Michelson Symposium

High Angular Resolution Observations of the Cool Giant V Hya

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Outline

- Introduction
- Project Aims
- Data Set
- Model Fitting
- Discussion
- Conclusion / Further Work

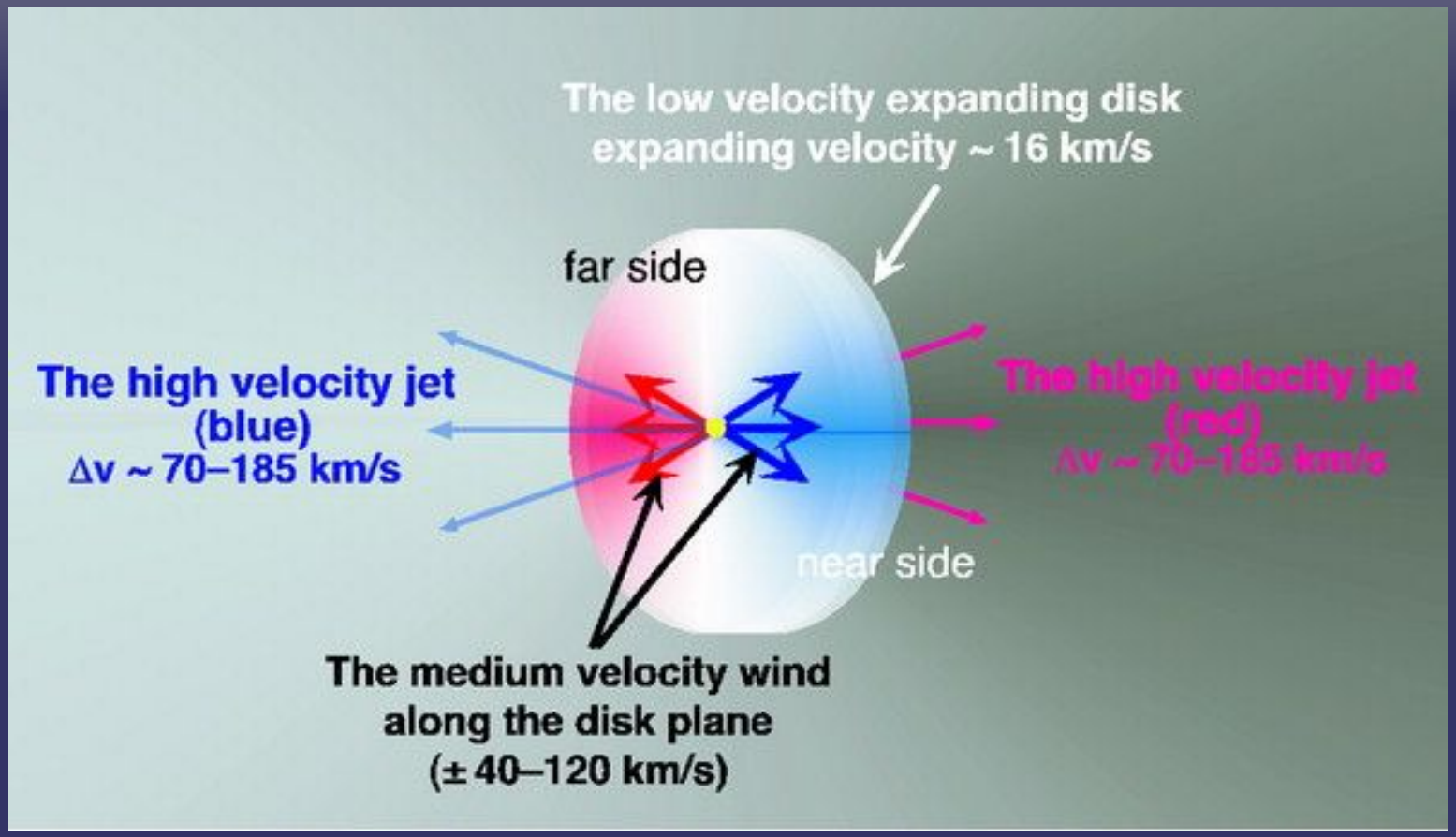
Introduction

- Carbon star (C/O abundance ratio greater than unity)
- Light curve (main period of 529 days) and high luminosity ($\sim 10^4 L_\odot$) consistent with Mira classification
- Heavy mass-loss consistent with asymptotic giant branch (AGB) stars
- Located in the region of the colour-colour diagram of the infrared astronomical satellite (IRAS) populated by AGB stars

Introduction

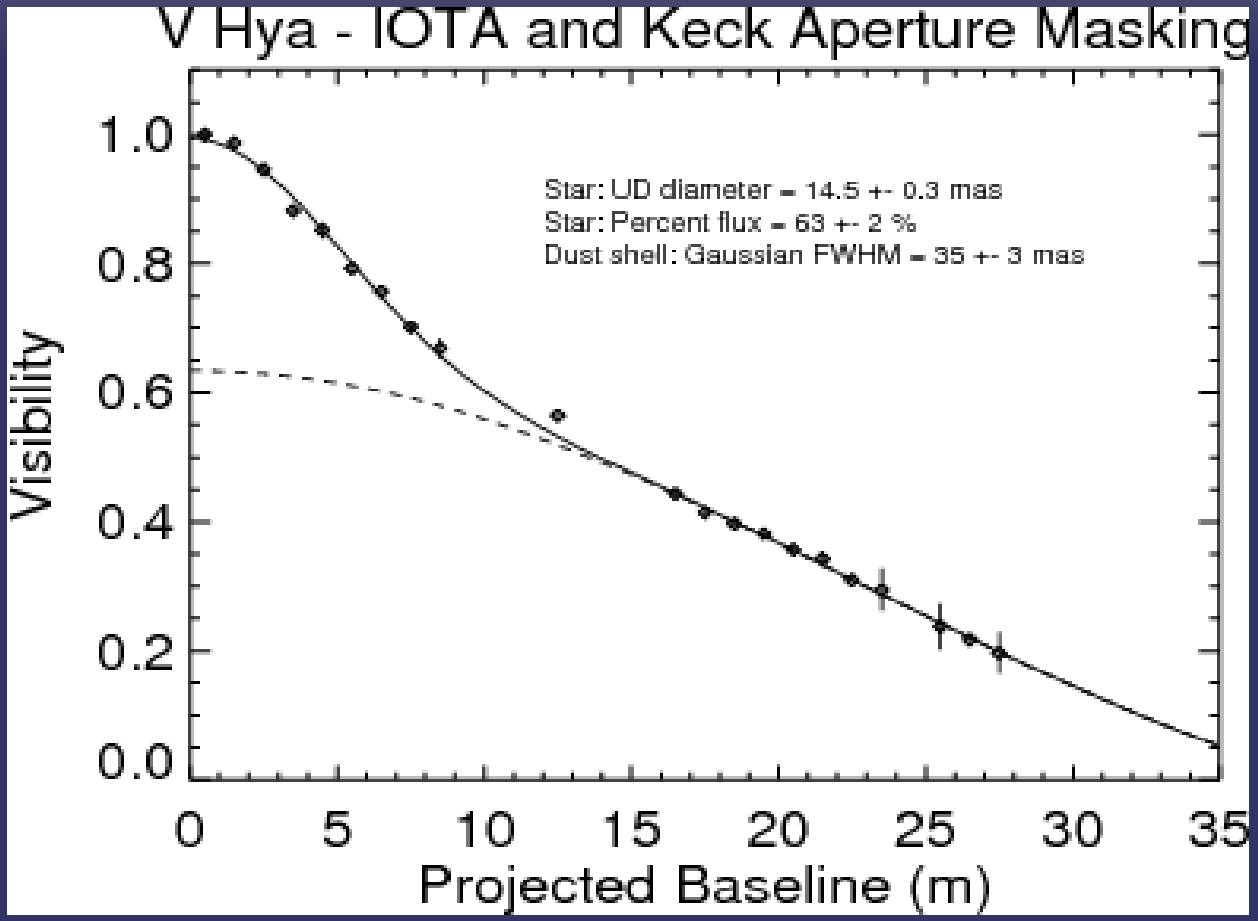
- High speed jets (~100 km/s) inconsistent with low escape velocity of AGB stars, (pre-cursor to planetary nebula?)
- Spectral line broadening in optical spectra in-consistent with slow rotation in AGB stars
- Light curve has an eclipse-like, secondary period of 6160 days (compact companion?)
- Jets launched by the companion?
- AGB star's external envelope spun up by the companion through tidal interaction?

Introduction



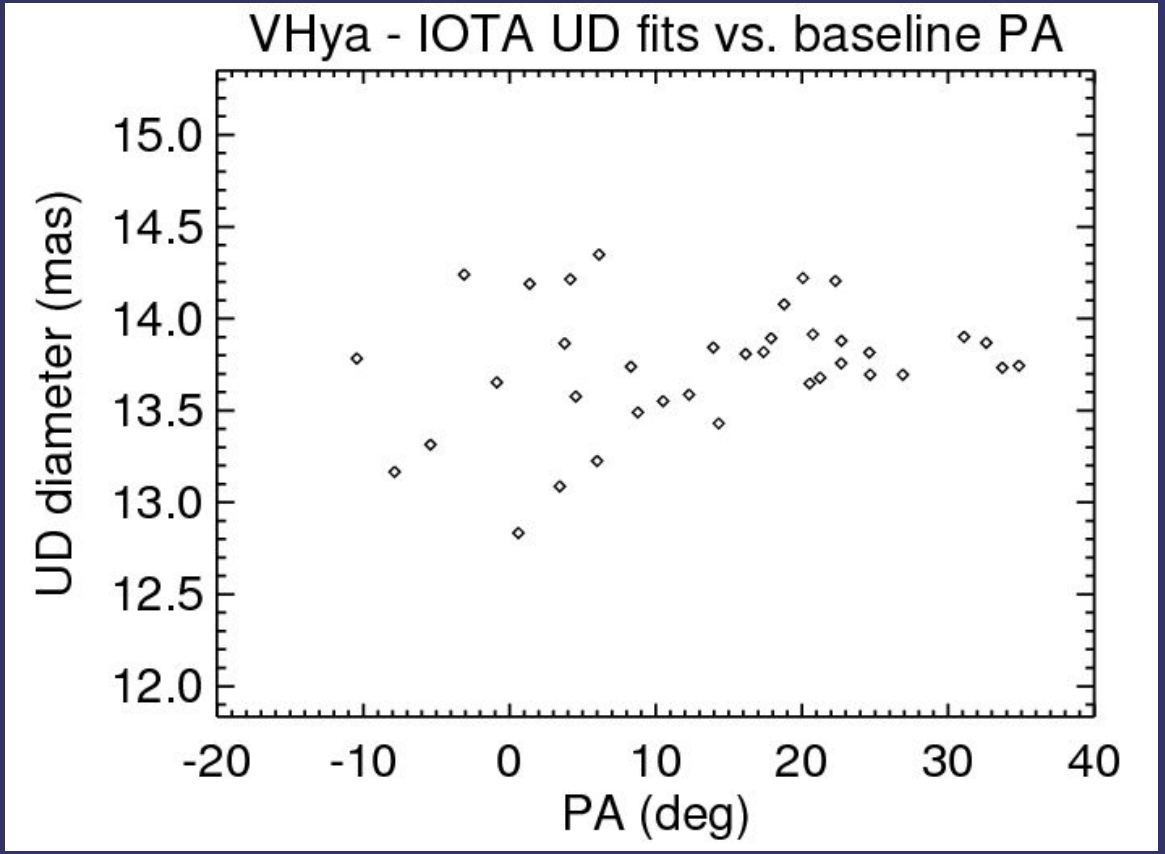
The circumstellar structure of V Hya from the Sub Millimeter Array (Hirano et al. ApJ, 2005)

Introduction



Data from the Infrared Optical Telescope Array (right), and the Keck aperture masking experiment (left), at K band (Millan-Gabet et al, SPIE 2003).

Introduction



No evidence of asymmetries plotting the diameter versus position angle

Project Aims

- Obtain an image of V Hya (difficult since the IOTA uv coverage is limited)
- Obtain a model that fit all the available data
- Obtain a model that does make sense physically
- Confirm / rule-out models proposed with different observing methods

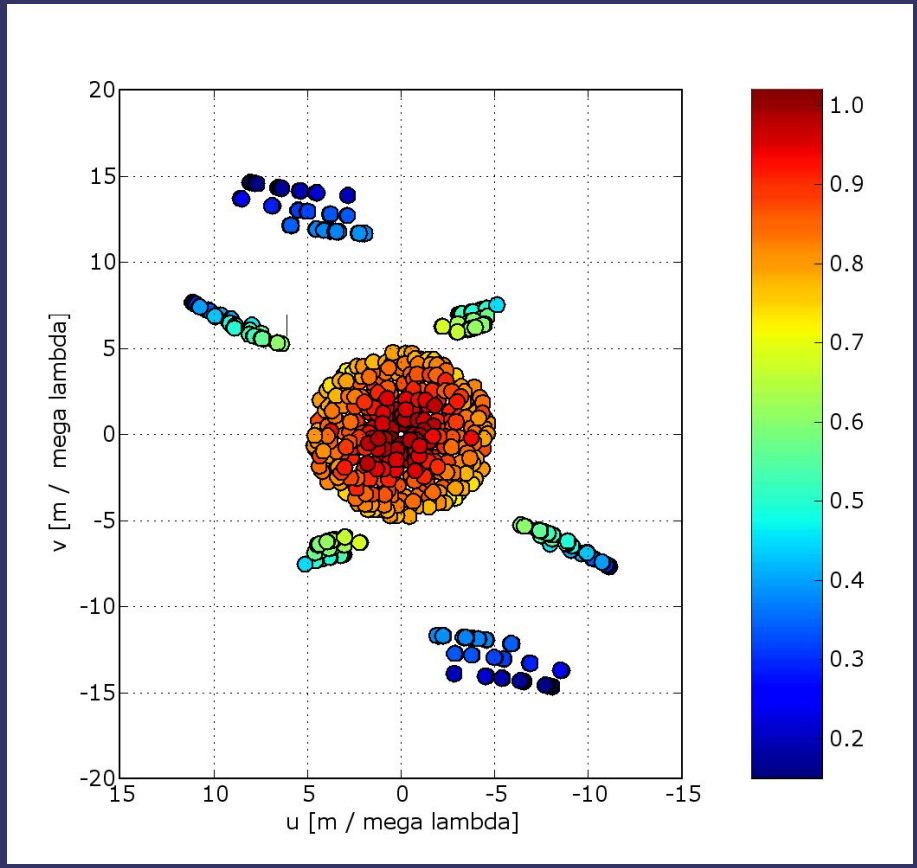
Data Set

- IOTA data, 3 narrow band-passes: 1.50 μm, 1.64 *μ*m, 1.78 μm, one baseline triangle, nine observed nights, from 15 April 2004 to 01 May 2004.

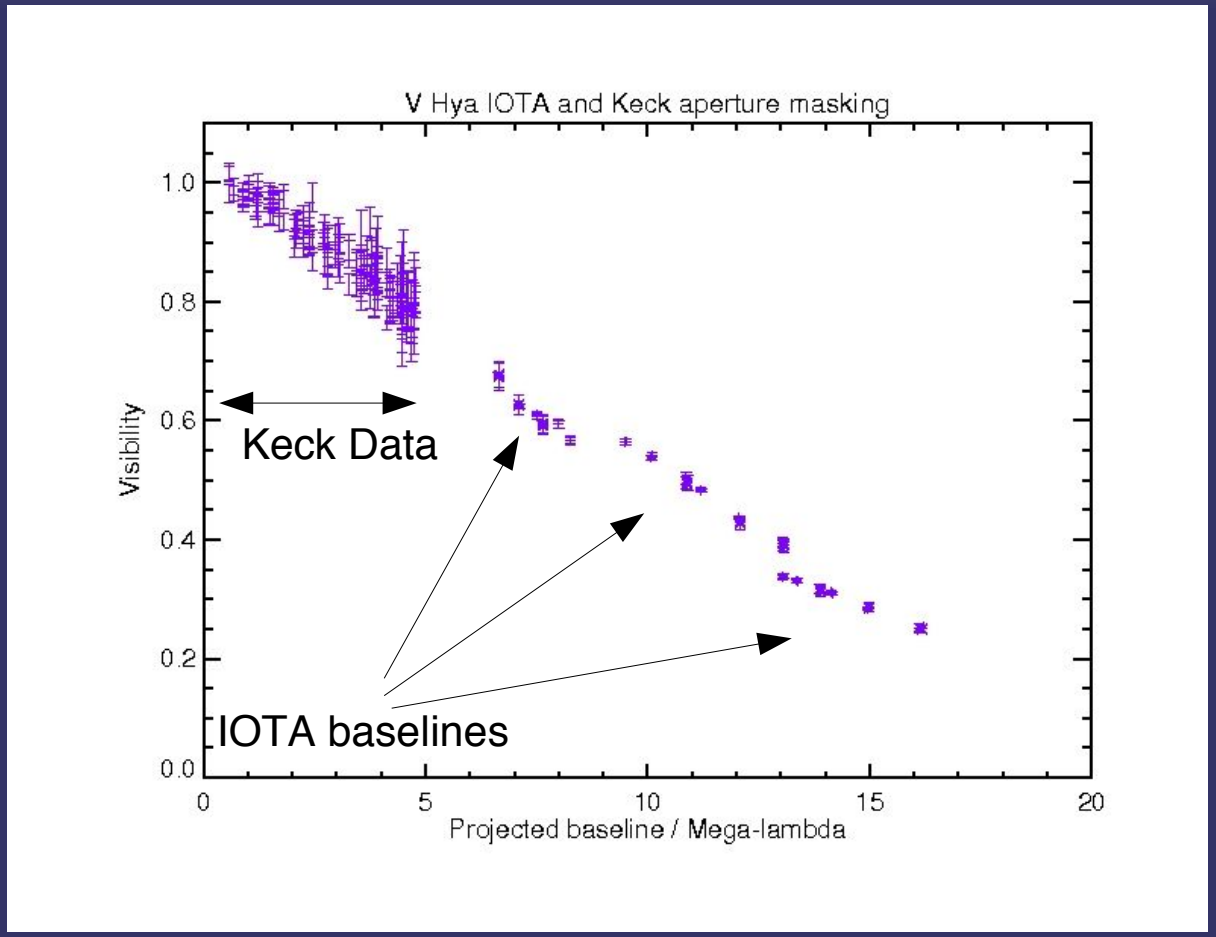
- Keck data, Golay mask, one observed night (28 May 2004)

Data Set

- Extensive Coverage of lower spatial frequency from Keck.
- Holes in the uv coverage in the East-West direction due to the IOTA baselines

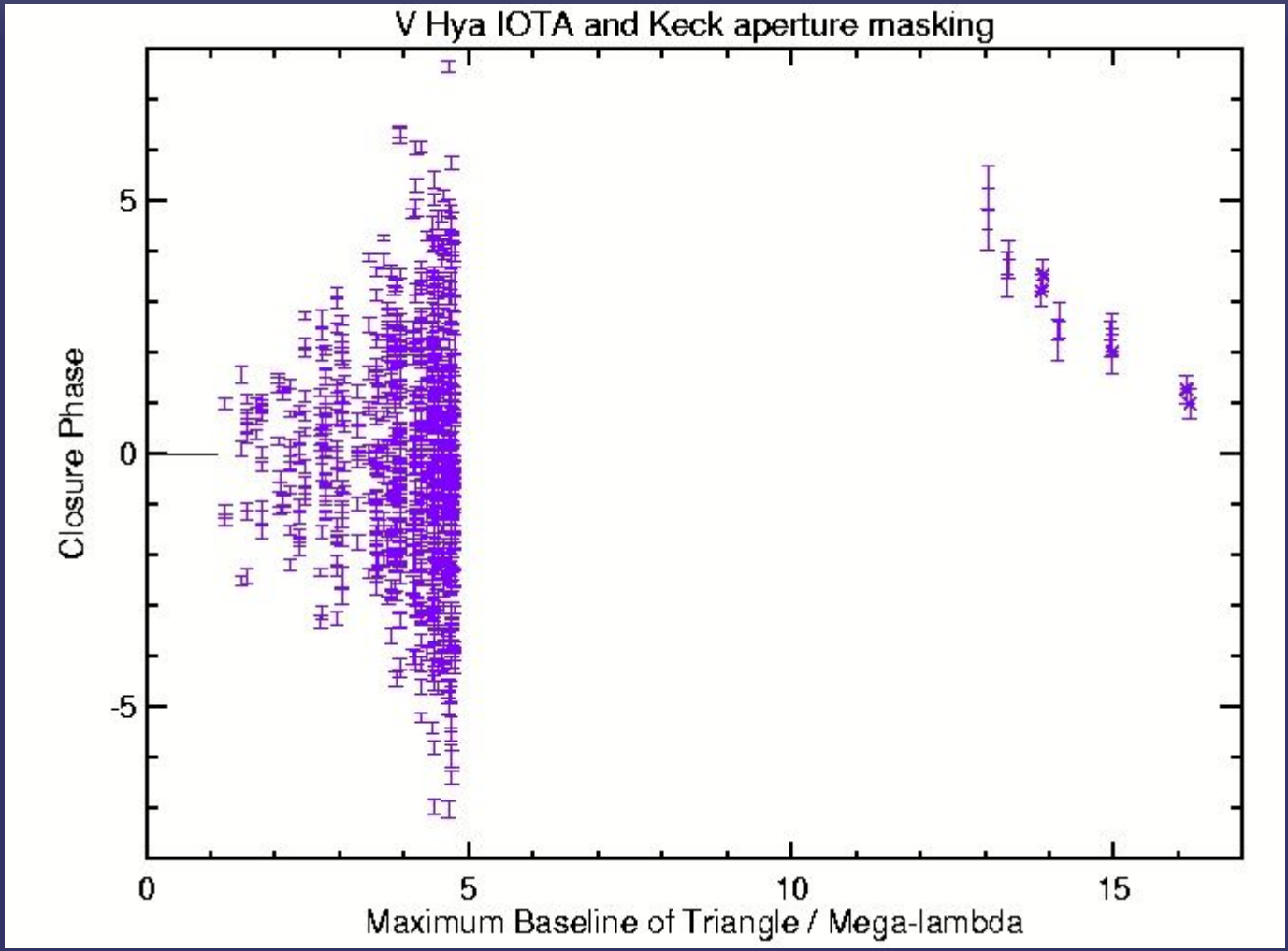


Data Set



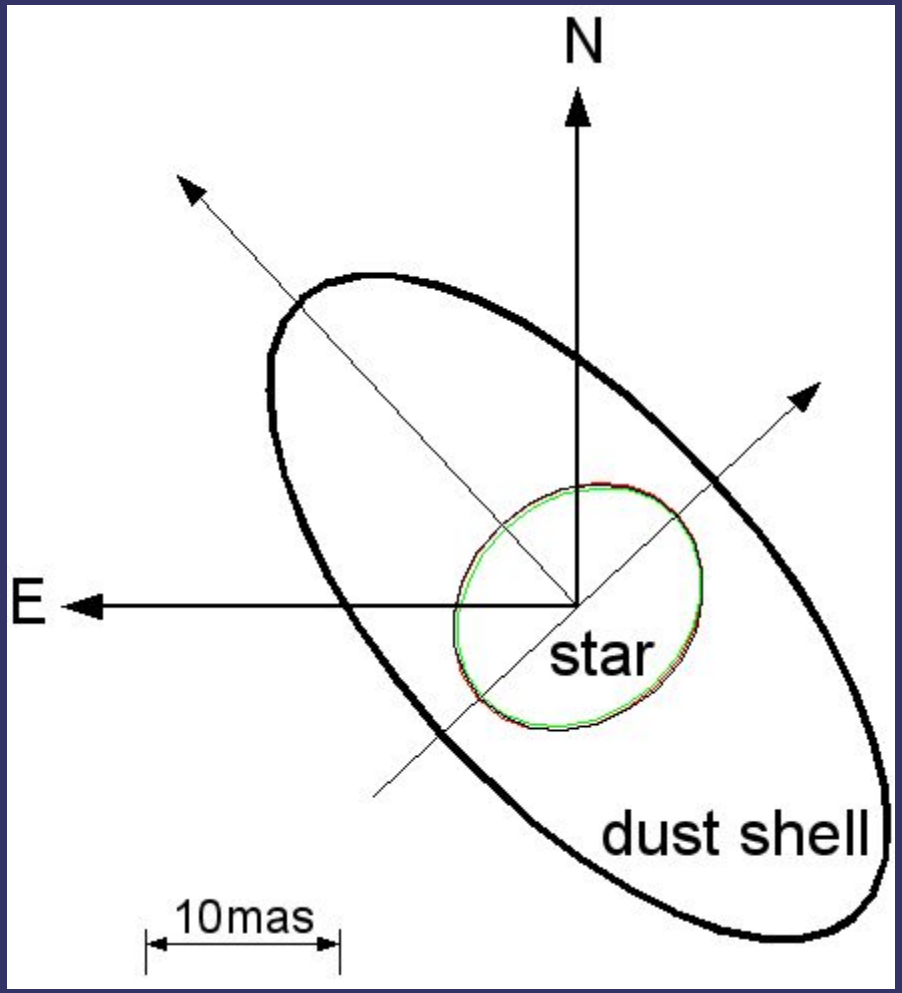
IOTA / Keck combined visibility at 1.64 um

Data Set



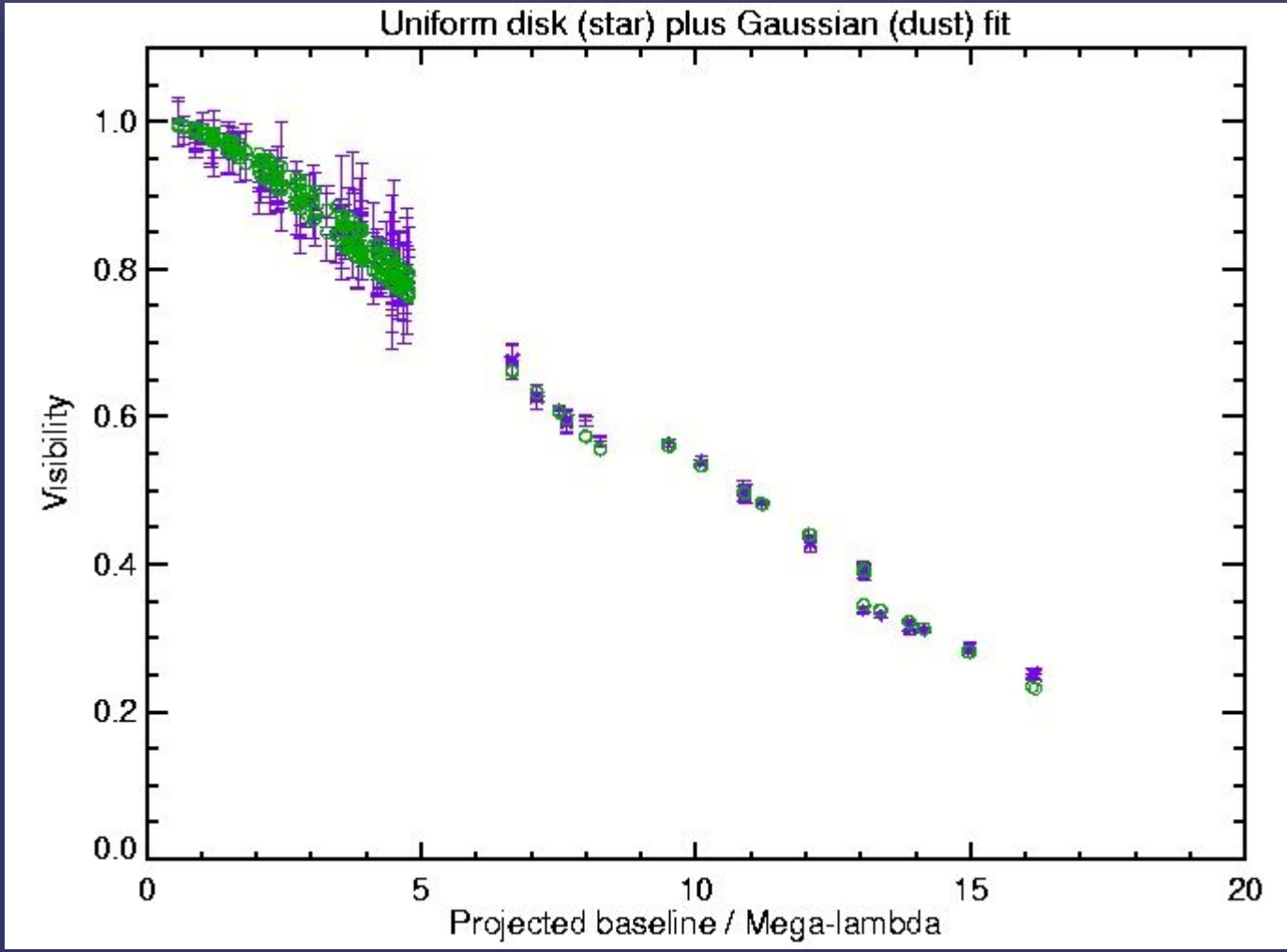
IOTA / Keck combined closure-phase at 1.64 um

Model Fitting



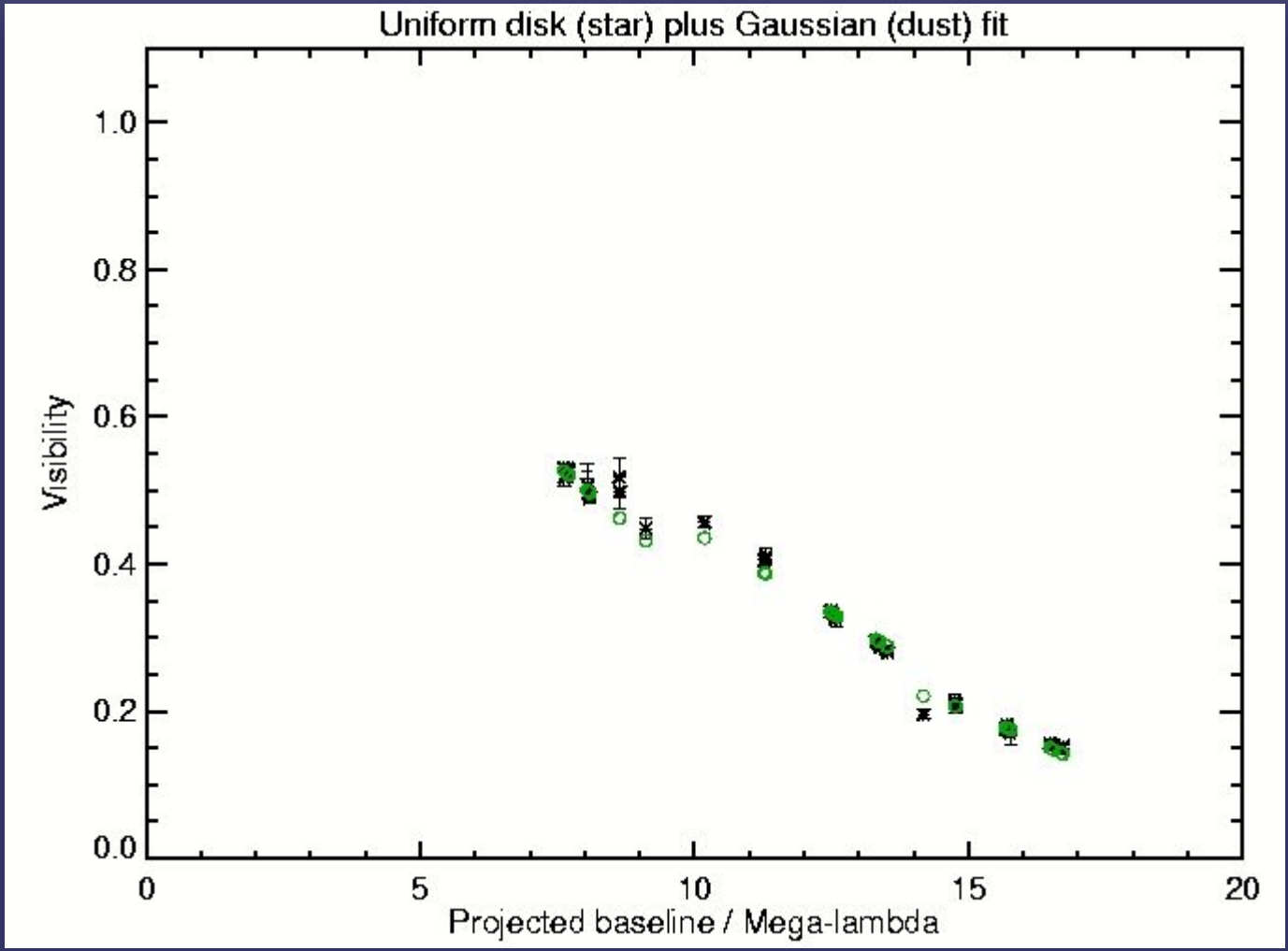
Dust disk + elliptical star for three wave-bands

Model Fitting



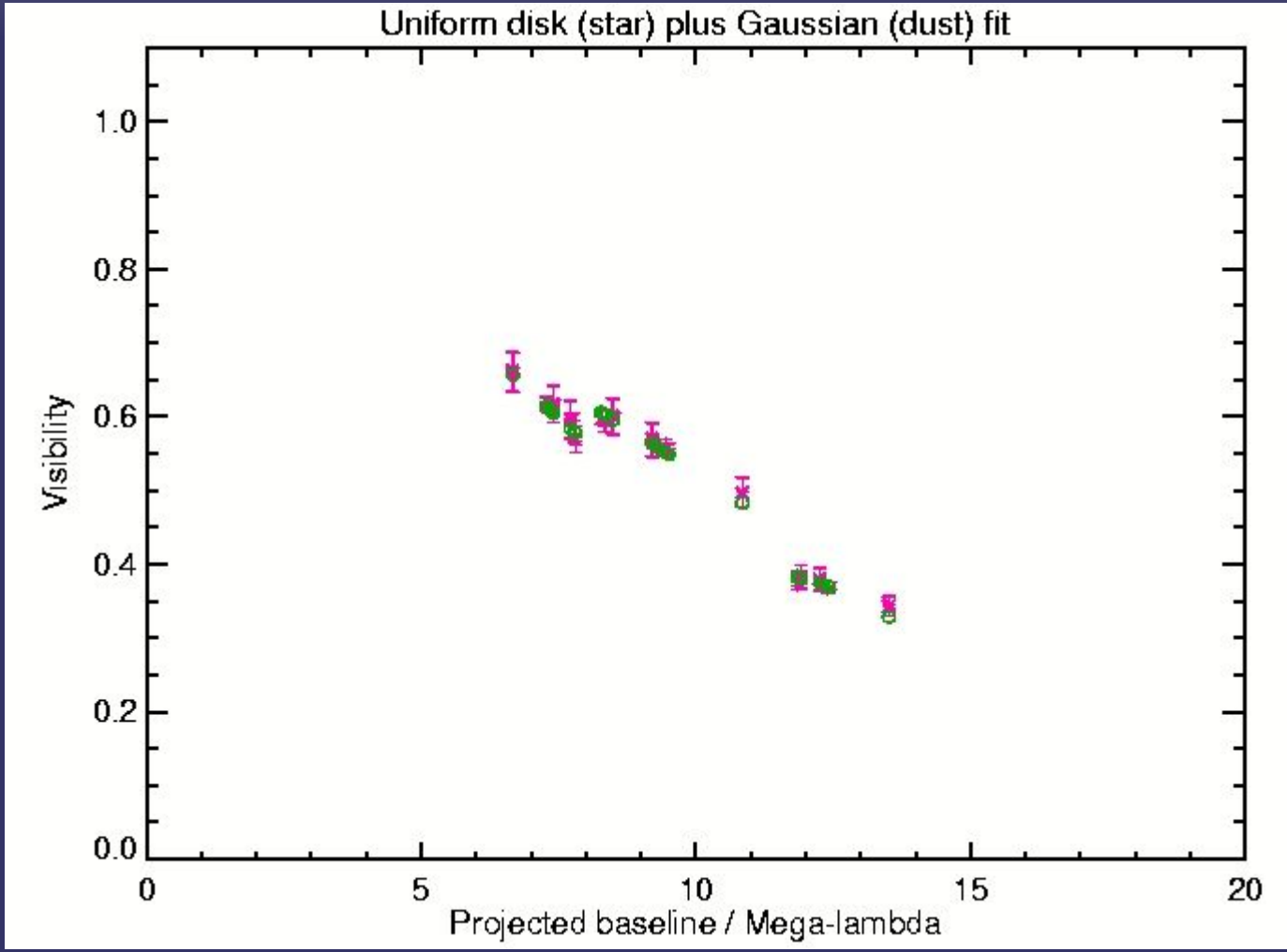
Fitting the model to IOTA / Keck combined data-set at 1.64 μm. Reduced chi squ. = 1.78

Model Fitting



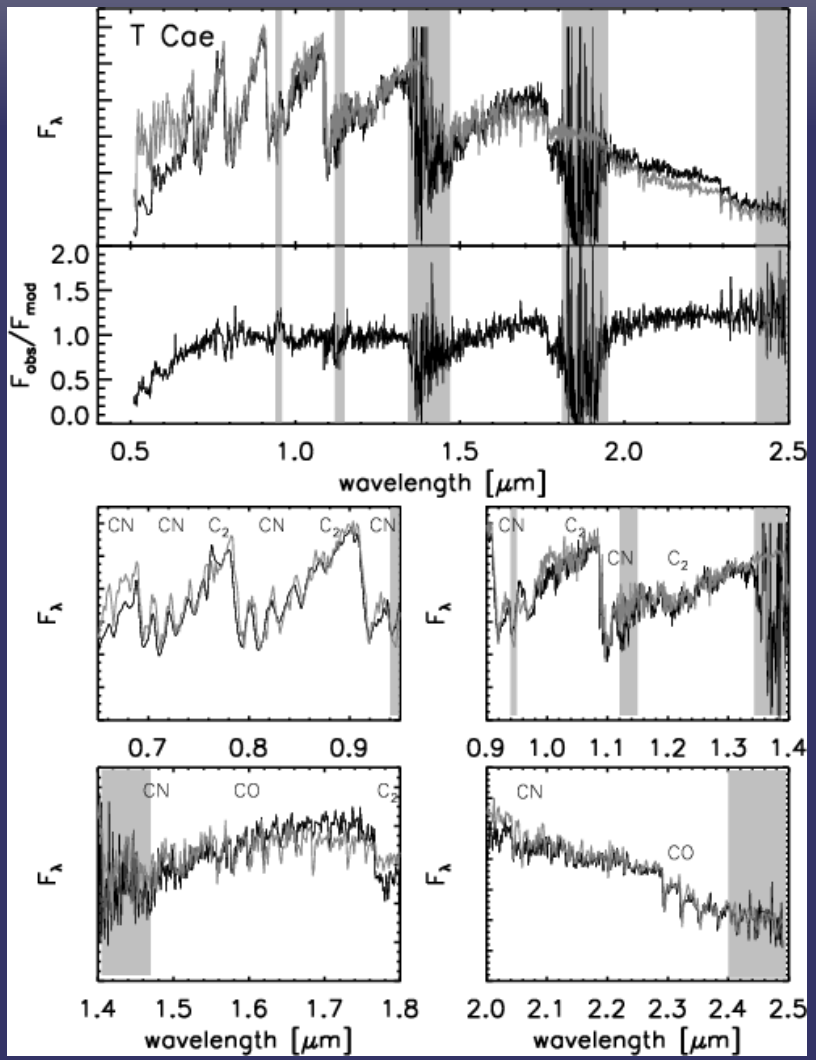
Fitting the model to the IOTA data-set at 1.50 μm.
Reduced chi squ. = 2.7

Model Fitting



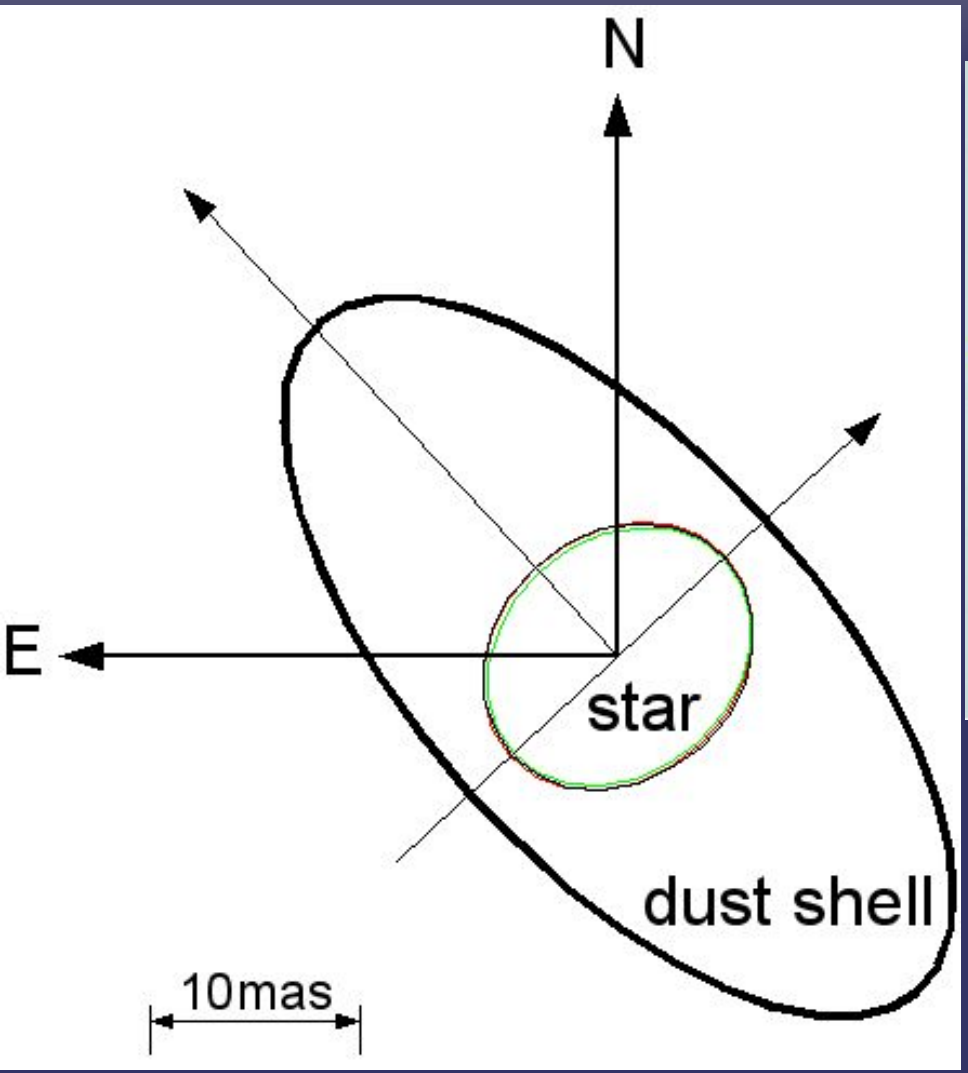
IOTA data-set at 1.78 μm Reduced chi squ. = 0.9

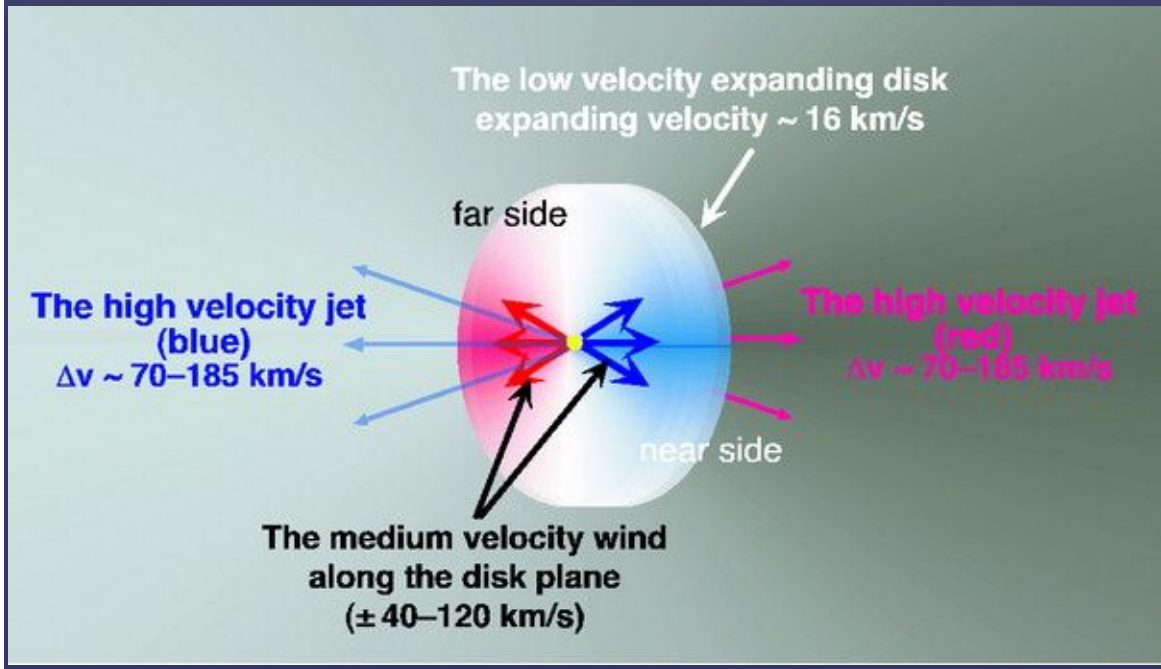
Discussion



Flux from star found lower at 1.5 μm, probably caused by 20% fainter star, due to CN, CO absorption bands (Loidl et al 2001, A&A).

Discussion



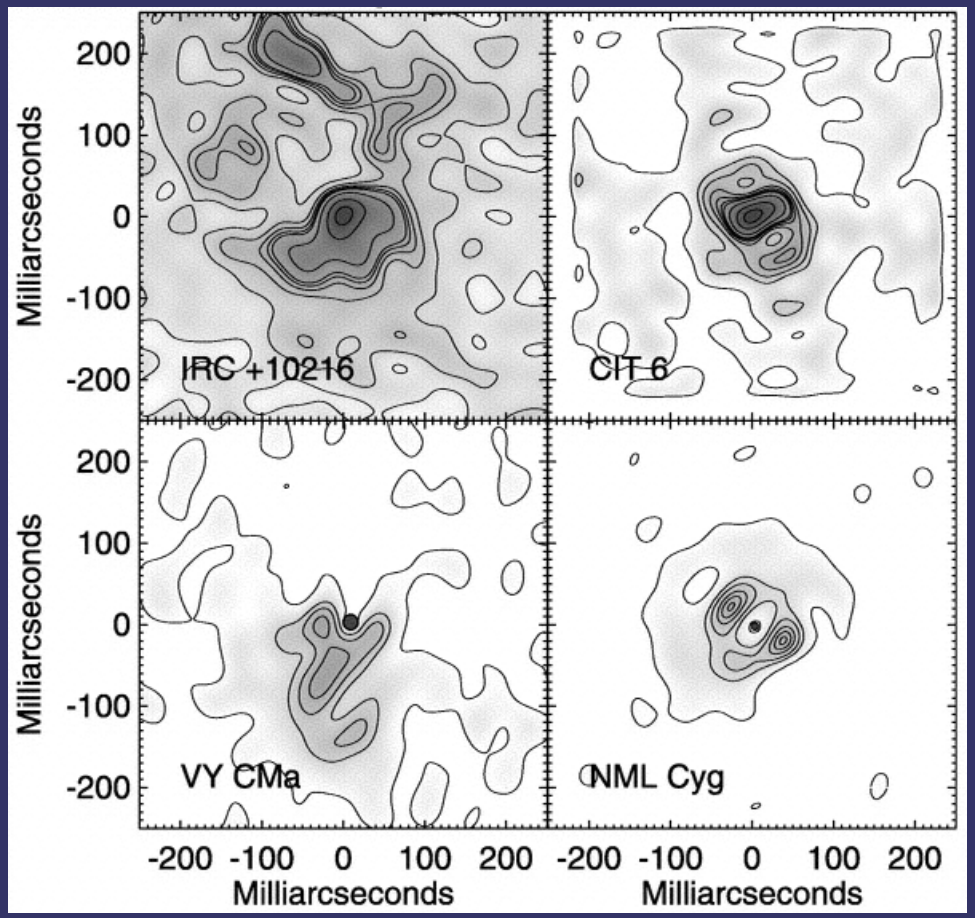


Models do not agree !!!

Discussion

- There is high resolution structure in the data that we cannot explain with our simple model
- Could we be seeing the binary?
- Could there be 'clumpiness' in the dust?

Discussion



Top half of the image shows two carbon stars from Keck aperture masking (Monnier et al, ApJ).

Conclusions / Future Work

- The model fits all the available data
- The model disagrees with previous observations at millimeter and visible wavelengths
- Data consistent with IOTA / FLUOR observations but asymmetries detected.

Conclusions / Future Work

- New observations at IOTA with spectral dispersion (spectro project) necessary
- Obtain infrared spectrum of V Hya
- Observe at other interferometer with better uv coverage (VLTI / CHARA).