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THE Mg II LIGHT CURVE OF AR Lac

AR Lac (HD 210 334) is one of the most important binary systems of the RS CVn type. Numerous observations have been performed in the ultraviolet wavelength (1100 Å - 3200 Å) by the IUE satellite. Presently we are working on the long wavelength images of AR Lac released from the IUE archive. Preliminary results of a limited number of observations have been reported previously (Kiziloglu, 1983). We want to thank all astronomers who made the observations and also the IUE project team who made the archive data available to us. In this work, 23 high resolution and 16 low resolution long wavelength (2000 Å - 3000 Å) images are used. The images cover the observation period of about five years between 1979 and 1984.

In Figure 1b, variation of fluxes obtained from the Mg II h+k resonance lines as a function of the orbital phase is shown. During the calculation of the fluxes, the main problem was the systematic difference of the flux values between the high and low resolution spectra. To our knowledge, no clear calibration analysis has been given in the literature for this discrepancy. To remove this systematic difference, all the high resolution Mg II spectra were degraded using the 8 Å Gaussian instrumental profile. The Mg II fluxes calculated from the degraded spectra are then compared to the fluxes calculated from the low resolution Mg II fluxes. For this comparison, images with the observation times close to each other are considered only to avoid a possible time variability of the activity. This process indicated that the low resolution fluxes were smaller than the high resolution Mg II h+k fluxes by a factor of 1.6 . Thus all the low resolution fluxes multiplied by this correction factor are plotted accordingly in Figure 1b.

A close inspection of the figure after this correction reveals the following:

i) The depths of the eclipse features of the Mg II light curve at the phases 0.0 and 0.5 are almost the same. The flux values at mid eclipses are about 70 % of that at the quadratures. This suggests that the Mg II emission from both components is the same for unit area on their surfaces.

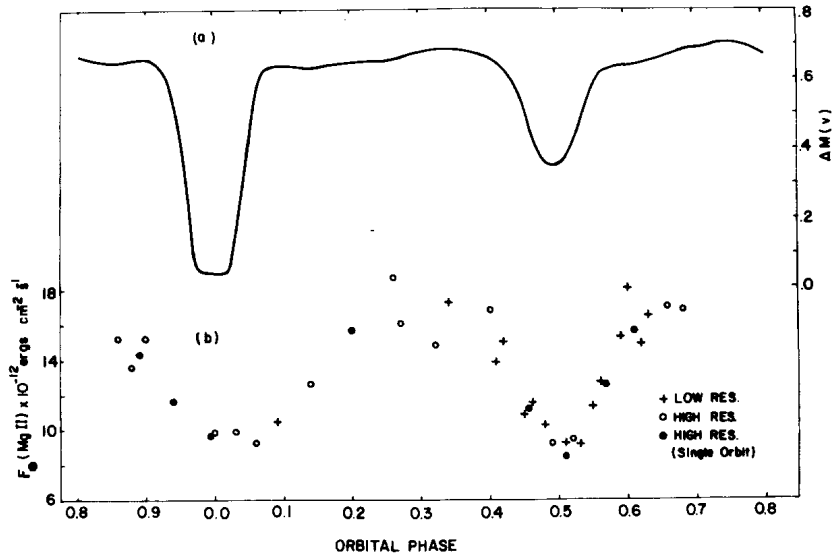

Figure 1. (a) Visual light curve of AR Lac (Ertan et al., 1982); (b) The Mg II h+k light curve of AR Lac between 1979 and 1984. Filled circles represent flux values observed in a single orbit (5-7 October 1983). Phases were calculated using Min I = J.D.Hel.2443672.0917 + $1^{d}.98318235$ E.

ii) Eclipse features do not show large flux variations globally during the observation period of about 5 years indicating the presence of quite stable chromospheres of both components.

iii) The eclipse profile is highly symmetrical at the phase 0.5 whereas asymmetry is observed at the phase 0.0 . The fluxes are scattered around the latter phase. A noticeable variation is also observed at the quadratures. The reason for this variation can be the change of the chromospheric activity within the five years of observations or short time scale activities during the observations. In the case of asymmetry several suggestions can be made; however, the small number of the observations prevents further comments.

iv) Comparing the V light curve (Figure 1a, Ertan et al., 1982) and the Mg II h+k light curve (Figure 1b) we notice that the eclipse durations are longer for the Mg II light curve. This points out that each companion has an extended chromosphere. Assuming that only the photosphere of one component can eclipse the chromosphere of the other, thicknesses of the chromospheres can be estimated geometrically. Results of such an analysis including all

observational points show that the chromospheric radii of the G and K stars of the AR Lac are 4.2 ± 1.0 and 5.7 ± 1.1 $R_\odot$ respectively. The photospheric radii for the G and K stars are 1.54 and 2.81 $R_\odot$ respectively (Chambliss, 1976). On the other hand, if the same procedure is applied to the points observed on a single orbit (day 278 in 1983, filled circles), 3.2 ± 0.4 and 4.6 ± 0.3 $R_\odot$ are obtained as the chromospheric radii for the G and K stars respectively. These values show that the chromospheres possibly extend to the first Lagrange point of the binary system. The above values agree with the values given by Naftilan and Drake (1977) but disagree with those given by Walter et al. (1983). Since the radii of the chromospheres of the binary components of the AR Lac calculated in this work are based on the observational fluxes within the accuracy of the IUE satellite, these values should be considered more reliable.

Detailed results will be published elsewhere.

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References:

Chambliss, C.R., 1976, Publ. Astron. Soc. Pacific, 88, 762.
Ertan, A.Y., Tümer, O., Tunca, Z., Ibanoglu, C., Kurutac, M., and Evren, S., 1982, Astrophys. Space Sci., 87, 255.
Kiziloglu, Ü., Derman, E., Ögelman, H., and Tokdemir, F., 1983, Astron. Astrophys., 123, 17.
Naftilan, S.A., and Drake, S.A., 1977, Astrophys. J., 216, 508.
Walter, F.M., Gibson, D.M., and Basri, G.S., 1983, Astrophys. J., 267, 665.