Interferometric Observations in two different scientific cases of special interest

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Abstract

In this contribution we present how interferometric techniques can be used for two different scientific cases:

Protoplanetary disks: Protoplanetary/debris disks has become a hot topic in astrophysics in particular after the first detection by the IRAS satellite of the massive β Pictoris debris disk. After two decades of research in the field, much has been learned about the outer and middle parts of them. However, the innermost AUs remain pretty unknown. The advent of long baseline infrared interferometry will directly explore this region for the very first time. **Darwin targets:** The ESA mission Darwin is aimed to detect and characterize Earth-like planets around nearby solar type stars. A deep knowledge of the stellar targets and on their environment is needed to achive this goal. One of the most important observational constraints for Darwin is the binarity/multiplicity nature of the stars. Interferometric observations can reveal faint objects located at extremely short distances from the Darwin targets.

Herbig Ae [illegible] disks

Scientific Case

Herbig Ae (HAe) stars are surrounded by protoplanetary disks (see e.g. Natta et al. 2000 PPIV,559). The transient circumstellar absorptions displayed by the spectra of the UXOR subclass (assumed to be observed with the disk nearly edge-on) suggests that the matter is transferred to the star via magnetospheric accretion, in a similar way to the less massive T Tauri stars (Natta et al. 2000 ApJ 542, 421, Mora et al. 2002 A&A 393 259).

However, recent observations with AMBER/VLTI of the HAe star HD 104237 do not support magnetospheric accretion as the source of the HI Br γ emission. Instead, a wind originated near the puffed inner rim of the dust disk, is postulated.

Both gas accretion and wind outflows are phenomena originated in the very first AUs surrounding HAe stars. Long baseline near infrared interferometry is the only technique able to probe this region.

Observations proposed

We propose to gather AMBER/VLTI and MIDI/VLTI interferometric data of a significant sample of HAe stars. With the current sensitivities provided by the instruments, the objective is to provide a tight set of constraints for the competing theoretical models. If the performance of AMBER improves and HAe star observations are possible with the Auxiliary telescopes, aperture synthesis images of a selected sample of stars would be performed, providing the first direct view to the most internal regions of circumstellar disks.

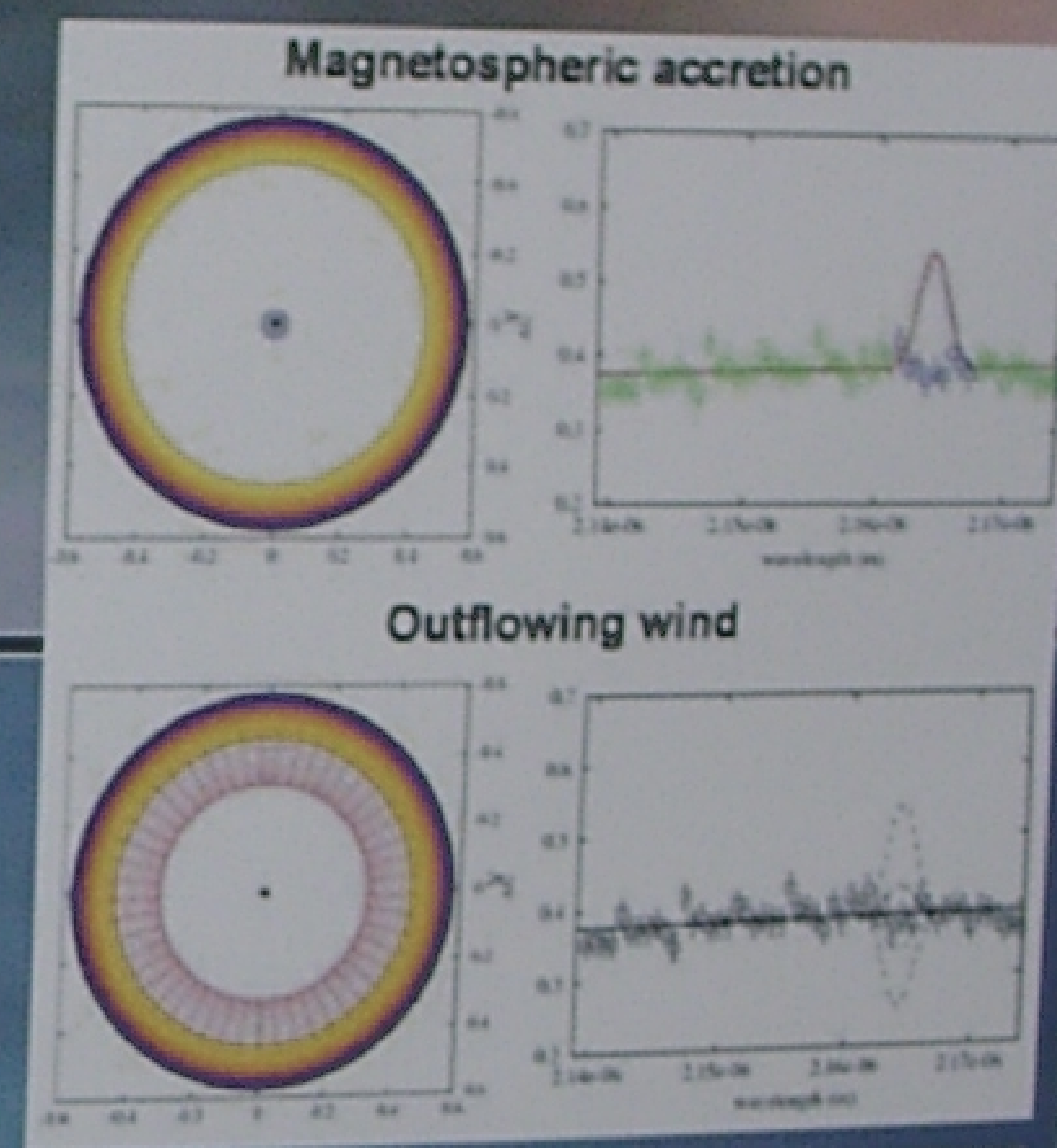

Fig. 1 AMBER/VLTI Near infrared interferometry of the Herbig HAe star 104237 in the Br γ region do not support magnetospheric accretion as the source of the Br γ emission shown in the integrated stellar spectrum. (Taken from Malbet et al. 2006 Proc. SPIE 6268)

Darwin stars

Scientific Case

The ESA mission Darwin will search for the presence of Earth-like planets orbiting nearby stars, study the planet atmospheres, carry out comparative planetology, and analyze potential spectroscopic signatures of life. A deep knowledge of the Darwin stars and their environment is required to achieve these objectives.

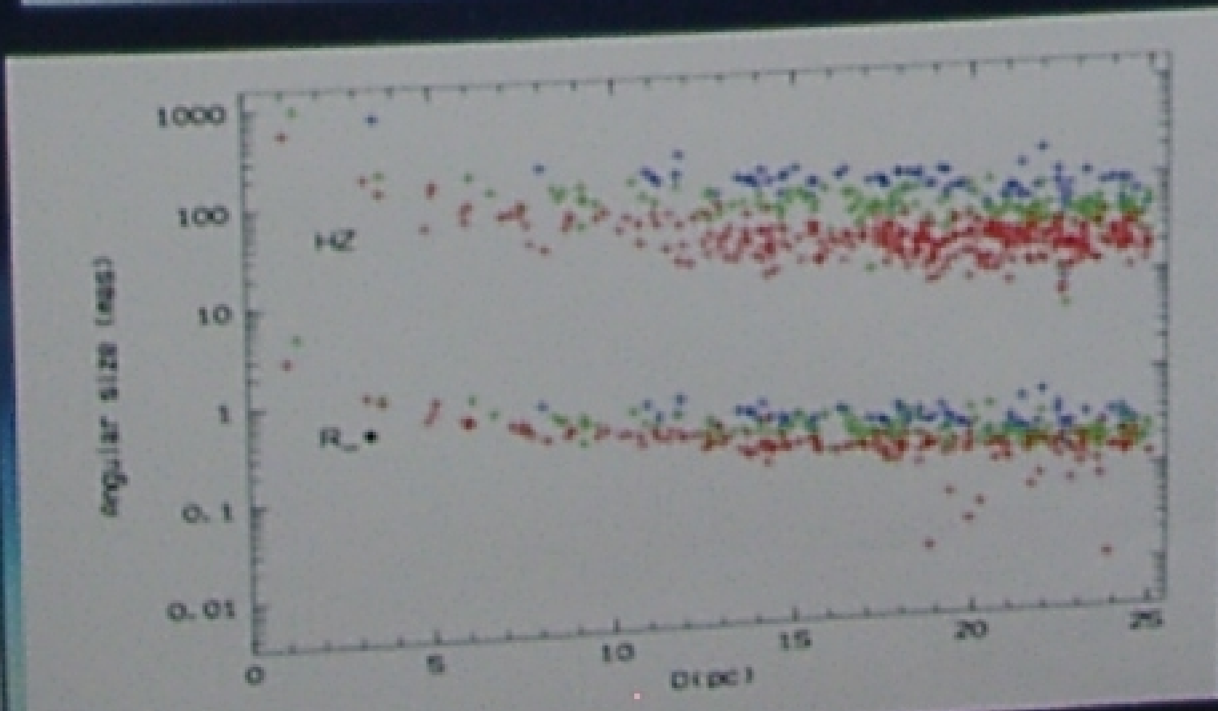

Fig. 2 Estimated angular sizes of the Habitability Zone (HZ) and Stellar Radii (R*) versus distance of all stars included in the preliminary Darwin target list. Such values provide a first approach of the projected locations forbidden for any kind of faint objects in order that Darwin can detect Earth-like planets. Blue: F star; Green: G stars; Red: K stars.

The binarity/multiplicity of the stars as an observational constraint

One of the most relevant observational constraints for Darwin is the binarity/multiplicity nature of the stars. Its incluence is twofold:

✓A faint object within the nulling interferometer field of view or in the inmediate surroundings can prevent us from obtaining a clear planetary signal.

✓ The existence of a physical companinon can influence the proper existence of an Earht-like planet in the stellar Habitable Zone.

ESA Darwin analysis shows that:

✓ Faint objects down to flux leves around 10^{-5} of the central star within an angular distance less than around 1.0" will render the detection of a planetary signal very difficult.

✓ Objets outside that angular distance will increase the scattered light through the system depending on the flux contrast ratio versus distance of the binary components.

A number of public archives and catalogues have been [illegible] to identify those stars with companions at angular distances lower than 1".0. However, [illegible] data revealing the presence or absence of very faint companions in the immediate surr[illegible]

Observations proposed

VLTI, KeckI and LBT can reveal faint objects located at extremely short distances form the Darwin targets, e.g. VLTI, can reveal faint objects at the 1-100 mas separation range, i.e. distances comparable to the size of the stellar HZ (see Figure 2). Astrometric interferometric signatures could appear if those objects are physically related.

In particular, the VLTI in its astrometric mode can be used to observe stars with a RV planet to solve the sini term and determine the mass of the planet with high accuracy.