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The 2008+ outburst of the Be star 28 CMa - a multi-instrument study†

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Abstract. Optical and IR spectra, optical to sub-mm photometry, visual imaging polarimetry, and IR high-resolution spectro-interferometry are being used to monitor the new outburst of 28 CMa, which started in 2008 and so far closely resembles previous ones. First modeling based on viscous decretion and focused on constraining the disk viscosity parameter, α, is presented.

Keywords. stars: circumstellar matter, stars: emission-line, Be, stars: mass loss

1. Introducing 28 CMa and its outburts

28 CMa is an early-type (B2 IV), pole-on ($v \sin i = 80$ km/s) Be star. Like most Galactic early-type Be stars, its line-profile variability can be modeled as $\ell = 2, m = +2$ nonradial pulsation (Maintz *et al.* 2003) and it undergoes discrete mass loss events (outbursts). Spectroscopic long-term monitoring (Štefl *et al.* 2003) only found a single 1.371-d period so that the outbursts cannot probably be attributed to multi-mode beating.

During outbursts, mass is transferred to a circumstellar disk. Because of the pole-on perspective of 28 CMa, this star's outbursts manifest themselves as brightenings by ~ 0.5 mag in visual light. They are spaced by 6-8 years and last about 2-4 years. Fluctuations by $\sim$0.1 mag within $\sim$10 days suggest that such major outbursts actually are phases of enhanced activity with numerous minor mass-loss events. This paper gives a first brief account of the most recent outburst detected through SO's naked-eye monitoring in 2008.

2. Observations and their modeling

Following the first alert, a broad suite of observations was undertaken. In addition to the dense visual photometry, *JHKL* photometry was obtained with the Mk II photometer of SAAO (4 epochs) and CAIN-II Tenerife/TCS camera (1 epoch); $Q1$ and $Q3$ measurements were added with *VISIR* on the VLT (1 epoch), and observations at 0.87 mm / 345 GHz were secured with *LABOCA* on *APEX* (1 epoch). Optical echelle spectra are available from *UVES/VLT* (Oct 2008-Mar 2009), *FEROS* / La Silla (2 epochs) and the 1-m telescope at Pico dos Dias Observatory (Jan 2009 - May 2010). *BVRI* imaging polarimetry was made with the 0.6-m telescope at Pico dos Dias (4 epochs). Finally, time was obtained with *AMBER* in its high-spectral resolution mode for interferometry with three *VLTI* Auxiliary Telescopes (3 epochs). Efforts are being undertaken to continue the observations through the decline to the visually faint phase, which is assumed to mark the end of the present active period. Following the very successful modeling of ζ Tau by

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† Based partly on observations collected at ESO; props. 282.D-5014, 284.D-5043.

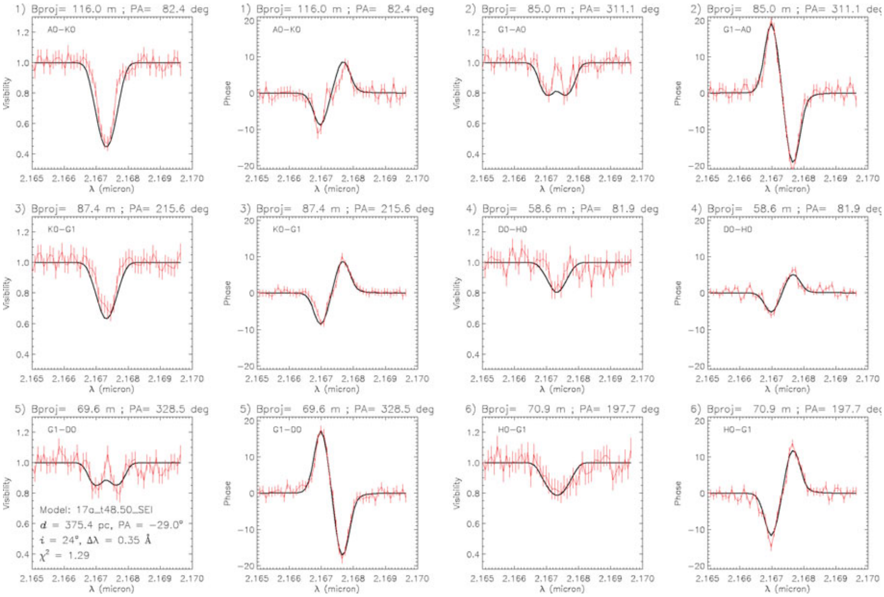

Figure 1. Differential visibilities and phases obtained at the six used baselines in April 2009. The model (black line) fits data well except the "central peak" in visibilities at PA = 310 - 330^o.

the HDUST code and viscous disk decretion (Carciofi *et al.* 2009), the analysis of the observations of 28 CMa is proceeding along the same lines.

3. First preliminary results

To the extent that comparable observations exist, the present outburst closely follows the two previous ones. Of all indicators studied, Brγ was the last to echo the disk build-up and a large phase amplitude is seen with *AMBER*. This confirms model calculations as well as other observations, e.g. of ζ Tau, that Brγ line emission does not form close to the central star. As for ζ Tau, the 28 CMa data are in agreement with Keplerian rotation, but the closure phase indicates less asymmetry in the disk. The differential visibilities and phases are shown in Fig. 1.

Because of the high level of repetivity of the visual light curve, an attempt was made to reproduce its shape between the decline from one outburst, when, in the model, decretion was switched off through the rise of the next one, at which time decretion was switched on. The disk was assumed to evolve completely passively between the two mass-loss phases. Since an outburst reaches its maximum very quickly, the inner disk fills and saturates quickly and so does not usefully constrain the disk viscosity parameter, α. This is different during the phases right after termination of the mass supply to the disk and the subsequent evolution. In both cases, $\alpha \sim 0.9$ well reproduces the observations (see Fig. 5 in Carciofi, these proceedings). This is unexpected as it would imply that the viscous torque depends very little on disk density, which varies a lot during this time interval.

References

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Portraits of young researchers in front of their posters. From left to right and top to bottom: André-Nicolas Chene, Rémi Fahed, Chloé Fourtune-Ravard, Nick Hill, Evgenia Koumpia, Meghan McGill, Christopher Russell, and Matthew Shultz.