From Interacting Binaries to Exoplanets: Essential Modeling Tools
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Reconstruction of an Accretion Disk Image in AU Mon from CoRoT Photometry

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Abstract. The long-period binary system AU Mon was photometrically observed on-board the CoRoT satellite in a continuous run of almost 60 days long which has covered almost 5 complete cycles. Unprecedented sub milimag precision of CoRoT photometry reveals all complexity of its light variations in this, still active mass-transfer binary system. We present images of an accretion disk reconstructed by eclipse mapping, and an optimization of intensity distribution along disk surface. Time resolution and accurate CoRoT photometric measurements allow precise location of spatial distribution of 'hot' spots on the disk, and tracing temporal changes in their activity. Clumpy disk structure is similar to those we detected early for another W Serpentis binary W Cru (Pavlovski, Burki & Mimica, 2006, A&A, 454, 855).

Keywords. accretion disks, (stars:) binaries: eclipsing, stars: individual (AU Mon)

1. Modelling light curves of the interacting binaries

One of the breakthrough outcome of UV spectroscopy on-board the IUE satellite was the discovery of emission lines of highly-ionized species in the spectra of the rather sparse group of long-period binary stars (Plavec & Koch 1978). The binaries in the sample were known for long for their active nature with large period changes, almost permanent Balmer emission features, peculiar light curves, etc. (Plavec 1980). It was Plavec who named this group after its prominent member *W Serpentis Binaries*.

It is now well-known that light curves of these 'Active Algols' cannot be solved with standard models. The first light curve synthesis model included an optically thick accretion disk surrounding a mass-gaining component; it has been successfuly applied in solving light changes in SX Cas by Pavlovski & Kříž (1985). The same simple disk model has been used in solving complex light variations in RX Cas (Andersen, Pavlovski & Piirola 1989). These authors also account for long-term cycles in light variations superimposed on the orbital light curve, and modeled it by changing the geometry of an accretion disk. Our further development of this disk model has been toward reconstruction of the disk image using eclipse mapping and optimization by genetic algorithm (Mimica & Pavlovski 2003, Pavlovski, Burki & Mimica 2006).

2. Disk image in AU Monocerotis

AU Mon (HD 50846, HIP 33237) is a long-period eclipsing and double-lined spectroscopic binary system with signatures common for W Serpentis interacting binaries. A comprehensive study was undertaken by Desmet *et al.* (2010) initiated by CoRoT space photometry, and complemented by ground-based high-resolution spectroscopy. Their analysis led to the determination of improved and consistent fundamental stellar and orbital properties for AU Mon. The light curve of AU Mon in Desmet *et al.* (2010) is

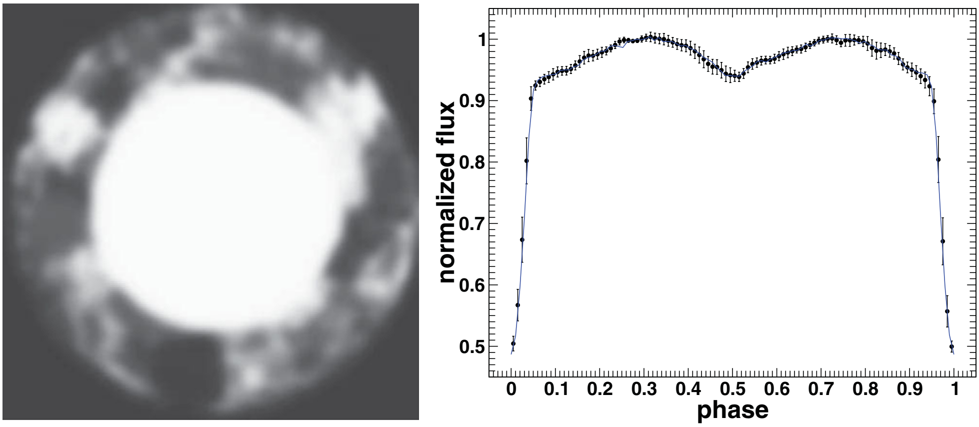

Figure 1. An accretion disk image reconstructed from an average binned light curve (left). The quality of fit of the phased light curve is shown on the right panel by solid line.

solved using a standard model, and does not account for superimposed fine changes in the light from the system. Djurašević *et al.* (2011) attempt to improve the fit of light curve by introducing a disk into the model. Since their disk model is homogenous, the fit was not satisfactory and only after the inclusion of hot spots they were able to improve it. Moreover, they modeled the light curve changes in a long-term cycle of about 416 days, by changes in disk geometry, just in the same way as was done for RX Cas by Andersen *et al.* (1989).

CoRoT photometry of AU Mon was secured in a continuous run of almost 60 days long and almost 5 complete orbital cycles were covered. Unprecedented sub milimag precision of CoRoT photometry reveals all complexity of its light variations in this, still active mass-transfer binary system. About 17 000 measurements were secured. Such quality and quantity of space-born photometry is ideal for an accretion disk image reconstruction along our model developed in Mimica & Pavlovski (2003), and applied for W Crucis in Pavlovski *et al.* (2006). Analysis is performed on binned light curves, and an improved release of our code which now is running on a computer cluster. A rather asymmetrical and clumpy (almost elliptical) disk is revealed. We are planning to publish a detailed paper elsewhere.

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