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ACCRETION DISK IMAGE RECONSTRUCTION IN CATACLYSMIC VARIABLES

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RESUMEN. Se presenta un programa para rescatar la distribución de brillo del disco de acreción de Variables Cataclísmicas, de la curva de luz durante el eclipse. Se discuten los resultados de las pruebas para datos sintéticos.

ABSTRACT. A program to recover the accretion disk brightness distribution in Cataclysmic Variables from their eclipse light curve is presented. The results of performance tests for synthetic data are discussed.

Key words: STARS-ACCRETION DISKS — STARS-CATACLYSMIC VARIABLES

I. INTRODUCTION

We have developed a program to map the accretion disk brightness distribution in Cataclysmic Variables (CVs) from their eclipse light curves (PRIDA). This program is an alternative implementation of the Eclipse Mapping Method (Horne, 1985), employing penalti function optimization techniques (Fiacco and McCormick, 1968) with a conjugate gradient algorithm (Press et al., 1986). We introduced the combination χ^2+T as a statistical check for consistency in the program. This prevents the existence of correlated residuals in the mid of the eclipse. Such residuals, present when only the χ^2 is used, produce distortions in the peak of the disk brightness distribution (Baptista, 1989).

II. PERFORMANCE TESTS

To test the performance of PRIDA we have constructed syntetic 19x19 pixels images which were convolved with an eclipse geometry matrix (Fig. 1) to generate synthetic light curves. We added random noise to these curves to simulate real data. Figs. 2 and 3 show reconstructions from synthetic light curves compared to the original synthetic images.

PRIDA has proven to be a useful tool for the study of the accretion disk structure in CVs, allowing the comparison between observations and current theoretical models. To accomplish this, the eclipse light curves used as input data should have high S/N ratio and maximum coverage and phase resolution allowed by the image-matrix used. One way to fulfill this requirement is by averaging many light curves in an eclipse mean profile. This not only reduces the uncertainty associated to each point in the light curve, but also allows a considerable reduction of the flickering contribution, characteristic of CVs, in the light curve. High S/N ratio average profiles can be used to eliminate problems as the multiplicity of maximum entropy solutions, the dependence of the final image on the initial one, and even the distortions in the peak brightness distribution caused by the use of χ^2 as the consistency statistical check, characteristics that are noticeable when the input data have low information content.

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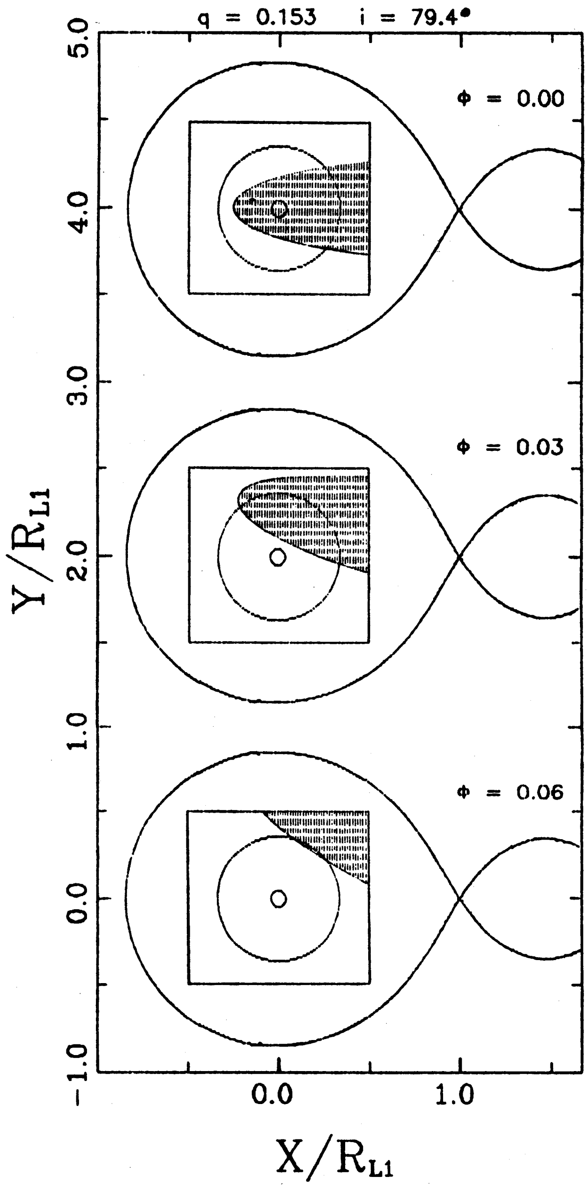

Fig. 1. Configuration obtained for the Cataclysmic Variable NSV 12615 in three different phases over eclipse. The Roche lobes are projected in the orbital plane and the stars move counterclockwise. The dashed regions corresponds to those parts of the disk eclipse in each phase. The circles in the primary lobe represents the white dwarf and the accretion disk. This eclipse geometry was used for PRIDA performance tests.

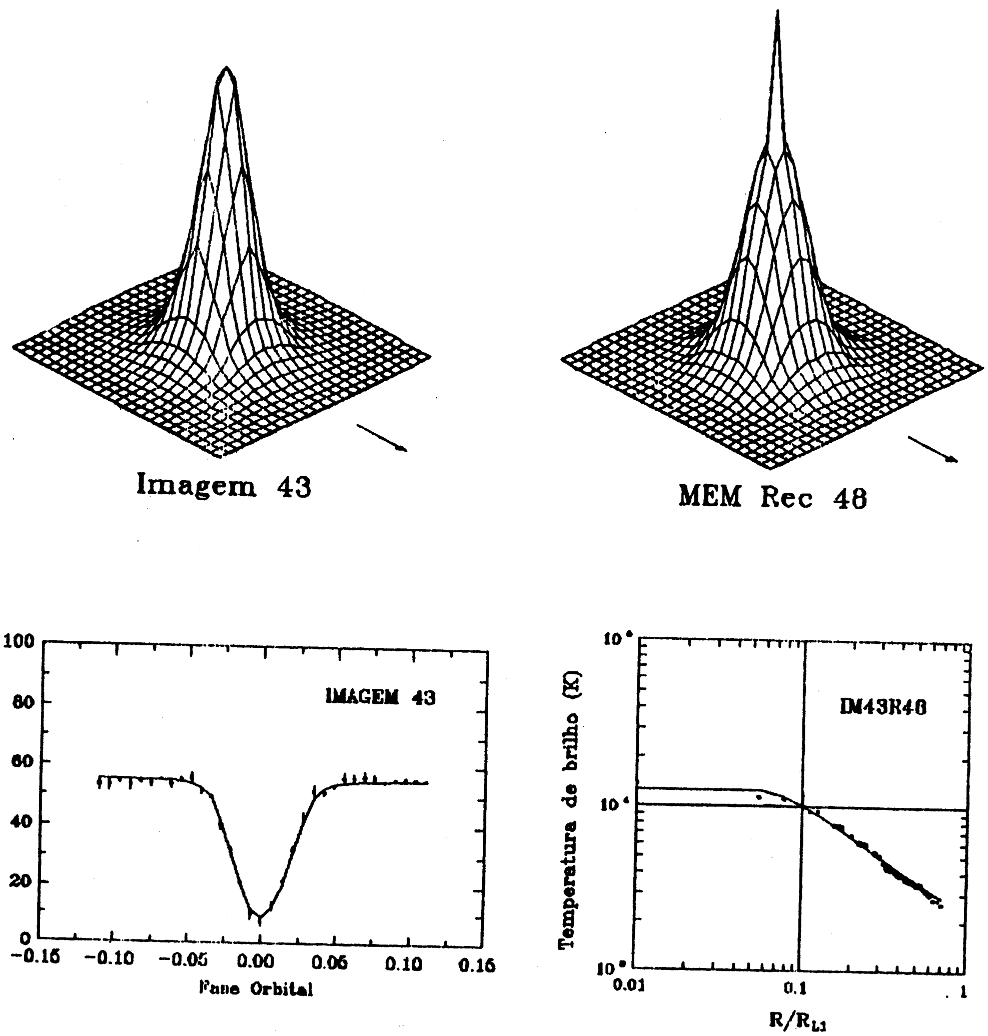

Fig. 2. The synthetic image 43 and one of its reconstruction. The arrows indicate the direction of the secondary star. The light curve used for the reconstruction has low S/N ratio (~20 out of eclipse). The lower left diagram shows the light curve obtained from the reconstruction. The points corresponds to the synthetic input data. The lower right diagram shows the reconstructed radial temperature profile. The solid line corresponds to the distribution of the original image.

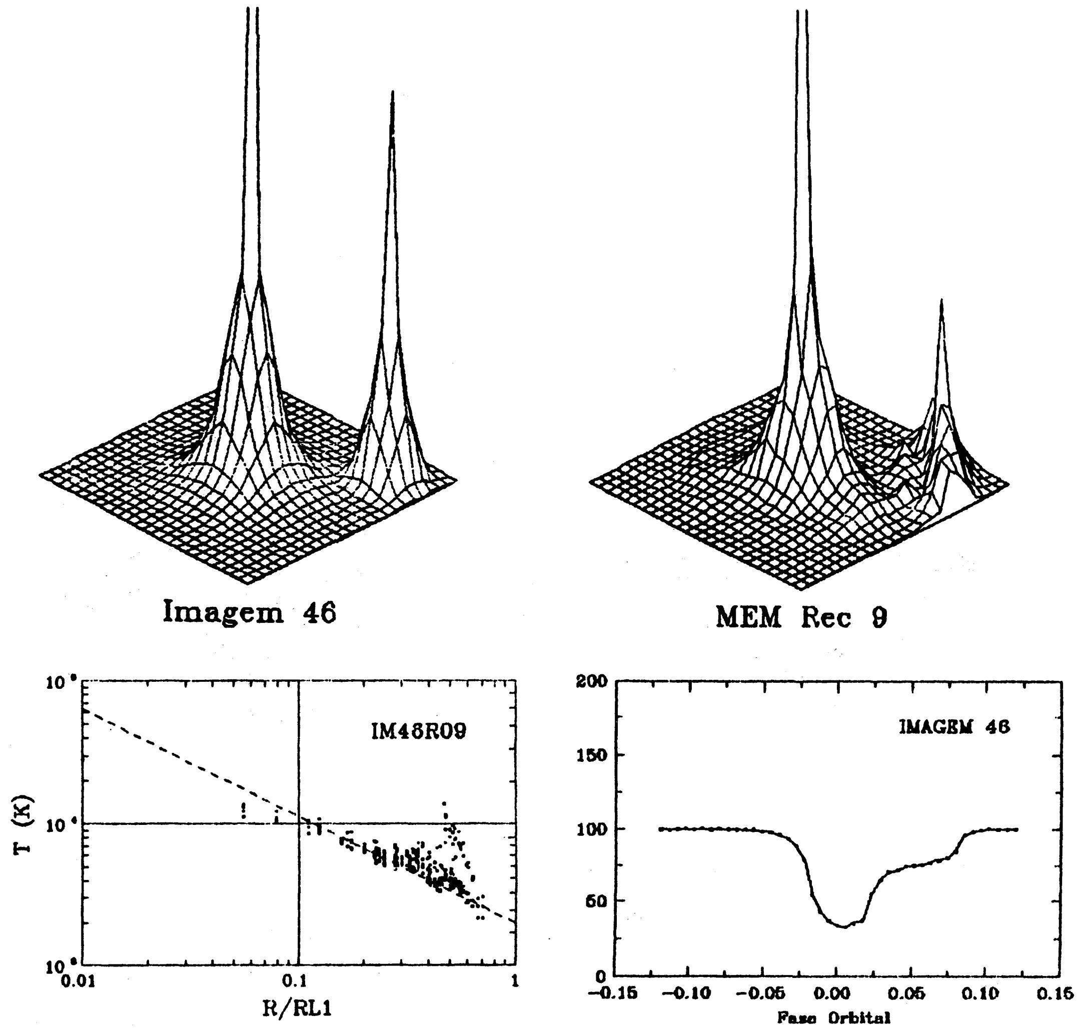

Fig. 3. Comparison between an assymetric synthetic image and one of its reconstruction. In this case the synthetic input data have high S/N ratio (~200 out of eclipse). the adjust of the light curve to the considerably assymetric eclipse profile is satisfactory. it can be seen that, despite the azimutal distortion, its possible to recover the localization of the assymetric source in the disk.

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