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ON THE OPTICAL VARIATIONS OF AH HERCULIS

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In the context of a long-term variability study of a sample of dwarf novae, we have been monitoring AH Her since 1994 (Spogli et al., 2001, 2002) and we have obtained photometric data during many outbursts and standstills with the aim to constrain theoretical models. AH Her is one of the intrinsically brightest dwarf novae in quiescence, with the optical emission dominated by the accretion disk and the secondary (probably a K2 V star, Bruch, 1987). The system has an inclination angle $i \simeq 41°$. Moreover, the FUV flux of AH Her is completely dominated by the accretion disk, with only a marginal fraction of the total light generated by the White Dwarf: $\simeq 3\%$ in quiescence (Urban & Sion, 2006) and $\leq 0.5\%$ during the outburst (Hamilton et al., 2007). For all these reasons, AH Her is a perfect candidate to study the accretion disk emission, thanks to the marginal contribution of the primary star and of the boundary layer region. The principal aim of this work is to test the steady state model making use of multicolour observations of AH Her on different parts of the outburst light curve. Since the secondary star is the same for the different observations, a set of disk spectra should exist which reproduces the different shapes of the simultaneous optical observations and the brightness differences.

All the observations have been obtained with a 0.30-m f/6.5 Schmidt-Cassegrain reflector, equipped with an AP-32ME CCD camera (Kodak 3200-ME, 2184×1470 pixels) and Schuler $UBVR_CI_C$ Johnson-Cousins filters. The exposure time was 120–600 s depending on the brightness of the object and the filter used. The CCD frames were first corrected for de-biasing and flat-fielding, then processed for aperture photometry. All the BVR_CI_C data were obtained in differential photometry using the photometric comparison sequence reported by Spogli et al. (2001). The U magnitudes have been measured only during good photometric nights with respect to a selected sample of standard stars (Landolt, 1992). Color transformation equations were characterized by slopes always within the margins 0.9–1.1.

AH Her has been monitored more intensively in the years 2007-2009, for a total of 121 different nights and 393 photometric points (see Table 1 in the electronic version). During the 2007 campaign many fast outbursts are evident in the light curve (Fig. 1), while during the 2008 campaign AH Her showed longer outbursts and standstill phases (Fig. 2).

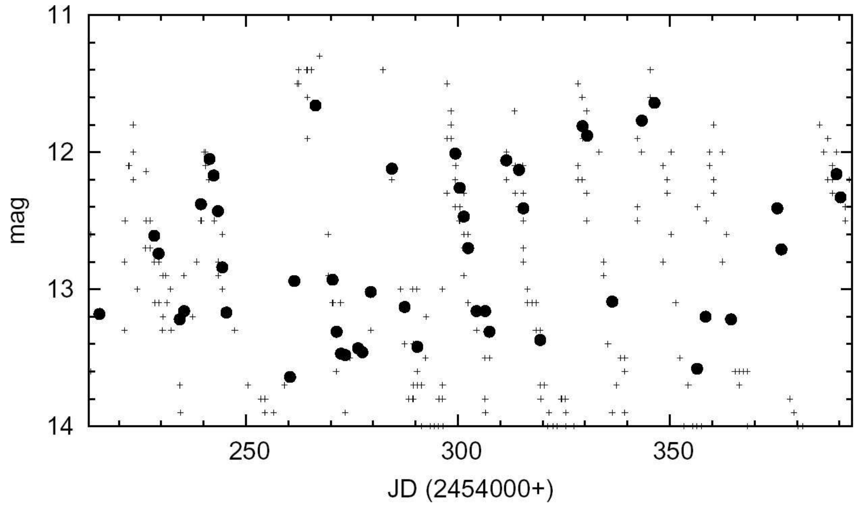

Figure 1. R_c data of AH Her from April 24th to October 16th 2007 from Table 1 (filled circles). Small crosses represent visual estimates available from AFOEV (`http://cdsweb.u-strasbg.fr/afoev/`).

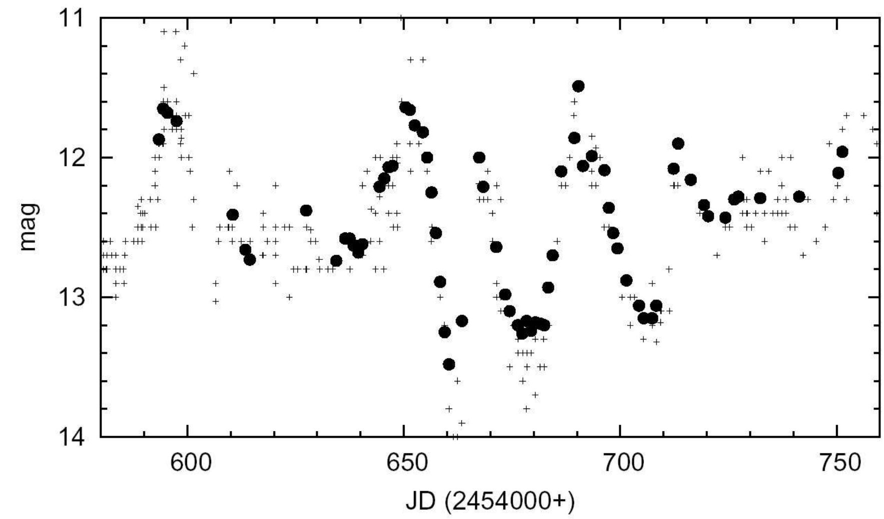

Figure 2. R_c data of AH Her from May 6th to October 11th 2008 from Table 1 (filled circles). Small crosses represent visual estimates available from AFOEV (`http://cdsweb.u-strasbg.fr/afoev/`).

To study the behaviour of the optical continuum of AH Her we corrected our observations by the interstellar extinction $E_{(B-V)} = 0.03$, then we converted the $UBVR_CI_C$ magnitudes in fluxes $f(\lambda)$ using the conversion factors reported by Bessell (1979). With this raw fluxes the spectral flux distribution is sensibly different from that expected by a standard accretion disk with the canonical power-law spectrum $f(\lambda) \propto \lambda^{7/3}$ (Lin & Papaloizou, 1996). For many times this behaviour has been considered an evidence that a steady and optically thick model disk cannot account for the continuum distribution of dwarf novae during the outburst (see, for example, Spogli et al., 1998). However, for AH Her the model is consistent with the observations if we take into consideration the secondary emission.

Fig. 3 shows the spectral flux distribution of AH Her at different stages of the outbursts cycle. The spectral slope is flatter in quiescence and steeper during the maximum, and in general is different from the spectral slope expected by a steady-state accretion disk. The same behaviour has been observed by many authors, for example by Hamilton et al. (2007) in the IUE spectra. Now we have considered the optically thick and geometrically thin disk model described by la Dous (1989) with angle of inclination $i = 45°$, and Fig. 3 shows that our observations are consistent with the superposition of this disk emission with a K5 V secondary star (Kurucz 1992, $T = 4250K$, $\log g = 4.5$, $\log Z = 0.0$). The disk emission during the maximum is $\simeq 13$ times brighter than at quiescence.

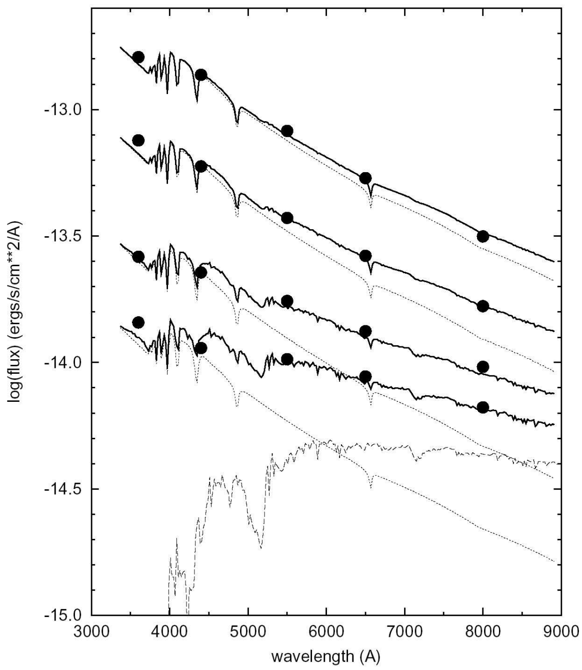

Figure 3. Examples of $UBVR_CI_C$ fluxes of AH Her from quiescence to the outburst (points). The solid lines represent the superposition of a K2 V secondary (dashed line) with an accretion disk with different levels of brightness (dotted lines). The dwarf nova and hot spot emissions have been omitted because they give a marginal contribution in the UV only.

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