NEW INSIGHT ON THE RAPID ROTATOR HD 199178*

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Abstract. Optical spectra were obtained of the rapidly rotating star HD 199178 to analyze the Hz profile. Excess emission was derived by subtracting a comparison star spectrum. The Hz line fluxes variability is stressed together with the discussion of this and previous data in the context of the surface phenomena for the FK Com family of stars.

1. Introduction

HD 199178 was classified as an FK Comae-type star by Bopp (1982). This kind of late type giants become conspicuous for their large rotation velocity notwithstanding the lack of evidence for binary companions. It is generally assumed that these stars have an active chromosphere as denoted by the strength of their optical and ultraviolet emission lines and by the enhanced X-ray emission. The high level of activity in these stars presumably results from the interaction between convection and rapid rotation. The abnormal broadening of the photospheric lines for such late-type giants, could be explained as the result of a coalescence of two cores in a WMa system as suggested by Webbink (1978). The periodic variation of the light curve is associated with the modulation induced by the appearance and disappearance of several surface inhomogeneities. The data gathered on HD 199178 set the spectral type as G5III–IV with a rotation rate of 80 km s\(^{-1}\) and an upper limit for the radial-velocity variation of 2 km s\(^{-1}\) (Huenemoerder, 1986).

2. Observations and Data Reduction

I observed HD 199178 with the 1.52 m telescope and the Echelle spectrograph equipped with an electronic camera at the ‘Observatoire d’Haute Provence’. The grating was centered on the Hz and an interferential filter took the place of the usual cross-dispersor. The wavelength scale was provided with both a thorium–argon and a neon–iron lamp. As there are very few comparison lines in the small window observed, the wavelength calibration was checked measuring a dozen photospheric absorption lines. No appreciable trend was found, and the uncertainties in their position was better than 6 km s\(^{-1}\). The full width at half maximum of several comparison lines was measured and the average value was assumed to represent the instrumental profile.

At 10 Å mm\(^{-1}\) the spectra were recorded with a resolution of 17000 and a signal to noise ratio that range from 80:1 to only 30:1.

Observations were also made on the CaII region to take advantage of a less red


sensitive cell. The echelle was substituted for an holographic grating and the interval from 3750 to 4100 Å were observed at a dispersion of 14 Å mm⁻¹ with a resolution of 5000; the signal to noise reached 65.

3. Results and Discussion

On the four spectra obtained there was no evidence of emission on the wings of the line as reported by Bopp et al. (1983). An acceptable description of the data is achieved by fitting the Hα profile as a broad gaussian absorption line. I did not find any appreciable wander of the central absorption 6562.74 ± 0.18 Å, as should be expected within the resolution achieved. The width of the line is variable (FWHM = 3.18 ± 0.29 Å) but due to the limited data set it was not possible to correlate this change with the rotation.

The core of the line should be partially filled in with emission because the Hα residual intensity measure ($R_e = 0.71 ± 0.05$) is greater than in the case of 35 Cnc and 31 Com (Bopp et al., 1988). To evaluate the excess emission a few non-active stars were observed in the same conditions. The sharp-lined π Cep (G2III), η Cep (K0IV) and τ Cep (K1IV) spectrum were used to estimate the underlying photospheric absorption and derive the net emission. The photosphere of HD 199178 should be well represented by these spectra due the similarity in spectral type and temperature as indicated by $R - I$. Also it should be noted that in cool stars the Hα absorption is insensitive to gravity. The comparison spectra were artificially broadened to 80 km s⁻¹ and shifted to align them in wavelength. The subtraction reveal some excess of radiation (Figure 1), but definitively less than reported by Huenemoerder (1986) with contemporaneous observations.

![Fig. 1. The Hα line in HD 199178 and in τ Cep broadened to 80 km s⁻¹. The excess emission is plotted below.](image-url)