Cool carbon star TX Piscium observed with AMBER ESO VLTI

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INTRODUCTION

Late-type giant stars are crucial branch for our understanding of evolution in Sun-like stars, but some of their characteristics are still not well understood. In particular process between the outer extended photosphere of star and circumstellar shell. Theoretical models usually have lacked sufficient observational data and constraints. To deliver the information on the scale of milliarcsecond (mas), only high image resolution techniques can be used. Optical long baseline interferometry is an ideal tool for that. We have used the fringe visibility, related to the complex degree of coherence in near-IR to compute the angular diameter of late-type giant star TX Psc.

TX Piscium

TX Psc is a non-Mira, cool carbon variable star (spectral type C II). It is an intermediate mass star, having already spent most of its life on the main sequence, and currently heading towards the asymptotic giant branch. It is surrounded by a very compact dust shell. Its circumstellar emission has been already detected by lunar occultations [1].

RESULTS

MEDIUM resolution: we selected two windows of 5 nm width within the K band. The wavelengths were chosen below and above 2.3 mm (thus names ”short” and ”long” wavelengths, respectively), and diameter values were averaged for them. The results (**Fig. 3**) show that the diameter in the ”short” window seems to be systematically smaller than the ”long” window.

LOW resolution: we obtained a relatively flat diameter distribution in the H and K parts of the spectrum (**Fig. 4**), with a continuous increase in the long part of the K band and a very steep increase to the short J wavelengths. It can be an indication of the circumstellar shell, which contributes more at long wavelengths due to re-emission, and even more at short wavelengths due to scattering.

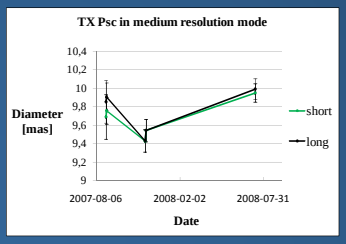

Figure 3. The diameter changes can be observed with a time. The diameter for shorter wavelengths is in general smaller than for longer ones, according to our expectations.

Figure 1. Used observations were done with the ESO VLTI (credit to ESO/Y. Beletsky)

DATA & METHODS

We used data taken with AMBER, the near-IR instrument of ESO Very Large Telescope Interferometer (**Fig. 1**). AMBER is a spectro-interferometric beam combiner, which provides simultaneously spectrally dispersed visibility for three baselines and one closure phase with a choice of 3 spectral resolutions [2].

Table 1. Summary of available observation nigths.

Resolution mode	Central wavelength λ [μm]	Number of nights	Telescopes setup	FINITO status
Medium K	2.3	5	UT1-UT2-UT3	OFF
Low	J,H,K	1	H0-G0-E0	ON

In the data reduction process the **amdlib 2.2** data reduction software was used. Afterwards, the model of a uniform disc (UD) was fitted to the visibility data (**Fig. 2**).

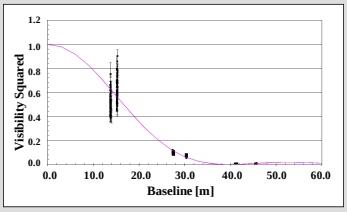

Figure 2. The model of a unifrom disc was used to fit the visibility data for each wavelength.

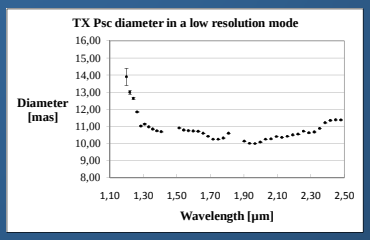

Figure 4. The results in the low resolution mode show significant changes of the diameter over the JHK band. It migth indicate the detection of a circumstellar shell.

CONCLUSIONS

We are aware that a UD model is not adequate for TX Psc, however in the first approximation of a hydrostatic star we expect its limb darkening profile to be not too different from the UD one. In this approximation, our initial analysis provides some preliminary conclusions.
Our results show a wavelength-dependent diameter and highlight changes with time, possibly related to the stars variability. In general, we find a characteristic size of about 9.5-10 mas, consistent with previous measurements. However, we also find possible asymmetries from the diameter measurement. These are probably due to the contribution from the circumstellar shell.

REFERENCES

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