Speckle observations of post-Hipparcos late type double stars

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1 Introduction

Late type stars are surrounded by an envelope of gas and dust. Several observations have shown the asymmetry of the envelope when the central star is a post-Asymptotic Giant Branch star. Everyone has in mind the spectacular image of Egg-Nebula made by the Space Telescope. The recent speckle-masking image reconstructions of the AGB Mira star R Cas (Hoffman et al, 1995) show a clearly elongated disc. These stars lose a fraction of their mass with a geometry that is still not well understood (bipolar jets, equatorial discs). Among the different models proposed to explain the geometry of the dust shell and of the mass loss, Morris (1987) referred to the presence of a double star system.

This assumption is supported by several observations. Since the discovery of the companion of Mira (Joy, 1926), about 20 binary systems involving a late-type star have been discovered using various techniques (spectroscopy, astrometry, speckle,...) from both ground-based telescopes and spatial observations (see Castelaz *et al.*, 1995 and references therein). A hundred of other systems have been discovered by the satellite Hipparcos during its observing run, with separations as close as 100 mas and up to a magnitude difference of 2.5 (Mignard *et al.*, 1995).

The study of such systems is of high interest for the knowledge of the stellar evolution and the understanding of the mass loss process of late type stars. Interacting mass exchange may exist in binary systems. Photometric variations of the companion could then result from this mass exchange. These photometric fluctuations have been observed for the prototype of Mira stars, Omicron Ceti, by the satellite IUE in the ultaviolet (Reimers *et al.*, 1985). Paul Couteau has observed Mira with the 50 cm refractor of Nice and has noticed some color variation of the companion (a B-type star).

2 The project

Our present project is to make systematic observations of these stellar systems in order to study the light curves of the companions. Due to the variability of the late -type stars (for example o Ceti has a V magnitude ranging from 3 to 9 with a period of 311 days, its companion is of 11th magnitude) the observations

must be foreseen at the main star's minimum. The close separations of these systems require long baselines and /or speckle interferometric techniques. The separation between Mira A and B is about 1 arcsec, corresponding to $\simeq$ 100 A.U. at the assumed distance of Mira (114 pc). With an interferometer of 1 mas resolution, one could observe such systems up to a distance of 100 kpc.

The stars discovered by Hipparcos have separations larger than 100 mas. They can be observed with a 1.50 m telescope. A speckle experiment has been developed at the "Laser Lune" telescope (Observatoire de la Côte d'Azur). It is currently under realisation and has given its first light on 05/30/1996. It is a simplified version of the "Tavélographe Masqué" (see below).

3 First observations

Preliminary observations were carried out in December 1995 at the Pic du Midi 2.0 m Bernard Lyot telescope using the specklegraph developed by the Aperture Synthesis group of Observatoire Midi-Pyrénées (France) and an ICCD video camera. Observations were made in green light (λ = 550 nm, $\Delta\lambda$ = 70 nm). Among the 15 post-Hipparcos observed stars, five have been processed and two have been detected as double. Results are presented in figure 1.

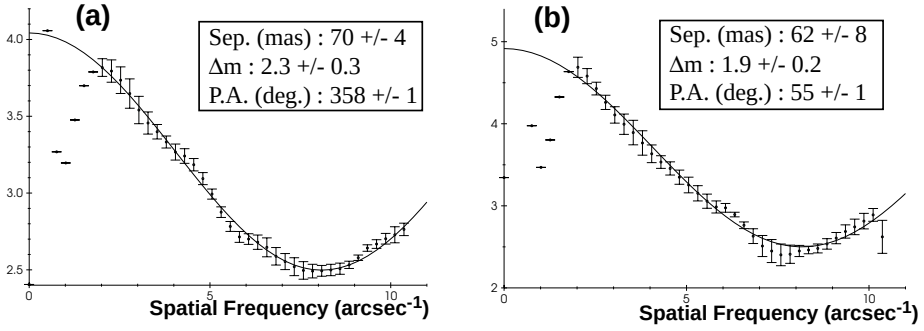

Fig. 1. Visibility functions for HIP 21046 (a) and HIP 21059 (b). The computation was made on $\simeq$ 1000 images (20 ms exposure) of the double stars and their reference star.

References

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