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THE OPTICAL COMPANION TO UX TAU A

(Research Note)

Franco Della Prugna, Nuria Calvet, and Gustavo Sánchez

Centro de Investigaciones de Astronomía, Venezuela

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RESUMEN

La compañera de UX Tau A, UX Tau C, se ha resuelto en longitudes de onda visibles; ésta fue observada por Herbig en 1975, y no pudo ser detectada en observaciones 'speckle' posteriores. La compañera está a 2.6±0.1 segundos de arco de UX Tau en ángulo de posición 184°±5°.

ABSTRACT

We have resolved in the optical the companion to UX Tau A, UX Tau C, first observed by Herbig in 1975, but that could not be detected in later speckle observations. The companion is at 2.6±0.1 arcsec from UX Tau in p. a. 184°±5°.

Key words: **ASTROMETRY – STARS-BINARIES**

I. INTRODUCTION

As a part of a series of tests performed with the new CCD detector acquired by the Observatorio Nacional de Llano del Hato, we obtained CCD images of the T Tauri star UX Tau. This star is actually a system of two stars, separated by $\approx 6''$ (Herbig and Bell 1988). A faint companion to the south of UX Tau A was seen by Herbig in 1975 at the coude focus of the Lick 3-m telescope (Jones and Herbig 1979; Herbig and Bell 1988). He estimated that the separation was $\approx 2''$ in p. a. $\approx$ 180°. Baier *et al.* (1985) could not confirm the presence of this star with speckle interferometry in the visible, but they could not detect companions with a magnitude difference greater than 3^m. In our CCD exposures of the UX Tau system, the image of UX Tau A was clearly asymmetric, and the companion UX Tau C, at the distance and p. a. reported by Herbig, became conspicuous after applying Fourier techniques to the original images.

II. OBSERVATIONS AND RESULTS

Three images of 90 sec exposure time each of the UX Tau system were obtained with the 1-m coude reflector of the Observatorio Llano del Hato, Mérida, using a TH-7883 CCD. No filter was used. The scale and orientation of the images were determined using six CCD exposures of reference stars from the PPM (Positions and Proper Motions) Star Catalogue (Röser and Bastian 1991). Astrometric reductions gave a scale factor of 0.23 arcsec per pixel.

In direct exposures, as shown in Figure 1, the image of UX Tau A is clearly asymmetric towards the south. The images were processed using IRAF routines. The Fourier transform $F(u,v)$ of each one was computed. On the other hand, a suitable filter function $H(u,v)$, able to attenuate the low frequencies and amplify the high frequencies simultaneously, was assessed by trial and error. A gaussian filter function centered at the origin of the frequency plane with a σ of 15 pixels gave good results. The adopted value for $H(0,0)$ was 0.2, increasing asymptotically to 1.2 at high frequencies. The inverse Fourier transform of the product $F(u,v)H(u,v)$ was computed for each image, and finally the three filtered images were added.

The processed image is shown in Figure 2. A faint companion to the south of UX Tau A is apparent. The distance of this object to A is 2.6±0.1 arcsec in position angle 184±5°. The difference of integrated magnitude between A and C is 4.4^m.

The detection of this close companion shows the potential of the coude 1-m telescope-CCD system for studying pre-main-sequence binaries. In particular, once the set of filters is acquired, we will attempt to carry out optical photometry of this and other close companions to T Tauri stars.

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Nuria Calvet, Franco Della Prugna, and Gustavo Sánchez: CIDA, Apartado Postal 264, Mérida 5101-A, Venezuela.

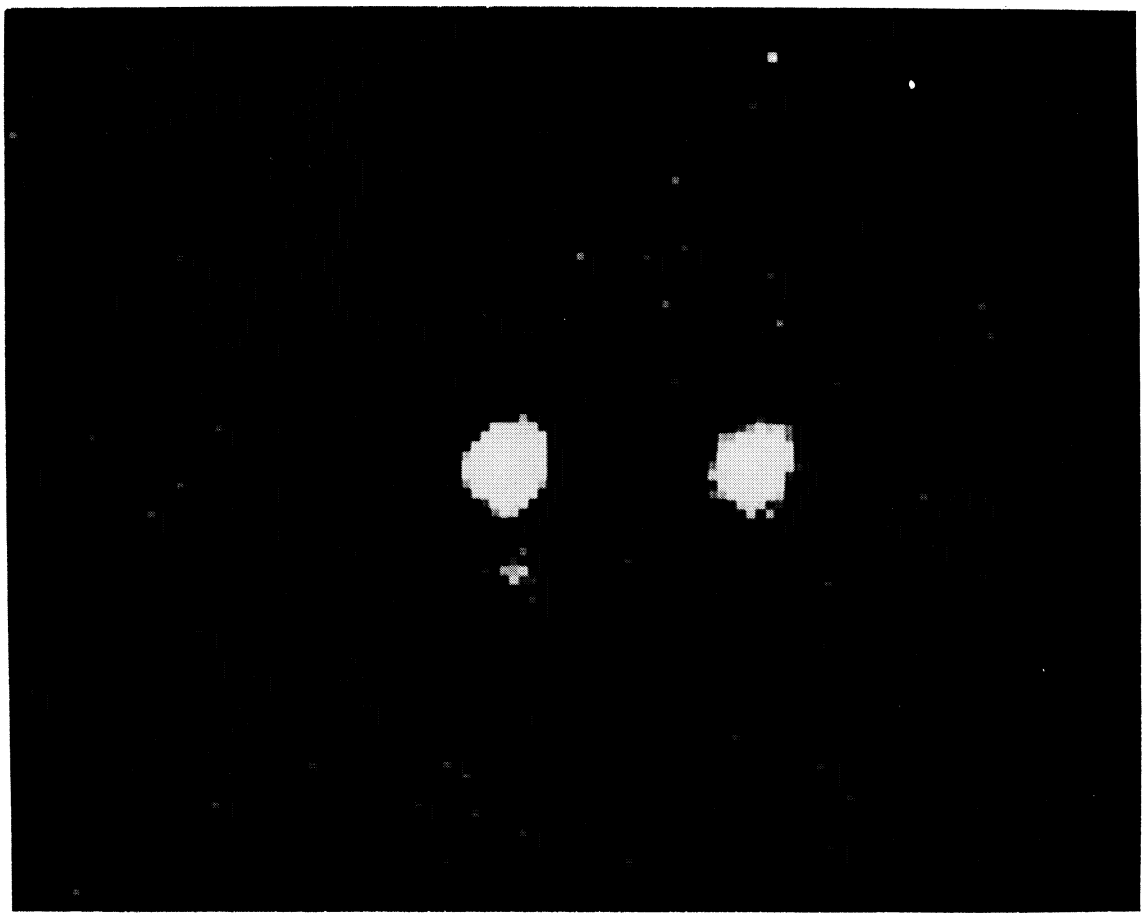

Fig. 1. Unprocessed image of the UX Tau system. North is up, east to the left.

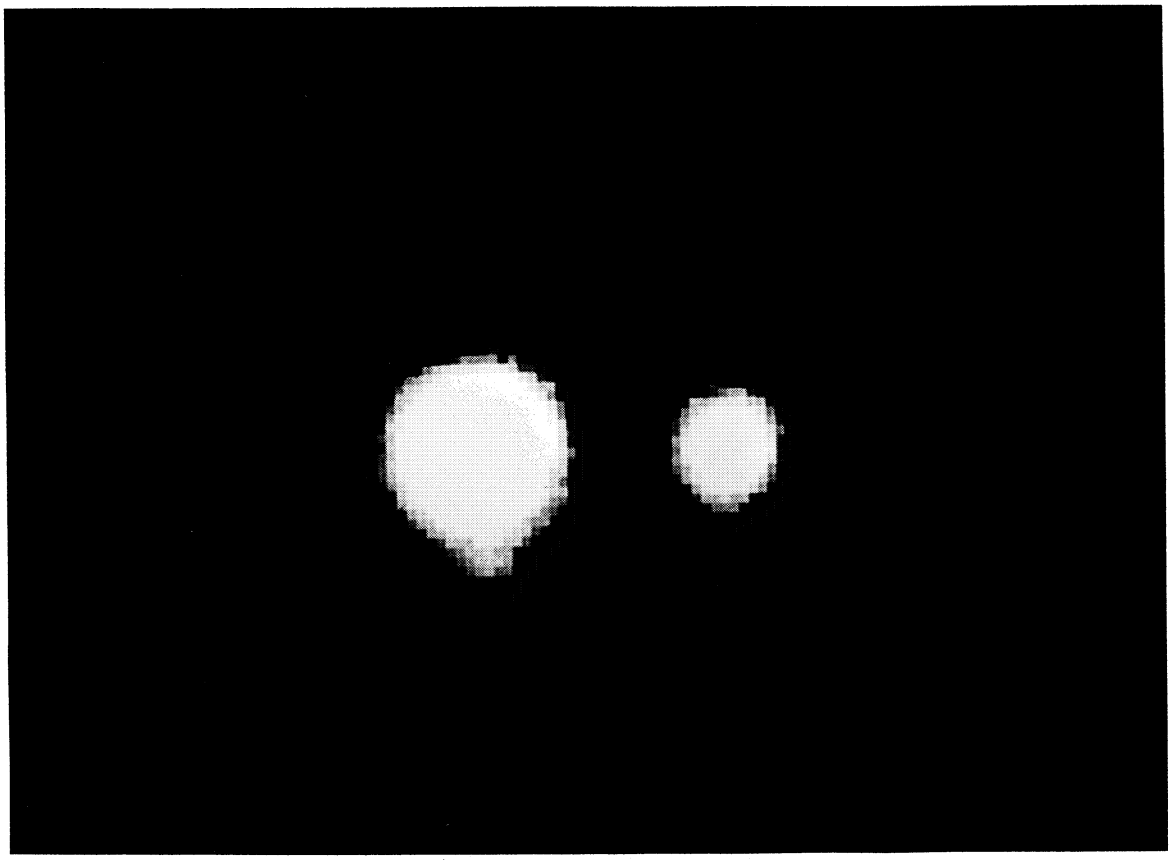

Fig. 2. Image of the UX Tau system after processing by Fourier techniques. The faint companion UX Tau C is clearly seen south of A. Orientation as in Figure 1.