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ORIGINAL ARTICLE

New face in the spectral behavior of Capella in the UV

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Abstract We present low and high resolution ultraviolet spectra of the Capella spectroscopic binary system from the observations taken by the International Ultraviolet Explorer (IUE) during the period between 1978–1990 and 1978–1995. Thirteen profile of Capella showing variations of line fluxes at different orbital phases are presented. This paper focuses on the C IV emission line at 1550 Å produced in the transition region of the secondary star and Mg II emission lines at 2800 Å produced in the stellar chromosphere of the secondary star by calculating spectral line fluxes. Our results show that there are significant variations of line fluxes with time. These spectral variations are similar to that found in the EUV by Dupree and Brickhouse (in Int. Astron. Union Symp. 176P:184D, 1995) in the UV for H 1 Ly α by Ayres et al. (in Astrophys. J. 402:710A, 1993), and in the near IR by Katsova (in Astrophys. Space Sci. 252:427K, 1997). We attribute these variations in line fluxes to the variations of both density and temperature in the line emitting regions as a result of the intermediate-scale magnetic fields responsible for stellar activity leading to these spectral variations.

Keywords Binaries: close · Line: profiles · Stars: late types · Stars: individual (Capella) · Ultraviolet: stars

1 Introduction

The Capella is a spectroscopic binary system with an orbital period of 104 days, consisting of two nearby cool giant stars, the primary is the G 8 III star and the secondary is the G1 III star (Weber and Strassmeier 2011; Torres et al. 2009; Pilachowski and Sowell 1992; Barlow et al. 1993). The physical parameters of Capella are well established (Batten et al. 1991; Barlow et al. 1993; Hummel et al. 1994; Torres et al. 2009; Weber and Strassmeier 2011). The G8 primary is slightly more massive than the G1 secondary (2.57 $M_{\odot}$ and 2.48 $M_{\odot}$, respectively). Capella has been a popular target for spectroscopic studies in the ultraviolet (Dupree 1975; Ayres and Linsky 1980; Ayres 1984, 1988), extreme ultraviolet (Dupree et al. 1993; Wood and Ayres 1995; Linsky et al. 1995, 1998), and X-rays (Lemen et al. 1989; Phillips et al. 2001; Raassen and Kaastra 2007). Capella is a prominent source at all of these wavelengths owing to high intrinsic brightness and close proximity ($d = 13$ pc).

Ayres and Linsky (1980) used data taken by the International Ultraviolet Explorer (IUE) to show that the G1 star is the dominant contributor to the emission lines in Capella's strong ultraviolet emission line spectrum. In general, the G1 star is more dominant in high excitation transition region lines such as CIV 1550 Å than it is in low excitation chromospheric lines such as Mg II 2800 Å. Since the G1 star rotates much faster than the G8 star ($v \sin i = 36$ km s^{-1} compared with $v \sin i = 5$ km s^{-1}; Torres et al. 2009), the Capella system illustrates the connection between rotation and stellar activity that has been the subject of some studies in many wavelength regions (Skumanich 1972; Ayres and Linsky 1980; Pallavicini et al. 1981; Wood et al. 1994). Further analysis of IUE observations have revealed that Capella's ultraviolet line fluxes are surprisingly constant with time, and that many of Capella's ultraviolet emission lines are significantly redshifted, with the high-excitation transition region lines generally having the larger redshifts (Ayres 1984, 1988). The line redshifts have been interpreted

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