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53 Aurigae revisited: a B9 Mn + F0 m composite spectrum

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Abstract. 53 Aur, a CP star without a unique peculiarity type determination, is revisited. Based on high-resolution high S/N CCD spectra the spectrum of the double star 53 Aur was disentangled to B9-Mn and F0m components.

Key words: stars: chemically peculiar – stars: binaries

1. Introduction

53 Aurigae (HD 47152, McA 27) is known as a CP star with many inconsistent determinations of the peculiarity type. Bertaud (1959) gives A0p-EuCr, while Abt *et al.* (1995) λ Boo-type. Glagolevskij and Chuntonov (2002) measured $B_e = 2064$ G. Renson (1991) noted its duplicity and variable radial velocity. A discrepancy also occurs in projected rotational velocity estimates. Palmer *et al.* (1968) deduced $v \sin i = 325$ km s^{-1} using the Ca II line while Abt *et al.* (1995) obtained 25 km s^{-1} from Mg II 4481 Å. Zverko *et al.* (1993) drew attention to wide absorptions around the Ca II 3933 and Mg II 4481 Å lines.

Gainer (1973) discovered the binary nature of 53 Aur by occultation, and tens of speckle interferometric observations have been performed since then. Hartkopf (1989) derived the orbital elements with $P = 22.32$ y and $e = 0.595$. Faraggiana *et al.* (2001) called attention to the need of taking the duplicity into account when a type of peculiarity is to be determined.

We obtained fifteen CCD spectra of 53 Aur with the 2-m telescope of the National Astronomical Observatory, Rozhen, between October 1999 and January 2007. The Photometrics AT200 SITe SI003AB 1024×1024 px camera placed at the coudé focus gives resolution $R = 22\,300$ at the Mg II 4481 region and $R = 28\,750$ at the Ca II 3933 region. The signal-to-noise ratio was $S/N = 150 - 350$ at the Mg II 4481 and $S/N = 120$ at the Ca II 3933 region.

2. Results

Baize (1989) estimated the total mass of the double star $M_{53\mathrm{Aur}} = 5.8\,M_\odot$ and suggested it was a pair of B9 stars. This is discrepant from the magnitude dif-

ference measured by HIPPARCOS, $\Delta m = 0.77$ mag, which corresponds to a difference at least 3 subclasses. As mentioned earlier there is a broad absorption around the Ca II line at 3933 Å in the observed spectrum of 53 Aur which is rather characteristic for a cooler atmosphere of an F spectral type. Indeed, our CCD spectra reveal numerous weak and narrow lines of 0.05 – 0.1 depths and $\lesssim 1$ Å FWHM. Therefore we chose $T_{\rm eff} = 7250$ K, $\log g = 4.0$ for the secondary F0 component and $T_{\rm eff} = 10\,750$ K, $\log g = 4.0$ for the B9 primary. Models from the "Atlas9-ODFNEW" grid of Castelli and Kurucz (1993) with [M/H] = 0, $v_{\rm turb} = 2$ km s^{-1} were adopted. Synthetic spectra were computed using SYNSPEC (Hubeny *et al.*, 1994; Krtička, 1998). A synthetic composite spectrum was derived using the radial velocity difference determined by crosscorrelating the individual synthetic spectra with the observed one, and setting tentatively the intensity ratio of the primary to secondary to $I_{\rm pr}/I_{\rm sec} = 0.9/0.1$. The projected rotational velocities used were 25 and 0 km s^{-1} for the primary and secondary, respectively.

While we were able to reach a fair fit between the synthetic composite and the observed spectrum a discrepancy exists between the magnitude difference $\Delta m = 2.38$ mag resulting from the component intensity ratio adopted here and the one by HIPPARCOS which corresponds to the intensity ratio $I_{\rm pr}/I_{\rm sec} = 0.67/0.33$. Moreover, the total mass of the system as the sum of the main sequence B9 and F0 stars results in 4.8 $M_\odot$ only. Baize (1989) however, does not mention the accuracy of his determination of the total mass.

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