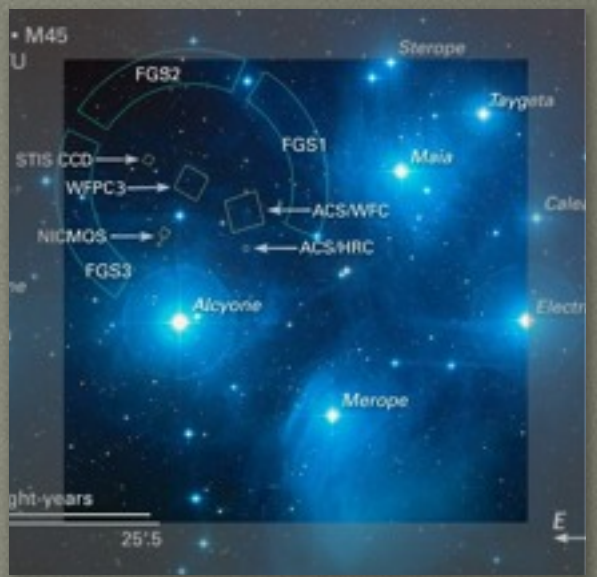
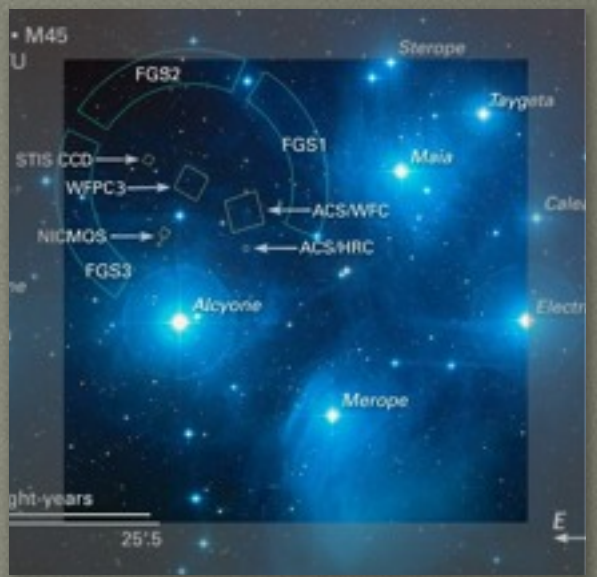




# `Imaka

CFHT User's Meeting 2013

M. Chun for the Imaka team

May 2013

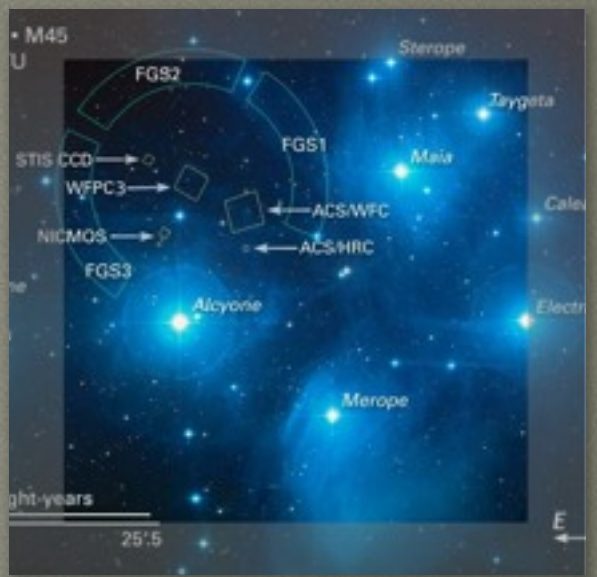




# `Imaka

CFHT User's Meeting 2013
M. Chun for the Imaka team
May 2013

## TEAM

Olivier Lai, Harvey Richer, Tim Butterley, Doug Toomey, Kevin Ho, Derrick Salmon, David Andersen, Simon Thibault, Vern Stahlberger, Yutaka Hayano, ...


# `Imaka

CFHT User's Meeting 2013
M. Chun for the Imaka team
May 2013

## "PHASE A" STUDY

- on-sky experiments for wide-field GLAO
- instrument concepts for CFHT

# mWFS


## GOAL

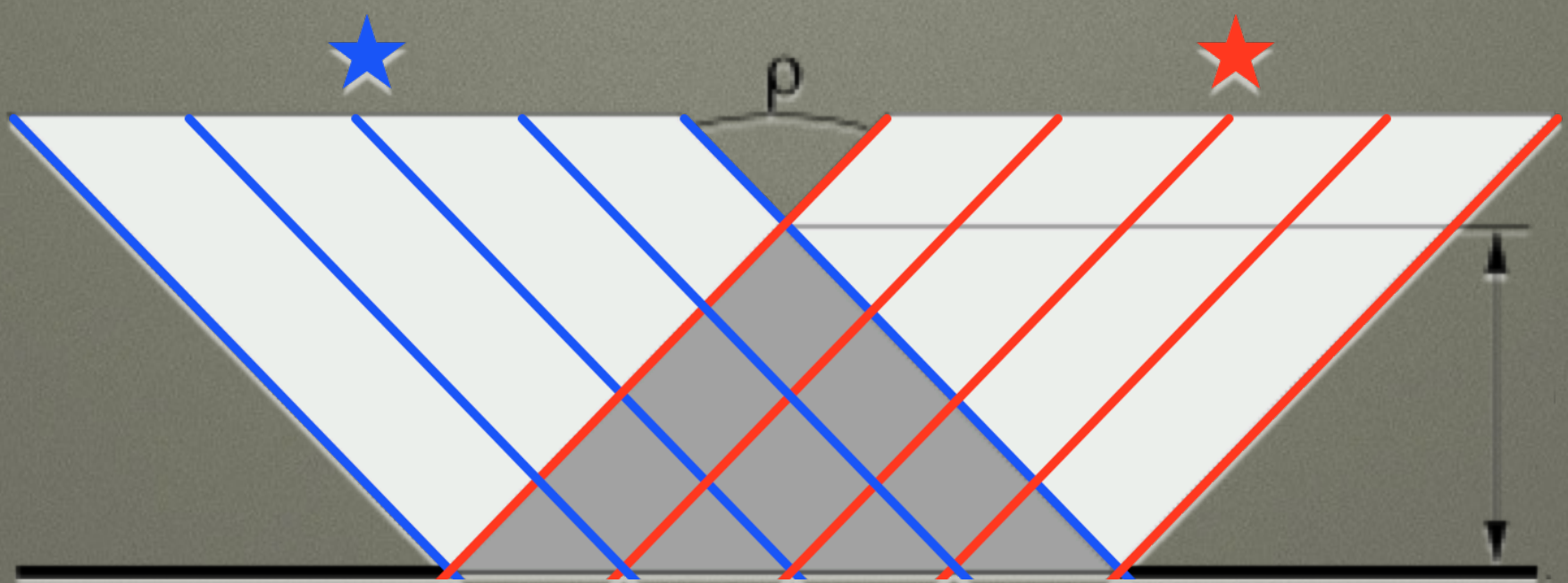
Measure the correlation of the wavefronts over the full `IMAKA field of view thru CFHT.

- Dome seeing?
- Is there a ground-layer?
- How high does it extend?
- Does GLAO reach FA seeing over IMAKA sized fields of view

# SETUP

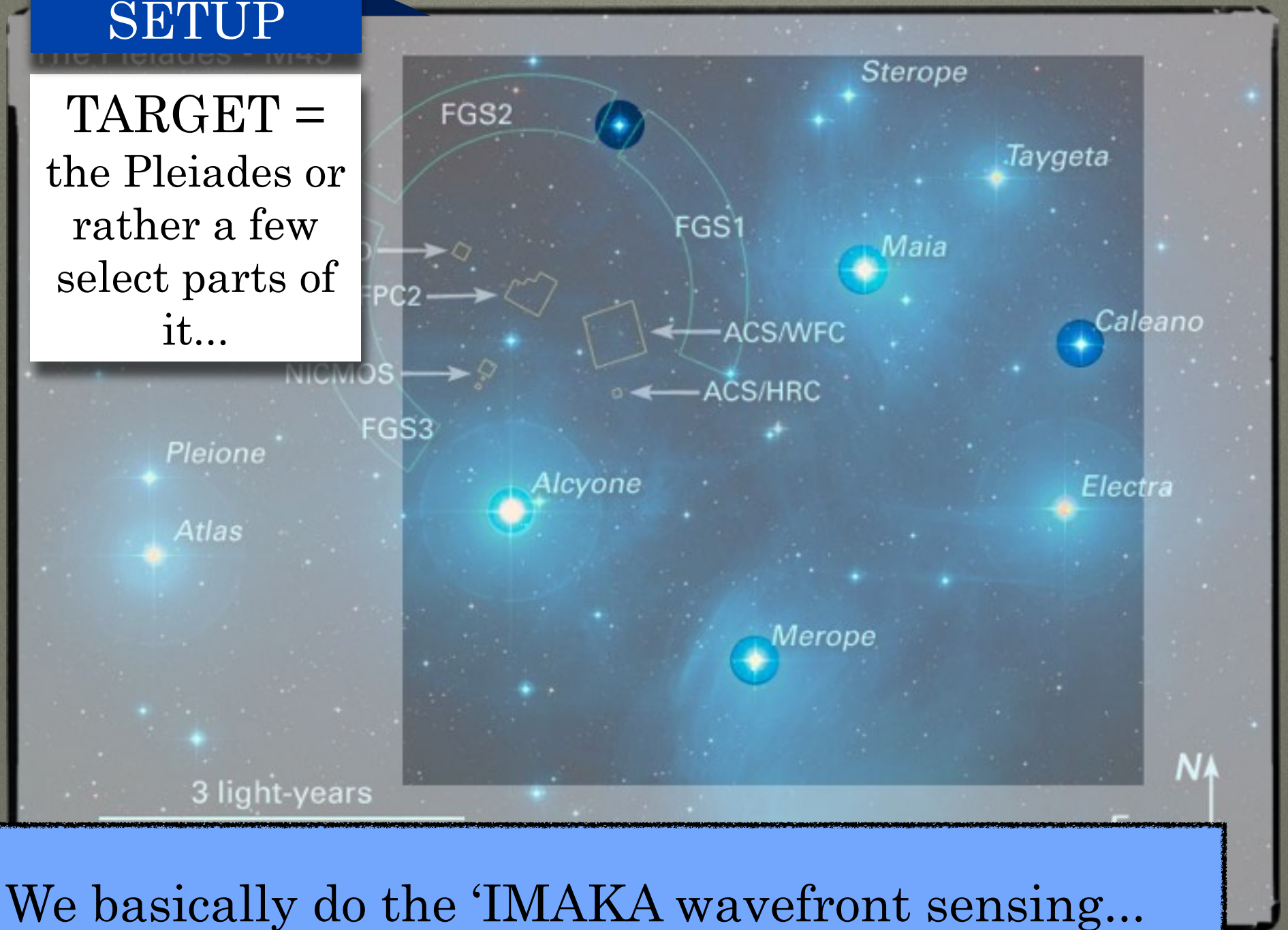
- Consists of five Shack-Hartmann WFSs on a constellation of bright stars with 15'-40' separations mounted to a fixed "plug plate" at the Prime Focus of CFHT (WIRCAM top-end and old WFC).

- sampled w/ 9cm subapertures at 25Hz for several minutes



# SETUP

TARGET = the Pleiades or rather a few select parts of it...




We basically do the 'IMAKA wavefront sensing...

# SETUP

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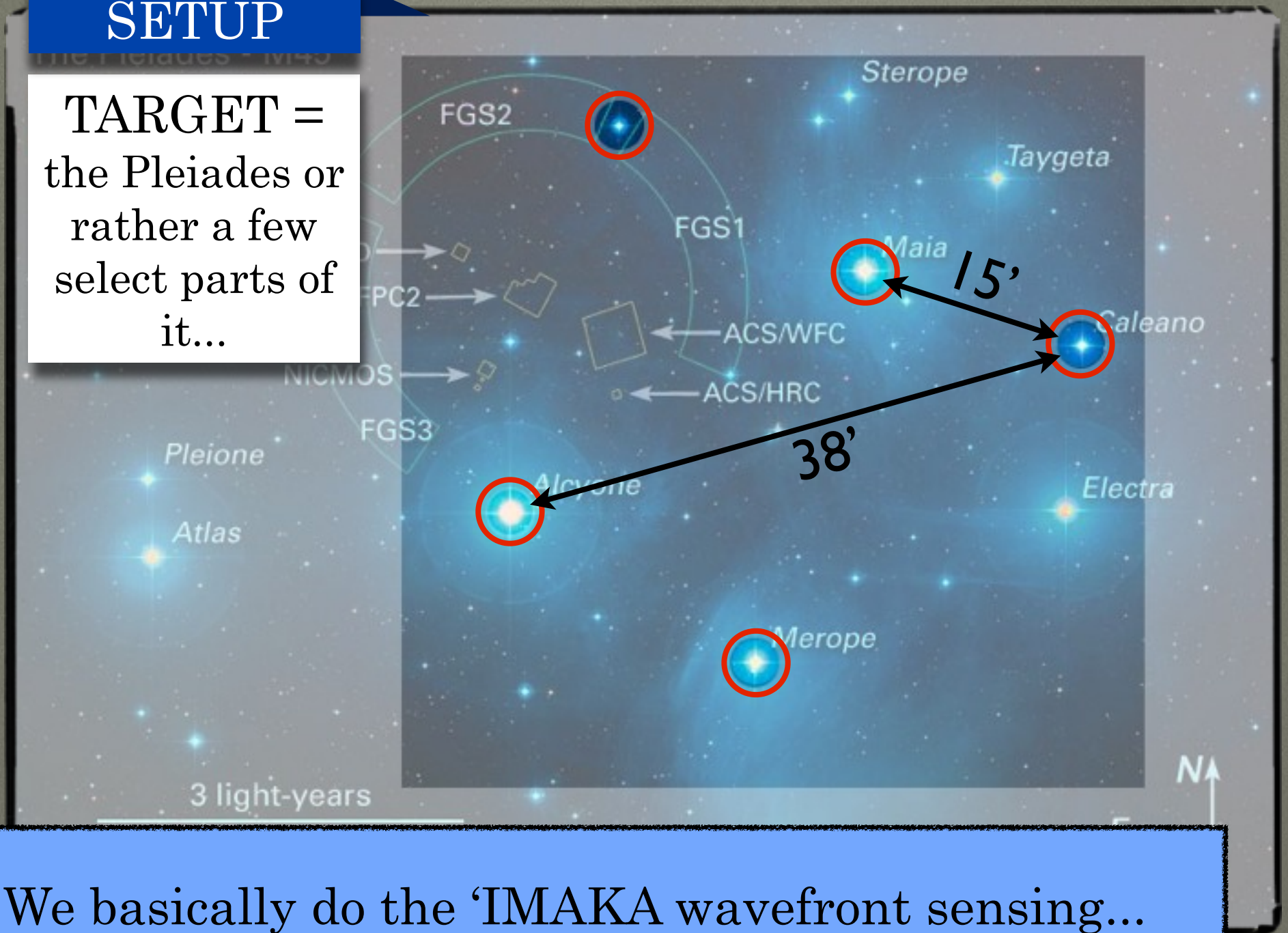


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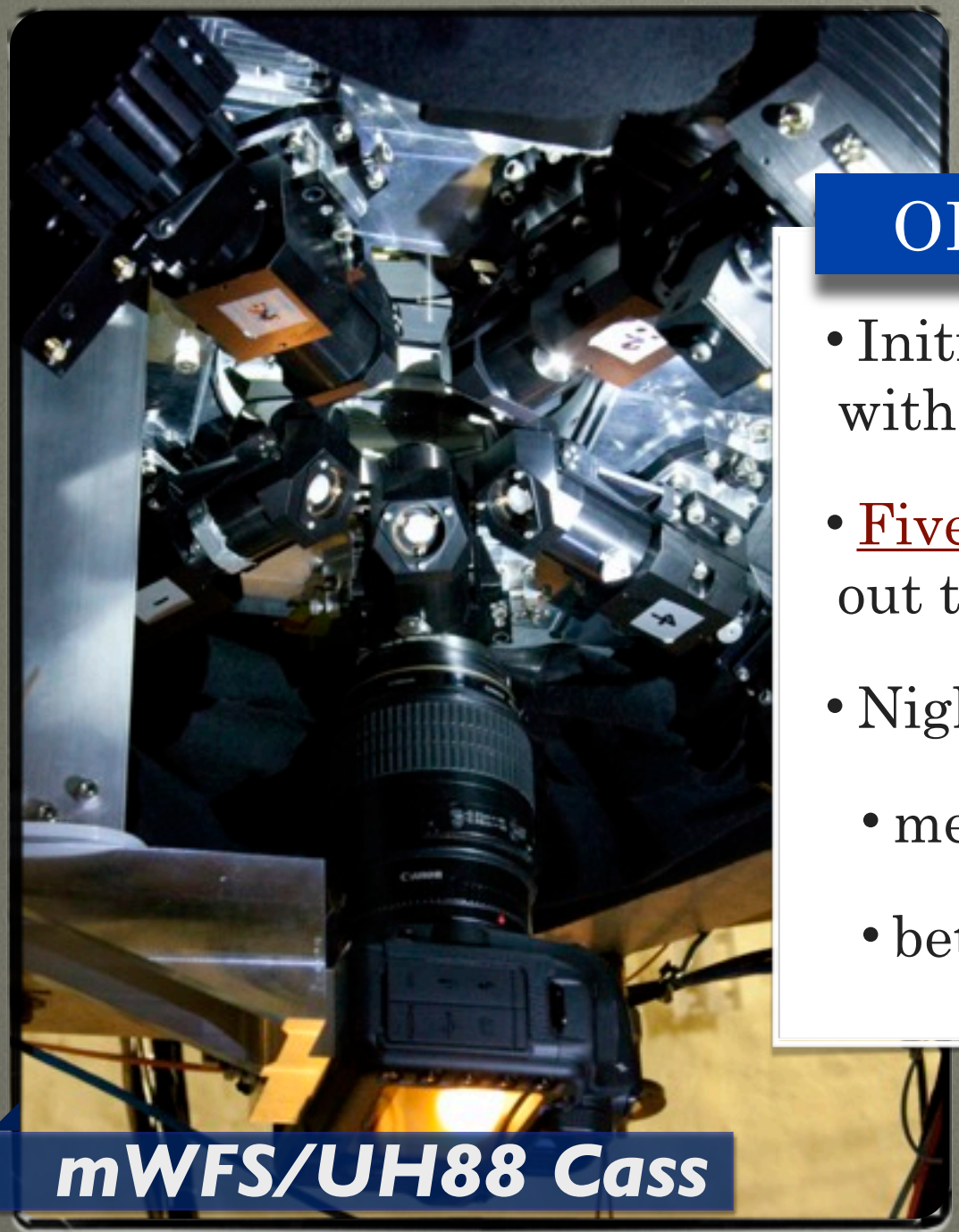
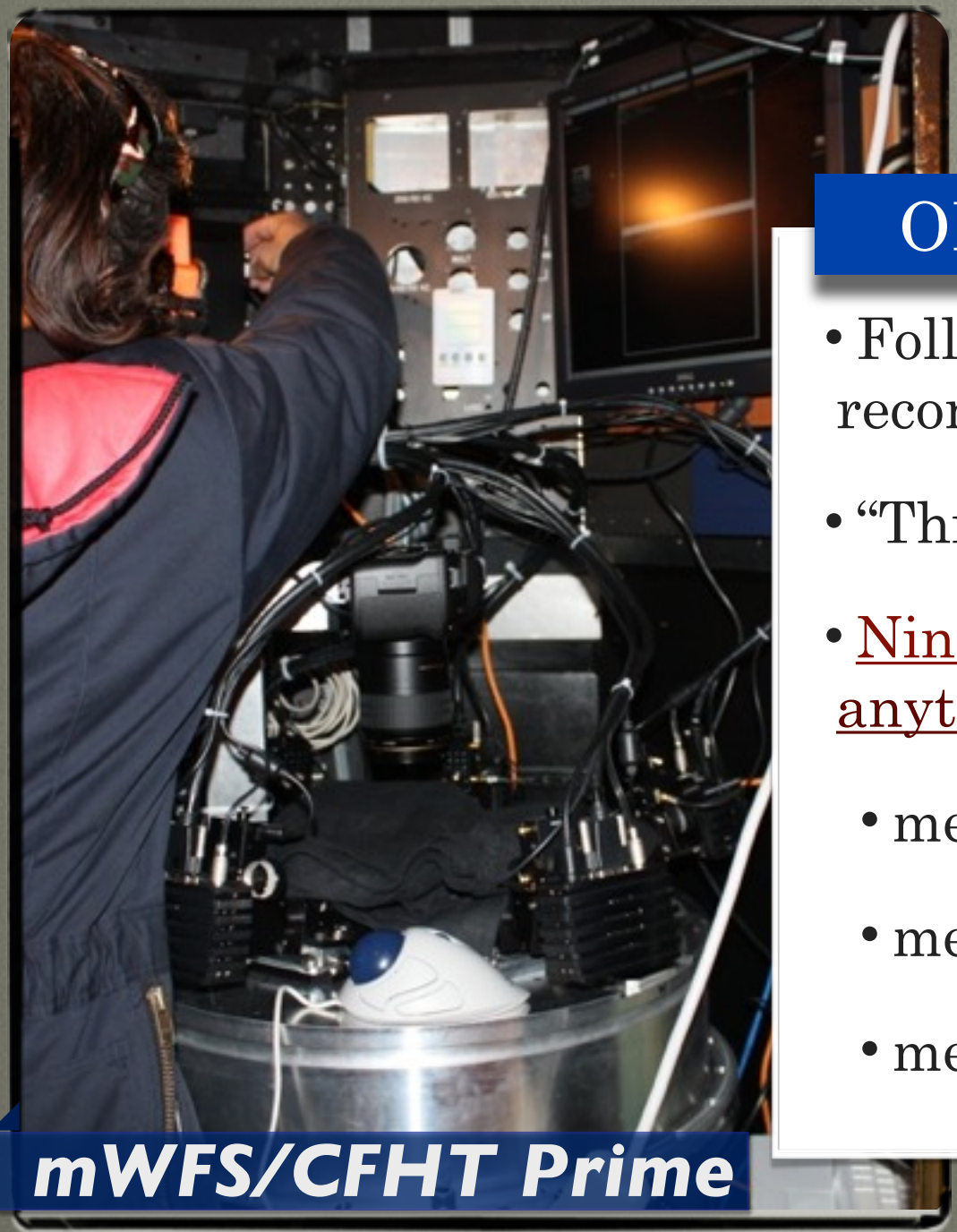



# OBSERVATIONS: UH88"

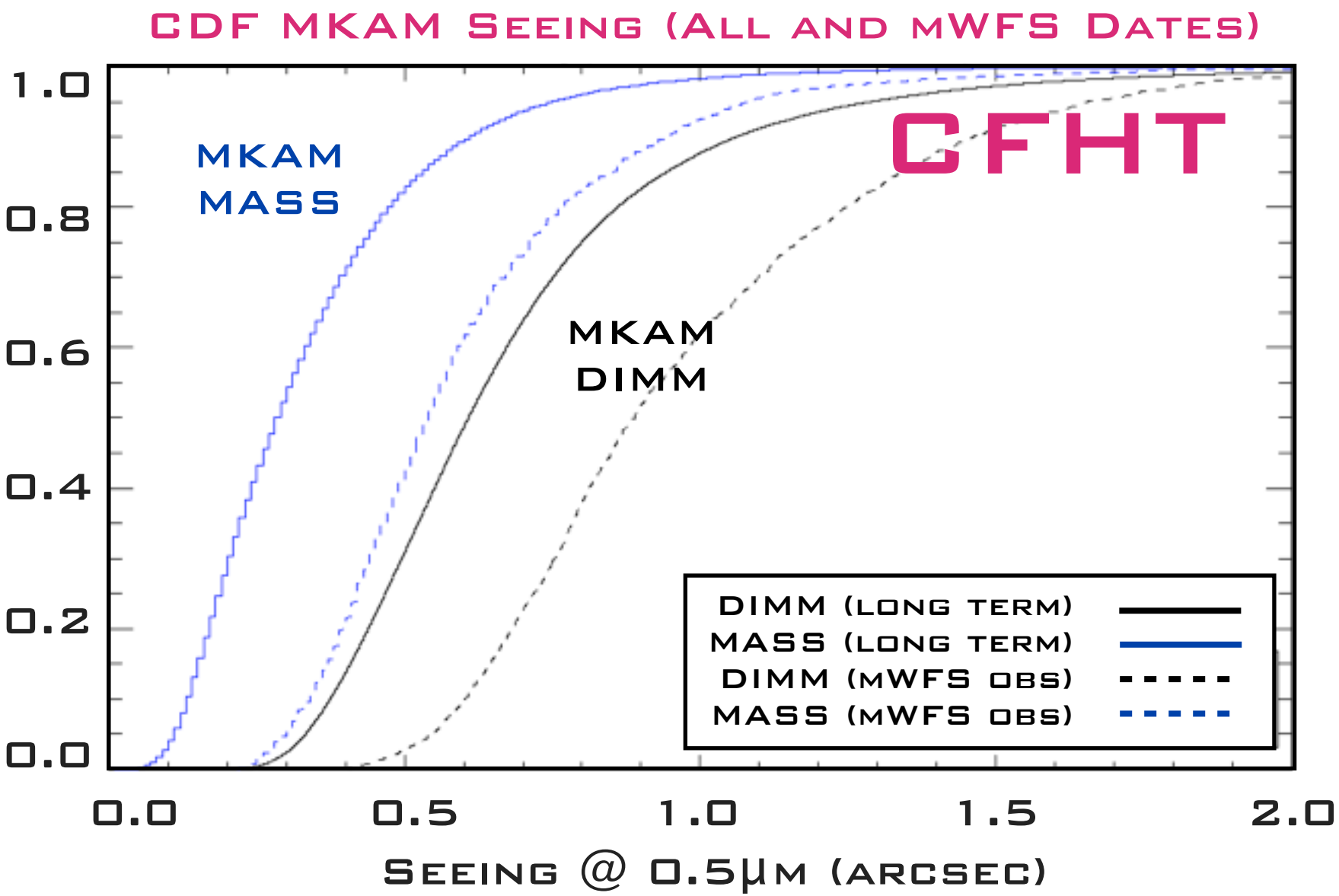
- Initial engineering in June 2012 with single WFS
- Five nights observing in Sept 2012 out to 35' separations
- Nights were "good" for GLAO
  - median free-atmosphere seeing
  - better than median ground-layer



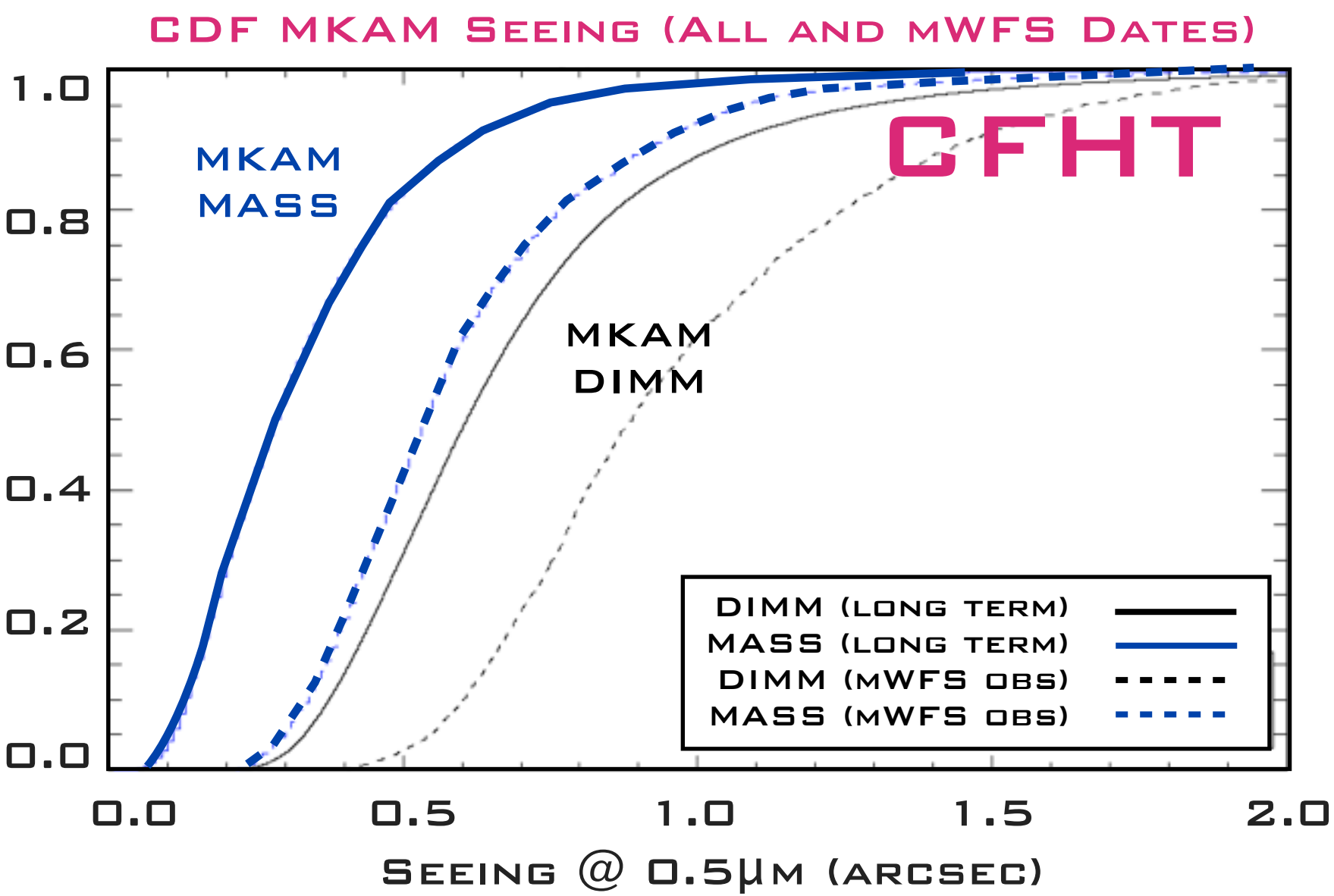

# OBSERVATIONS: CFHT

- Following UH88" run we reconfigured mWFS for CFHT
- "Three" night run in Dec 2012
- Nine nights of poor seeing (bad for anything...)
  - median FA seeing was ~90%-tile
  - median GL seeing was ~60%-tile
  - median total seeing ~80%-tile

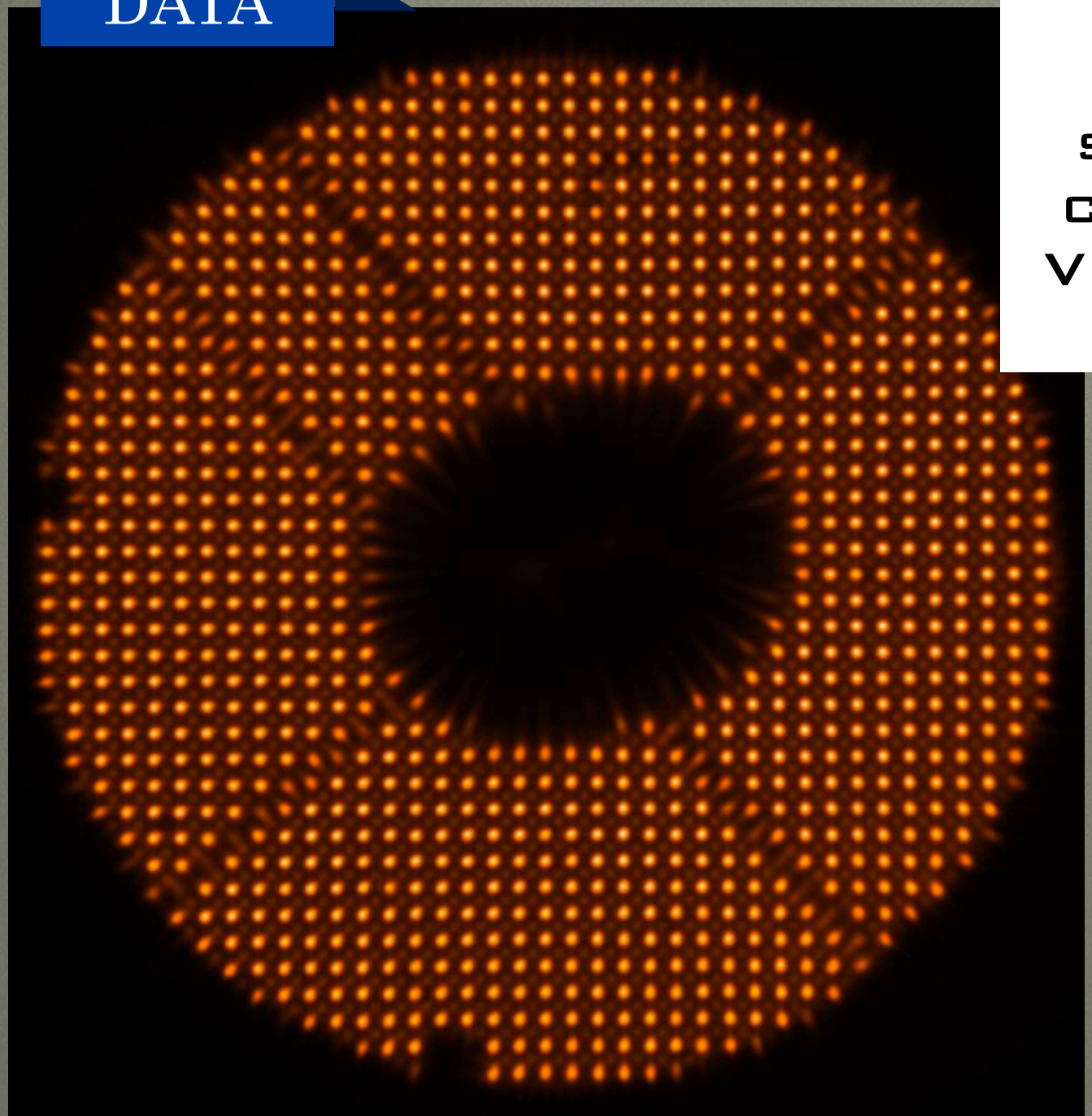
# OBSERVATIONS: CFHT



# OBSERVATIONS: CFHT

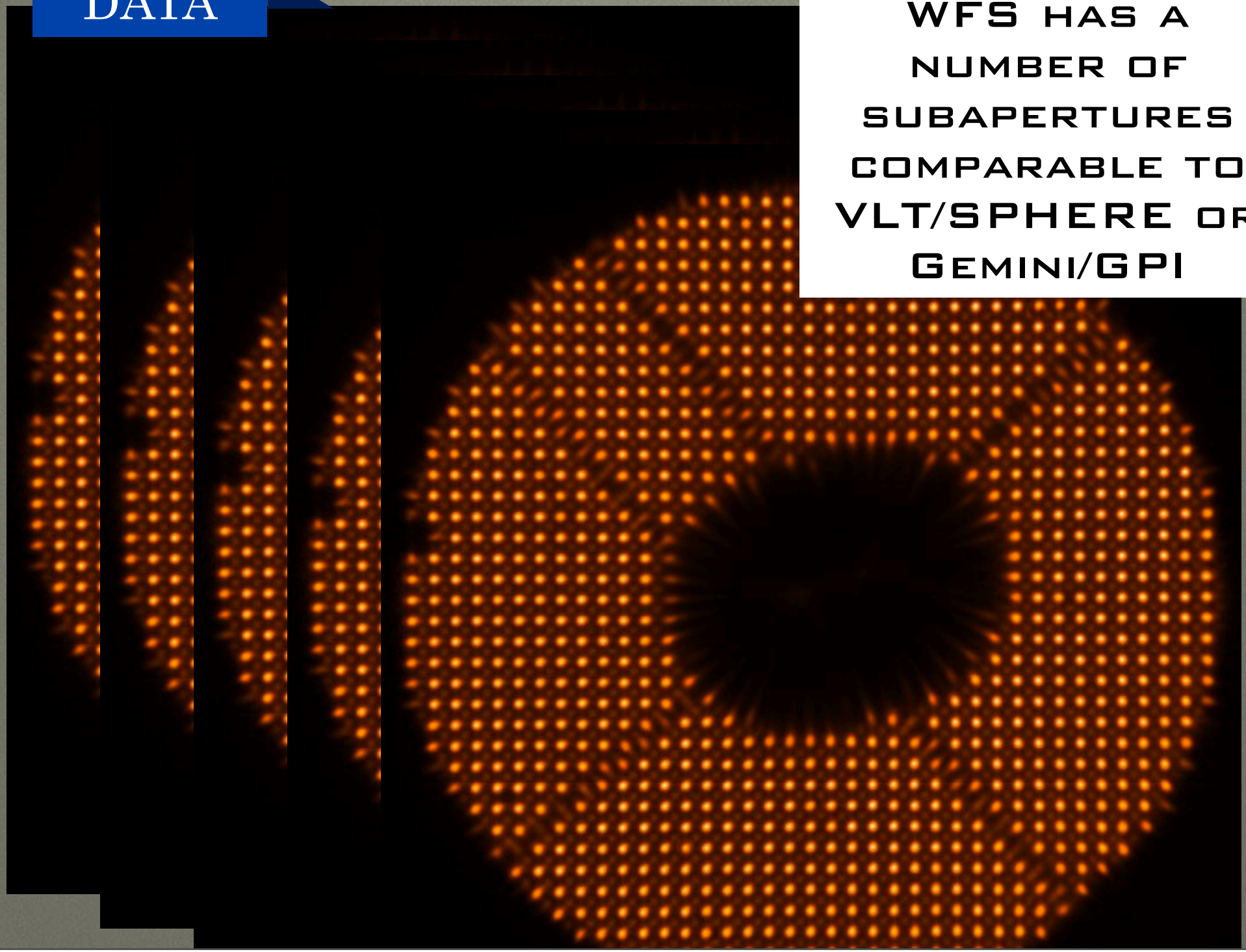


# DATA



Each mWFS/CFHT WFS has a number of subapertures comparable to VLT/SPHERE or Gemini/GPI

# DATA



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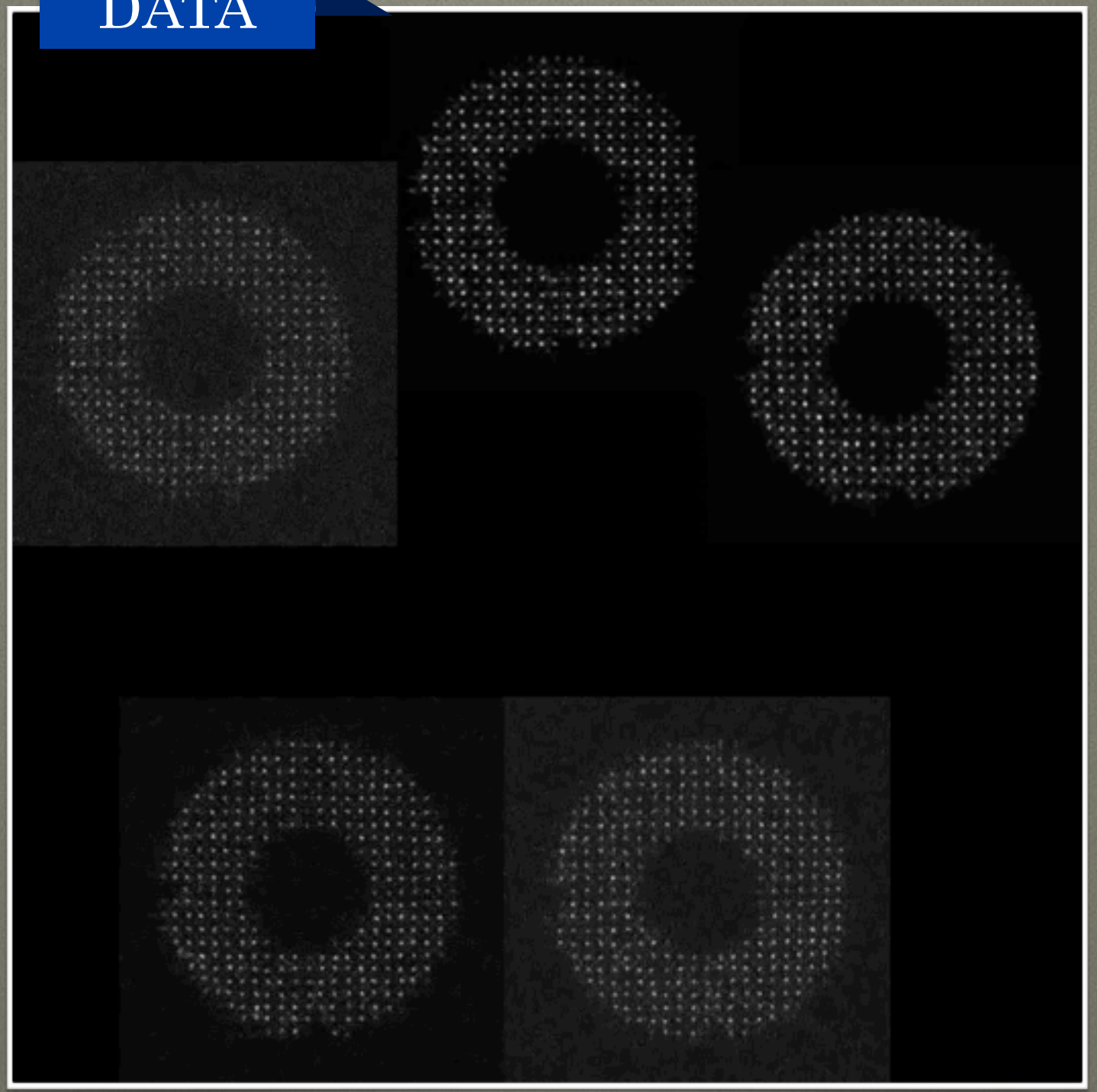
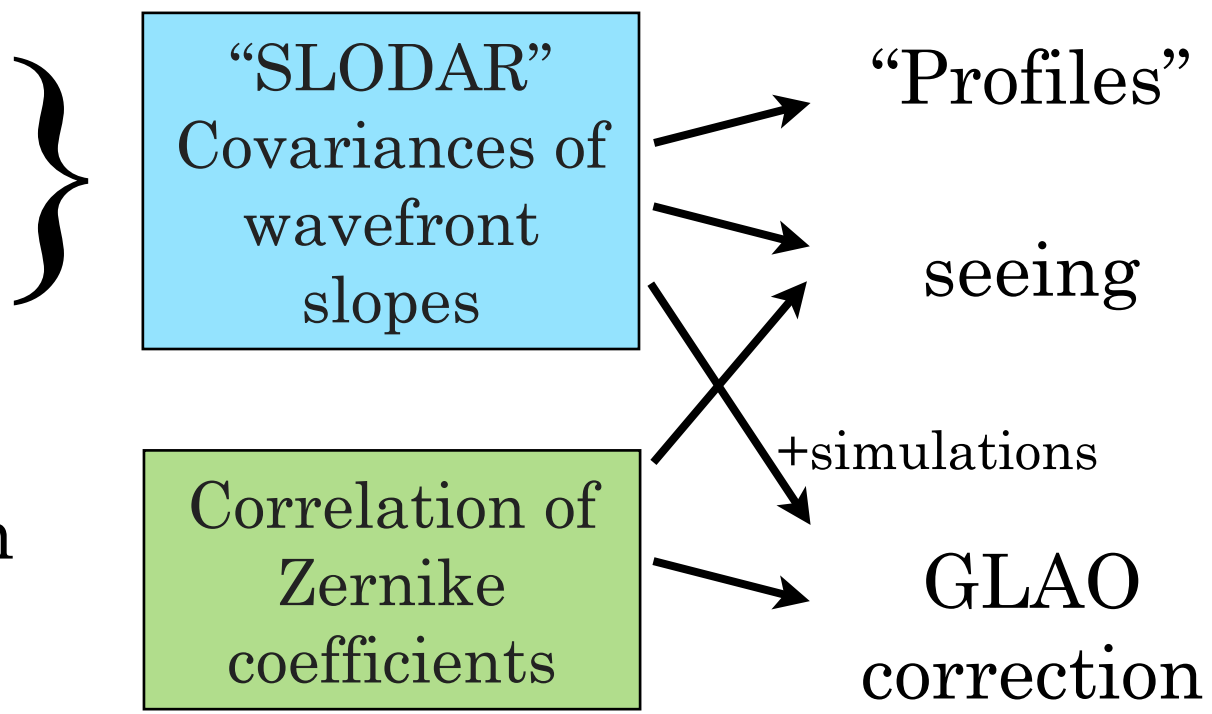
# DATA



# ANALYSIS

# THREE PIPELINES

- Tim Butterley (Durham)
- Olivier Lai (Gemini/Subaru)
- Mark Chun/Sean Goebel (UH/IfA)



# ANALYSIS

## TEMPORAL COV and xCOV MAP

GL#1

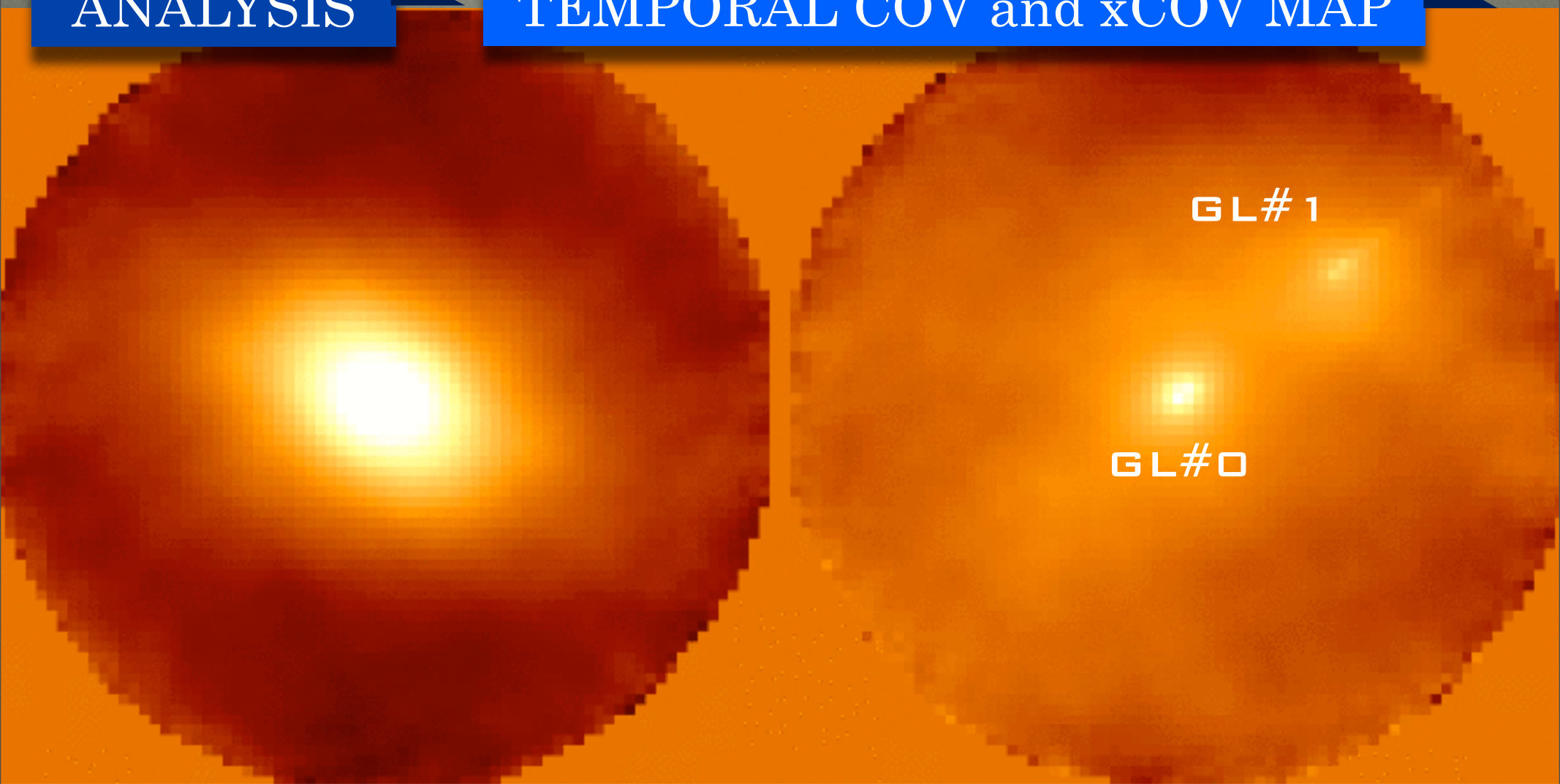
GL#0

WFS1 - WFS1

WFS1 - WFS2

# ANALYSIS

## TEMPORAL COV and xCOV MAP

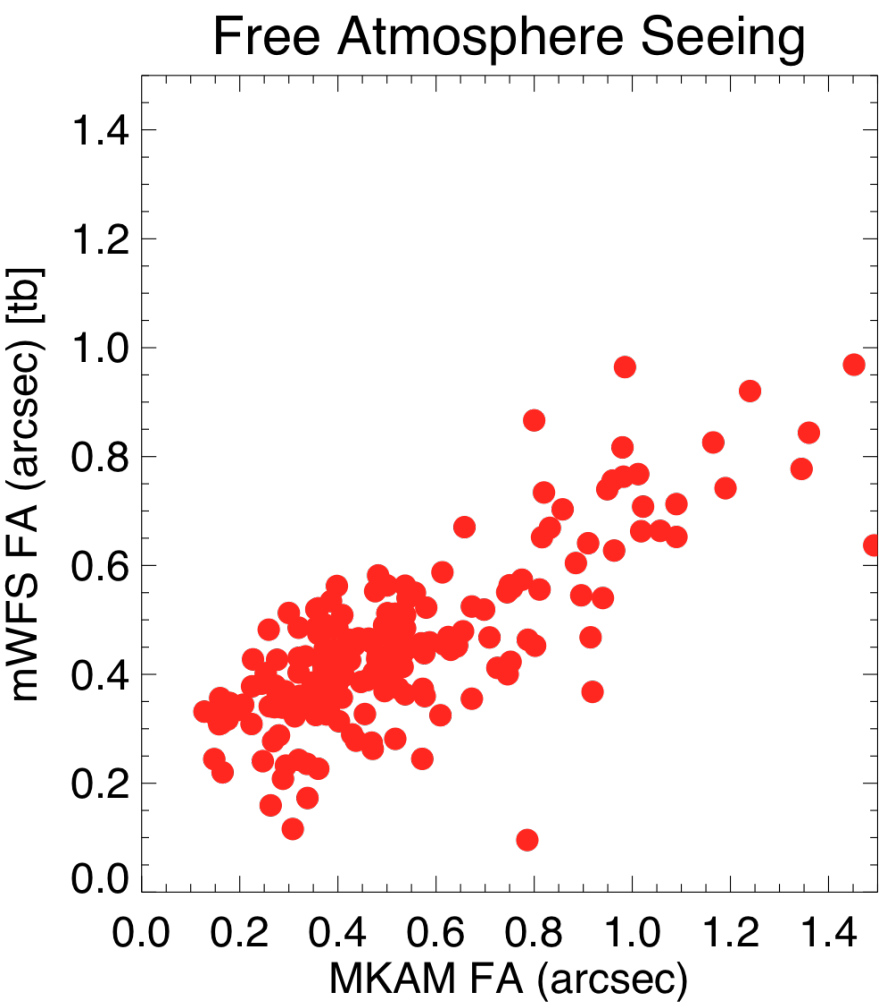


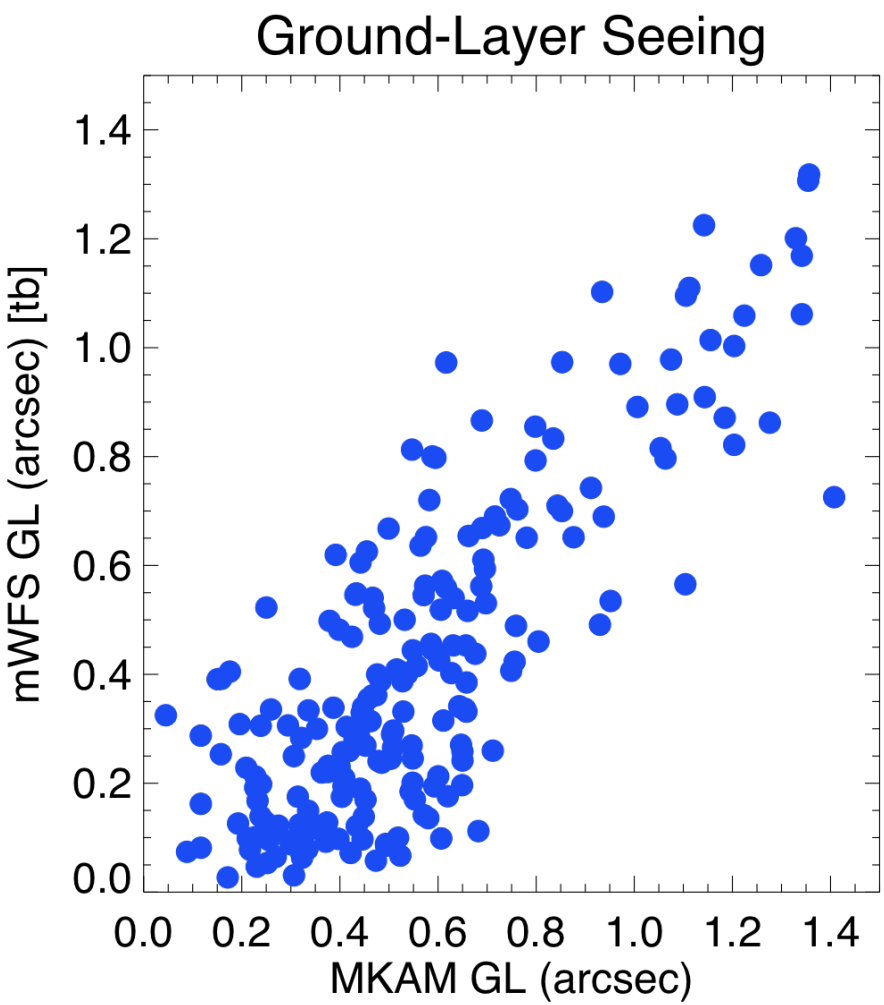

WFS1 - WFS1

WFS1 - WFS2

# RESULTS

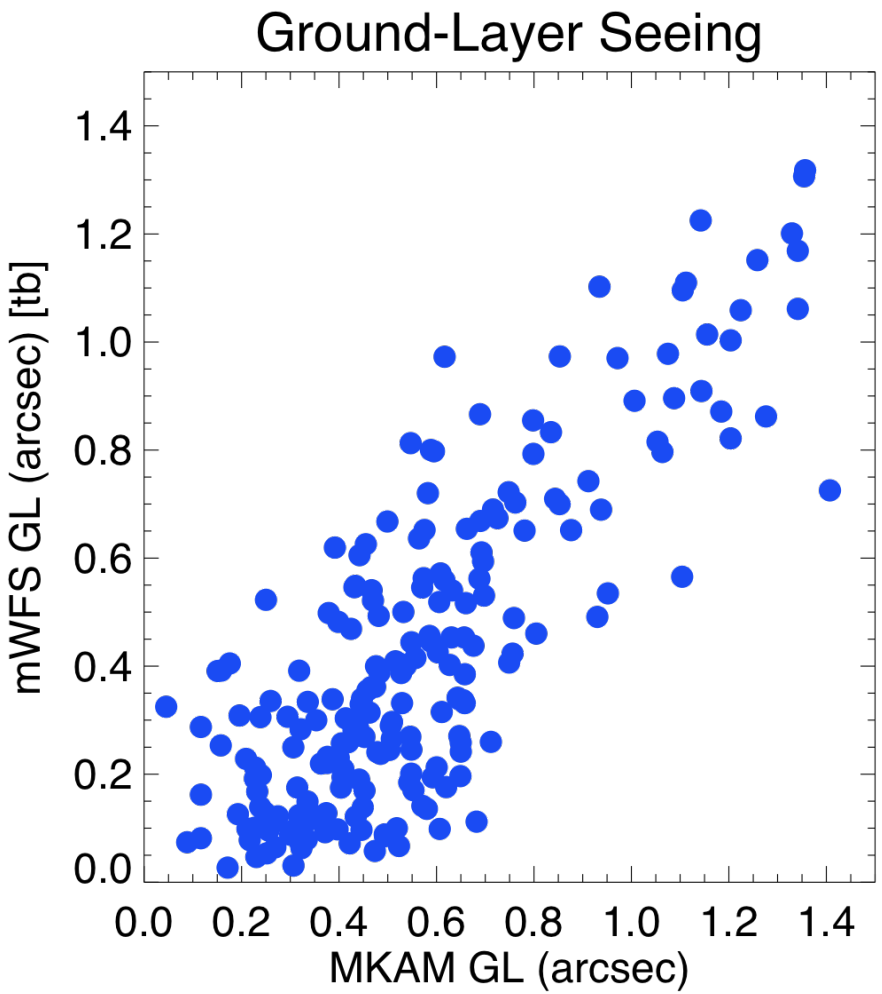
## CROSS CHECK w/MKAM

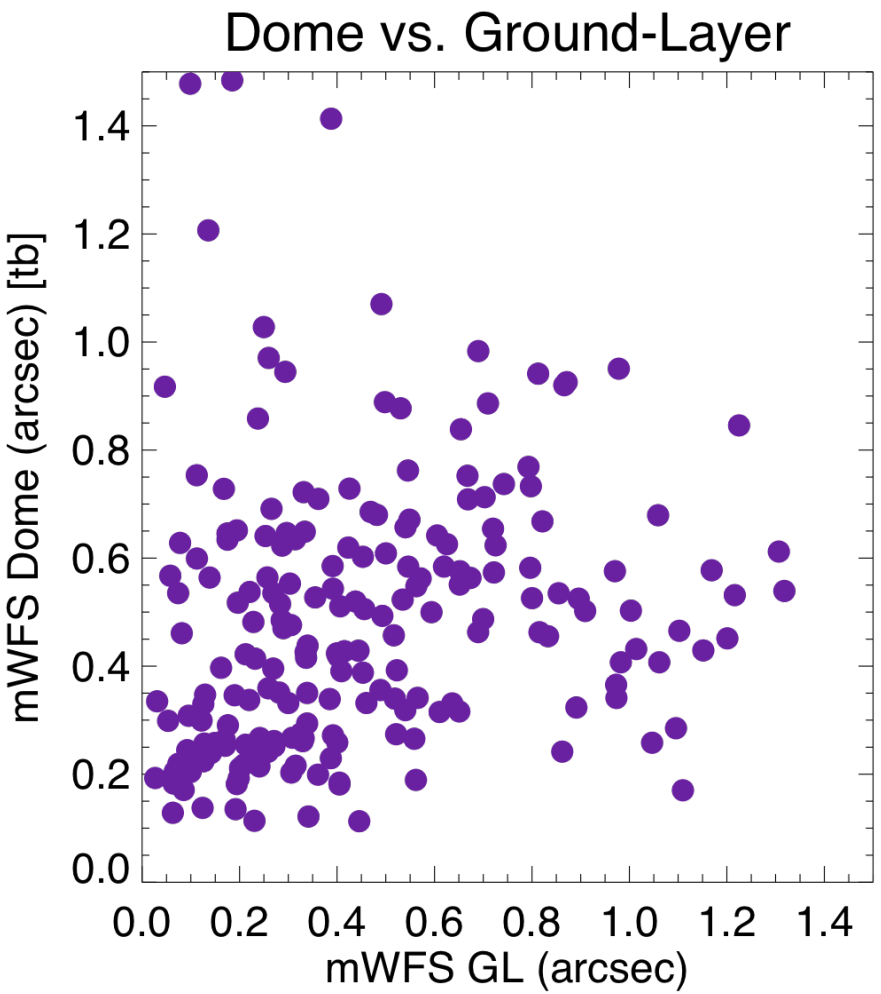


# RESULTS

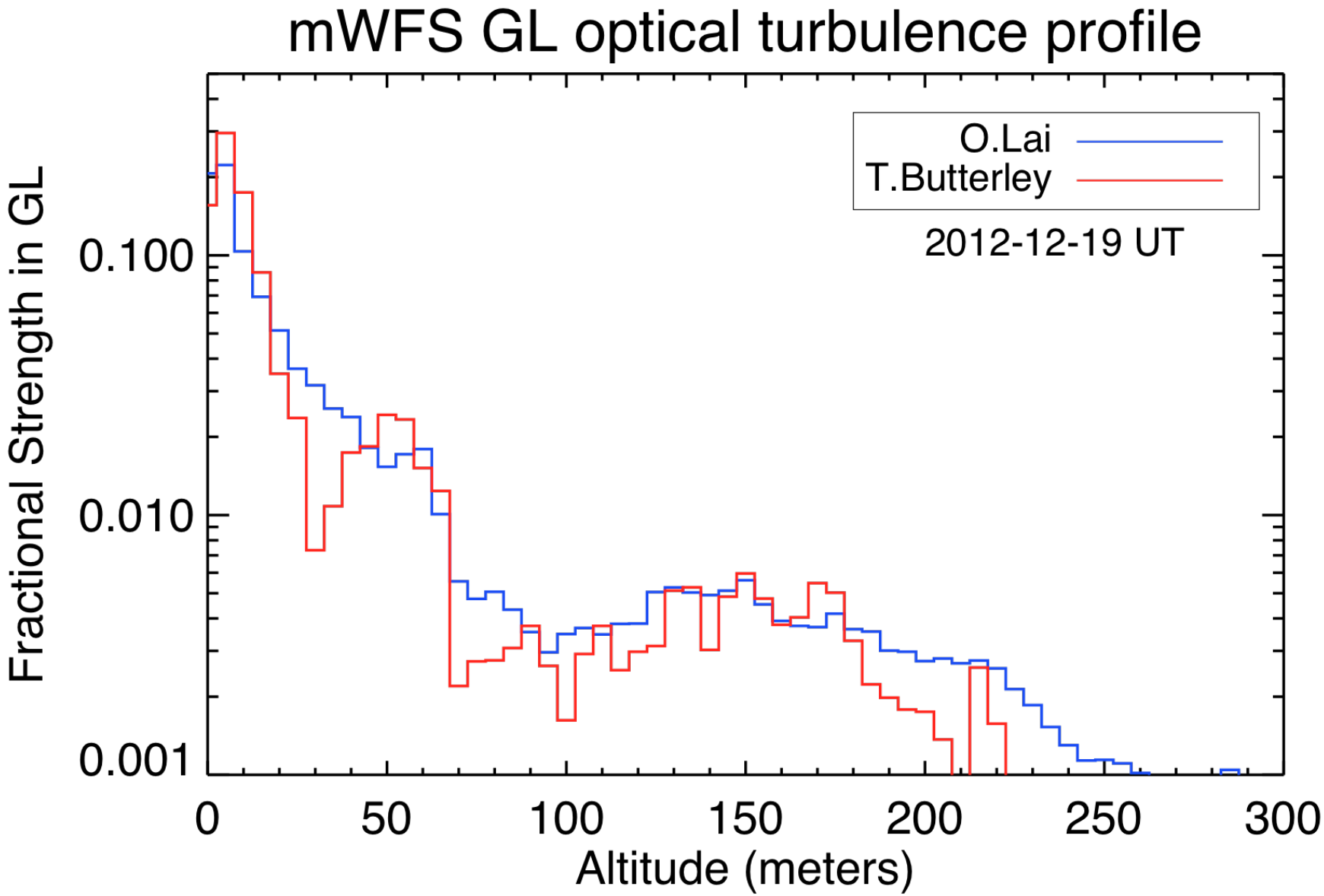
# DOME SEEING



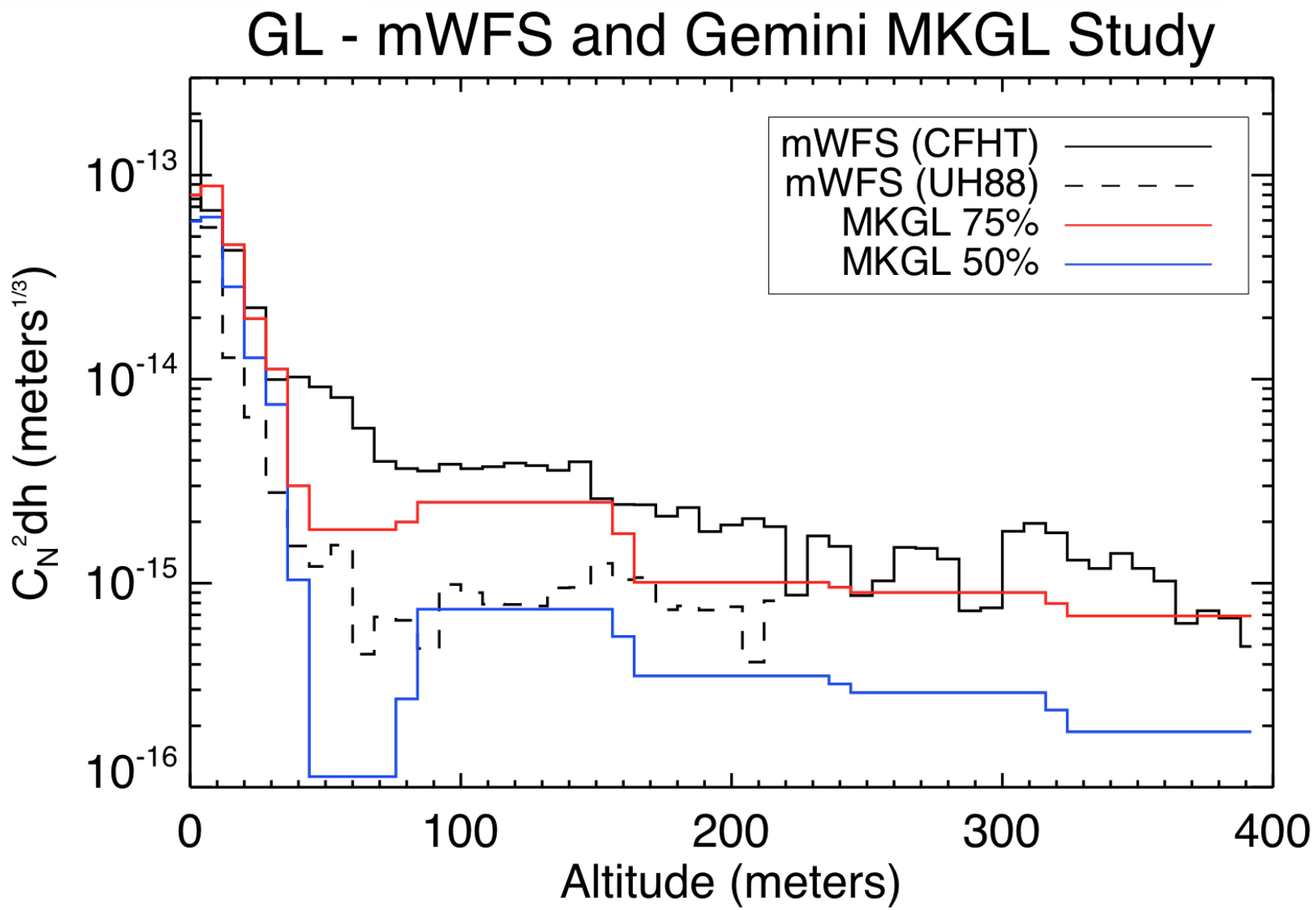
# RESULTS

## PROFILE COMPARISON



# RESULTS

## AVERAGE PROFILE



# RESULTS

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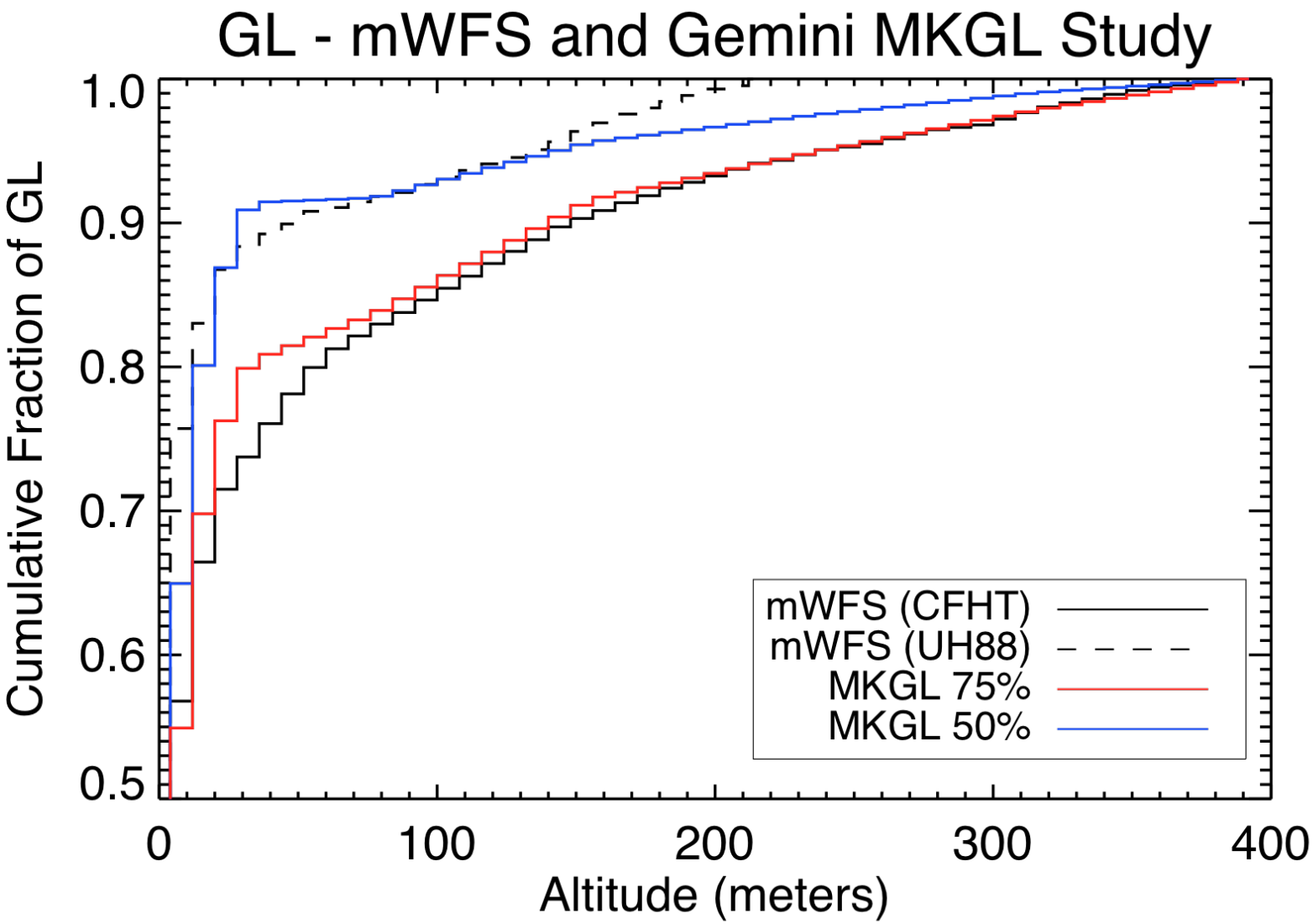
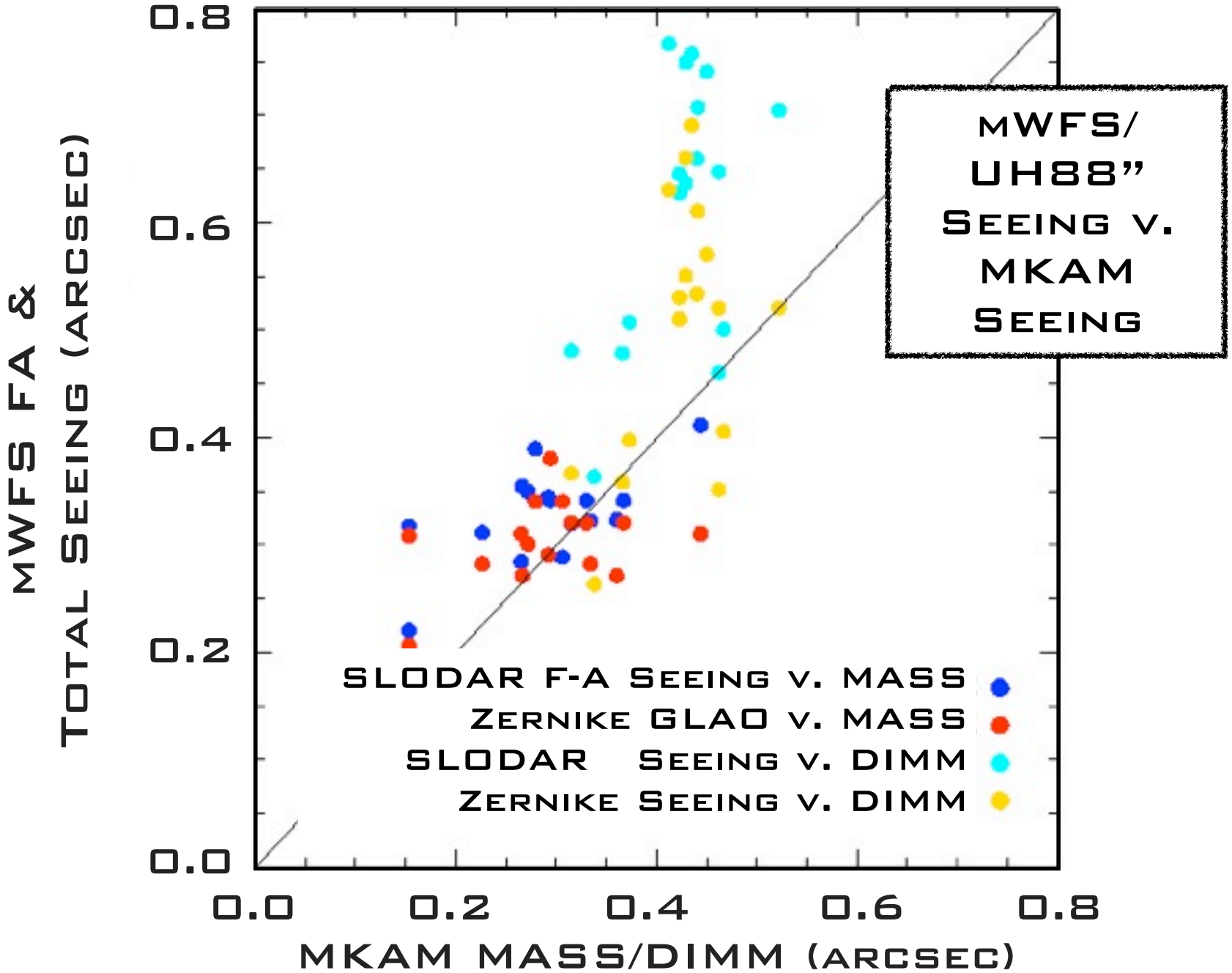
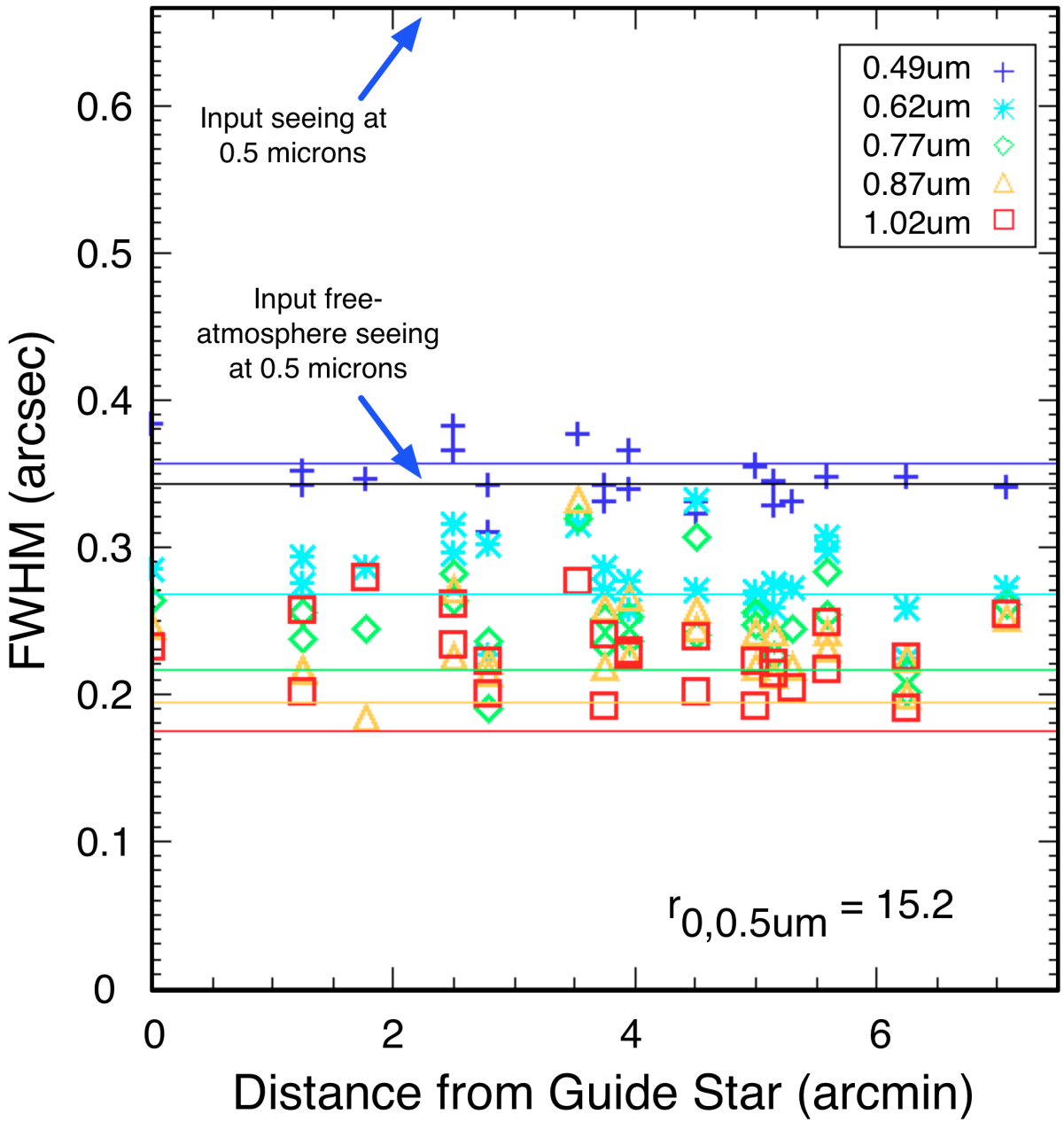


# RESULTS

## GLAO PERFORMANCE



# GLAO Performance - mWFS/UH88 profile



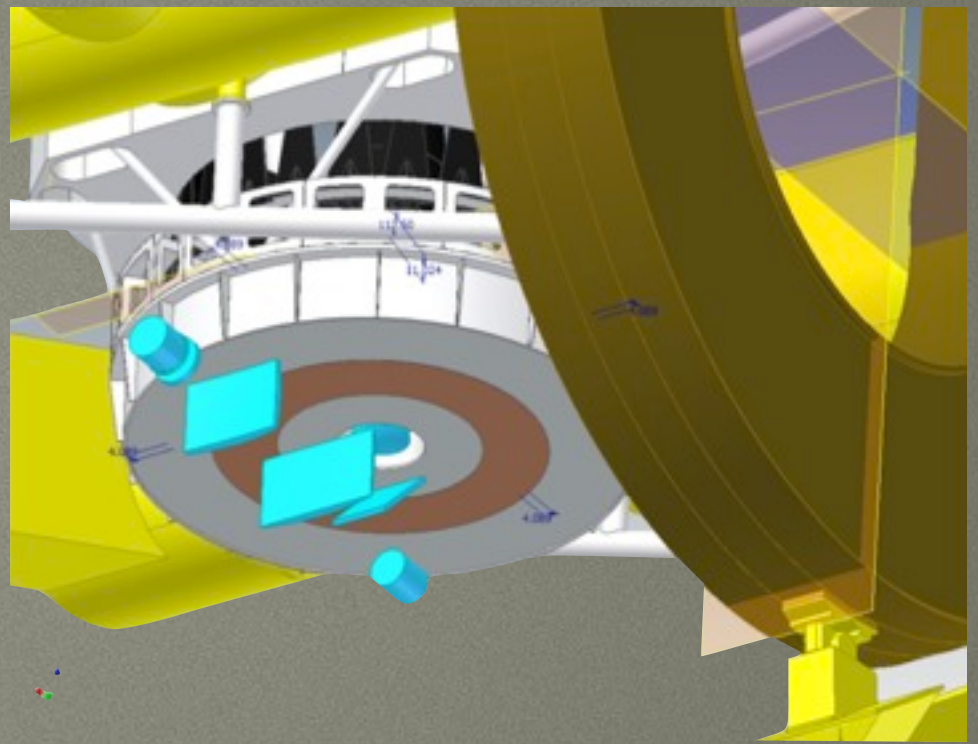
mWFS/CFHT Prime

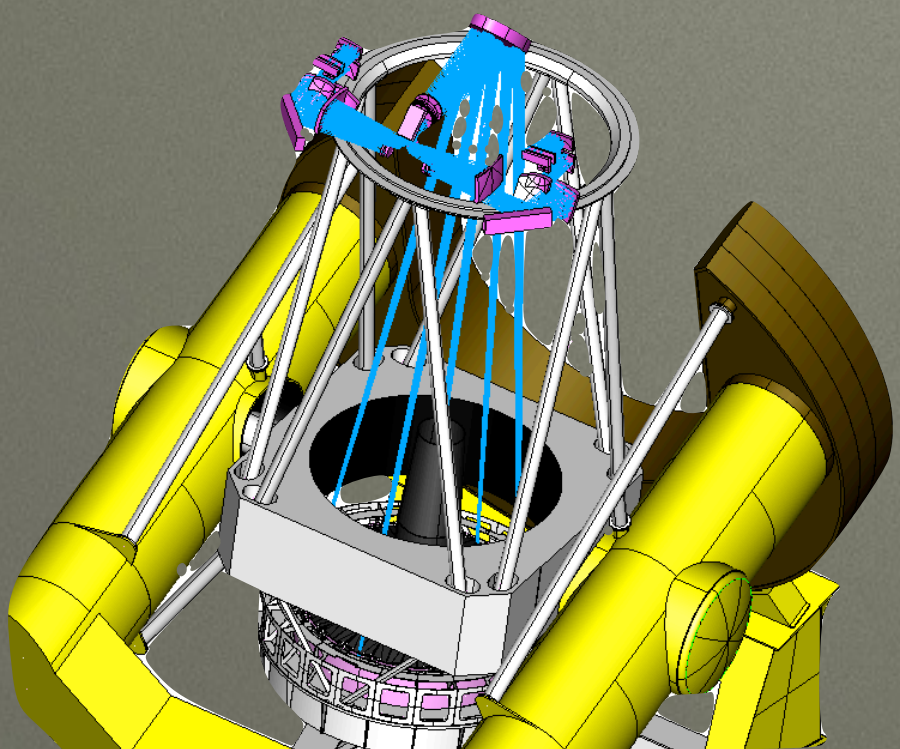
## GOAL

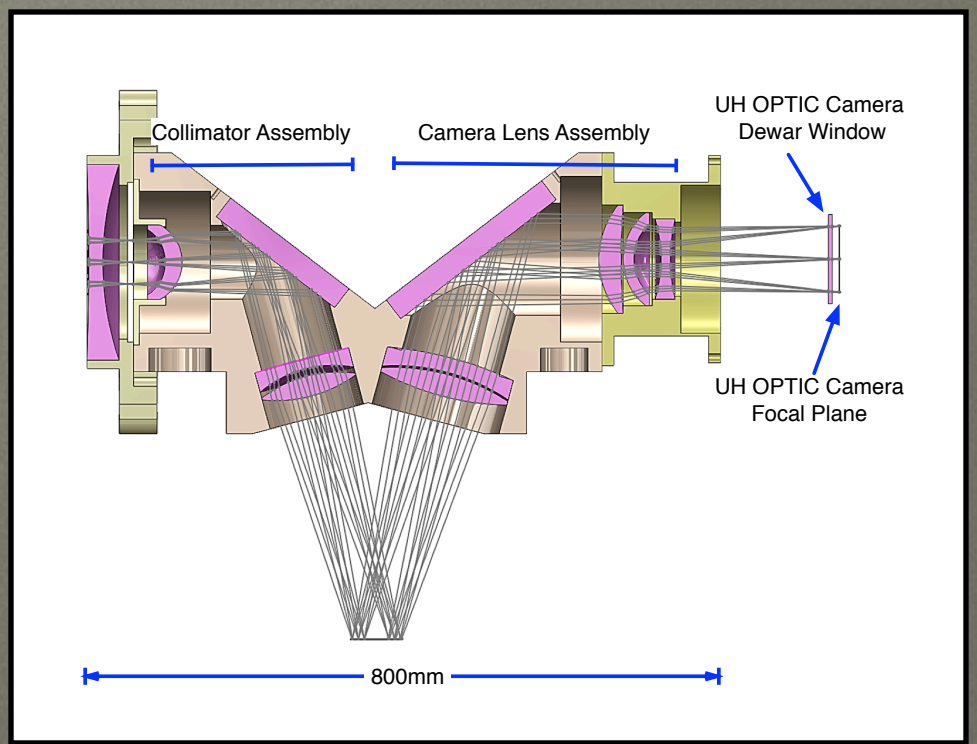
*Do we really see large correlations of the wavefronts over these large angles when we look thru the telescope?*

*YES!*

# Realizing `imaka

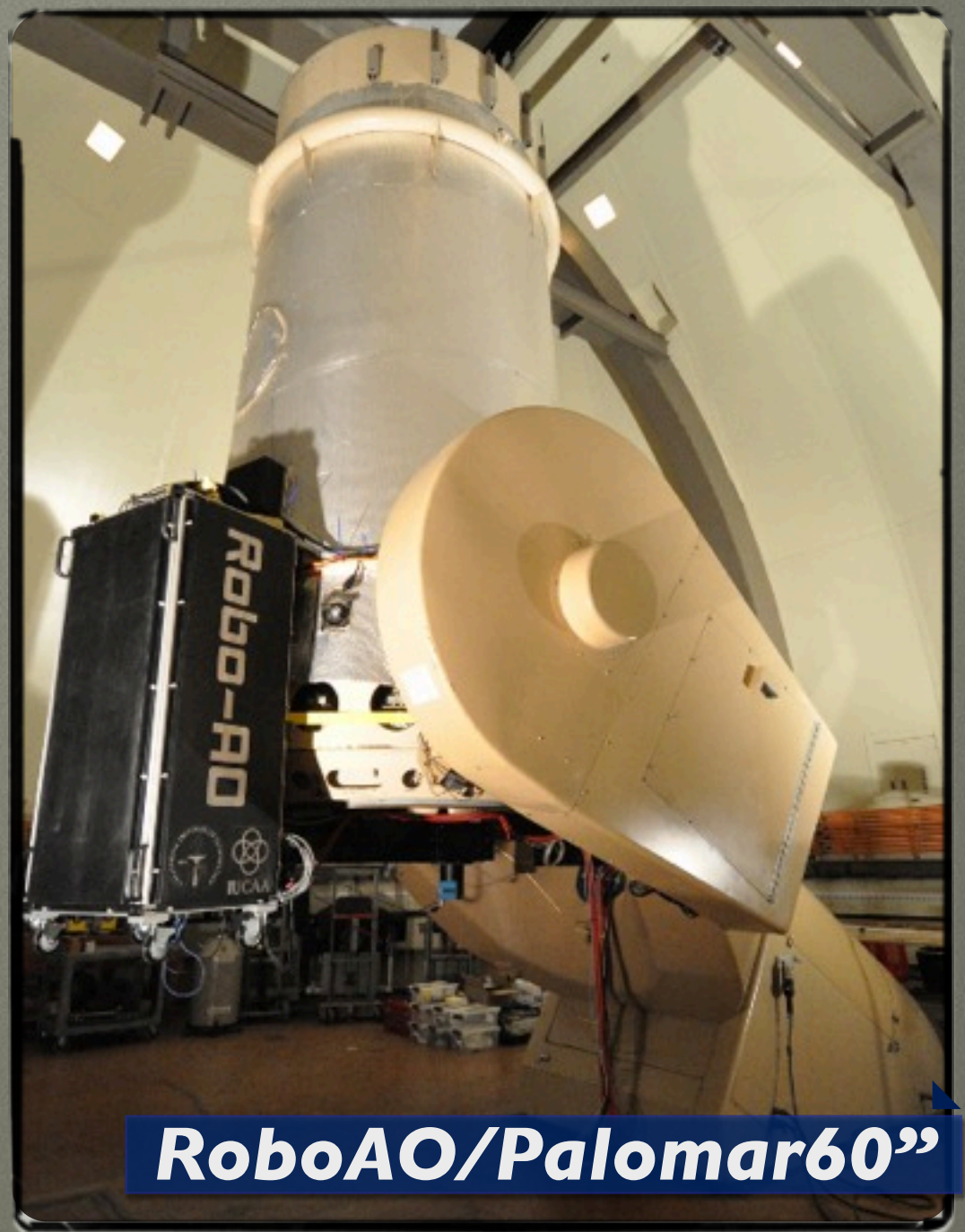






# ROBO-AO

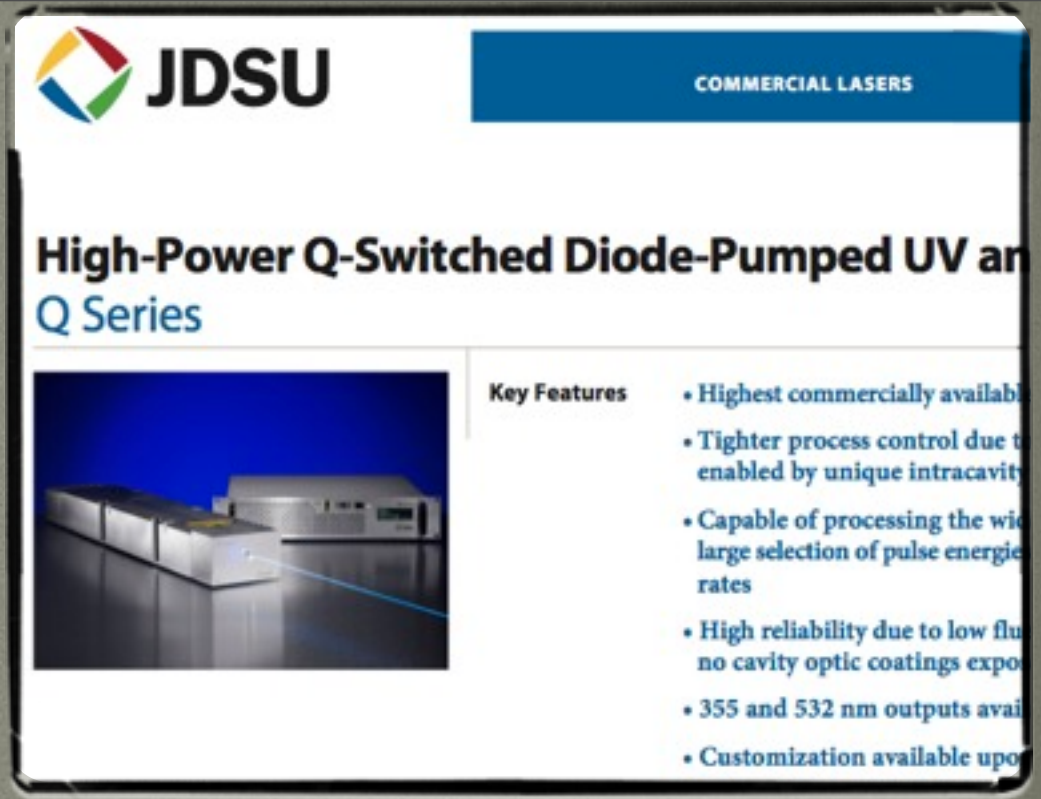
- An autonomous, rapid-response Rayleigh LGS AO system running on the Palomar P60
- Not GLAO but a "classical" LGS AO at visible wavelengths
- Telescope and RoboAO are routinely by one person in a scripted and automated observing procedure.



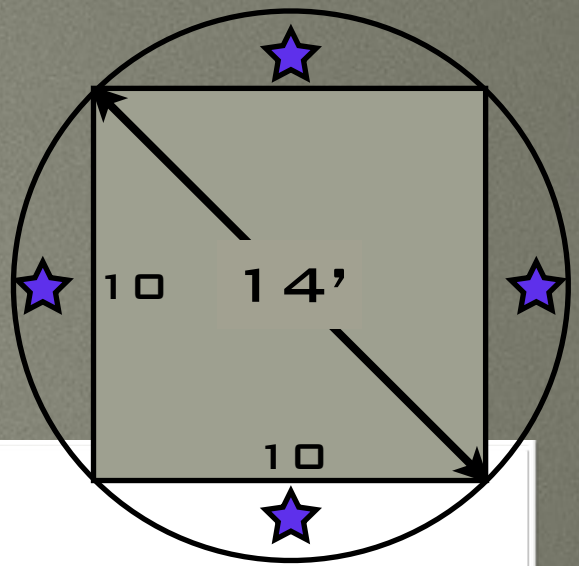

RoboAO/Palomar60"

# ROBO-AO

- Uses a commercial UV laser (~$100k) to produce a LGS at ~10km range
- Off-the-shelf item for machining silicon, metals, etc.
- Launched beam is Eye-safe (no FAA)
- Palomar has flexible "window" with Space Command - not target specific




# `Imaka with rLGS




- We have a conceptual design for a 14' diameter FOV `Imaka on CFHT
- rLGS provide same sky coverage as full `Imaka (limited by tip/tilt guide star)
  - copy RoboAO launch, WFSs, and s/w
  - maybe synergy with other GLAO projects
- "cone effect" does not effect GLAO performance.

# `IMAKA PERFORMANCE UPDATE

- `IMAKA w/rLGS on periphery of 14' diameter FOV.

| | FWHM | NEA | 5σ, 1hr | σ=1mas in 1hr |
|---|---|---|---|---|
| g | 0.39" | 0.95as$^2$ | 26.6 | 21.1 |
| r | 0.34" | 0.83as$^2$ | 26.4 | 21.1 |
| i | 0.31 | 0.73as$^2$ | 26.0 | 21.3 |
| z | 0.30" | 0.68as$^2$ | 25.5 | 20.9 |
| Y | 0.29" | 0.63as$^2$ | 24.2-24.5 | ~20 |
| J | 0.27" | 0.59as$^2$ | >24.5 | |
| H | 0.26" | 0.54as$^2$ | >24.3 | |

# Next steps...

- Work on optics
  - FOV - Increase to 20‘x20’?
  - wavelength range (UV, NIR?)
- Work with CFHT on infrastructure/impact
- Seek feedback from the community on instrument/science case (Harvey’s talk).