# The Sydney University Stellar Interferometer

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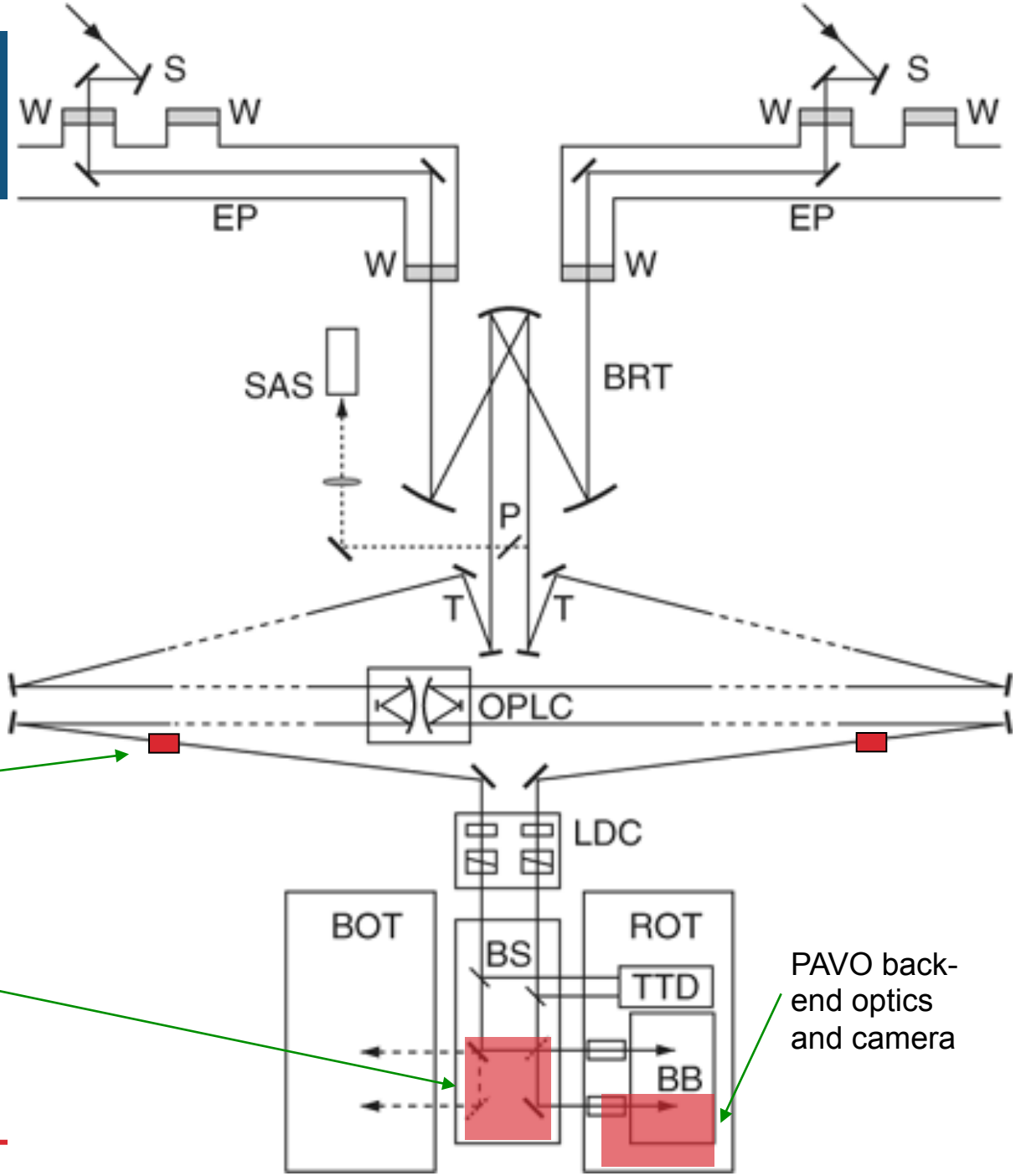
# In Memoriam: John Davis 1932 - 2010

# Overall layout




*f* = 40 m lens

PAVO front-end optics

PAVO back-end optics and camera

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# Optical path length compensator

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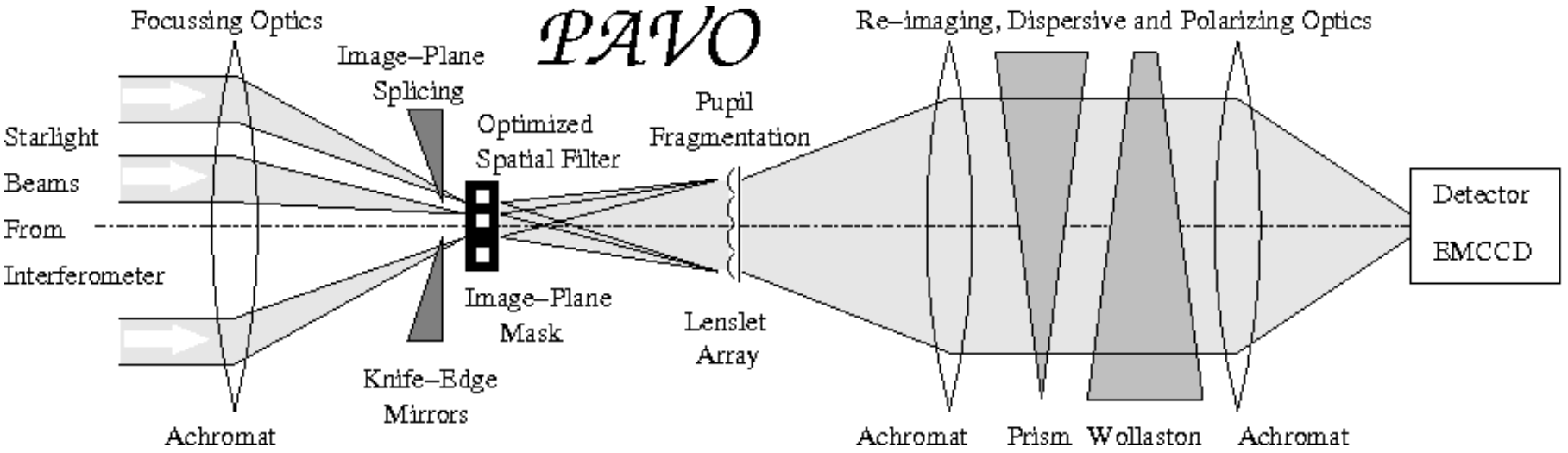
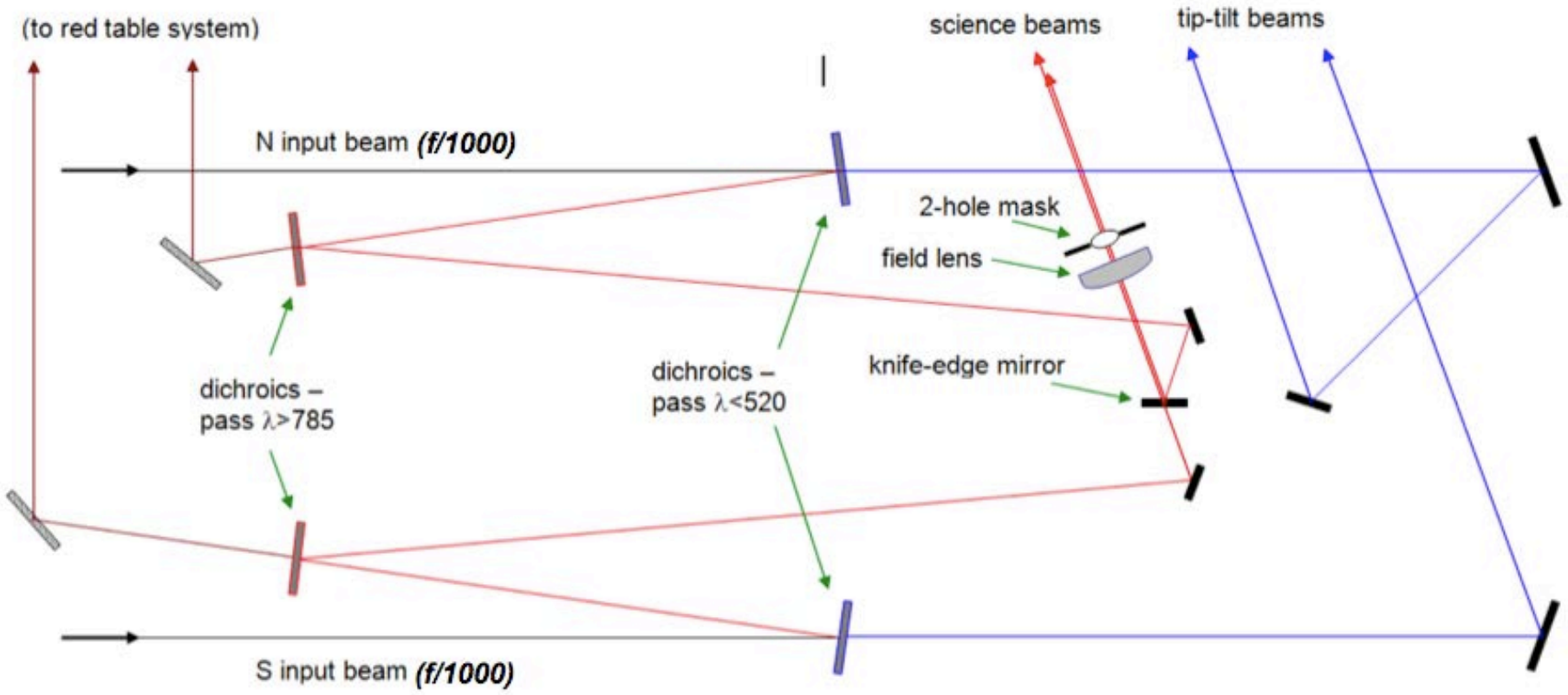
# 35m focal length achromats

# PAVO: Precision Astronomical Visible Observations

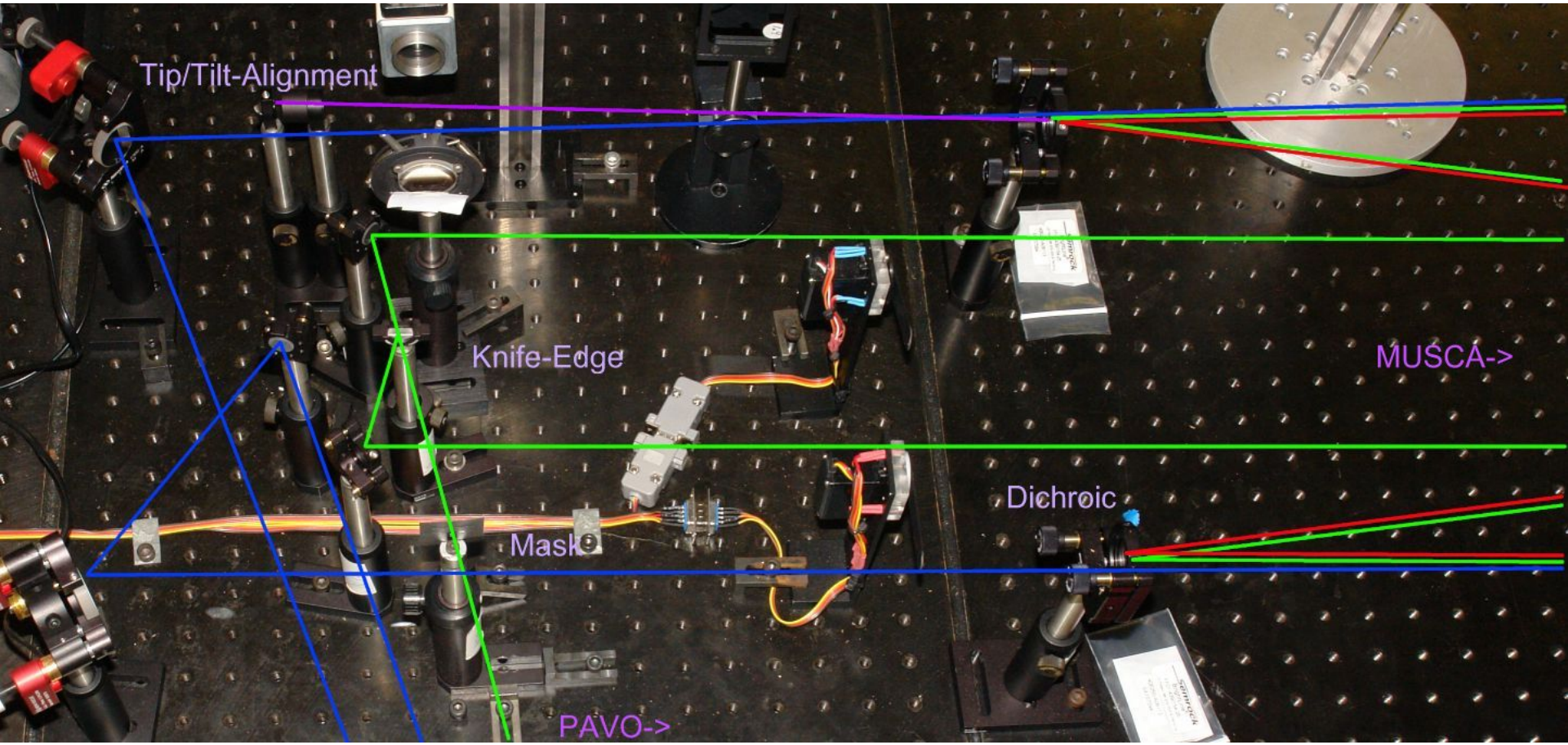
- "Twin" instruments at SUSI and CHARA
- PAVO uses ~1000 pixels, splitting the pupil into 16 parts (CHARA) or 4 parts (SUSI), with 30 wavelengths and spatial modulation.



# PAVO@SUSI (old layout)



# PAVO@SUSI Mask and Tip/tilt



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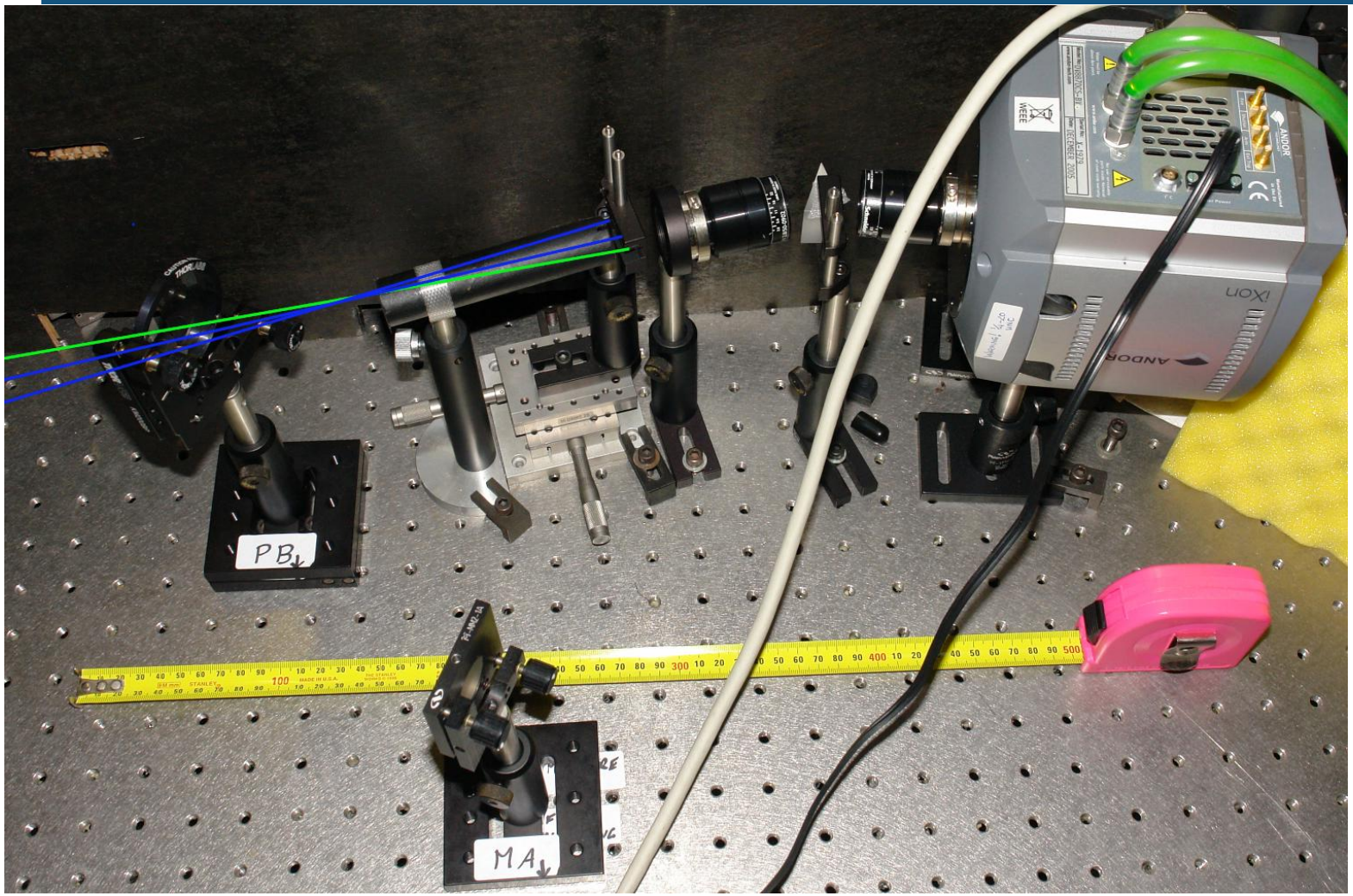
# PAVO@SUSI Back-End



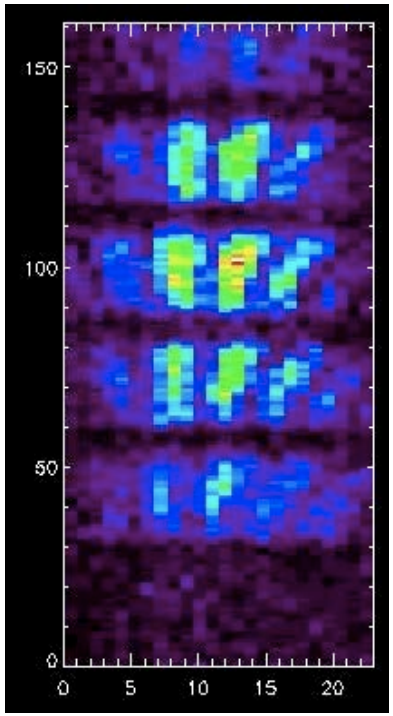
# PAVO Remote observing…

SUSI regularly operates under full remote control (in fact is rarely driven from site). Once set up a queue-scheduler mostly takes care of the work.

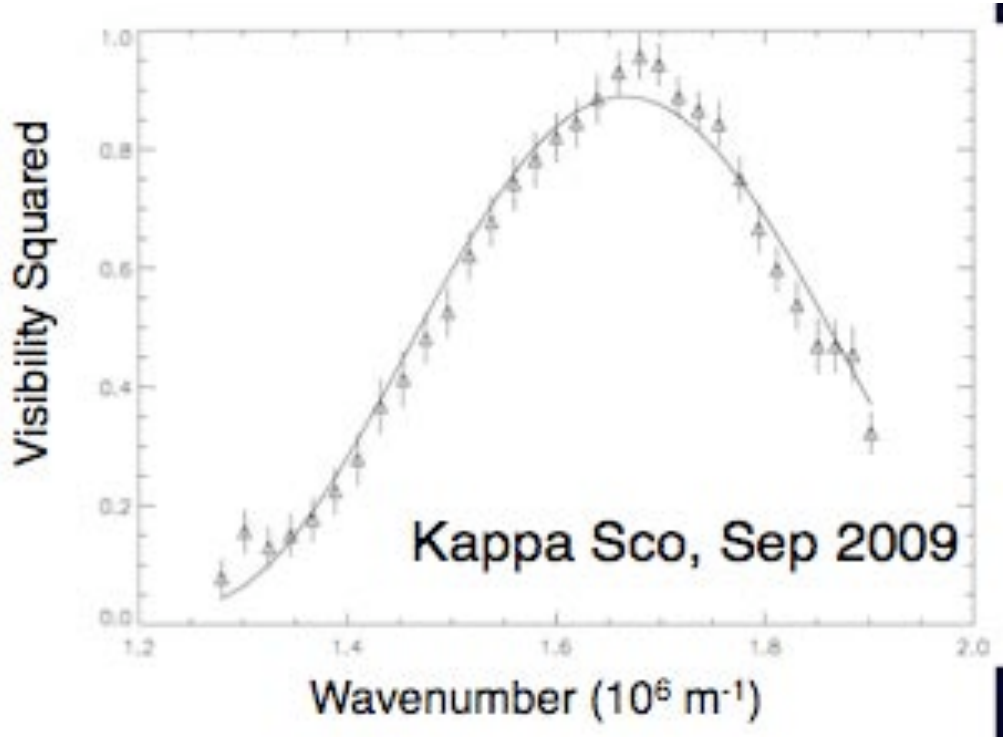
# PAVO Remote observing…

# PAVO@SUSI: Multiplicity Survey of bright Sco-Cen

- Preliminary Sco-Cen survey for companions.
- Several companions, that were not in major catalogs (kappa Cen, ups Sco)
- A major part of the research effort for Aaron Rizzuto

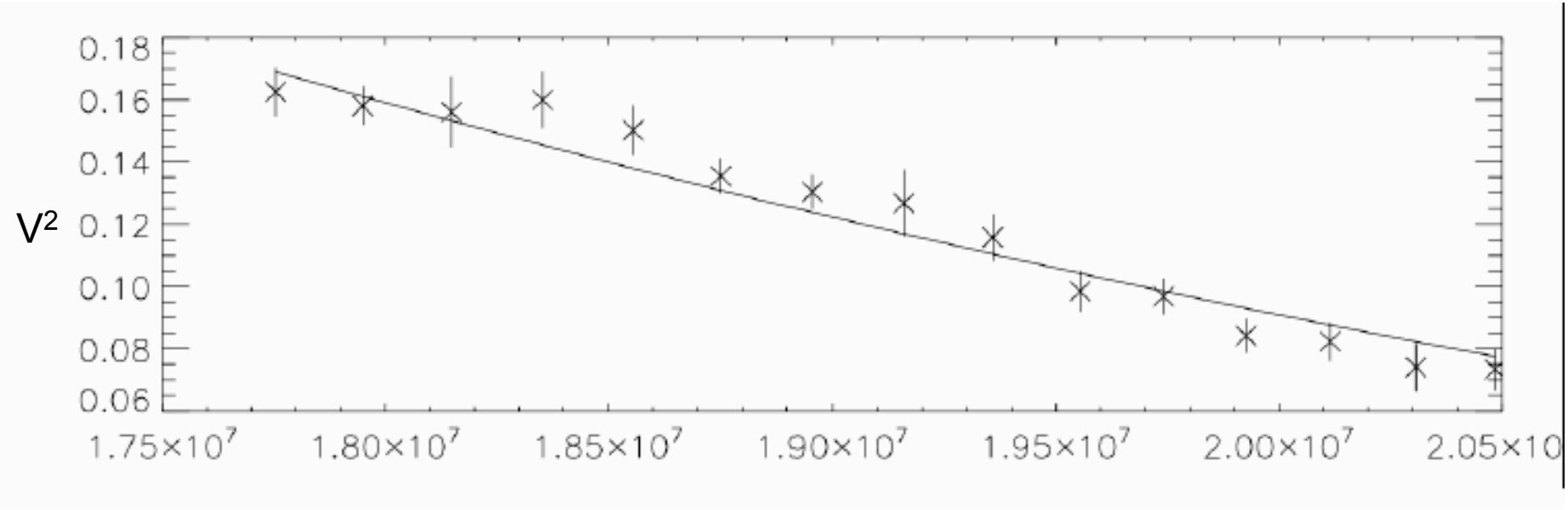



7ms of raw Fomalhaut data.



# Preliminary Science 1: Alpha TrA

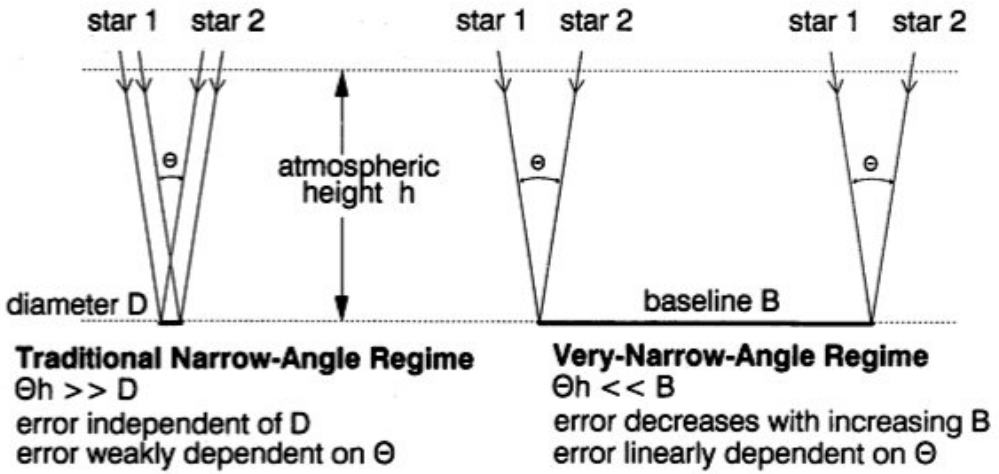
- Pulsating K-giant, a “hybrid bright giant” that is UV-bright and has a wind that is both cool and hot (coronal). Precision diameter required for asteroseismology collaboration with Tim Bedding/Graham Harper
- UD Diameter 9.08±0.07 compared with Cohen’s 8.98+/-0.1 mas LD estimation. Double checking wavelength scale calibration before publication…



# The outback is not always a desert …

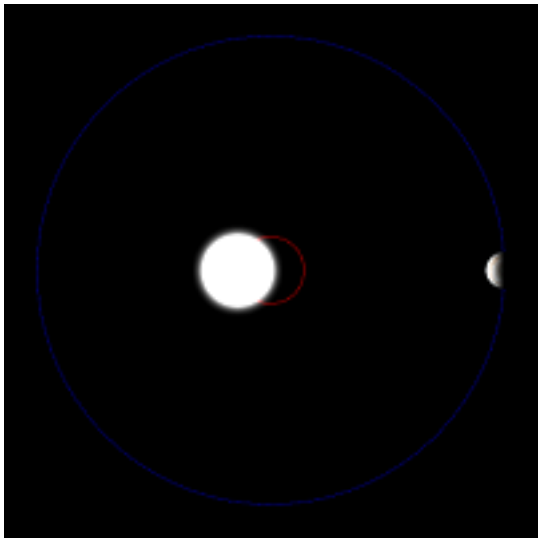
$V^2$

# MUSCA: A Project for Finding Tatooine ….

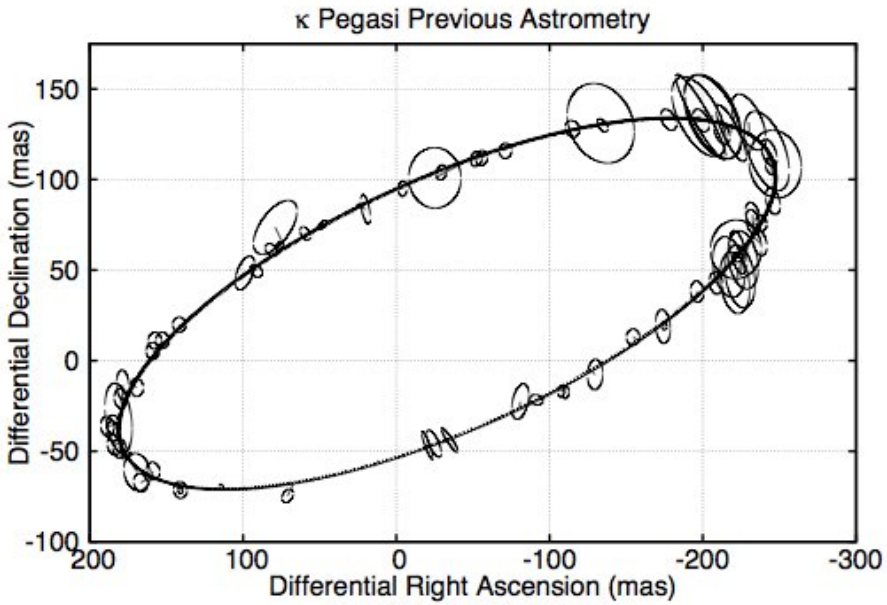


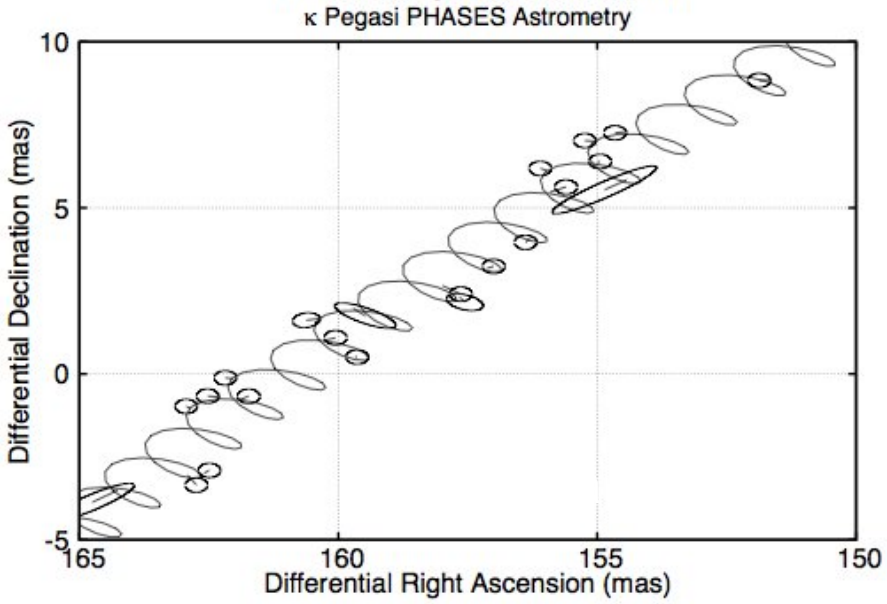

**Traditional Narrow-Angle Regime**
Θh >> D
error independent of D
error weakly dependent on Θ

**Very-Narrow-Angle Regime**
Θh << B
error decreases with increasing B
error linearly dependent on Θ

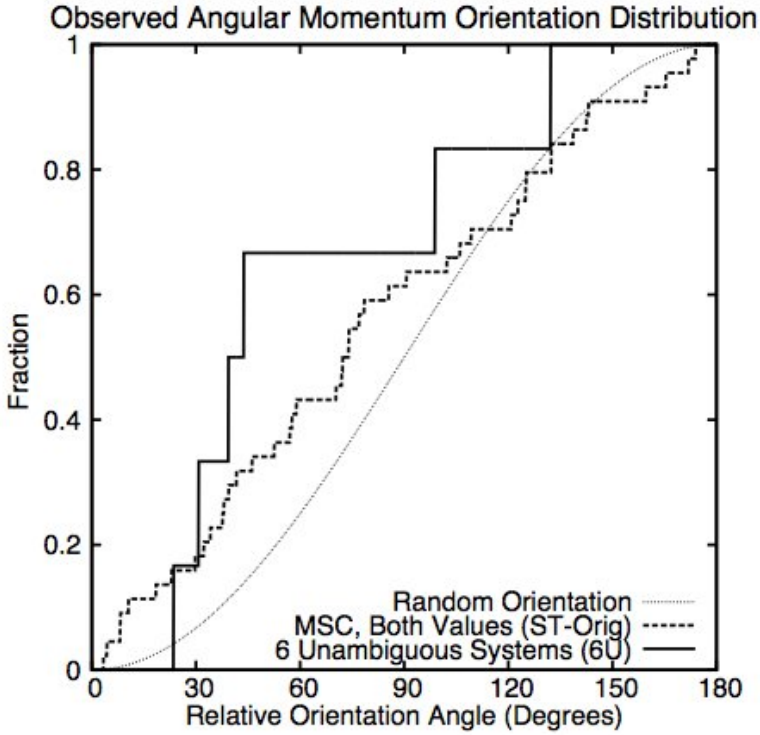


# Searching for companions astrometrically

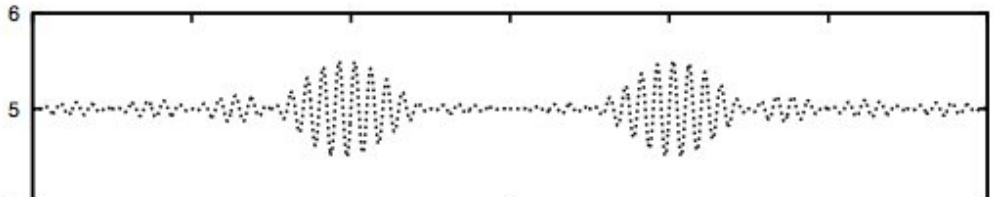



- Side-to-side wobble, not back and forth wobble.
- Unlike radial velocity: gives inclination and a unique mass.

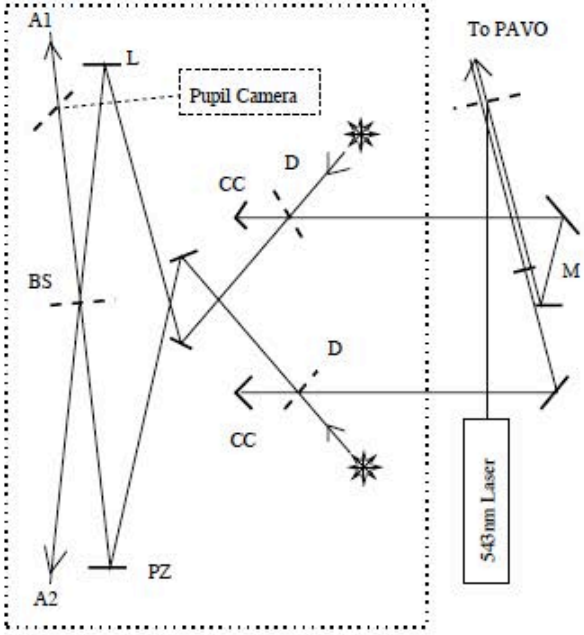


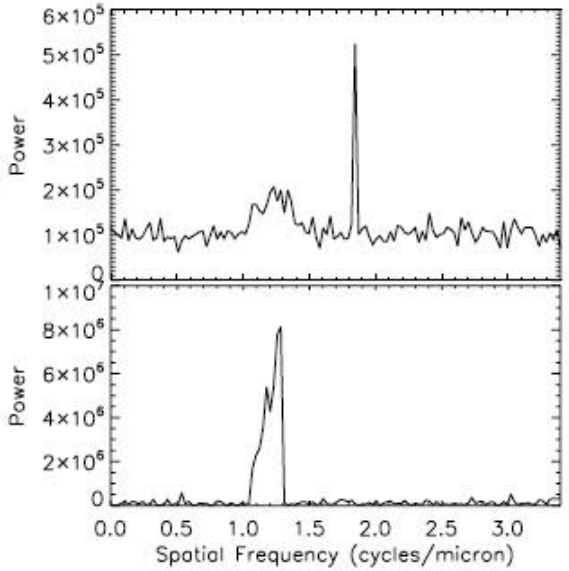
# Very Narrow Angle Astrometry with SUSI

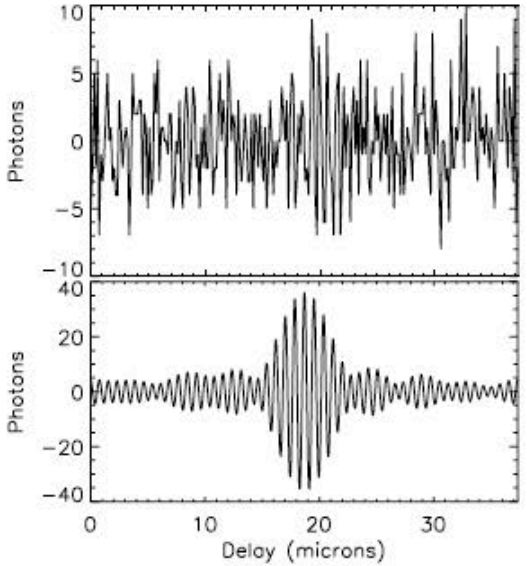



Optics concept, 4th mag, 50ms simulation with 543nm laser and reconstructed fringe.

1. PAVO tracks the phase for star 1. The “red table” measures the phase for star 1 and star 2.
2. Only the *difference* in optical path between two closely-spaced beams affects the astrometric measurement.
3. Corrections to the delay can be applied in post-processing (photon-counting).



# SUSI Planet Search

- Astrometric signature of Jupiter at 10pc is 100μas.
- Fundamental limits for 1 hour observing are:
  - 2.6μas from photon-noise (S/N of 1 per scan)
  - 3μas from anisoplanatism (1" binary).
- Practical limits will likely be $10^{-5}$ fractional precision: 10μas for a 1" binary or 75μas for α Cen.
- Competitor (VLTI-PRIMA) will mostly focus on wider binaries.
- 50-100 targets