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Physical Parameter Eclipse Mapping

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Abstract. We present a new eclipse mapping technique, which is able to map distributions in physical parameters of accretion disks in ecliping cataclysmic variables.

1. Description of the method

The Physical Parameter Mapping Method is based on Hornes (1985) classical "Eclipse Mapping Method" (see also Baptista & Steiner 1991) which reconstructs intensity distributions of the accretion disk in eclipsing cataclysmic variables. Images are determined by the eclipse light curve and a maximum-entropy-method (MEM) (Skilling &Bryan 1984) leading to the smoothest image still compatible with the data.

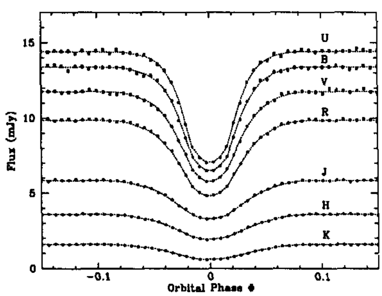

Fig. 1a: The test eclipse light curve in UBVRJHK (dots with errorbars, artificial S/N = 100) and the fitted eclipse light curve of the reconstructed black body disk image (dotted line, light curves are offset by 1.0 mJy each). The fit is good ($\chi^2 = 1.87$)

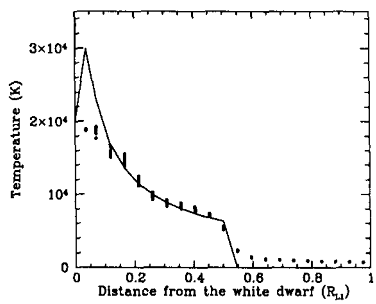

Fig. 1b: The **temperature** distribution of the black body test image (solid line) and the reconstructed one (circles) by fitting all 7 light curves simultaneously. The behaviour of the temperature is very well reproduced.

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Instead of intensities we map physical parameter distributions within the accretion disk. Therefore, N light curves in different wavelengths are used to map $\leq N$ maps of physical parameters, determined by the given model, e.g. optically thick black body, optically thin LTE disk.

2. Discussion

Good fits can be achieved for the black body case (Fig. 1a-b) and the optically thin (pure hydrogen) case (Fig. 2a-c). The general behaviour of the parameter distributions are reproduced. Due to the MEM algorithm, steep gradients are avoided as long as consistent with the data. Regions of low intensity are less reliable, here data at infrared wavelengths are essential.

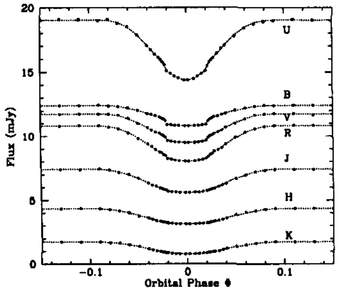

Fig. 2a: The test eclipse light curve in UBVRJHK (dots with errorbars, artificial S/N = 100) and the fitted eclipse light curve of the reconstructed optically thin disk image (dotted line, light curves are offset by 2.0 mJy each). The fit is good ($\chi^2 = 1.06$)

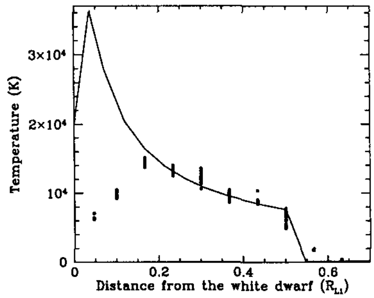

Fig. 2b: The **temperature** distribution of the optically thin test image (solid line) and the reconstructed one (circles) by fitting all 7 light curves simultaneously. The behaviour is well reproduced, except for the low intensity central region.

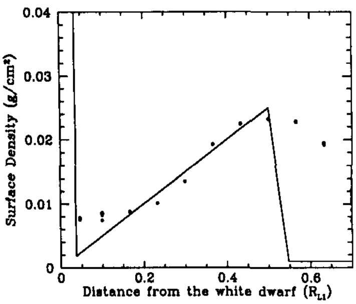

Fig. 2c: The **surface density** distribution of the optically thin image (solid line) and the reconstructed one (circles) by fitting all 7 light curves simultaneously.

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