Circumstellar Envelopes of OH/IR Stars*

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Abstract

We present near-infrared interferometric observations of three tip-AGB stars carried out with the VLTI/AMBER instrument in April 2008. These stars are evolved oxygen-rich single stars belonging to the OH/IR type. The data were taken in low resolution mode in *H* and *K* bands, using the 1.8-m Auxiliary Telescopes (ATs) with three different baseline lengths of 15.92, 31.83 and 47.76 meters. We fit the resulting visibilities with a model consisting of a Gaussian component plus a central uniform disk obtaining apparent diameters of the dust shell and the central star and their flux ratios.

Introduction:

The final phase of the evolution of low to intermediate mass stars is crucial for the chemical enrichment of the interstellar medium. While a star ascends the Asymptotic Giant Branch (AGB), its luminosity rises several thousand times. Furthermore, pulsations and radiation pressure on dust grains cause a dense stellar wind, obscuring the object at short wavelengths At the tip of the AGB, mass-loss increases reaching rates of up to several $10^{-5} M_\odot\ yr^{-1}$ and leaving the star surrounded by the dust envelope created during this “super-wind” phase, while layers close to its core become exposed. The ejected envelope slowly expands and cools, revealing the central star and forming a planetary nebula (PN).

Data analysis:

The data were downloaded from the ESO archive and reduced with the standard procedure of the *amdlib 2.2* package and the *yorick* interface provided by the AMBER consortium and the Jean-Marie Mariotti Center.

We model the visibilities as a Gaussian circumstellar shell plus a central uniform disk for the star (a cartoon representing this is shown as background).

The plots show the best fit model for each star. Since the optical depth of the dust shell in each star is different, we may be observing different stages of evolution, where IRAS 17020-5254 is the least evolved showing a more diluted dust component and a molecular shell, IRAS 14086-6907 has a 50/50 flux contribution from the star and the shell, and IRAS 13479-5436 shows almost a point source in the center with most of the emission coming from the dust envelope.

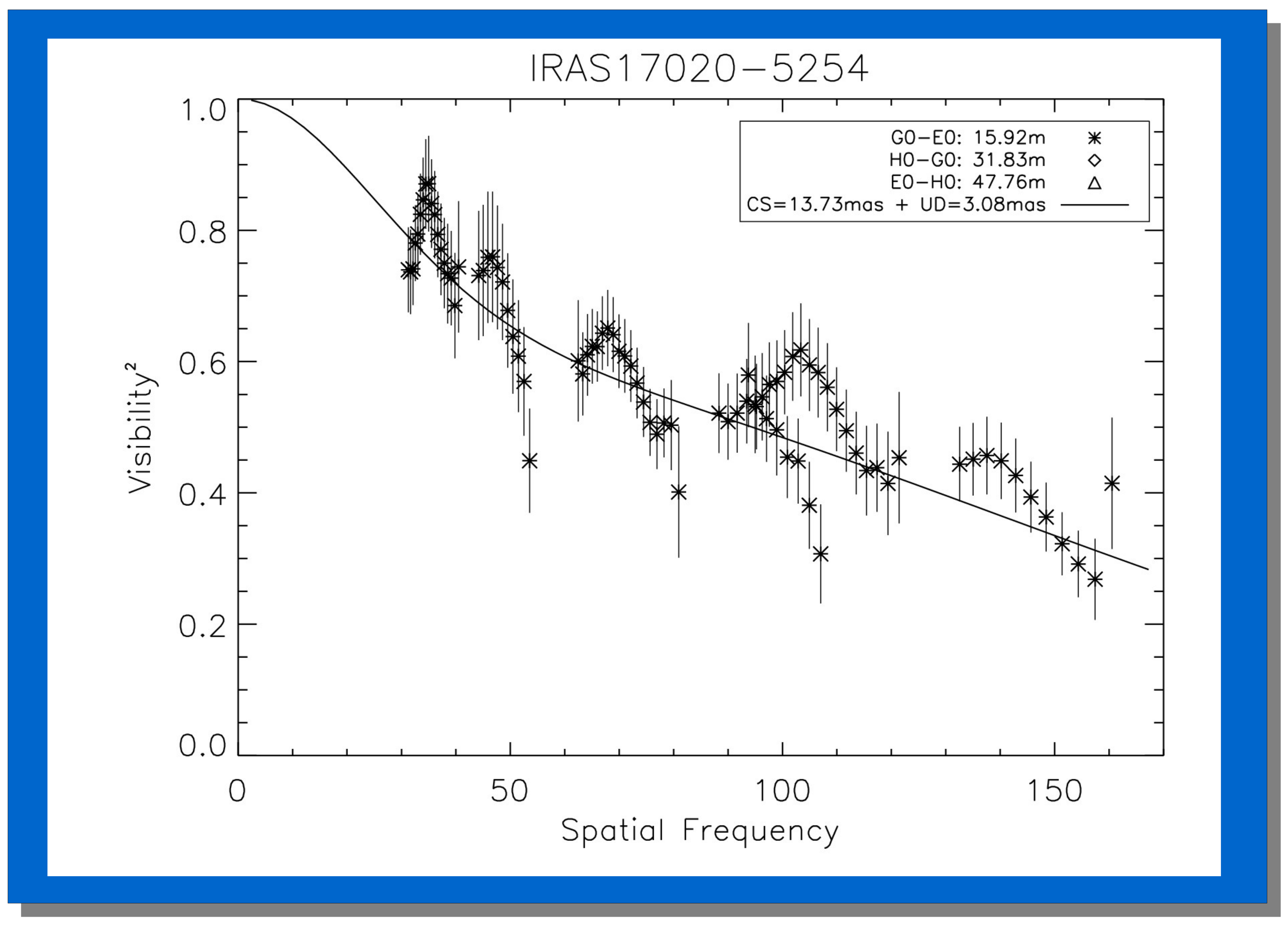
Since the distance to the stars is unknown, the apparent diameters cannot be compared in this context.

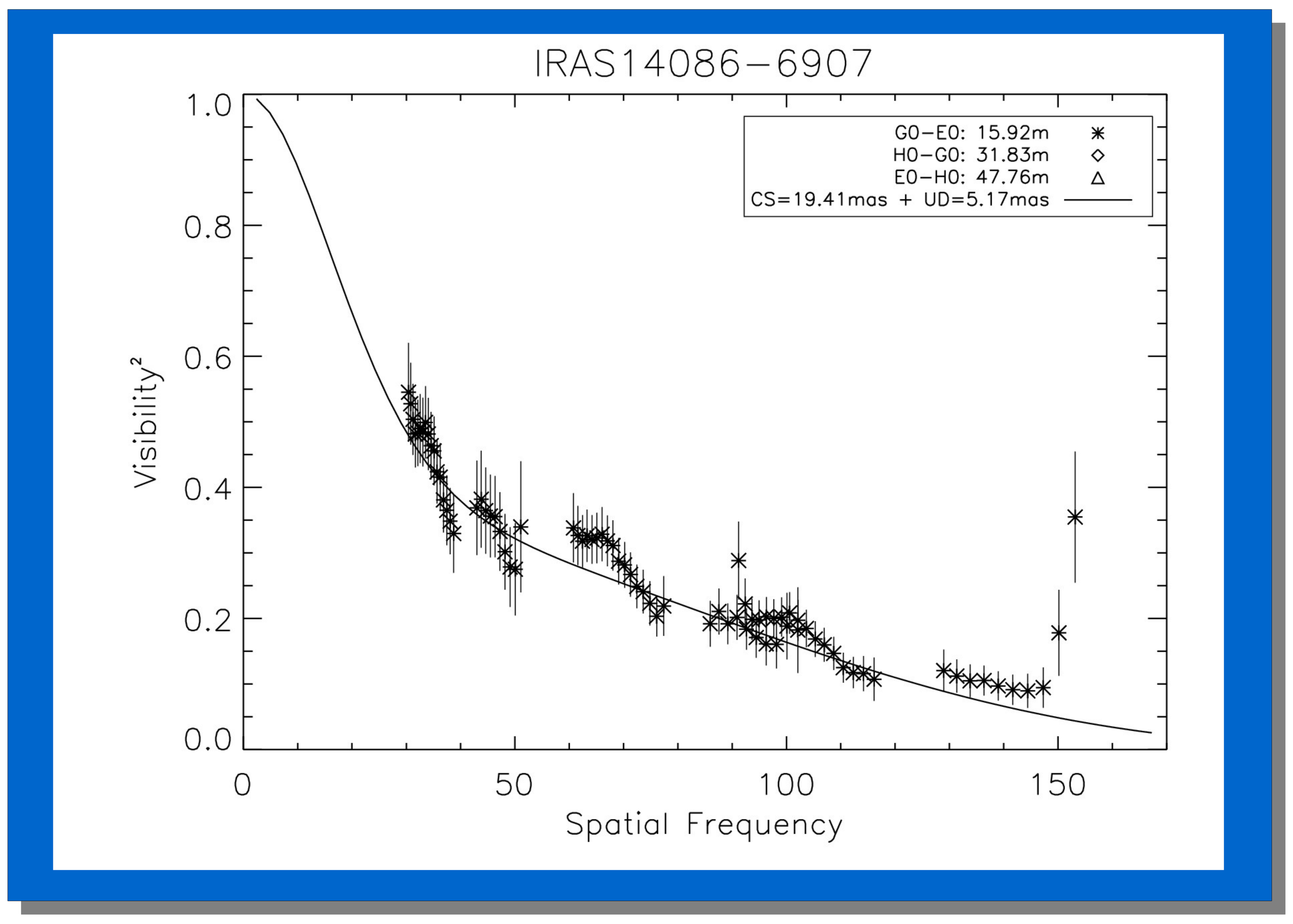
The closure phase does not show any significant deviation from zero that could be caused by asymmetries.

IRAS 17020-5254:

Visibility fit of a Gaussian shaped envelope with FWHM of 13.7 mas plus a central uniform disk of 3.1 mas in diameter contributing with 80% to the total flux of the system.

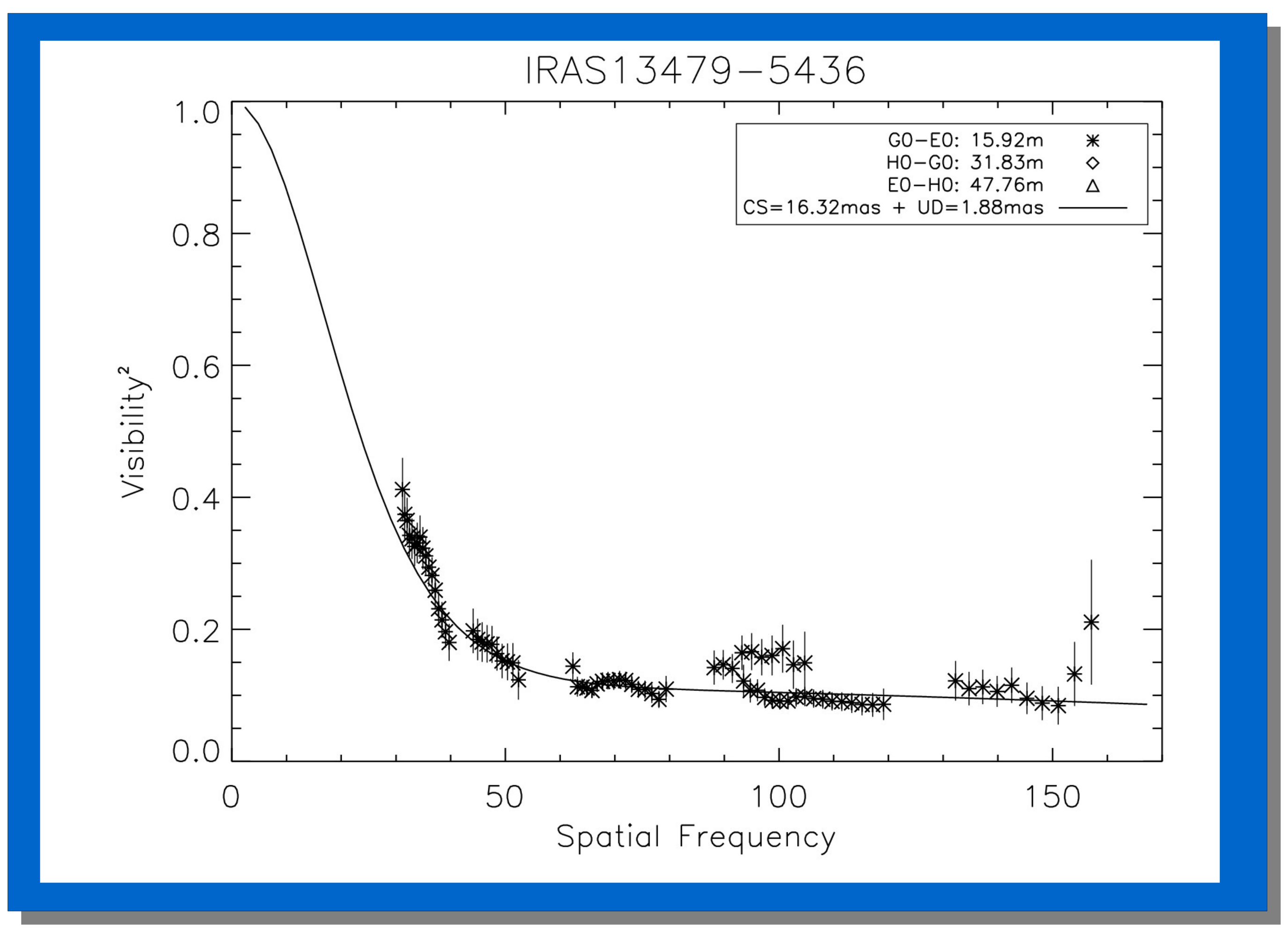
The bumpy features indicate the presence of a molecular shell composed of water vapour located very close to the star (this was not taken into account for the fitting).





IRAS 14086-6907:

Visibility fit of a Gaussian shaped envelope with FWHM of 19.4 mas plus a central uniform disk of 5.1 mas in diameter contributing with 61% to the total flux of the system.



IRAS 13479-5436:

Visibility fit of a Gaussian shaped envelope with FWHM of 16.3 mas plus a central uniform disk of 1.9 mas in diameter contributing with 34% to the total flux of the system

Conclusions and future work:

We determined apparent diameters of three OH/IR stars and their circumstellar envelopes. For one star we resolve the molecular features around the photosphere.

In further investigations we will additionally use mid-infrared observations taken with the VLTI/MIDI instrument available in the archive and compare them to theoretical data based on density profiles of hydrodynamical wind models in order to constrain the models.

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*Based on observations made with the Very Large Telescope Interferometer (VLTI) at the Paranal Observatory under program ID 081.D-0325(H).