A COMPACT FLARE ECLIPSED IN SV CAM

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ABSTRACT

The eclipsing active binary SV Cam (G0V/K6V) was observed during two campaigns in 2001 and 2003. No eclipses of the quiescent emission are clearly identified, but a flare was eclipsed during the 2001 campaign. We have applied a new technique, using purely geometrical considerations at the phases of the four contacts, to constrain the position and size of the flare: the flare is compact ($<$0.4 $R_\odot$) and it is formed at a latitude below 65°. The size, temperature and Emission Measure of the flare imply an electron density consistent with the measurements that are obtained from density-sensitive line ratios in other similar active stars. Quiescent emission, however, seems to come from either extended or polar regions. We have succesfully applied the same technique to calculate the flare size and location in eclipses observed (and reported in the literature) in Algol and VW Cep, better constraining the possible solutions.

Key words: stars: coronae; binaries: eclipsing; stars: late-type; X-rays: stars.

1. POSITION AND SIZE OF ECLIPSED FLARES

We have applied a new method to calculate the positions and sizes that are consistent with the observed eclispe in the flare of SV Cam (Fig. 1). This assumes a spheric shape for the emitting region, and calculates the contact phases for a grid of all possible values of the geometrical variables involved: θ (latitude), λ (longitude), h (height from the center of the star), R_3 (radius size of the emitting region). Only those cases in which the values agree with the observed four contacts are considered valid results. No results are prefered to others since we apply only geometrical considerations. The results for the different geometrical configurations are displayed in Fig. 2 and Table 1. Further details can be found in Sanz-Forcada et al. (2005).

We have identified three other cases of eclipsed flares reported in the literature: VW Cep (Nov 1993) with ASCA (Choi & Dotani, 1998), Algol (Aug 1997) with Beppo SAX (Schmitt & Favata, 1999), and Algol again (Feb 2002) with XMM-Newton (Schmitt et al., 2003). We have applied the same technique to calculate the parameters in the cases of VW Cep and the XMM observation of Algol (the Beppo SAX observation has different requirements and it is not included here). A paper with all the details of this calculation is in progress (Sanz-Forcada et al., in preparation).

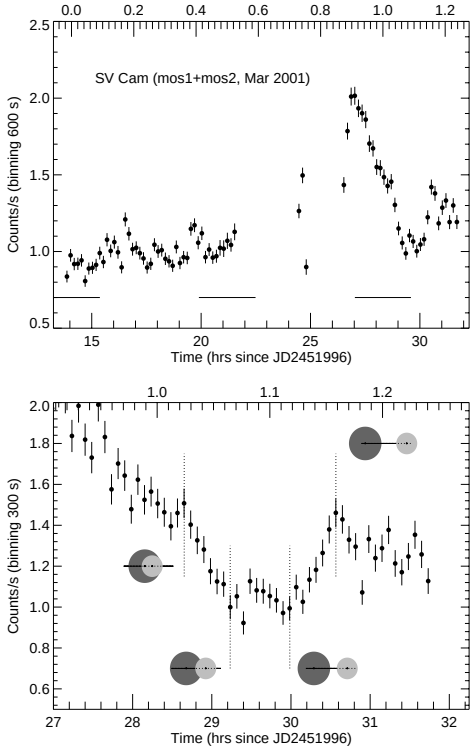

Figure 1. SV Cam light curve (EPIC/MOS) in March 2001. An eclipse in the flare, around $\phi \sim 1.1$, is displayed in the lower panel. Dotted lines indicate the phases used for the four contacts. The relative postions of the stars during the contacts are also indicated (at ϕ=0 primary star is behind).

Table 1. Range of possible solutions (northern hemisphere only) of the SV Cam eclipse

Flaring star	Ecl. star	$\theta(^\circ)$	$\lambda(^\circ)$	h ($R_\odot$)	R_3 ($R_\odot$)	$\log n_e$ (cm^{-3})	B (G)
Pri	Sec	0–14	4.7–55.7	1.91–3.28	0.012–0.41	10.6–12.9	66–930
Sec	Sec	0–65	145.1–149.1	0.83–2.99	0.006–0.41	10.6–13.4	66–1600
Pri	Pri	9.7–62	145.1–149.1	1.31–3.30	0.013–0.37	10.7–12.8	72–880
Pri	S+P	12–18	145.0–147.6	2.77–3.36	0.20–0.36	10.7–11.1	74–110

Table 2. All possible solutions found in SV Cam (G0V/K6V, $R_{1,2}$=1.18/0.76), VW Cep (G5V/K0V, $R_{1,2}$=0.93/0.50), and Algol (B8V/K2III, $R_{1,2}$=3.09/3.29) XMM flare. Note that in Algol it is assumed that the flare comes from the secondary star.

Star	$\theta(^\circ)$	$\lambda(^\circ)$	h ($R_\odot$)	R_3 ($R_\odot$)	$\log n_e$ (cm^{-3})	B (G)
SV Cam	-65 — $+65$	∼5–56 or ∼146	0.83–3.36	0.006–0.41	10.6–13.4	66–1600
VW Cep	-66 — $+48$	∼21–30 or ∼94–170	0.53–1.87	0.009–0.28	10.7–13.1	90–1200
Algol	-50 — $+16$	∼197–323	3.75–10.7	0.078–0.76	10.4–11.9	76–420

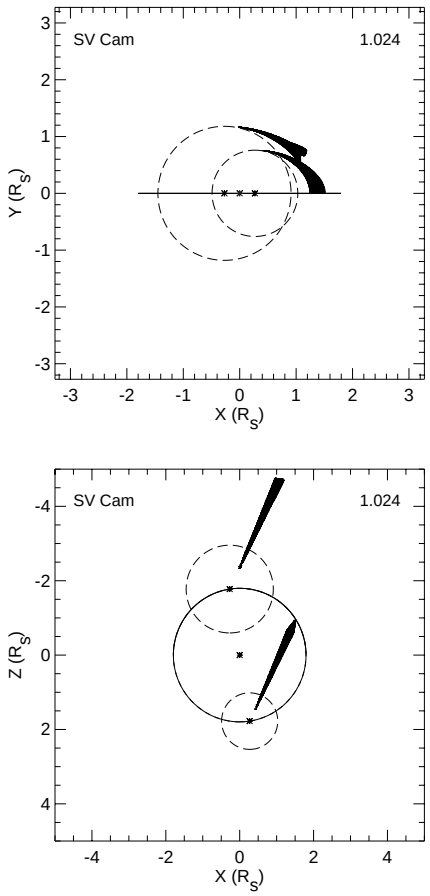

Figure 2. Relative positions of the two stars (dashed lines) during first contact (ϕ=1.0240), as seen from the front (left panel) and top (right panel). The solid line marks the orbit of the stars around the center of mass. All the possible results are represented with black points indicating the center of the emitting region (only the solutions in the northern hemisphere are represented).

2. CONCLUSIONS

The set of possible solutions found in all three cases yield the next general conclusions:

- The latitude is always below 66°, therefore no polar configuration is possible.
- The sizes are always below 0.28 $R_\odot$ for VW Cep, 0.41 $R_\odot$ for SV Cam, and 0.76 $R_\odot$ (0.23 R_*) for Algol. In most cases a larger size implies a more equatorial latitude.
- The Emission Measure and sizes of the emitting regions of the flares yield a density consistent with calculations from density-sensitive line ratios, and it implies magnetic fields of up to 1600 G.

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