We searched the weak lines and made the next conclusions. The following splitted stellar lines are seen: O II 4699, Mg II 4481, Si IV 4116, N II 5747, N II 5001, N II 5747 and others. The contours of these lines are complex: each have absorption contour, emission core and an Orion nebulae emission line. It made difficult the line recognition. Also are seen the splitted circumstellar lines Na I 5890 and 5896 with the same radial velocities as stellar lines. If that fact is real the next parameters of the system may be derived: K_1 = 156 km/s, K_2 = 232 km/s, so the mass ratio M_1/M_2 = 1.5 and M_1 = 24, M_2 = 15 $M_{\odot}$; radii of the primary and secondary are 4 and 13 $R_{\odot}$. The errors may be about 10%. Both stars are of B2 spectral type, both are surrounded by gas/dust envelopes but the secondary has more opaque dust envelope and that produces the reddening about 0.3 optical thickness greater then for the primary. That is the reason of the different minima depth for the different spectral regions. All results are preliminary and are to be confirmed.

Key words: Stars: Binary: Eclipsing.