

W Hydrae

Preliminary analysis of MIDI
observations and comparison with
previous results

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Summary

- Introduction to W Hydrae
- Previous diameter measurements
- MIDI observations
- New results
- Future work
- Conclusions



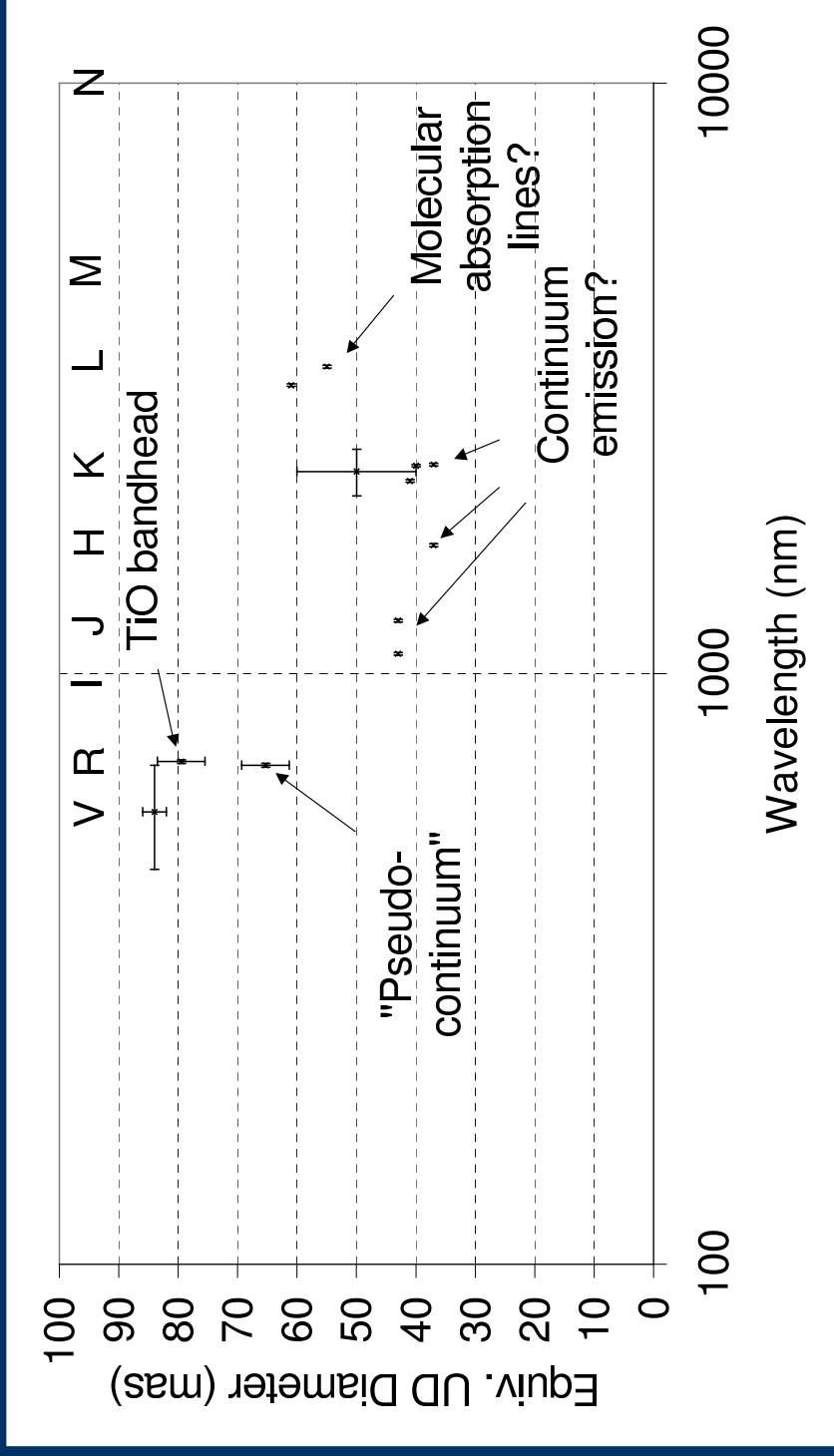
W Hydrae

- Semi-regular long period variable star, $T=2460\text{K}$
- Interferometric observations in the visible and near infra-red have resolved the stellar disk (probably dominated by emission lines in the outer atmosphere)
- Pulsation mode

*(Lattanzi et al 1997, Tuthill, Haniff & Baldwin 1999, Tuthill, Monnier & Danchi 1999, Meisner 2003)



W Hydrae diameter



Previous diameter measurements at other wavelengths



W Hydrae geometry

- Stellar disk shows deviations from circular symmetry at V and R (hotspots?)
- Stellar disk may be more symmetrical at N band (ISI observations?)



W Hydrae dust shell

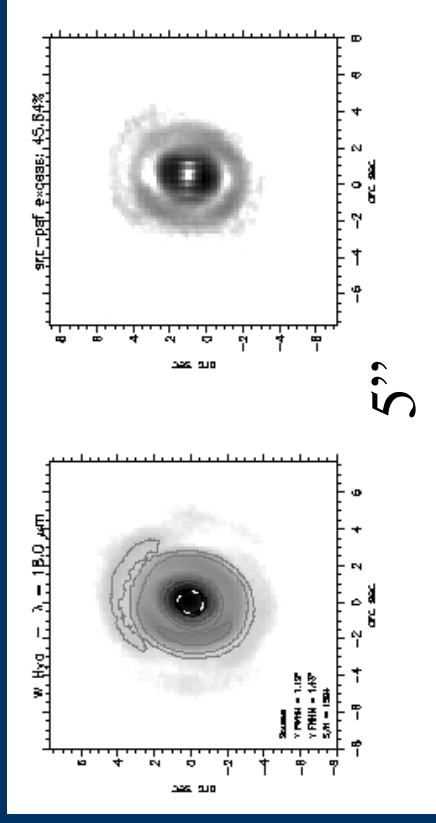
- Theoretical models predict a dust sublimation radius of 40-60 mas, so the *minimum* inner diameter of a dust shell would be 80-120 mas
- A much larger shell has been observed – too resolved to be observed with MIDI



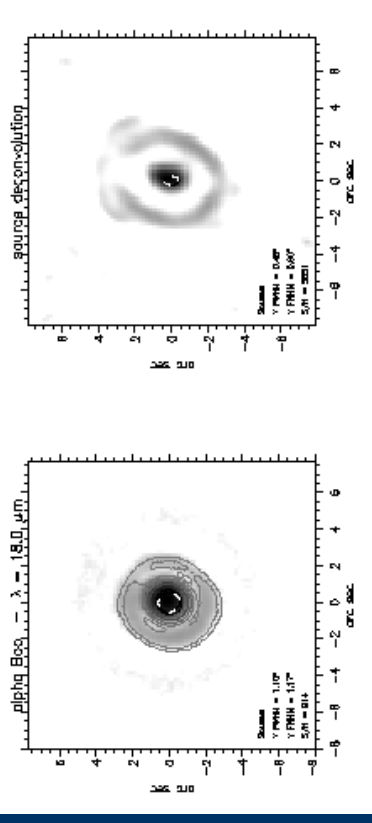
W Hydrae dust shell

18 μm observation at IRTF, taken from M. Marengo PhD thesis (2000), at 12 μm >20% of flux is from dust

Raw data



Deconvolved image





MIDI Observations

- One observation of W Hydrae was undertaken during Guaranteed Time Observing on 13 June 2003
- The projected baseline was 81.7 m
- Dispersed into ~30 spectral channels from 8-13 μm across 104 pixels of an array detector
- 30 datapoints to compare with theory



MIDI Observations

- Data reduced using Walter Jaffe's software
- Calibrated using observations of partially resolved star HD120323 (~15 mas) before and after W Hydrae observation
- W Hydrae variability phase = 0.84



MIDI Observations

All of the spectral channels are observed through the same atmosphere, so we can investigate the differential phase between the channels

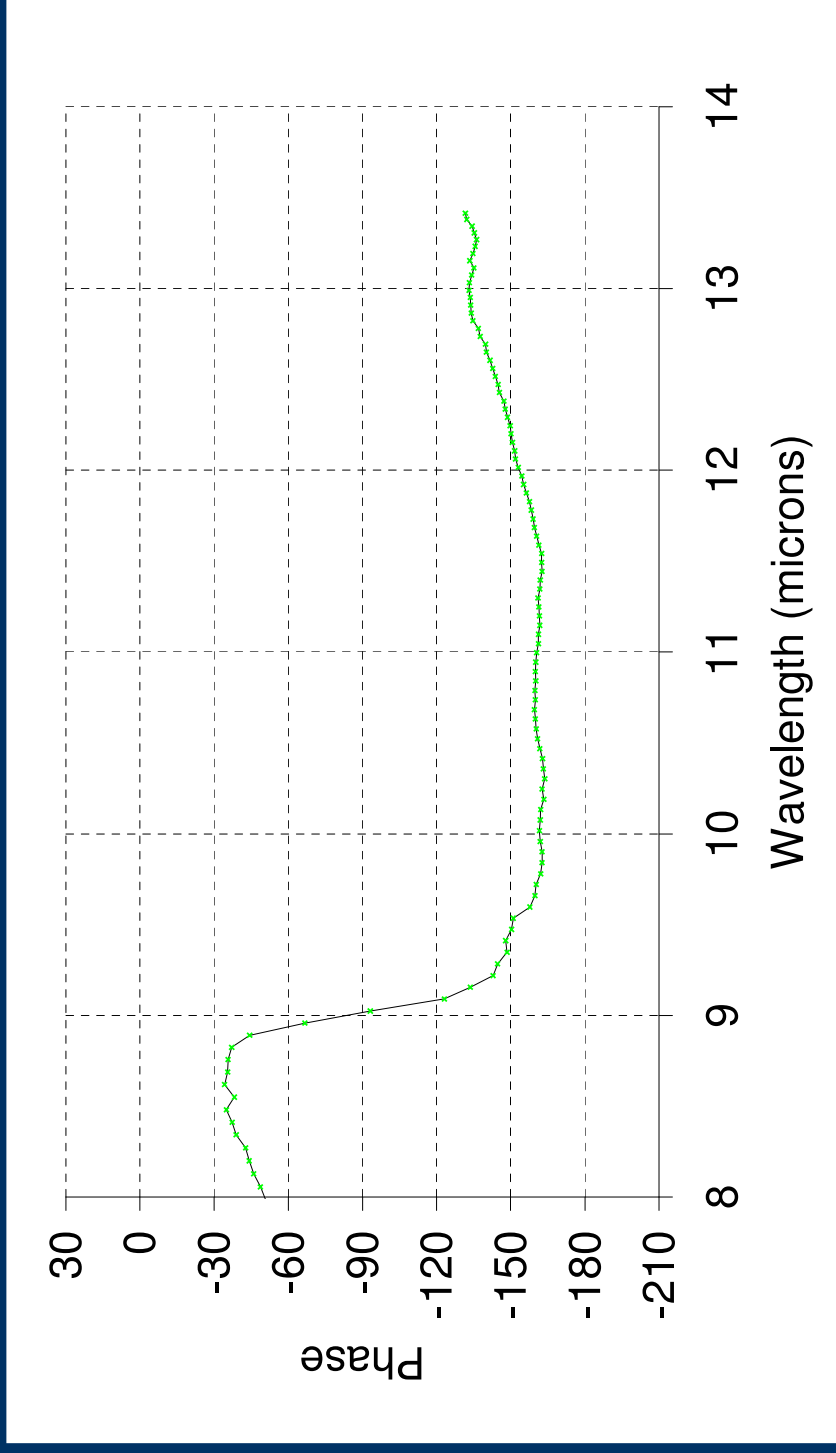


Calibrator observations

Differential phase measurements showed good agreement between the two calibrator measurements (RMS difference $\sim 1^\circ$ between observations after the mean optical path difference (OPD) subtracted)



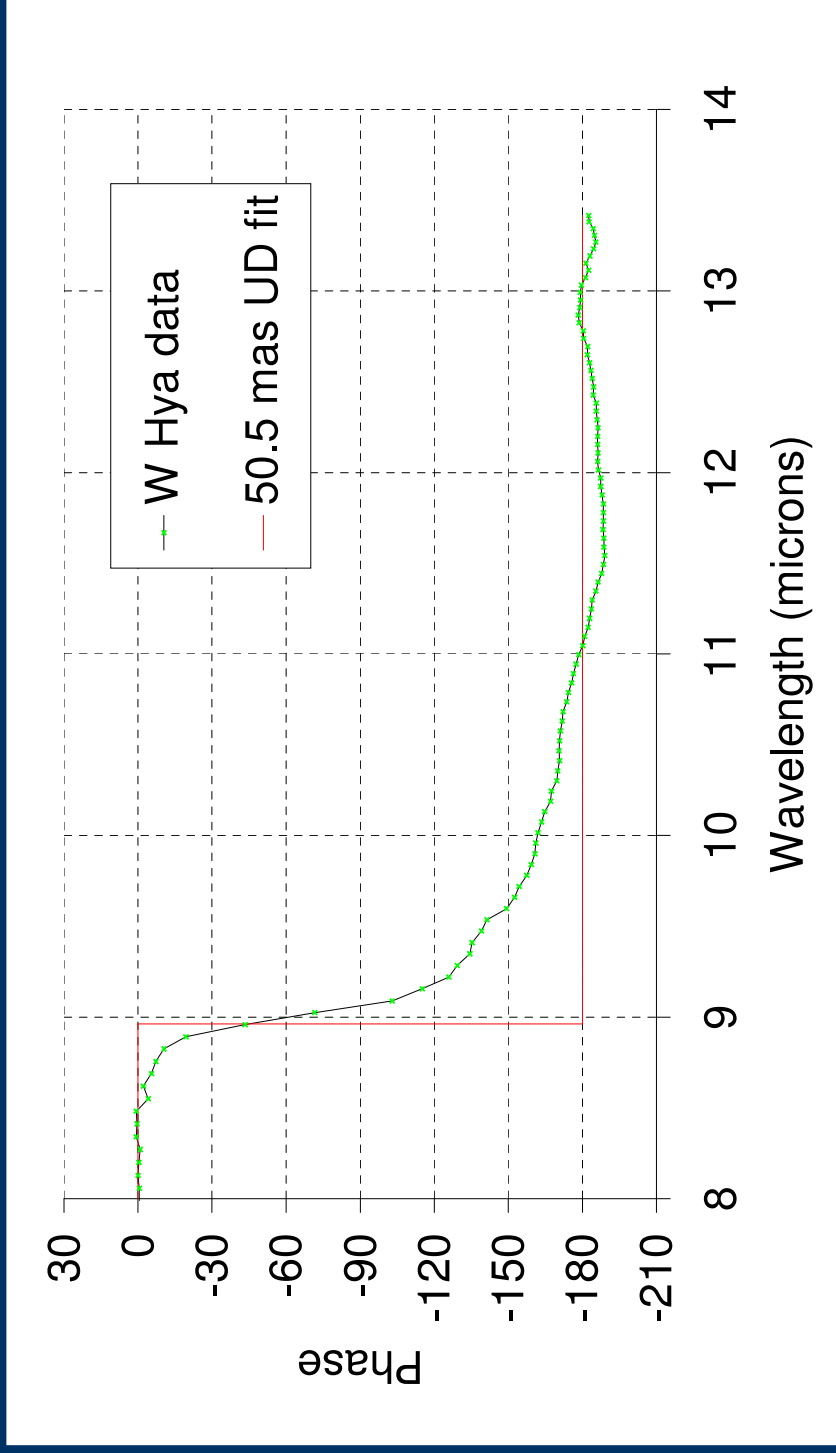
Results - differential phase



Unknown OPD offset and phase offset



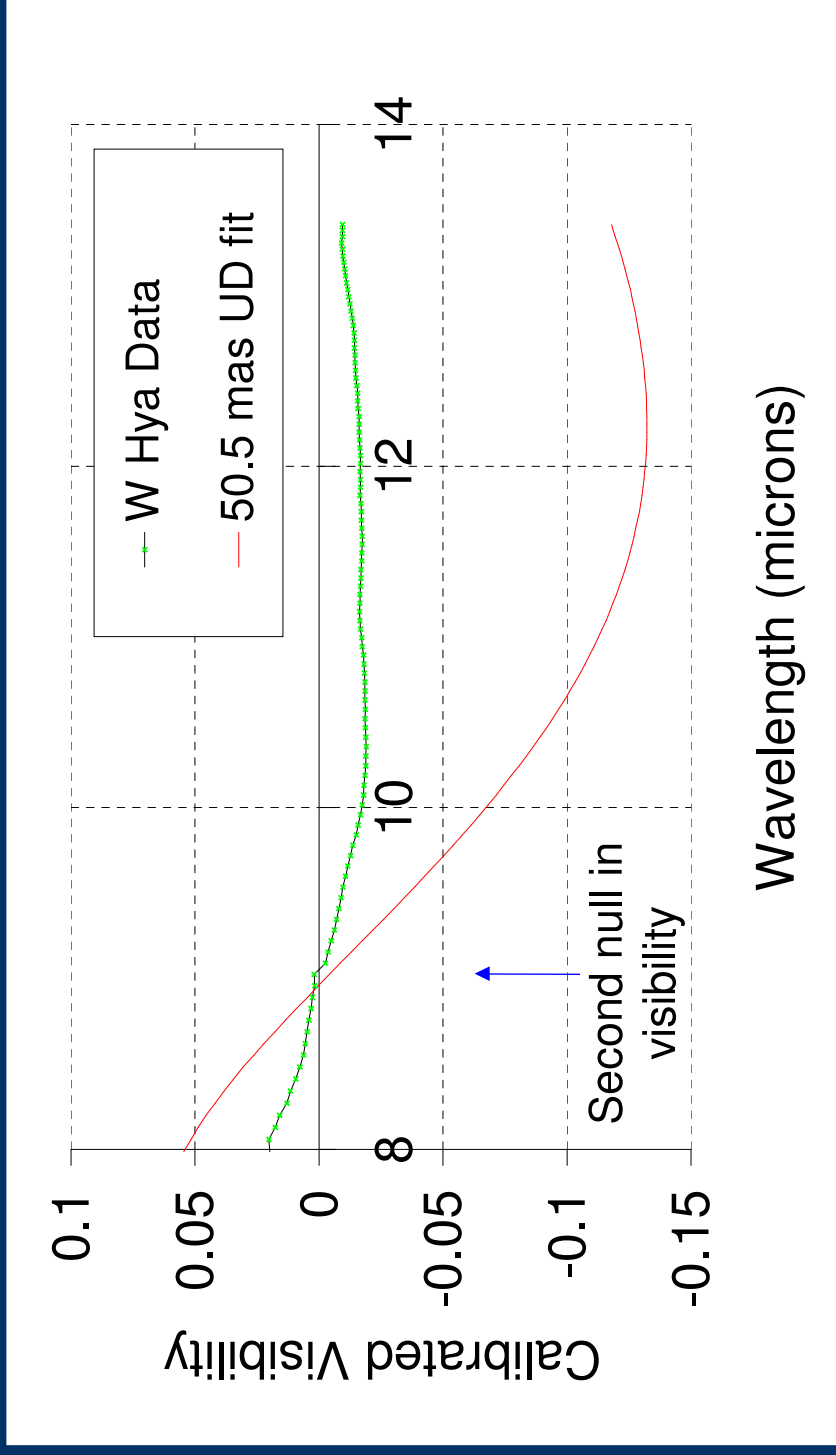
Differential phase



My guess for the OPD offset and phase offset



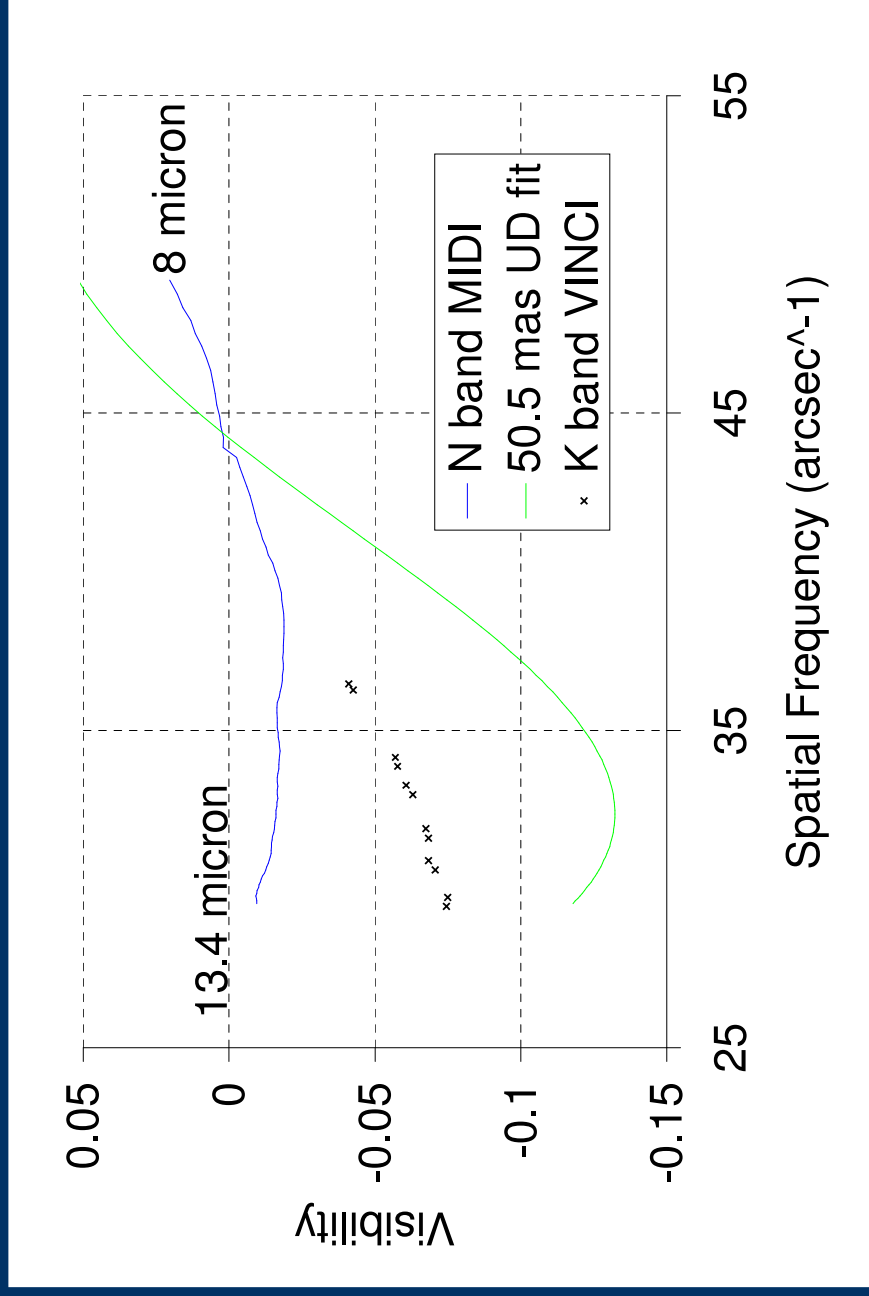
Calibrated visibility



Assuming calibrator to be 14.7 mas UD
W Hydra geometry may change with wavelength



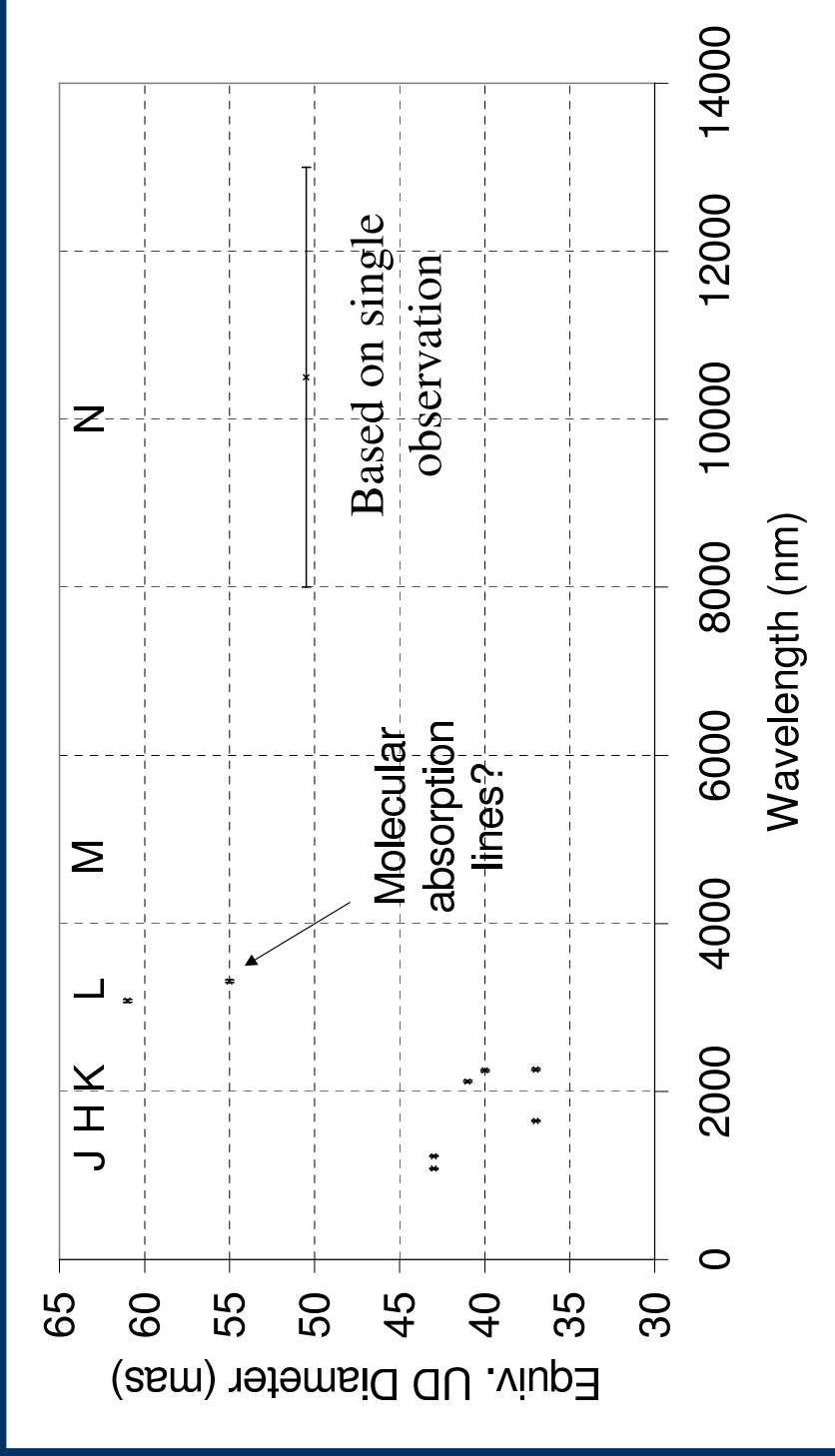
Calibrated visibility



Comparison with K-band visibilities from VINCI
(J. Meisner 2002 – Jenam VLTI workshop)



W Hydra UD diameter



All diameter measurements at the same phase



Discussion of new results

- The visibility null at $9\text{ }\mu\text{m}$ is consistent with observations of W Hydrae in the near infra-red
- The visibility is anomalously low beyond $10\text{ }\mu\text{m}$, perhaps due to dust emission/molecular lines
- No visibility measurements on short baselines



Conclusions

- The spectrally dispersed mode of MIDI can provide valuable results from a small number of baselines
- MIDI cannot resolve emission lines
- Contemporary observations with multiple baselines will be required to understand the structure of W Hydra at N band (including some short baselines)



Conclusions

- Marengo (PhD 2000) finds dust emission on <600 mas length scales
- This could be mapped using the shortest Auxiliary Telescope (AT) baselines given sufficient uv coverage
- The central star could act as a phase reference for the mapping process



Conclusions

Contemporaneous observations on intermediate baselines may be required to distinguish the dust shell signature given our limited knowledge of the stellar disk geometry



Conclusions

- Observations with baselines of similar lengths but different position angles would also be of interest
- It may be better to observe fewer sources but using more baselines
- A large survey will probably have to wait for the ATs



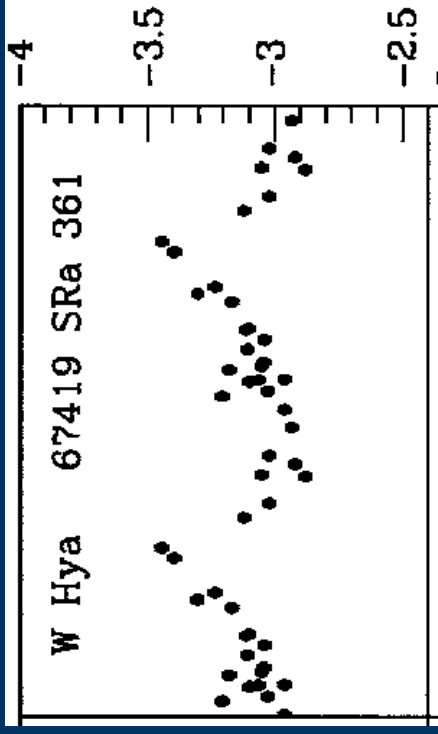
Observations log

Instrument + (uv points per channel)	Wavelength + (channels)	Date	Phase
HST FGS	.46-.70 (1)	17/12/95	.51
WHT (120)	.70-.71 (2)	09/06/93	.04
Keck I (420)	1.1-3.3 (8)	15/04/98	.79
VINCI (12)	2.0-2.4 (1)	22/01/02	.48
MIDI (1)	8.0-13 (30)	13/06/03	.84



Variability

K band light curve
for W Hydrae



K band light curve of
Mira for comparison

