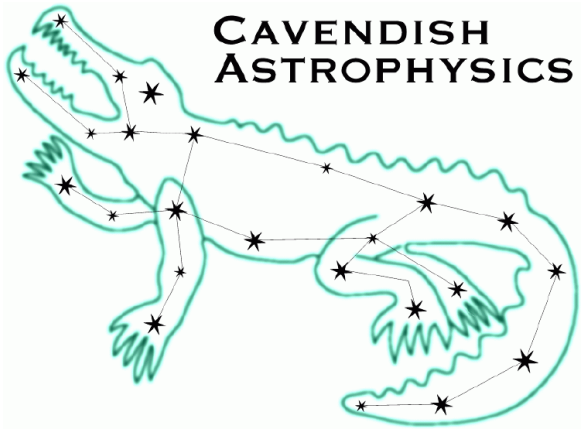
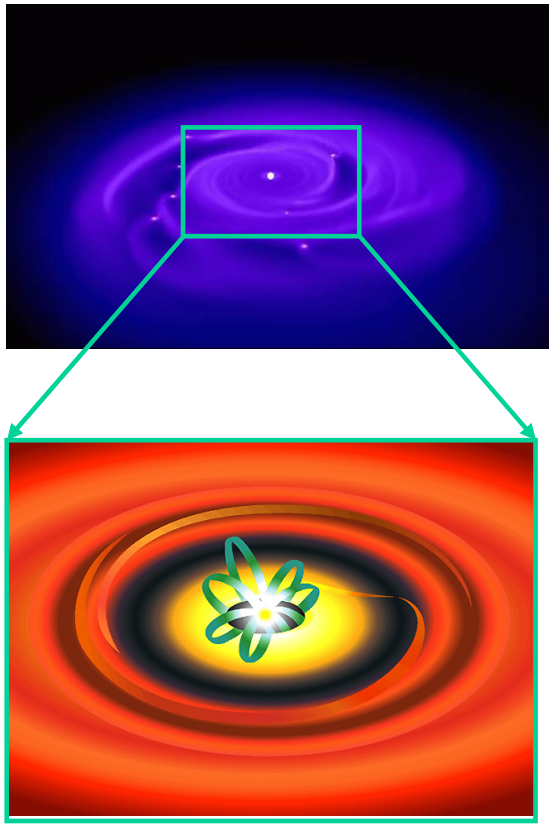


NPOI and MROI

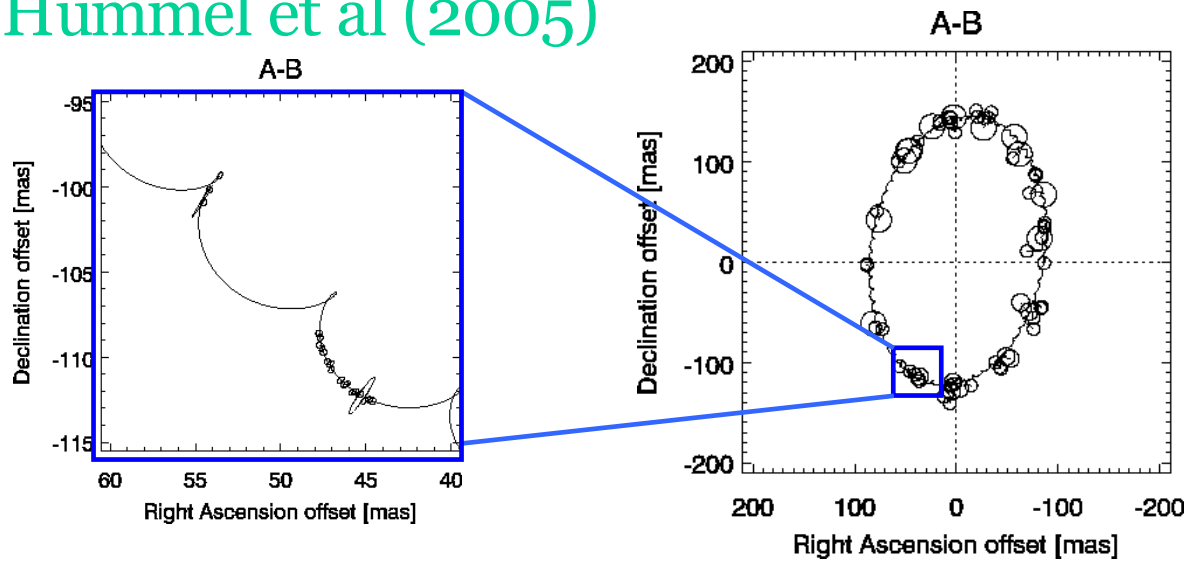
David Buscher
University of Cambridge

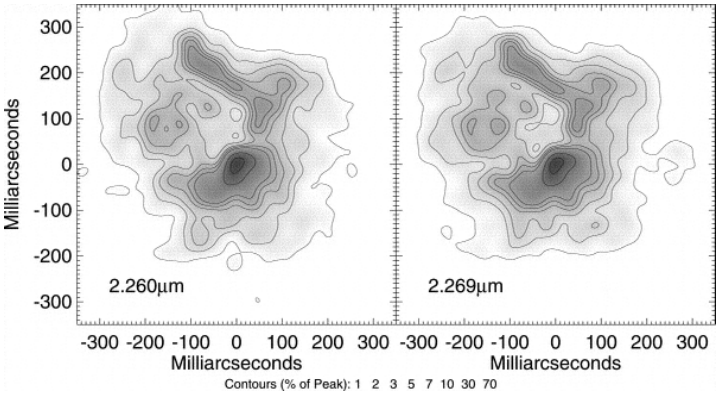
Interferometry is opening up access to a unique discovery space



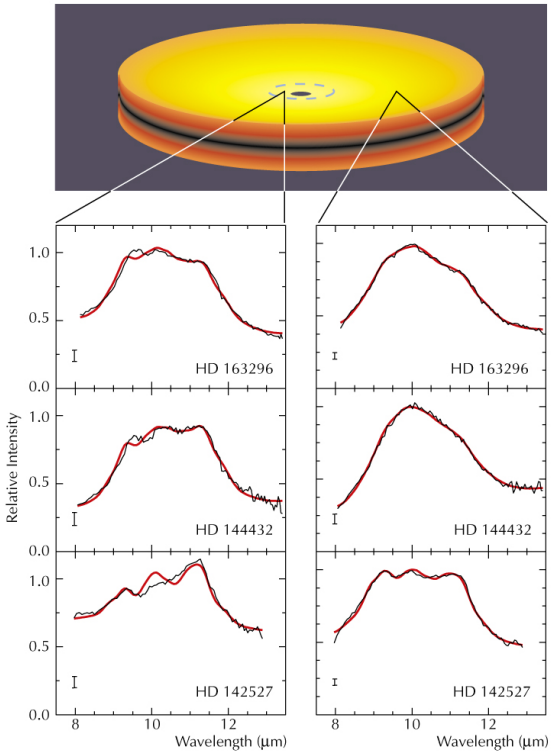
You want to use the best instrument to do your science

Hummel et al (2005)





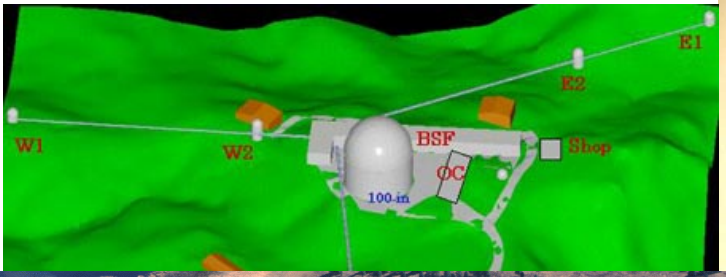
Tuthill et al (2005)

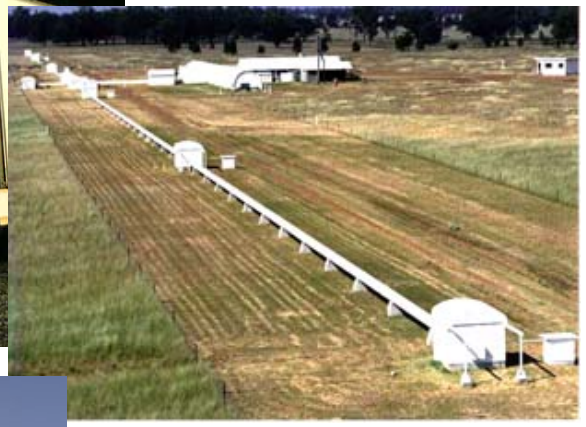


Mid-IR Spectra of Inner and Outer Discs Around Three Young Stars

Van Boekel et al (2004).

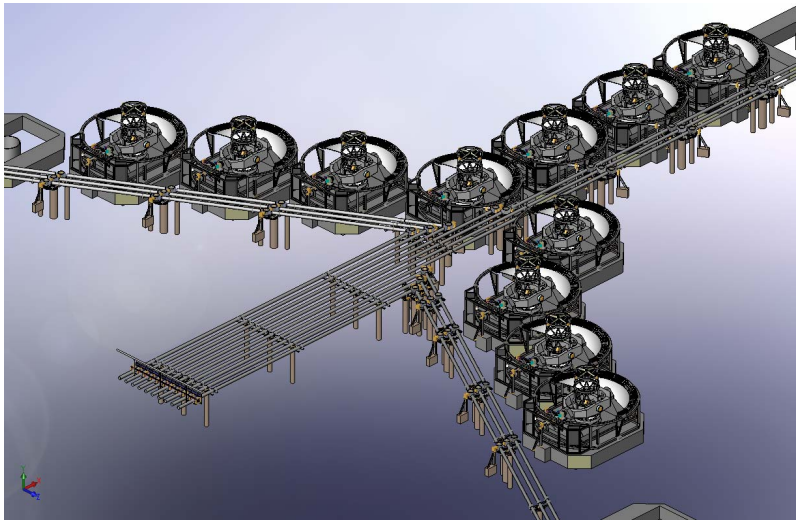
There is a confusing “array” of interferometers to choose from





You can increase your ability to choose the right interferometer by understanding the why and the how of 2 arrays

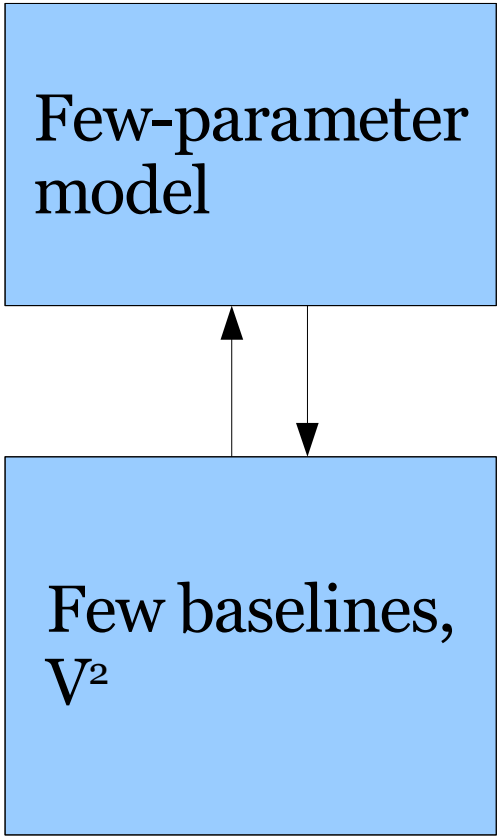
NPOI



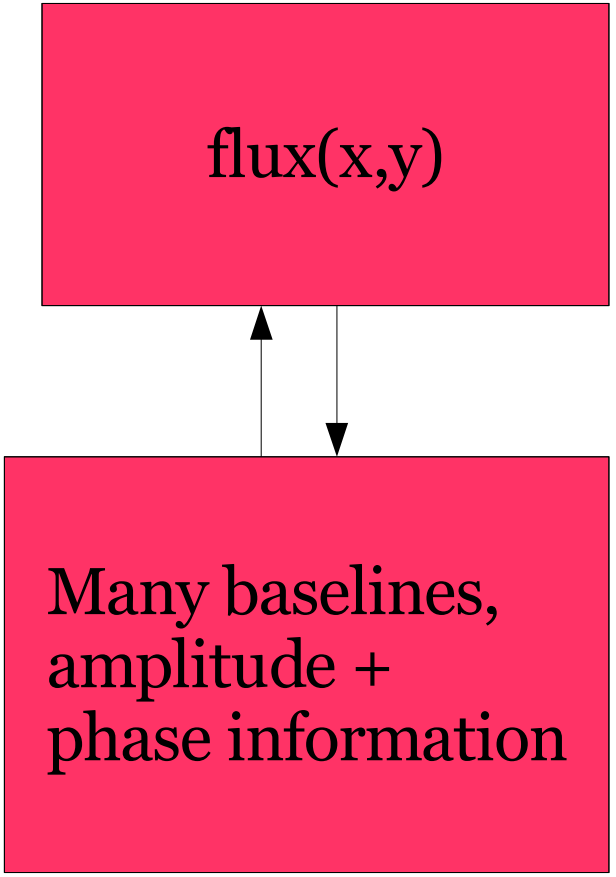
MROI

A key science motivation for NPOI and MROI is the ability to make true images

Parametric imaging

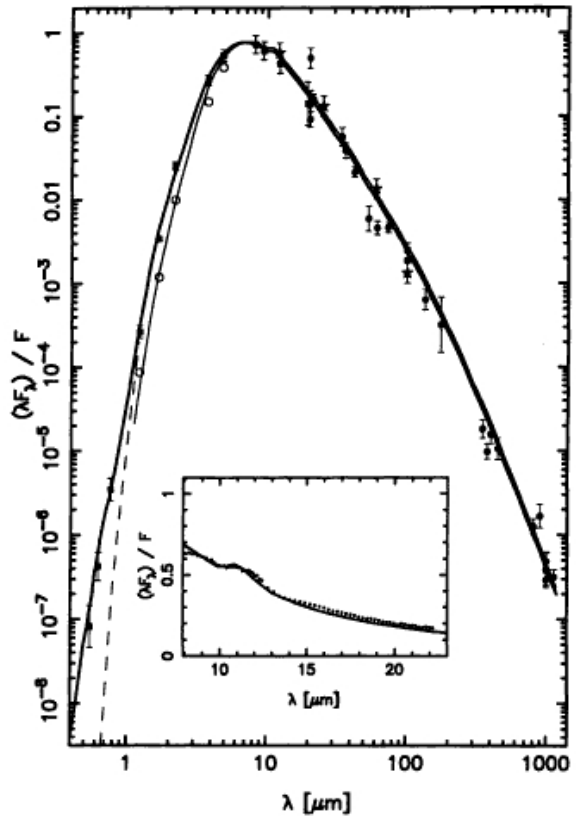


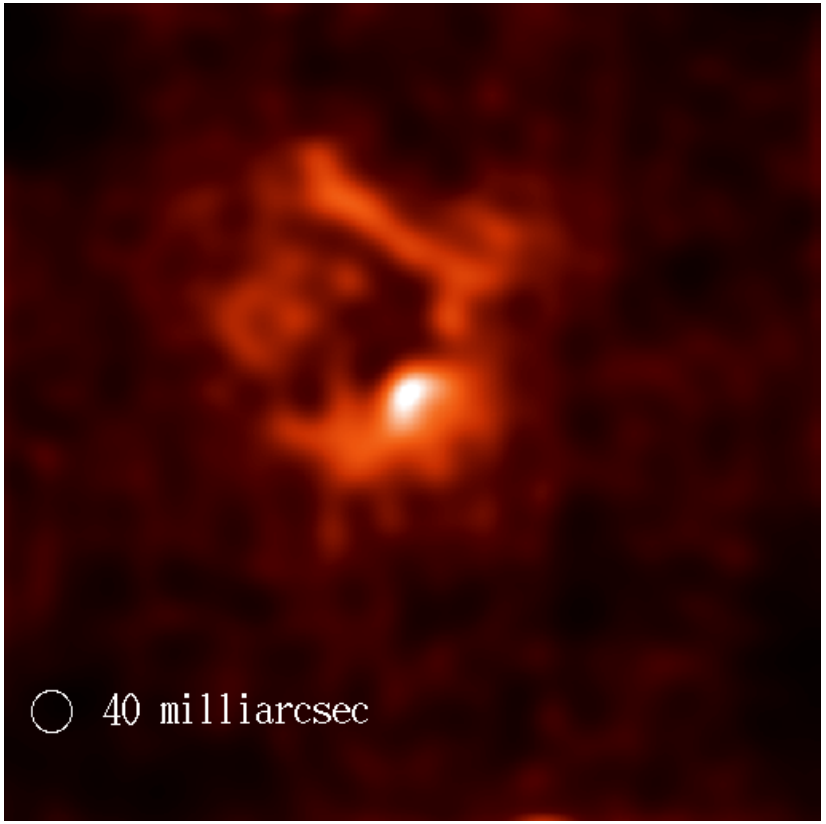
Model-independent imaging



Model-independent imaging allows us to tell if our models are wrong

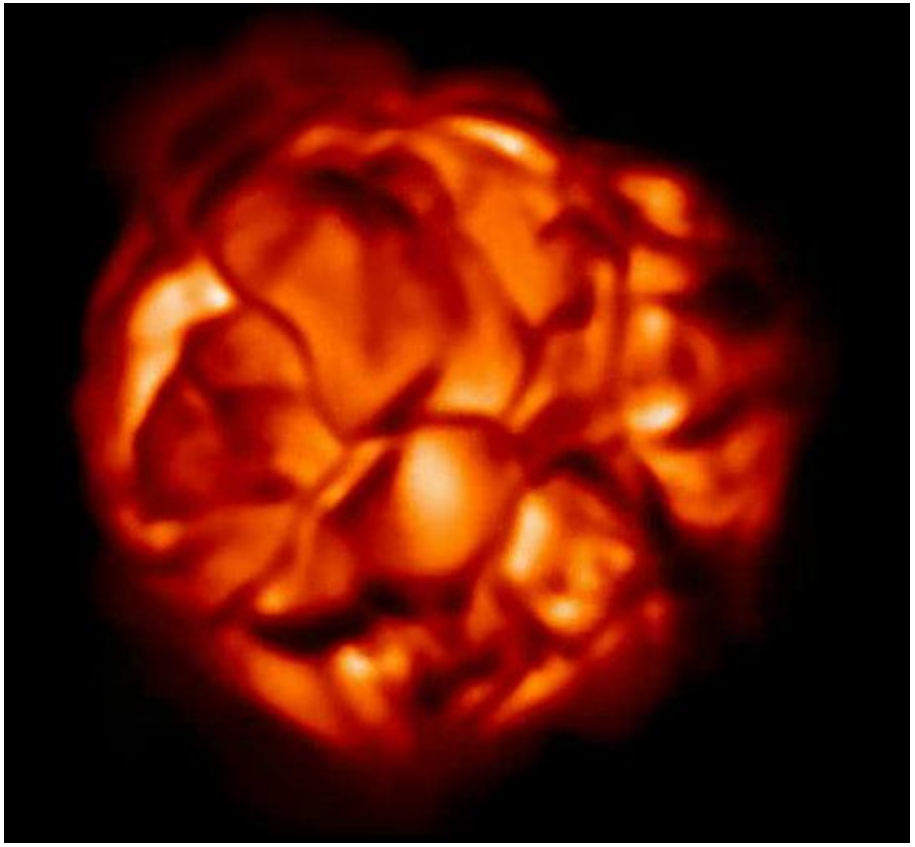
SED of IRC+10216: spherically symmetric model (Ivezic & Elitzur, 1996)





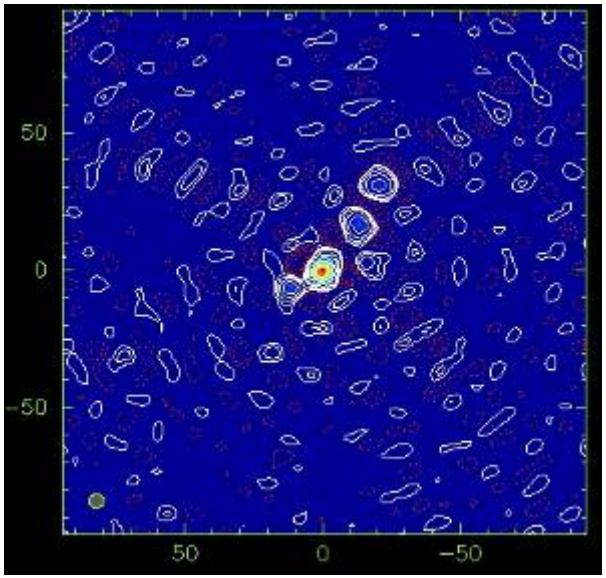
Actual distribution of 2 micron flux (Tuthill et al, 2000)

Modelfitting becomes degenerate if our models are complex

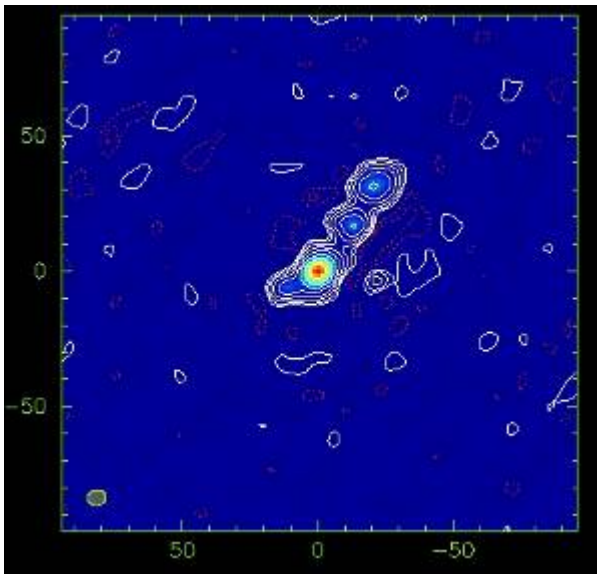


We need to be able to make images rapidly

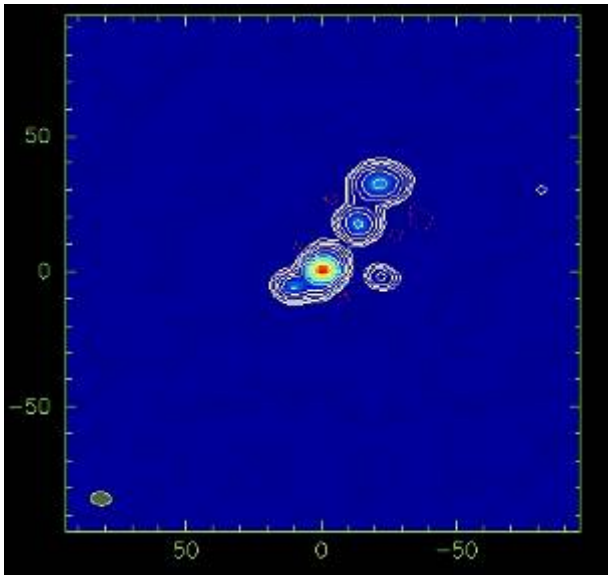
Imaging needs many telescopes



4 telescopes



6 telescopes



8 telescopes

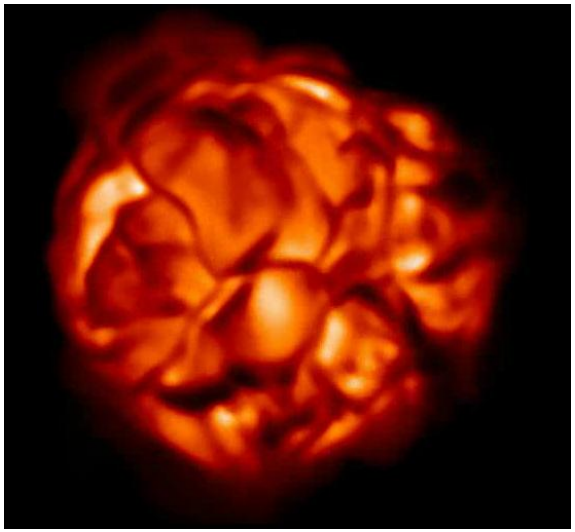
We need to get significant amounts of phase information

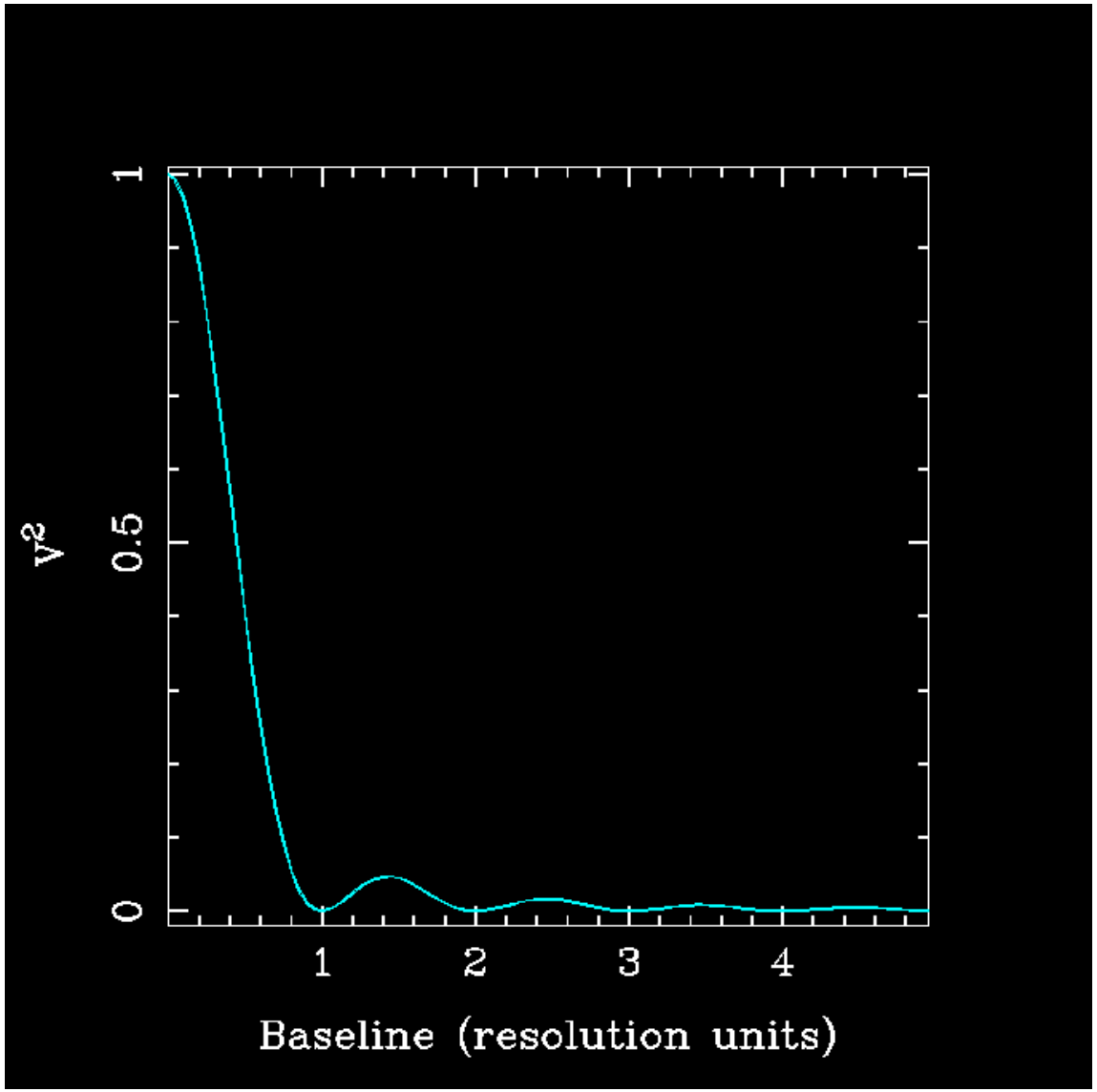
FT, take amplitudes

Combine, take IFT

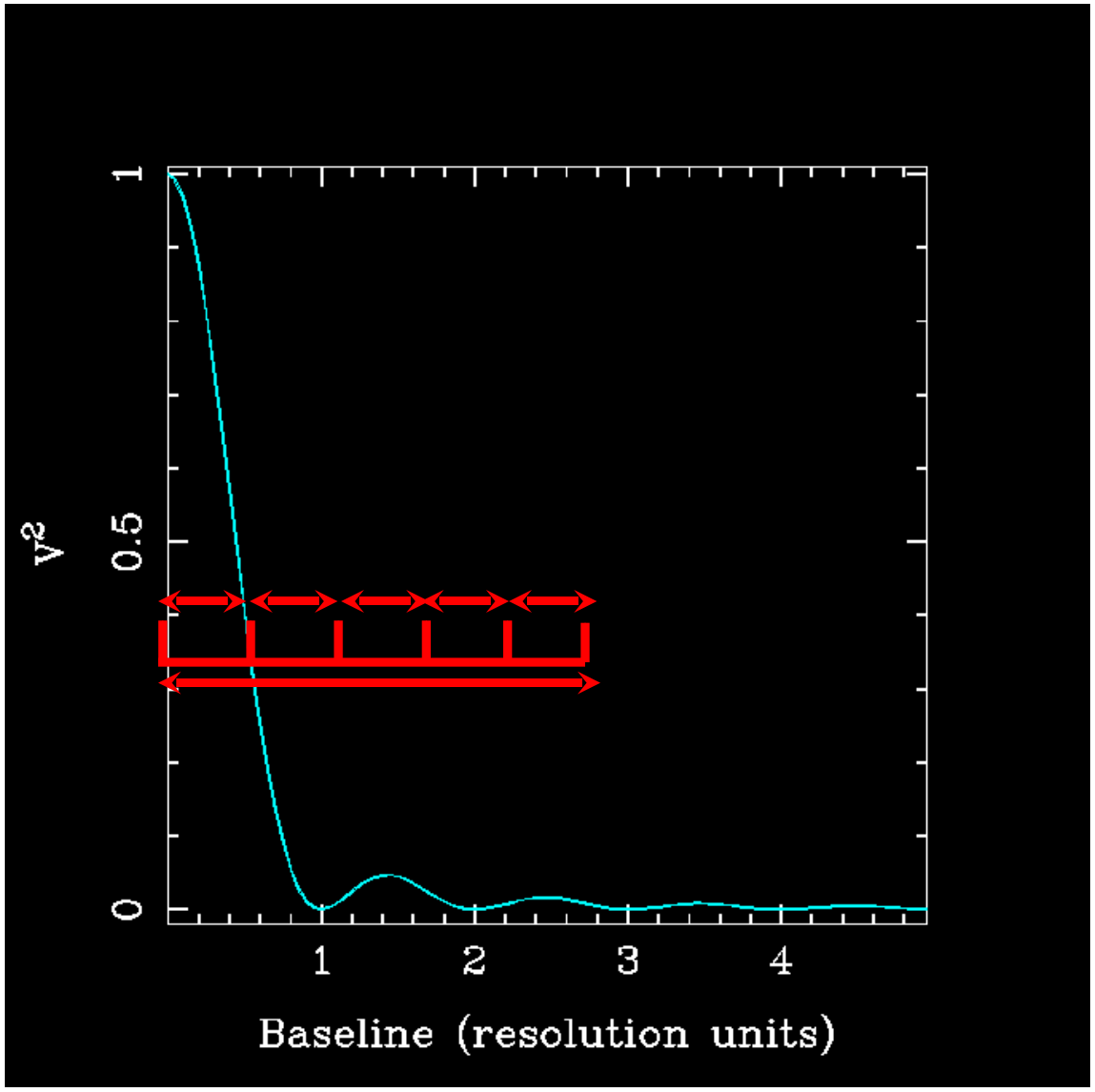
FT, take phases

To do useful imaging, we must work with low visibilities



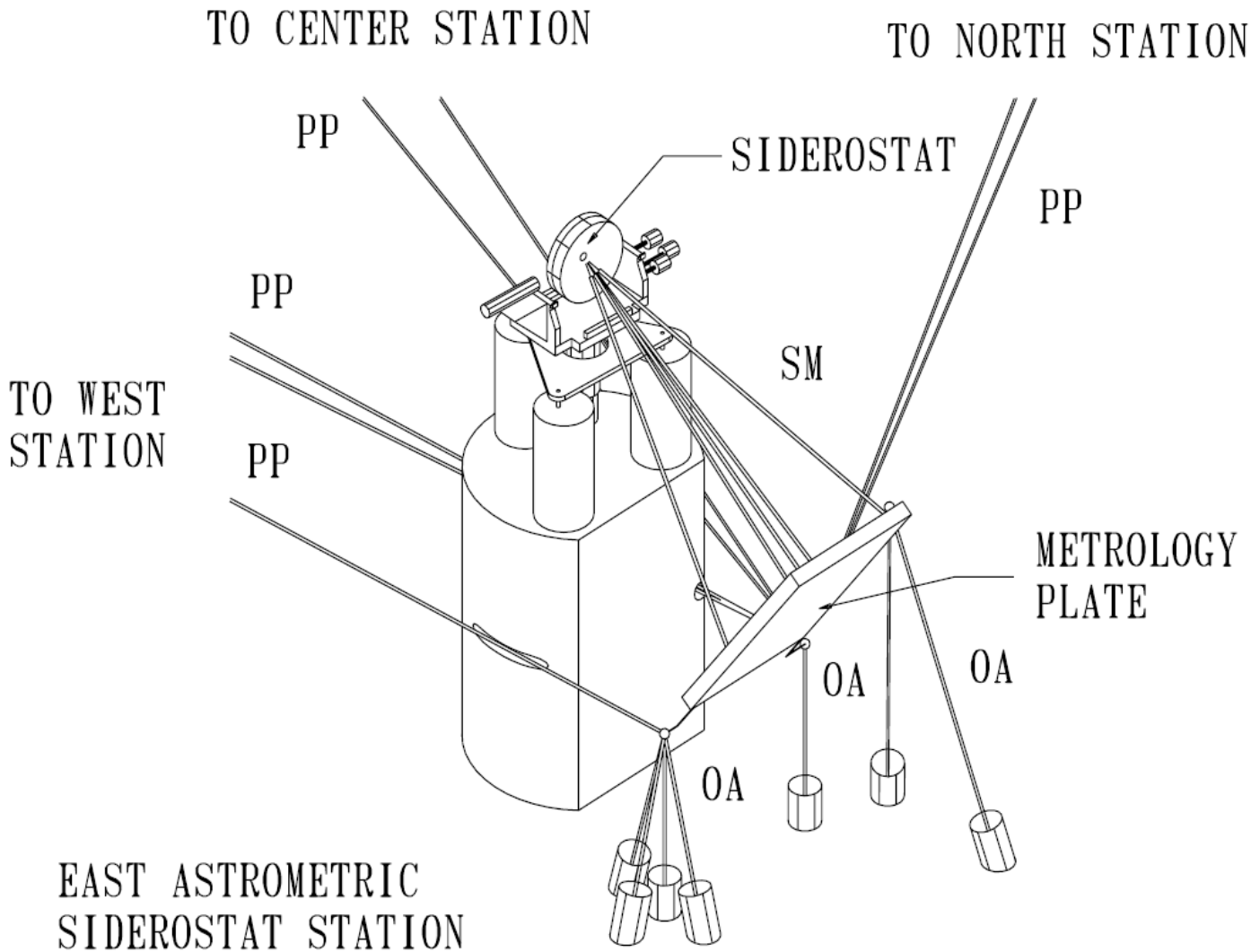


Baseline bootstrapping makes use of a chain of short baselines to find fringes on long baselines



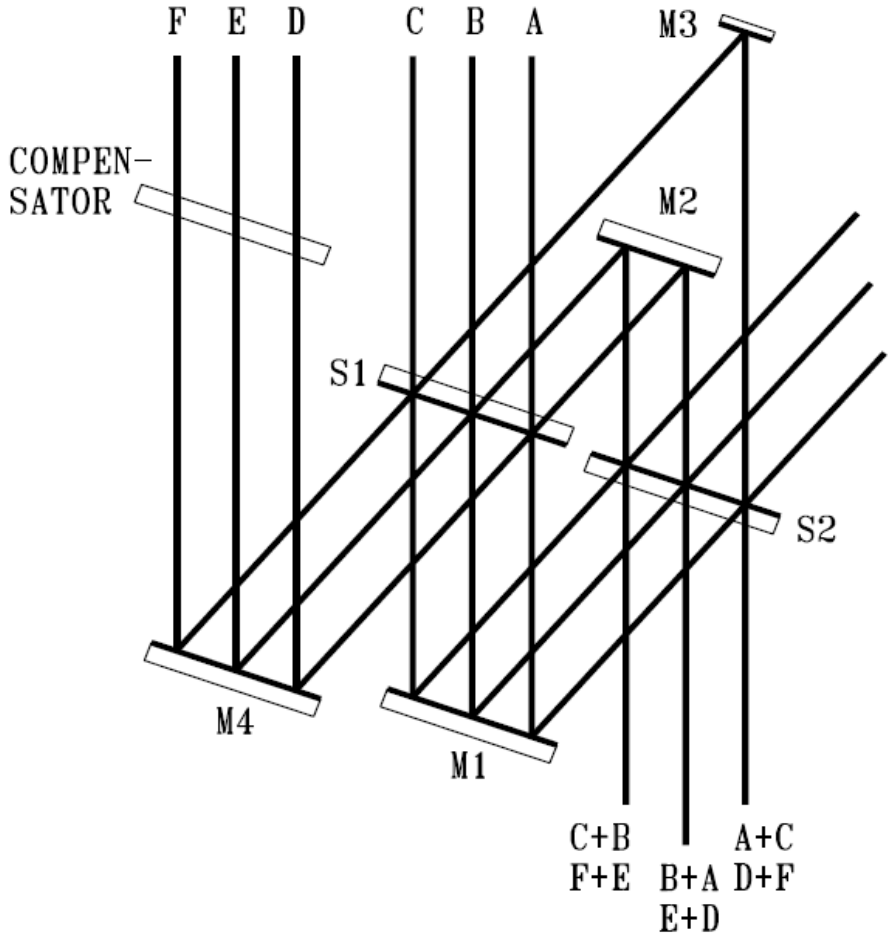
The Navy Prototype Optical Interferometer is essentially two co-located arrays

Wide-angle astrometry requires the baselines to be continuously monitored

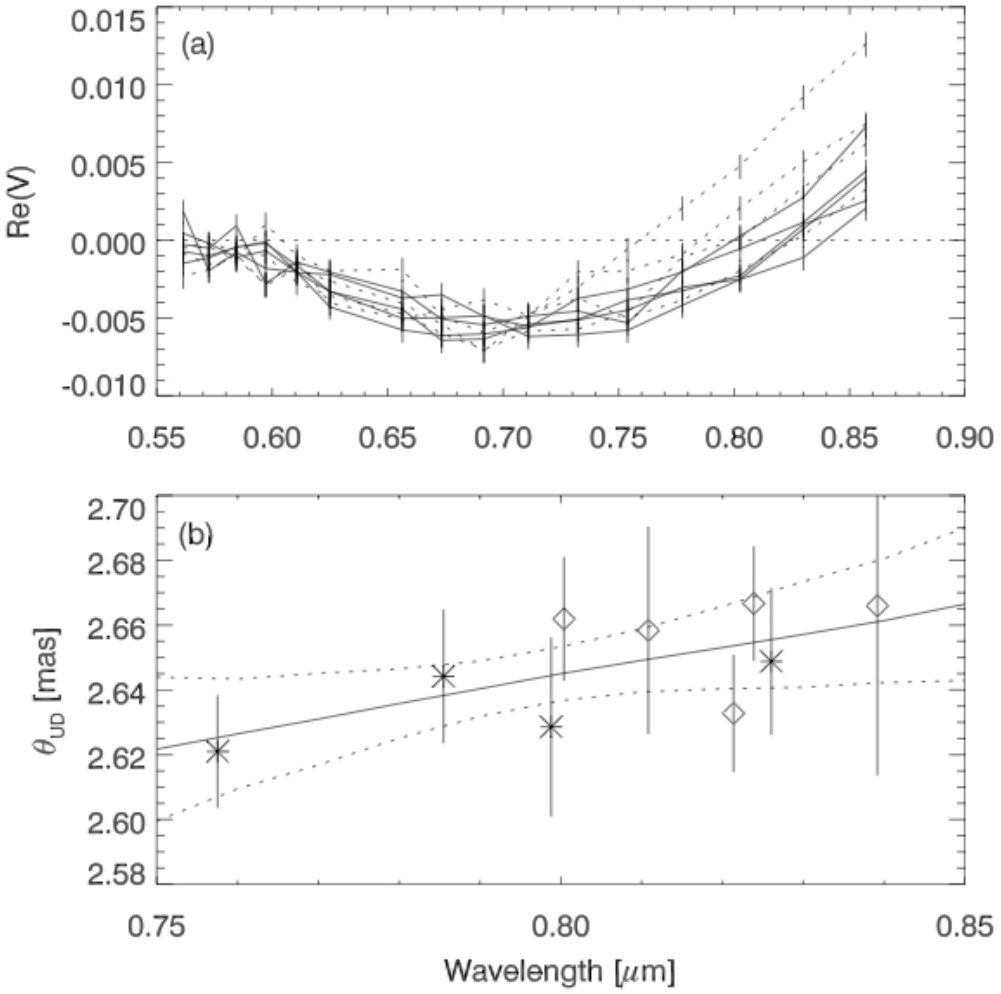


The 2 (3) imaging siderostats are movable to give a baselines 19-79(99)m

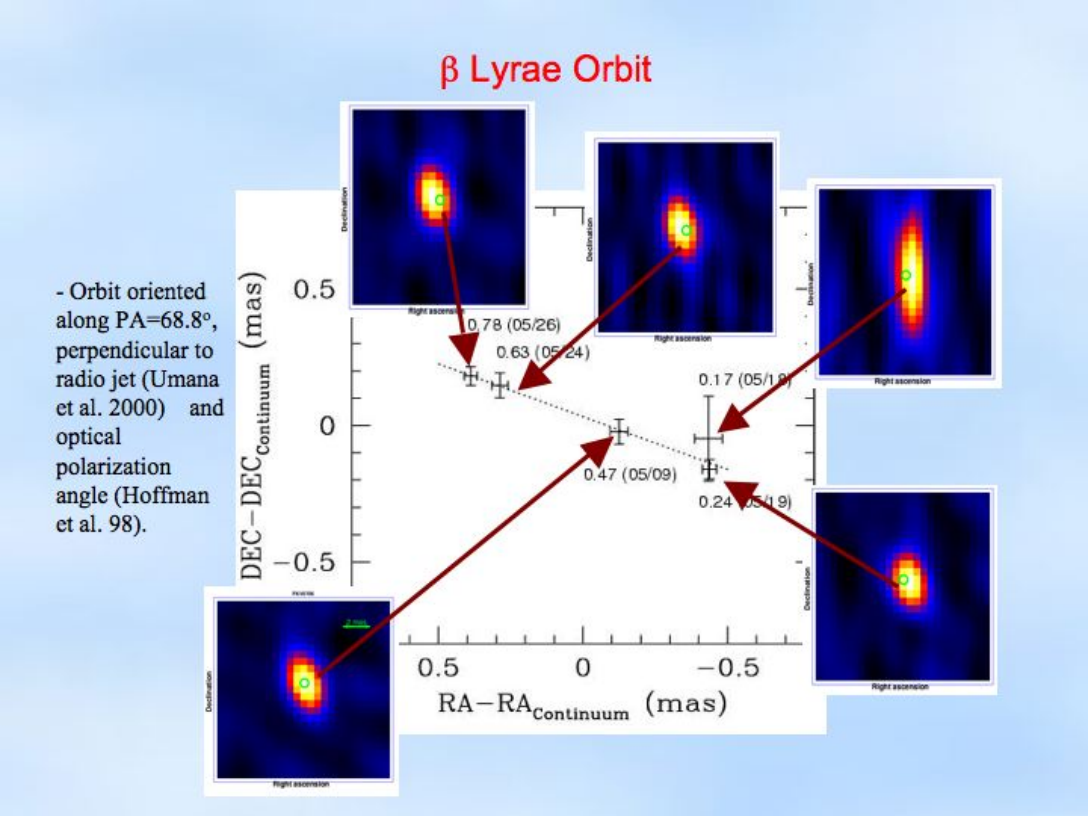
The beam combiner provides all 15 baselines from a 6-element array



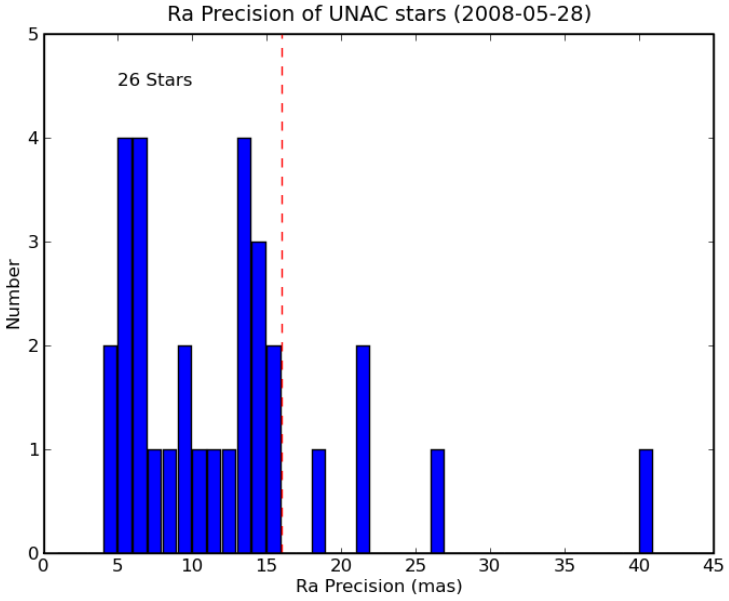
“Self-phase-referencing” allows complex visibilities to be measured

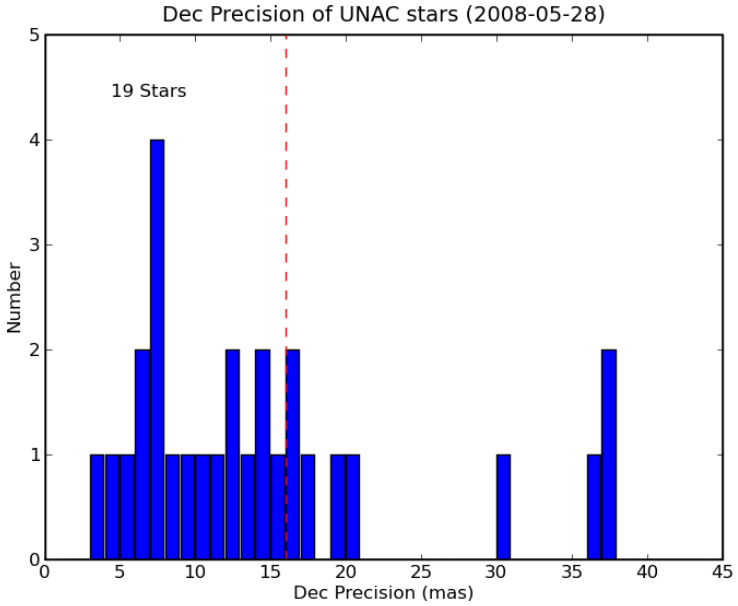


Imaging is used for a variety of stellar astrophysics



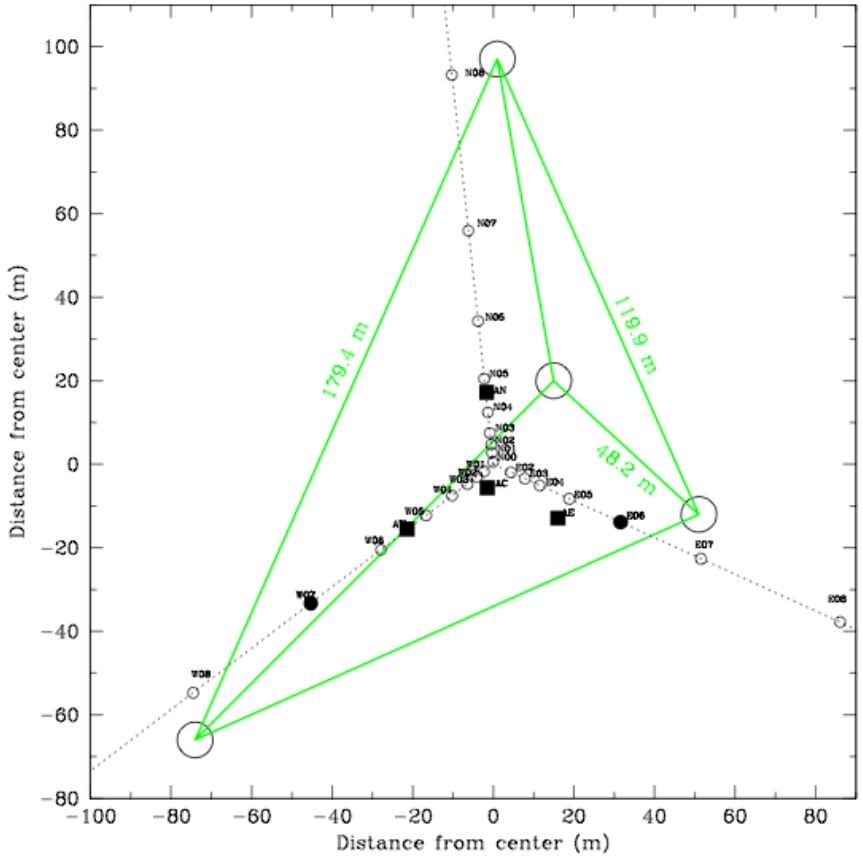
Wide-angle astrometry at the 16mas level has been achieved



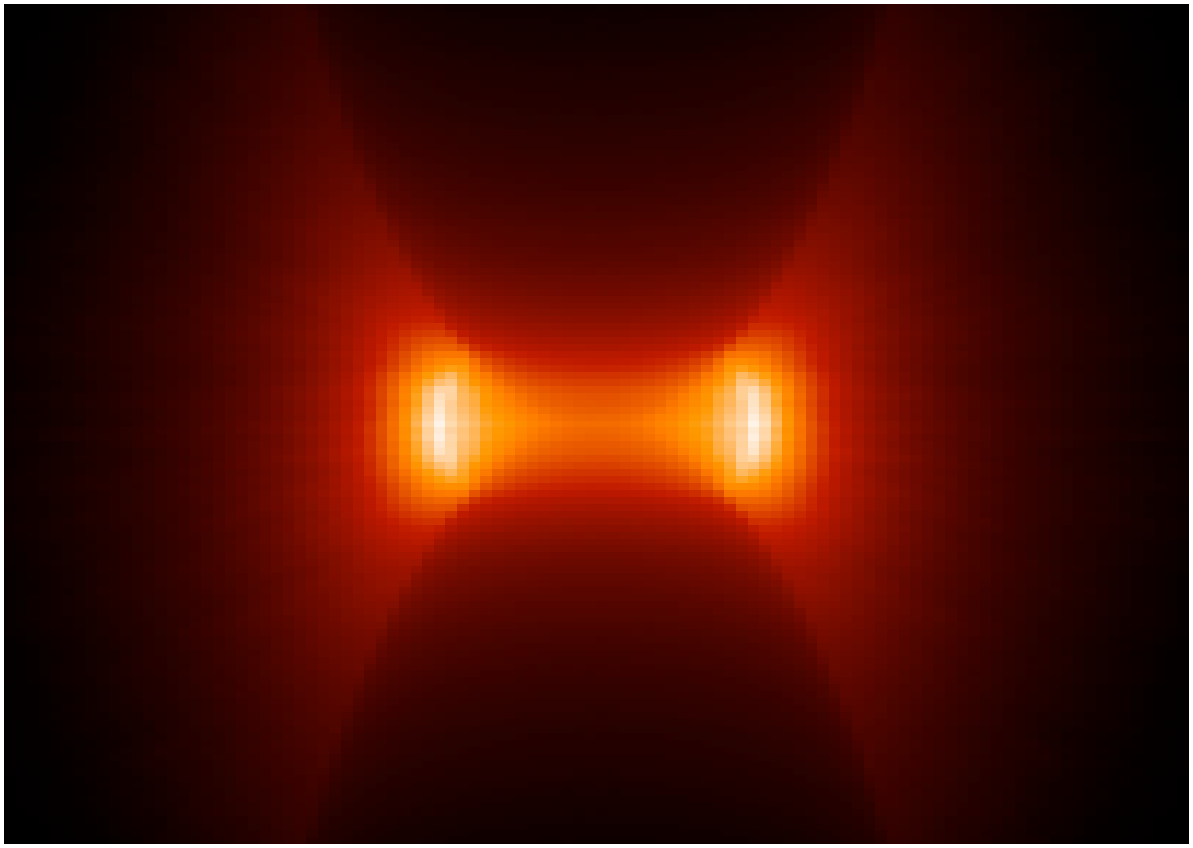


To use NPOI contact Don Hutter at USNO Flagstaff

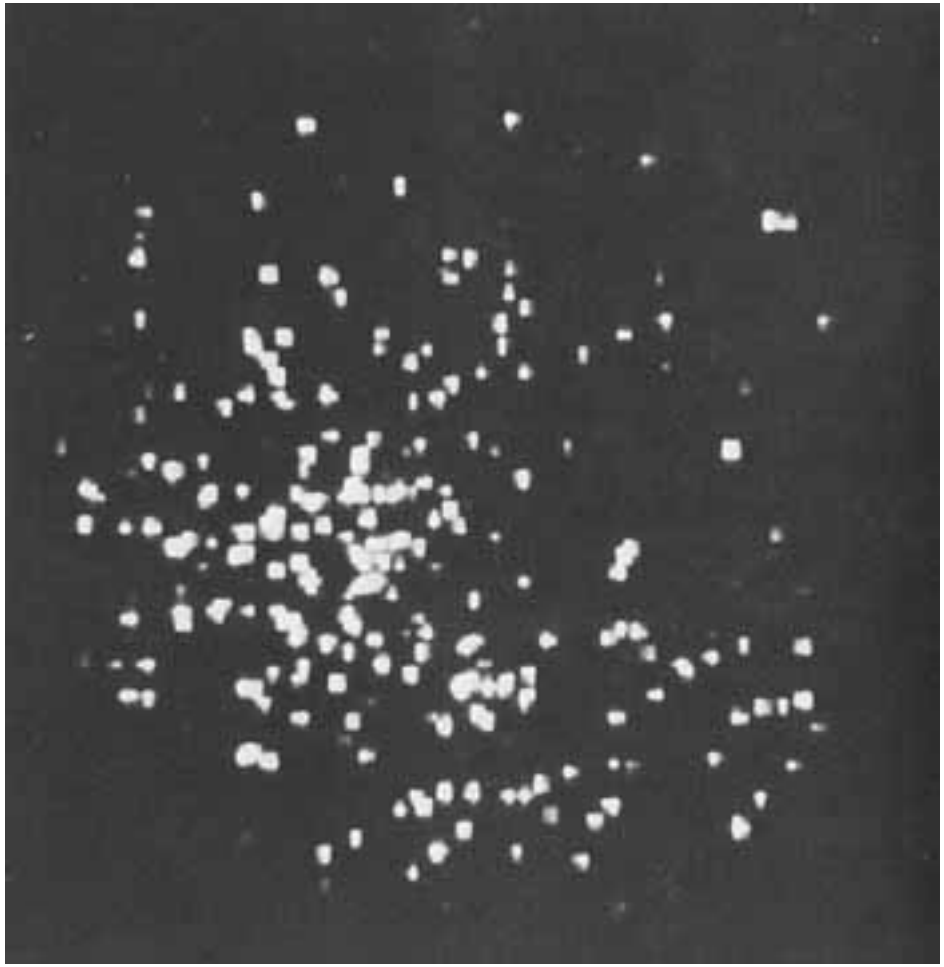
- Wavelengths 450-950nm
- Limiting magnitude V=6.1
- In the next few years:
  - Beam compressors increasing aperture to 35cm
  - Keck outriggers?
  - Baselines to 472m?



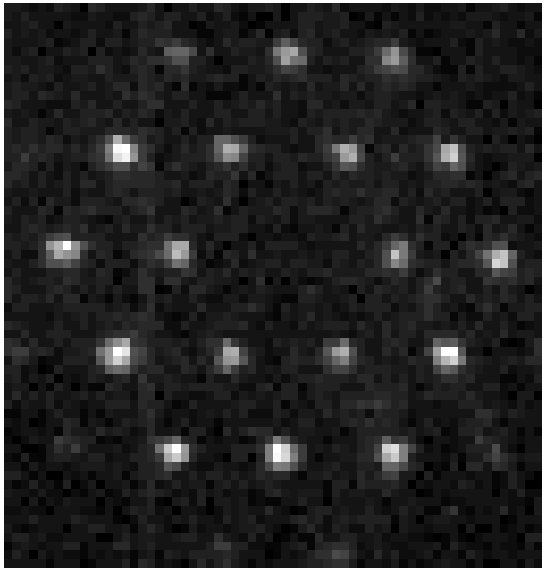
MROI combines imaging with the sensitivity to access the really interesting classes of target



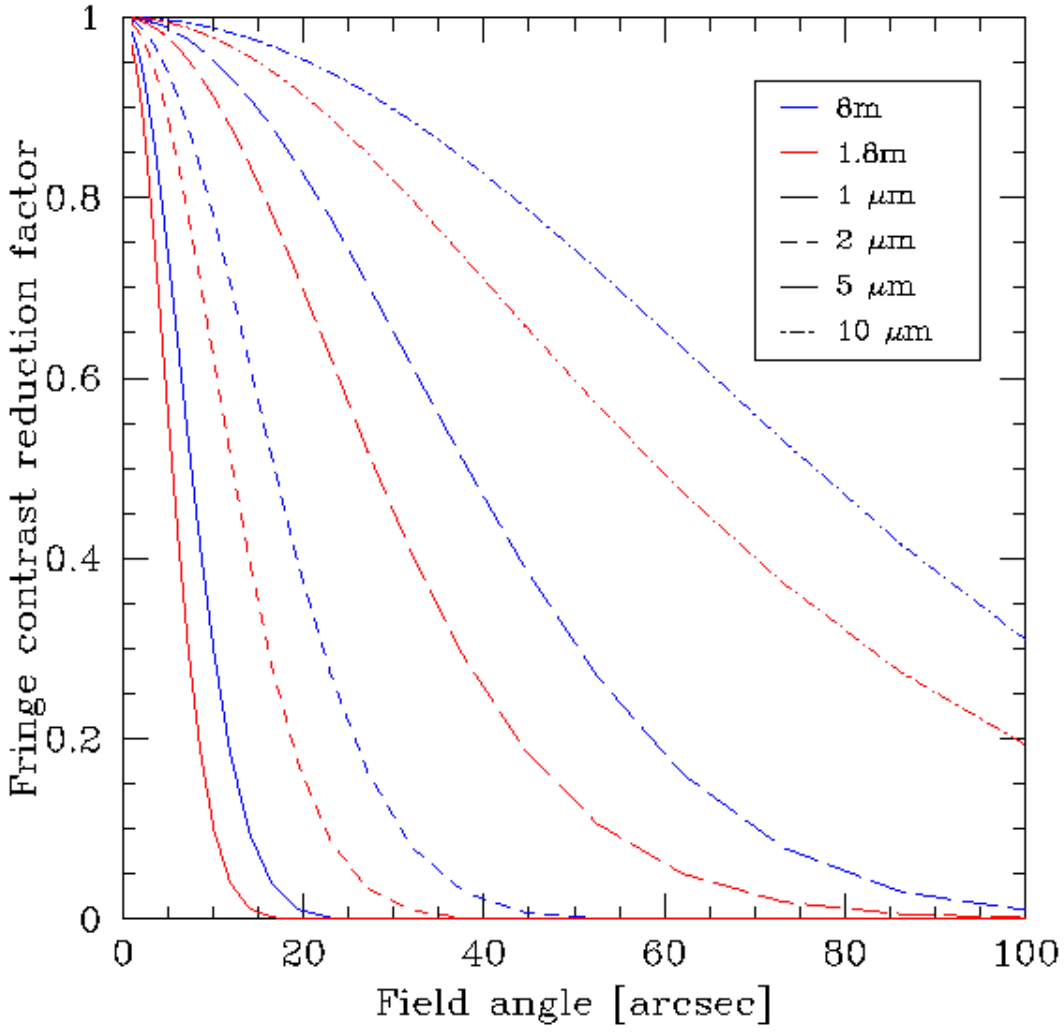
We only collect a few photons per exposure on faint sources



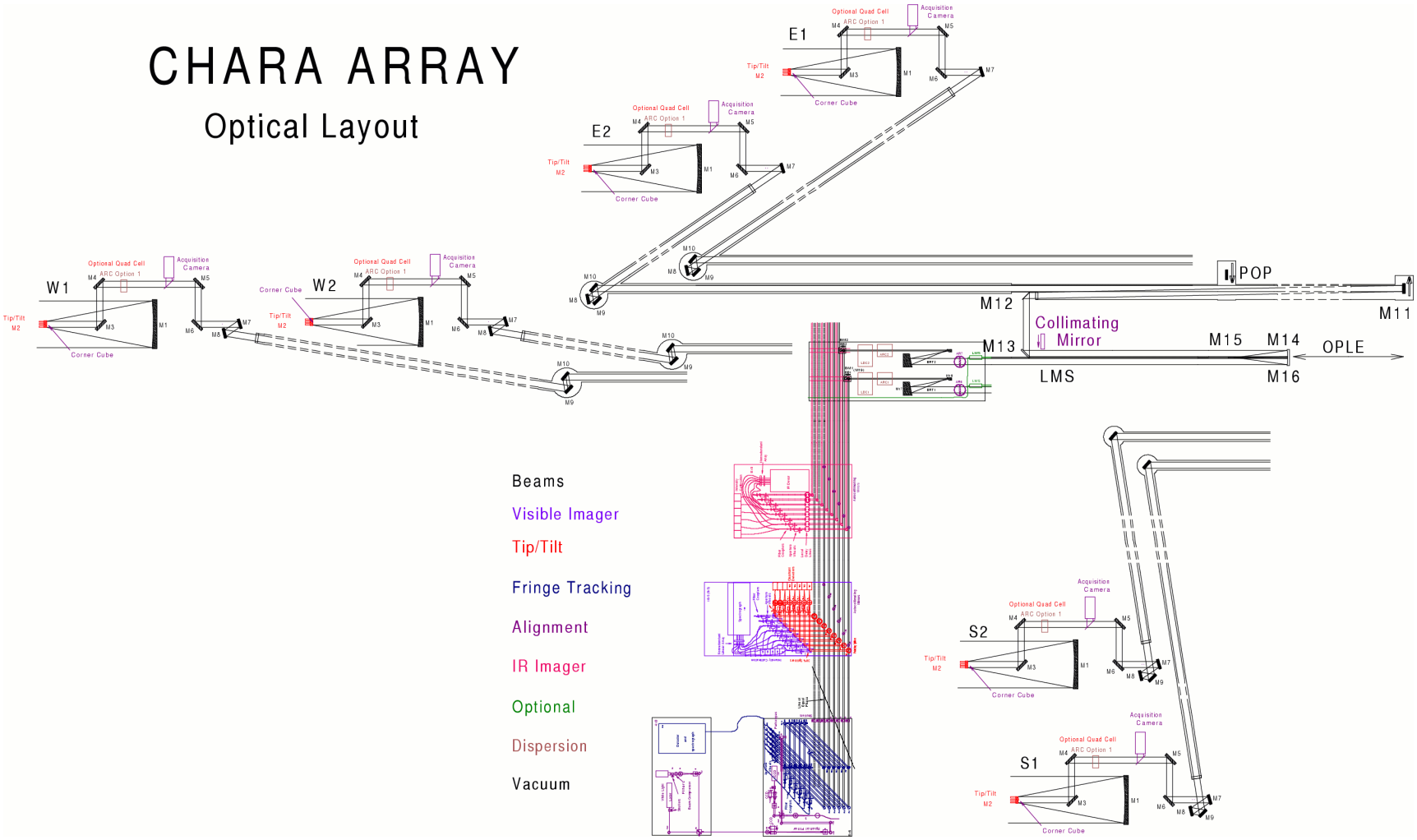
We cannot simply use large telescopes: AO needs photons for the wavefront sensor



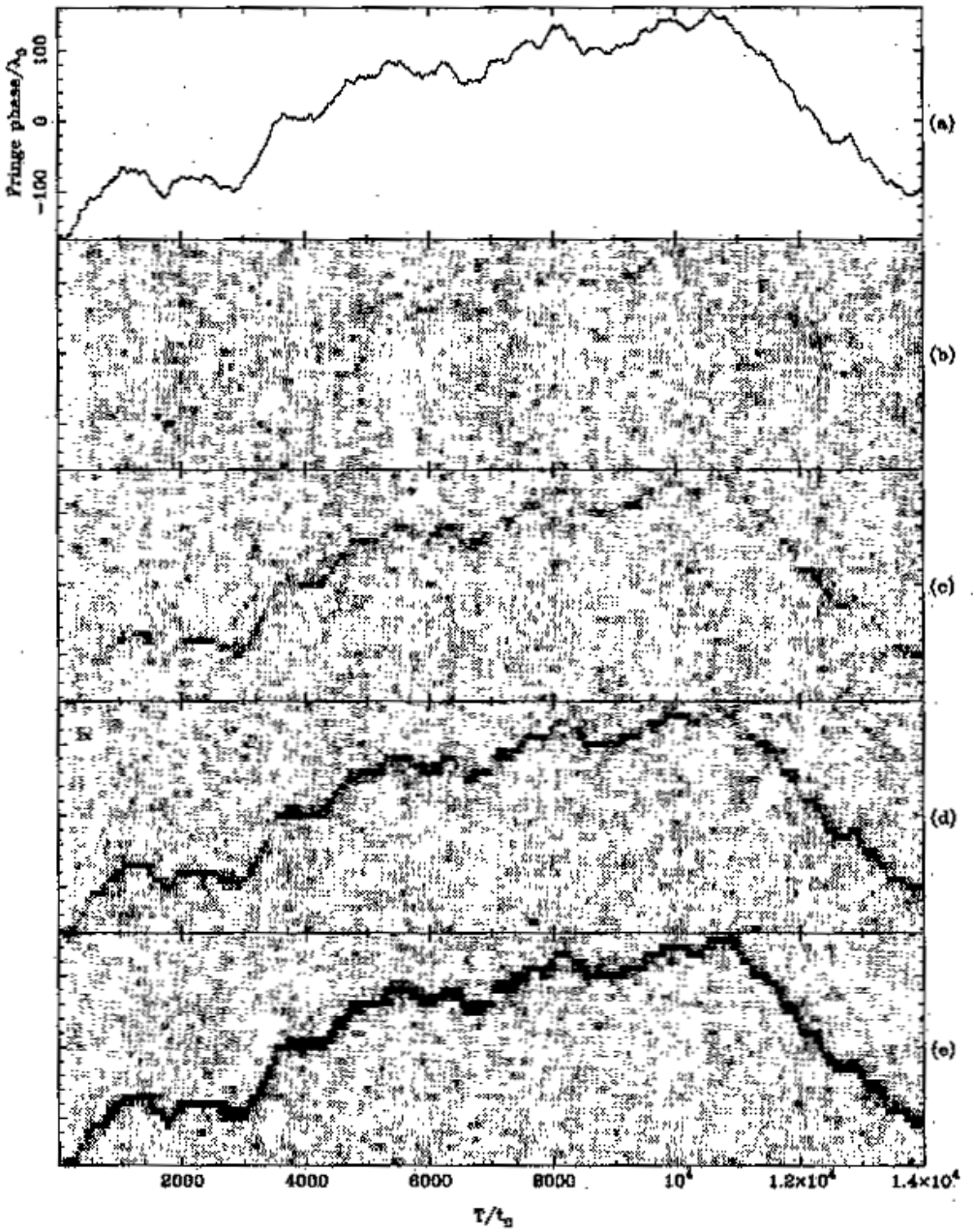
Dual-star systems require nearby bright reference sources



Most interferometers throw away >95% of the photons they collect

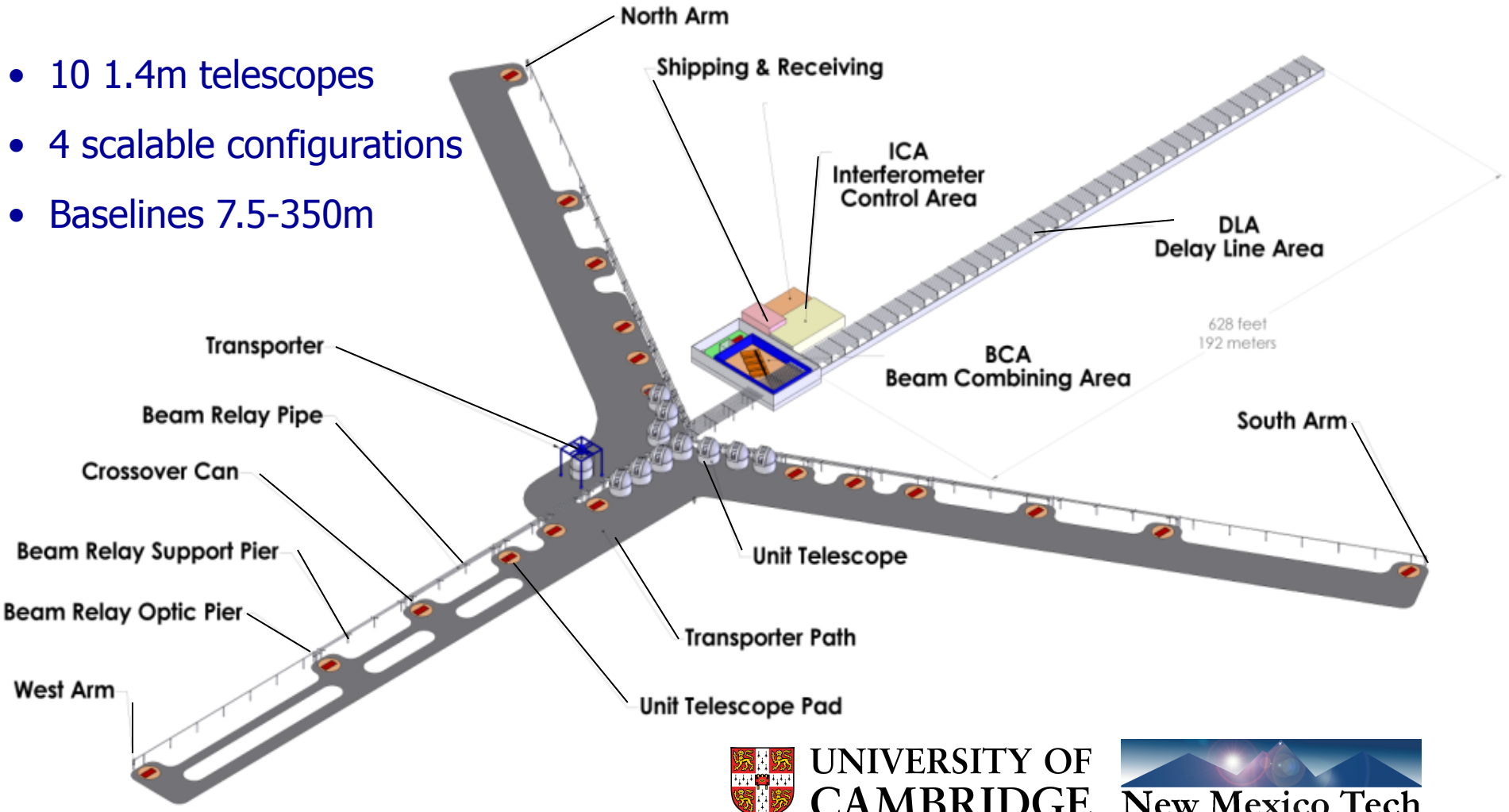


Group-delay tracking can track sources 10 times fainter than conventional phase tracking



The MRO Interferometer is being built by a partnership between NMT and Cambridge

- 10 1.4m telescopes
- 4 scalable configurations
- Baselines 7.5-350m



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New Mexico Tech
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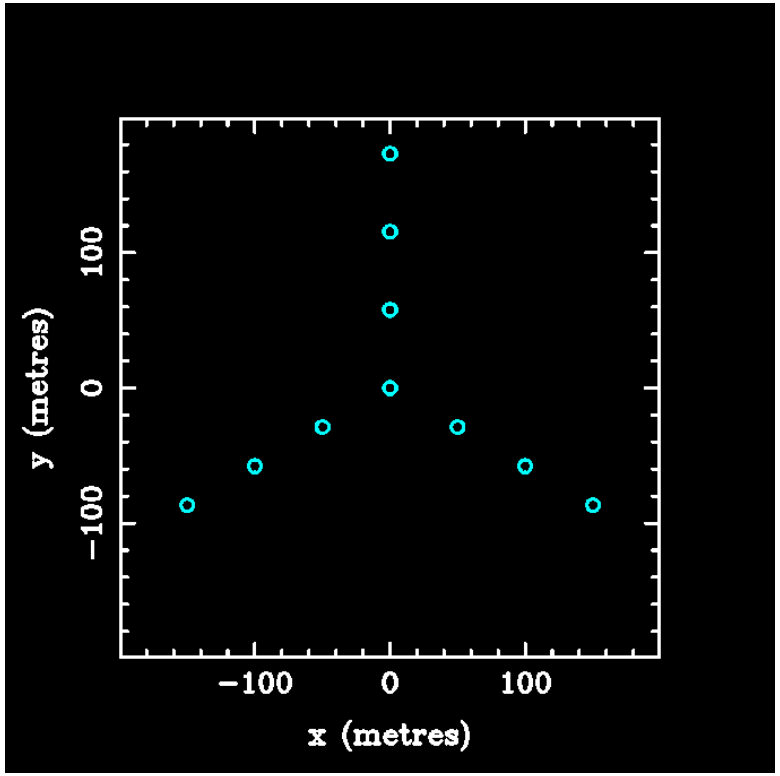
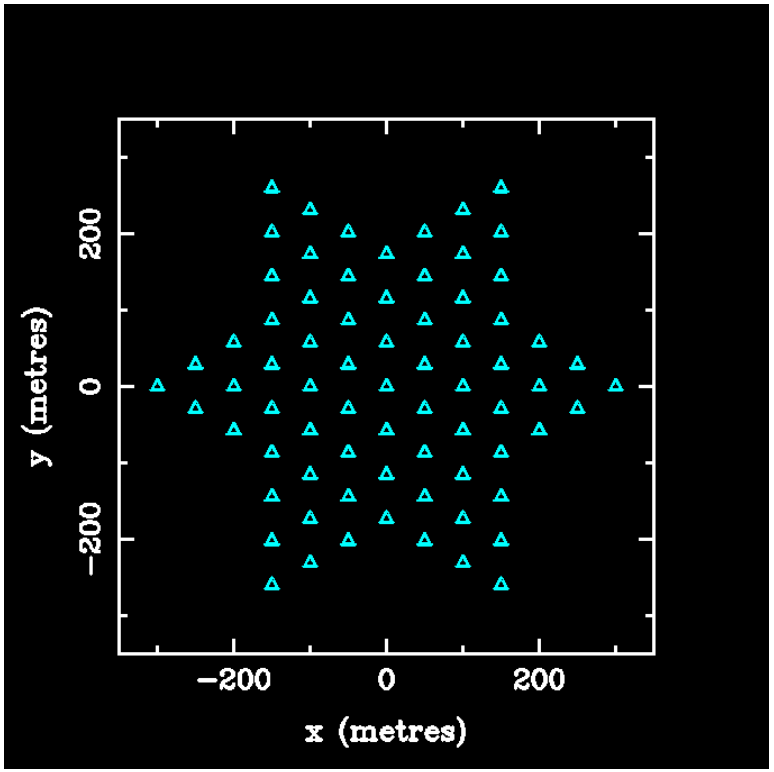
With 10 relocatable telescopes, MROI will have unequalled imaging capability

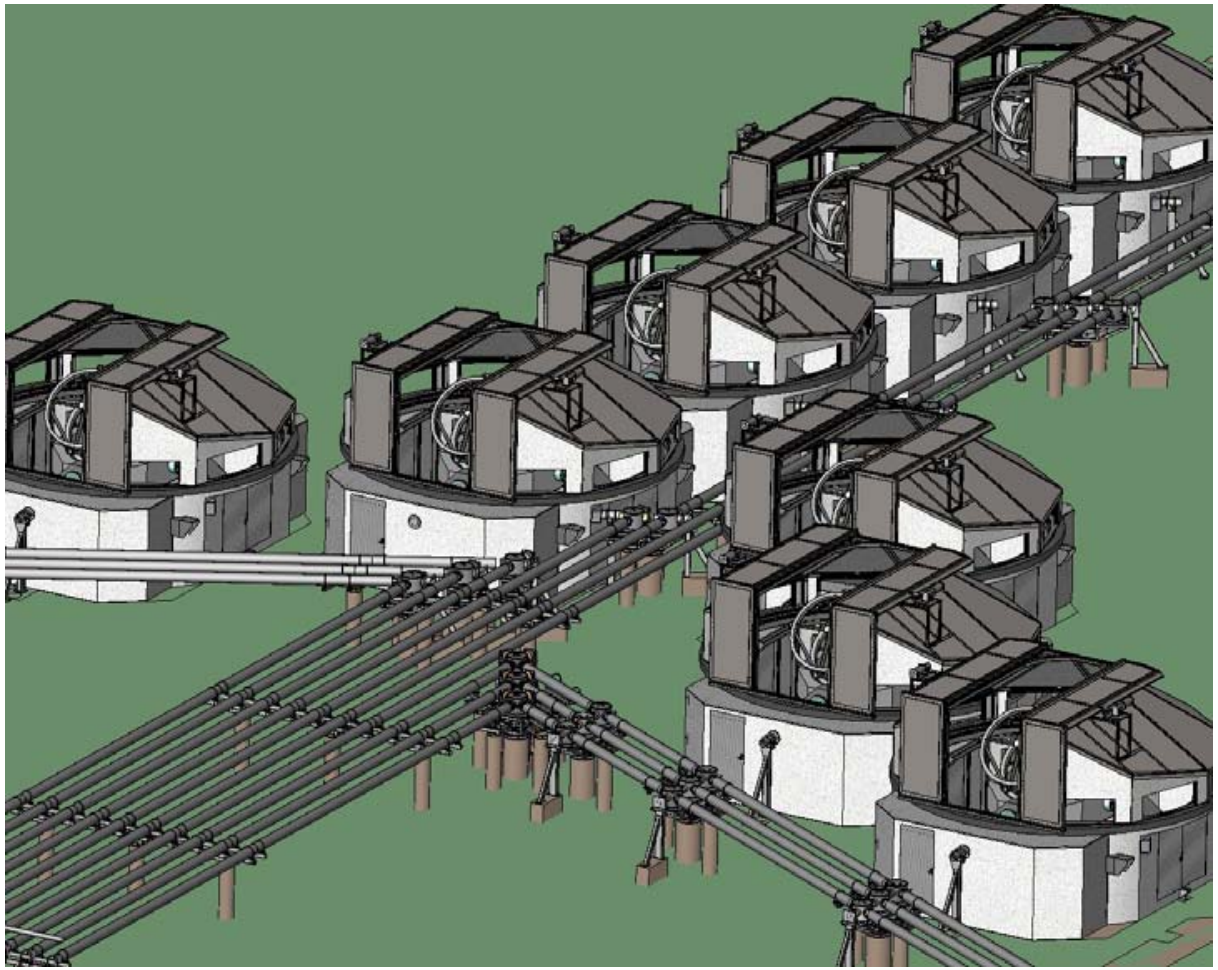


Array layout

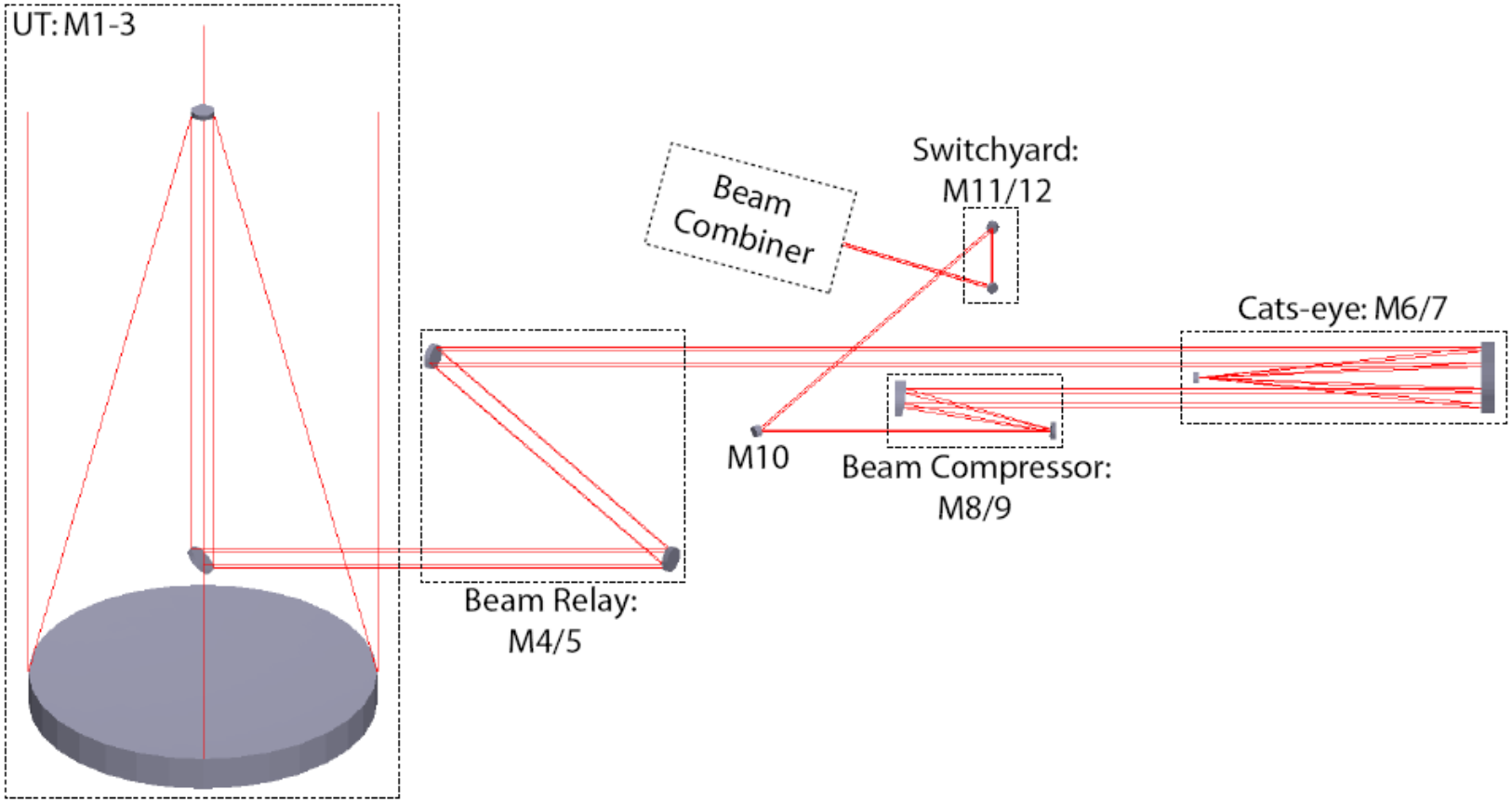


Instantaneuous (u,v) coverage

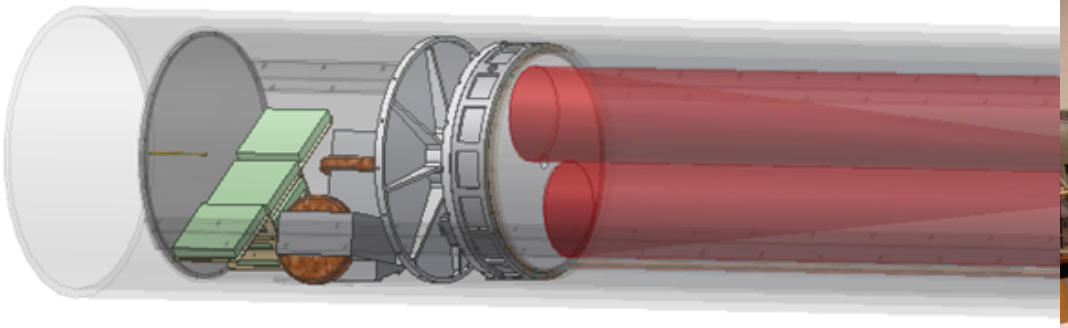
The array is scalable to access both large and small scales

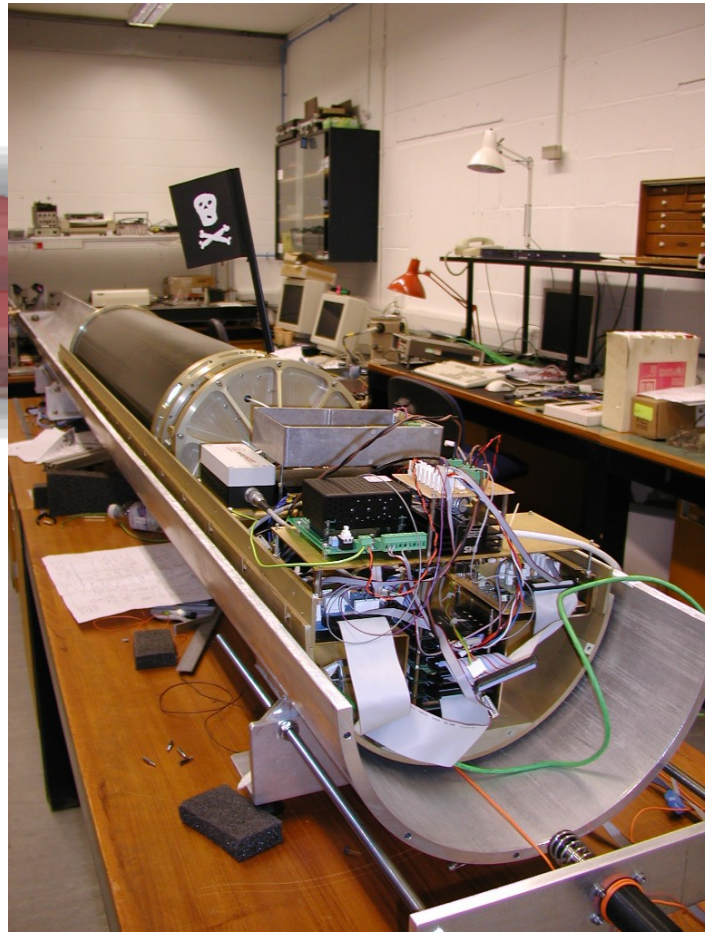


The beam train is optimized for maximum throughput

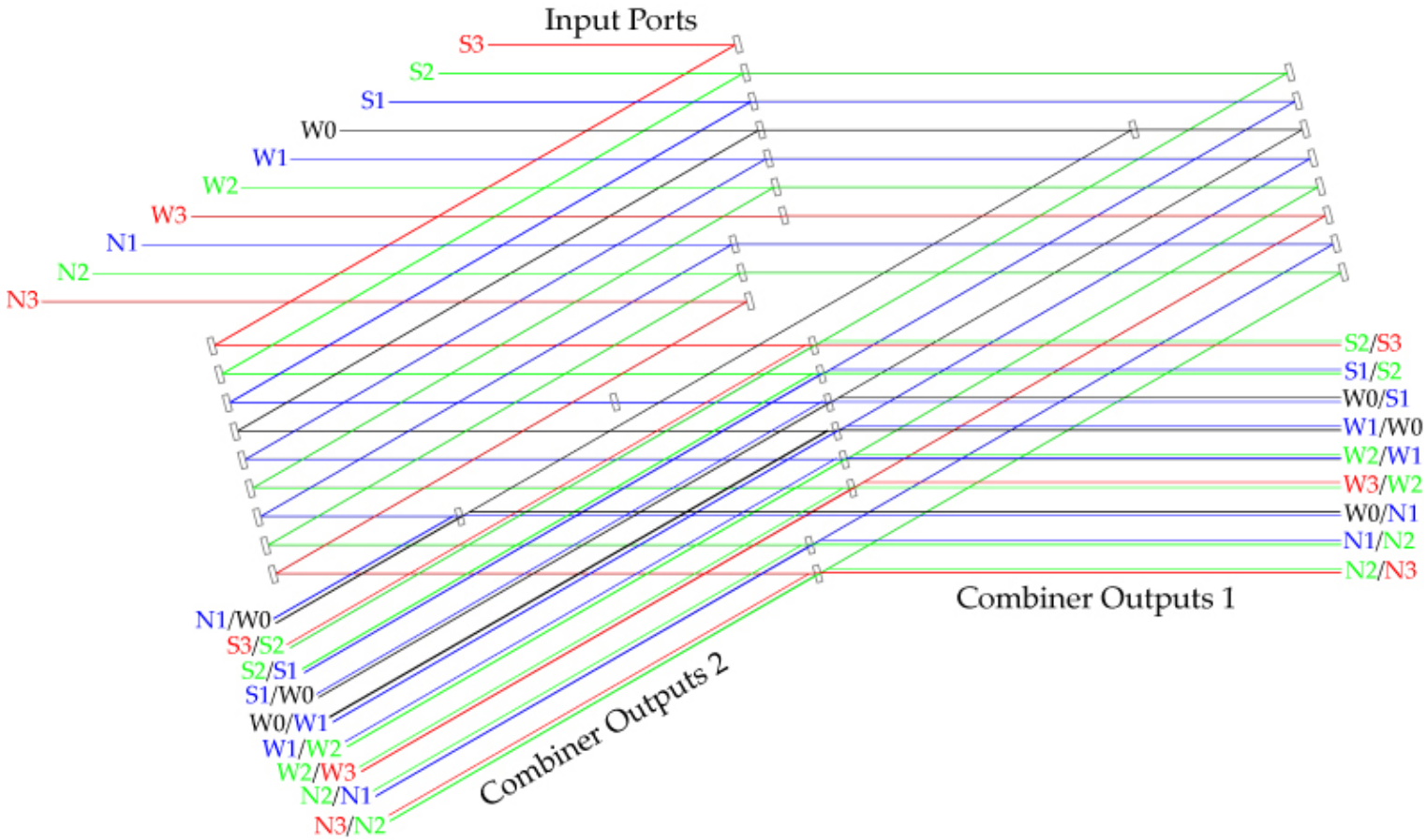


The delay line can switch between any two stars in the sky in less than three minutes

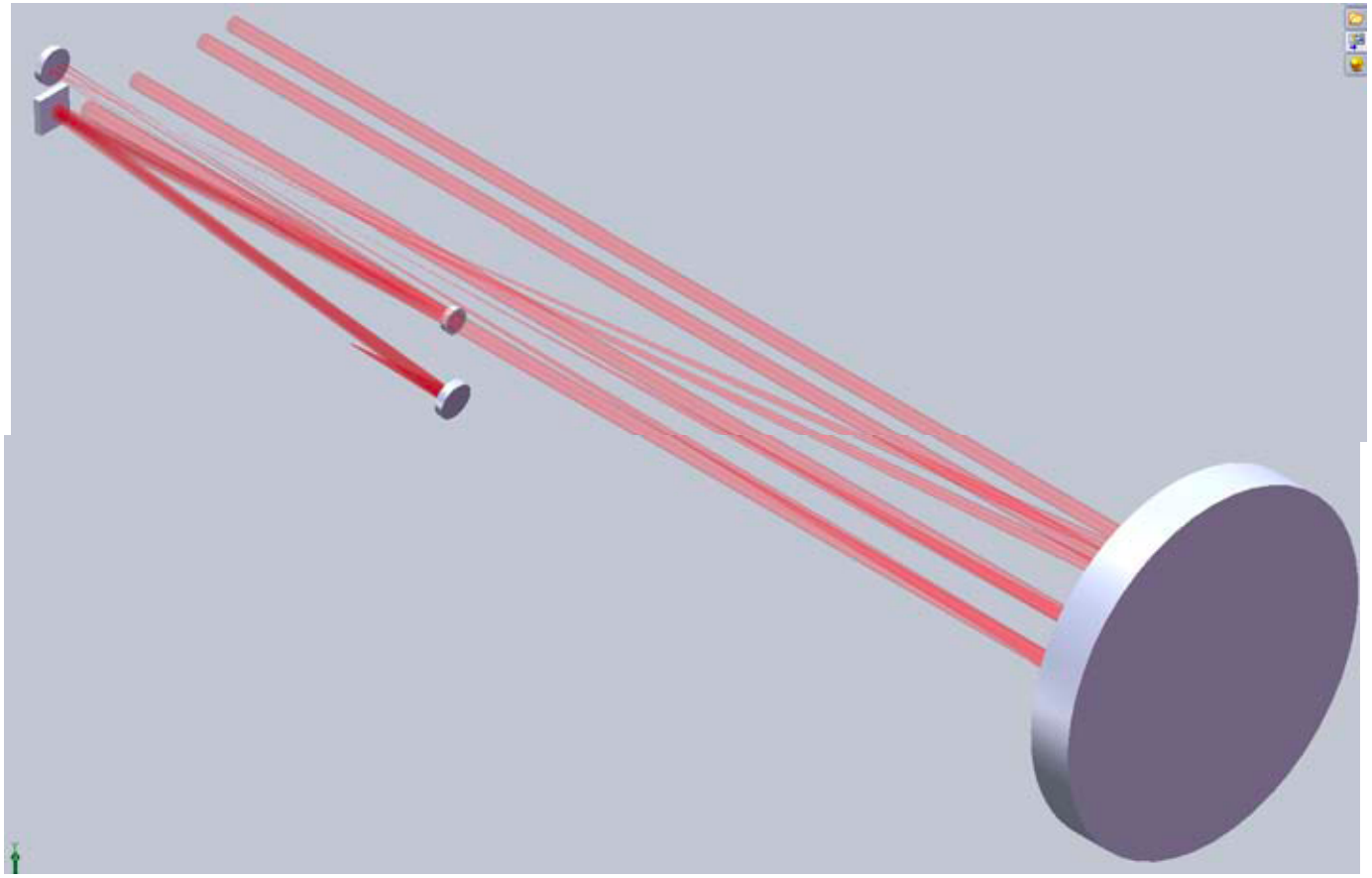




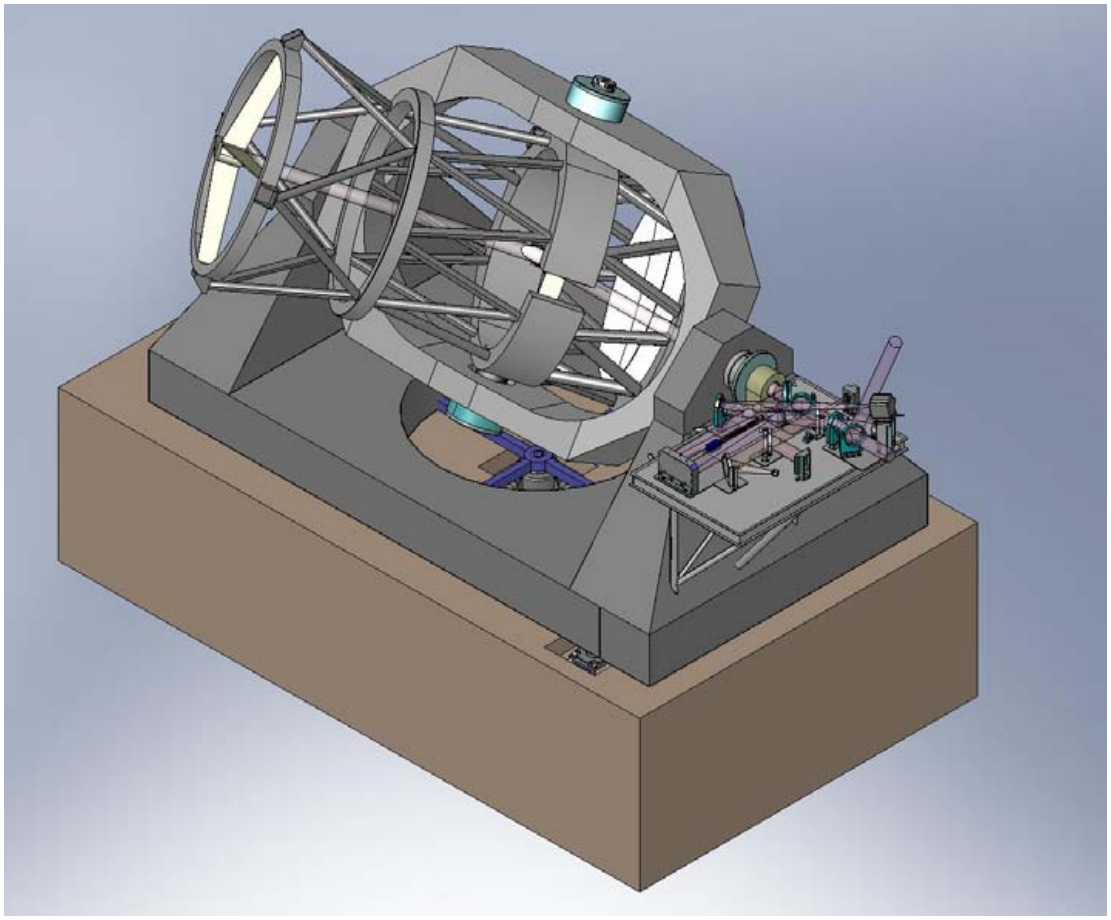
The group-delay fringe tracker does nearest-neighbour bootstrapping



The science combiner is optimised for signal-to-noise in “speckle mode”



The unit telescopes are due to arrive in early 2010



A phased deployment is envisaged


June 2008

MROI will be the first interferometer able to image dozens of AGN