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THE Am STAR HD 43478 IS AN ECLIPSING BINARY

The star HD 43478 = BD +32°1246 was classified A3-F2-F5 from the Ca II K line, the H Balmer lines and the metallic lines respectively by Osawa (1965). It had been earlier classified A3p SiSr by Bertaud (1959) and was, for that reason, included in a CORAVEL survey of radial velocities of cool Ap stars. CORAVEL measurements made with the 1m Swiss telescope at Observatoire de Haute-Provence (France) in 1986 showed this star is a double-line spectroscopic binary. The orbital period is

$$P = 5.46414 \pm 0.00013 \text{ days},$$

the excentricity is negligible and the masses are

$$M_1 \times sin^3 i = 1.76 \pm 0.02, \quad M_2 \times sin^3 i = 1.59 \pm 0.02 M_\odot.$$

This star had been observed in the Geneva photometric system at the same telescope and was suspected of variability, so it was reobserved at the 76cm telescope of the Jungfraujoch Observatory (Switzerland), especially in 1987, 1988 and 1989. Although bad weather prevented a complete and dense phase coverage to be obtained, two well-defined minima could be observed at both phases 0.25 and 0.75, which coincide with the epochs of zero radial velocity (relatively to the systemic velocity). The lightcurve is shown in Figure 1. HD 43478 is therefore an eclipsing binary, although the minima are no deeper than 0.1 magnitudes.

The [U-B] and [B-V] indices do not vary in a significant way, showing that both components have nearly the same effective temperature. Since the components seem nearly identical, it is not irrelevant to estimate their physical parameters from the colour indices of the system. HD 43478 has been measured in the $uvby\beta$ system by two different groups and the average indices, found in the database of Hauck et al. (1990), give $E(b-y) = 0.029$, $T_{\rm eff} = 6970$ K and $\log g = 3.71$, using the calibration by Moon & Dworetsky (1985) with the correction on $\log g$ for Am stars (Dworetsky & Moon 1986). Taking $E(B2-V1) = 1.15\,E(b-y) = 0.033$ and using the calibration of Kobi & North (1990), the Geneva indices give $T_{\rm eff} = 6850$ K, $\log g = 3.72$ and $M = 1.82\,M_\odot$. The results from both photometric systems are in perfect agreement, the effective temperature is exactly that expected for the hydrogen spectral type (F2) and the mass estimated from the Geneva colours matches the spectroscopic masses extremely well. The components of this system appear to be somewhat evolved on the main sequence. Combining the photometric mass and surface gravity leads to a radius $R = 3.1\,R_\odot$.

The projected rotational velocities, estimated from the widths of the autocorrelation peaks measured with CORAVEL, are 29.2 ± 0.9 and 20.5 ± 0.7 km s^{-1} for the primary and the secondary component respectively. If the axial rotation of both components is synchronized with the orbital period, then the radius of the primary is *exactly* that inferred from photometry, while the secondary has $R = 2.2\,R_\odot$, implying $\log g = 4.0$. From the depths of the minima, a rough estimate gives $i \approx 80°$, so the masses of the primary and of the secondary may be about 1.84 and 1.66 $M_\odot$ respectively.

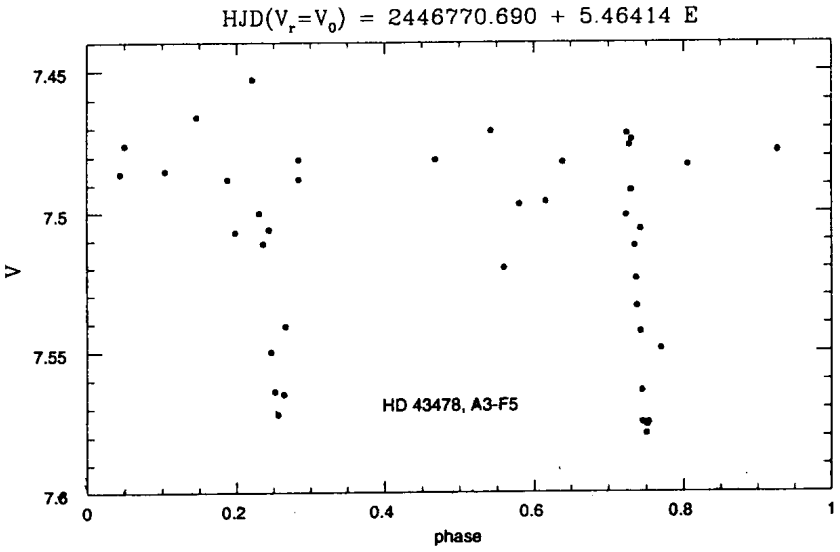

Figure 1: V magnitude of HD 43478 as a function of phase, according to the ephemeris given on top of the figure. The zero phase corresponds here to the quadrature, not to an eclipse.

The discovery of this SB2 system tends to confirm the high rate of SB2 binaries among Am stars, noticed by Abt & Levy (1985).

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