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ORIGINAL PAPER

Similarities and differences in the spectral behavior of W Ser and UX Mon in the ultraviolet

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Abstract We present ultraviolet spectra of two eclipsing interacting binary systems, W Ser and UX Mon, with good coverage over the 14.16-day and 5.9-day orbital periods, respectively, using observations taken by the *International Ultraviolet Explorer* (*IUE*) during the period between 1978–1993 and 1981–1991. Two profiles of W Ser and UX Mon showing variations of line fluxes at two orbital phases are presented. This paper focuses on the N V emission line at 1240 Å, C II emission line at 1336 Å, C IV emission line at 1550 Å, O III emission line at 1666 Å and the Si III emission line at 1892 Å, produced in an extended gaseous envelope around the mass-gaining component by calculating spectral line fluxes. Our results show that there are variations of line fluxes with time, similar to the light curves found for both W Ser and UX Mon. We attribute these spectral variations to eclipse effects and to variations in the mass transfer rate. These results from the IUE observations support the thick disk model around the primary star in which variations of mass transfer affect the observed radiation from the gaseous envelope around the hot star. Future, high-resolution imaging is recommended to confirm the inferred asymmetrical circumstellar envelopes.

Keywords Accretion · Accretion disks · Binaries: eclipsing · Circumstellar matter · Stars: individual (W Serpentis, UX Monocerotis) · Ultraviolet: stars

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1 Introduction

W Ser is a partially eclipsing and highly interacting binary system with an orbital period of 14.16 days (Piirola et al. 2005). The spectral type of the secondary component as classified from its optical spectrum is F5 II (Bauer 1945; Sahade and Struve 1957; Hack 1963; Young and Snyder 1982), while the primary hot component could be a B-type star (Plavec 1989) embedded in an opaque disk that is both geometrically and optically thick. The system is characterized by strong ultraviolet emission lines from different ionized species—N V 1240 Å, Si IV 1400 Å, C IV 1550 Å, C II 1336 Å, O III 1666 Å, Si III 1892 Å—and a UV continuum with a higher color temperature than deduced from optical spectra (Plavec and Koch 1978; Weiland et al. 1995). The system is less luminous before the eclipse and much more luminous immediately after (Piirola et al. 2005). There is rapid mass transfer taking place, as indicated by the increasing period—increasing at a rate of 14 s yr^{-1} (Koch and Guinan 1978). W Ser is surrounded by extensive circumstellar matter having multiple radiation components pointing to a quite intricate morphology (Young and Snyder 1982; Guinan 1989).

Weiland et al. (1995) presented spectroscopic observations of the W Ser system at two orbital phases using the Goddard High Resolution Spectrograph (GHRS) aboard the Hubble Space Telescope (HST). They found that differences in the Si IV 1400 Å emission line strengths and profile shapes observed between the two phases suggest that a hot spot exists where the giant stellar companion has transferred mass to an accretion disk surrounding the mass-gaining component. Moreover, strong absorption features superposed on the Si IV emission lines also indicate that the accretion disk is geometrically and optically thick.