Interferometry Workshop Ringberg, September 2, 2003

MIDI after the first observing run

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contributing to MIDI:

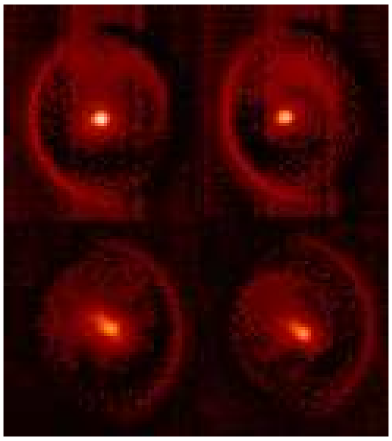
Contributing:

- **MPIA Heidelberg:** Ch. Leinert, U. Graser, H. Baumeister, S.V.W. Beckwith (now STScI), H. Becker, A. Böhm, O. Chesneau, M. Feldt, A. Glindemann (now ESO), B. Grimm, T. Herbst, Th. Henning, S. Hippler, R. Köhler, W. Laun, R. Lenzen, S. Ligori, R.J. Mathar, K. Meisenheimer, W. Morr, R. Mundt, U. Neumann, E. Pitz, I. Pascucci, I. Porro (now MIT), F. Przygodda, Th. Ratzka, M. Robberto (now STScI), R.-R. Rohloff, N. Salm, P. Schuller (now CfA), C. Storz, K. Wagner, K. Zimmermann
- **Amsterdam:** L.F.B.M. Waters, R. van Boekel
- **ASTRON:** A. Glazenborg-Kluttig, S. Damstra, J. de Haas, H. Hanenburg
- **Groningen:** J.-W. Pel
- **Leiden:** W. Jaffe, E. Bakker, W. Cotton (now NRAO), J. de Jong, J. Meisner, I. Percheron (now ESO), H. Rottgering
- **Paris-Meudon:** G. Perrin, J. Bonmartin, G. Chagnon, V. Coude du Foresto, M. Nafati (now Nice)
- **Nice:** B. Lopez, P. de Laverny, G. Niccolini
- **Grenoble:** A. Dutrey, F. Malbet
- **Freiburg:** O. von der Lühe, L. Gantzert, Th. Sonner, K. Wallmeier
- **Tautenburg:** B. Stecklum
- **ESO:** A. Richichi, M. Schöller, P. Ballester, P. Biereichel, C. Sabet, F. Derie, Ph. Gitton, A. Glindemann, S. Guisard, N. Haddad, N. Housen, B. Koehler, S. Levêque, J.-M. Mariotti (†), S. Menardi, S. Morel, F. Paresce, J. Spyromilio, M. Tarenghi (now ALMA), A. Wallander

Contents

1a. Imaging with MIDI

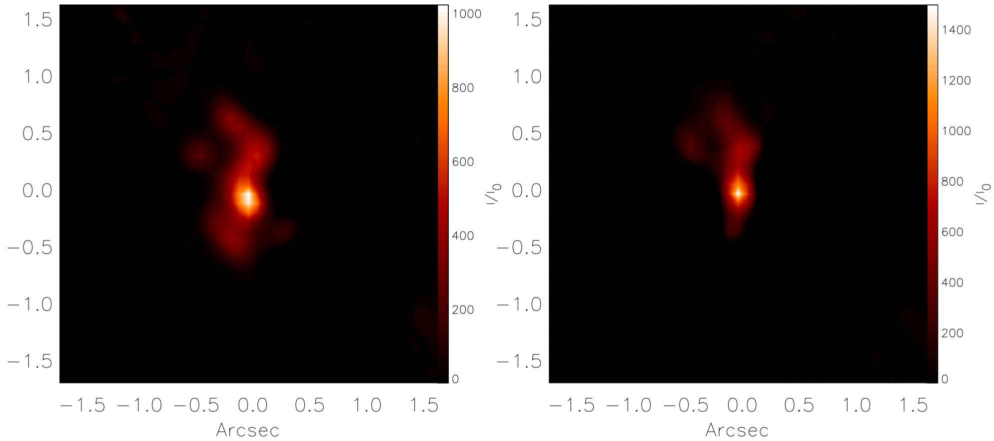
Example: NGC 1068



raw images:

unresolved star

NGC 1068

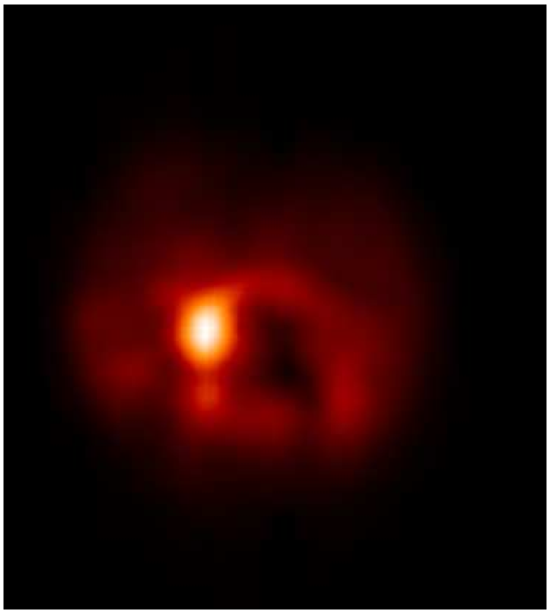


deconvolved images of NGC 1068

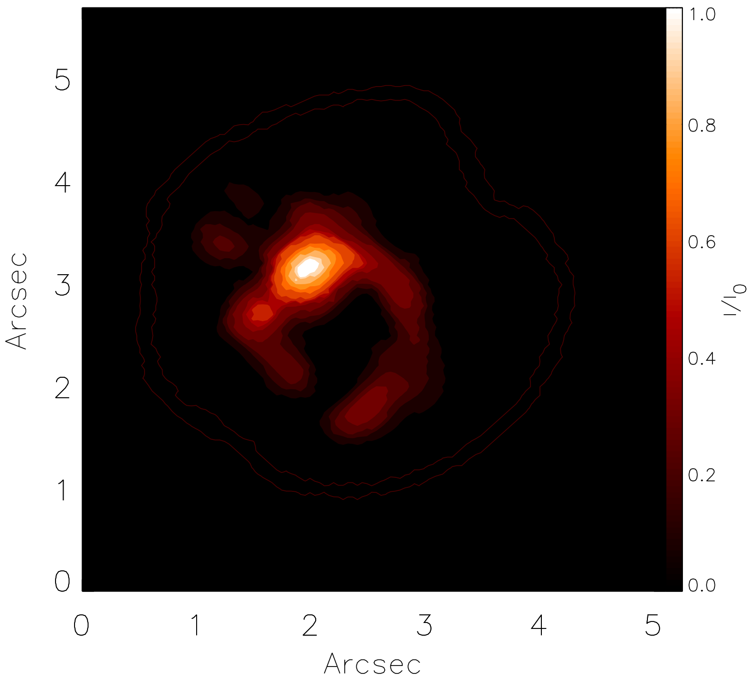
raw images: North is at position angle ≈ 50 °
deconvolved images: North is up and East is left

Focal plane on the MIDI detector:
The interferometric field of $\pm$ 1 arcsec

Example: η Car



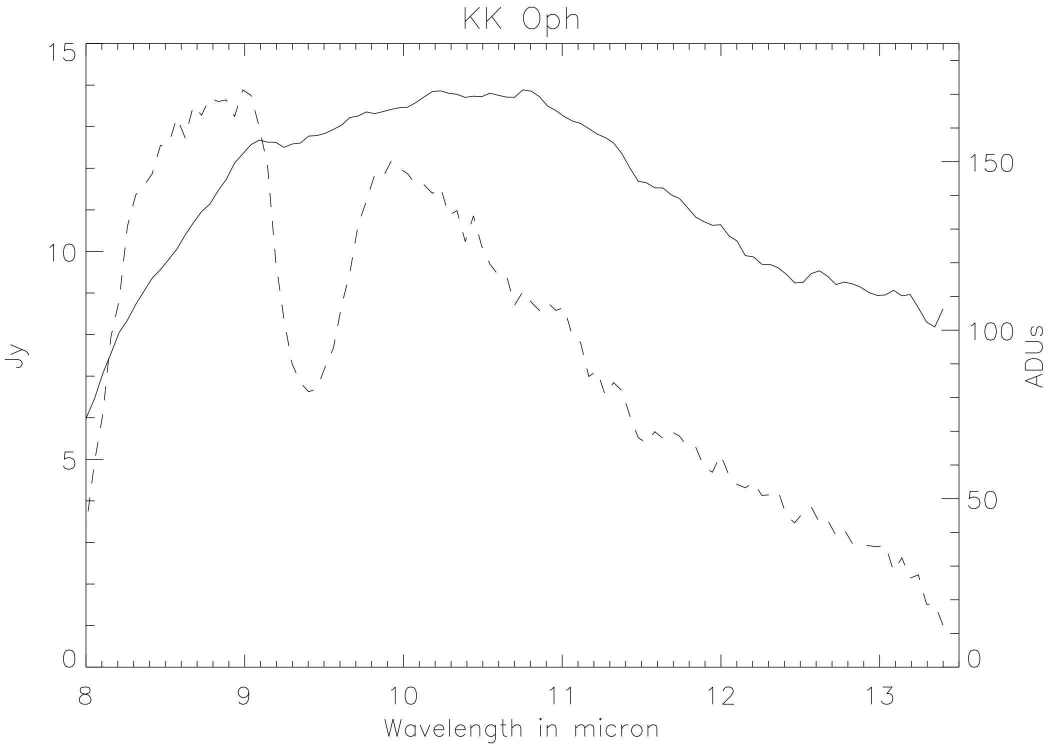
chopped raw data



deconvolved

in the deconvolved image: North is up and East is left

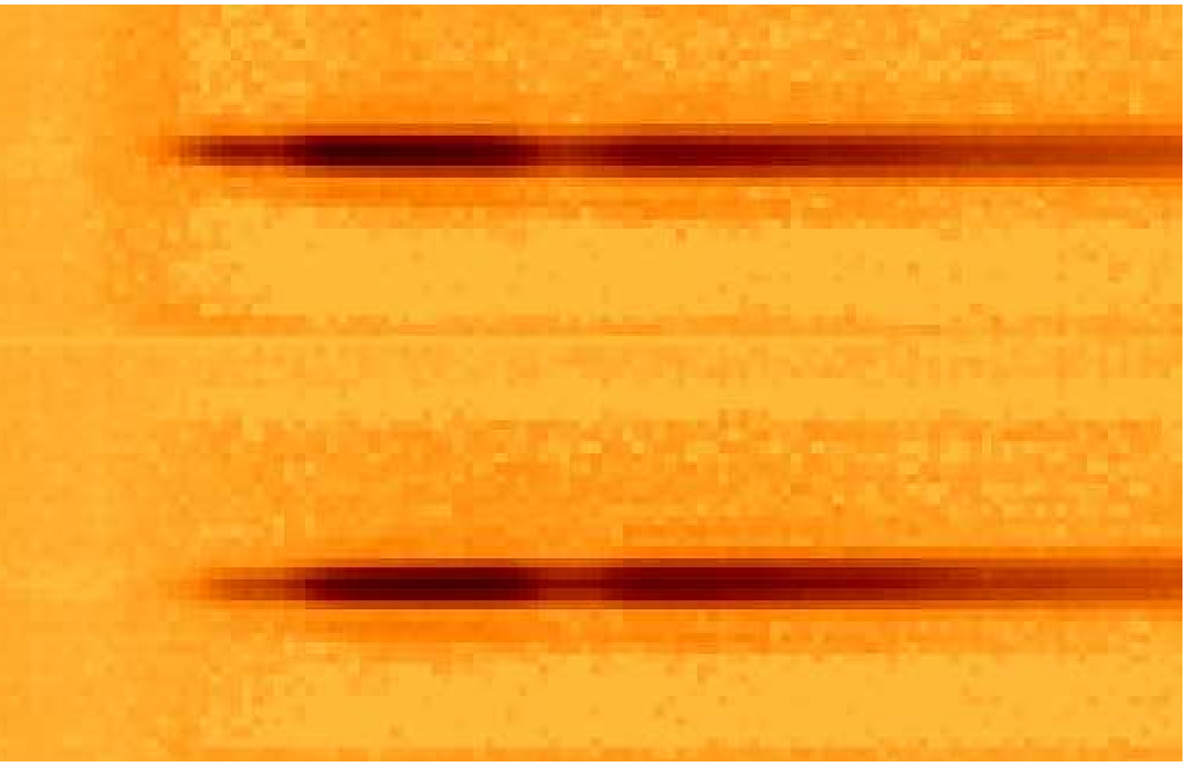
1b. Prism spectrum for KK Oph, $\lambda/\Delta\lambda \approx 30$



above: raw (- - -) and calibrated (—) spectrum of KK Oph

below: traces of the spectra on the detector, one for each telescope

Ozone band ⇳



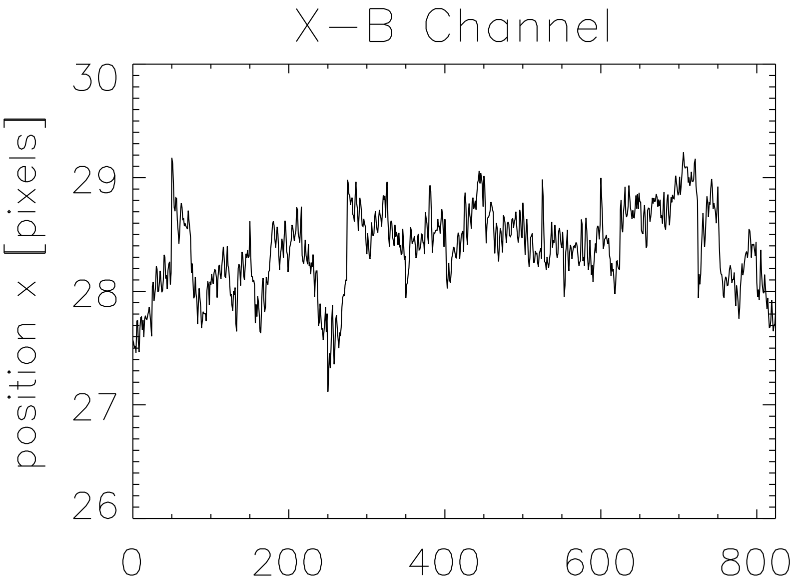
2. Observing modes for MIDI

Mode 1	basic: OPD stepping a few λ with prism	working
	same for filter	readout non optimal
	same with photometric beams	to be commissioned
Mode 2	OPD stepping a few λ with grism	to be commissioned
Mode 3	"dispersed" self-fringe-tracking with prism,grism	to be commissioned
Mode 4	external fringe tracking with FINITO/AO	to be commissioned
Transfer	verification of these modes with ATs	to be commissioned

Observing sequence:

acquisition image → prism interferometry → prism photometry

1. Technical use of acquisition image: study image jitter

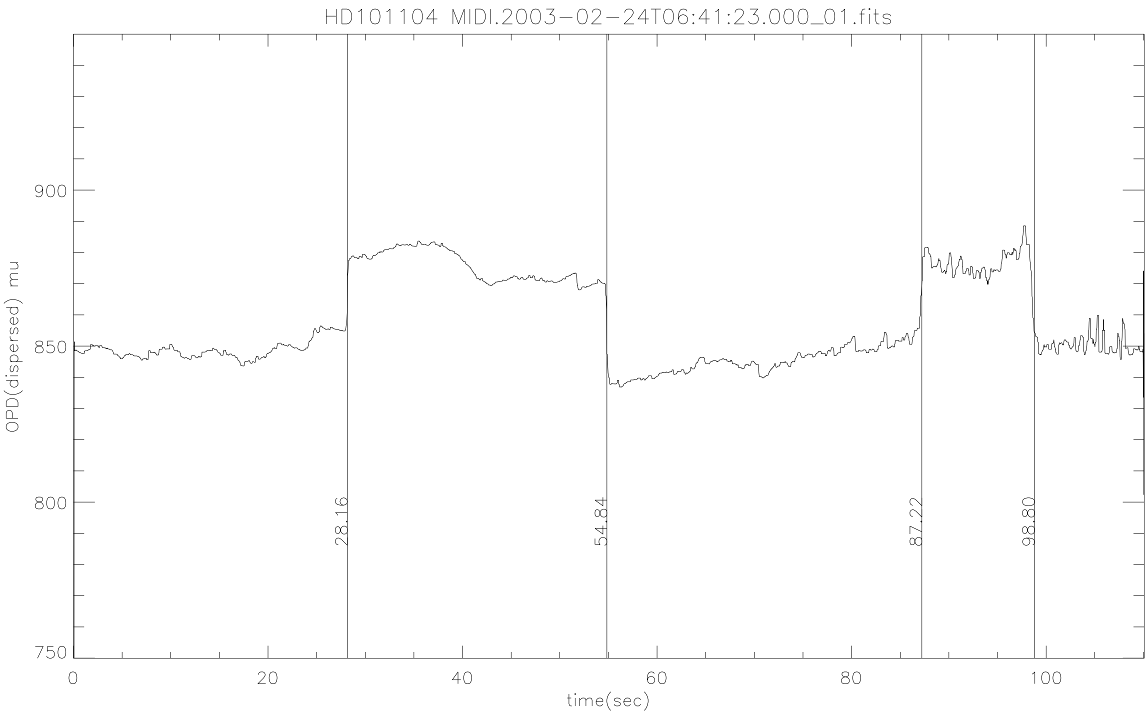


jitter during chopping
≈ 1 pixel (0.08″)

to be compared with: tip-tilt error 0.025″
chopping rms 0.030″

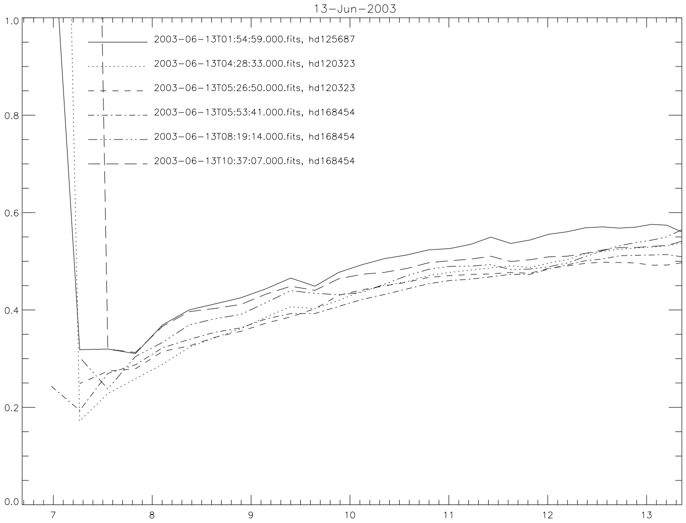
2. Technical use of prism interferometry: OPD stability

Result: active optics operations cause OPD jumps



instrumental visibilities on different nights

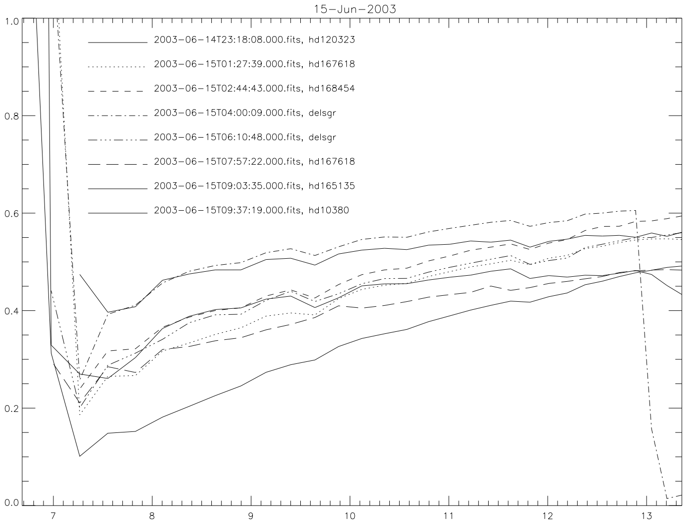
instrumental visibility versus wavelength (μm)



June 13, 2003

good stability

instrumental visibility versus wavelength (μm)



June 15, 2003

stability worse

Raw visibilities measured during one night with different calibrator stars, numerical values to be multiplied by $\sqrt{2}$.
rms values are 8% (June 13 and 14%.

3. Results from guaranteed time and science demonstration observations in June

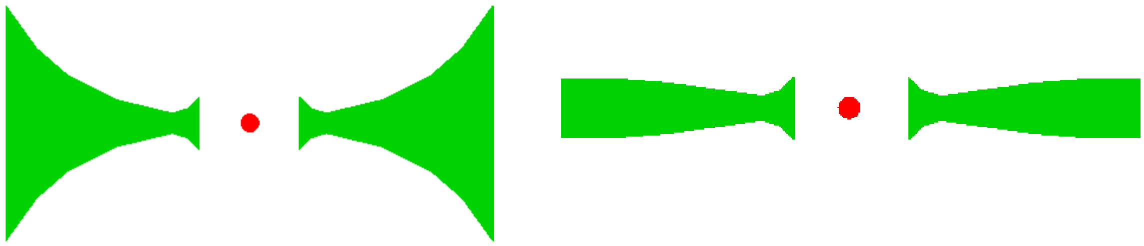
The following fields are touched:

- **AGNs**
- **cool evolved stars**
- **massive young stars**
- **low mass young stars**
- **Herbig Ae/Be stars**

Disk geometries proposed for Herbig Ae/Be stars

Group I | **Group II**

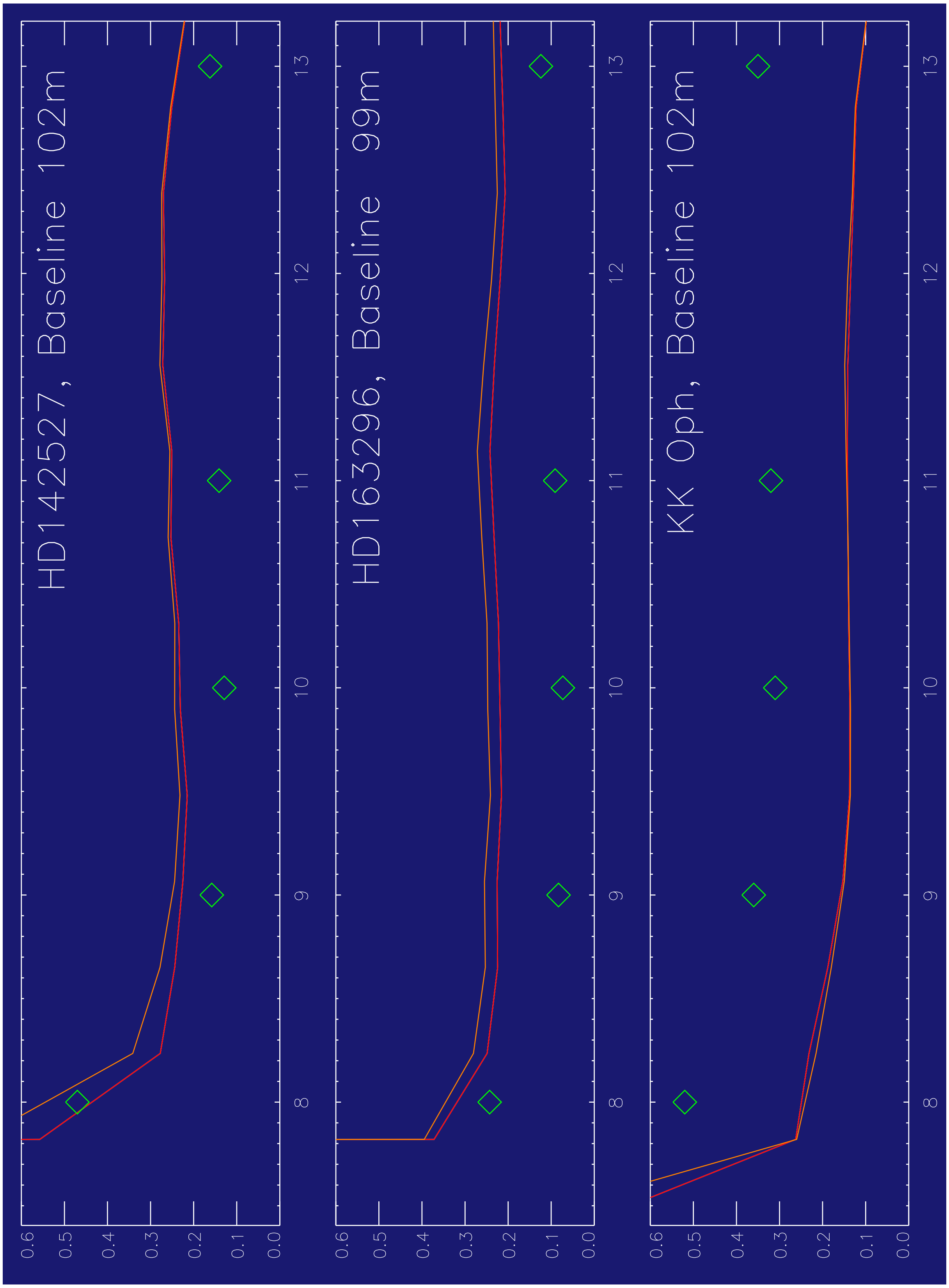
(with FIR excess) | **(no FIR excess)**



flaring disk | **self-shadowing disk**

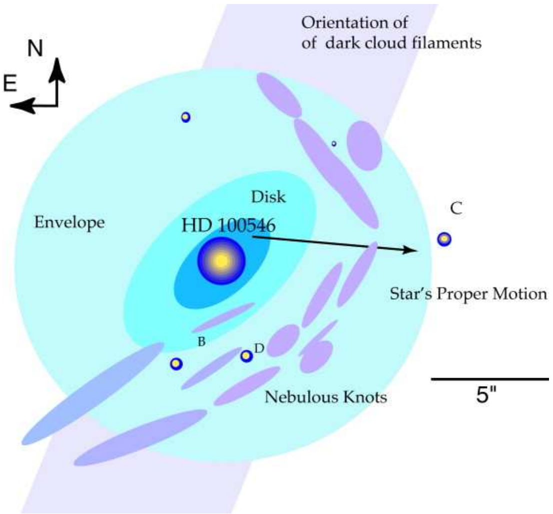
The special feature of these models is the puffed-up hot inner rim of the disk.

(Dullemond, Dominik & Natta 2001)
(Dominik, Dullemond, Waters & Walch 2003)

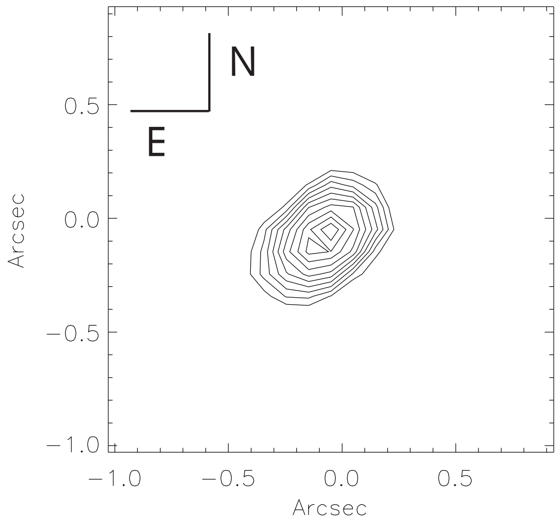


comparison of visibilities predicted by DDN model (◇) with observed visbilities (—)

HD 100546 – Ae/Be star with known arcsec scale disk



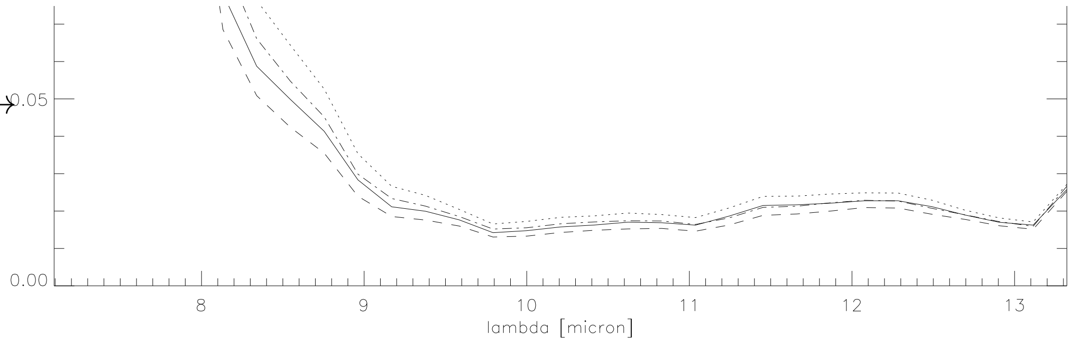
Grady et al. 2001
extended 11.7 μm,
point source 10 μm, 18 μm



MIDI – deconvolved 8.7 μm image

measured visibility

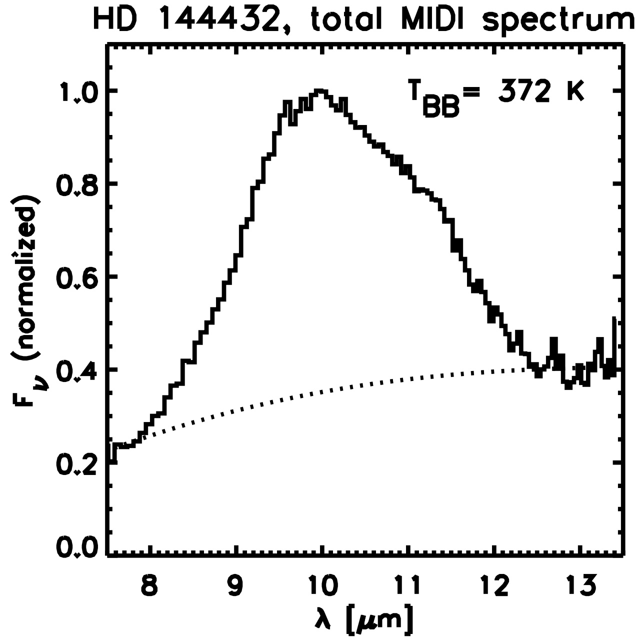
V =
0.05→



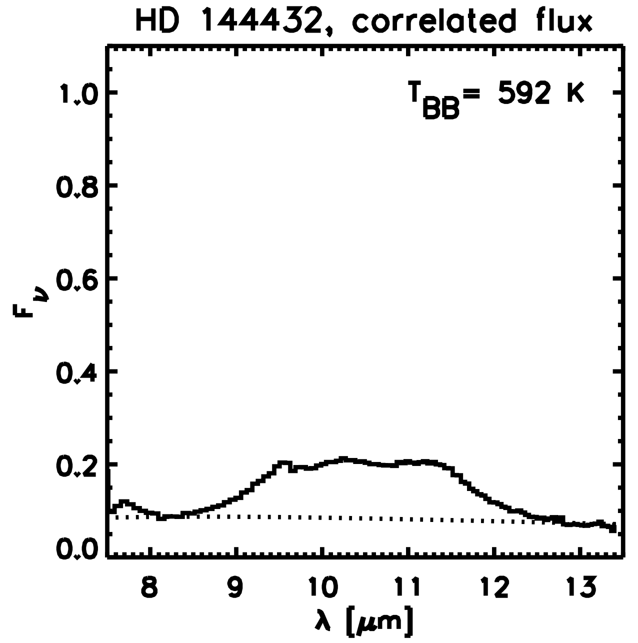
⇒small structure in extended emission

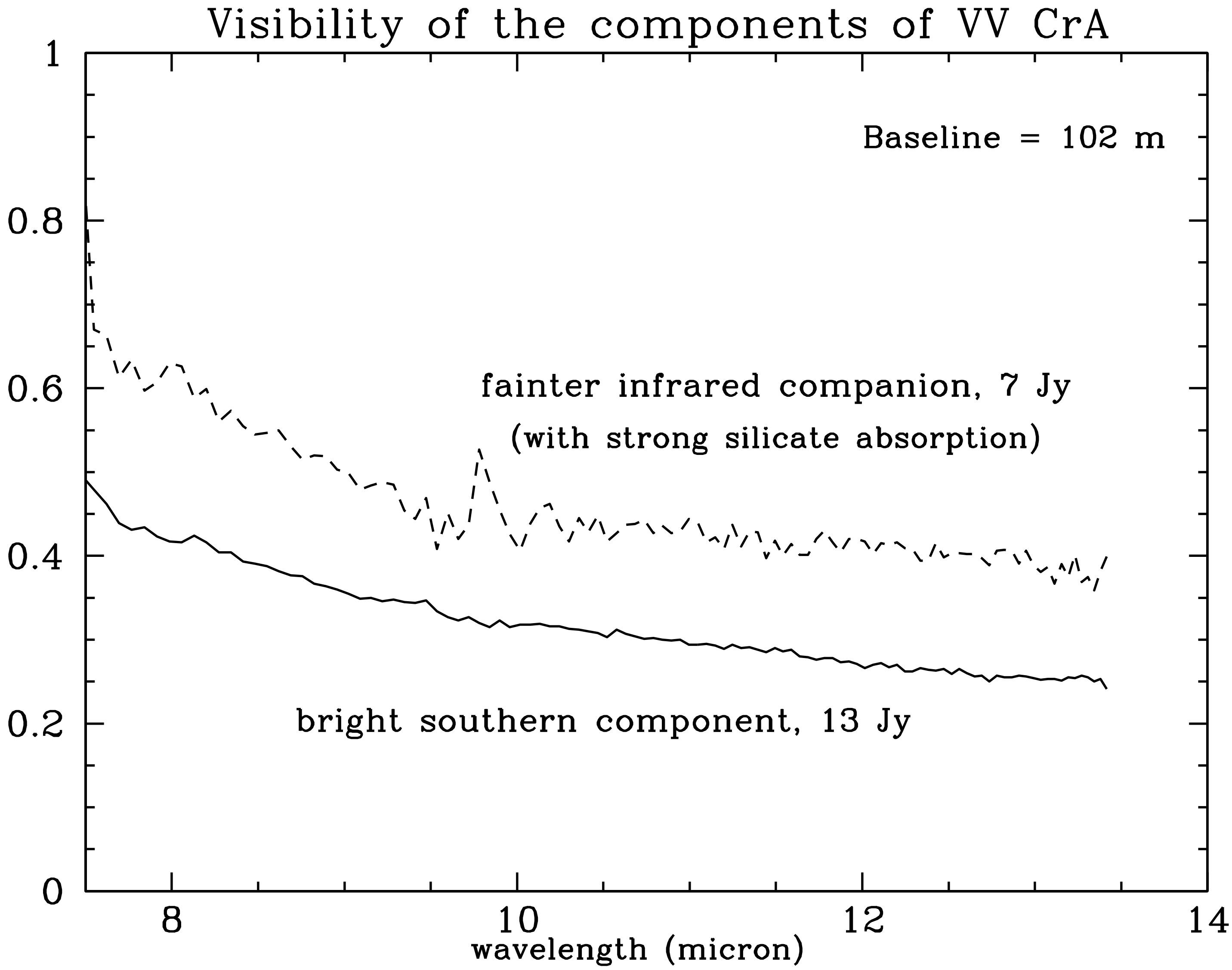
Spectral change with scale in the Herbig Ae/Be star HD 144432

half-arcsecond scale
→ peaked



interferometric scale
→ flat

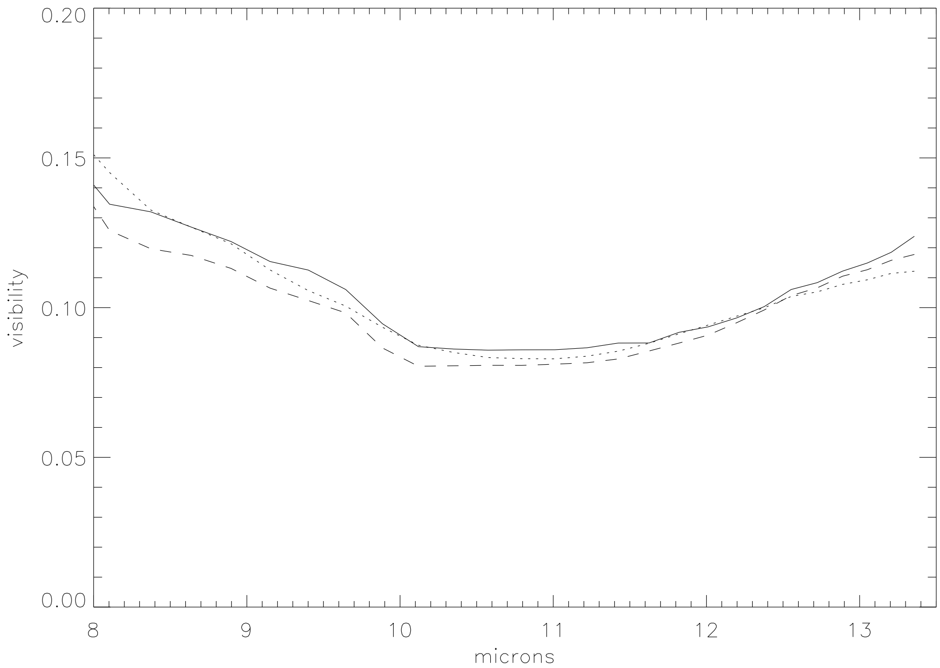




This example shows that the less luminous T Tauri stars are also reachable by observations with MIDI.

The massive young star M8E IR:

visibility versus wavelength (μm)



no tip-tilt!

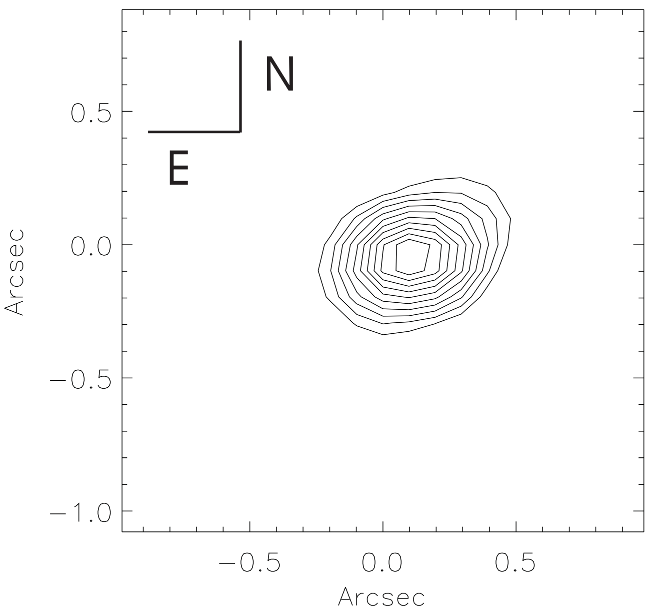
visibility not untypical for circumstellar emission

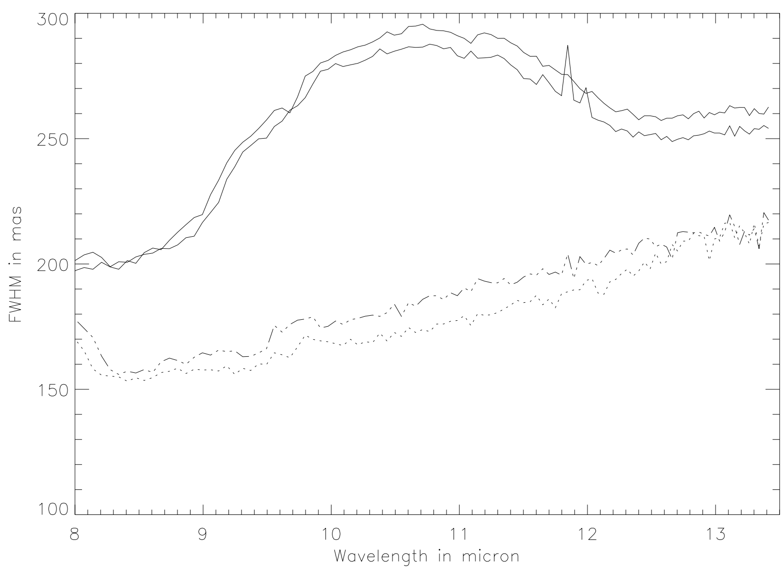
to be compared with Herbig Ae/Be stars

OH 26.5+0.6 seen with MIDI

8.7 μm image

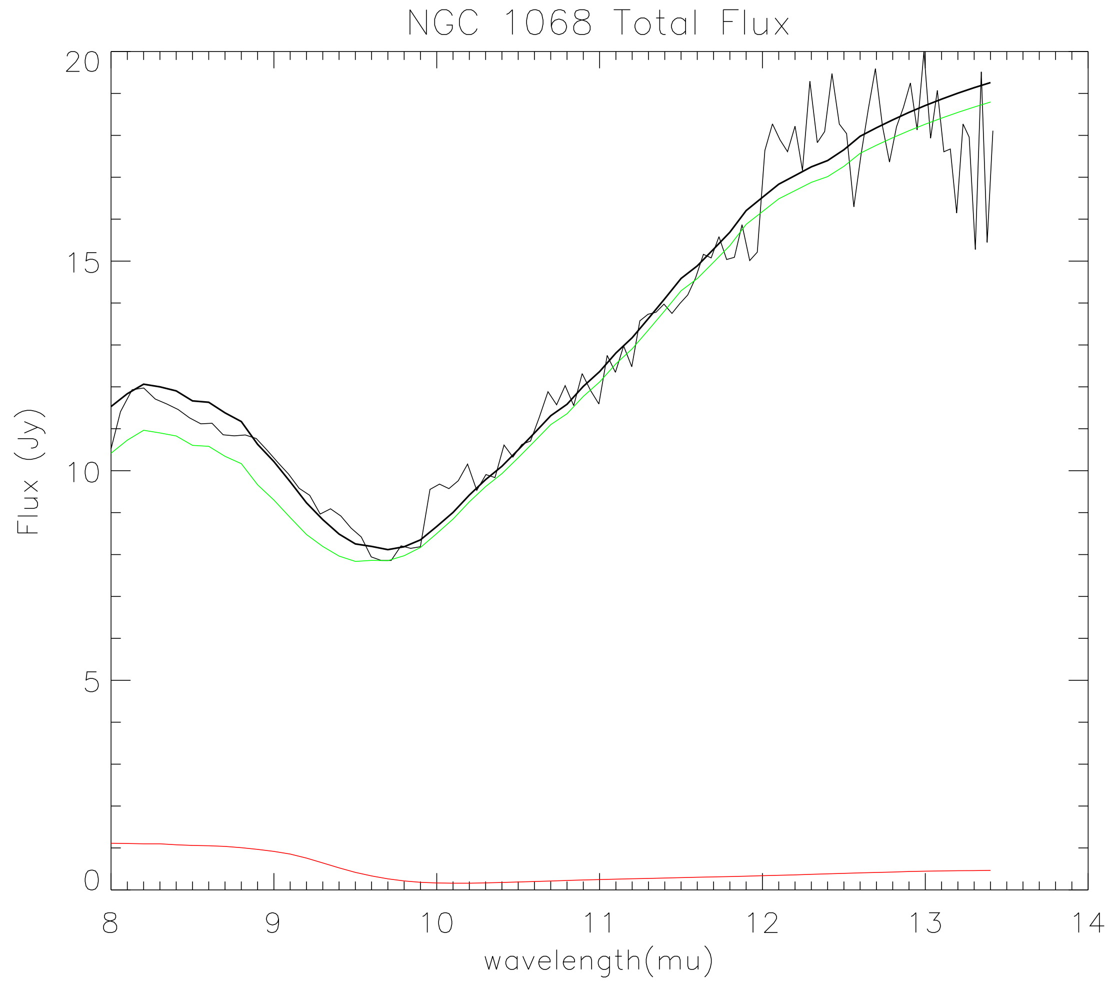
deconvolved
FWHM
102$\pm$ 10 mas



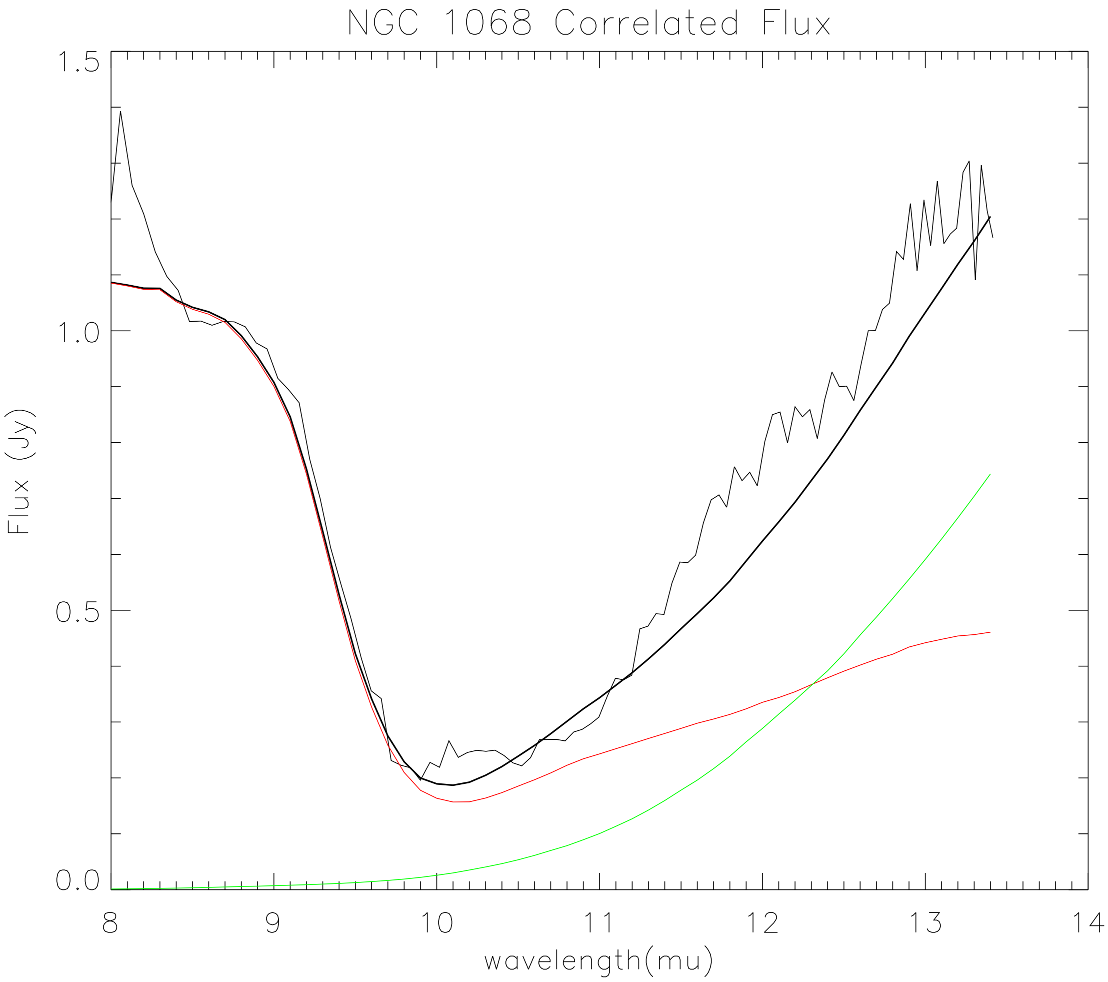


width in y

OH 26.5+0.6 (top)
unresolved star
(bottom)



NGC 1068 Total Flux
Flux (Jy)
wavelength(mu)



NGC 1068 Correlated Flux
Flux (Jy)
wavelength(mu)

Conclusions

MIDI works (self-fringe-tracking,results), **but**

- visibility calibration difficult, a challenge for observing procedures and reduction software
- image overlap important, offset 2 pixels $\Rightarrow$ 40 % visibility loss
- modes to improve on sensitivity, overlap monitoring, spectral resolution, reliability of fringe tracking, observability of faint objects still to be commissioned

VLTI works (OPD guiding, tip-tilt, chopping), **but**

- still developing (pupil imaging, fringe tracking)
- not yet prepared for infrared specifics (centering of pure infrared source, offset Coudé tracking)

what is needed is

$\Longrightarrow$ MIDI Commissioning