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A HIGH RESOLUTION SPECTROSCOPIC STUDY OF THE INTERACTING BINARY R ARAE

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We analize a series of high-resolution optical spectroscopic observations of the eclipsing binary R Arae obtained at CTIO, Chile that cover more than an orbital cycle. The spectra show both absorption and emission features that follow the movement of the brighter component of the system and display changes throughout the cycle of light variations. We study the behavior of the stronger features with the purpose of shading light on the phenomena that are taking place in the circumstellar material.

R Arae is an eclipsing binary with a spectrum classified as of B9 Vp type, and an orbital period of P = 4.42509 days that increases with time, and, as a consequence, suggessting mass loss. It is probably similar to the strong interacting system β Lyrae. The main differences in the spectroscopic behavior between both systems may be related to differences in the relative dimensions of both objects.

Sahade (1952), who first study the object spectroscopically, reported that, in the photographic region, the spectral lines undergo important changes in appearance, sometimes even looking like shell lines. In the photographic region, as well as in the red region of the spectrum, the line profiles suggest the presence of a line, probably of stellar origin, upon which a narrower and stronger core is superimposed.

The spectrographic material on which we are basing our present study of R Arae was secured in Chile, at the Cerro Tololo Interamerican Observatory, by Barbá & Sahade in 1991, during six nights, from june 26 to july 1, 1991. The material was obtained with the fiber-fed bench-mounted CCD echelle spectrograph at the 1.52 m telescope and cover the spectral region 5500–7000 Å. A TEK 1024 CCD was used and the spectral resolution was 27000. The observations cover more than one orbital cycle of R Arae.

R Arae displays complex spectra that result from the fact that the spectral lines that are supposed to be of stellar origin are badly blended with strong, narrower and deeper lines arising from a gaseous envelope. Thus, the measurements of the supposedely stellar features require the reconstruction of a broader profile, a task that, at some phases, it is imposible, and generally, very difficult to carry out.

With the 1991 Cerro Tololo material we have produced tracings of three strong features that show on the covered spectral region, namely, those of the He I 5876, Hα and Si II 6347 Å, and we note that: **(a)** Hα displays a red emission border in the phase interval 0.584–0.634P and at phases 0.109P and 0.114P, and a blue emission border in the phase interval 0.032P–0.072P. **(b)** The Hα feature is extremely faint in the phases intervals: 0.659–0.884P and 0.360P–0.371P. **(c)** He I 5876 displays a blue emission border 0.032–0.072P similar to what is seen in Hα. **(d)** In the phase interval 0.943–0.169P, He I 5876 and Hα profiles display a strong narrow feature which is absent in Si II 6347 line. We also notice in this phase interval the presence of some broad weak lines that may be of stellar nature. **(e)** In the phase interval 0.807–0.114 P, the spectra show a rather broad absorption that is blue-displaced relative to the shell feature. As for the Si II 6347 line, the blue shifted absorption is rather faint and is noticeable, on our material, only at phase 0.807 P. **(f)** The profiles are definitively composite in the phase intervals 0.159–0.169P and 0.360-0.884P. **(g)** The feature that suggests the existence of a shell shows throughout the orbital period indicating that the gaseous envelope is present all around the system and, consequently, that the two stellar components are inmersed in it.

In summary, the spectroscopic system of R Arae appears to be formed by a B9 primary component and a smaller late type secondary, surrounded by a semitransparent envelope that may be somewhat thicker at about the phases that correspond to primary minimum. The stellar lines are badly blended with the lines that originate in the envelope, making it very difficult to try to measure their position for the determination of reliable orbital elements.

REFERENCES

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