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Ca II H AND K, AND H_α EMISSION VARIABILITY IN AR LACERTAE

AR Lac (= BD + 45°3813) is a well known RS CVn type eclipsing binary system. Many interesting phenomena are associated with the system such as light curve variations, star spots and radio flares. Many investigators found it to be a source of radio emission. Recent photoelectric observations by Kurutac et al. (1981), Srivastava (1981) and Evren et al.(1983) found it to be an active system. Srivastava (1983) reported optical flares present in the system.

The presence of CaII H and K emission has been detected in AR Lac by Wyse (1934), Naftilan and Drake (1977), Weiler (1978) and Naftilan and Aikman (1981). These authors found rapid (hourly) variability of CaII H and K emission, but could not establish any correlation of the variability of emission either with the orbital phase of the system or with the migrating photometric wave.

In order to find the activity of the system in 1983, the system AR Lac was observed spectrophotometrically on 20 November 1983 with the 104-cm reflector of Uttar Pradesh State Observatory. A Hilger and Watts monochromator having a dispersion of 70 Å mm^{-1} was used. The exit slit corresponding to a band pass of 20 Å was used for obtaining the spectral scans in the H_α and $\lambda\lambda$3600 - 5000 Å wavelength region. Ten spectral scans of the system secured in the CaII H and K region and four in the H_α region (between phase 0.863 to 0.877) are shown in Figure 1. Although the noise is present in our scans, yet some important features are noticeable.

Looking at Figure 1, it is evident that in the first two scans, the H line emission of CaII is stronger than the K line emission. In the third scan, the K line emission seems to have either disappeared or merged with the H line emission. In the fourth scan, the K line emission has reappeared. In the fifth scan, the K line emission seems to have either disappeared or merged with the H line emission again. In the sixth scan, the K line emission has reappeared and the H line emission has become double peaked.

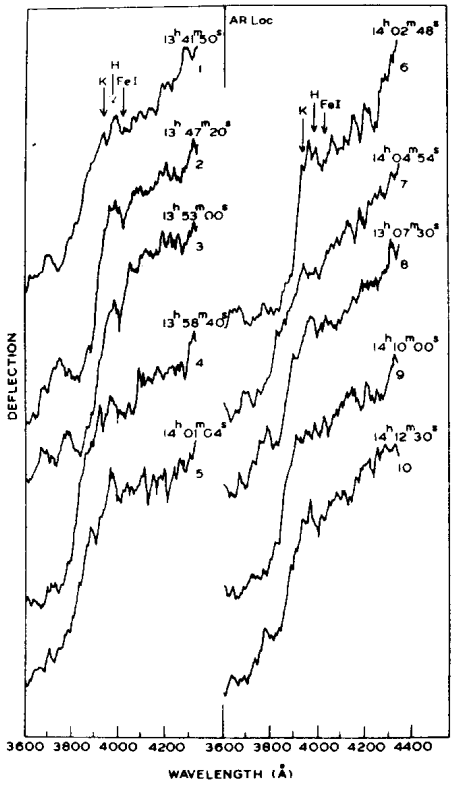

Fig.1. CaII H and K line scans of AR Lacertae. Vertical lines in the figure indicate the position of CaII H and K, and FeI lines. The time on the scans is shown in UT.

The seventh scan indicates that the K line emission has become stronger than the H line emission. In the eighth and ninth scans, the two line emissions appear to have merged. In the tenth scan, the H line emission became stronger than the K line emission.

Also, the fourth, fifth and sixth scans show that the H line emission of CaII is blue shifted from the position of the line centre. The seventh and ninth scans show that the H line emission is minutely shifted towards red. In addition, it is apparent from the first and eighth scans that the H emission feature is broader than seen in other scans. The scans also indicate that CaII H and K emission is surrounded by absorption which may be

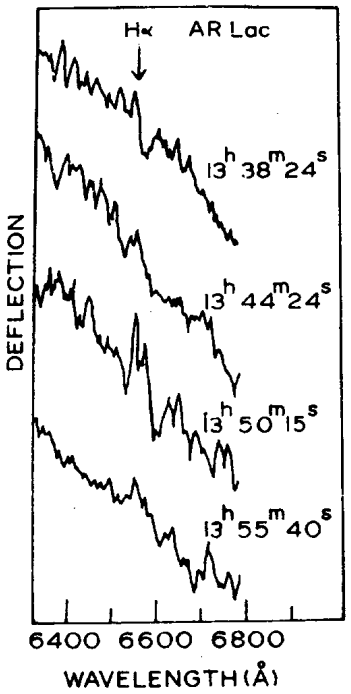

Fig. 2. H_α line scans of AR Lacertae. The vertical line in the figure denotes the position of H_α line. The time on the scans is shown in UT.

originating in a thick shell.

The position of H_α line is shown in Figure 2. The H_α line is also seen in emission. In the uppermost scan, the H_α emission is single peaked, while in the remaining scans it is seen as double peaked emission. Also, the line of H_α emission is broadest in the last scan in comparison to the other scans. The shift of H_α emission line from its line centre is not detectable.

The FeI line is seen apparently in absorption. Its features are not clear, yet some shift is seen in the line from its line centre.

We conclude from the present observations that CaII H and K, and H_α emissions are variable. These emission features change both their shape and intensity. The CaII H and K emissions seem shifted sometimes towards blue and at times towards red side from the line centres. Also,the variability of these emissions is not regular but random. In addition we can say

that short-term (as short as 3 minutes) emission variability is present in AR Lac. The source of these emissions is not stable.

Wilson and Skumanich (1964) concluded that mere presence of CaII H and K emission in late-type binaries implies active chromospheres and the presence of variable H_α emission further supports this conclusion. Thus we infer that an active and dynamic chromosphere exists in the system AR Lac.

Since our observations are centered around 0.87 phase (outside the eclipse) and the scans are not taken at the eclipse phase, hence it is difficult to infer which of the component of the eclipsing binary system AR Lac is contributing to these emissions. We have mentioned above that at times double-peaked emissions are also noticed, hence the possibility of contributions from both the components cannot be ruled out.

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