

Spectral Resolution in Interferometry



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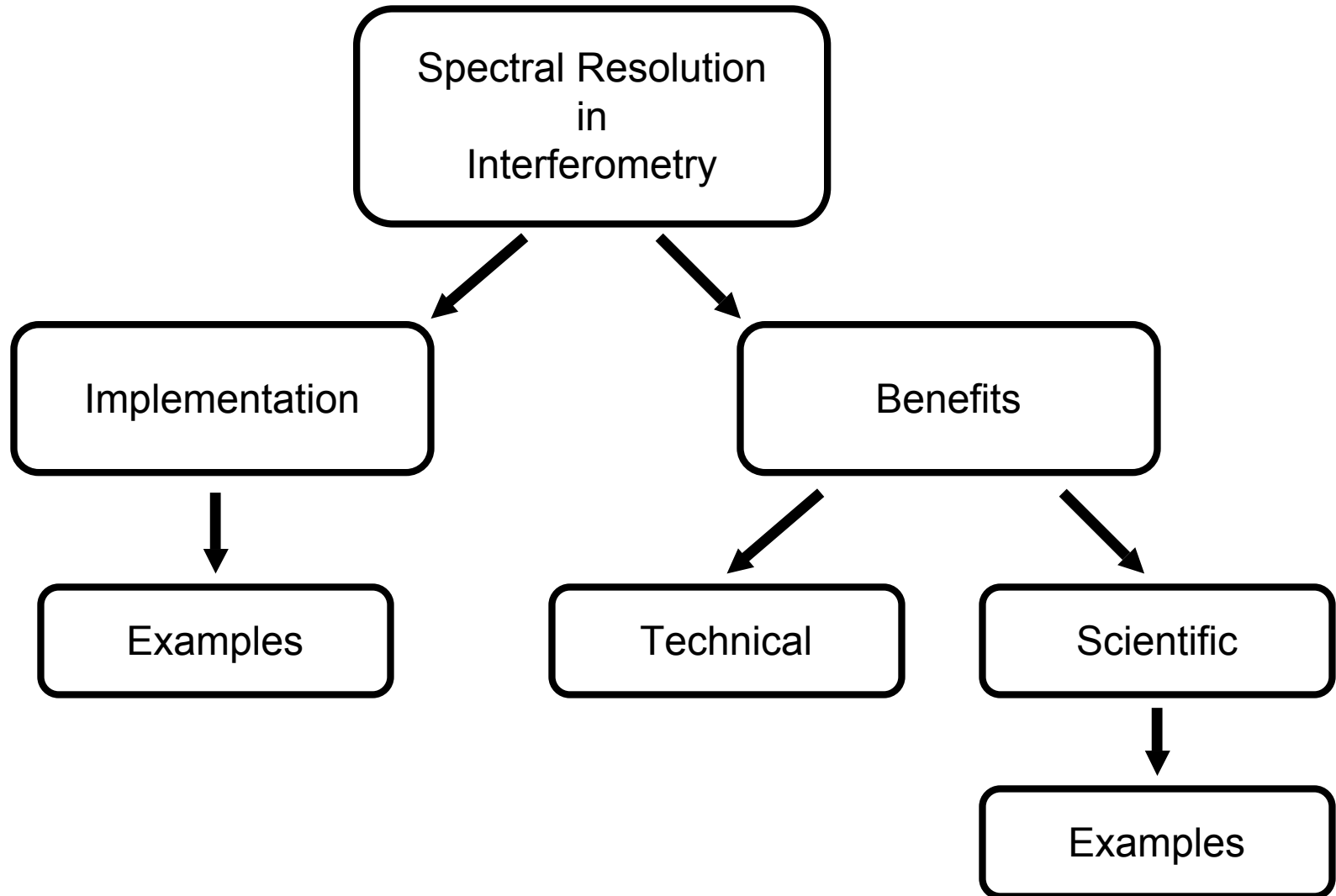
U. S. Naval Observatory

Flagstaff Station



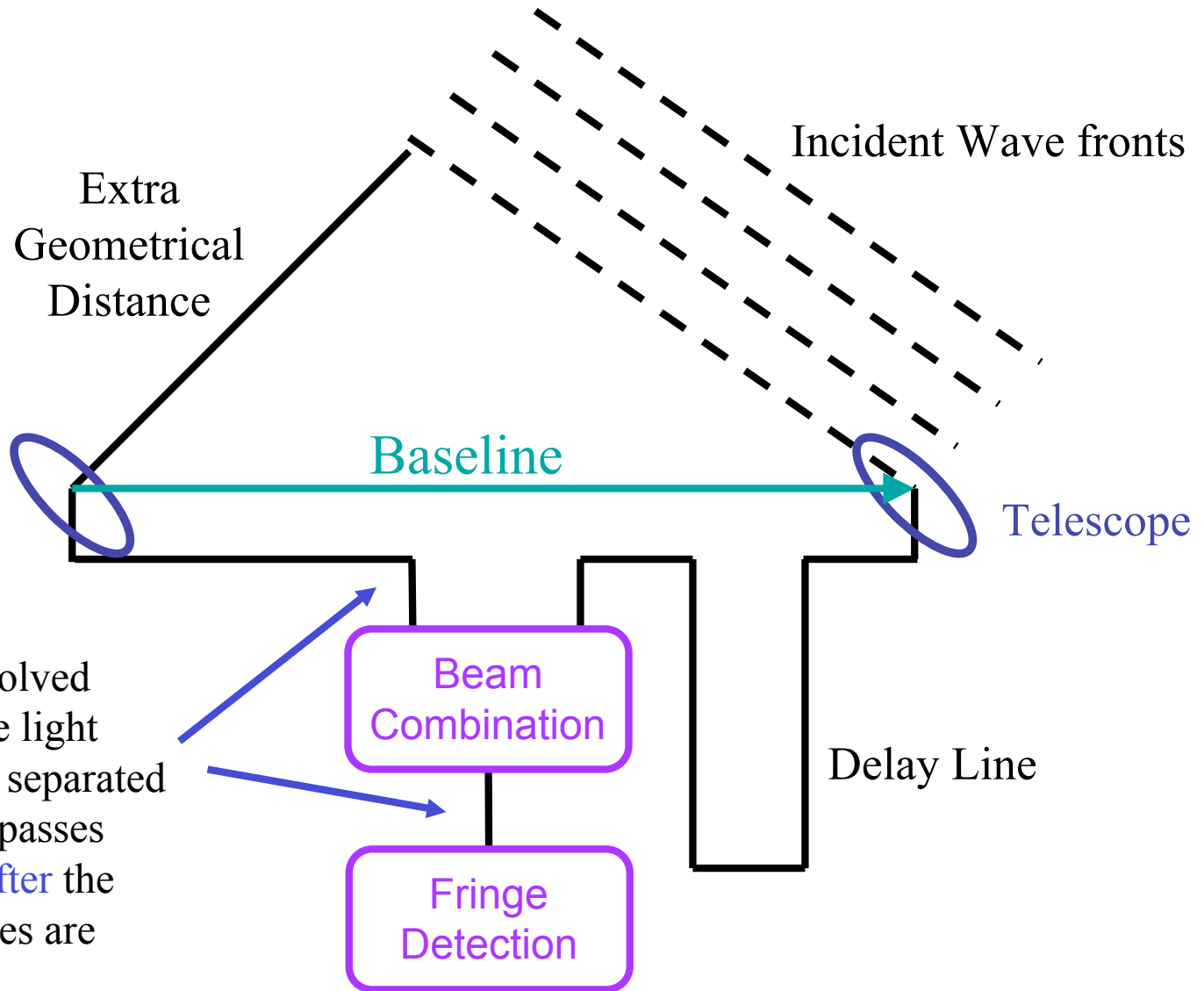


Outline





Implementation

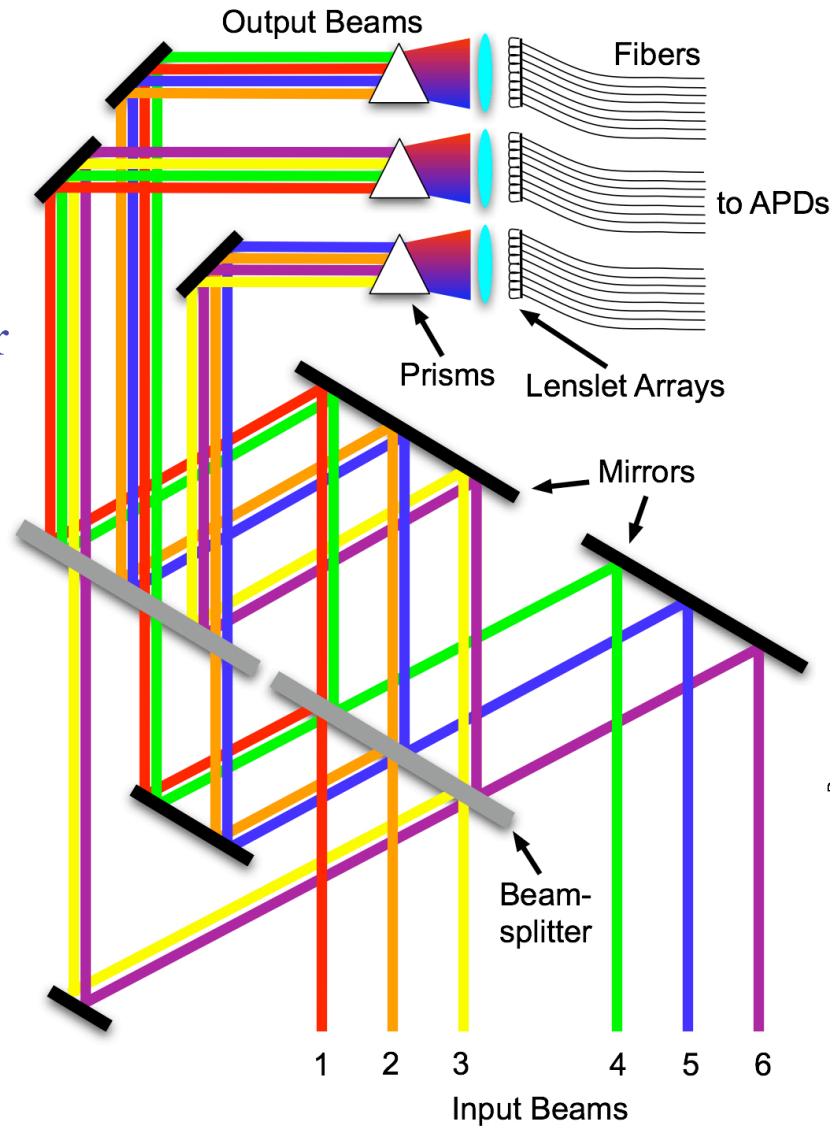


For spectrally resolved interferometry the light beams need to be separated into smaller bandpasses either **before** or **after** the interference fringes are formed

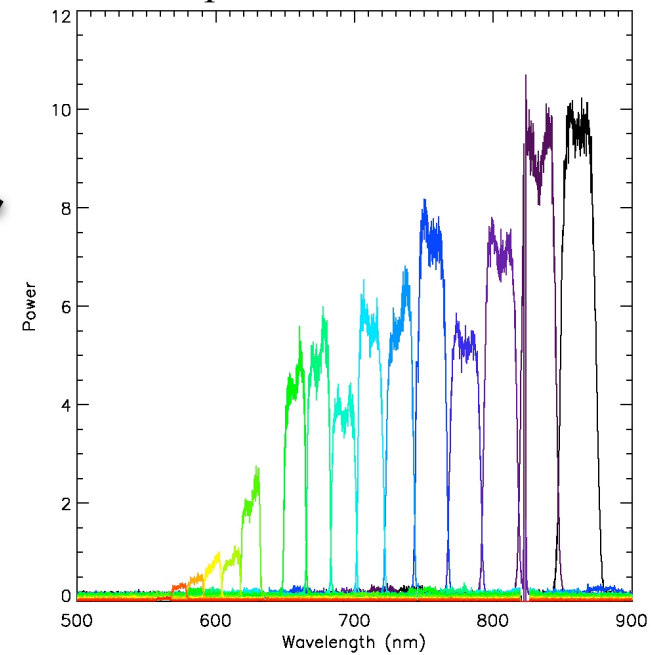


Example: NPOI

The Navy
Prototype
Optical
Interferometer
beam combiner



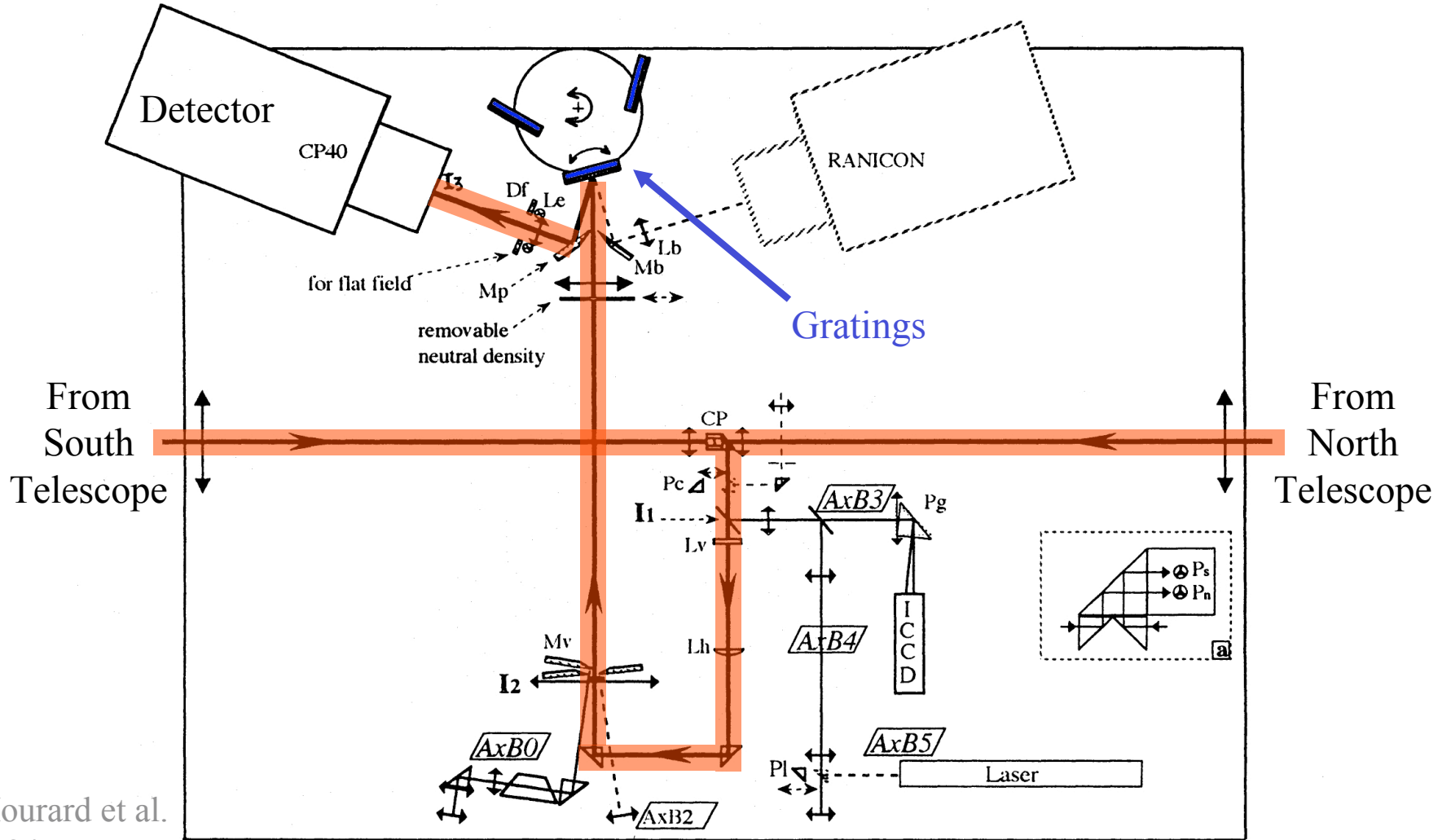
Sample Flux Distribution





Example: GI2T

The Grand Interféromètre à 2 Télescopes beam combiner

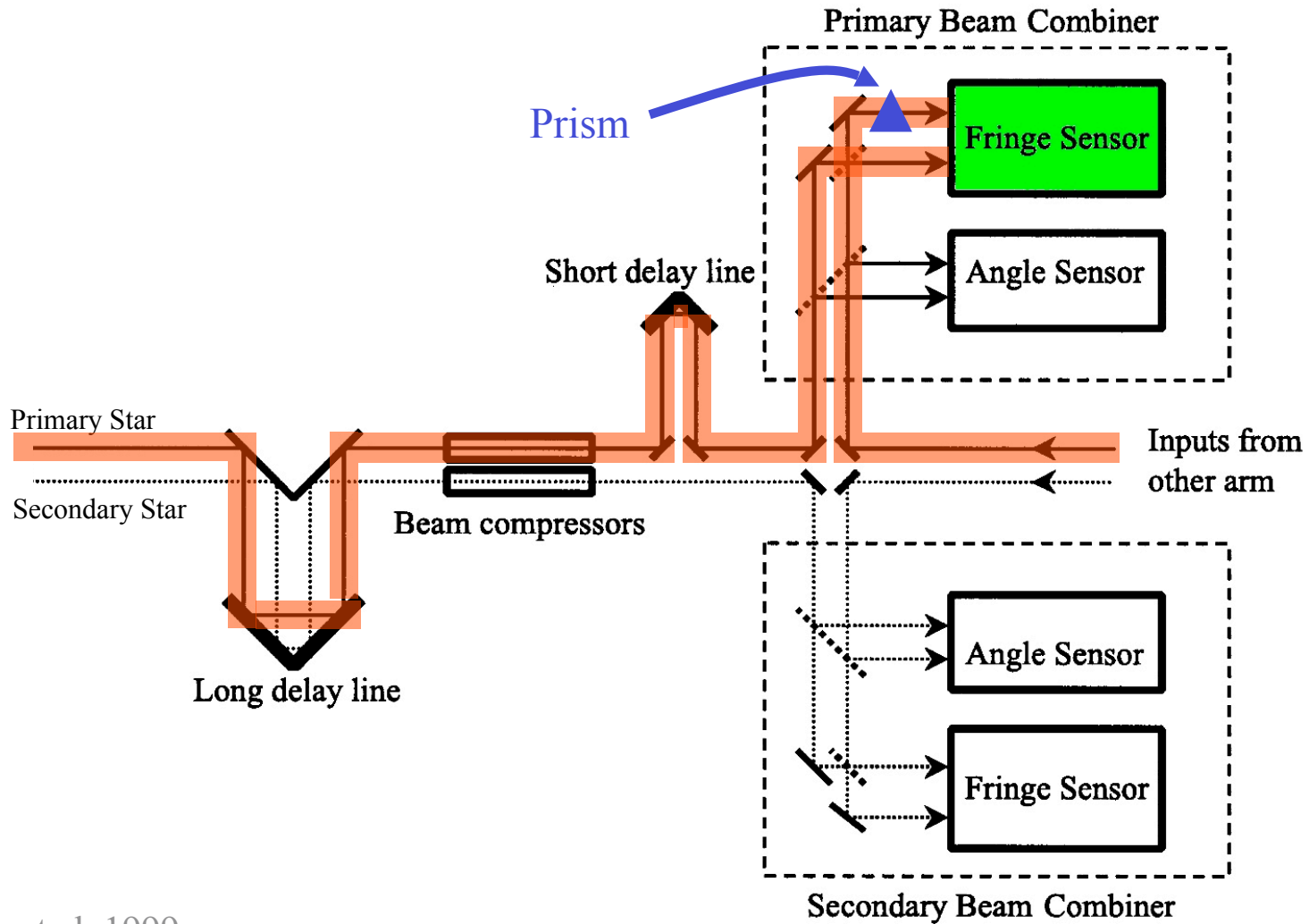


Mourard et al.
1994



Example: PTI

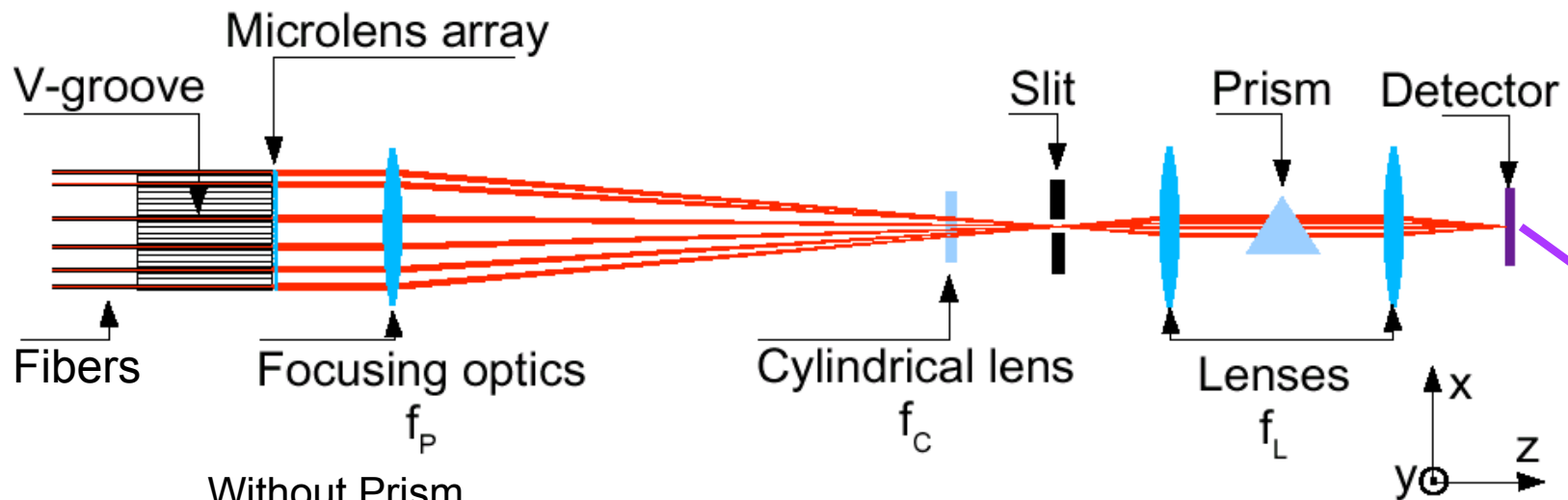
The Palomar Testbed Interferometer beam combiner



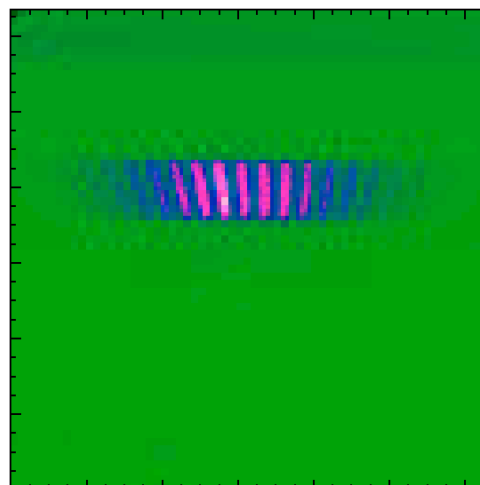
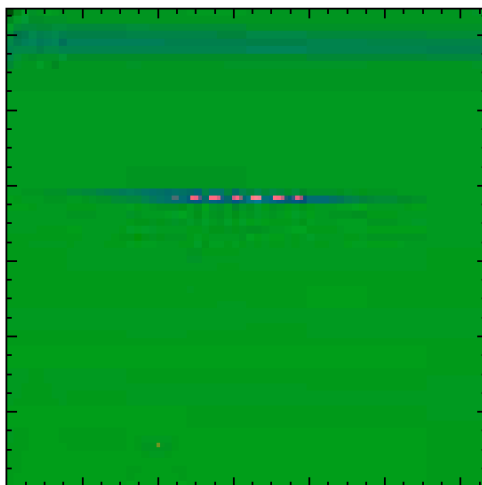


Example: MIRC

The Michigan Infra-Red Combiner for the CHARA array



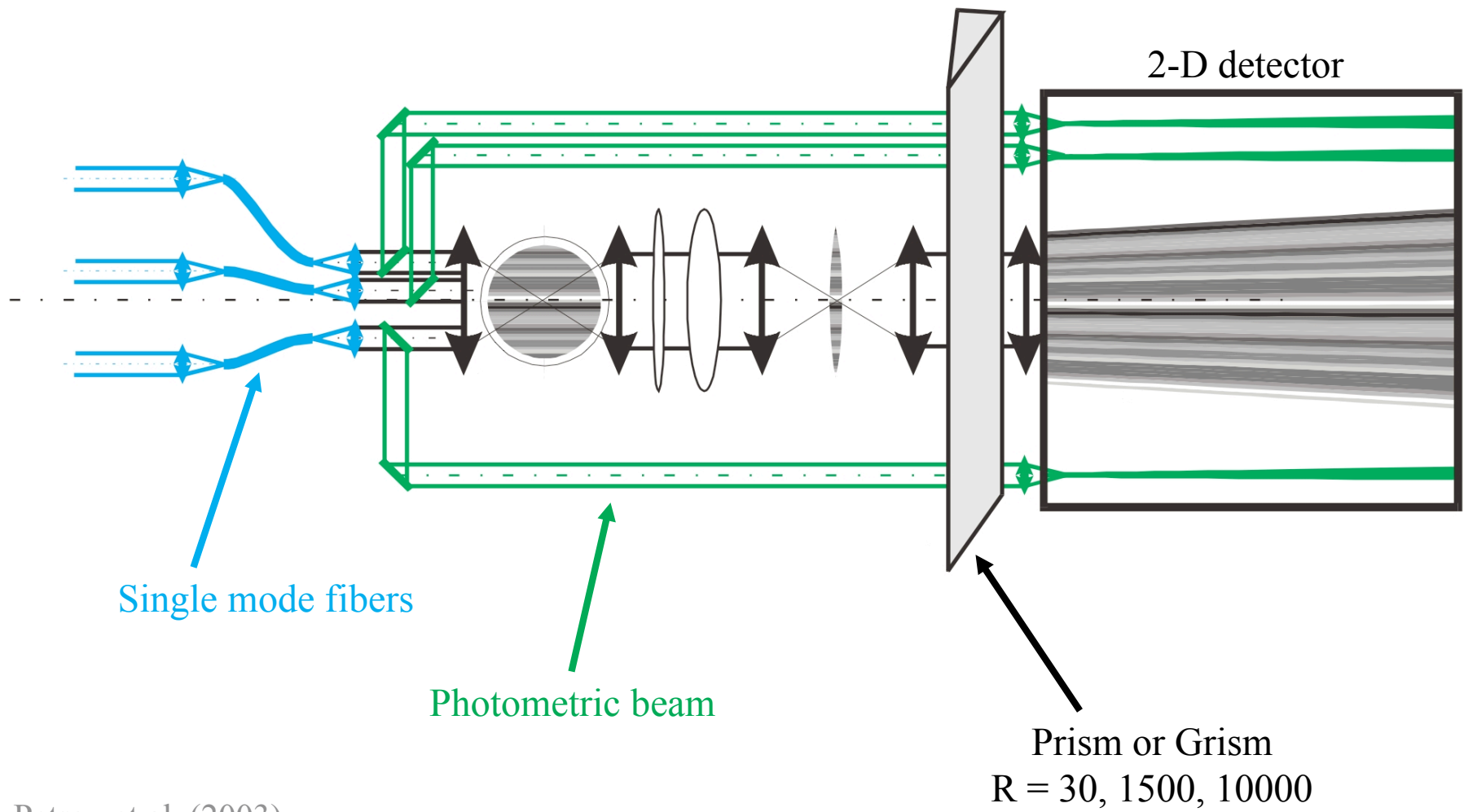
Without Prism



Courtesy of John Monnier



Example: AMBER

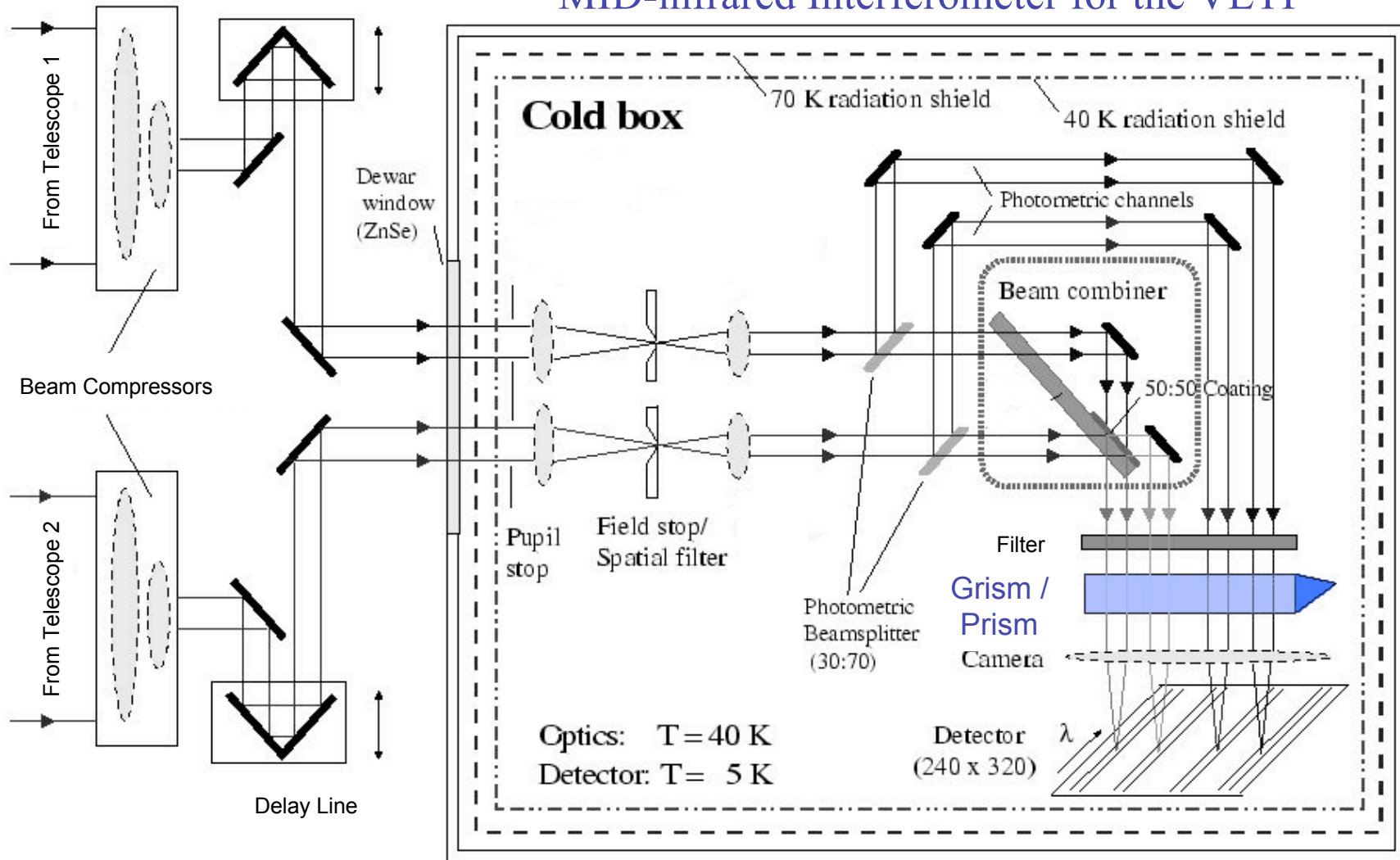


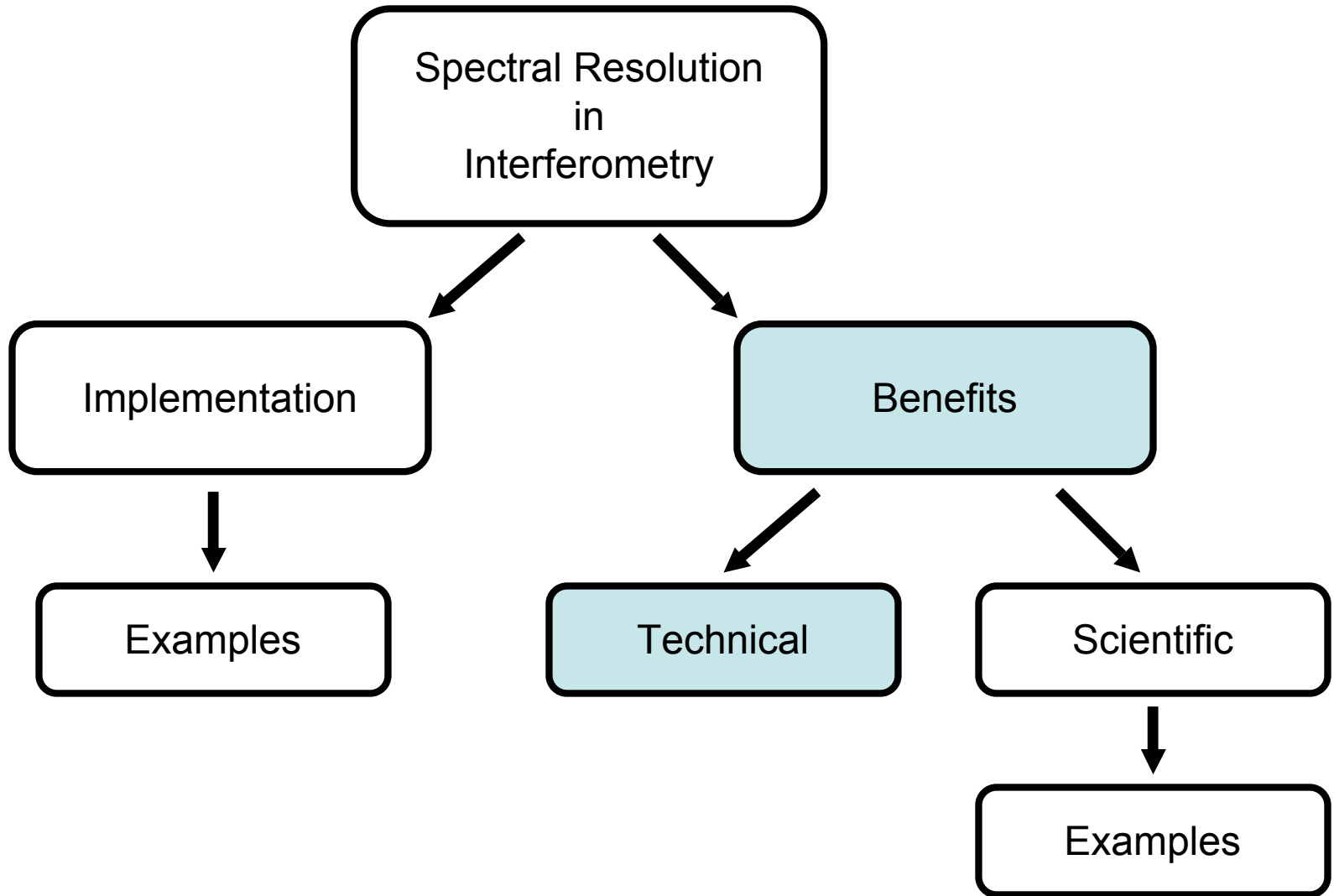
Petrov et al. (2003)



Example: MIDI

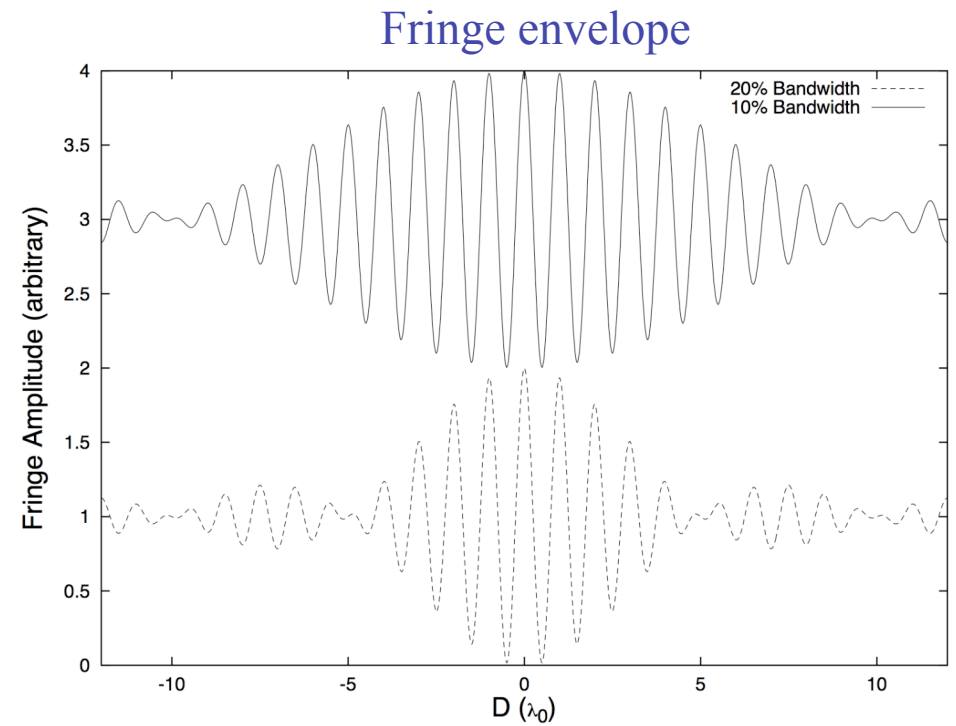
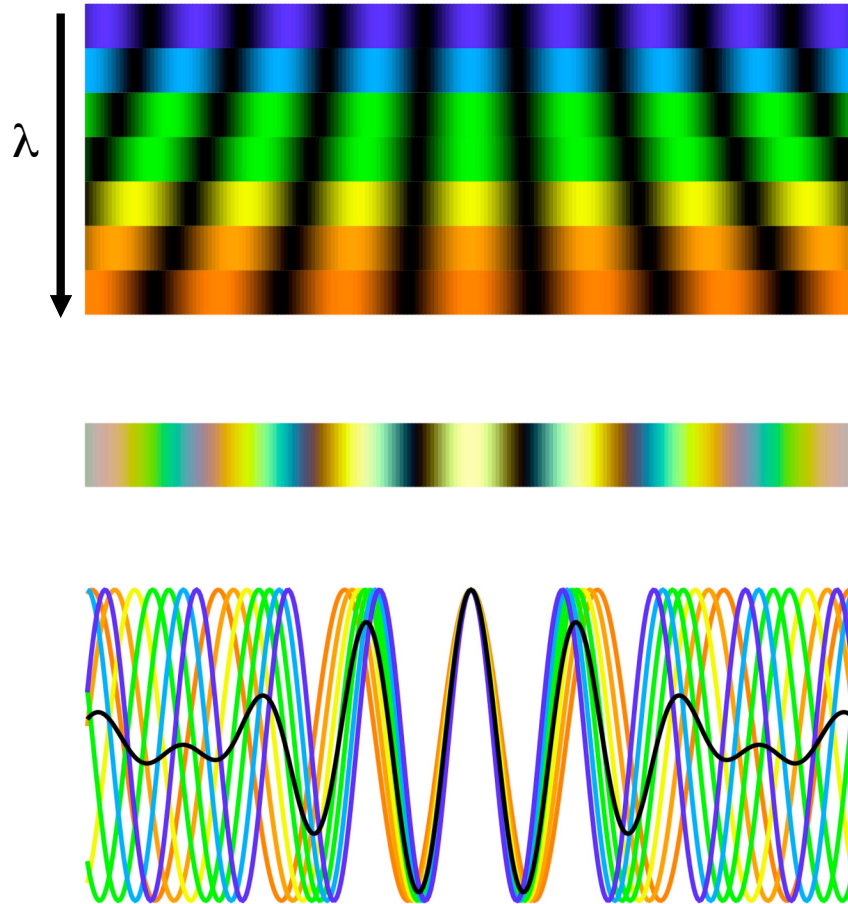
MID-infrared Interferometer for the VLTI







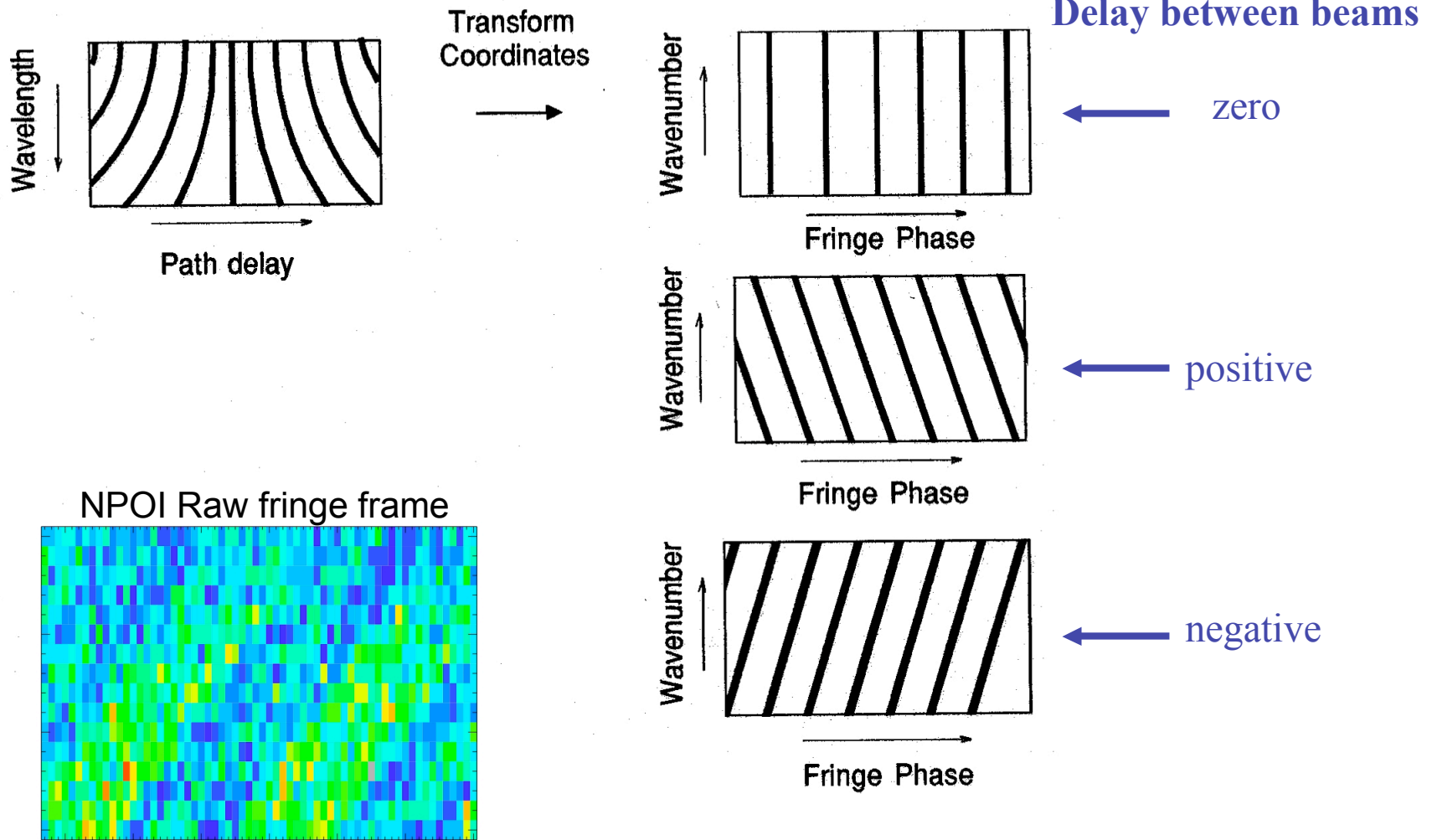
Smaller Bandwidth



Figs. 2.3 and 8.2 - Course Notes from the 1999 Michelson Summer School



Group-delay Fringe Tracking



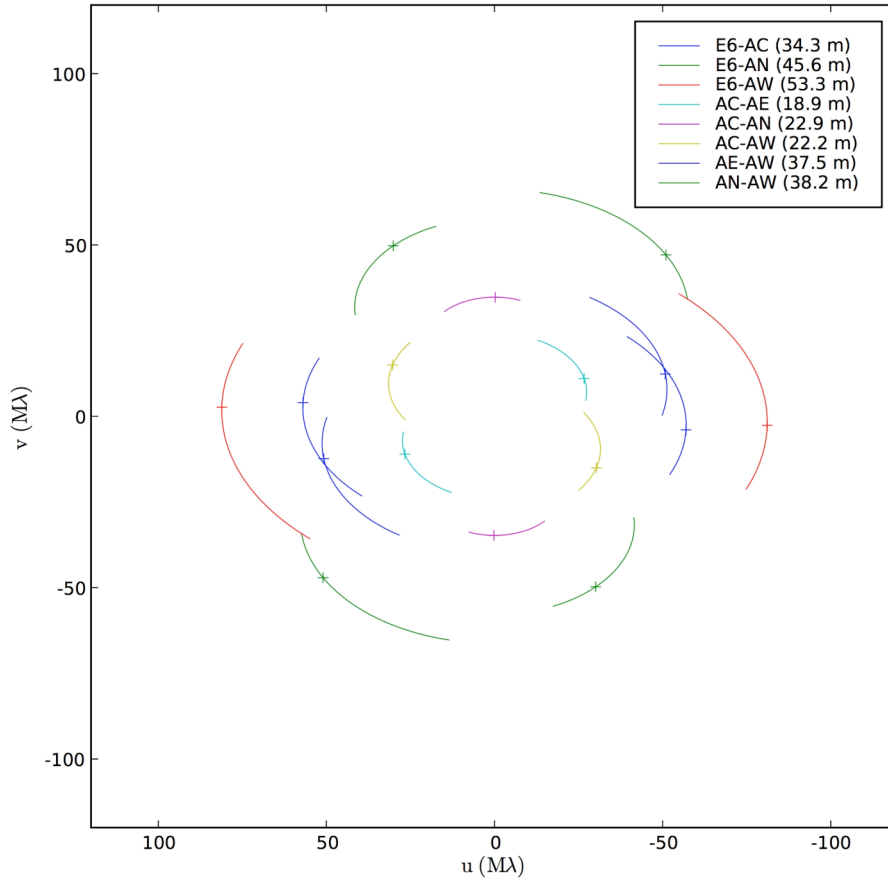
Buscher 1988 (p. 74)



Improved (u,v)-plane Coverage

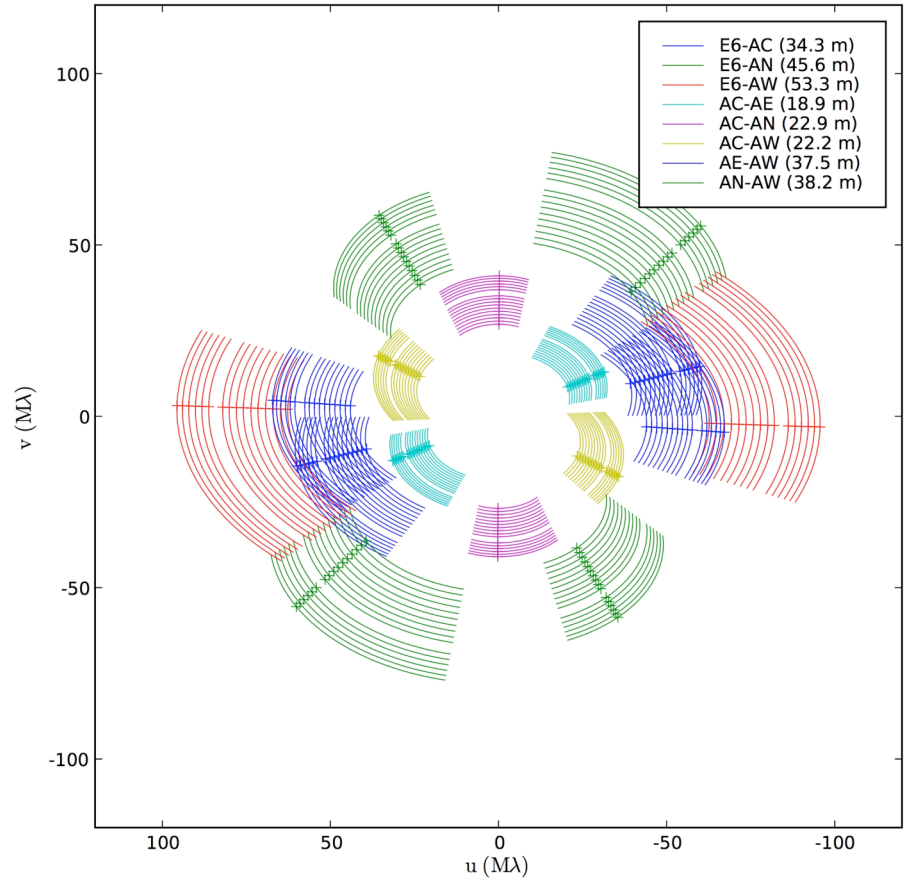
1 channel / baseline

FKV0699: 2006-06-26: $-3.23 < HA < 1.45$



16 channels / baseline

FKV0699: 2006-06-26: $-3.23 < HA < 1.45$

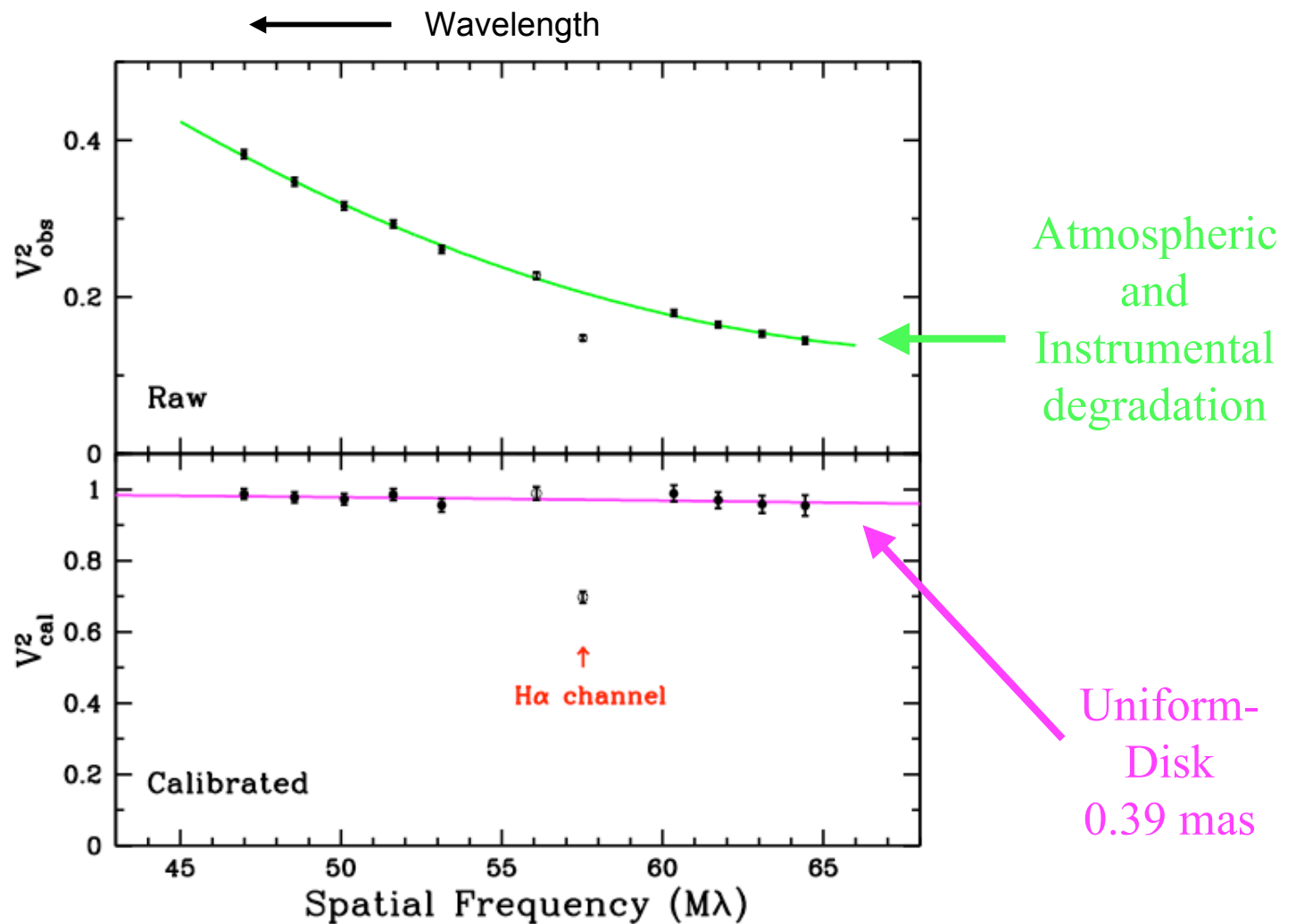


Sample (u,v)-plane coverage for Vega on 8 baselines of the NPOI



Differential Calibration

H α -emitting
Source

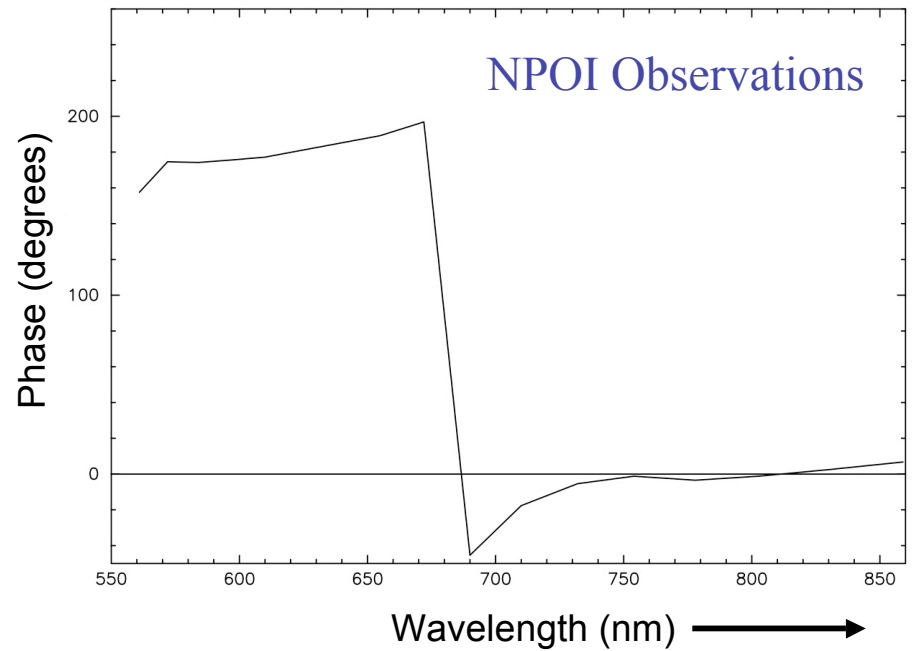
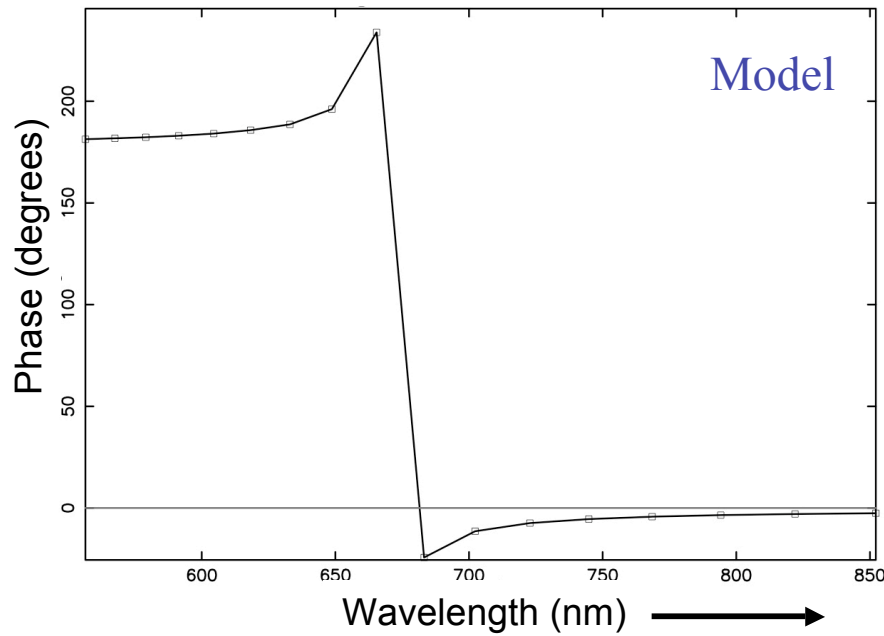
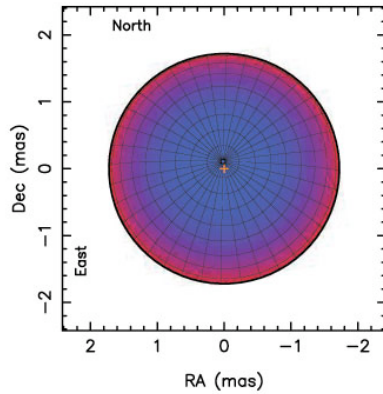


Tycner et al. (2003)

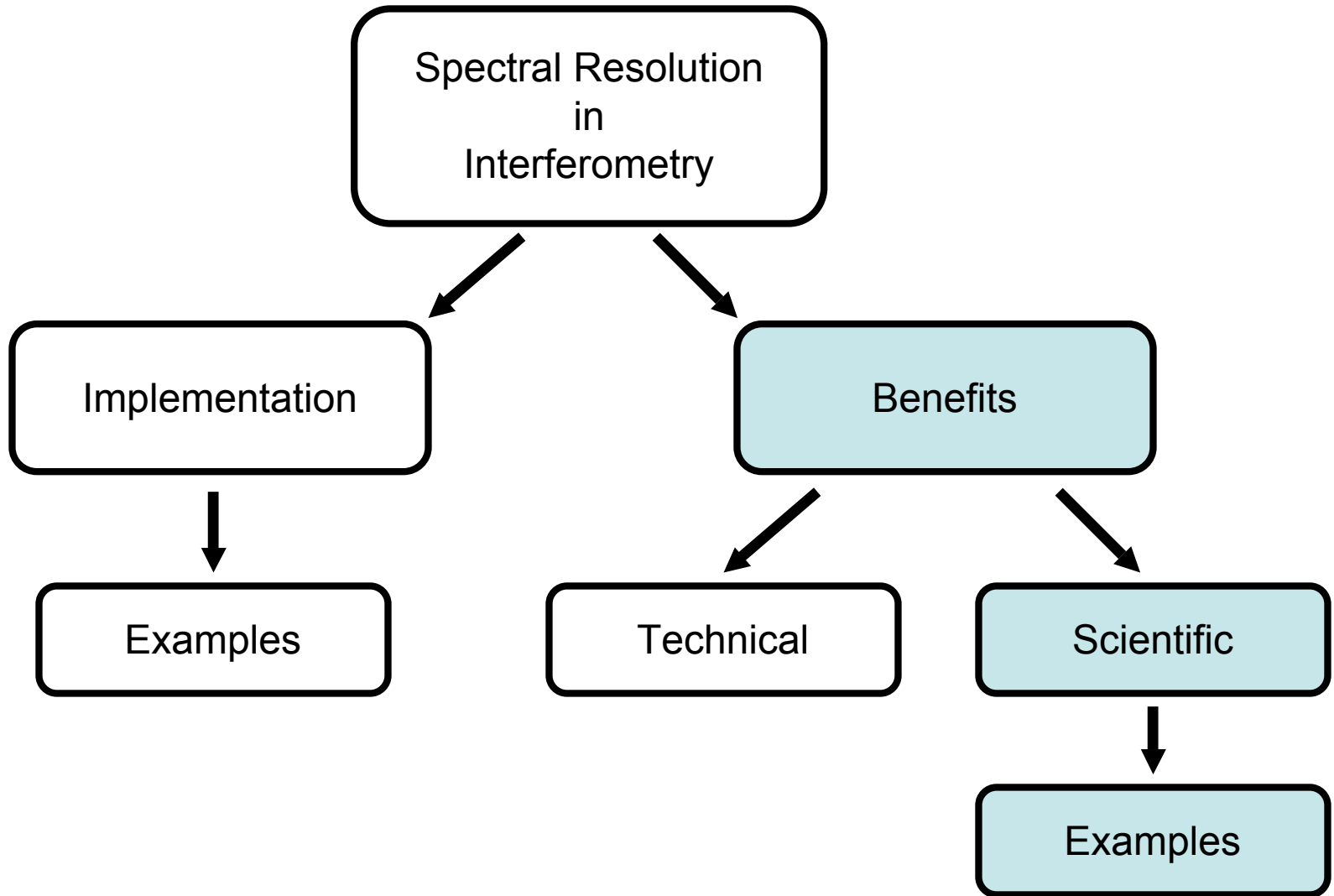


Differential Phases

Vega
 $i = 4.54^\circ$
PA = 8.6°

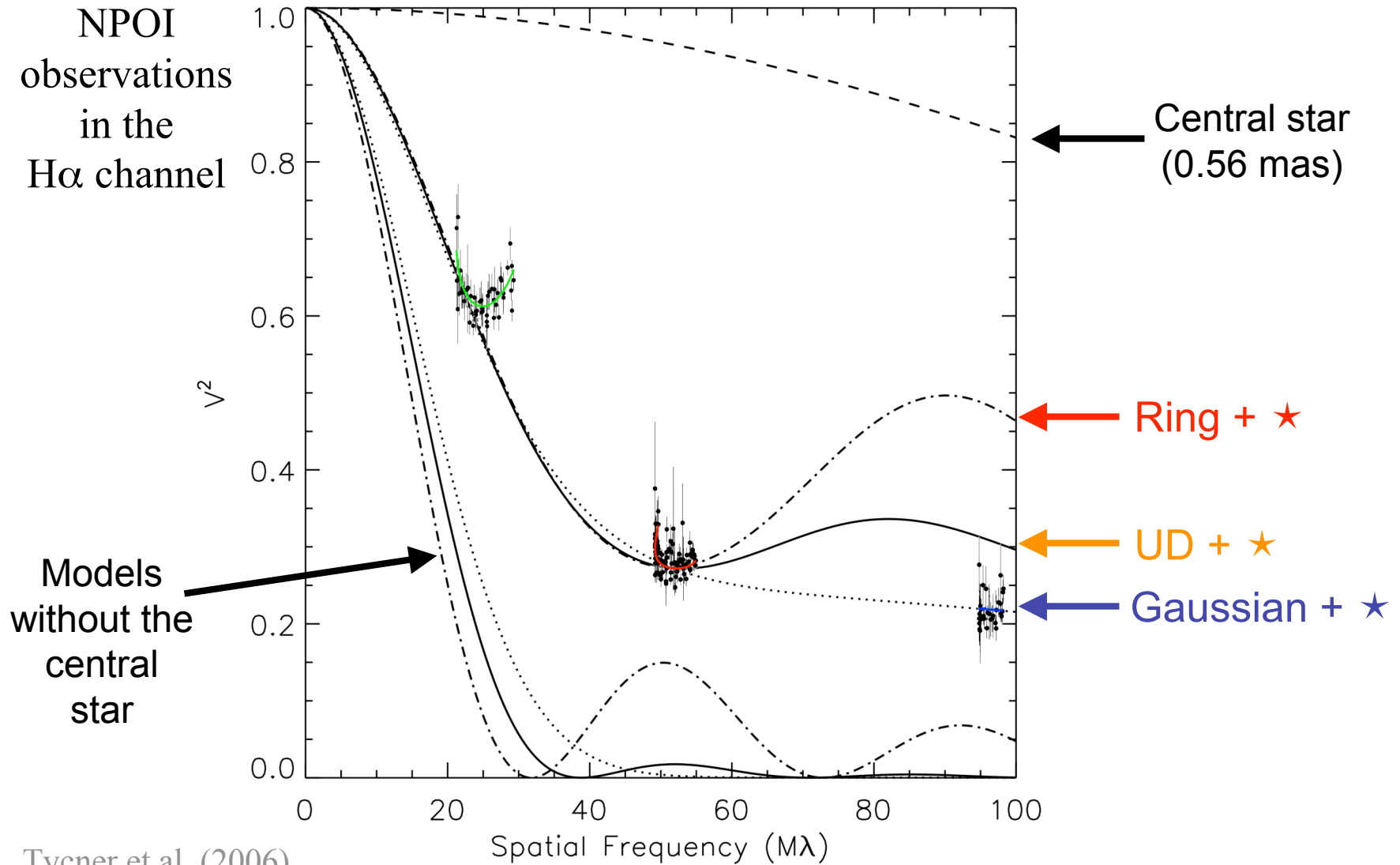


Schmitt et al. (2006)





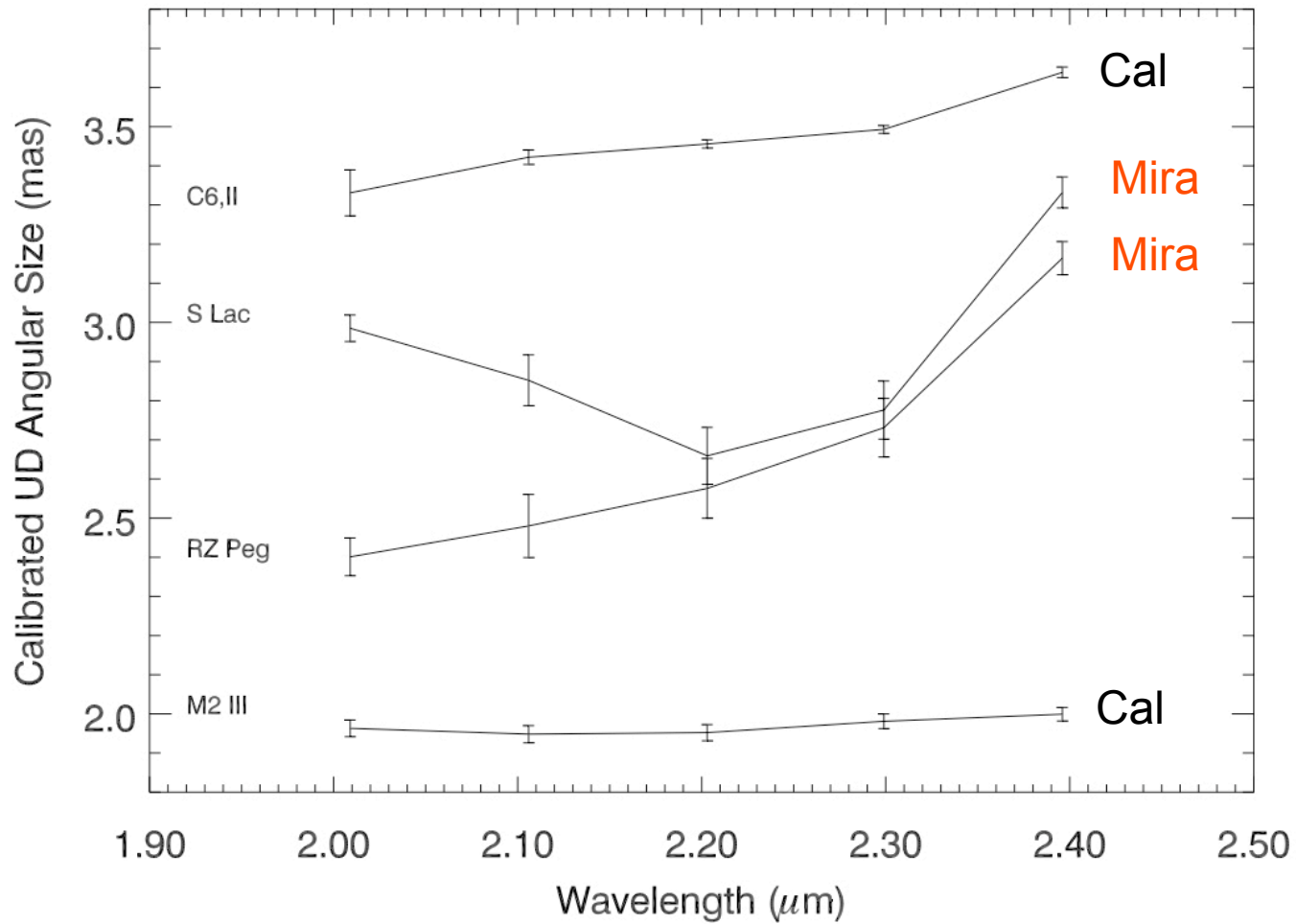
Recent Observations of γ Cas



Tycner et al. (2006)



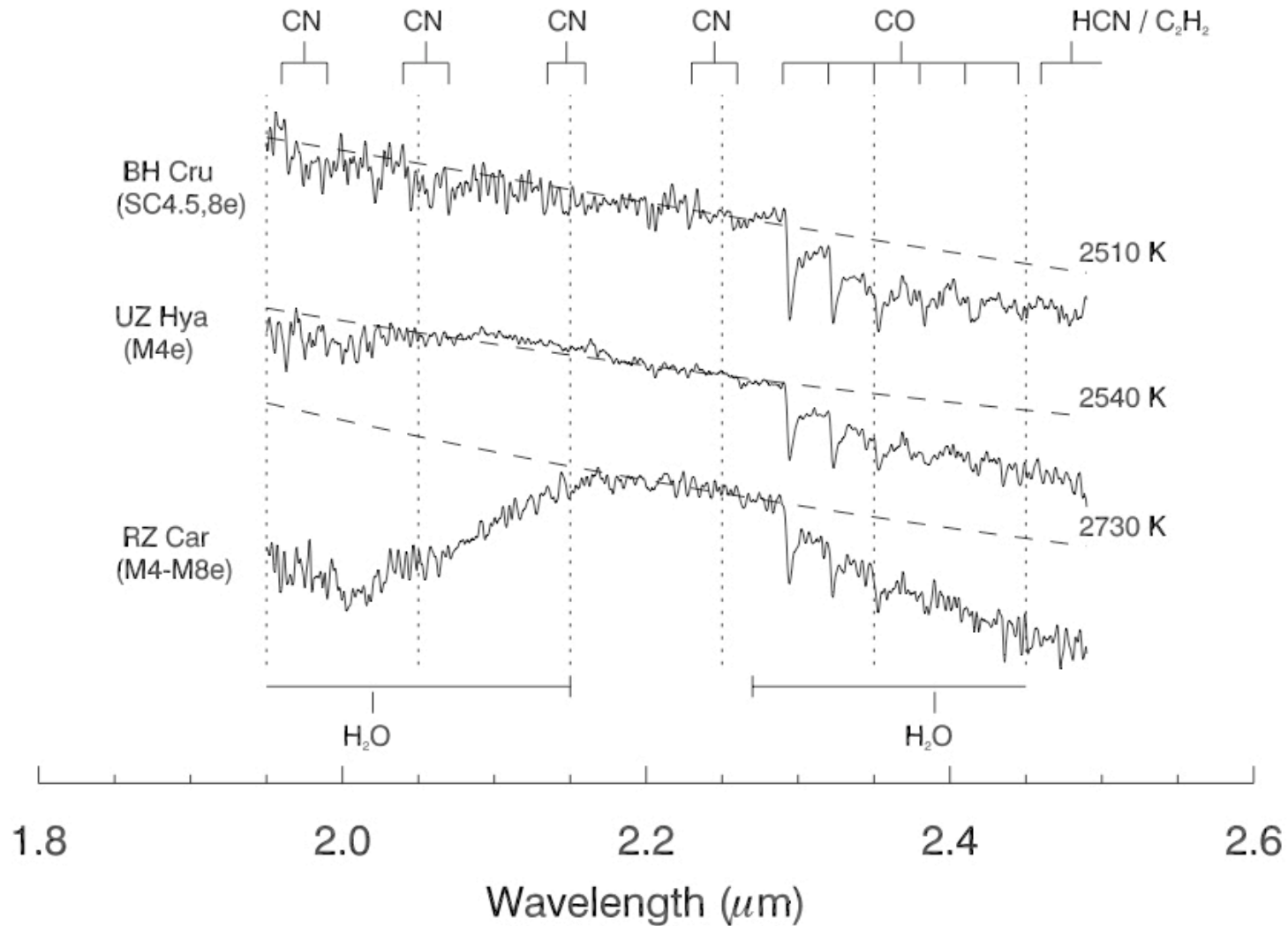
Mira variables with PTI



Thompson et al. (2002)



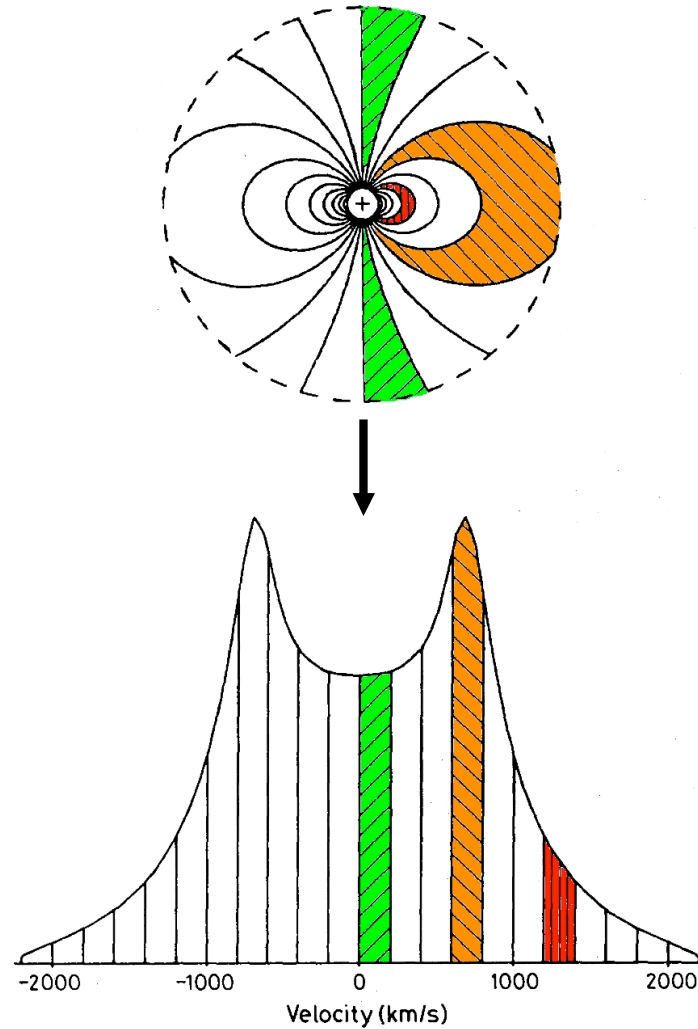
Mira variables with PTI



Thompson et al. (2002)

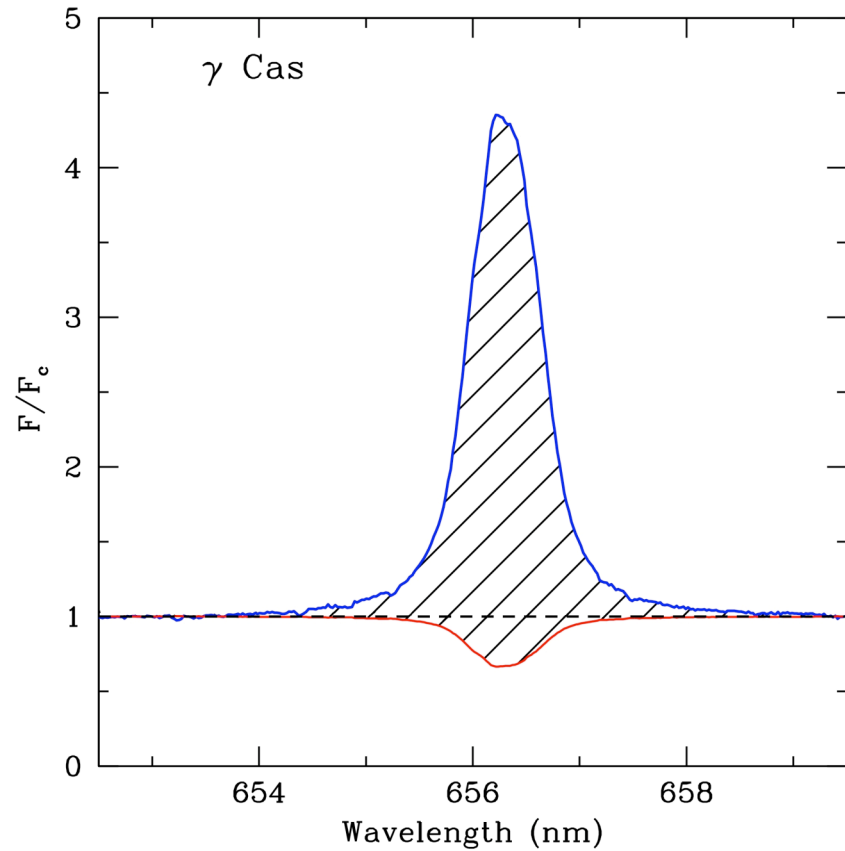
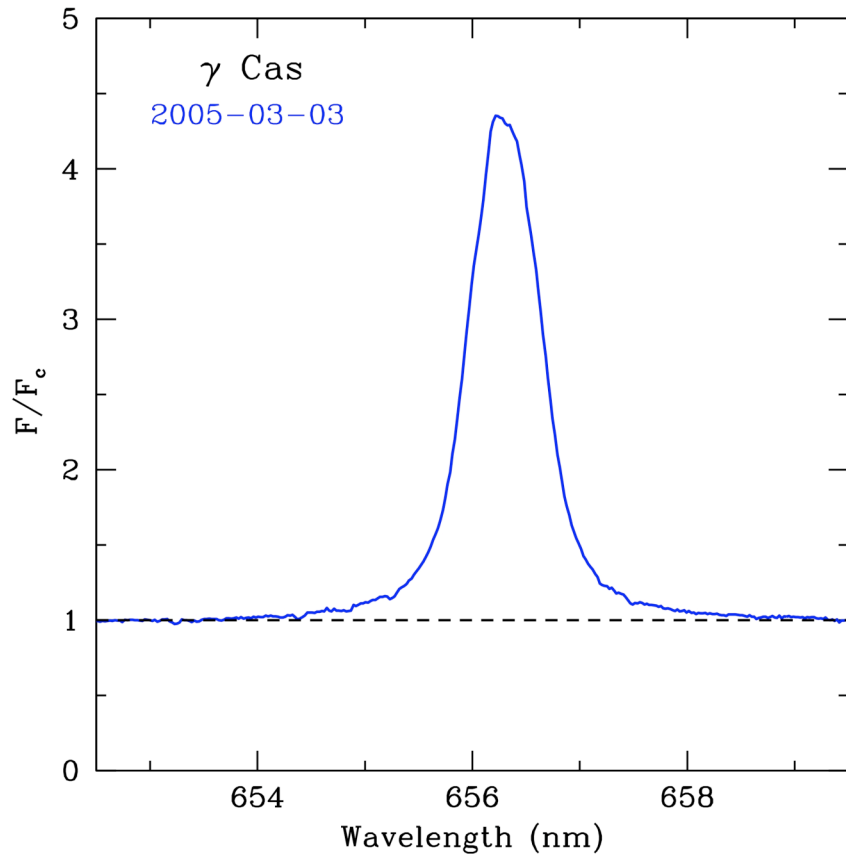


Line formation in Keplerian Disk





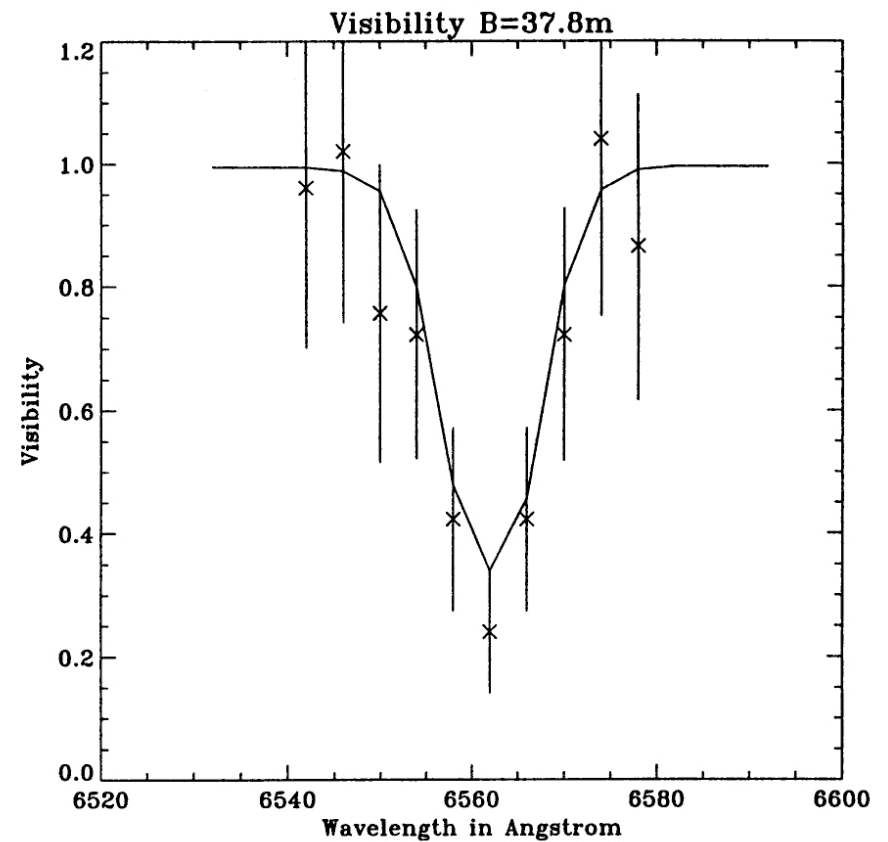
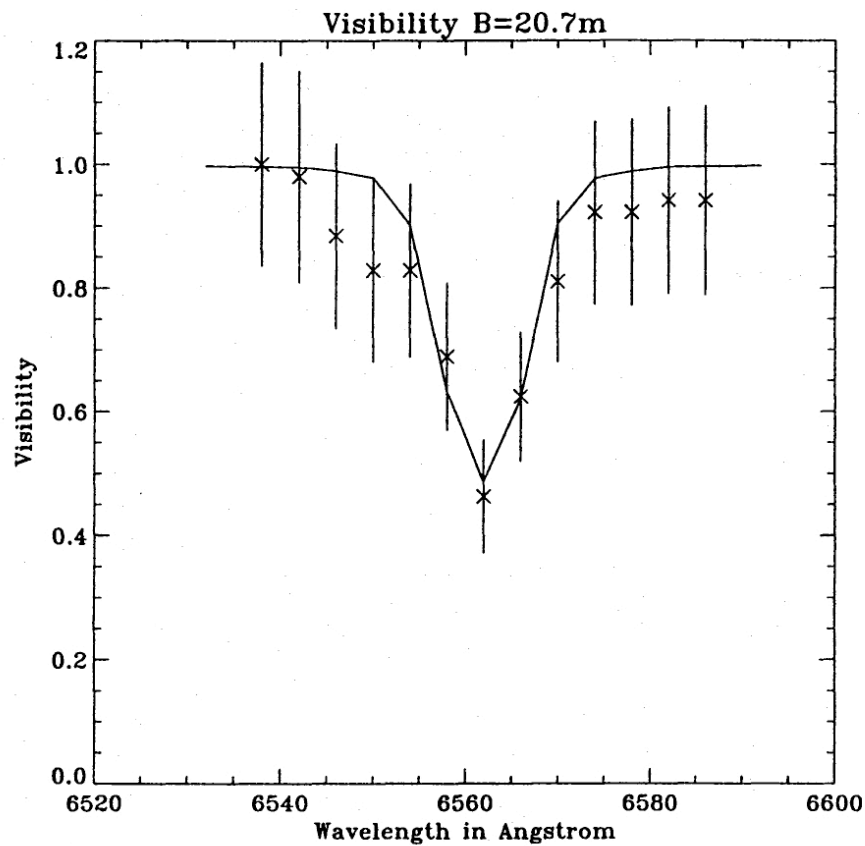
Line Emission





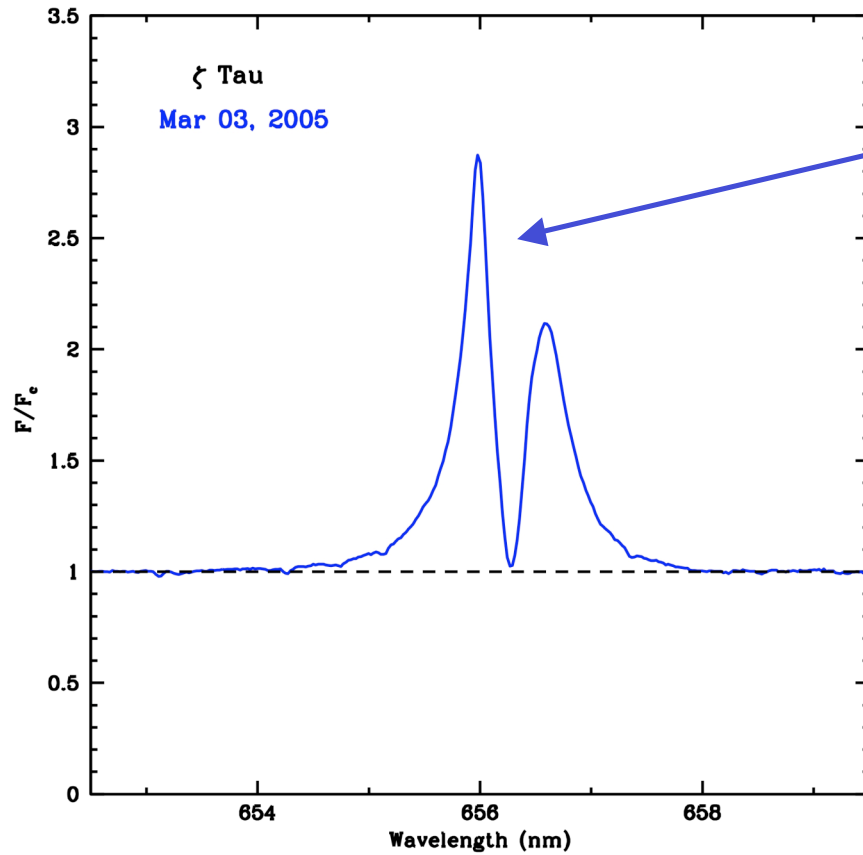
GI2T and line emission

H α observations of γ Cas

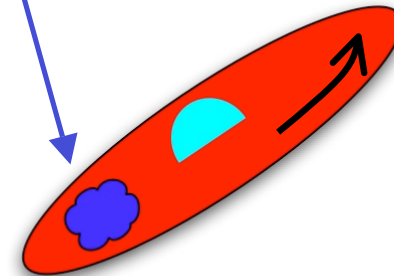




Density Waves in ζ Tau

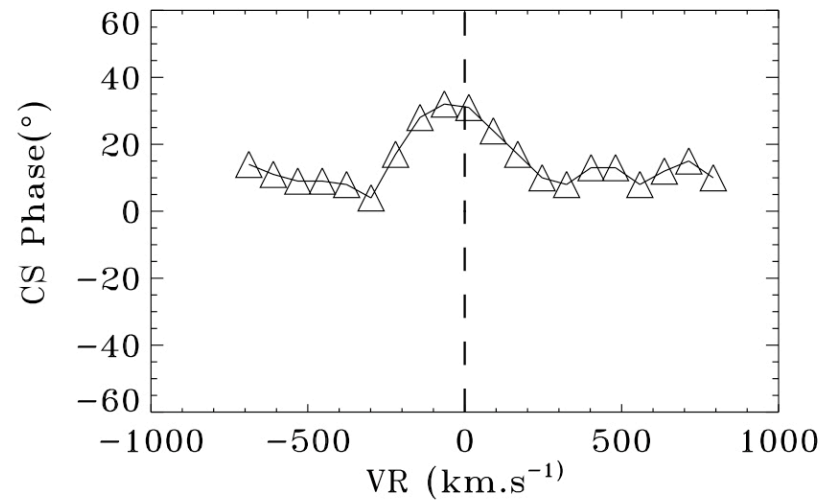
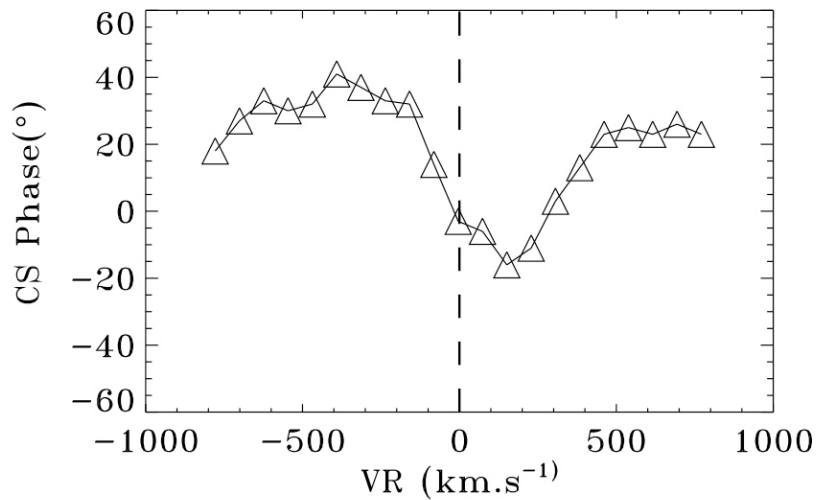
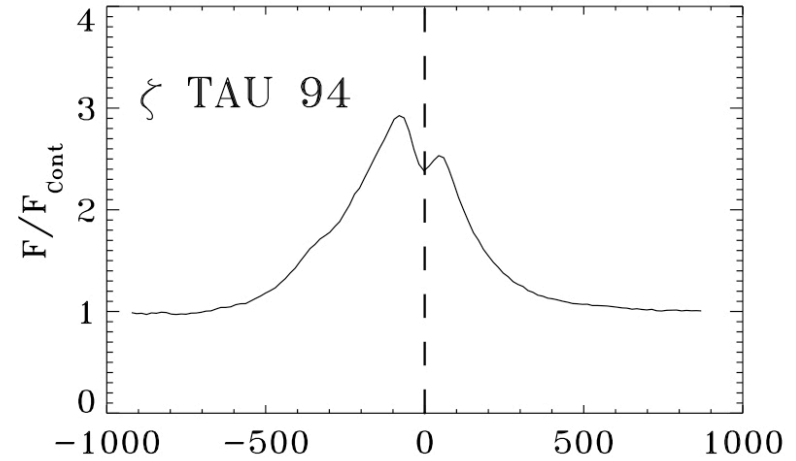
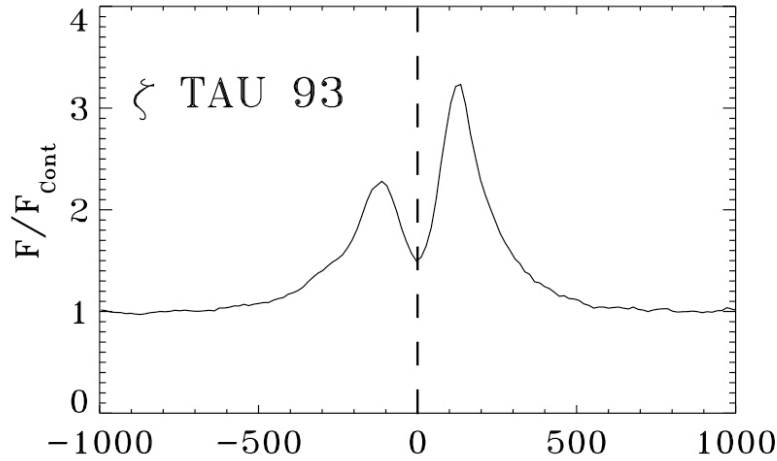


Asymmetric Disk





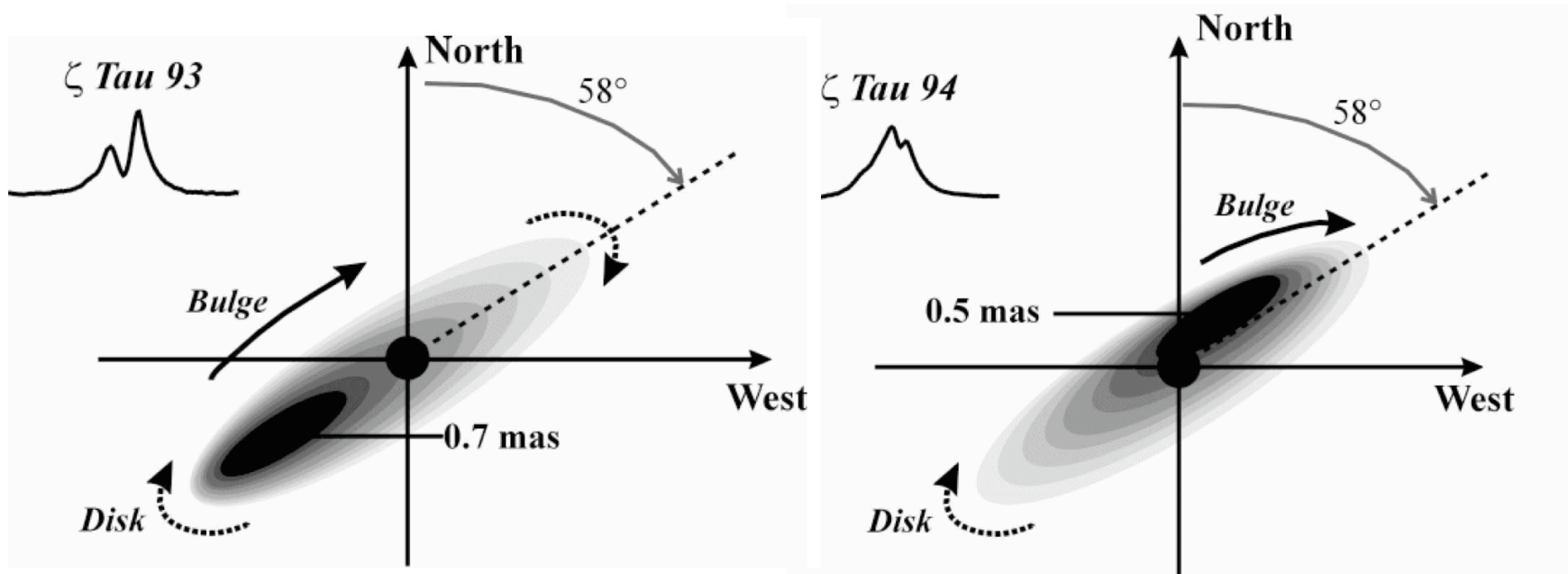
One-armed Oscillation: GI2T Observations



Vakili et al. 1998



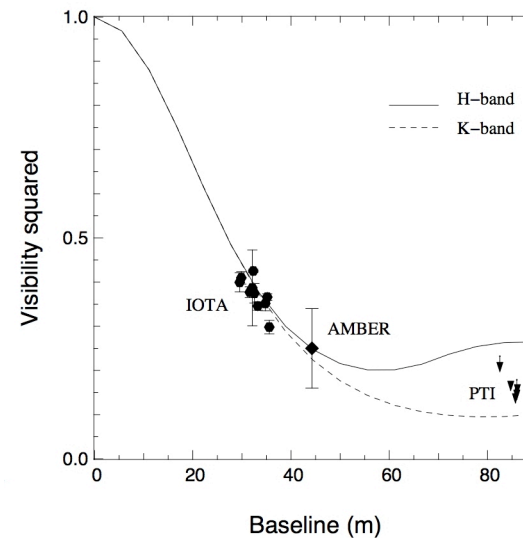
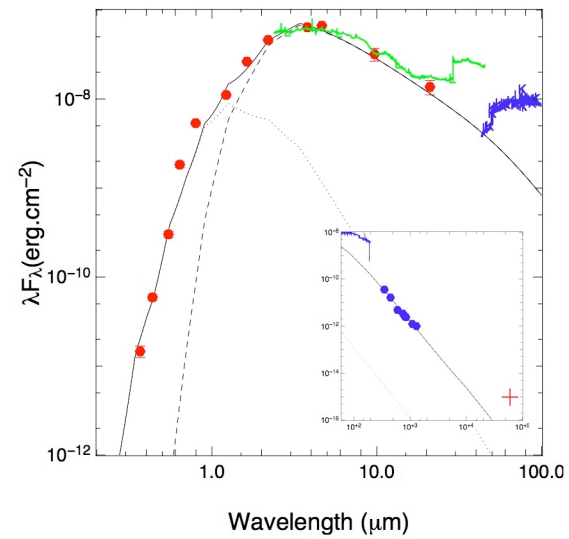
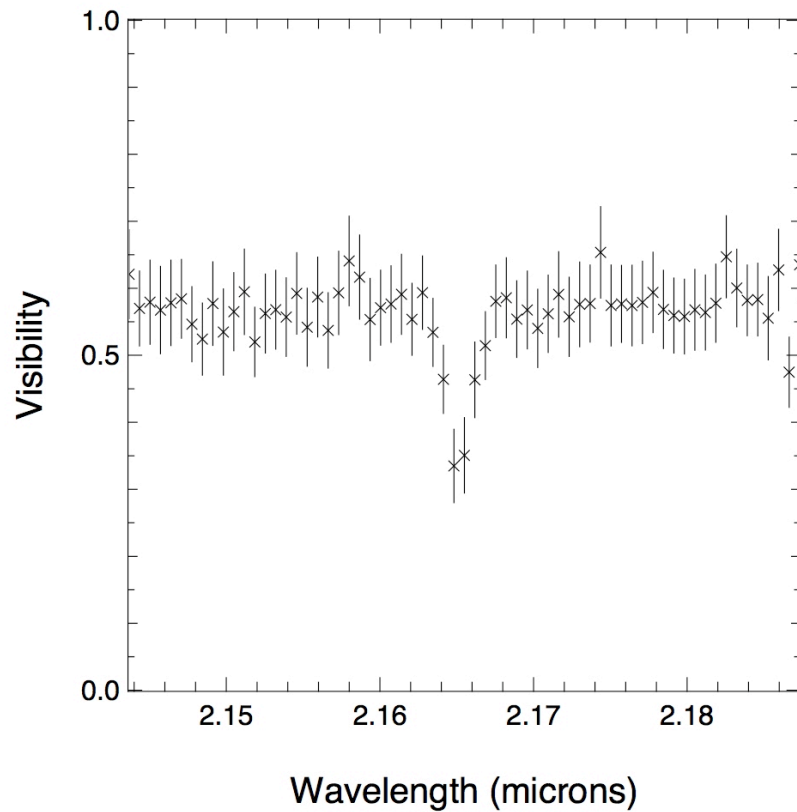
One-armed Oscillation: GI2T Results



Vakili et al. 1998



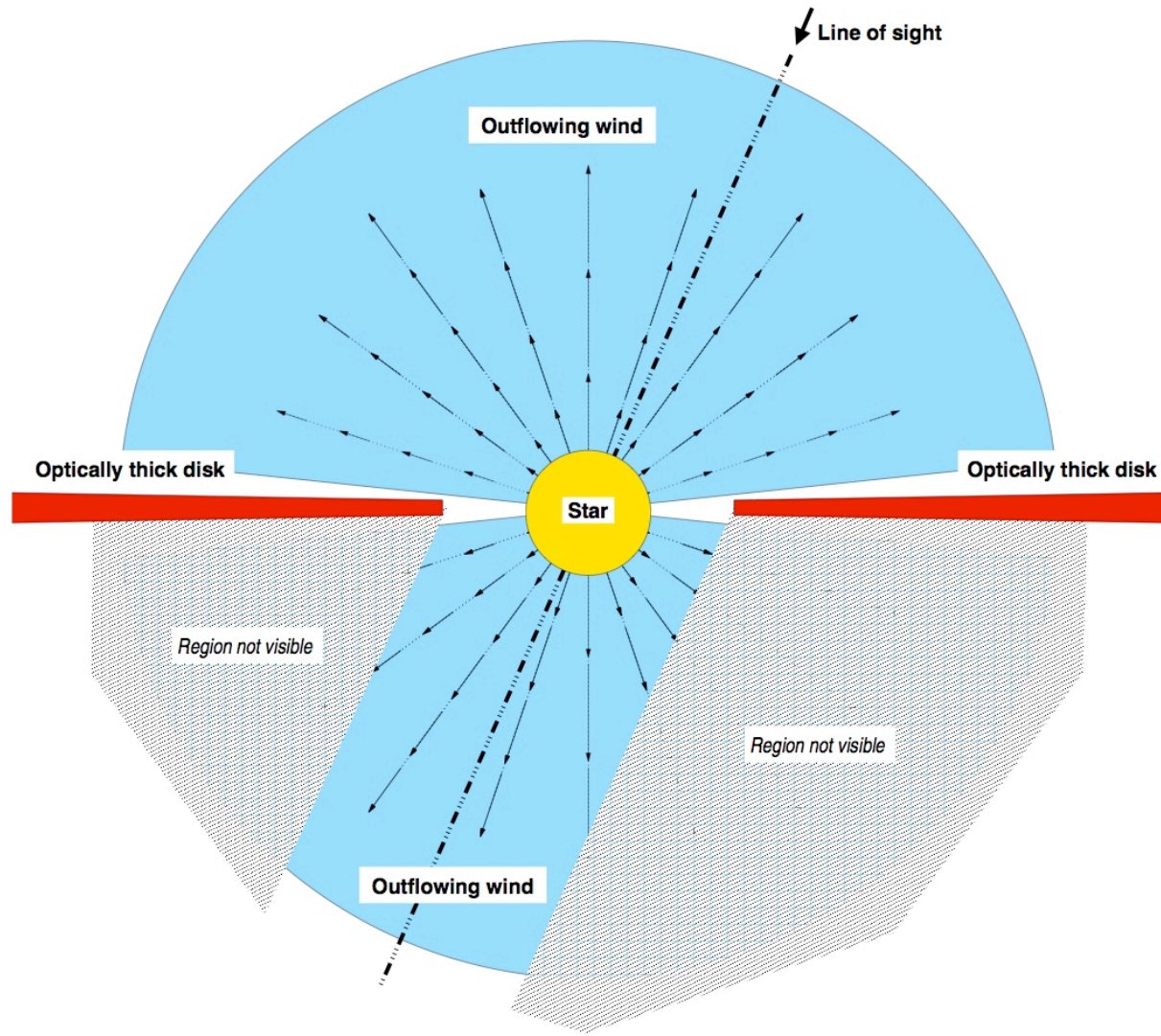
MWC297 with AMBER



Malbet et al. (2006)



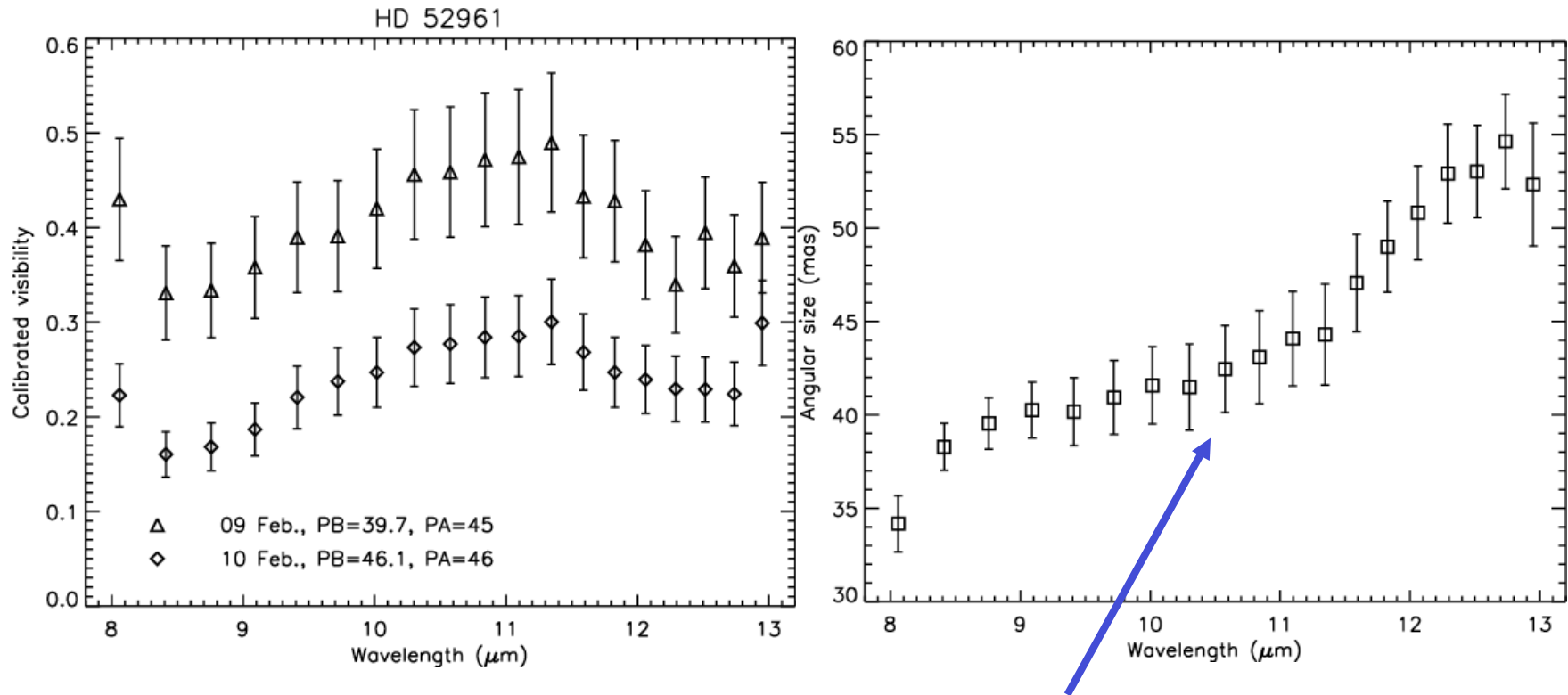
MWC297 with AMBER



Malbet et al. (2006)



Post-AGB star HD 52961



VLT/MIDI N-band interferometry

The increase towards longer wavelengths is consistent with a dust-distribution where T decreases with distance from the star



Summary

- It is **common** for long-baseline interferometers to incorporate spectral resolution
- Main technical advantages are:
 - Smaller bandwidth and **wider fringe envelope**
 - Allows for group-delay **fringe tracking**
 - Differential measurements are possible resulting in **high accuracy measurements**
- Main scientific advantages
 - Probing **disks** via spectrally resolved emission lines
 - Measuring the **opacity effects** in absorption lines/bands
 - Spatially resolving the emitting regions at different wavelengths **simultaneously**