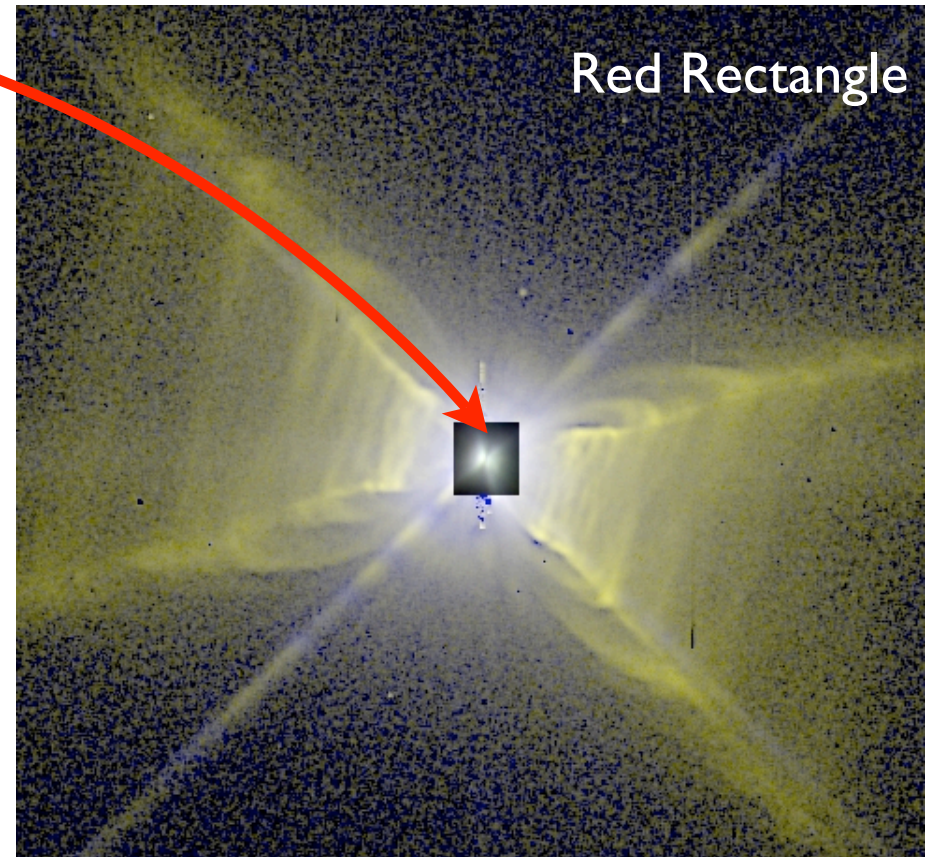
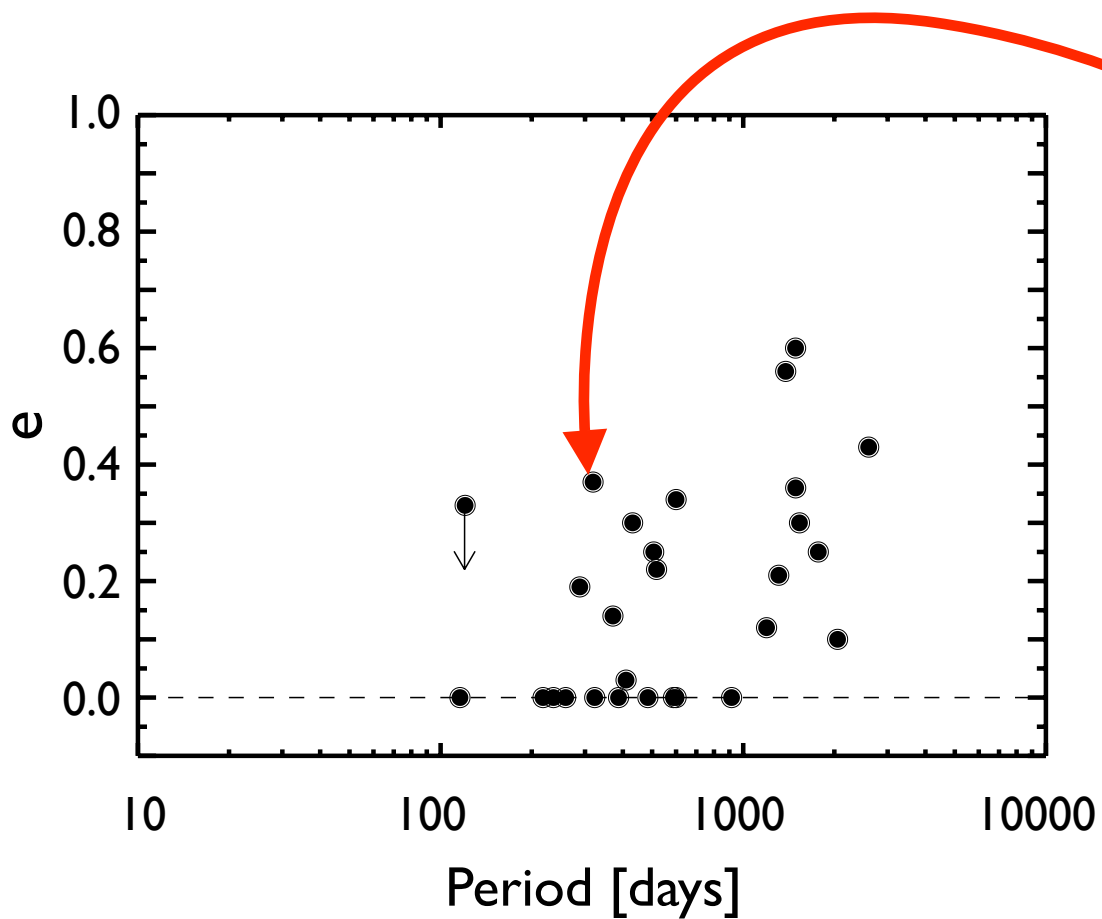


HOW DO BINARIES EVOLVE ?



RESOLVING THE COMPACT DUSTY DISCS AROUND BINARY POST-AGB STARS

- binary post-AGB objects
- chemo-physical structure of the CSE
 - ▶ case study: K and N-band interferometry
 - ▶ sample results
- conclusions

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VERHOELST, C. DOMINIK, C. GIELEN, B. ACKE, E.
VIDAL-PEREZ

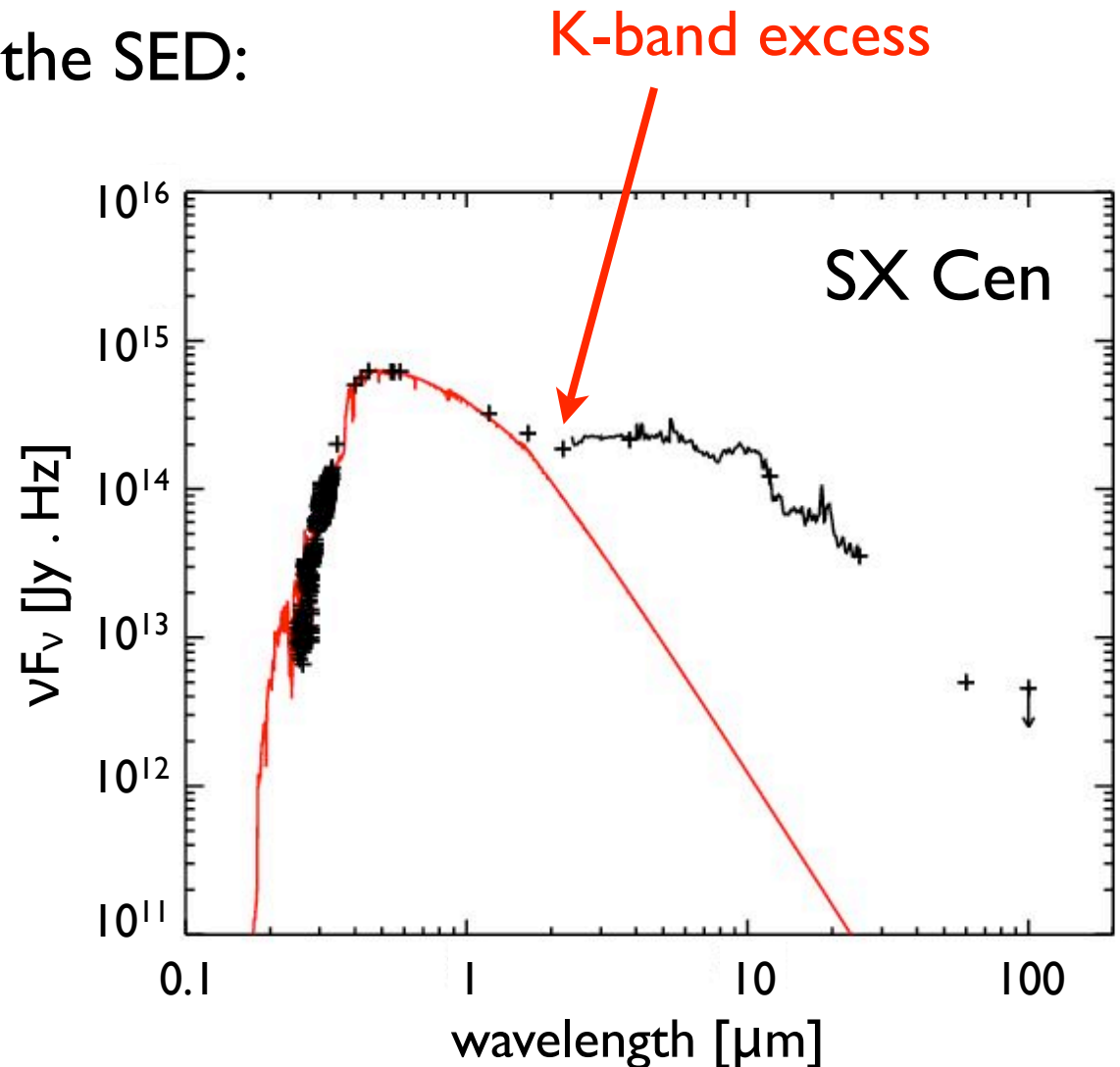
SYSTEMATIC SEARCH FOR BINARY POST-AGBs:

Binary post-AGBs based on the SED:

- post-AGB stars (F-G sp. type)
- broad IR excess starting around H or K

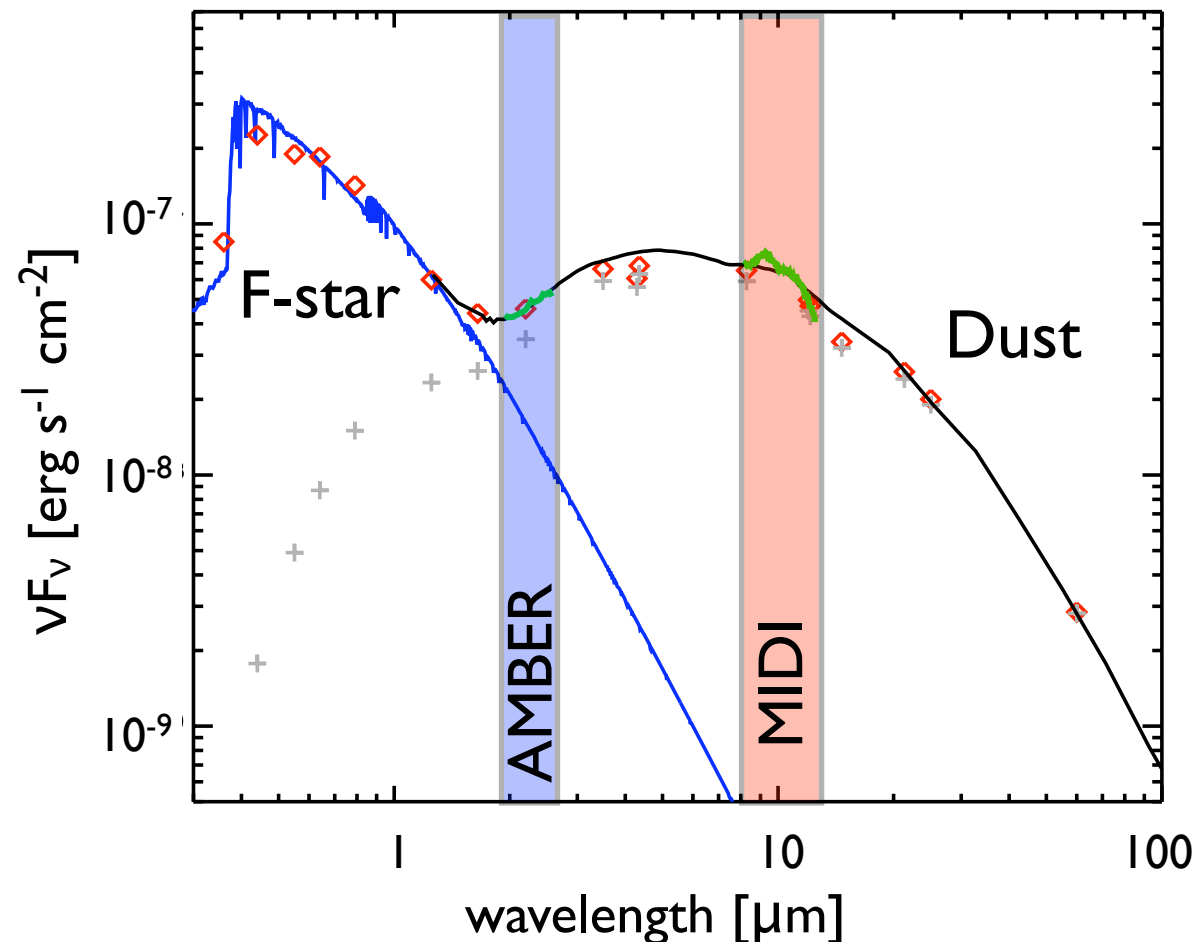
➡ both hot and cold dust
➡ in a stable geometry

- 51 objects
(De Ruyter et al. 2006)
- also in the LMC
(Poster 43 M. Reyniers et al.)



THE GEOMETRY OF THE CSE:

distances: few kpc
dust starts at few AU } mas scale \Rightarrow interferometry



VLTI/AMBER

- focal-plane instrument
- K-band (1.8 - 2.4 micron)
- **3** beam combiner
 - ➔ spectral resolution ($R \sim 30$)
 - ➔ closure phase capability

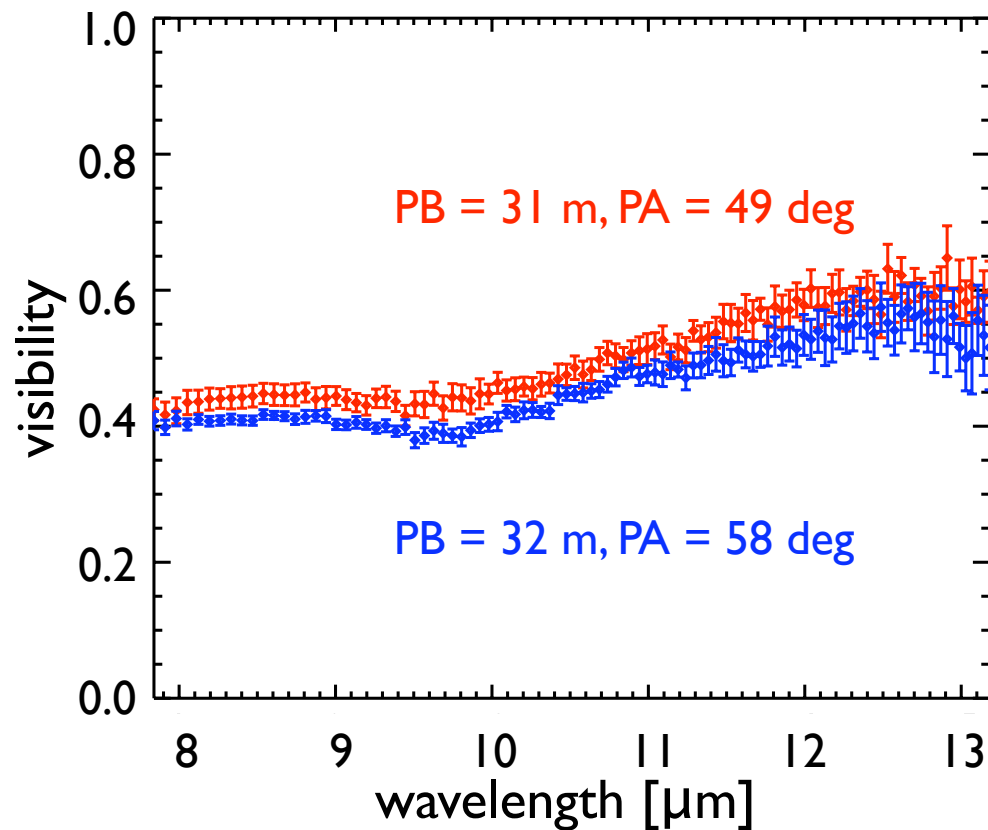
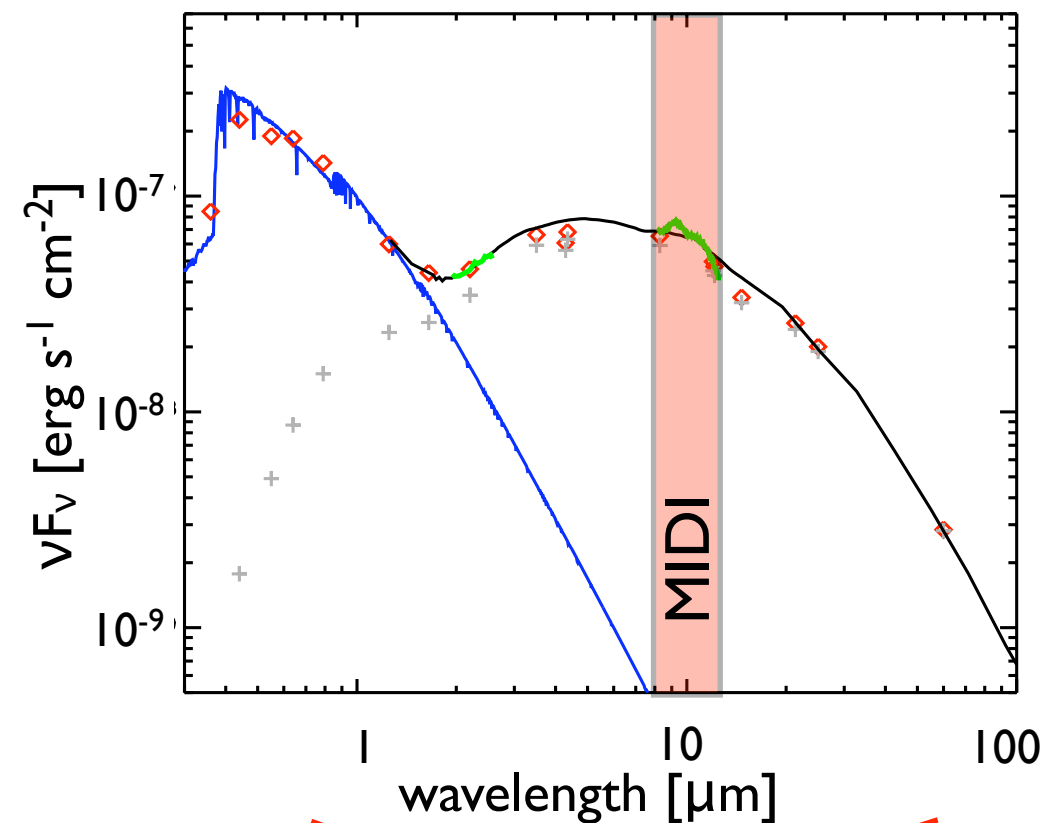
VLTI/MIDI

- pupil-plane beam combiner
- N-band (8 - 13 micron)
- **2** beam combiner
 - ➔ spectral dispersion ($R \sim 30$)

IRAS 08544-4431

N-BAND REGIME: MIDI

UDDiam = 40 - 50 mas $\xrightarrow{d = 0.8 \text{ kpc}}$ UDDiam = 30 - 40 AU



~~dynamical age ~ 8 years
outflow model ~ 2 x larger~~

}

stable (keplerian) disc

IRAS 08544-4431

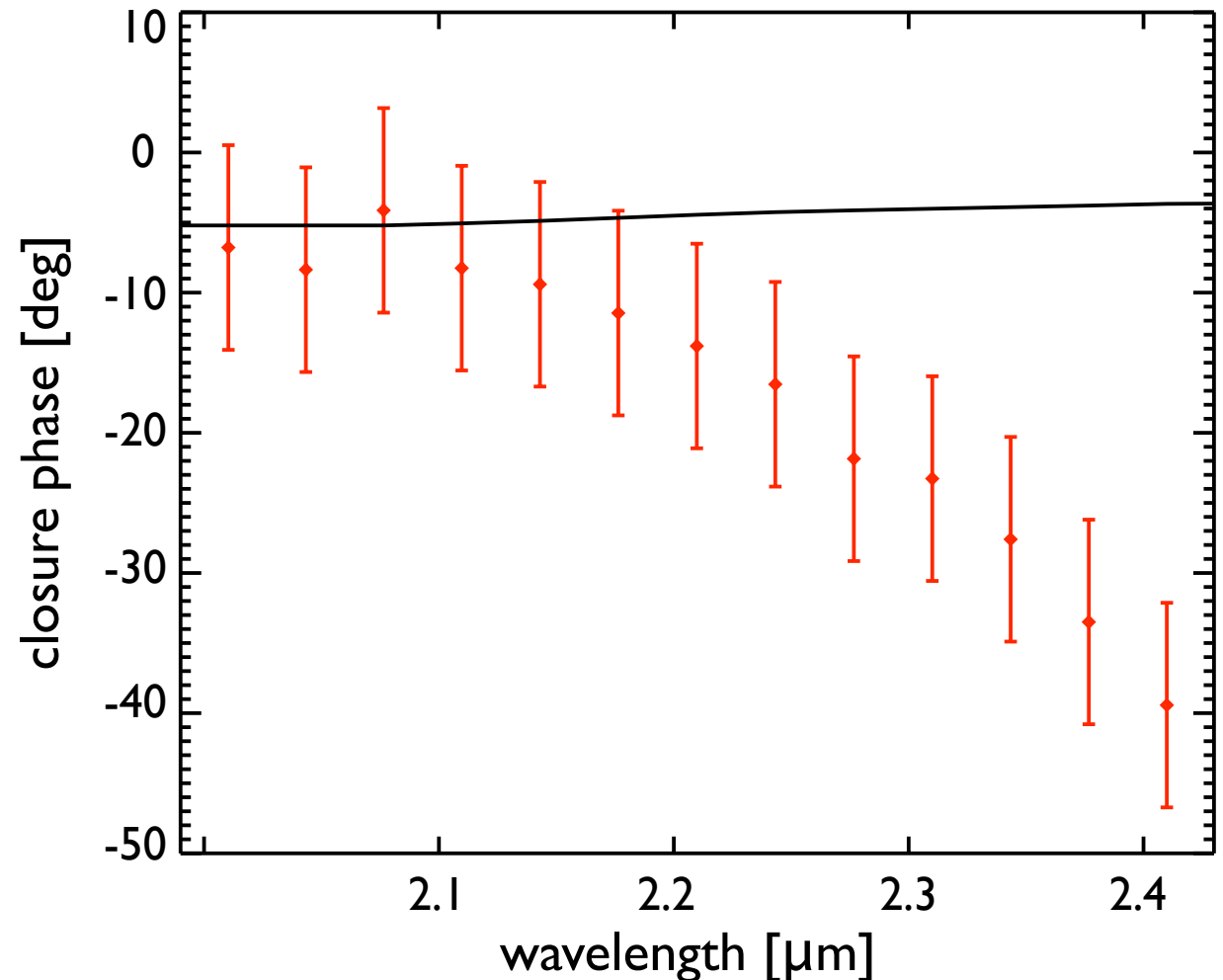
K-BAND REGIME: AMBER

closure phase:
measures the asymmetry

- centrosymmetric
 ➔ $CP = 0$
- $CP \neq 0$
 ➔ asymmetric

spherical outflow

- $CP = 0$
- $CP < 5$ deg due to
binary motion

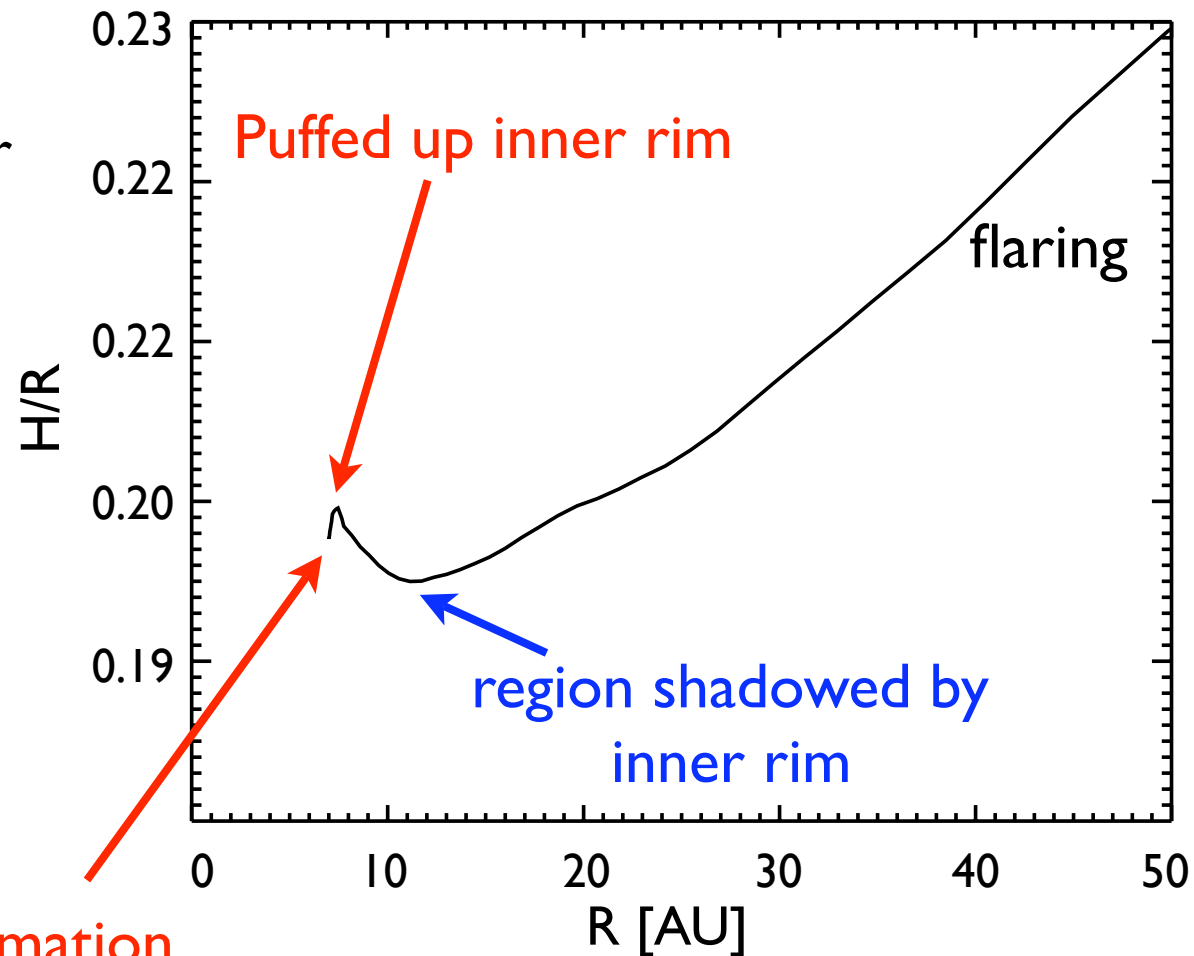


strongly asymmetric dust geometry

SELF-CONSISTENT 2D - MODEL:

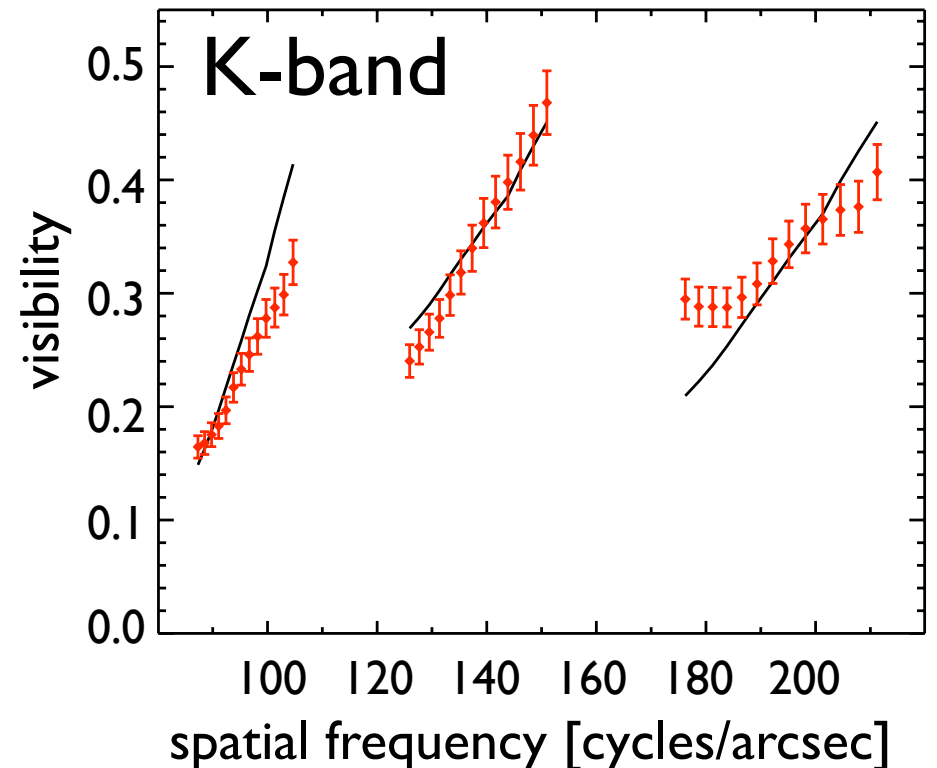
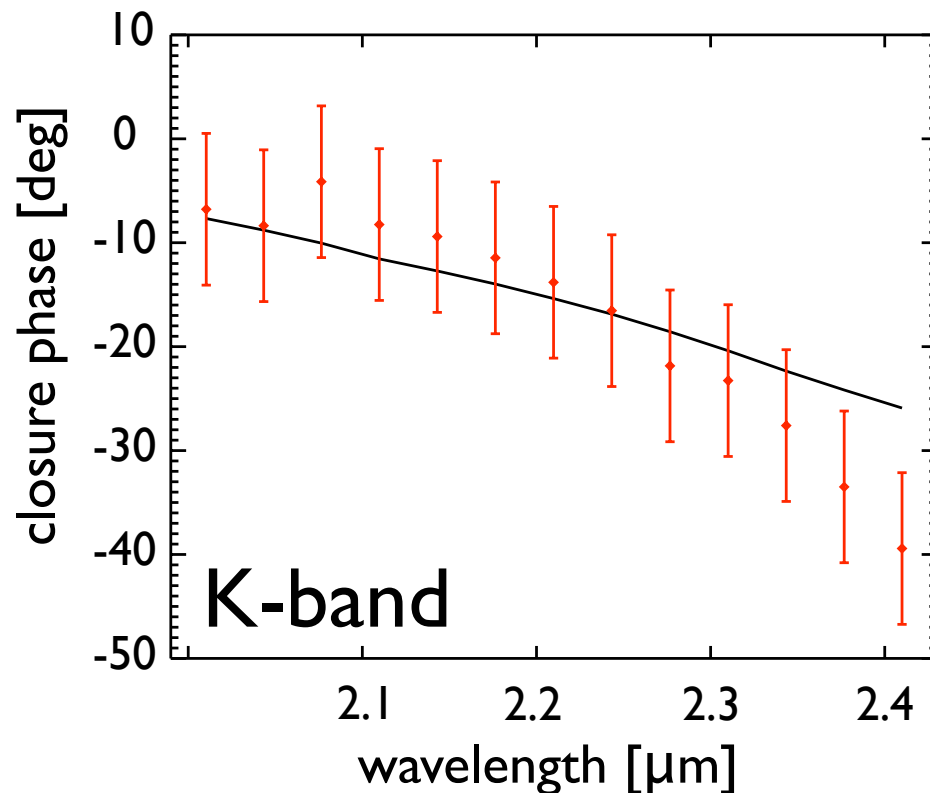
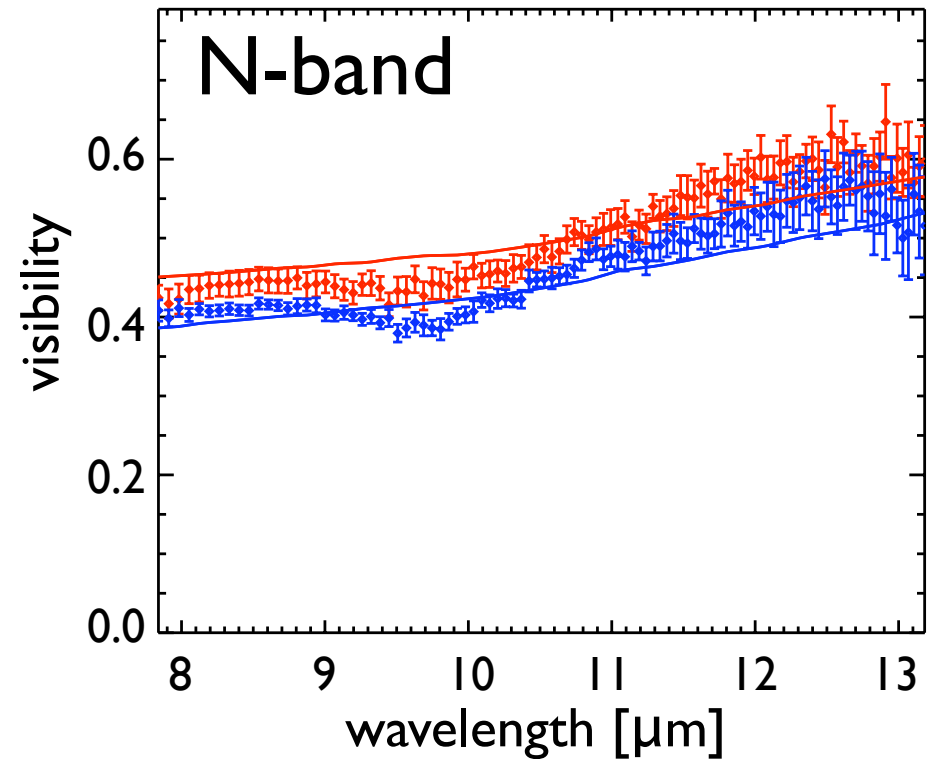
passive **disc** radiative transfer model: Dullemond et al., 2002

- mixture of gas and dust
- dust irradiated by central star
- structure:
hydrostatic equilibrium
- dimensions:
SED constrained
 - ➔ large and processed grains
 - ➔ $R_{in} = 7 \text{ AU}$
 - ➔ $H/R_{in} = 0.2$
(total height = 2.8 AU)



dust at sublimation
temperature

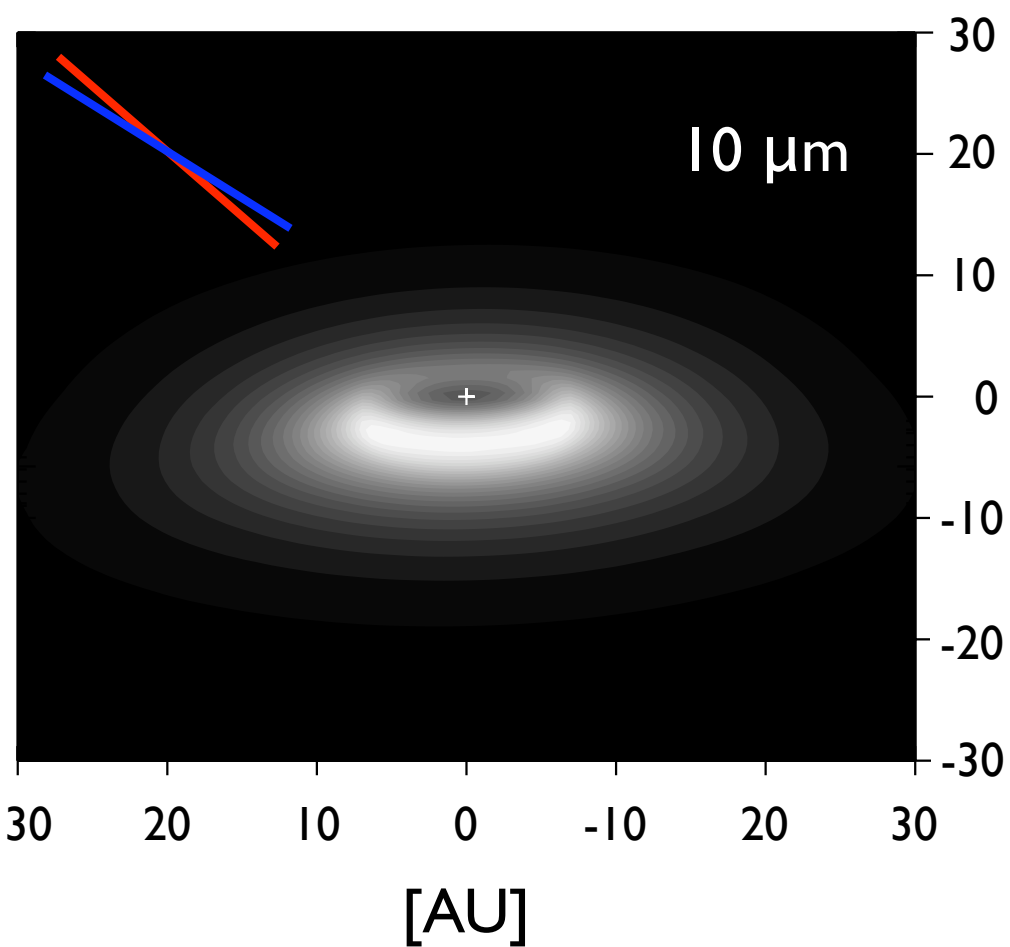
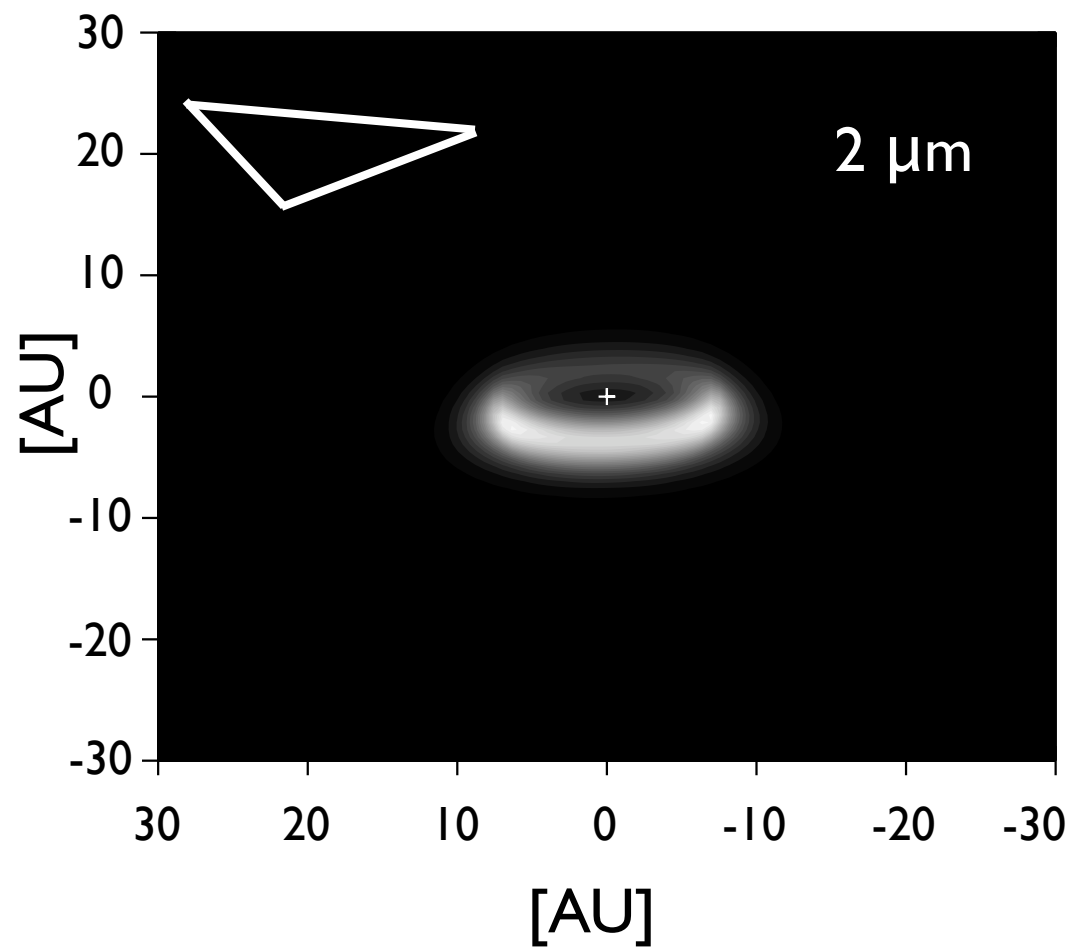
- ✓ Fits the SED
- ✓ Fits the spatially resolved temperature structure from K to N.
- ✓ Fits the angular scales
- ✓ Fits the measured asymmetry
- ✓ Is self-consistent



FINAL MODEL: IMAGES

76 mas

60 AU !!



IRAS 08544-4431

CONCLUSION:

- **binary** post-AGB star [$P = 503 \text{ d}$; $a = 0.36 \text{ AU}$]
- surrounded by **disc** much bigger than the orbit [$R_{\text{dust}} > 7 \text{ AU}$]
 - ➡ circumbinary disc
- disc is passive irradiated and in hydrostatic equilibrium (see also Poster 21 C. Gielen)

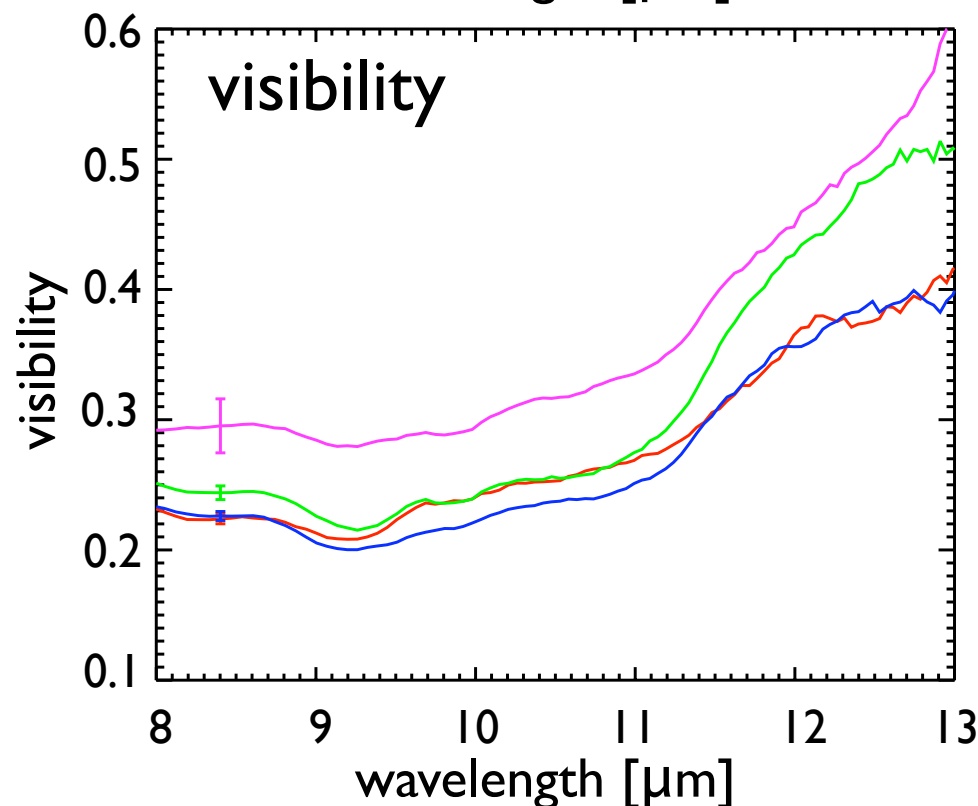
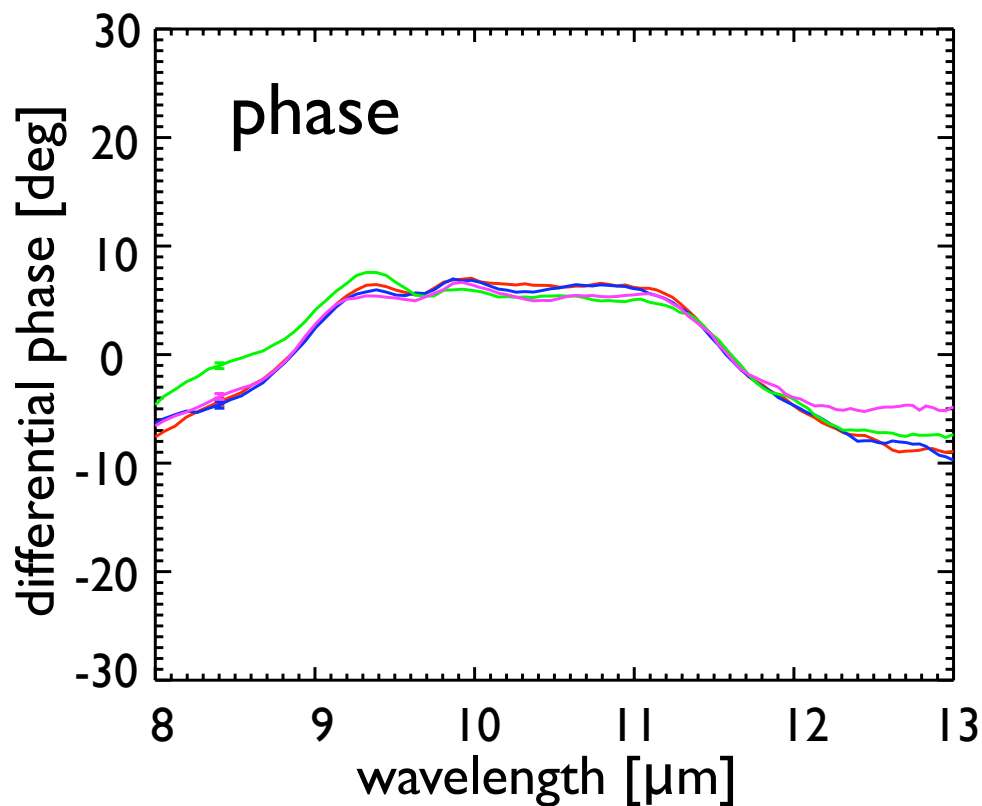
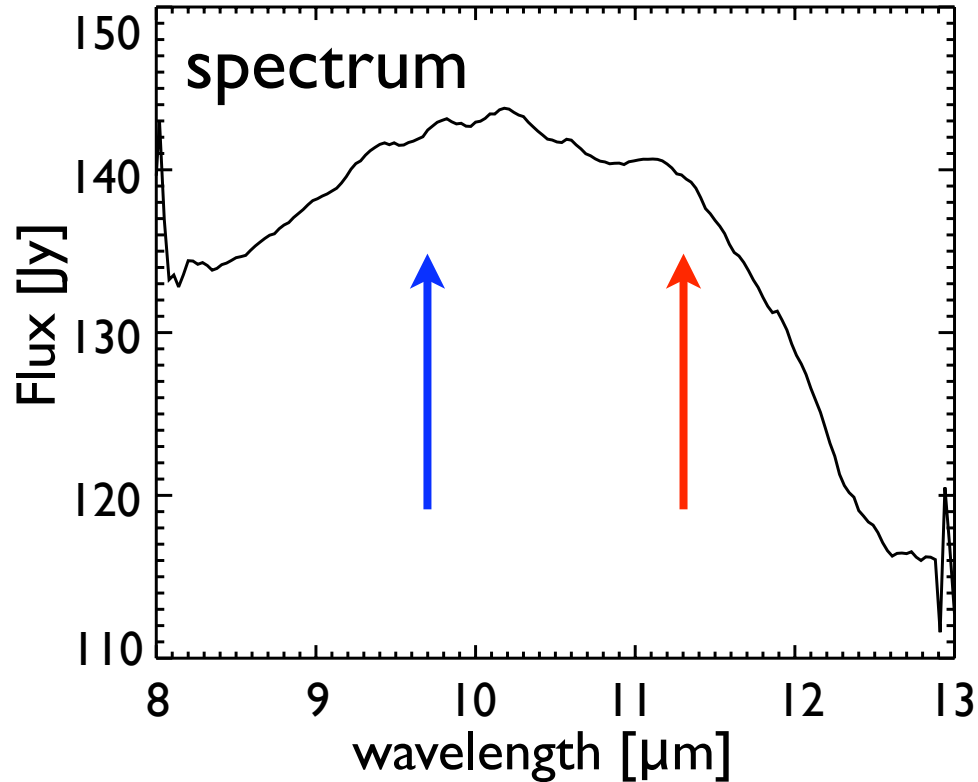
THE BINARY SAMPLE: N-BAND

Name	Diameter [AU]	P _{binary} [d]
89 Her	< 30	288 <small>Bujarrabal et al., 2007</small>
AC Her	60	1194
SX Cen	< 30	595 <small>Deroo et al., 2006</small>
HD 52961	70	1310 <small>Deroo et al., 2006</small>
AR Pup	90	binary motion
IRAS08544-3213	30	503 <small>Deroo et al., 2007</small>
IRAS10456-5712	30	588
IRAS17038-4815	80	1350
IRAS17243-4348	40	483
IRAS19125+0343	30	520
IRAS15469-5311	40	387

Similar model applies

MAPPING THE DUST COMPONENTS:

AR Pup



CONCLUSIONS:

- binary post-AGB stars have passive **dust discs** starting near sublimation temperature
- scale height is significant
- interferometry is ideal (and needed) to:
 - ▶ determine the geometry of the inner dusty structure
 - ▶ map the chemical profiles within the disc
- post-AGB binaries are surrounded by circumbinary discs very similar to those found around planet forming stars
- the formation and structure of the disc is of vital importance in the evolution of the system and its outflow

Post-doc