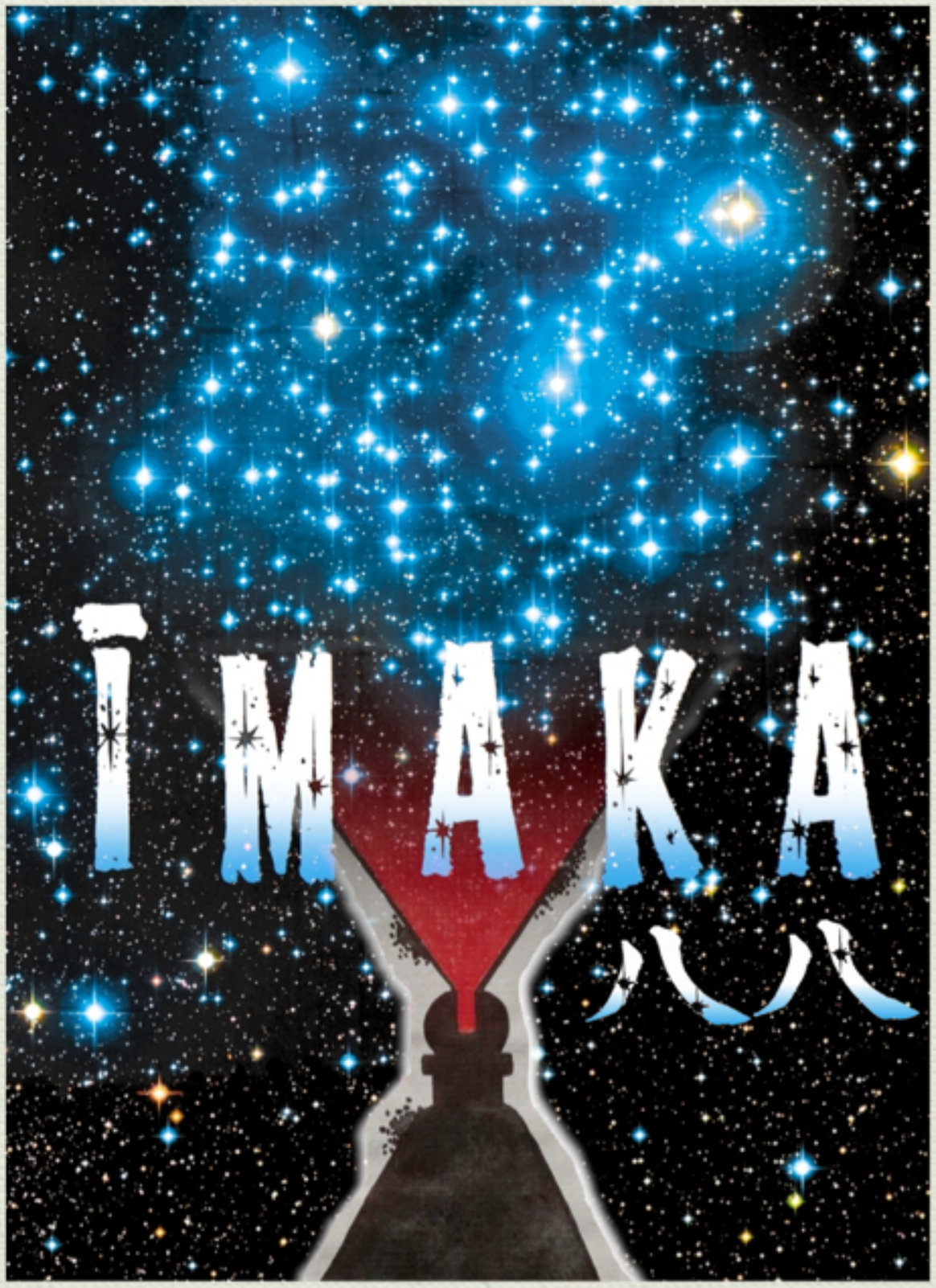


a pathfinder for wide-field GLAO for the UH2.2m on Maunakea

Mark Chun
for the imaka team

2014 Sept 15

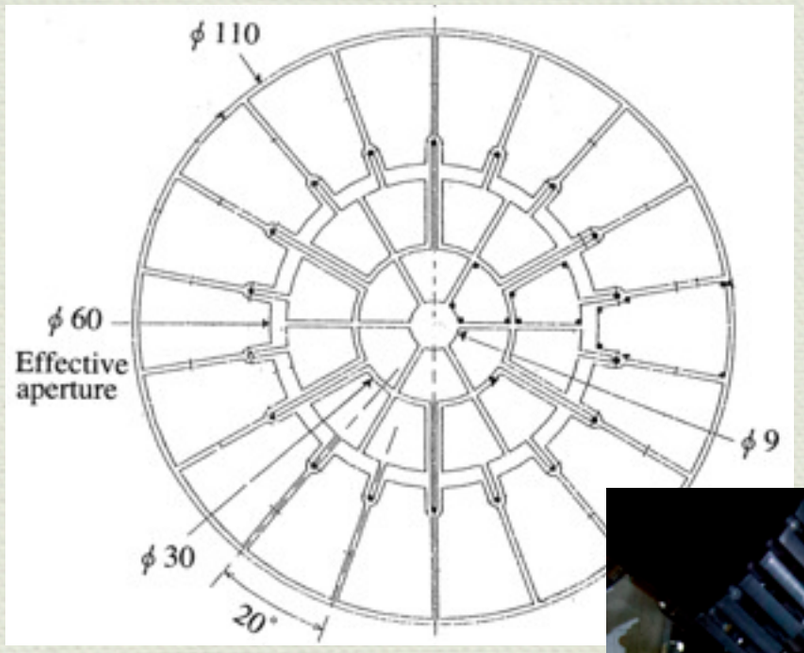
CalTech GLAO Workshop

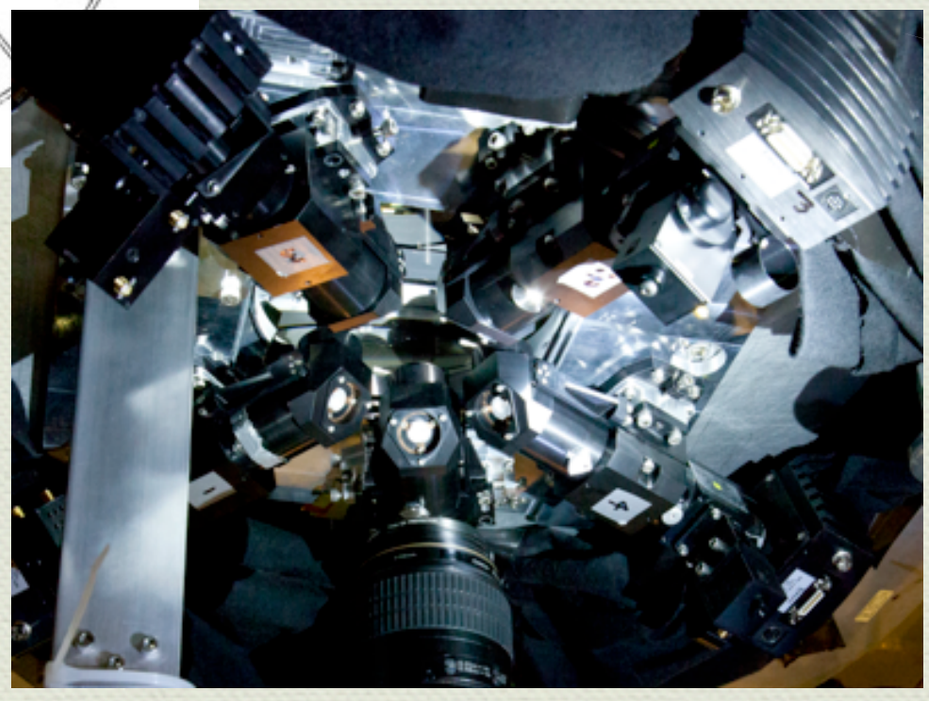
`imaka project

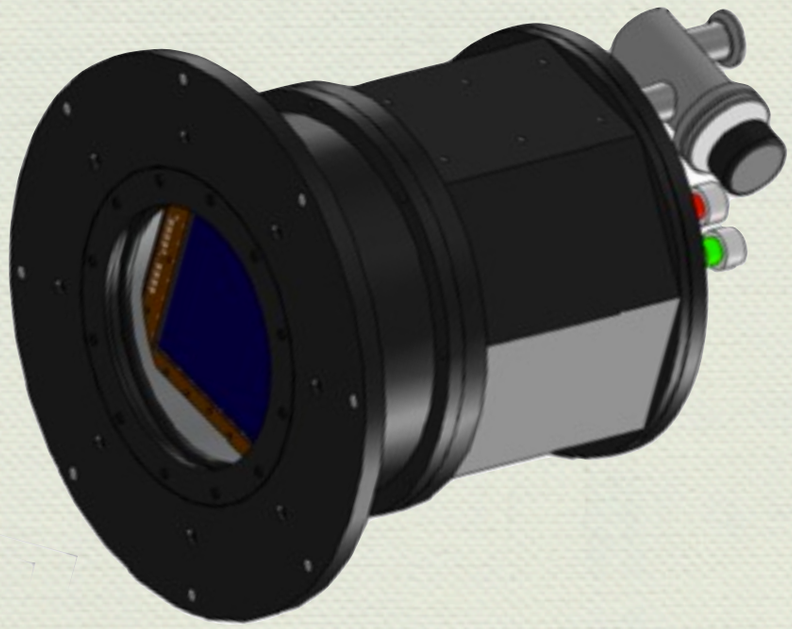
- An NSF-funded testbed for wide-field GLAO on MK to develop on-sky astronomical/AO expertise in prep for GLAO on larger telescopes.
  - reuses hardware/software/expertise from around the MK AO community including UH, Subaru, Gemini, CFHT.
  - limit ourselves to natural GSs and design to do science and technical demonstrations on a limited set of “design targets”
  - Reconfigurable final focal plane and entrance FP (cal unit)
- Lab integration next year...

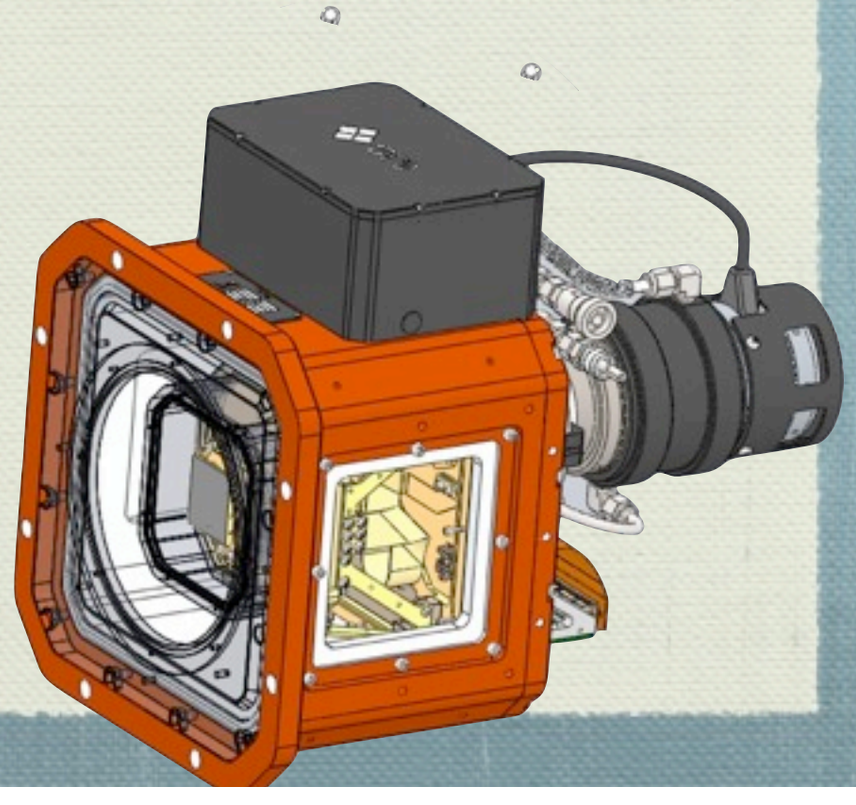
a wide-field GLAO pathfinder

Major Components from other projects





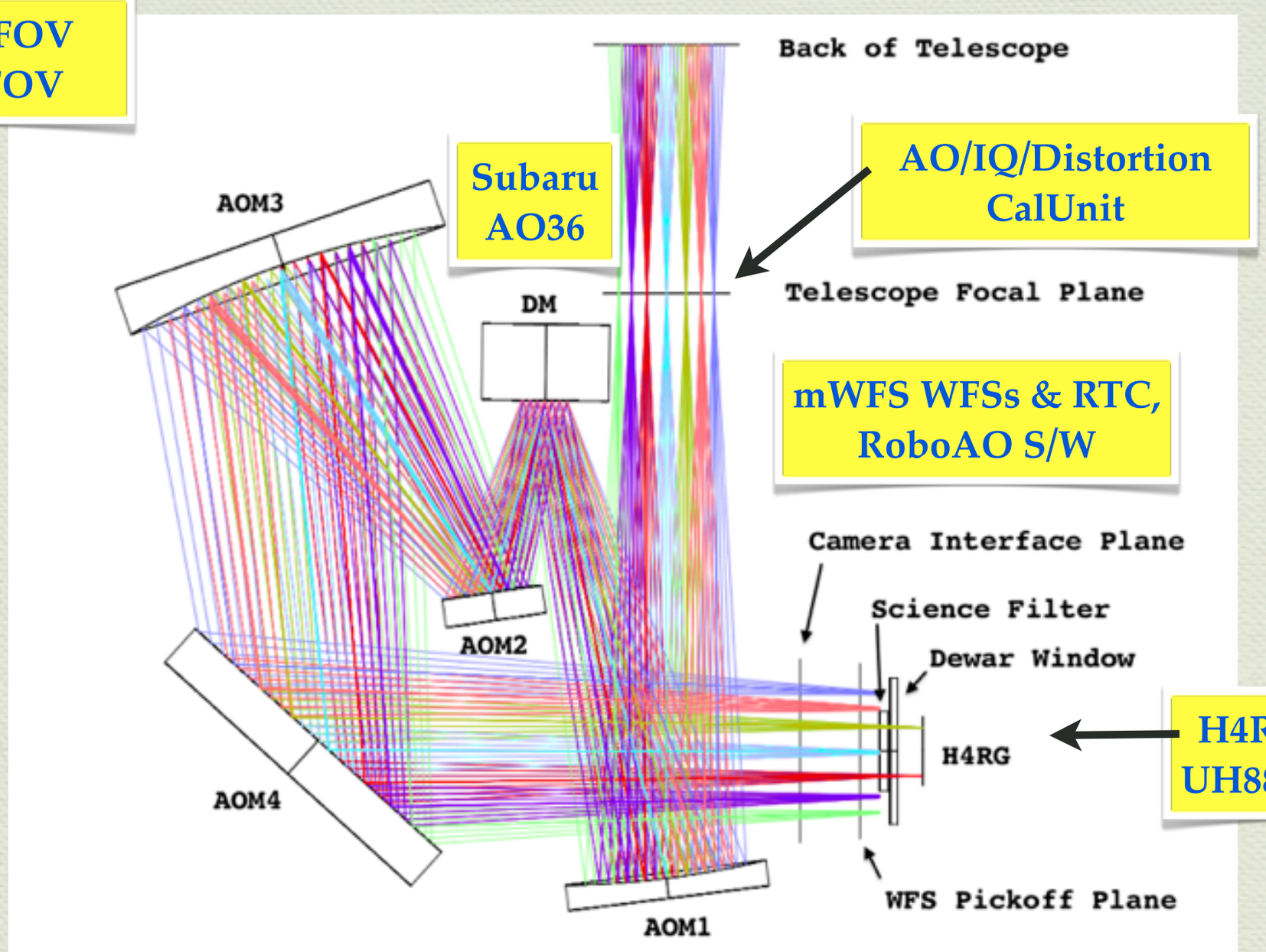




a wide-field GLAO pathfinder

Layout

0.4x0.3 deg FOV
12'x12' SciFOV



a wide-field GLAO pathfinder

Mechanical Design

- Stability and thermal changes in the alignment (IQ and distortion stability) are drivers given the overall size
- We also have a mass limitation at the back of the telescope (500# total)
- Working concept is a carbon-fiber box structure with light-weighted mirrors

a wide-field GLAO pathfinder

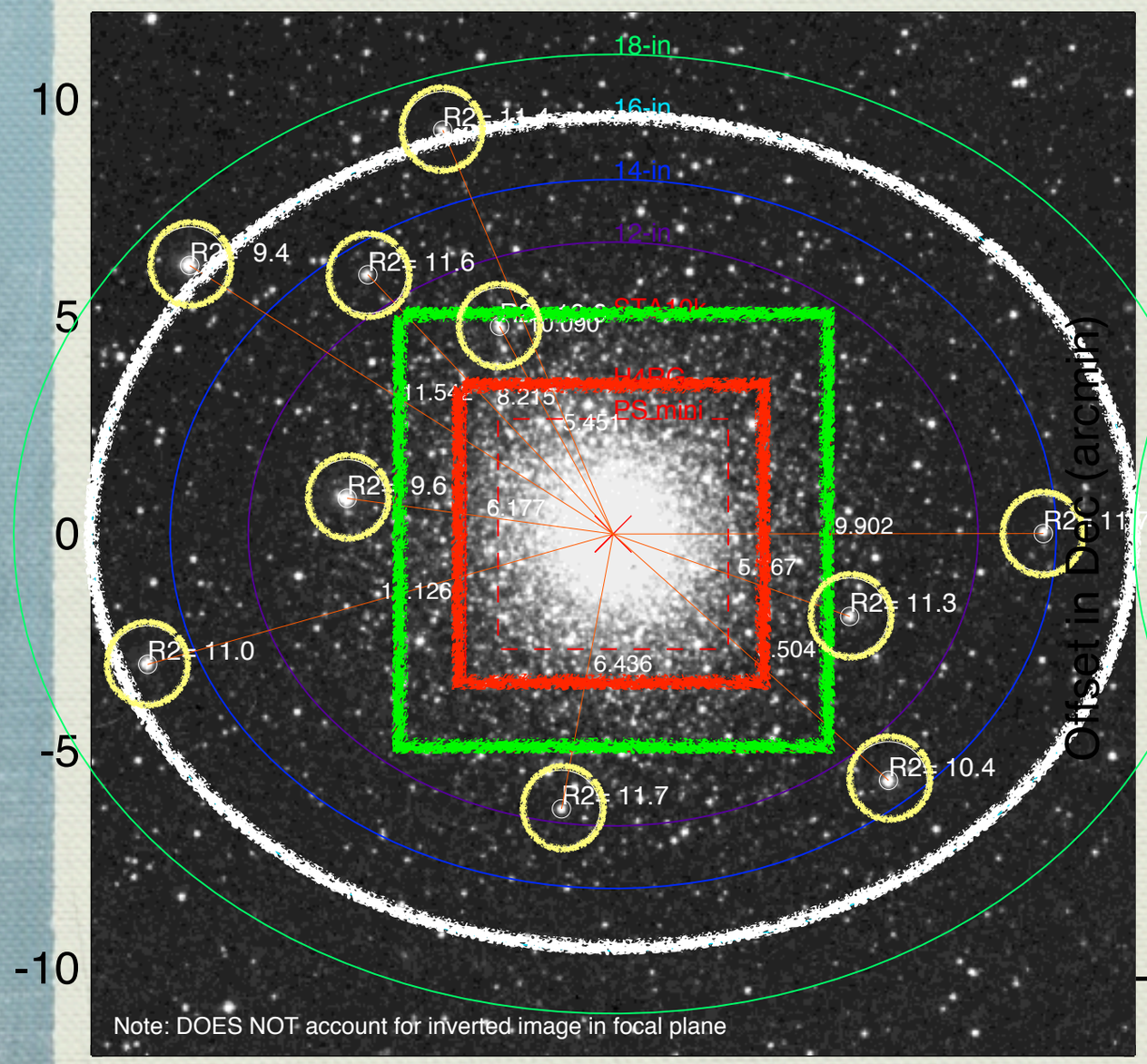
Basic System Specs

AO Relay	0.4 x 0.3 deg acquisition for GS 12'x12' "Science FOV"
DM	CILAS curvature bimorph from Subaru AO36
WFSs	3-5 SHWFSs with 8x8 subap, 10 pixels/subap, 0.4" /pixel, Pupil Imaging mode
RTC	COTS PC and RoboAO s/w, 200Hz sampling
Science Cameras	STA10k H4RG-15

a wide-field GLAO pathfinder

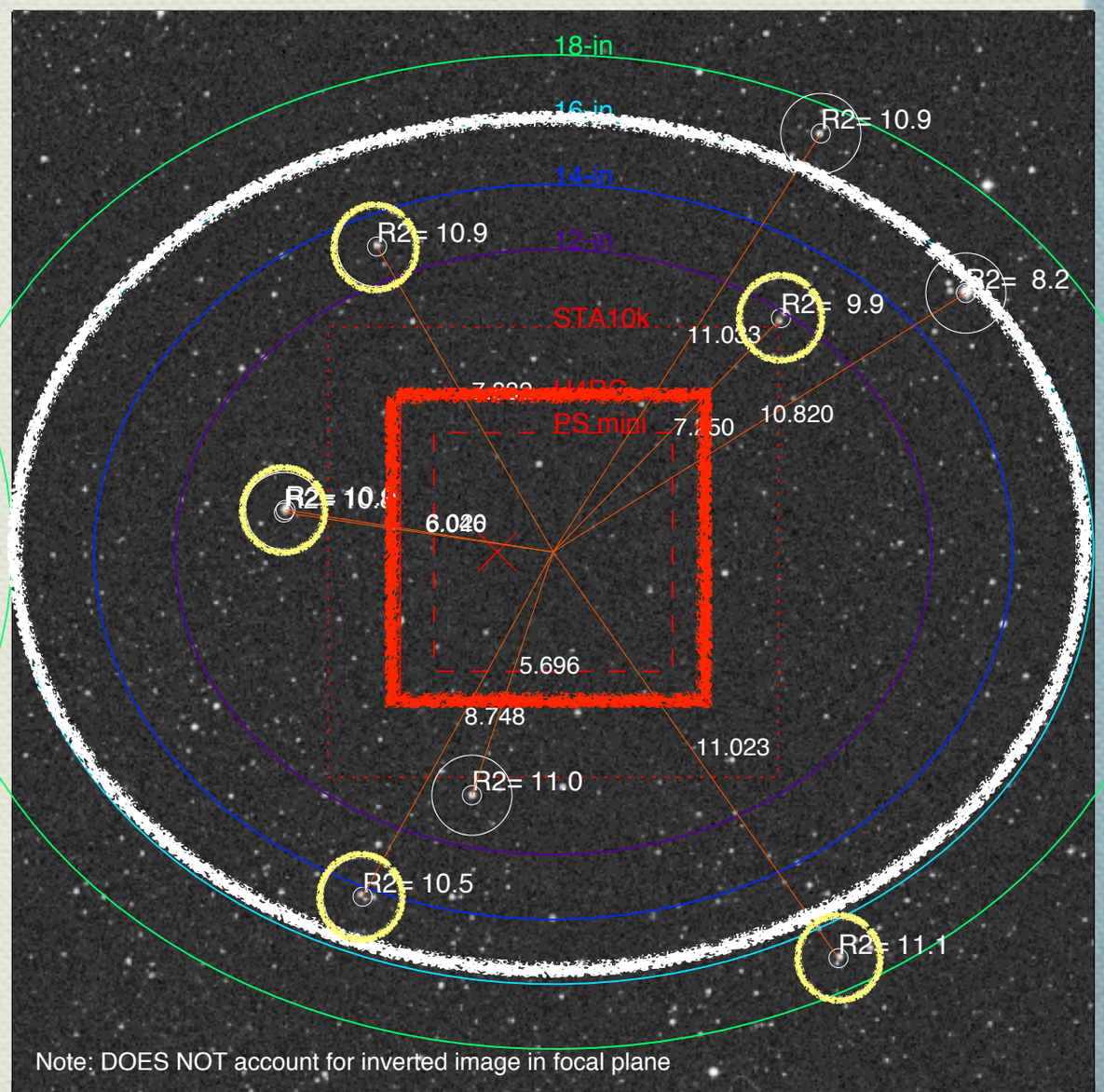
Example Fields

M92-USNOB



Offset in RA (arcmin)
FldCenter: (259.2808, 43.1358)

RSGC2-USNOB



Offset in RA (arcmin)
FldCenter: (279.8125, -6.0861)

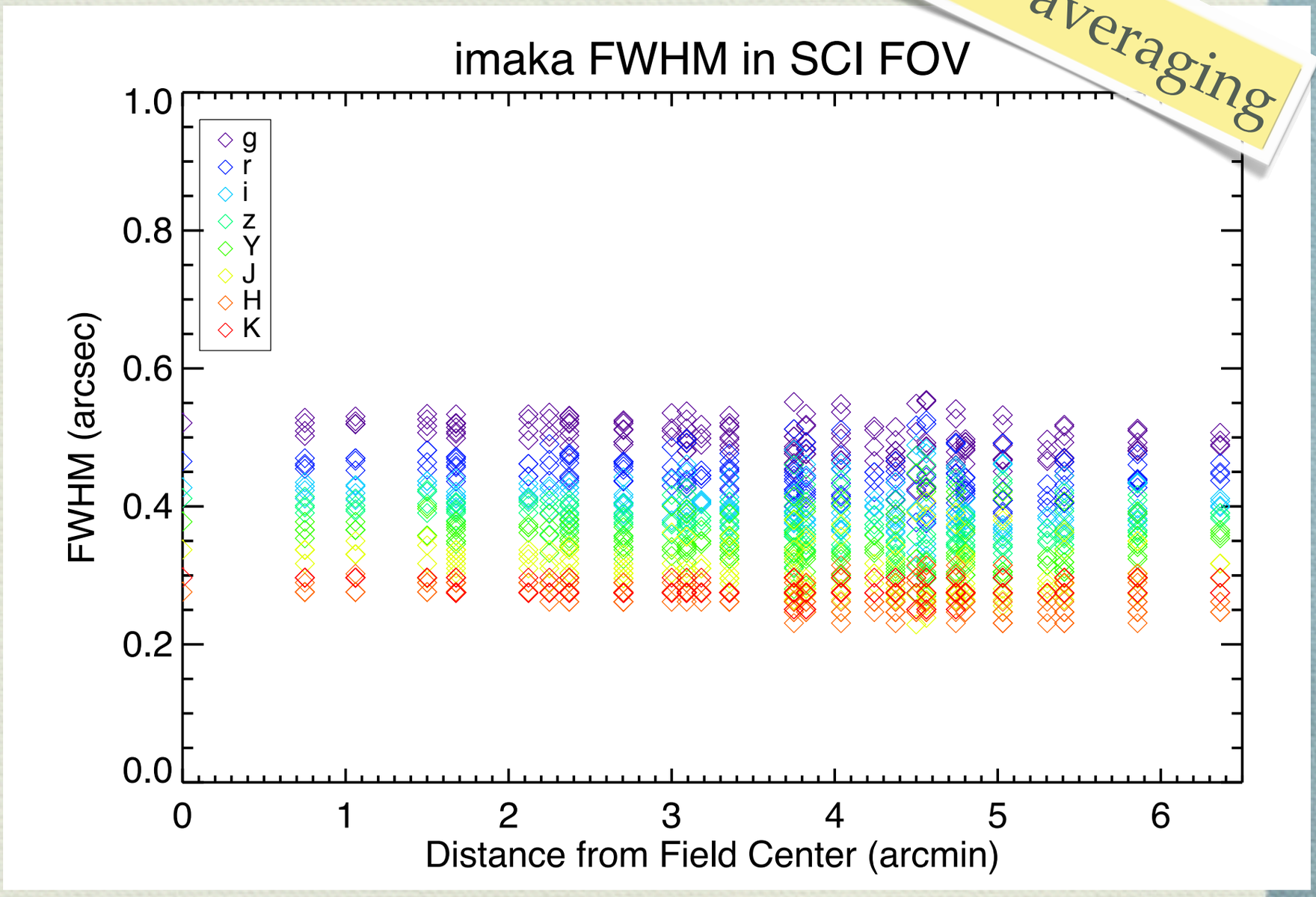
a wide-field GLAO pathfinder

Performance Estimates

N.B.

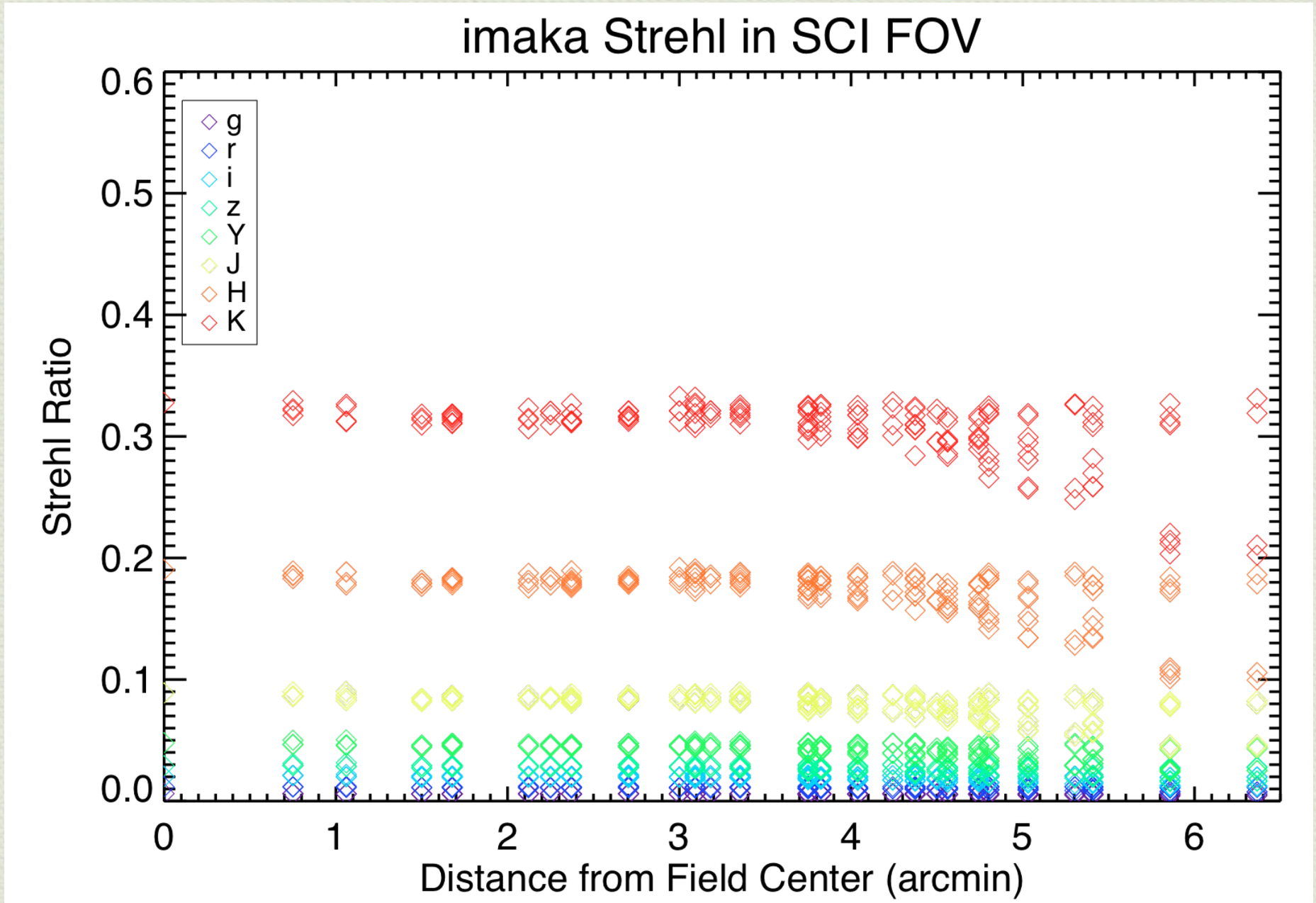
WFS averaging

- Developing error budgets and Monte-Carlo simulations
- Agree in FWHM ~ 10%
- Detailed PSFs from simulations
- NCP errors...



a wide-field GLAO pathfinder

Performance Estimates



Performance Metrics

- Usual: FWHM, Wavefront Variance? Strehl?
- Equivalent Noise Area (King 1983 PASP)
  - The optimal aperture size for an isolated background limited point source.
  - King relates this to the shape of the PSF

$$ENA = \alpha / \sum f_i^2 = 1 / \int_{dA} \phi^2 dA$$

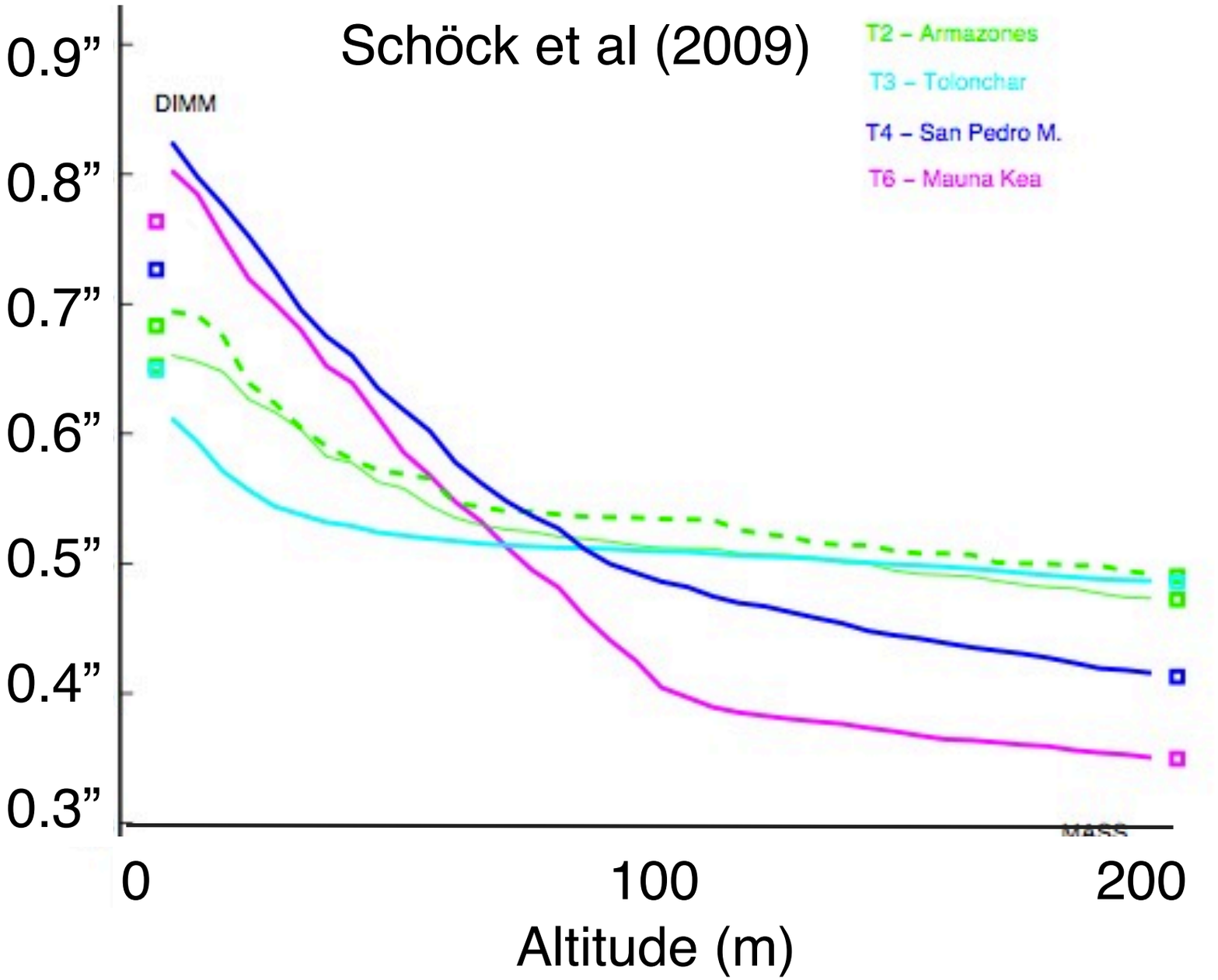
  - Easily related to point source sensitivity, astrometric error
  - ENA x2 better GLAO. time to SNR down x2. "centroid error" down x3

`imaka Team

- Mark Chun, Jessica Lu, Christoph Baranec, Mike Connelley (UH)
- Olivier Lai, Yutaka Hayano, Shin Oya (Subaru/NAOJ)
- Doug Toomey (Mauna Kea Infra-Red)
- Simon Thibault, Denis Brousseau (Laval)

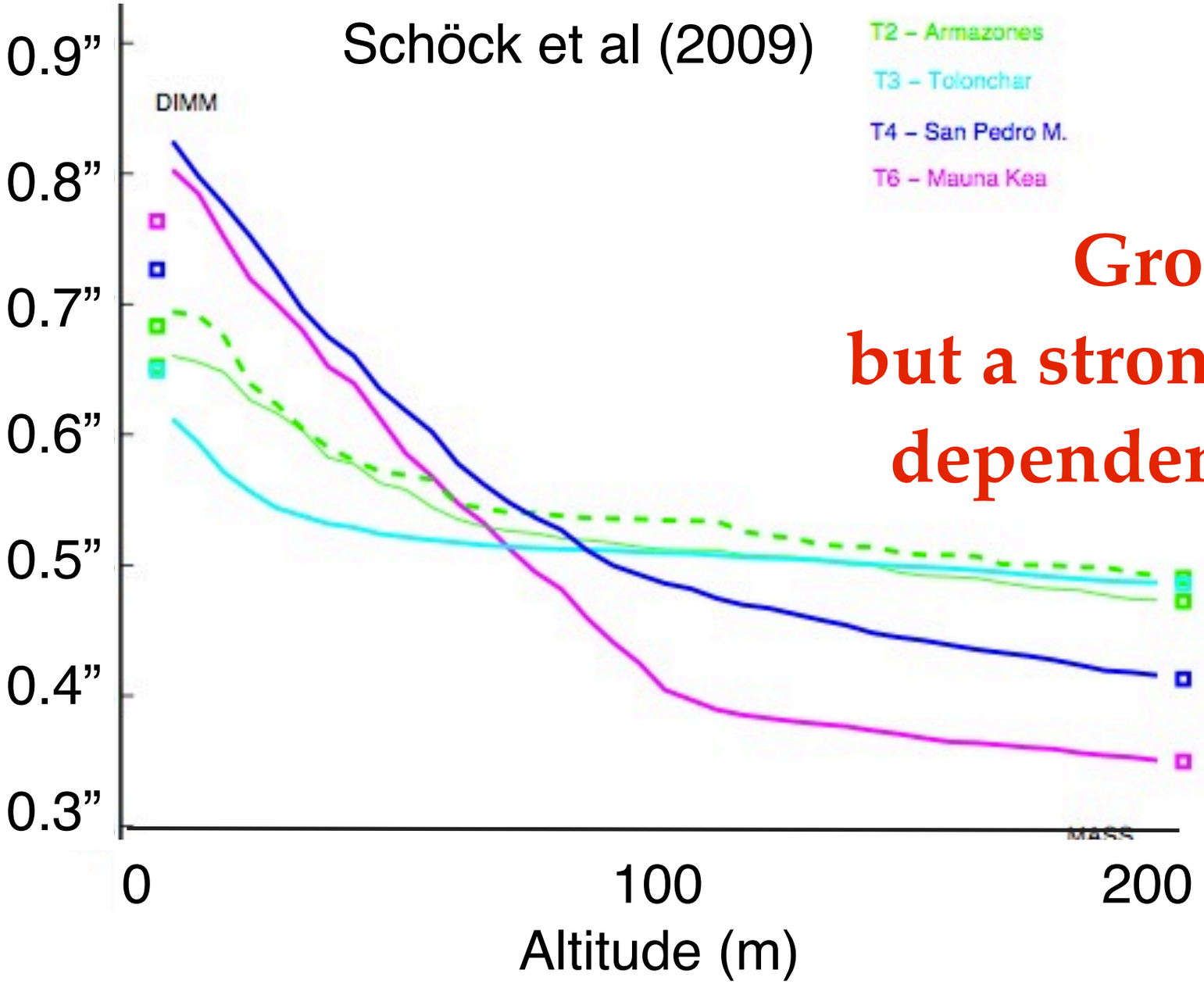
http://www.ifa.hawaii.edu/~mchun/imaka.html

Seeing from above 13N (TMT)



Seeing from above 13N (TMT)

Schöck et al (2009)



Ground-Layer AO
but a stronger FWHM-field size dependence than the summit