Multi-Object Adaptive Optics (MOAO) Demonstration Instrument Subaru Telescope

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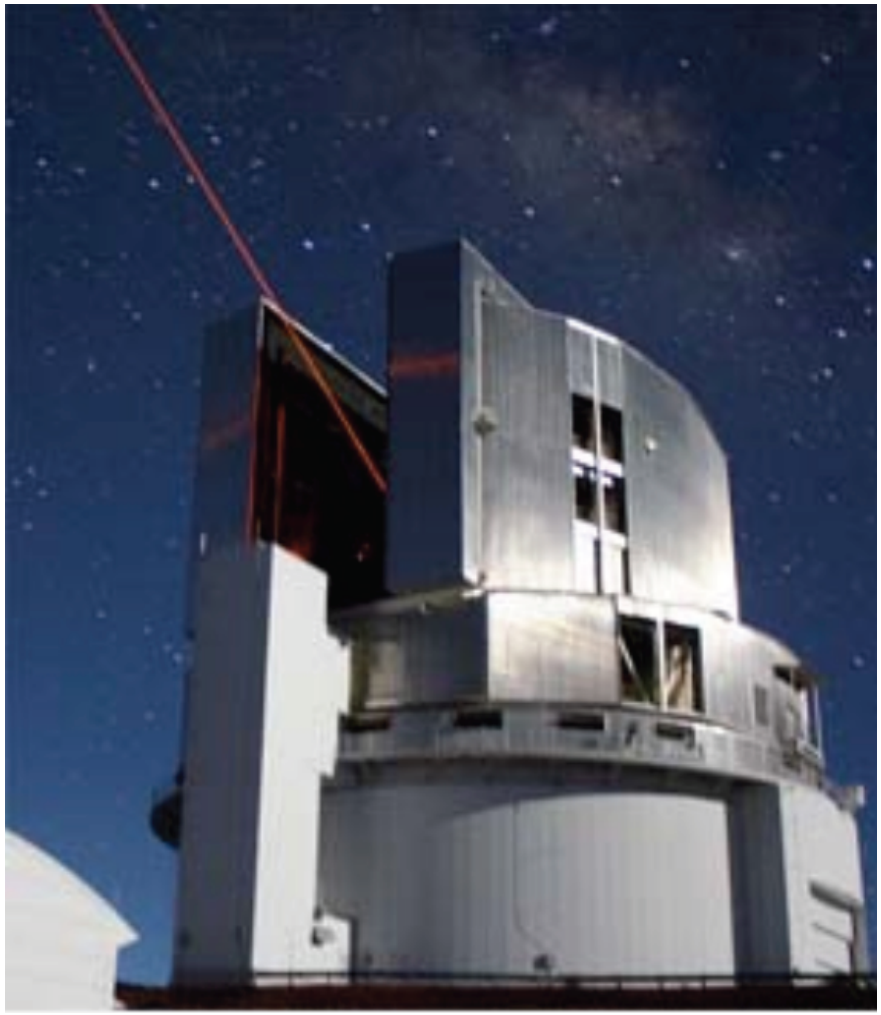
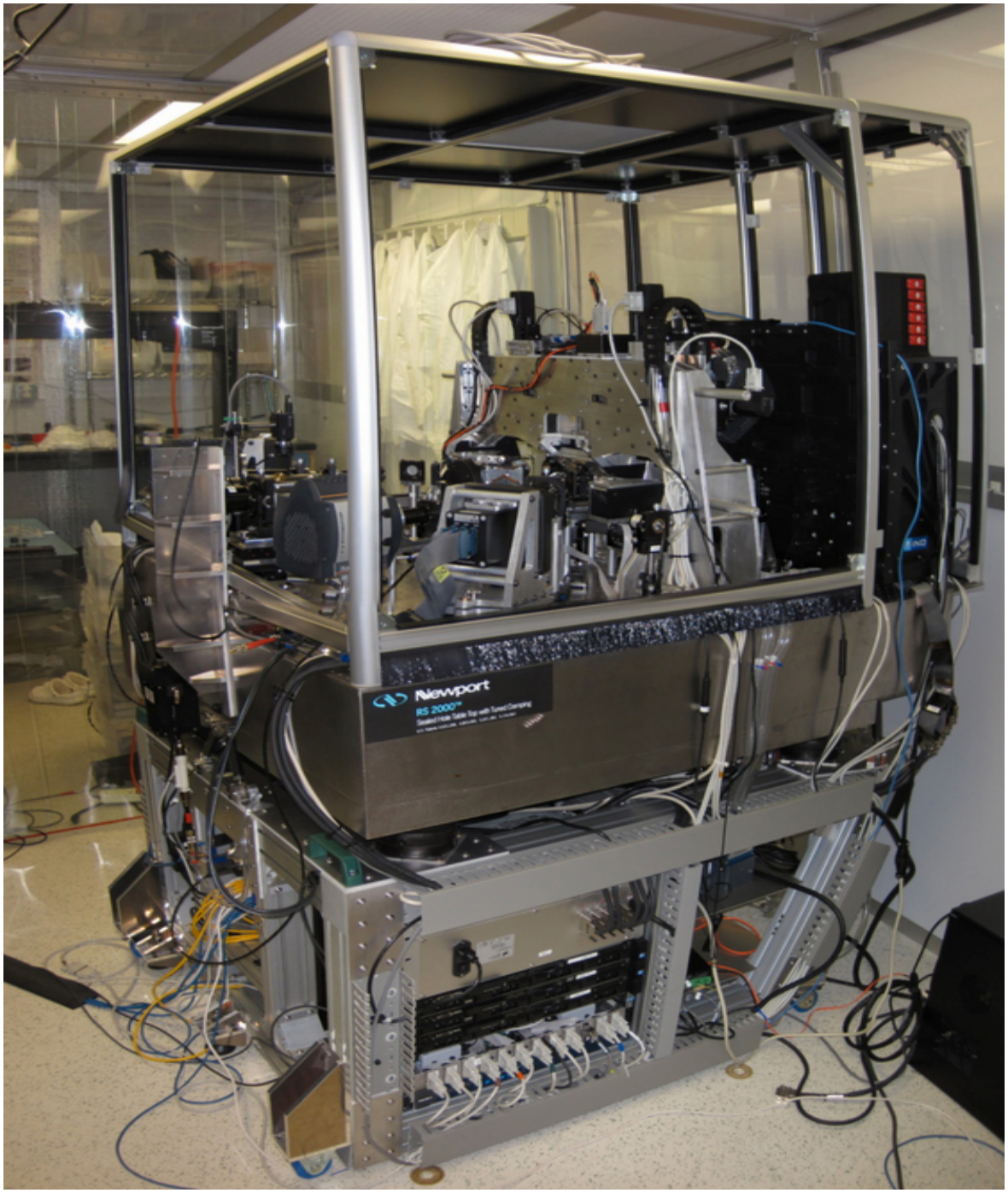
- Introduction

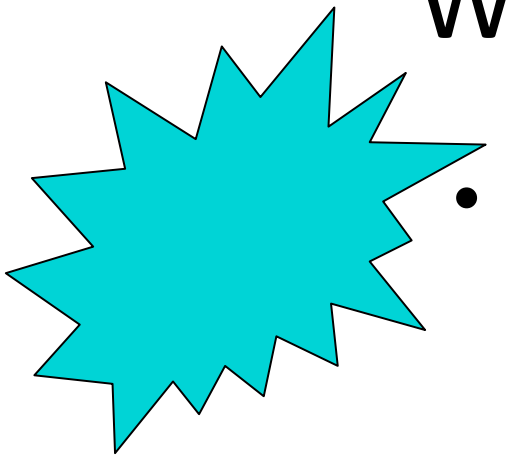
- MOAO demonstration on Subaru 2014/2015.
- AO review.
- Why build this demonstrator?
- What's next?



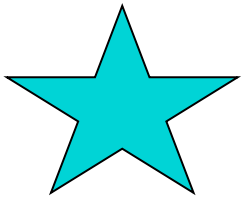


RAVEN

What's in an image



- Image Blurred by atmospheric effects.

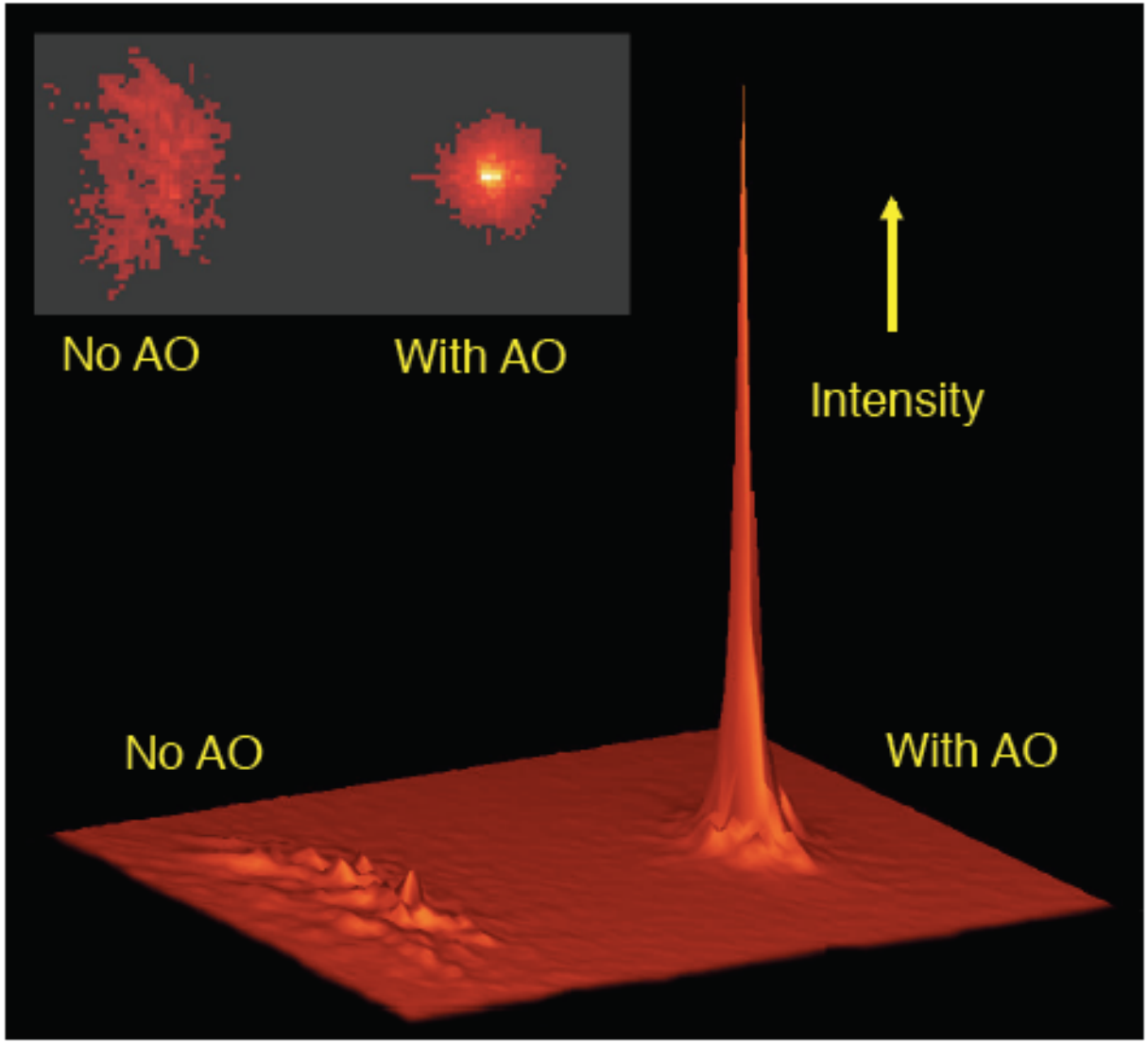


- Image corrected by a TT mirror

- Image further corrected by a DM

- Equivalent HST image

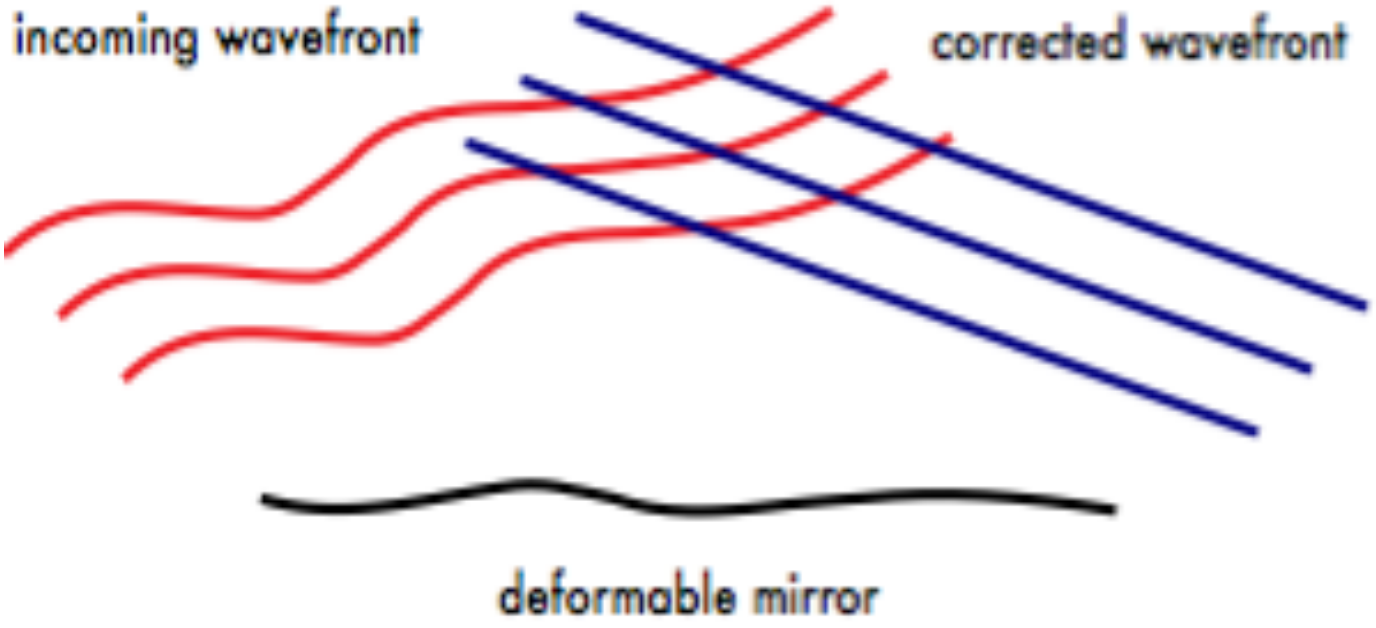
Adaptive optics increases peak intensity of a point source



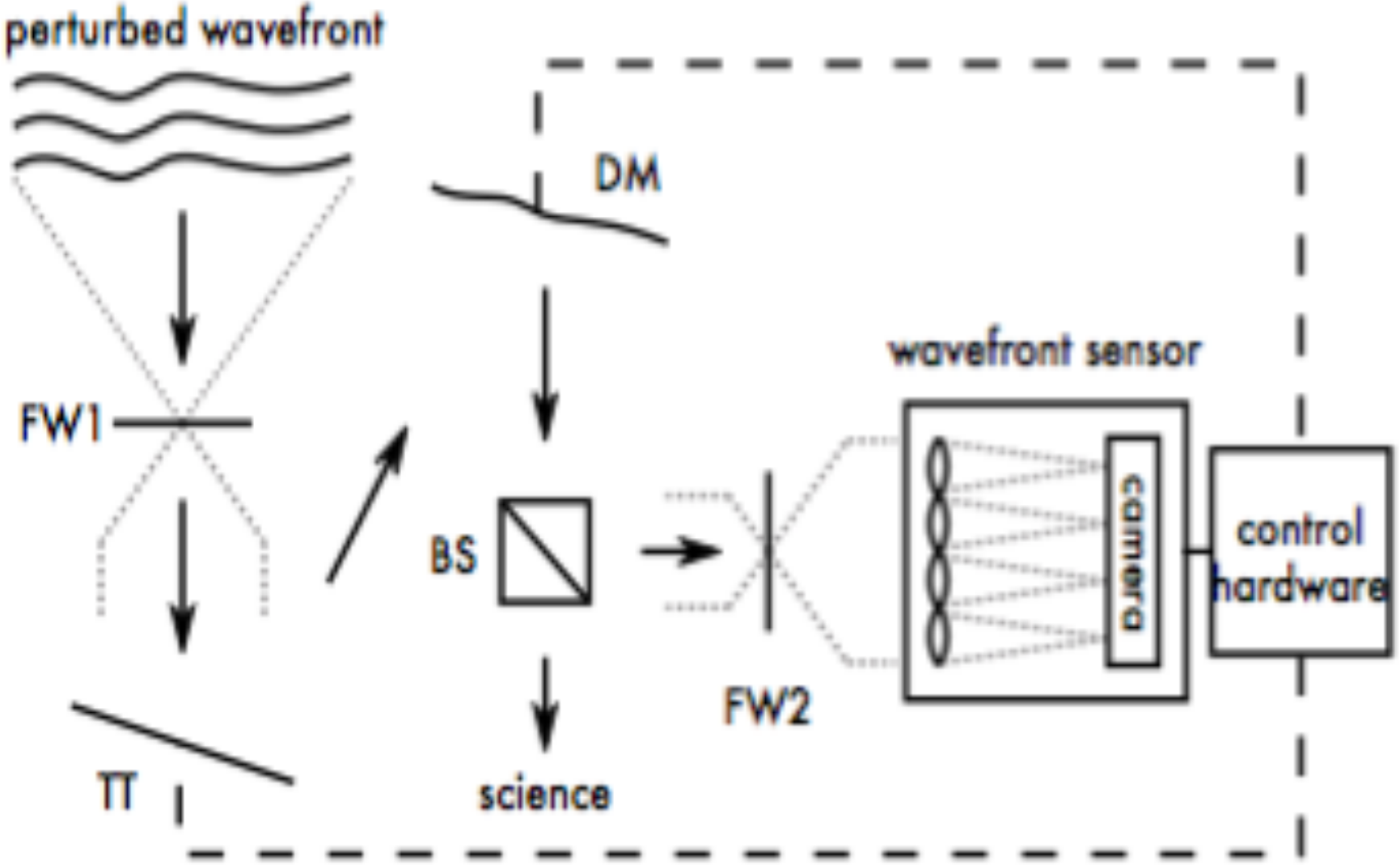
Lick Observatory

Why Build a RAVEN Demonstrator ?

- AO – Successful on large telescopes, but small images (10 arcsecs). Good for Stars – Galaxies?
- GMT, E-ELT, TMT - need MOAO to be fully utilized.
- Raven demonstrated MOAO AND did science tasks.

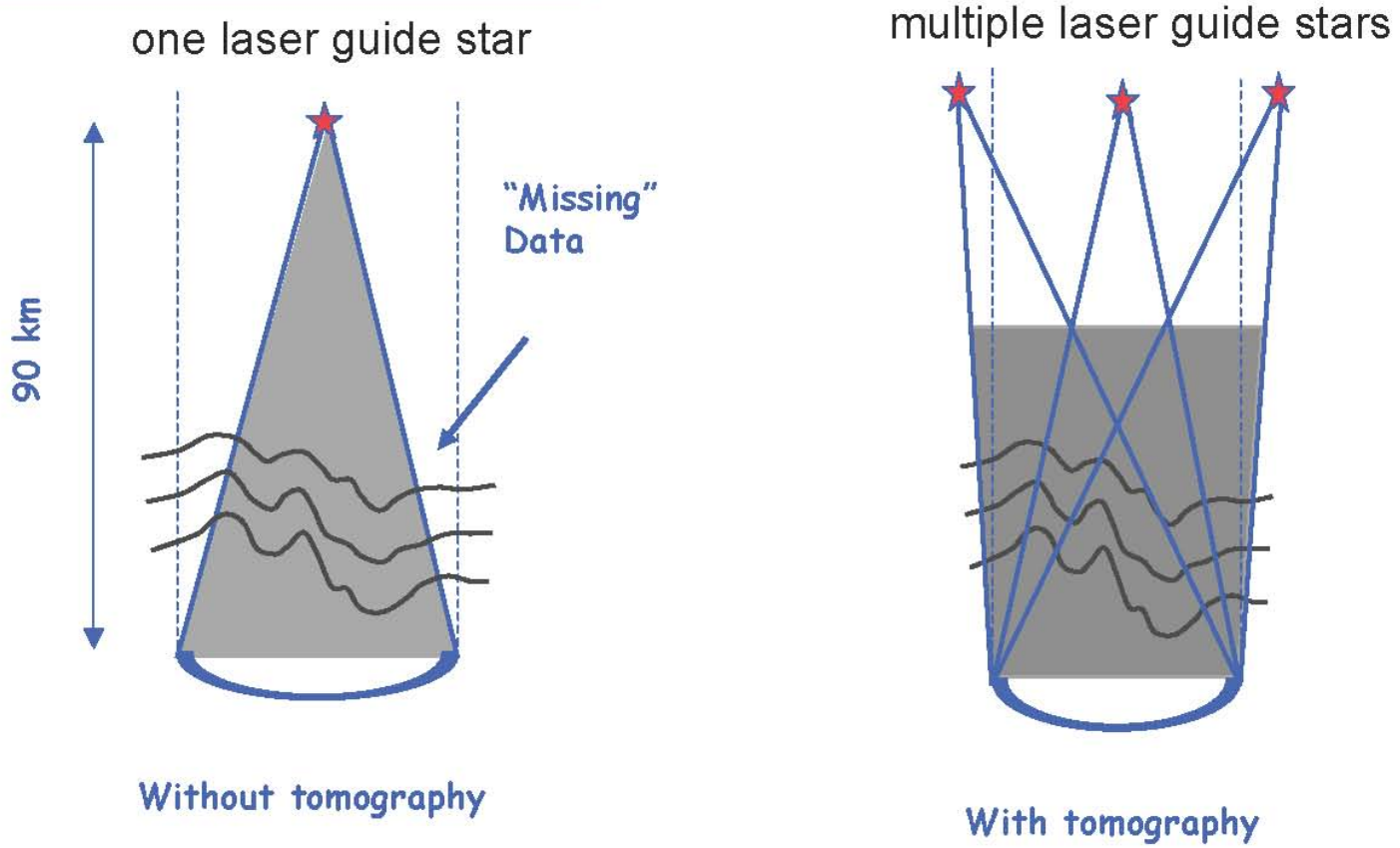


AO – Key Elements



LGSコーン効果の低減: LTAO

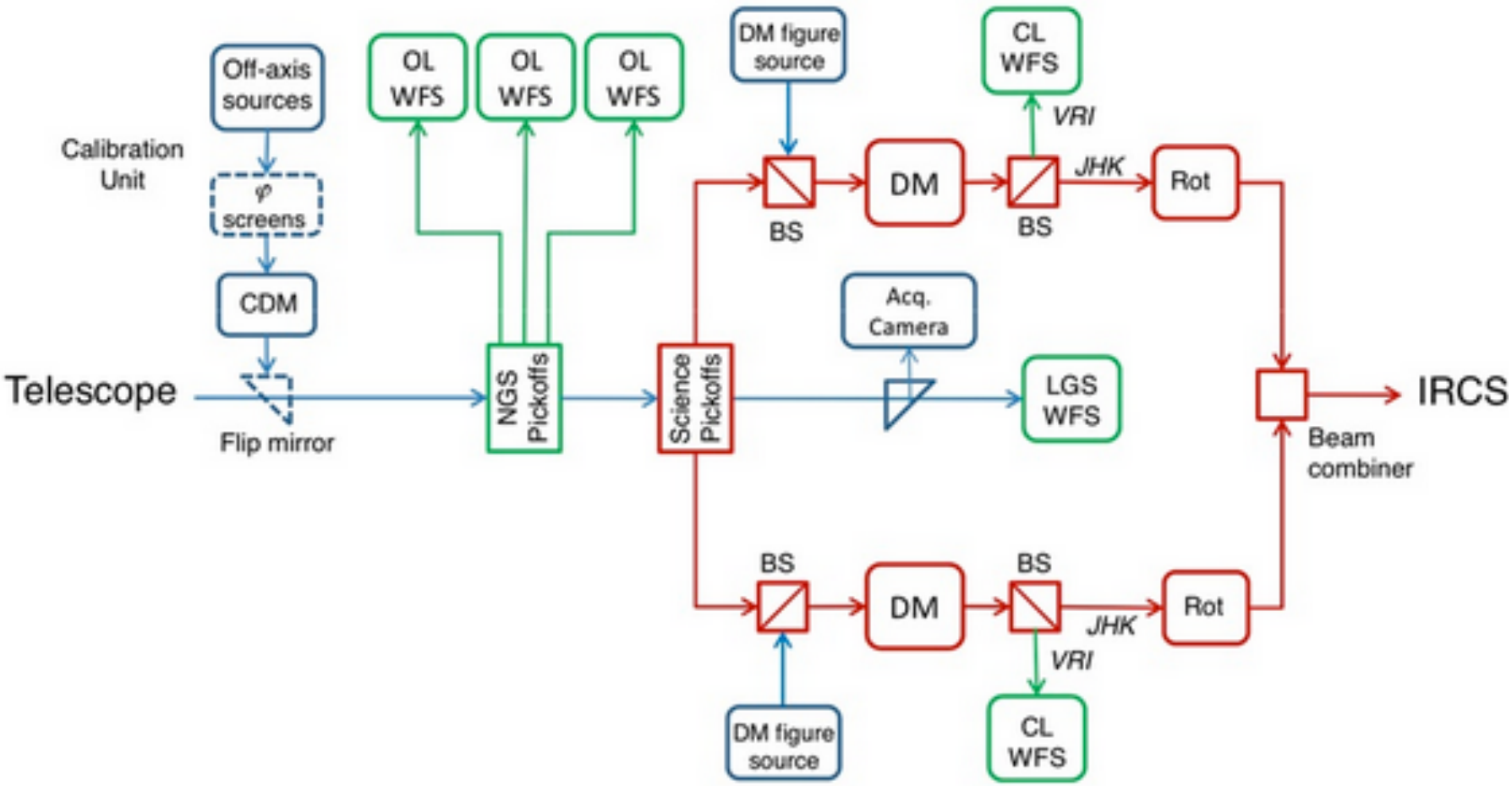
AO tomography: measure turbulence and correct for “cone effect”



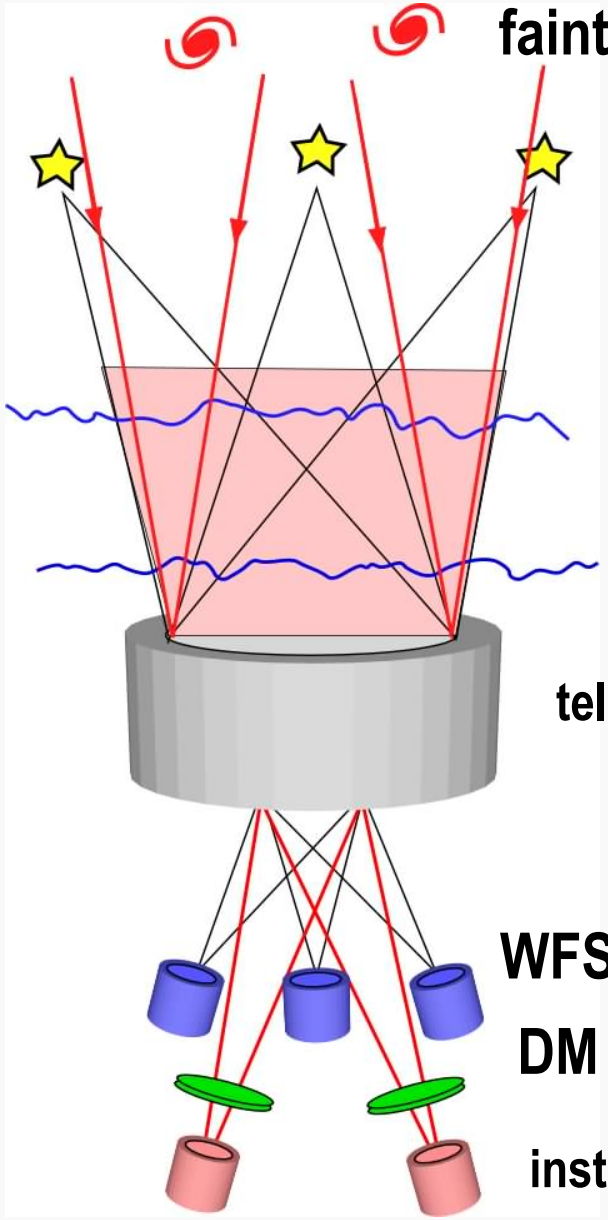
With AO tomography, measure 3D distribution of turbulence above telescope

Credit: ESO web page

Raven System Block Diagram



MOAO: Multi-Object AO



FOV:
-patrol: ~arcmin
-unit: ~arcsec
-diffraction-limit
-targeted obs.

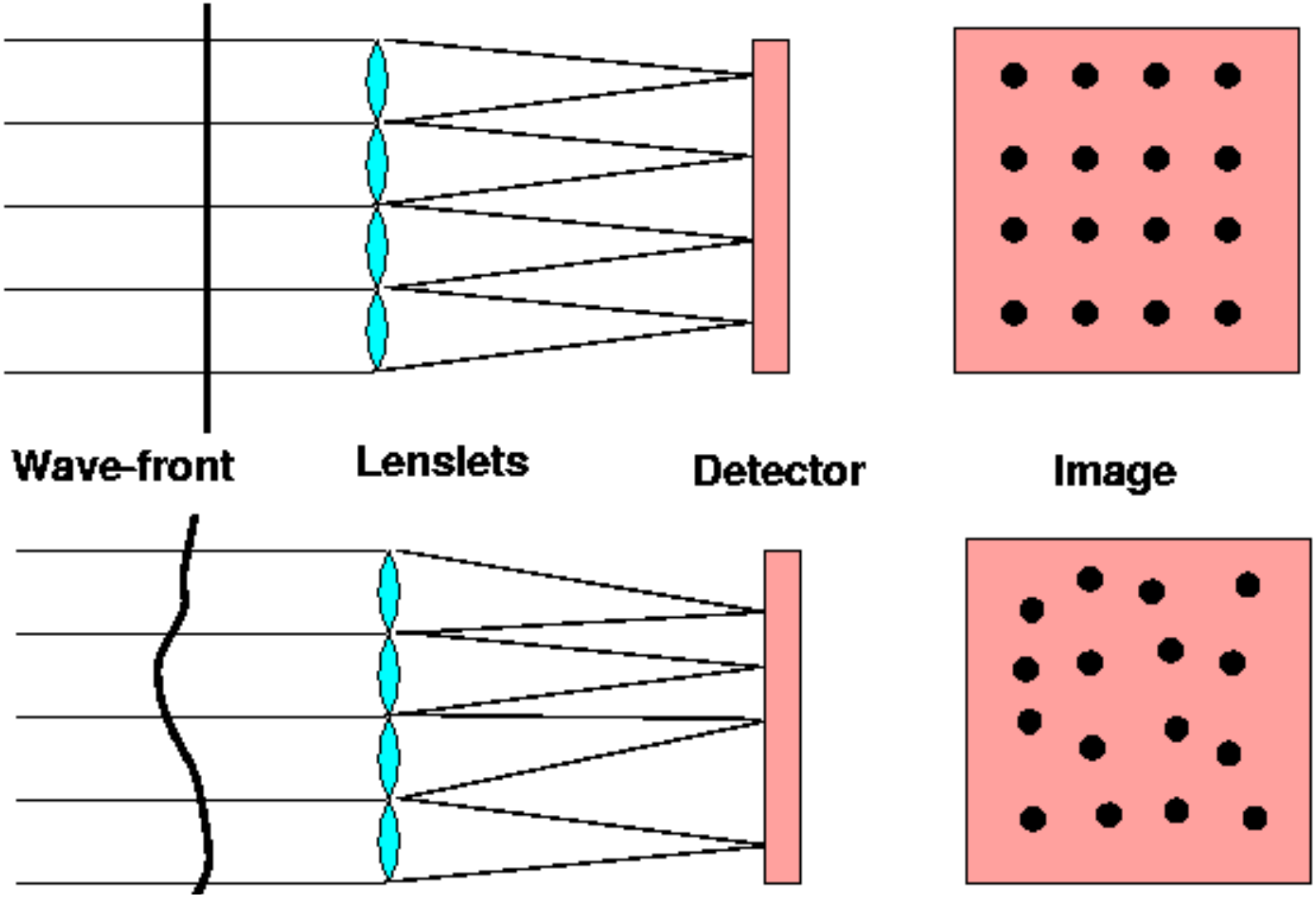
Tomographic wavefront reconstruction

Key Technology

Open-loop control

Calibration !!

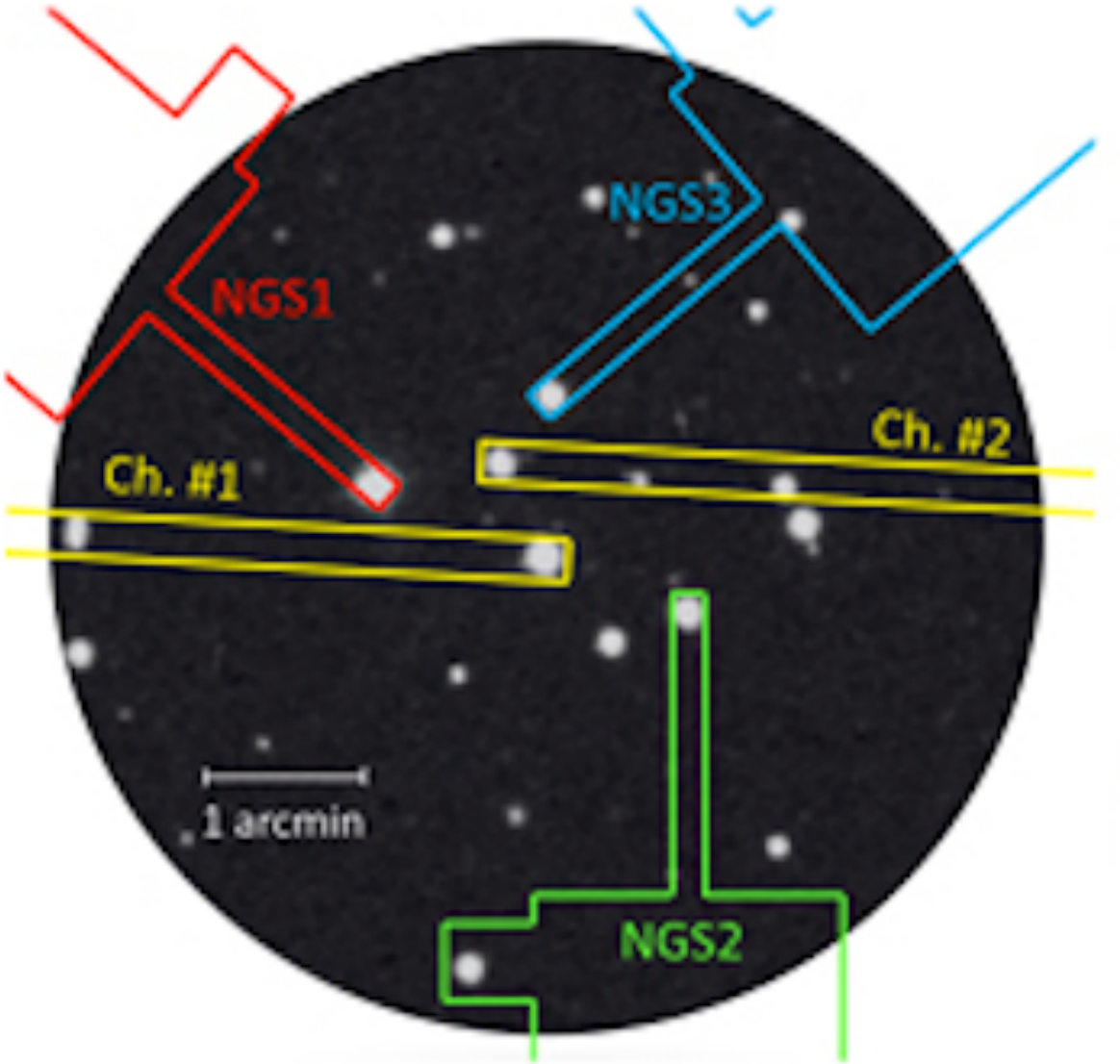
WFS (Shack Hartman)



DM's

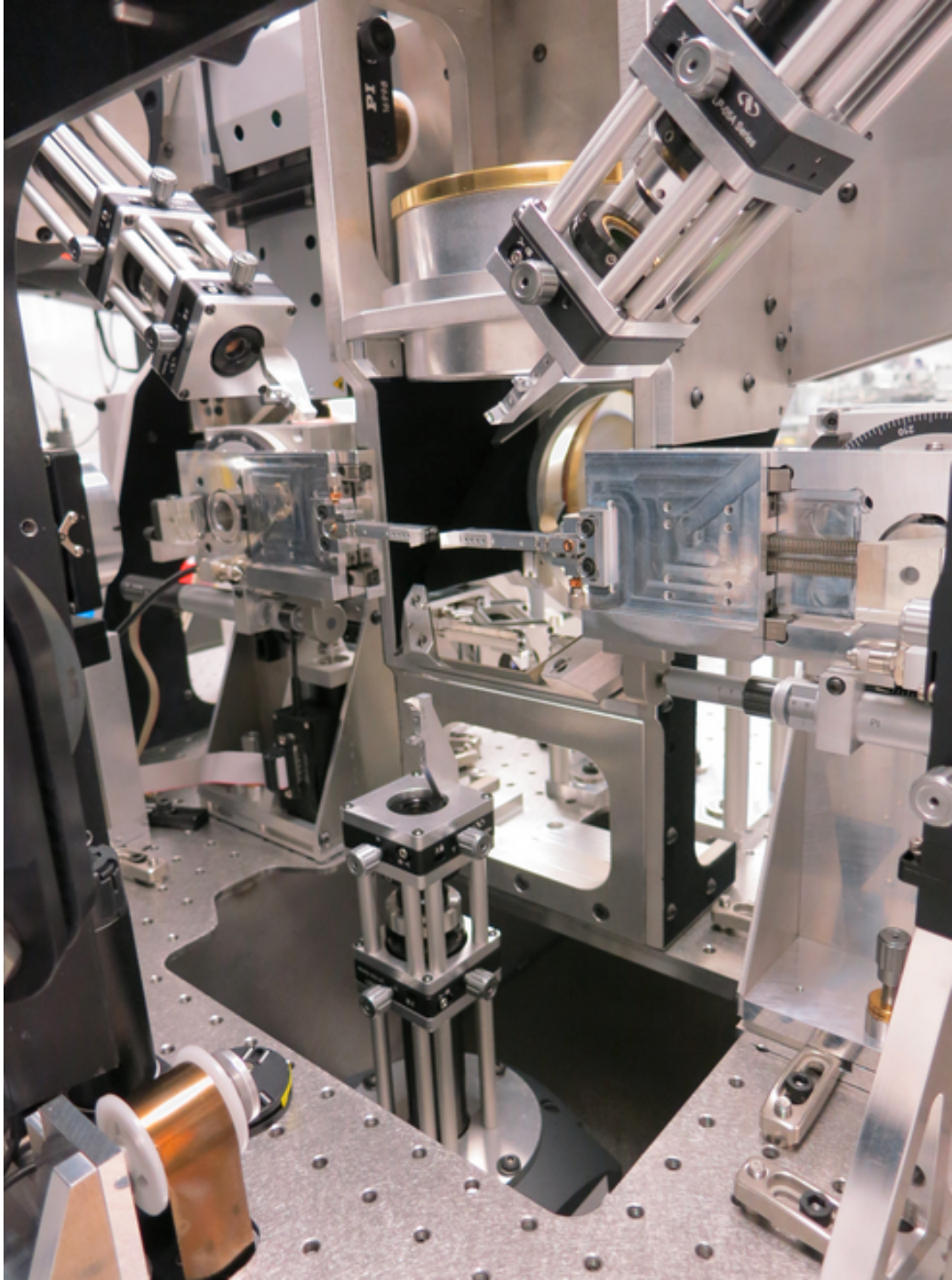
- Mirror Tilt/Tip (T/T)
- Mirror surface deformed by actuators (DM)
- Raven's DM's have both T/T and DM

RAVEN Pick-Off arms in Light Beam

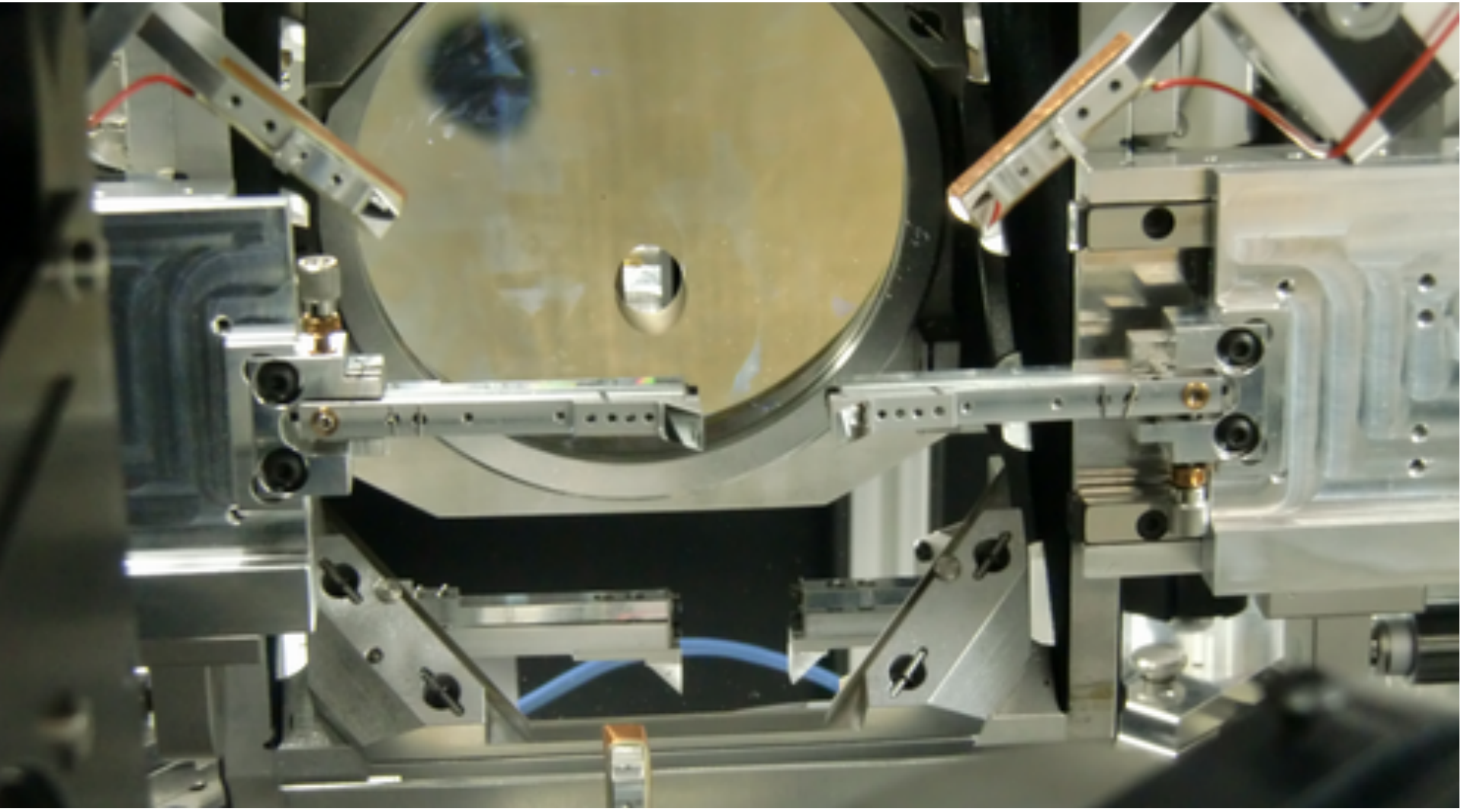


MOAO

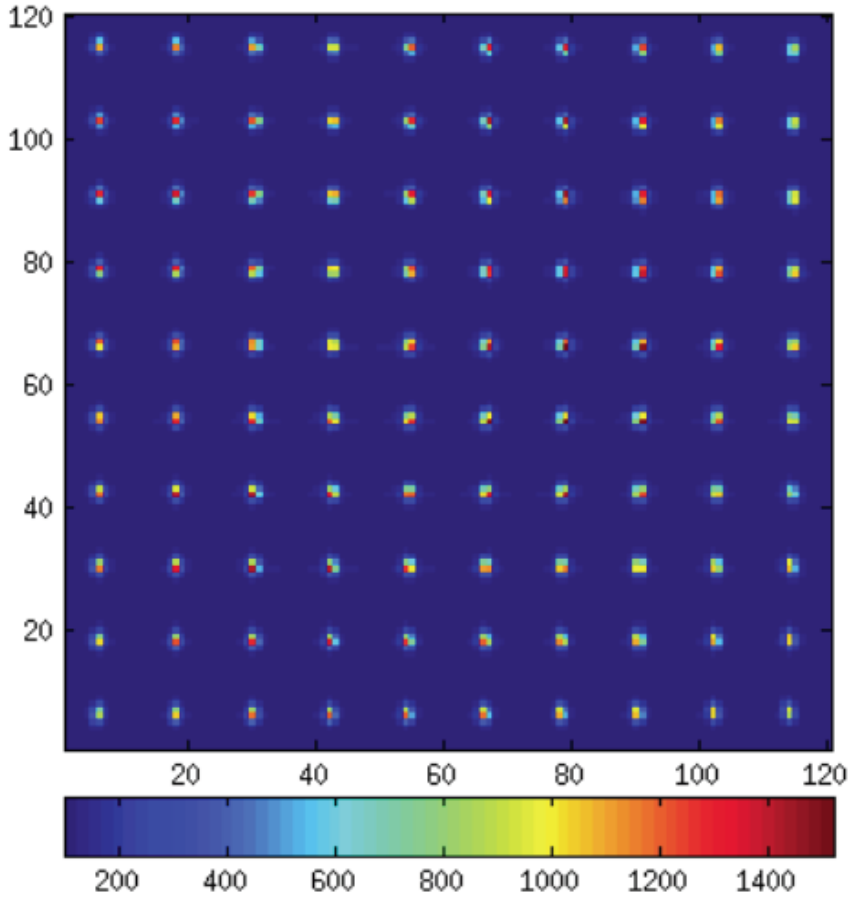
- Multiple NGS's
- Multiple LGS's
- Multiple WFS's
- Multiple DM's
- Multiple Pick-off mirrors
- Multiple Science measurements

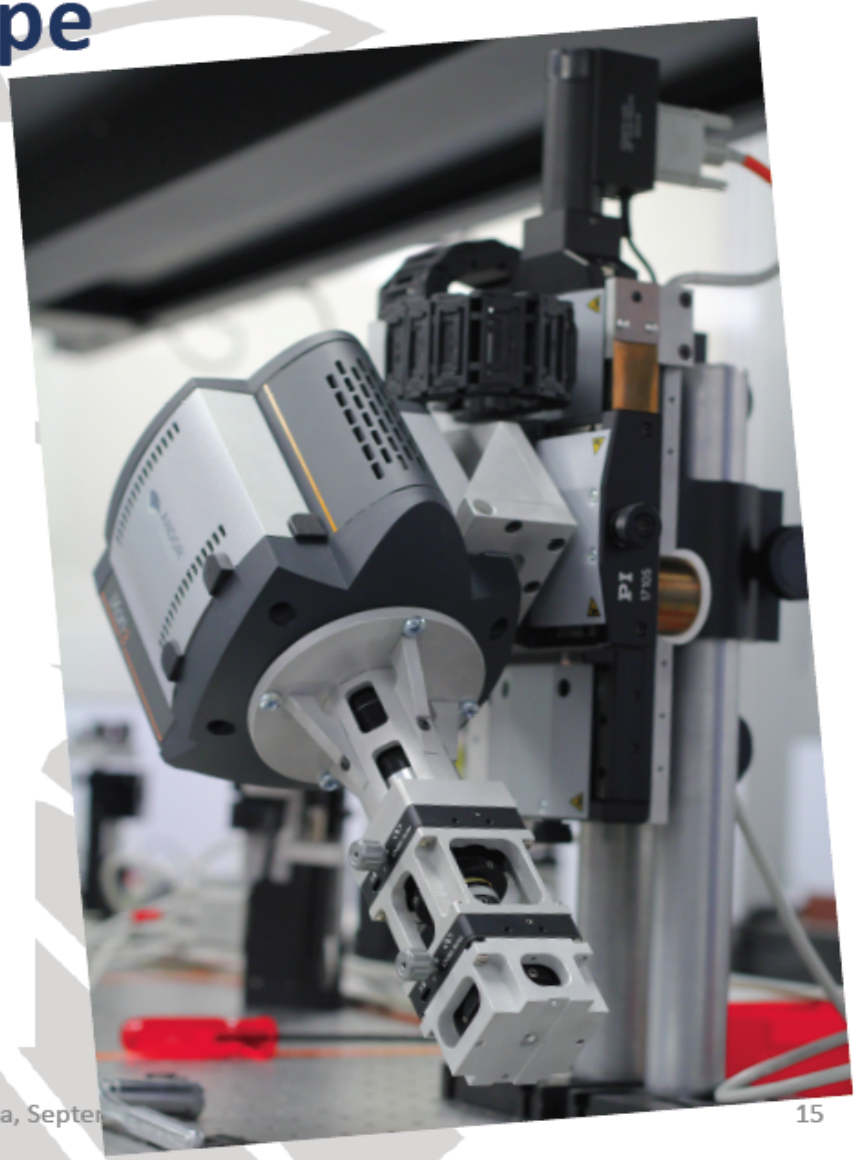


Pick Off Arms

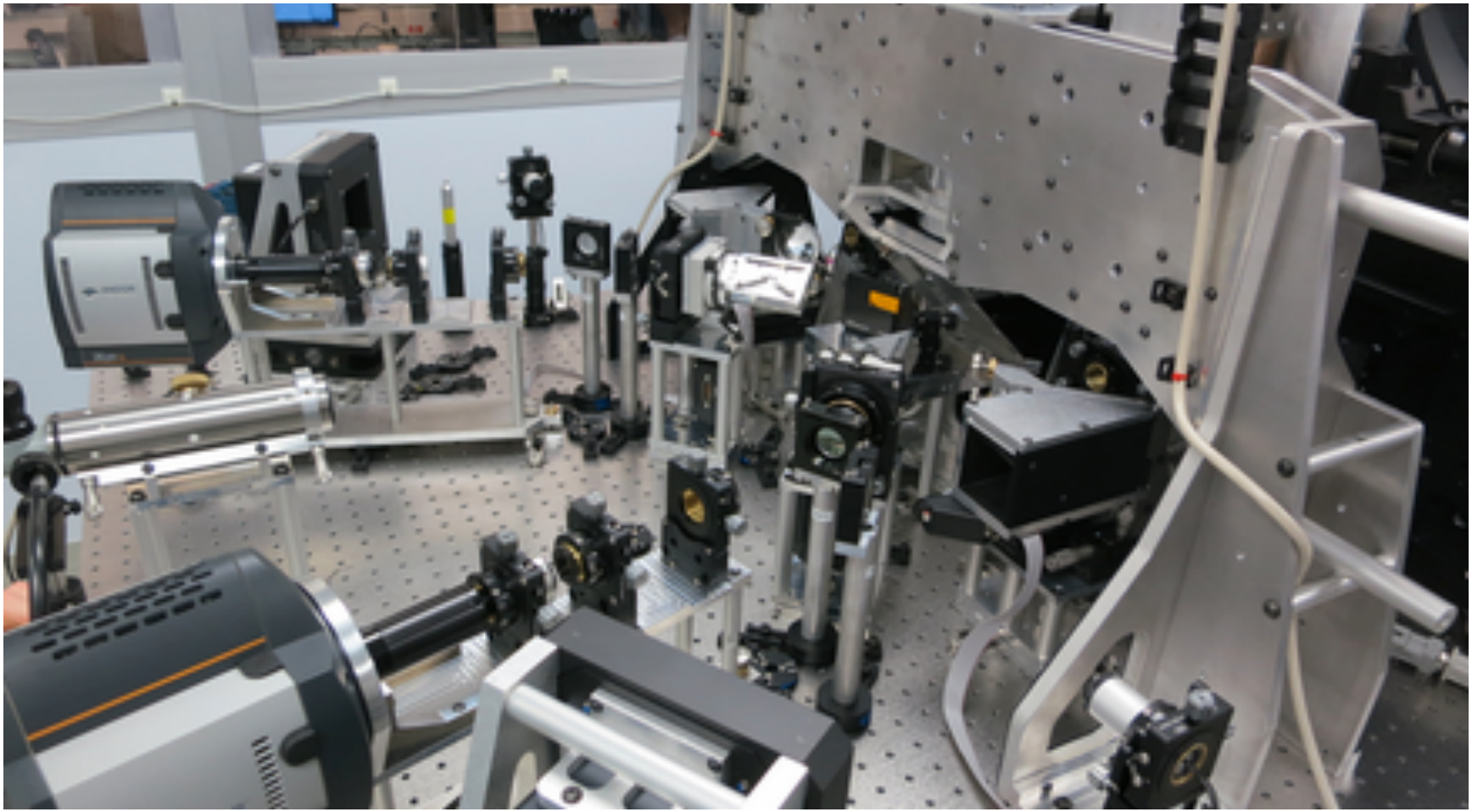


OL WFS Prototype



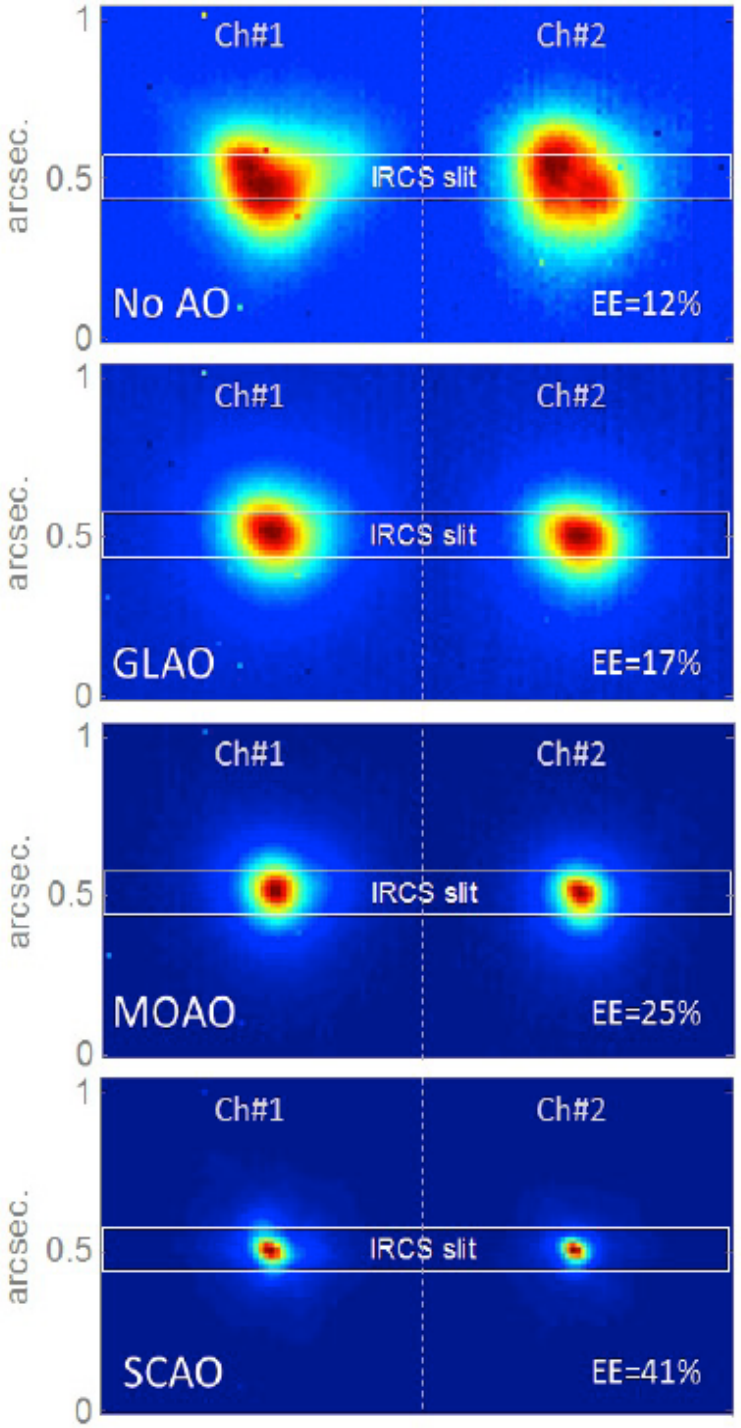


RAVEN optical bench



Final assembly

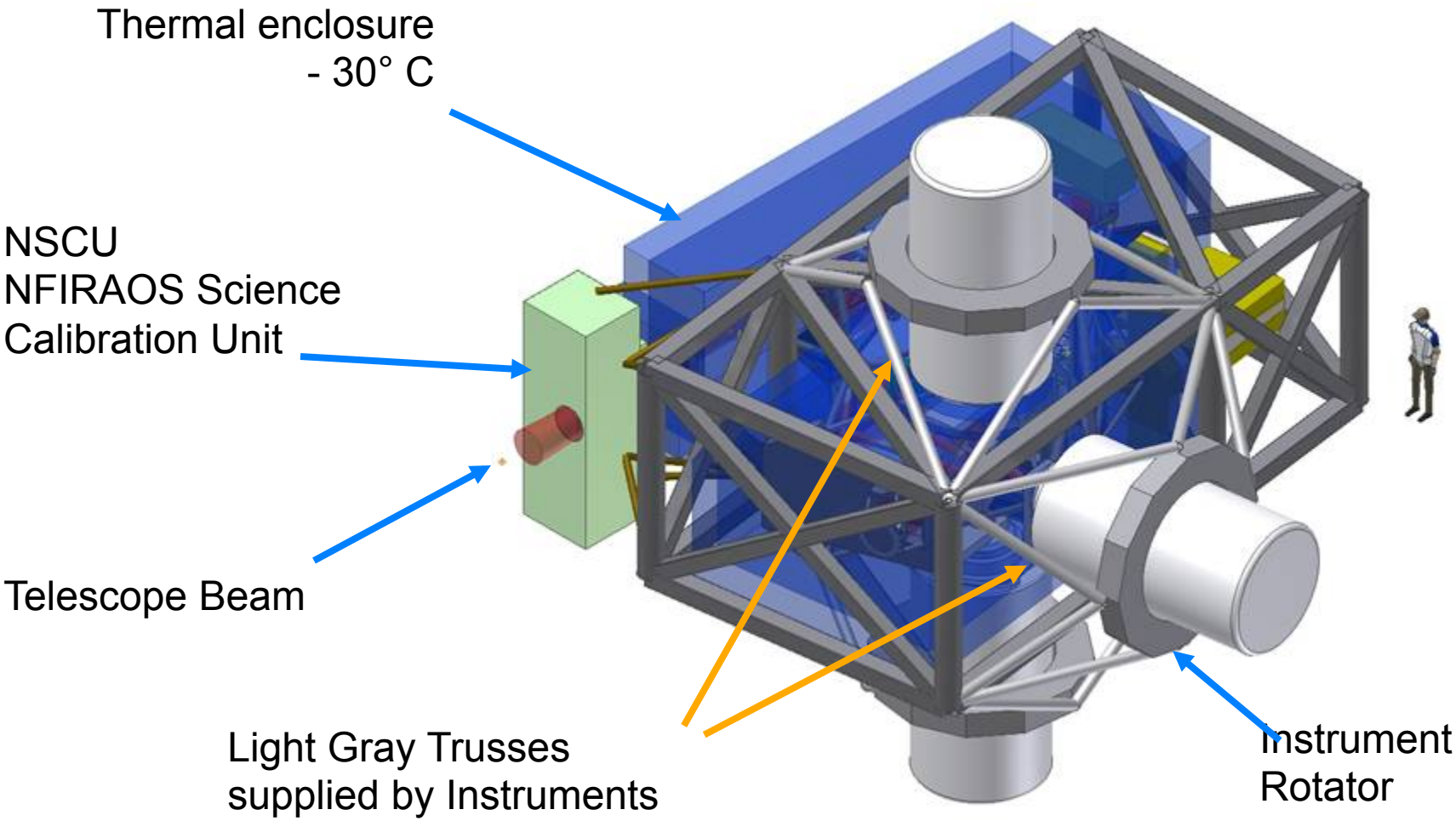
Results


Ch#1
Ch#2
IRCS slit
No AO
EE=12%
GLAO
EE=17%
MOAO
EE=25%
SCAO
EE=41%
arcsec.
1
0.5
0

Overview

- *One small target at a time limits observing efficiency.*
- *Next generation of large telescopes (GMT,E- ELT, & TMT) will need AO over large fields of view. Hence MOAO systems.*
- *Such MOAO systems "might have on the order of 8 LGS sensors and 20 science pick-off arms" (Andersen 2014).*
- *Raven has demonstrated feasibility.*
- *Raven did this and performed science tasks!*
- *HIA and UVIC are part of the TMT Team!*

Cooled Enclosure with Calibration Unit, 3 Instruments, and Support Structure



Questions? Comments!

The Raven Team

References

- Brent Ellerbroek, TMT Early Light Adaptive Optics, TMT @ SPIE 2010, San Diego, June 26, 2010, TMT.AOS.PRE. 10.054.REL01
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