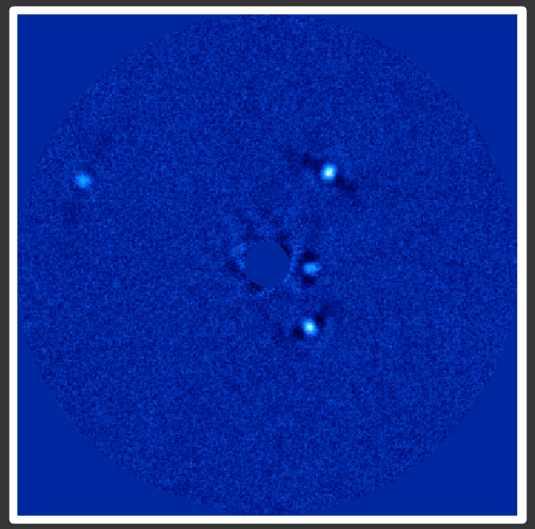
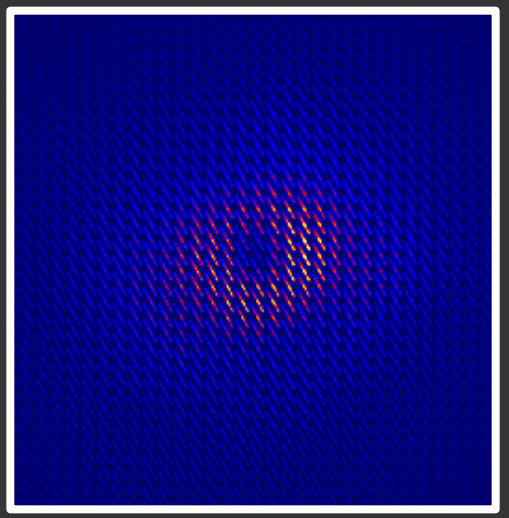
LBTI: latest results and prospects

D. Defrère
University of Liège





VORTEX yearly meeting -- Liège – August 2018

The Large Binocular Telescope

Mt Graham, Arizona (10400 feet -- 3170 meters)

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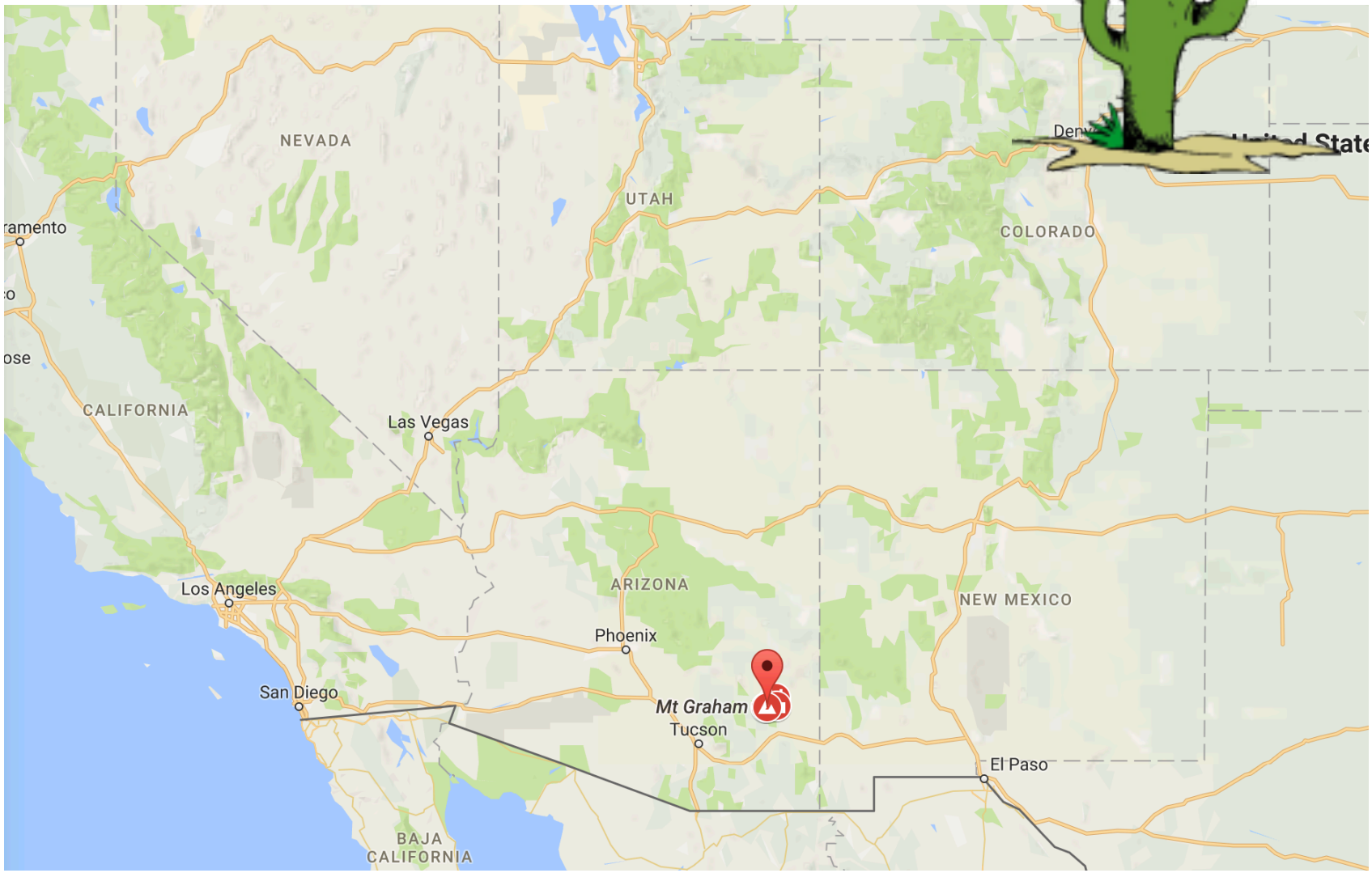

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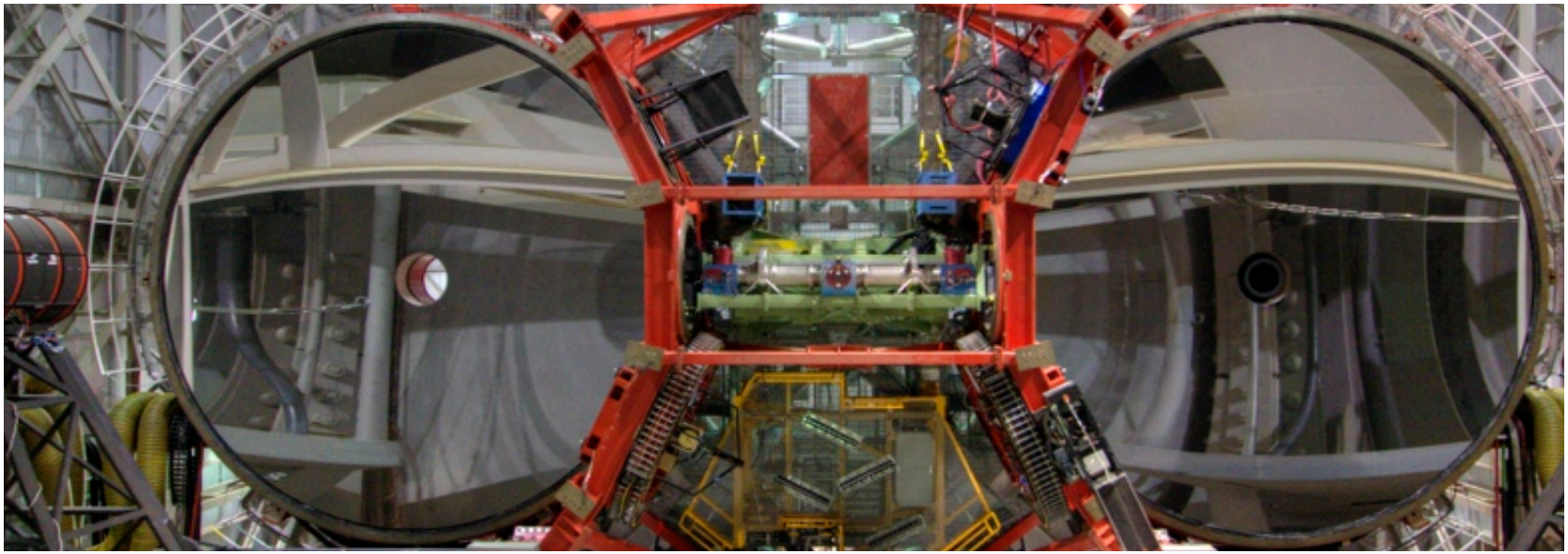

Resolution
Beam combination provides the equivalent resolution of a 22.7-m telescope.

High Contrast
The AO system creates an image with a Strehl of >90% at 3.8 µm.

Sensitivity
LBT has two 8.4-m mirrors mounted on a single structure (collecting area of a single 11.8-m aperture)

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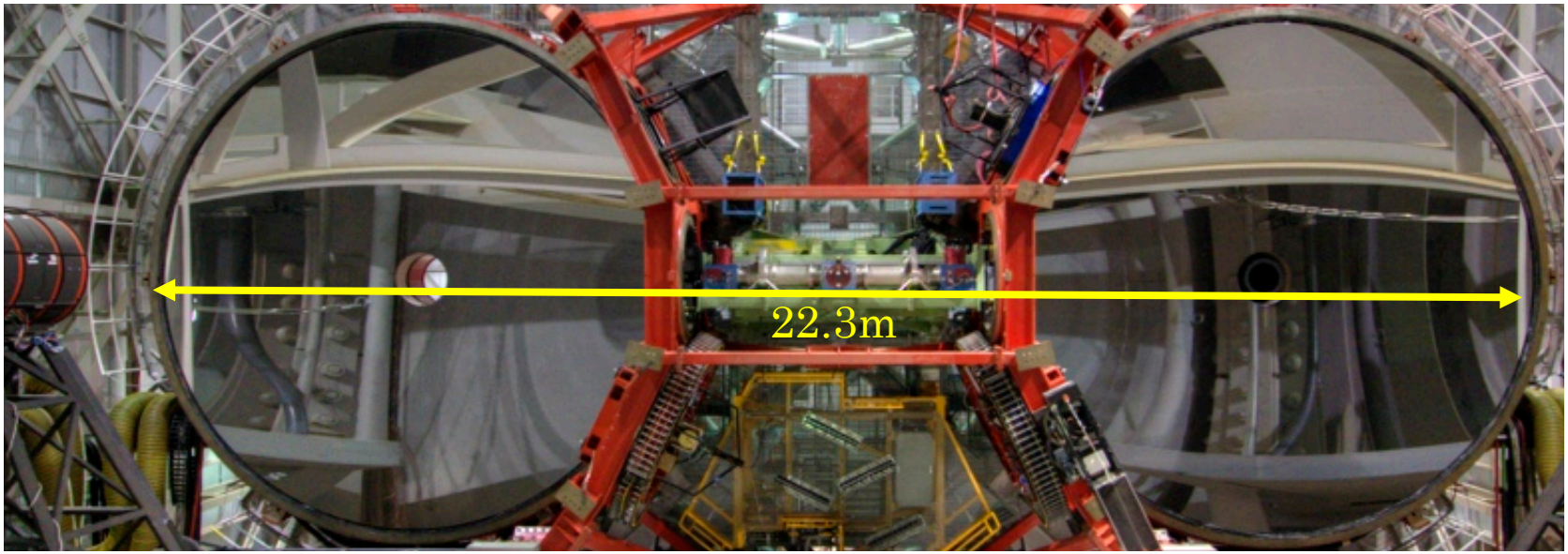

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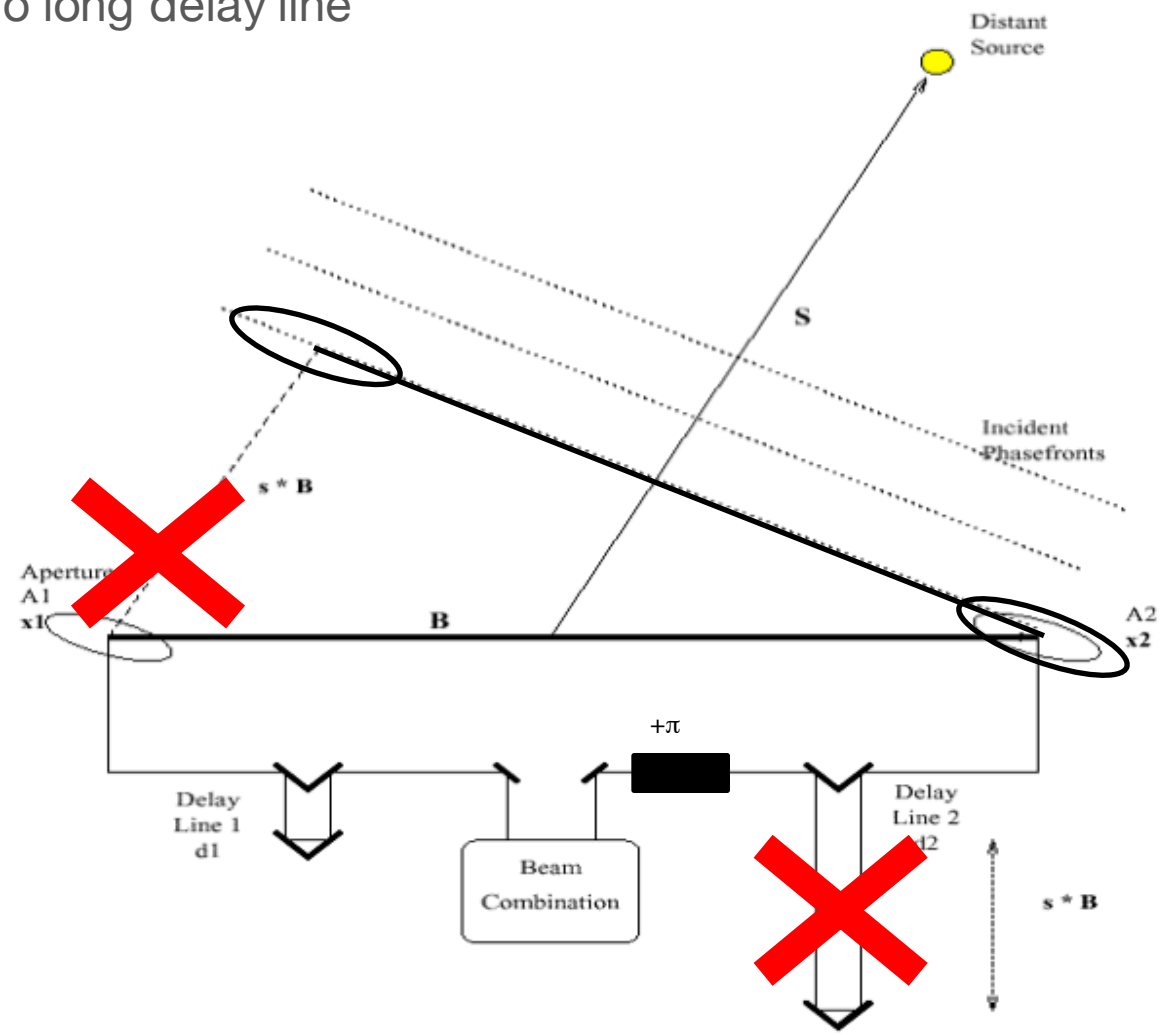
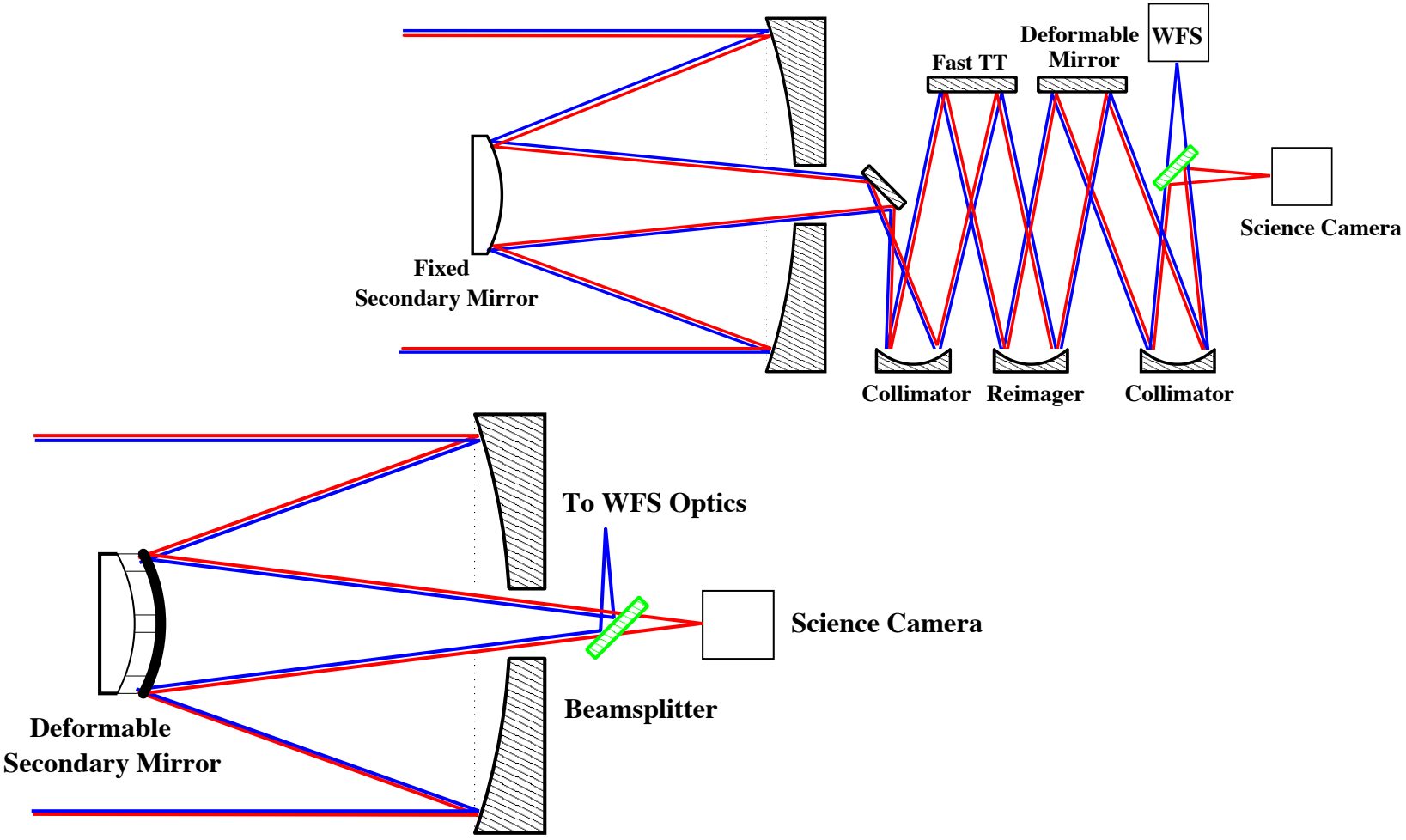
Key specifities

1. Common mount interferometer
   ⇒ No geometric delay
   ⇒ No long delay line



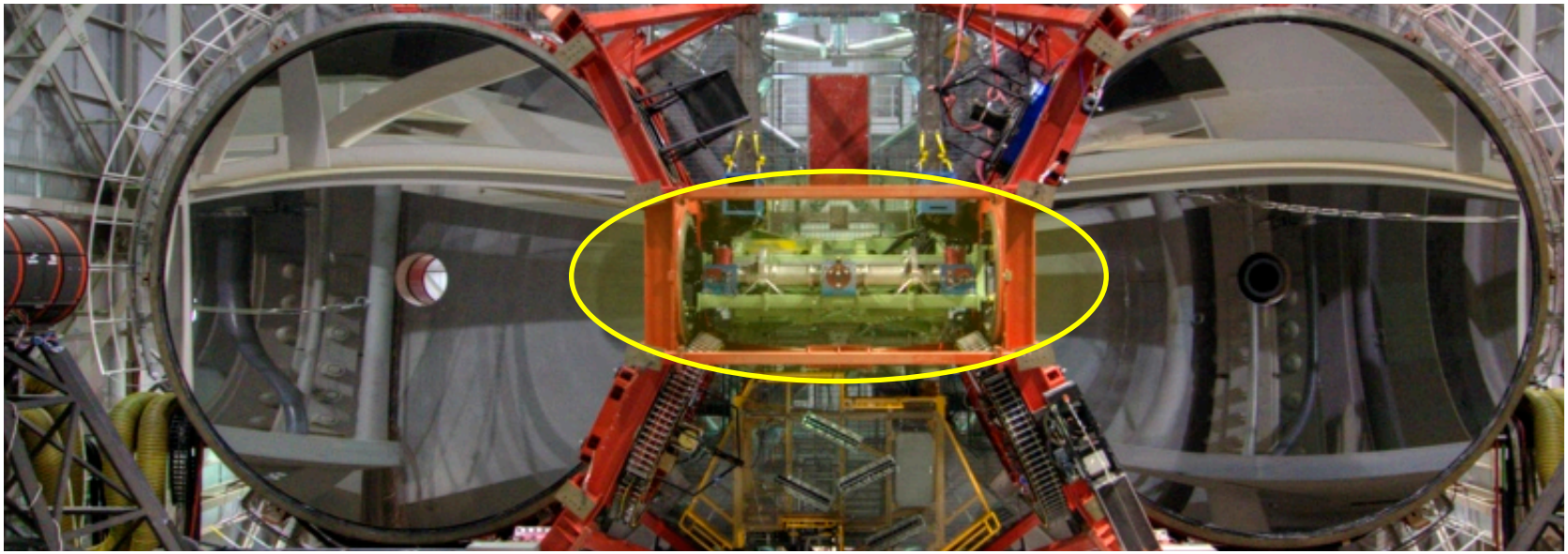
Key specifities

2. Deformable secondary mirrors
   => Low thermal background



AO figures by Matt Kenworthy

The LBT interferometer (LBTI)



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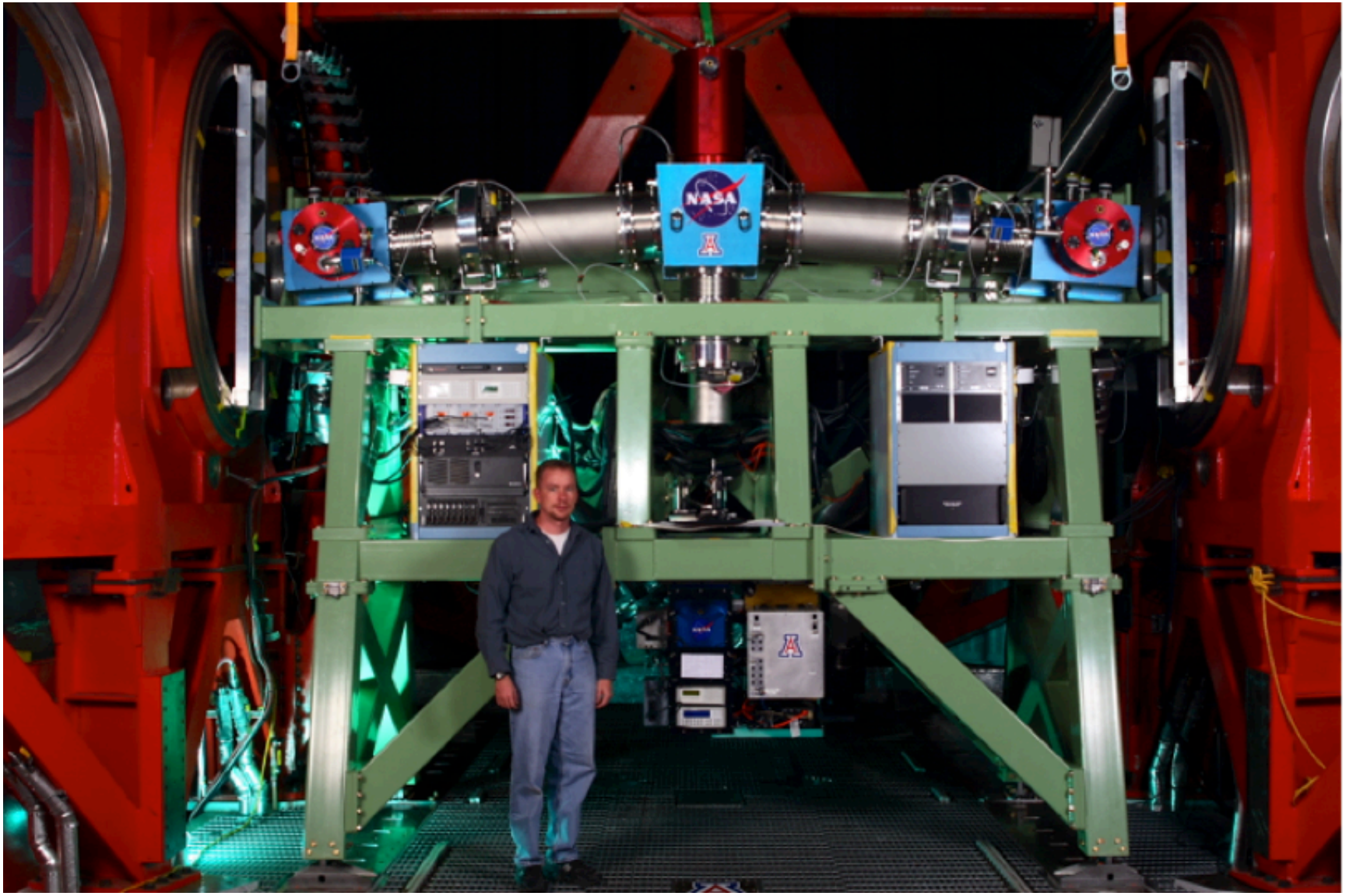

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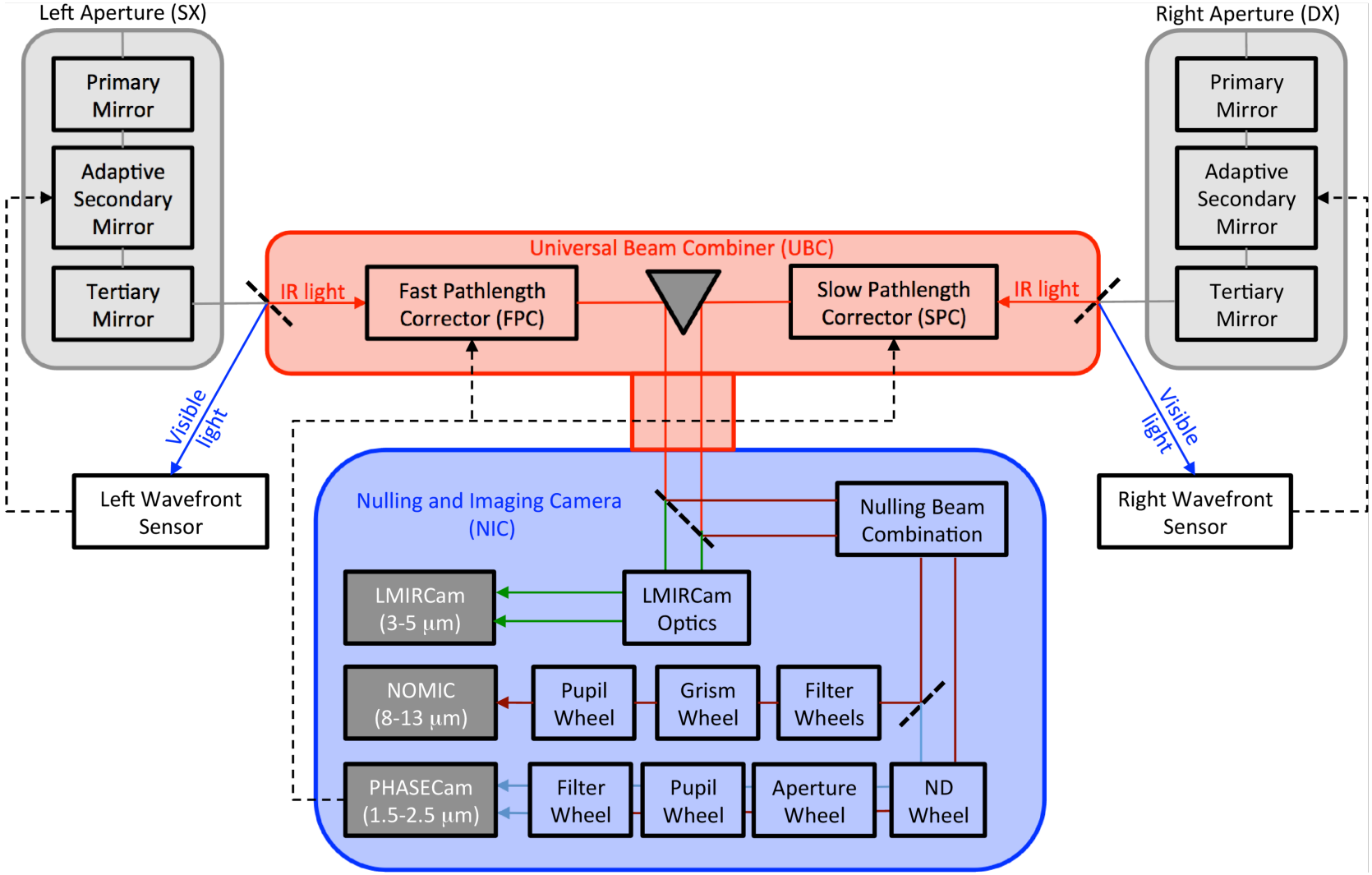


Versatile instrument

High-contrast AO imaging

IFU imaging

1.5 to 13 μm

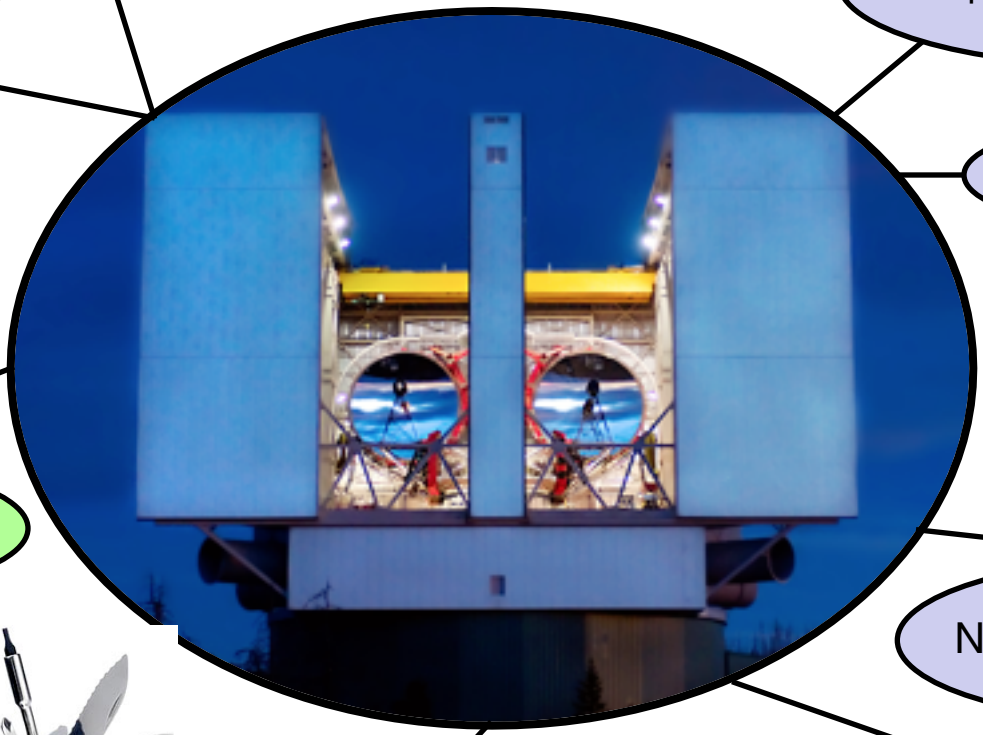
Dispersed interferometry

Coronagraphy

Nulling interferometry

NRM imaging

Fizeau interferometry



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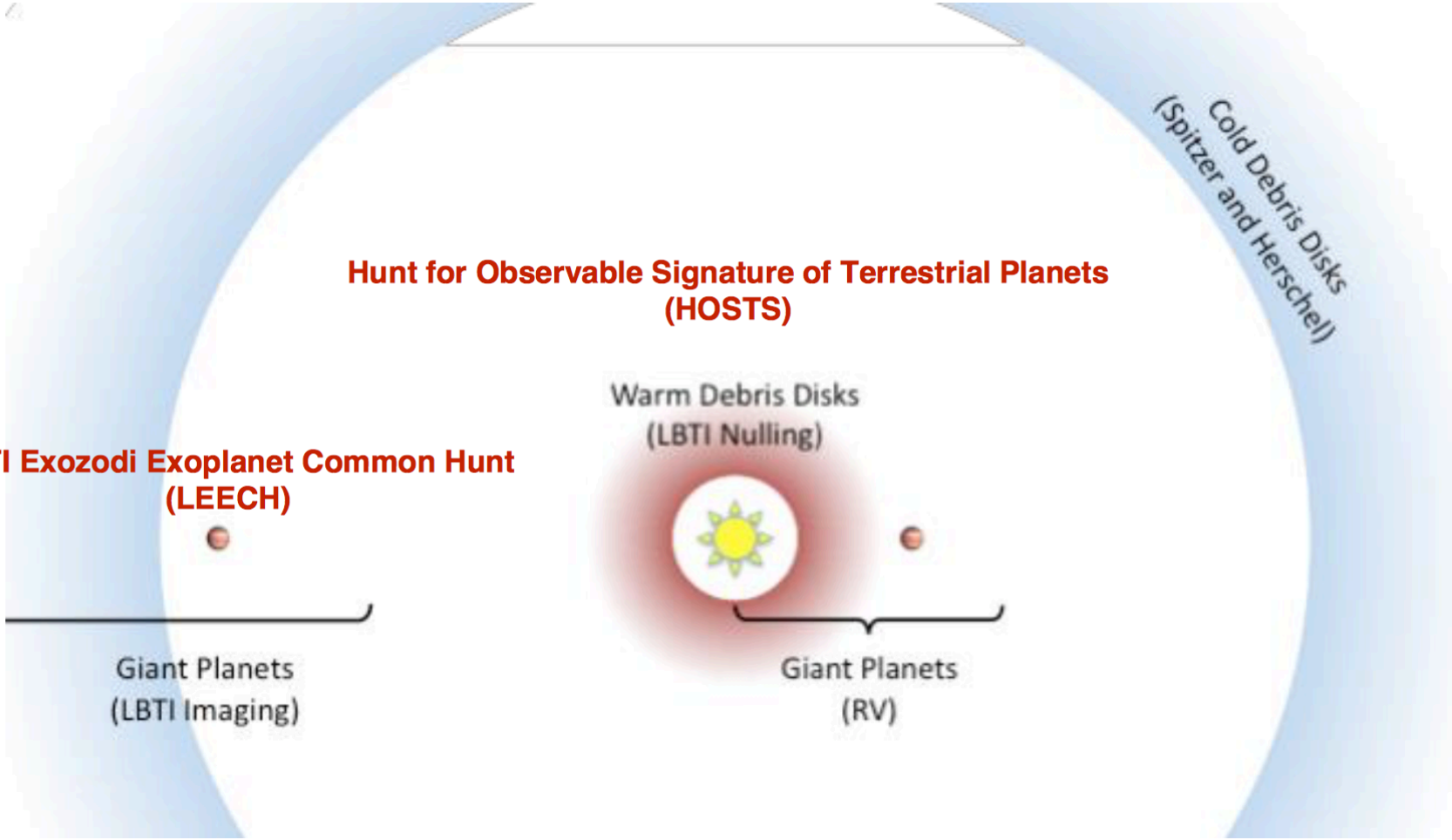
LBTI science

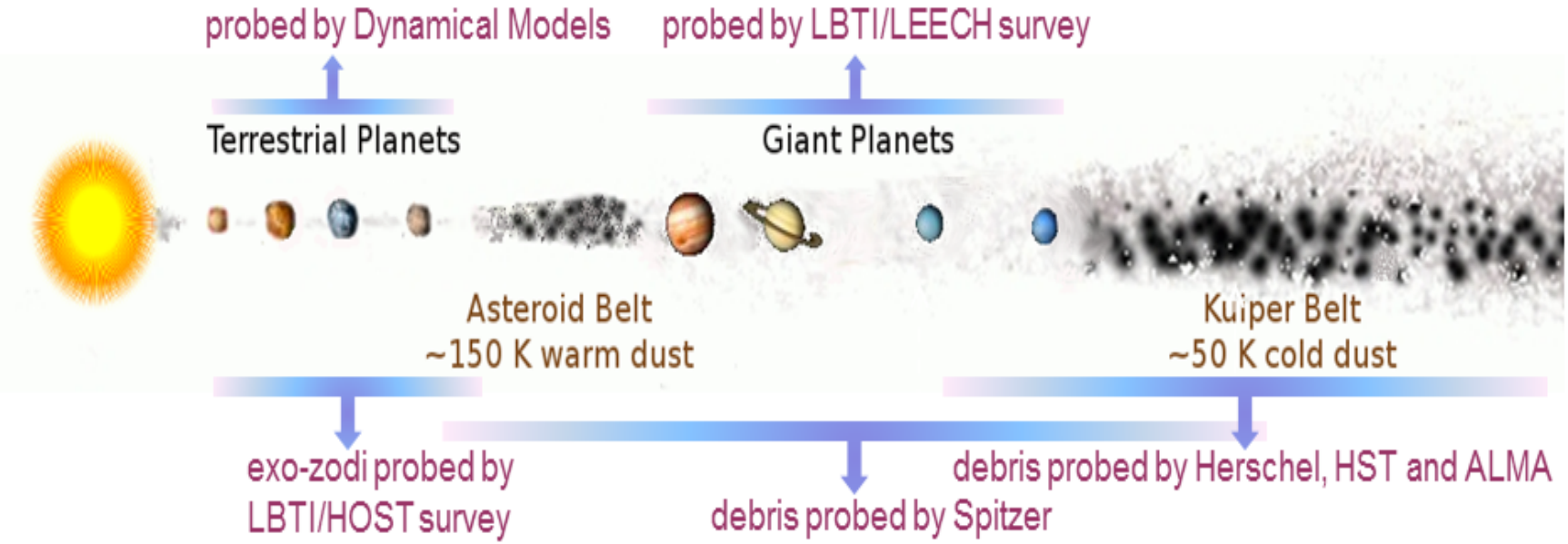
LBTI surveys

- LEECH (planet survey): Stone et al. (submitted)
- HOSTS (exozodi survey): Ertel et al. 2018



HOSTS survey

- NASA-funded exozodi survey at 10 μm
- Main design driver for the Binocular nature of the LBT
- What is an exozodi?



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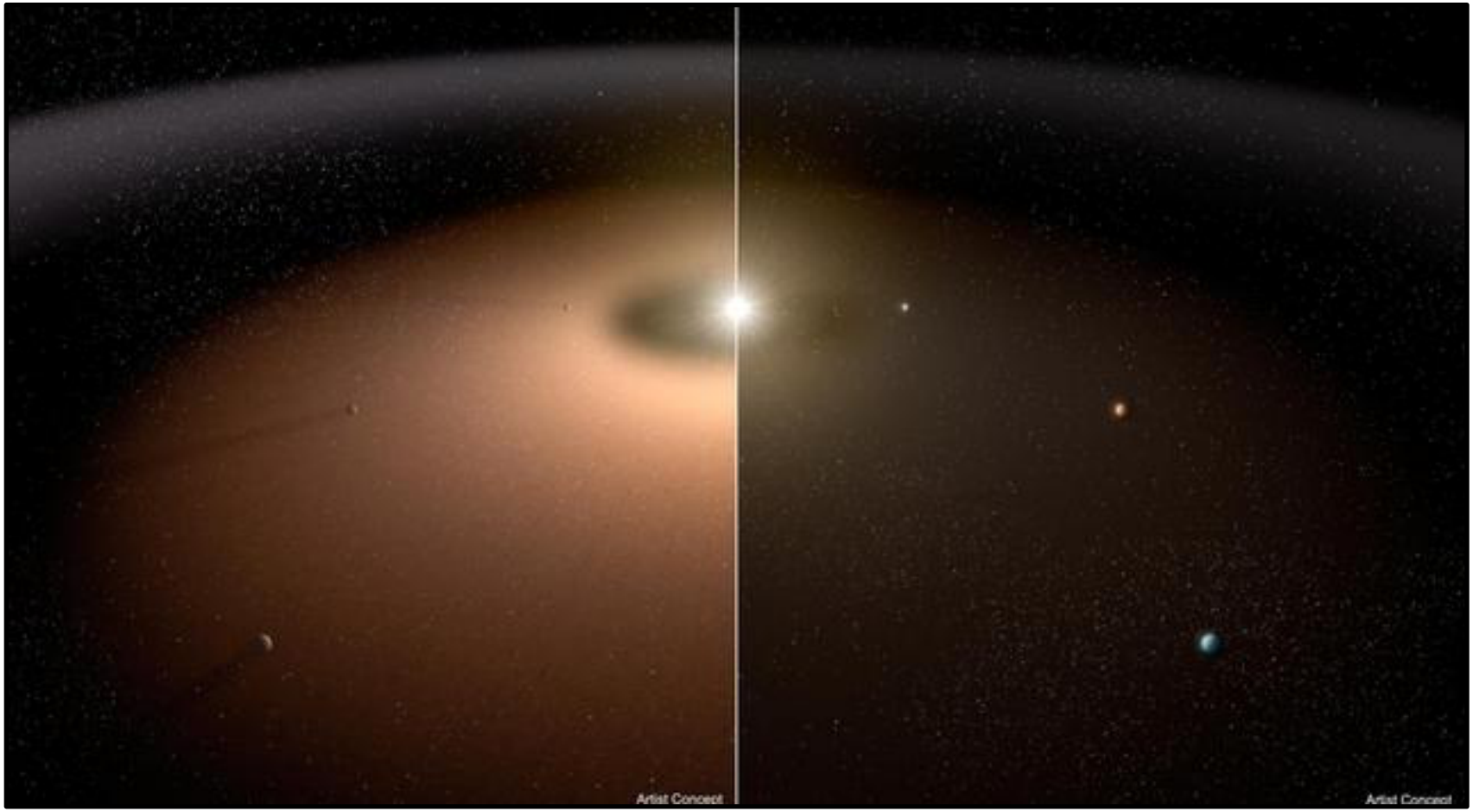
- What is an exozodi?

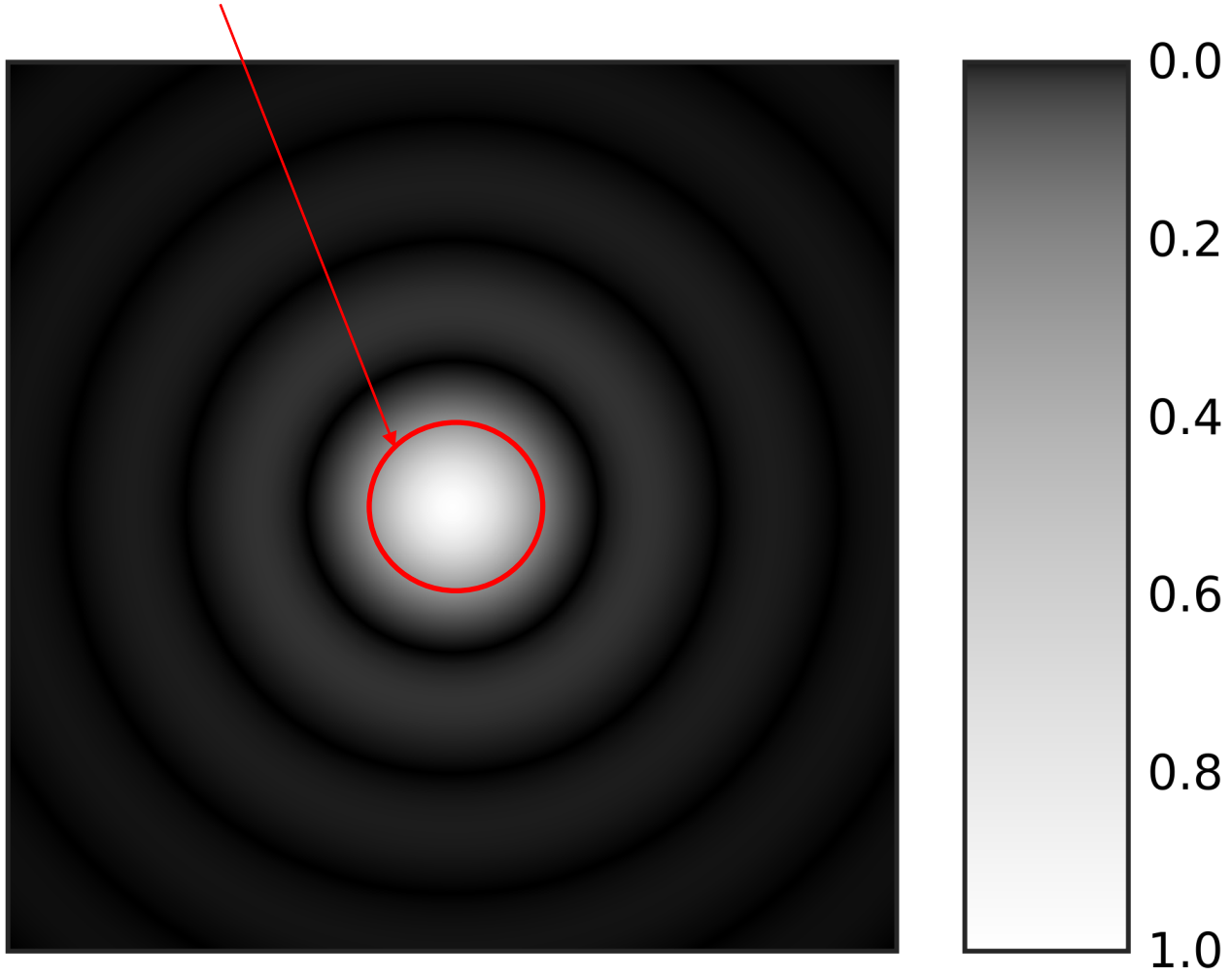
Why an exozodi survey?

- Source of noise and confusion for future direct imaging missions



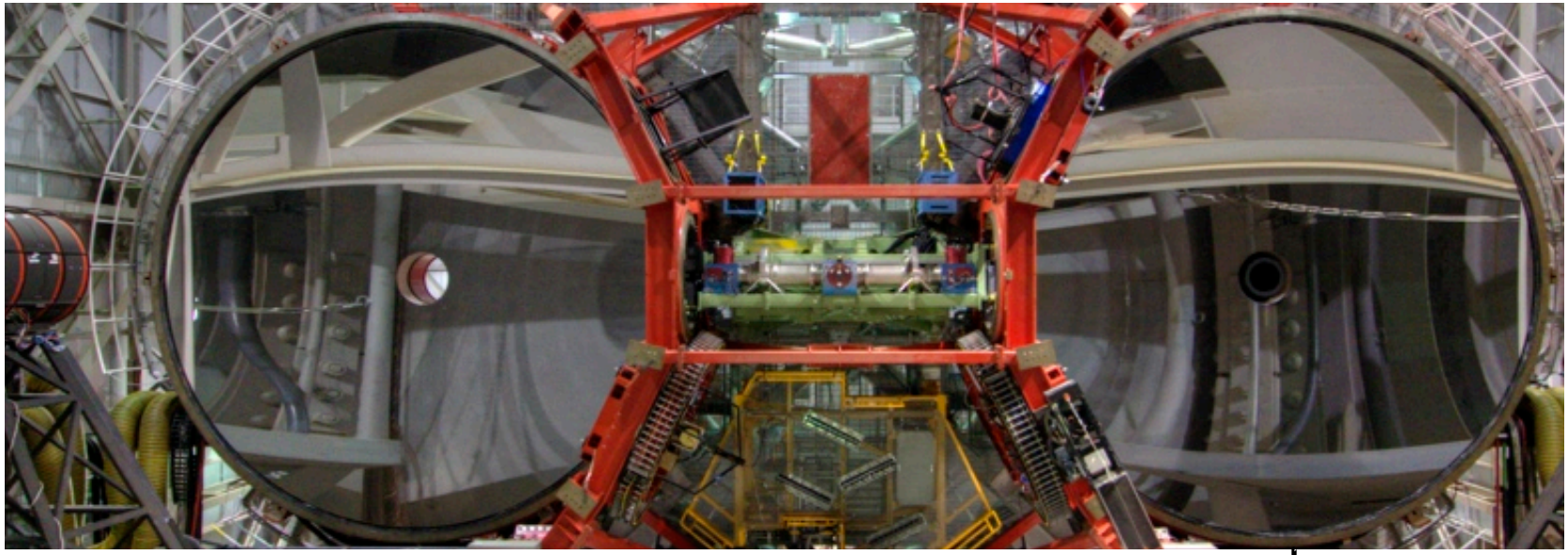
HOSTS: observing challenge

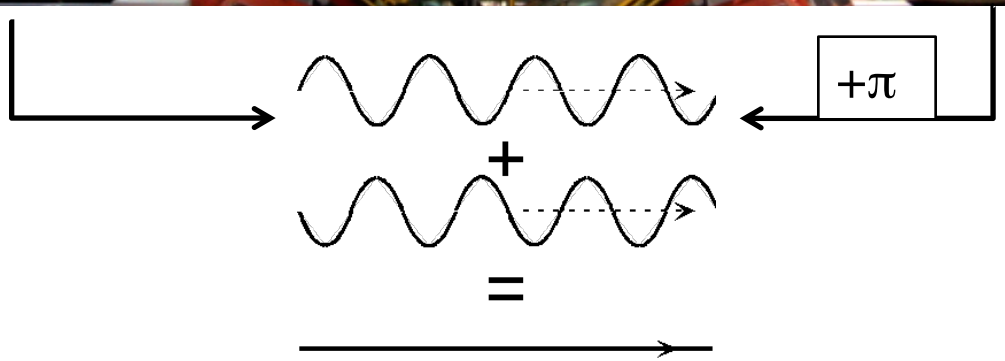
- 1 zodi around a 2-Jy star is ~**1 million times** dimmer than the background and **~20000 times dimmer** than the star
- Signal mixed with the stellar PSF!



The Large Binocular Telescope

- Employing nulling interferometry
- 36 nearby main-sequence stars observed





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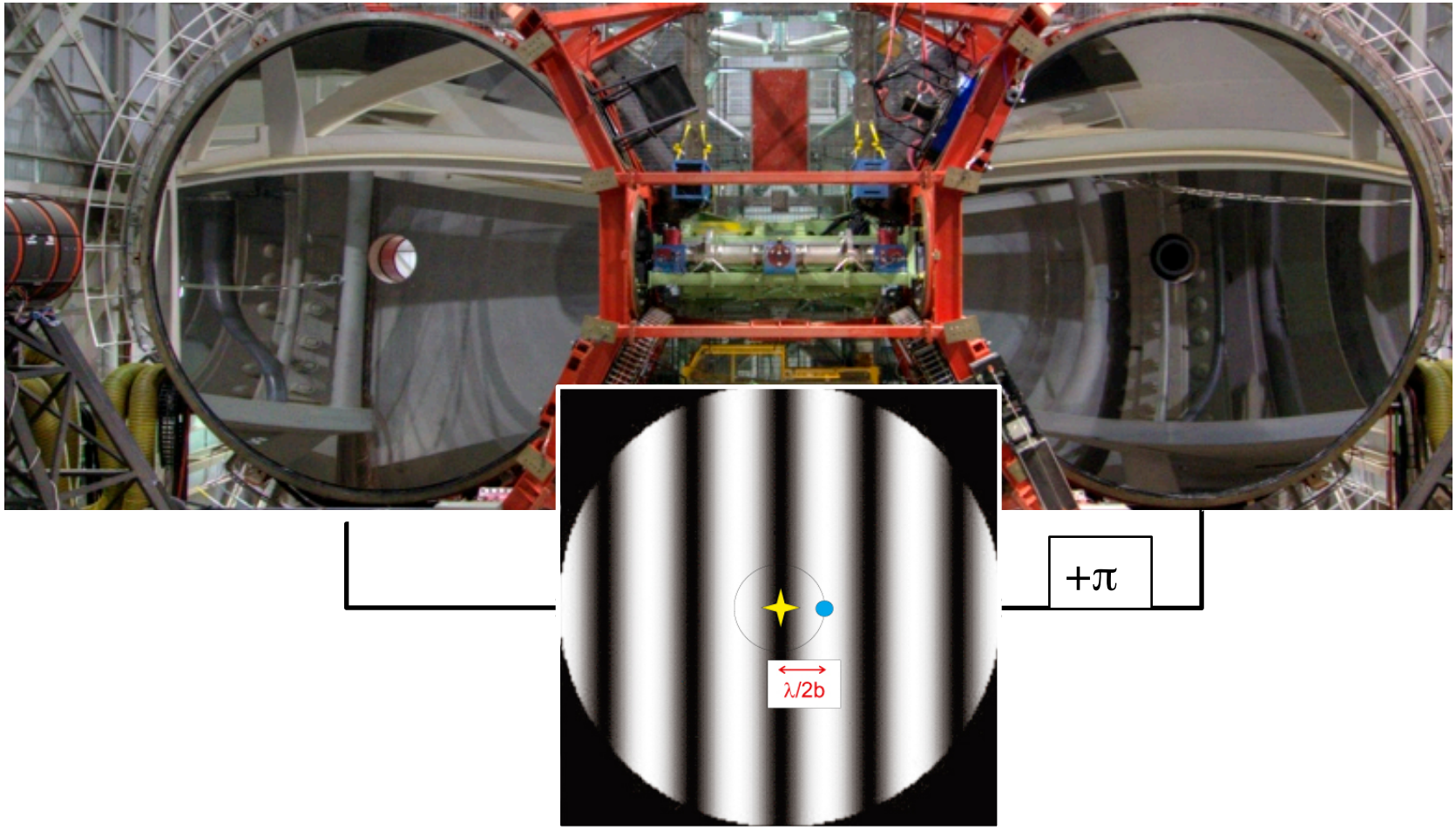

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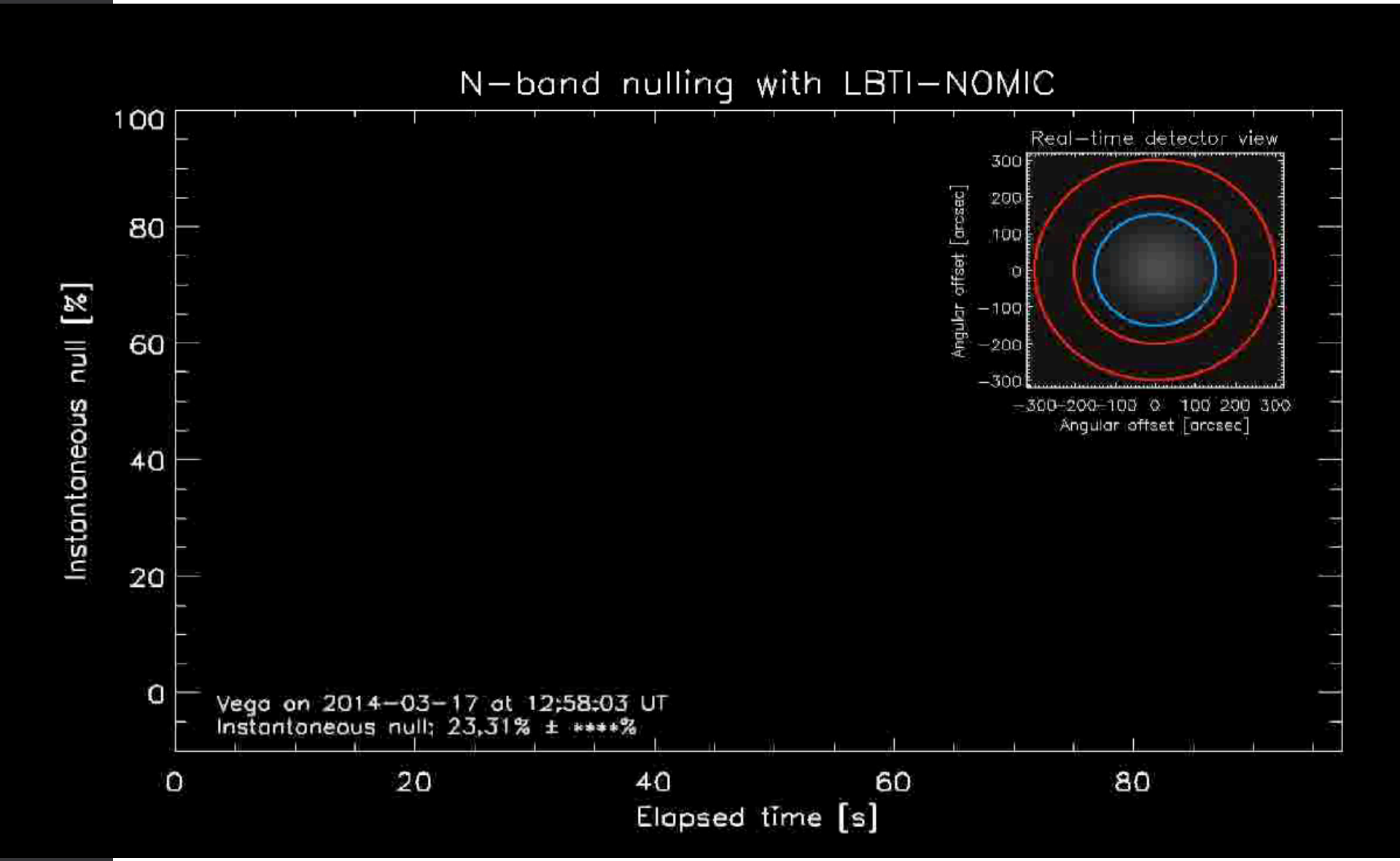
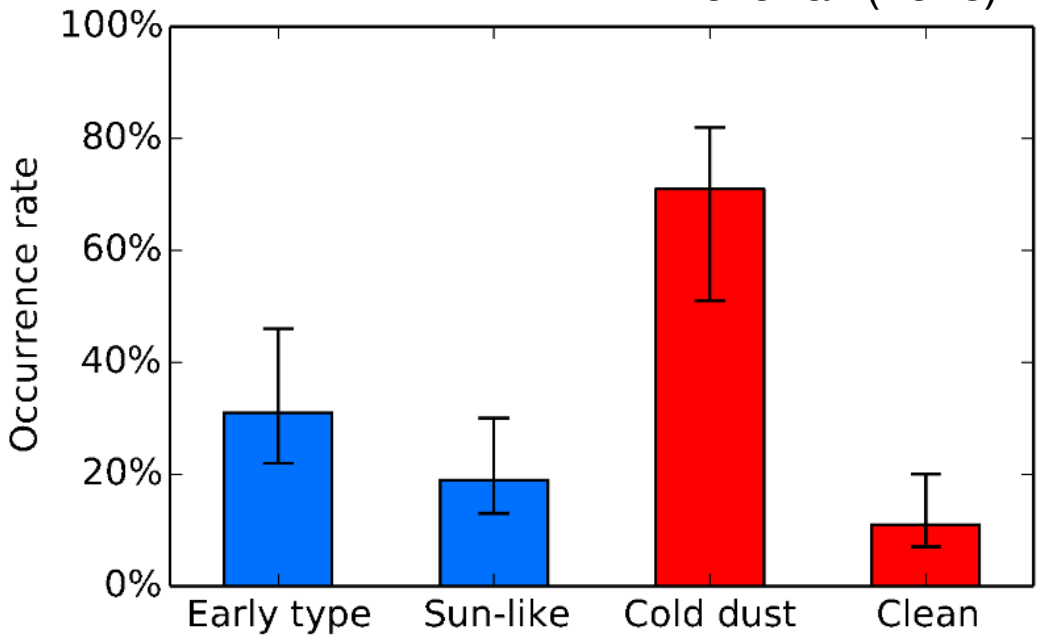


HOSTS: results

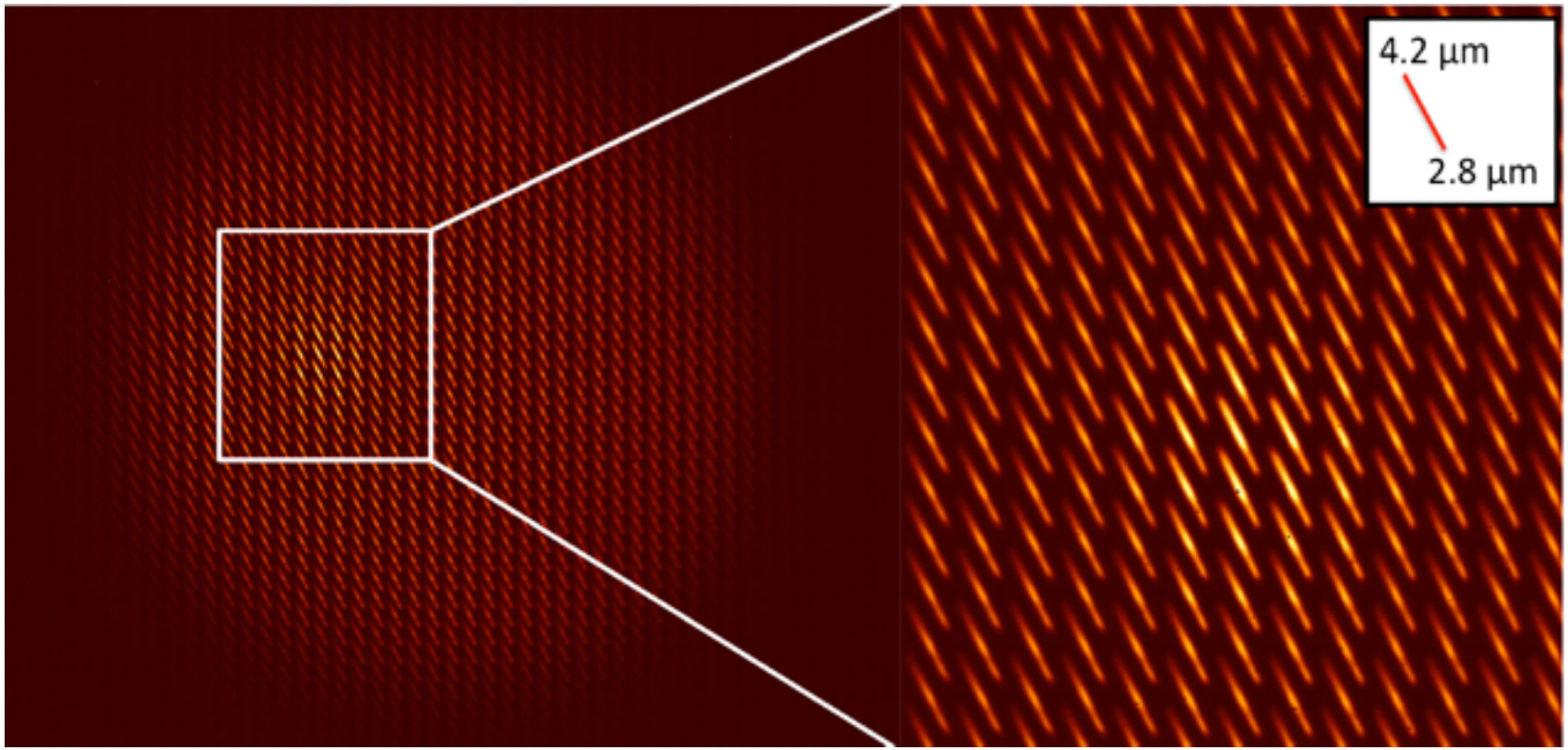
- 36 nearby main-sequence stars observed
- Deepest N-band interferometric survey to date
- Exozodi more frequently found around stars with cold dust
- Good news for future imaging missions! Median exozodi density around “clean” stars < 16 zodis

Ertel et al. (2018)



ALES (Arizona Lenslet for Exoplanet Survey)

- First tests of system carried out on June 1-3 (2015).
  - spaxels are 25 mas.
  - FOV is 2.6”



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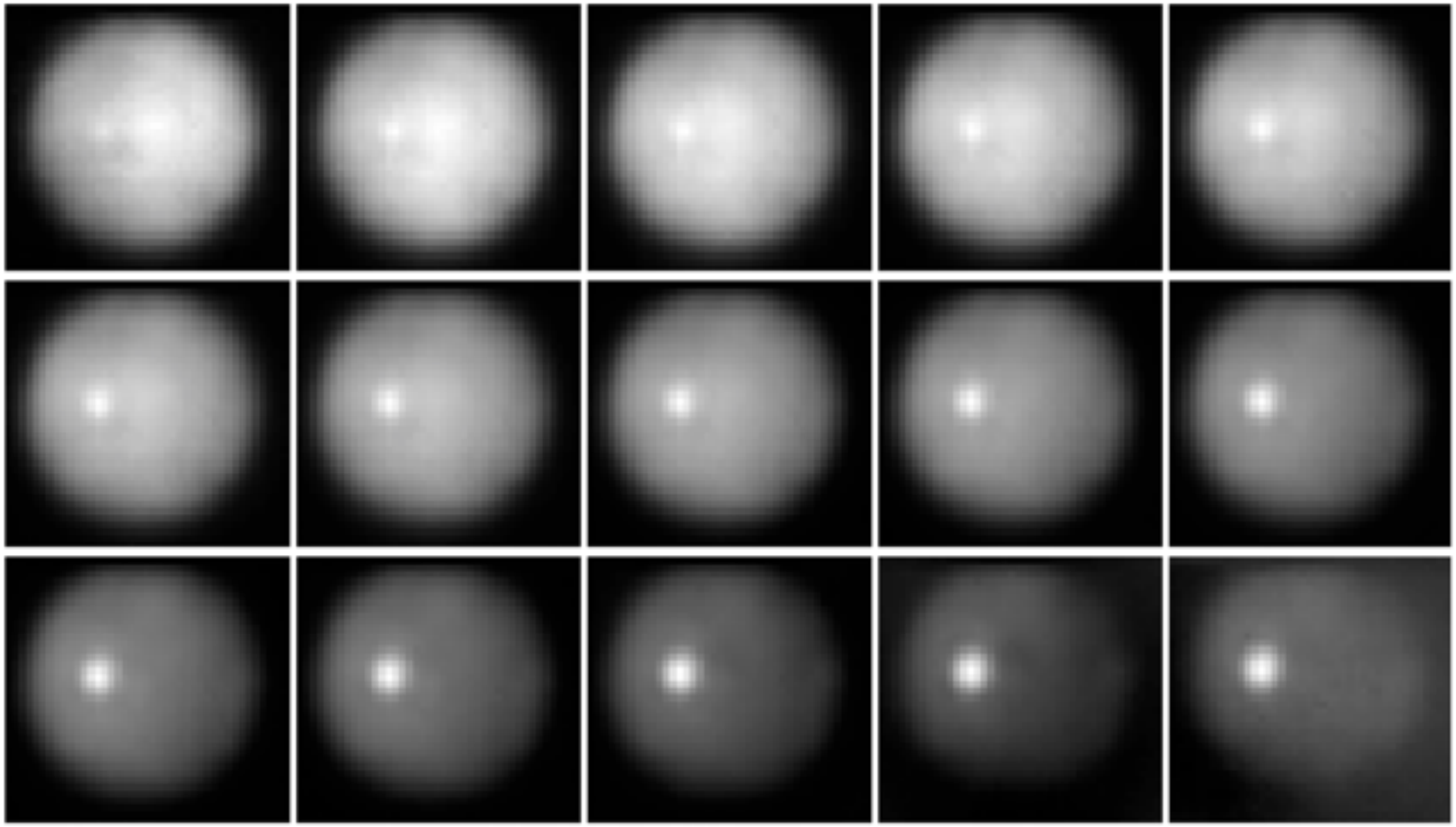
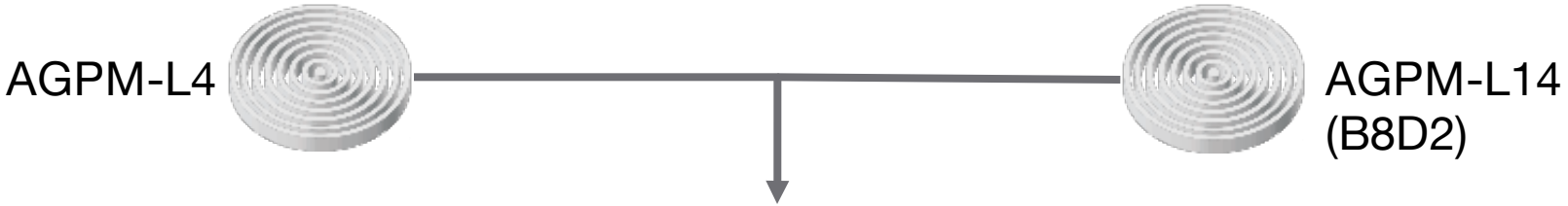
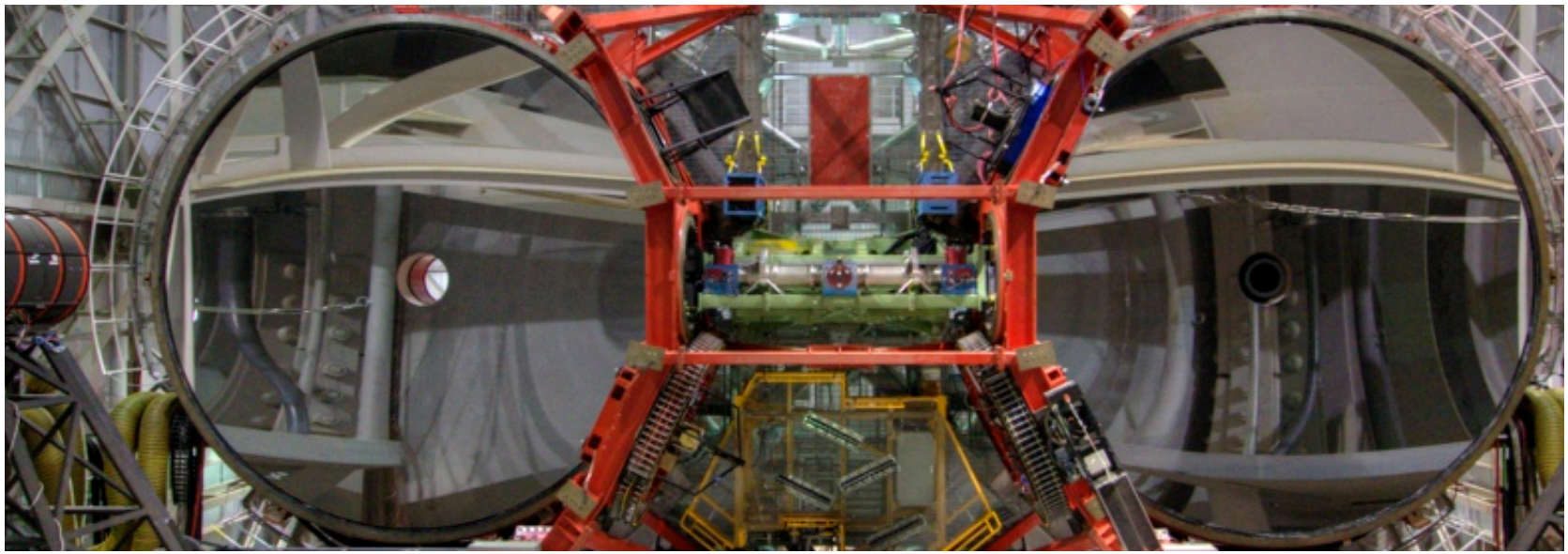


VORTEX

The Vortex modes

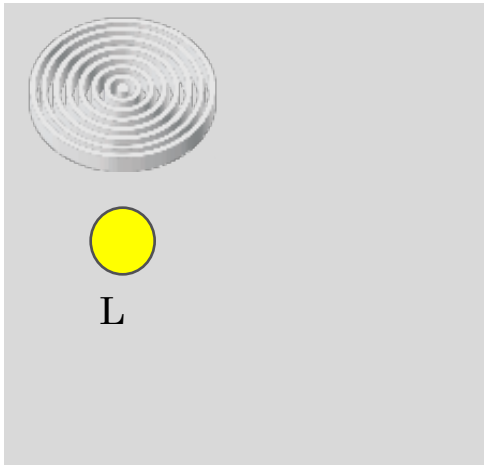
The Large Binocular Telescope





Several possibilities

Single AO+AGPM imaging



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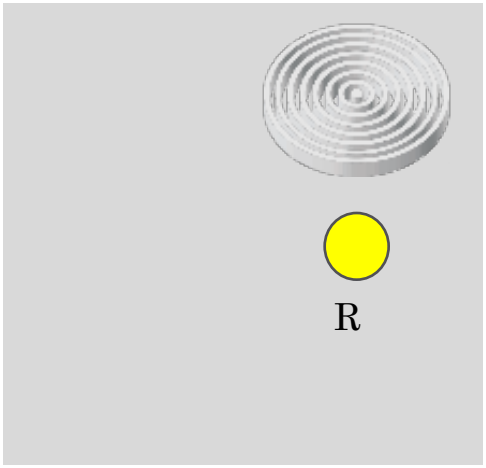
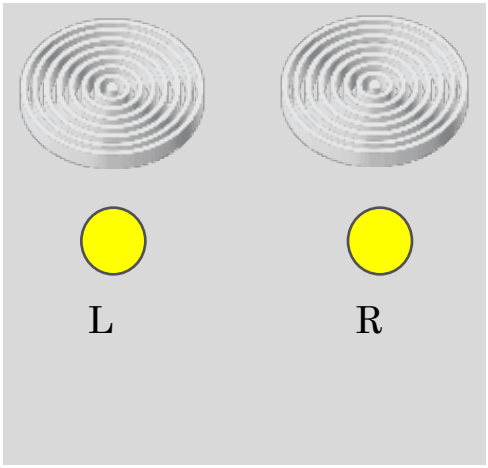


Binocular AO+AGPM imaging



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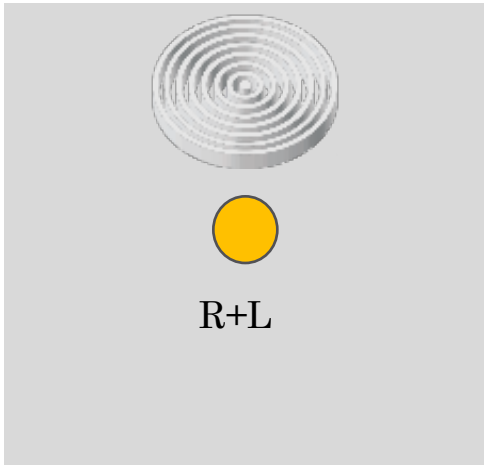
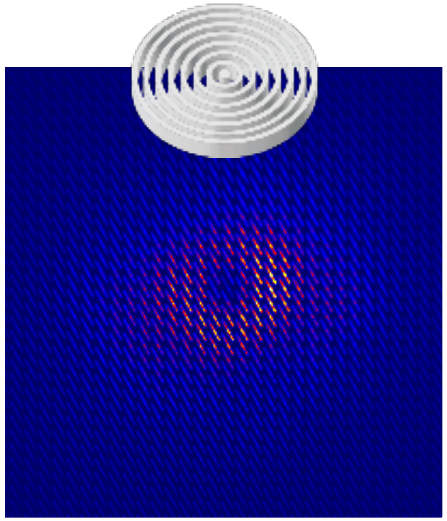
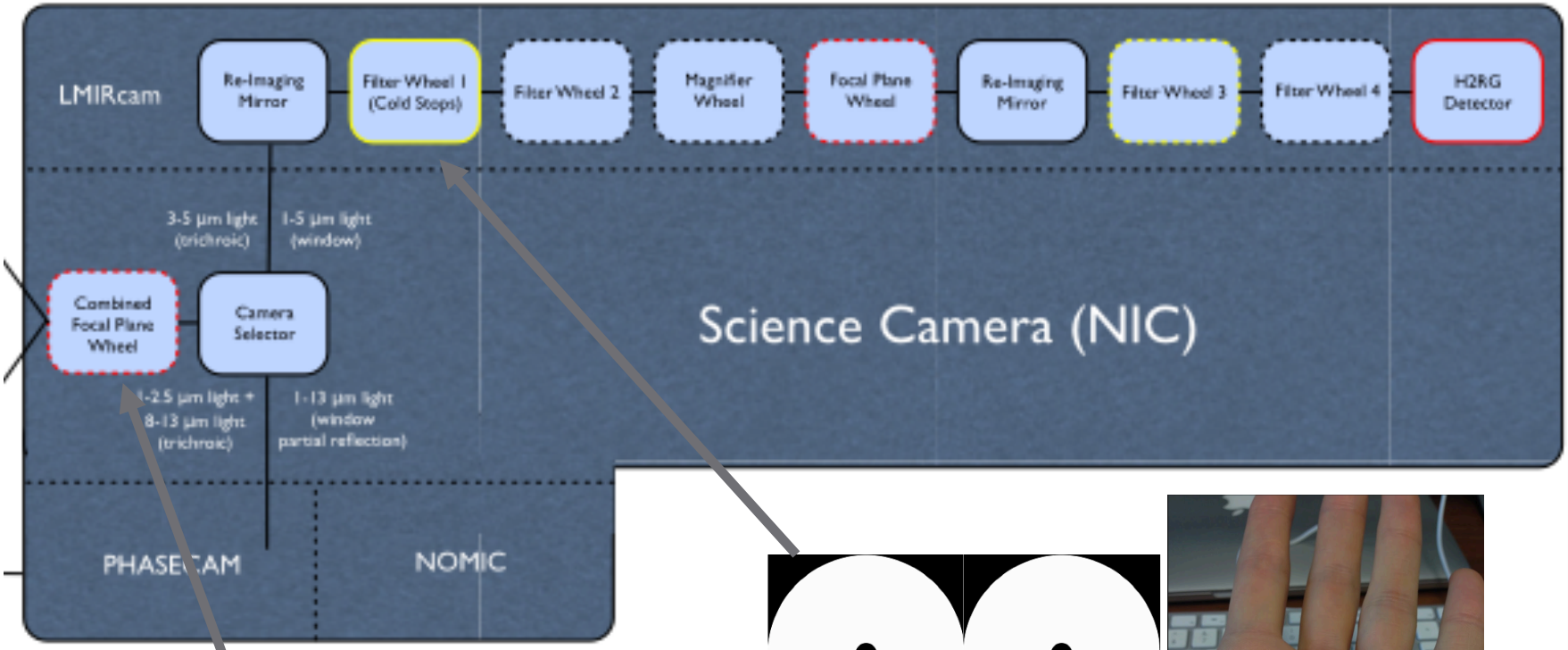


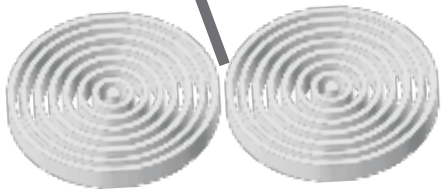


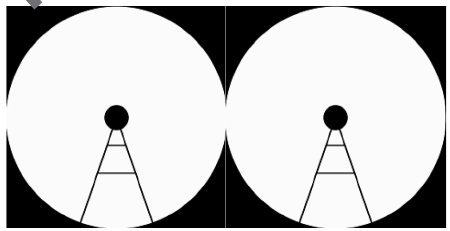
New mode

Single IFU+AO+AGPM imaging

Optical setup





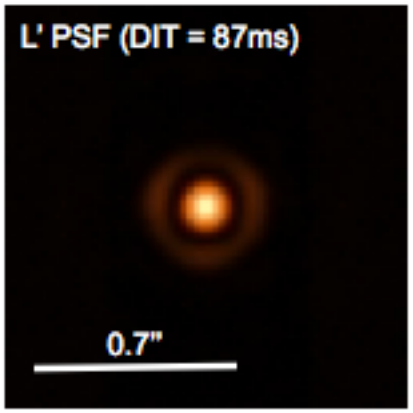


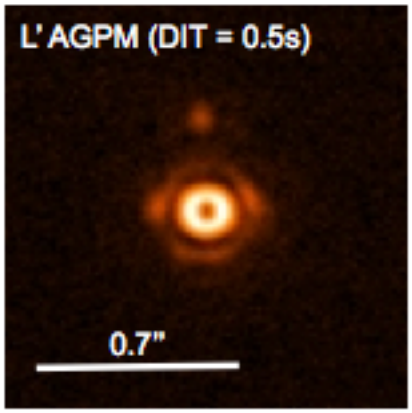
Lyot stop

2015 (AGPM-L4&L14)

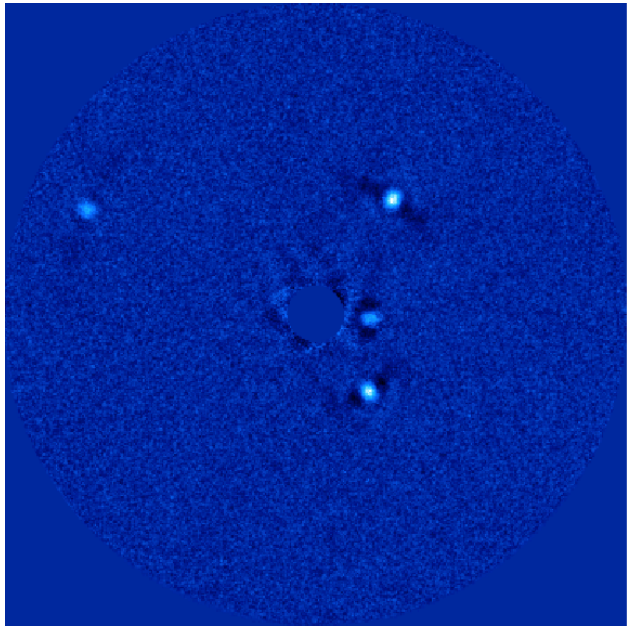
Nov. 2013: first-light observations

- First-light observations on October 17, 2013 (AGPM-L4, **1 telescope**)
- Only one side and with un-optimized Lyot stop



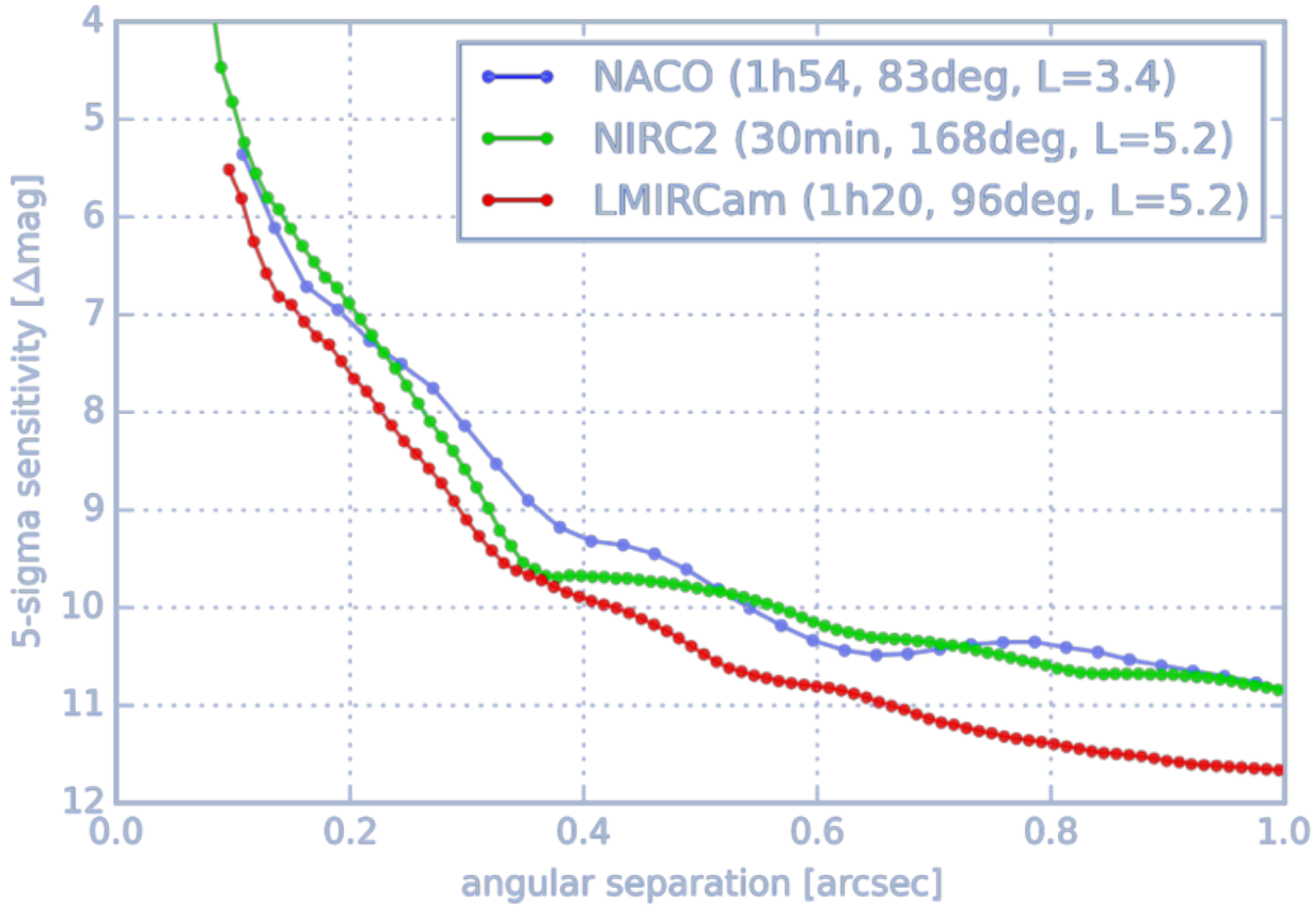


Peak rejection ~35:1
(far from optimal)



Gomez et al. 2017

Comparison with other instruments

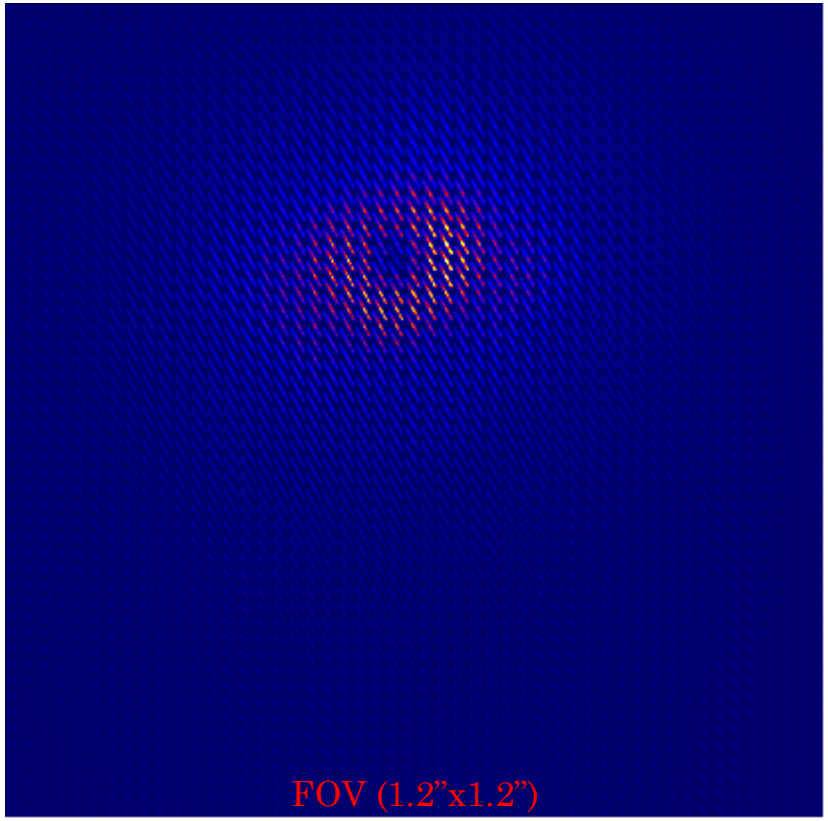


Absil et al. 2016

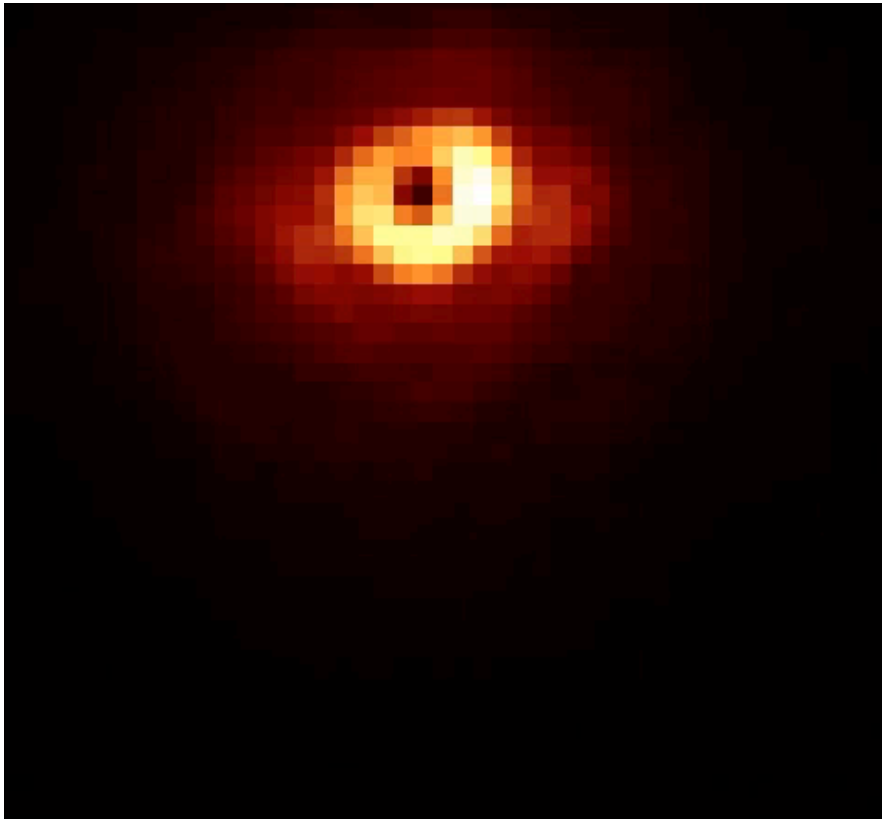
ALES+AGPM observations

- Can be used with ALES (now field-of-view of ~3")
- Re-aligned this summer

First AGPM+IFU image (beta Aur)



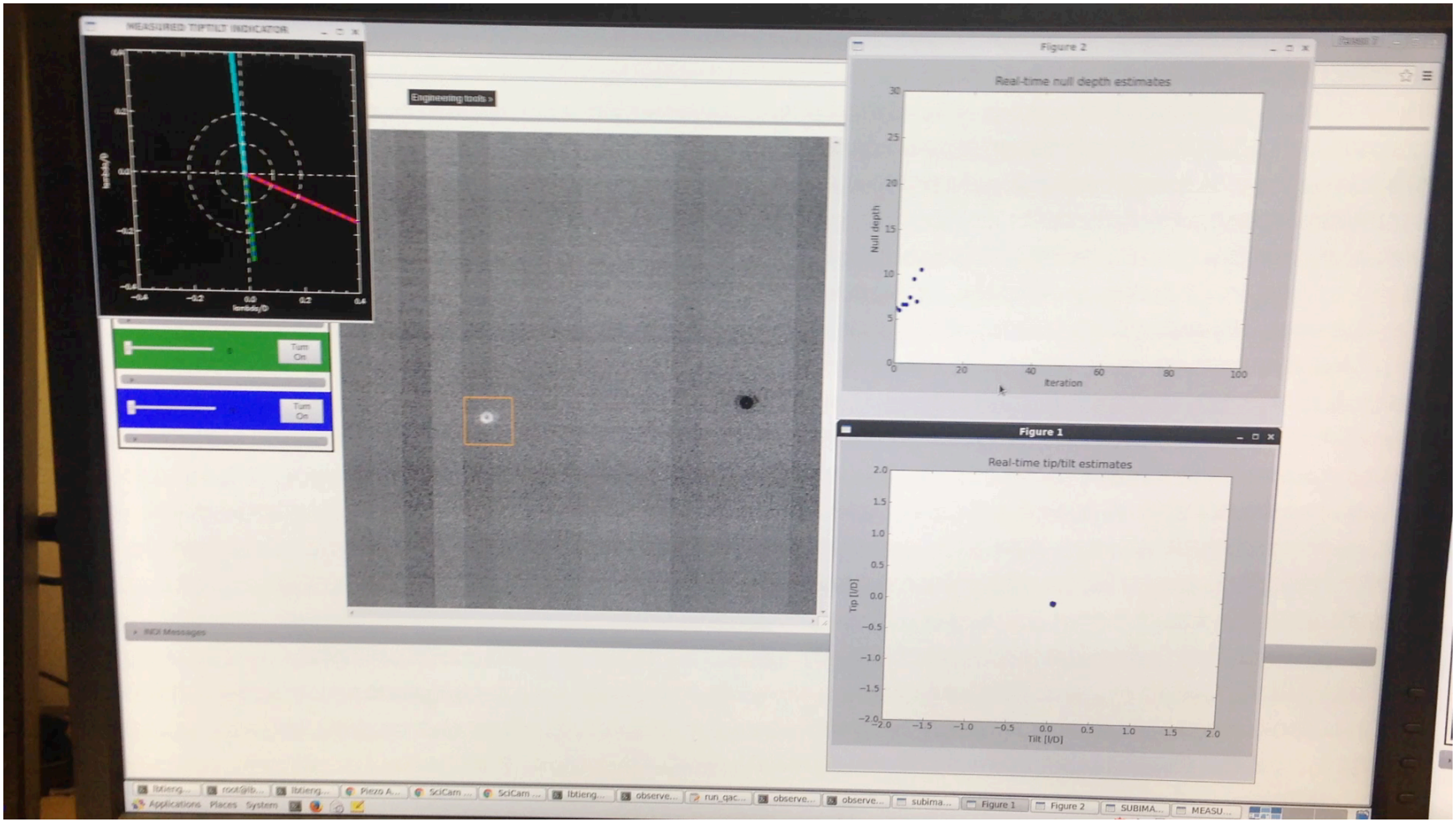
Spectral image cube (2.8 – 4.2 microns, R~20)



Data processing by Jordan Stone (UoA)

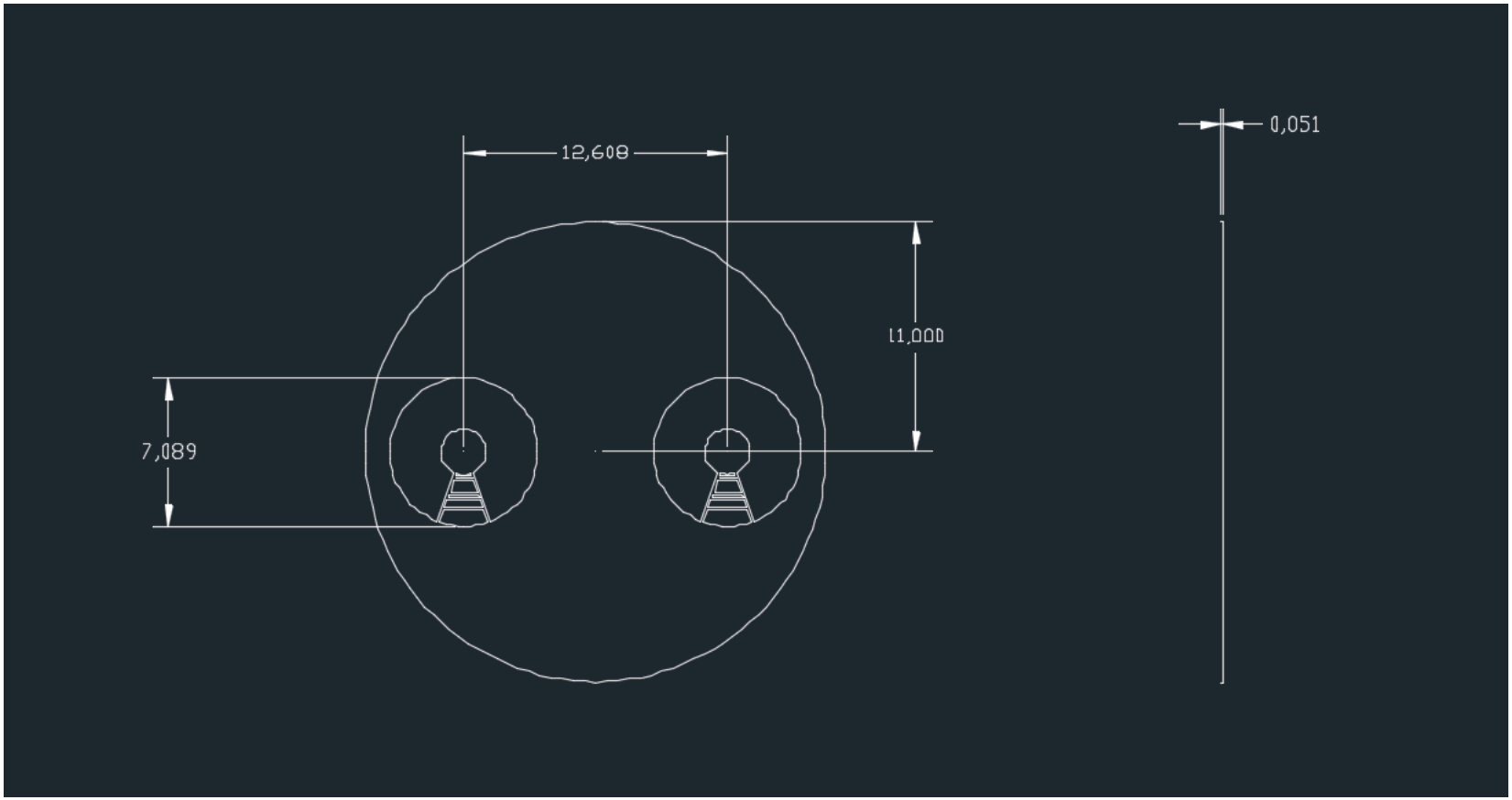
QACITS commissioning

- Implemented a IDL-Python wrapper to call QACITS
- Commissioned 1T QACITS



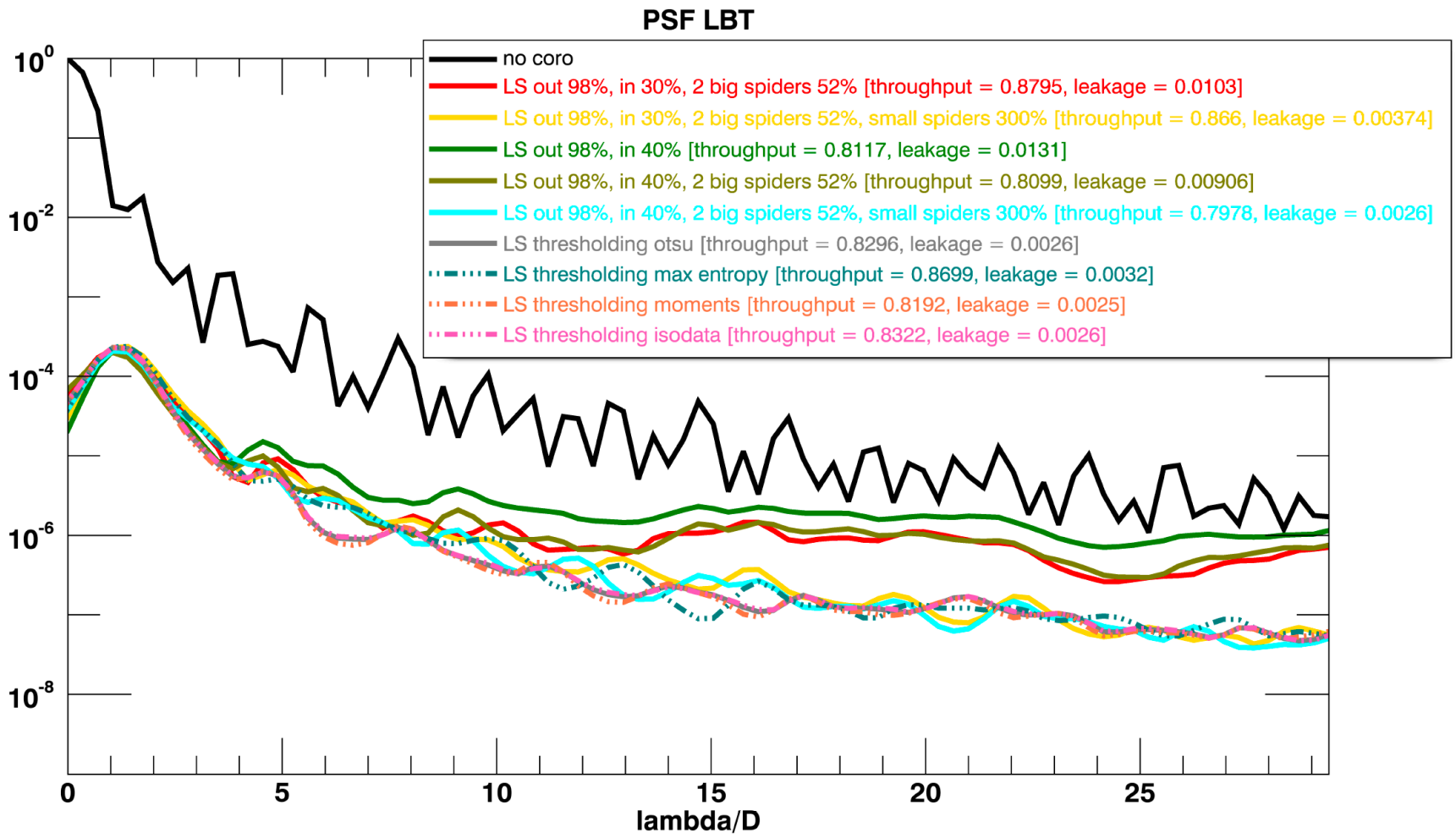
New optimized Lyot stops

- Ordered on Tuesday



Simulations done by B. Carlomagno

New optimized Lyot stops



Simulations done by B. Carlomagno

Status

- Only ~1 night on sky since 2013 (out of 3.5 allocated nights):
    * 0.5 night for HR8799 images
    * 2 hours for commionning QACITS and testing new ALES+AGPM mode
    * 2.5 hours on HD179128
- Need observing time!
    * Loosing expertise at LBT

Summary and future observations

- LBTI + AGPM is the most sensitive L-band imager
- IFU + AGPM mode (R=40) available
- Need observing time! No observing time since 2016B…
- Proposal for 2019A due by the end of September