Spectral Imaging of the HR 1099 chromosphere in December 1992

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The bright RS CVn-type system HR 1099 (V 711 Tau) was observed by IUE continuously along two contiguous orbital periods in December 1992, during a MUSICOS campaign (Huang et al. 1995). The main purpose of these observations was to obtain a series of high-resolution spectra of the Mg II h & k lines suitable for *Spectral Imaging* analysis (Neff et al. 1989).

We report on preliminary results of *Spectral Imaging* analysis of the Mg II h line that are indicative of a stationary down-flow towards the pole of the K1 IV component and mass motion during a flare event. Results on the contemporary optical photometry can be found in Cutispoto et al. (1995).

1. Results on Mg II h line profiles acquired during quiescence

The radial velocities of the line components resulting from the decomposition of the Mg II h line profiles are shown in Figure 1. The sinusoidal solid line represents the K1 IV radial velocity, whilst the dotted line is the best sinusoidal fit to the points due to the *additional* plage-like components, which lie on the red part of K1 IV radial velocity curve. This sinusoidal curve is vertically shifted of +50 km s^{-1}with respect to the radial velocity curve of the K1 IV star. This plage-like component is always observed on the red part of the K1 star line profile. Being its integrated flux and FWHM larger than those of the G5 star, this component dominates and all other discrete emission components can be only marginally identified. This red shifted feature could be interpreted as falling material on the visible pole of the cooler and larger star. As a speculative scenario, we can imagine a down-flow along flux tubes anchored to a magnetic active region close to the pole. Evidence of a polar magnetic field of $\sim$-300 G had been found by Donati et al. (1992). Polar spots on HR 1099 were invoked by several authors both to account for spectral line profile varibility (e.g. Vogt & Penrod 1983, Jankov & Donati 1995), and to account for rotational modulation in visible light (e.g. Rodonò et al. 1986, Zhai et al. 1994).

2. Results on Mg II h line profiles acquired during flares

Five flare episodes were observed on HR 1099 during the monitoring time (see Neff et al. 1995). The most intense flare in Mg II h & k emission lines peaked during the acquisition of the LWP24490 spectrum on Dec 14 at 10:30 UT (ϕ=0.55). The rising time of this event was less than 2 h, and the decay time was about 9 h. The increment of integrated flux at flare maximum in the range from 2780 Å to

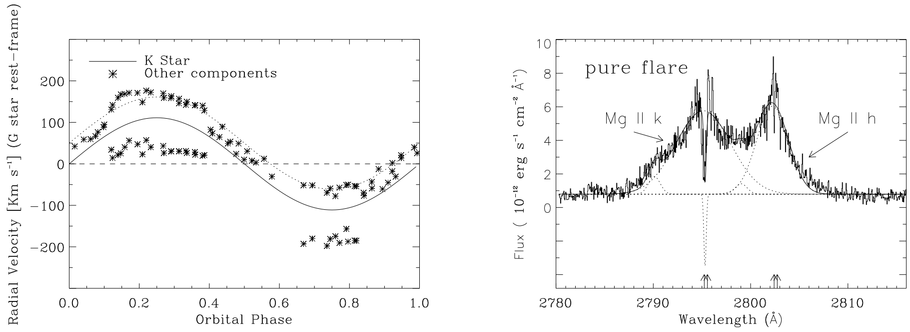

Figure 1. *Left panel:* Radial velocities of the components resulting from the spectral decomposition of the Mg II *h* line profiles. *Right panel:* Pure flare spectrum of the event occured on Dec 14, 1992 at 10:30 UT. Arrows on x-axis indicate the two stars radial velocities.

2810 Å, was of 150%. The pure flare spectrum, i.e. the quiescent spectrum having been subtracted, (right panel in Fig. 1) can be fitted by means of two main emission components, each representing the flare emission in the *h* & *k* Mg II lines, respectively, plus two little emission components due to the subordinate Mg II lines at 2791 Å and 2799 Å. The absorption component appearing in the pure flare spectrum is an artifact because the Mg II *k* line core is actually saturated in the LWP24490 image. The flare Mg II *h* & *k* lines are blue shifted with respect to those of the K1 star by -20 km s^{-1}, or by -50 km s^{-1} if we consider the G5 star. This slight blue shift of the flare emission is no more present in the spectrum acquired at late flare phases. The FWHM of Mg II *h* & *k* lines of the pure flare component, deconvolved of the instrumental profile, correspond to velocities of 700 and 400 km s^{-1}, respectively, indicating high level of turbolence in the flaring material. The integrated flux in the Mg II *h* & *k* lines of the pure flare component is ~25 times the mean G5 Mg II *h* & *k* lines flux. Therefore, it appears unlikely that this flare had developed on the primary star. Given the system configuration at phase of flare maximum (0.55), we can conclude that, analogously to the UX Ari Mg II *h* & *k* flare reported by Simon et al. (1980), the flare of Dec 14 on HR 1099, is consistent with a flaring site on the visible K1 star emisphere with mass motion towards the G5 companion.

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