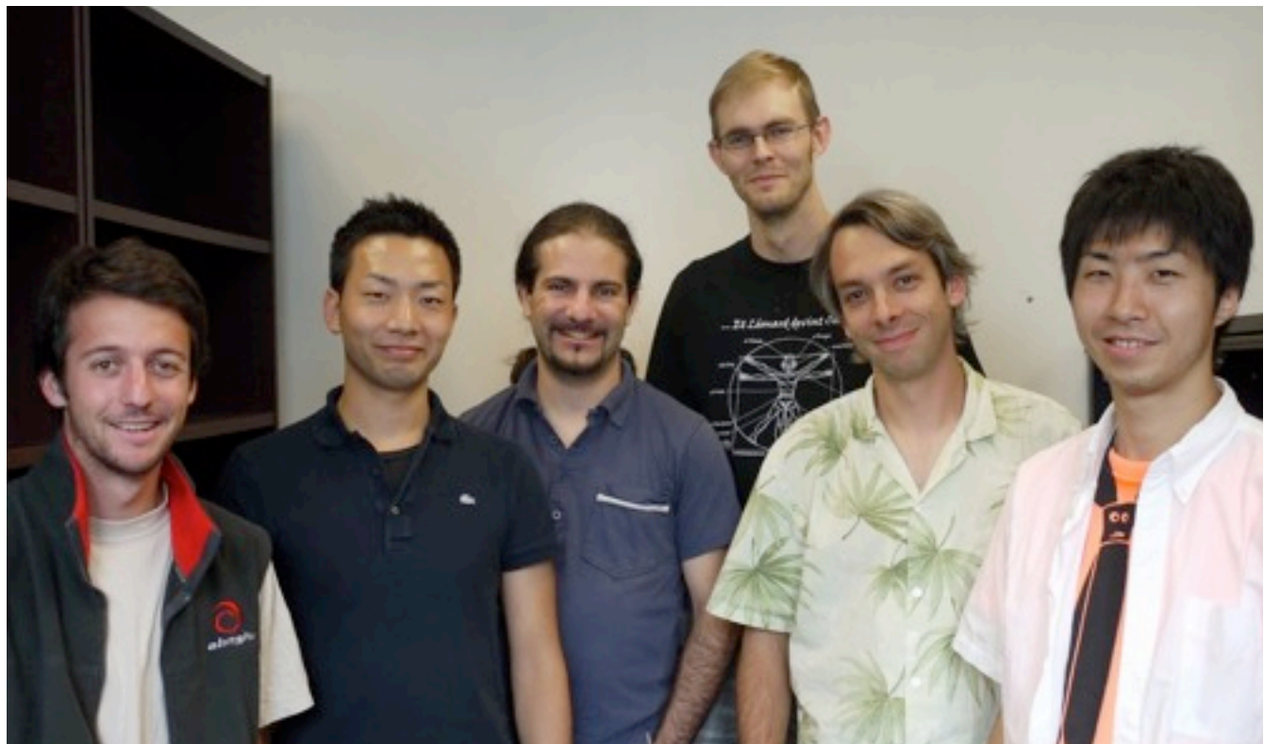
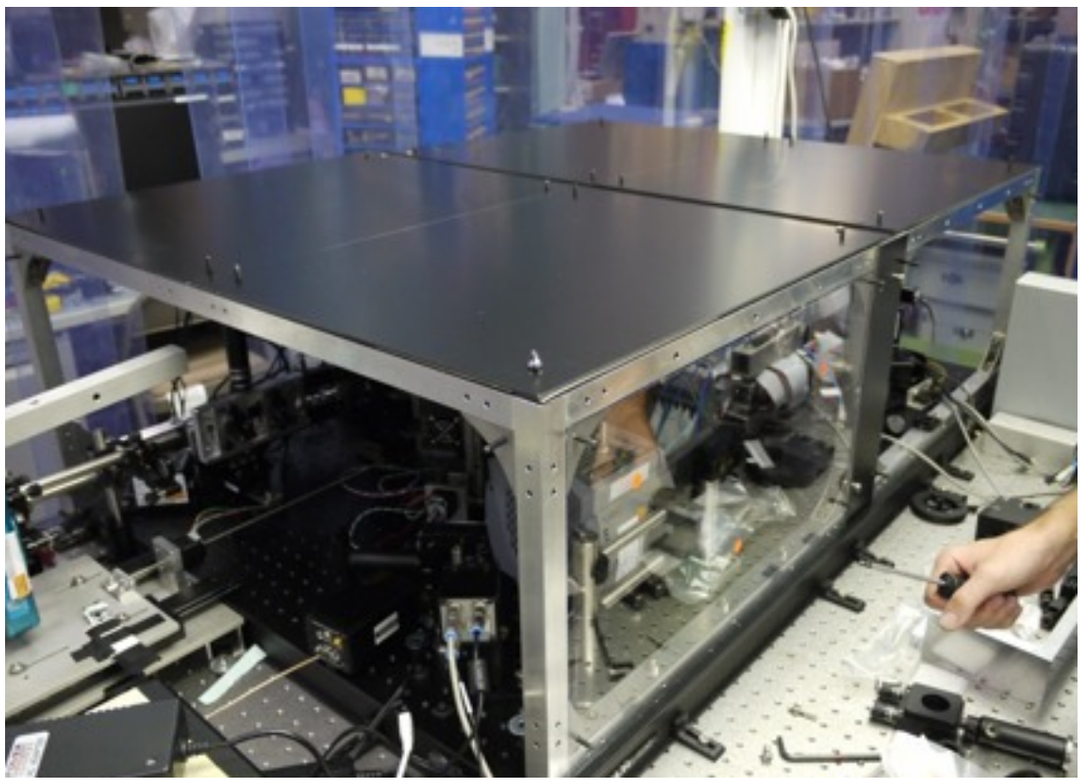




The Subaru Coronagraphic Extreme AO Project

Frantz Martinache, Olivier Guyon, Motohide Tamura
& the SCExAO group!

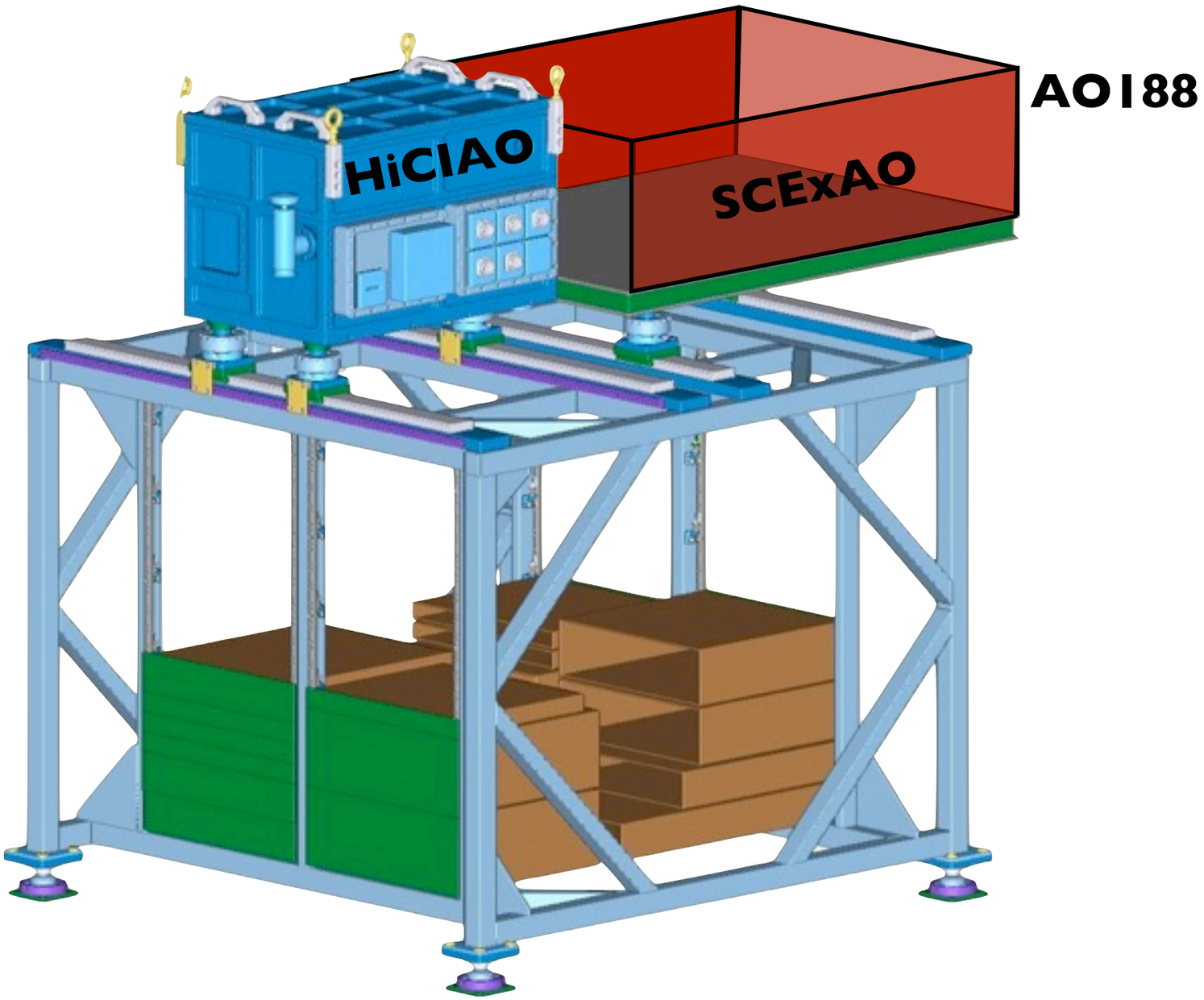
Project URL: http://www.naoj.org/Projects/SCEXAO/

SCExAO?

the idea: replace HiCIAO's fore-optics when needed, with "something" to probe low angular separations

take advantage of a bunch of cool tech developments made in recent years @ Subaru: PIAA, WF-control, interferometry

Replace the HiCIAO frame



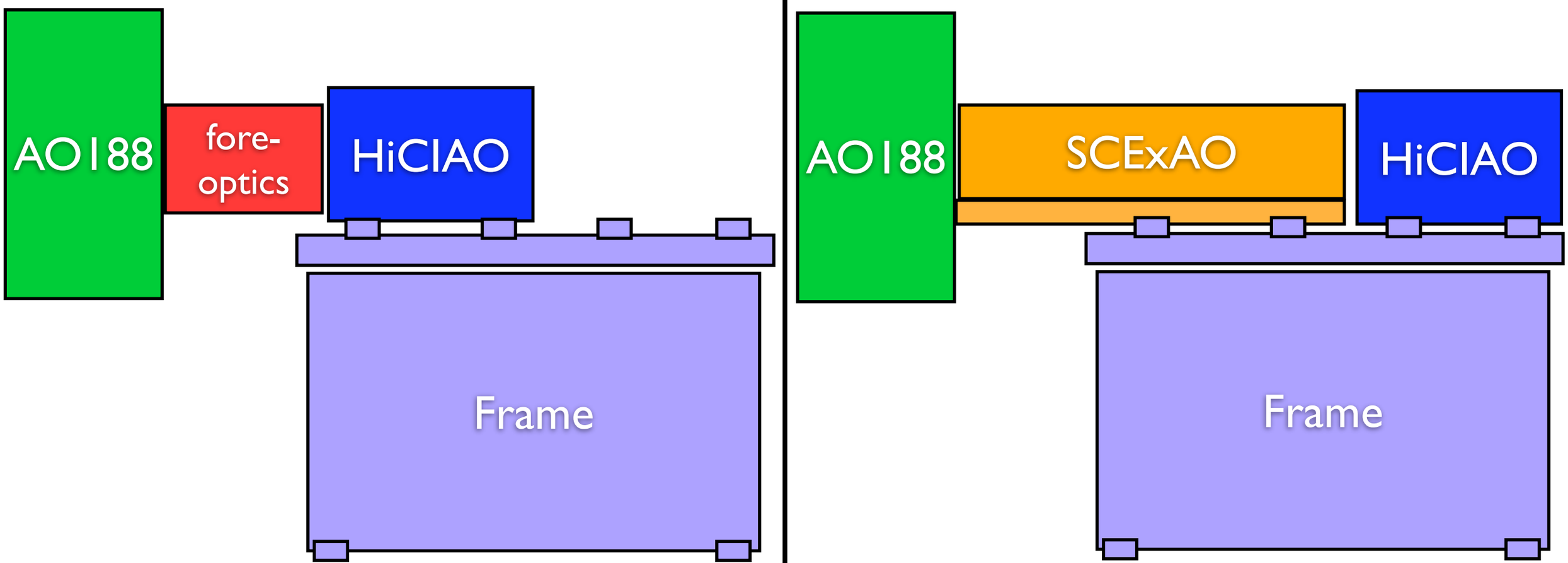
CAD drawings by Yoshi Doi

<u>New frame requirements</u>:

Emulate current frame
Accommodate HiCIAO + SCExAO + guest
More rack space
Dual position
Lighter structure

Delivery 02/2010
Tests 03-??/2010

Flexible frame for multiple modes



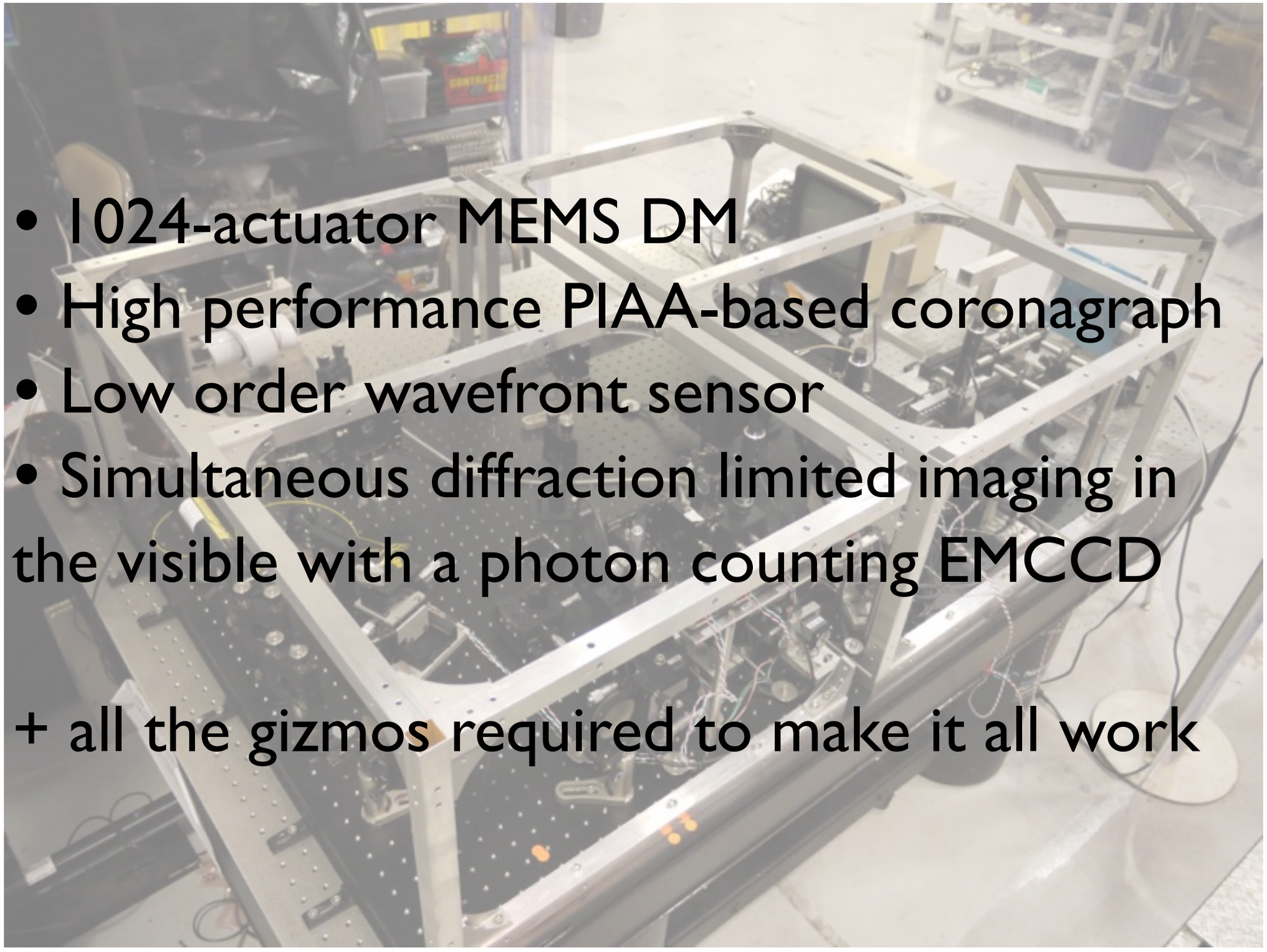
HiCIAO front position | SCExAO front position

Minimize impact on telescope and instrument interface

No mechanical interface between AO188 and SCExAO

Optical design accommodates errors of alignment

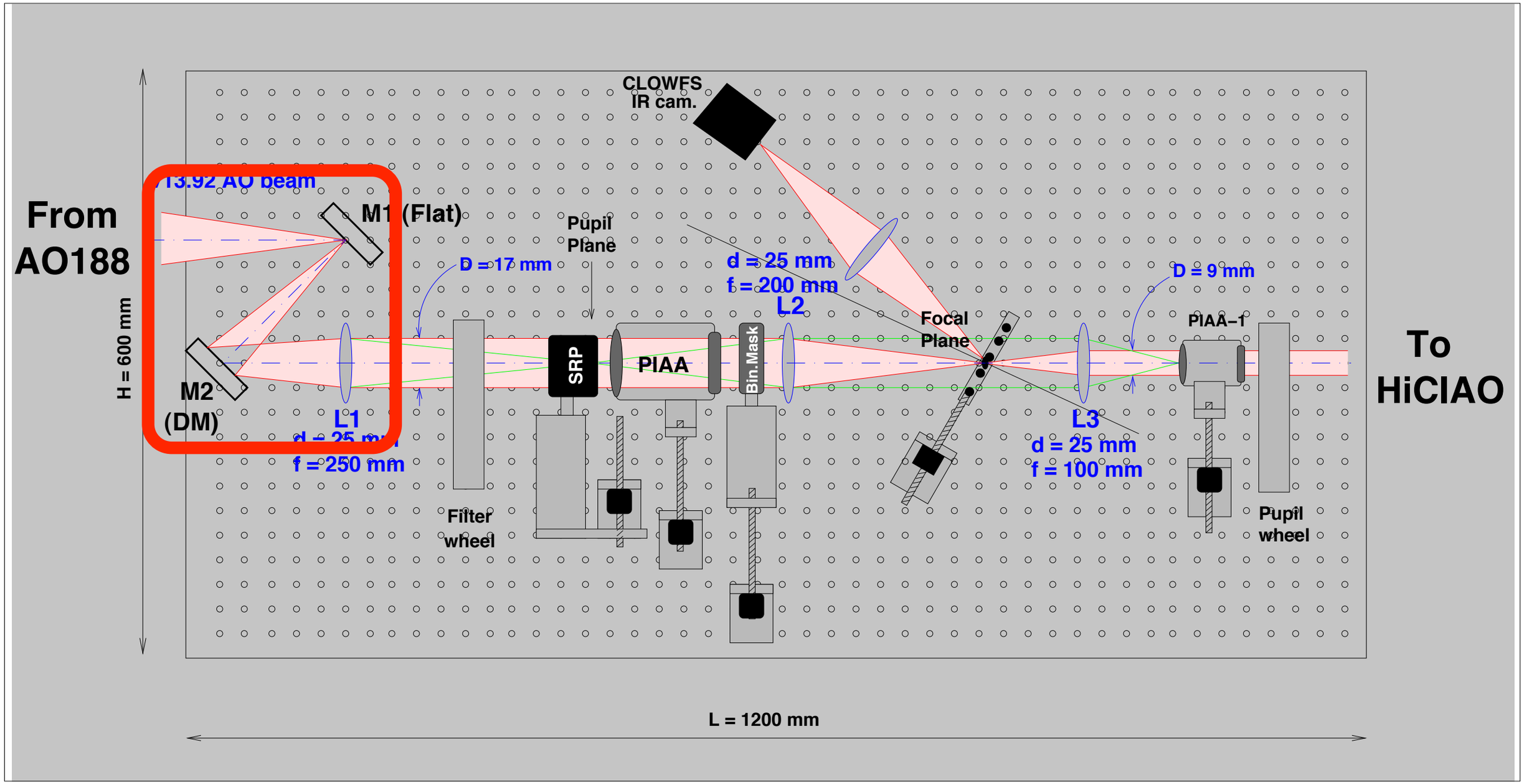
What's in the box?



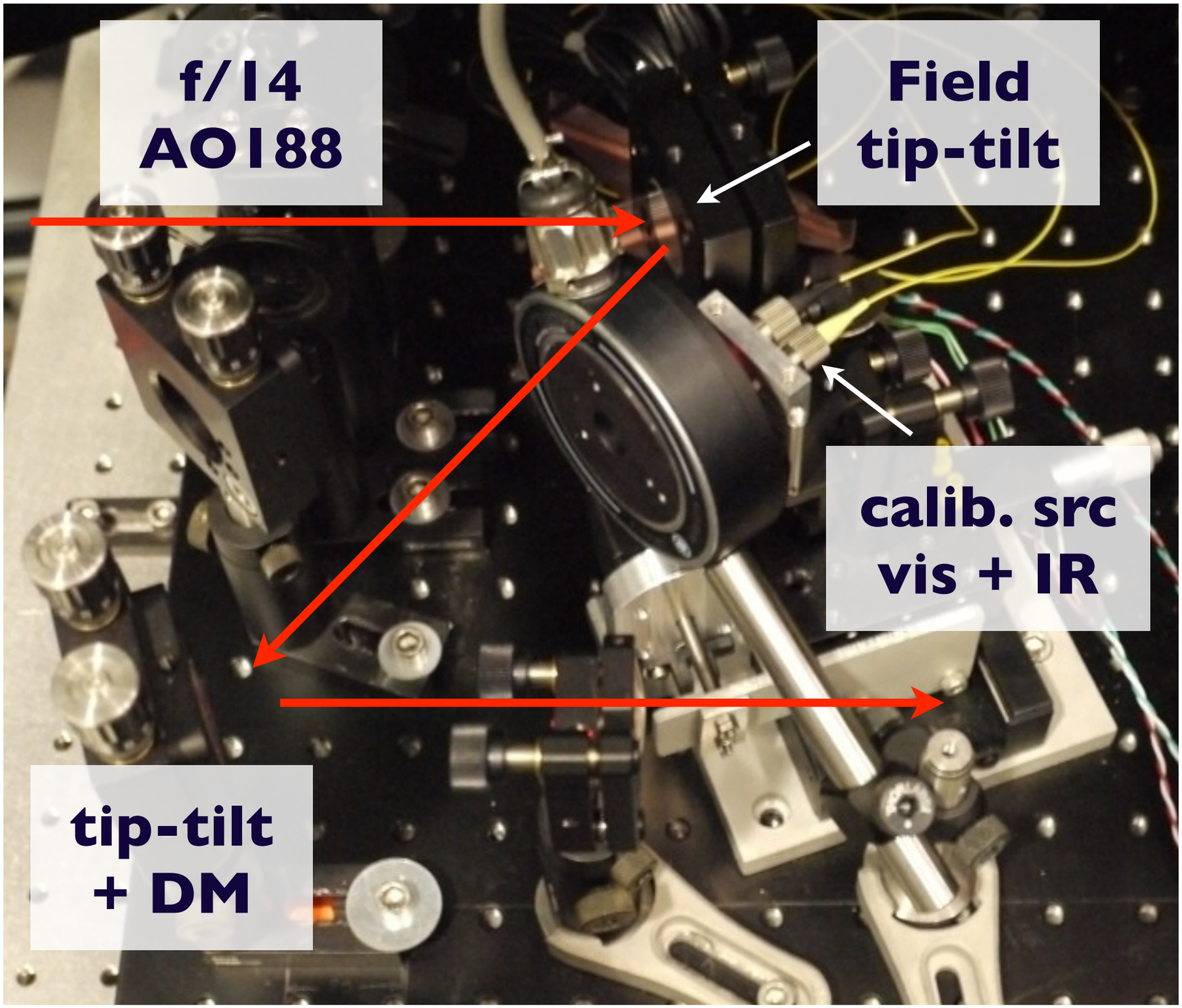
- 1024-actuator MEMS DM
- High performance PIAA-based coronagraph
- Low order wavefront sensor
- Simultaneous diffraction limited imaging in the visible with a photon counting EMCCD

+ all the gizmos required to make it all work

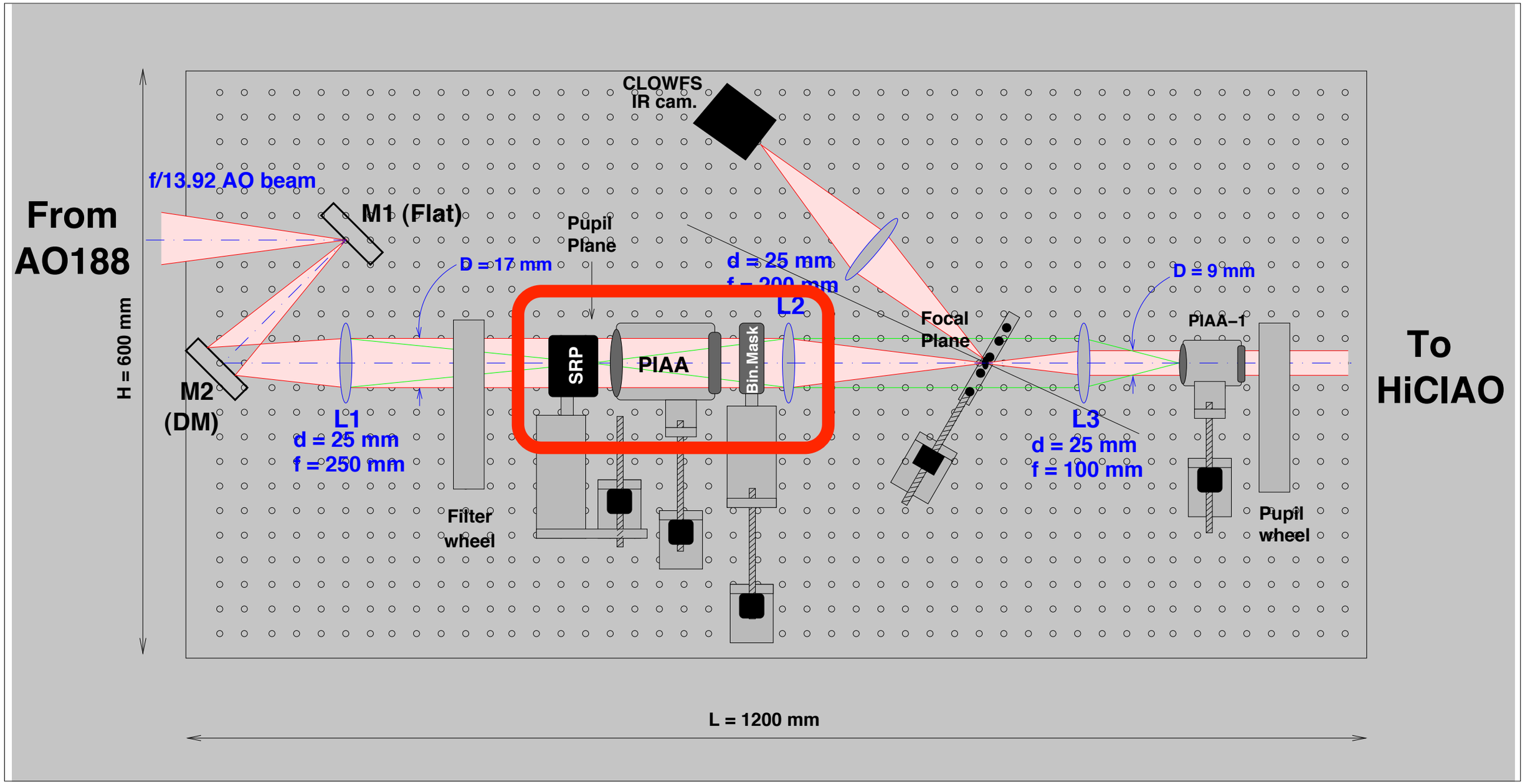
IR coronagraph phase I design

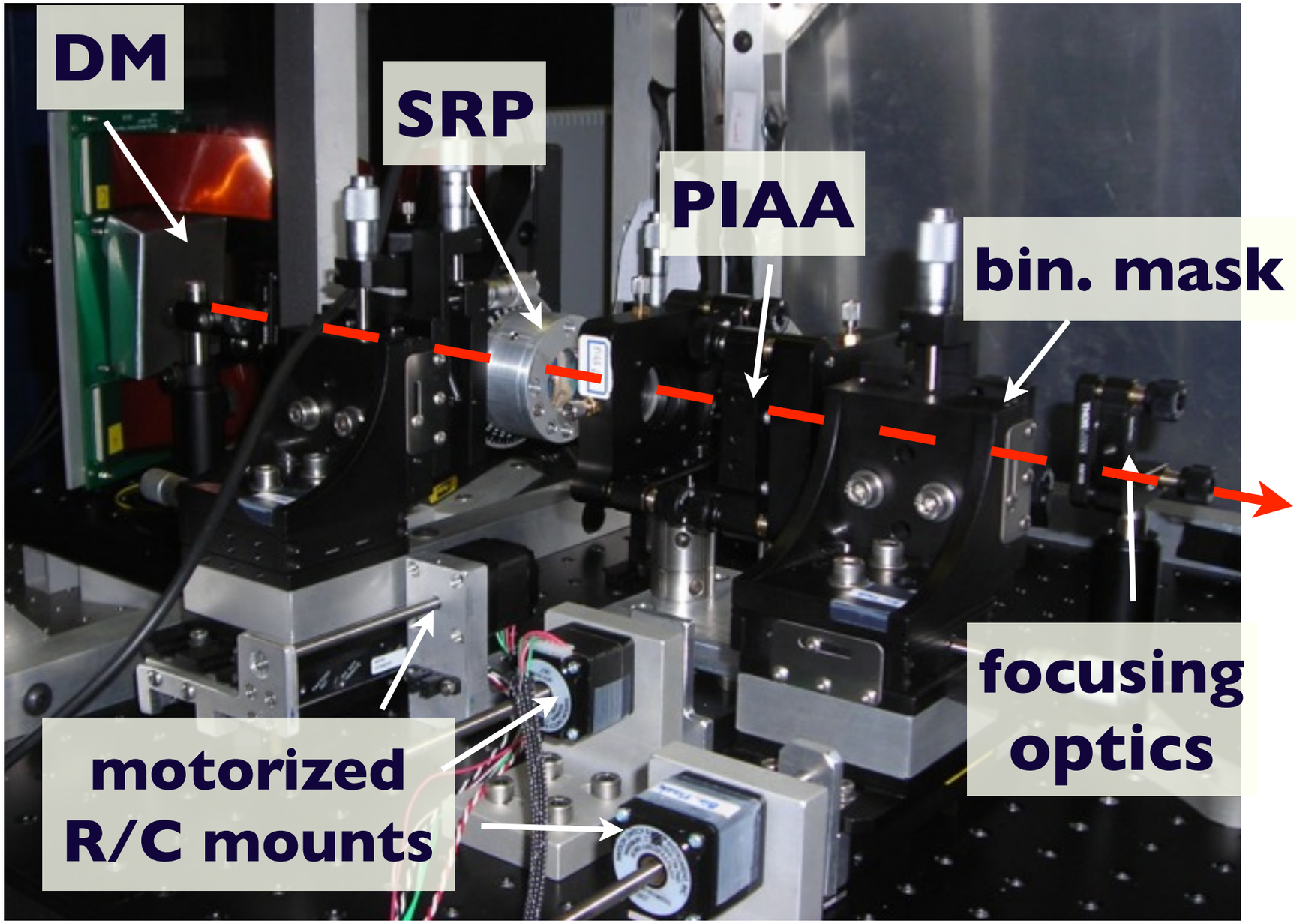


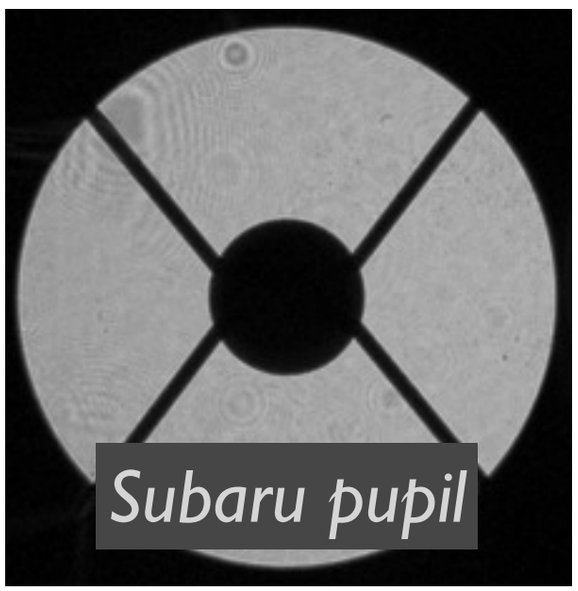
Martinache et al, 2009, SPIE, 7740, 22

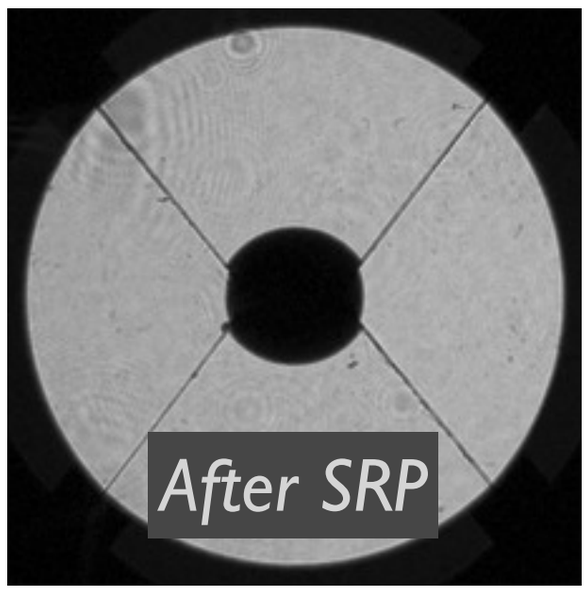

f/14
AO188
Field
tip-tilt
calib. src
vis + IR
tip-tilt
+ DM

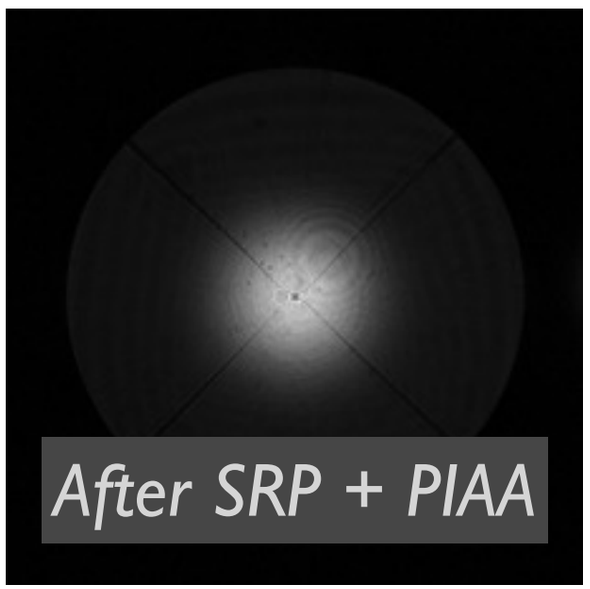
Beam shaping for high contrast



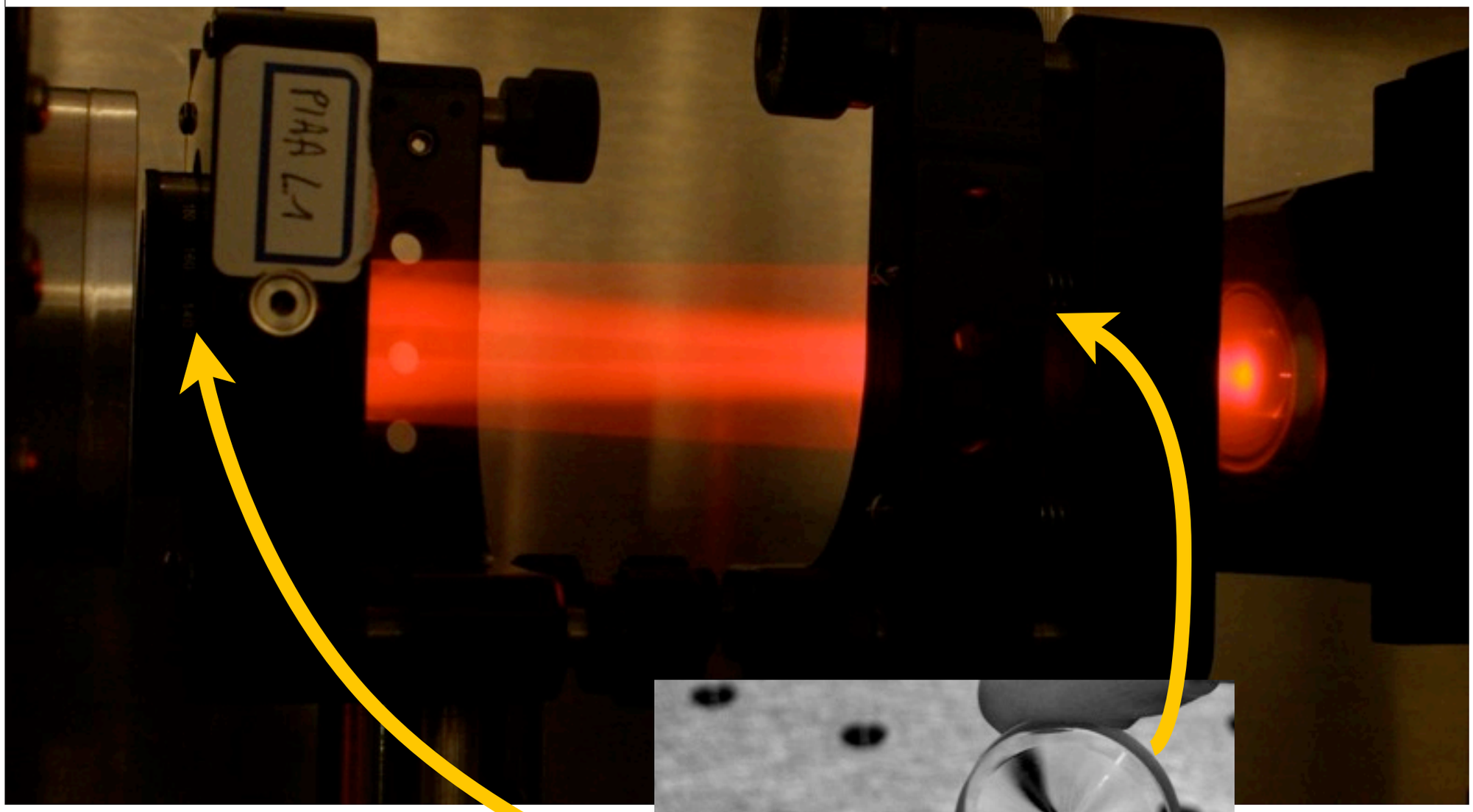

DM
SRP
PIAA
bin. mask
focusing optics
motorized R/C mounts


Subaru pupil


After SRP


After SRP + PIAA

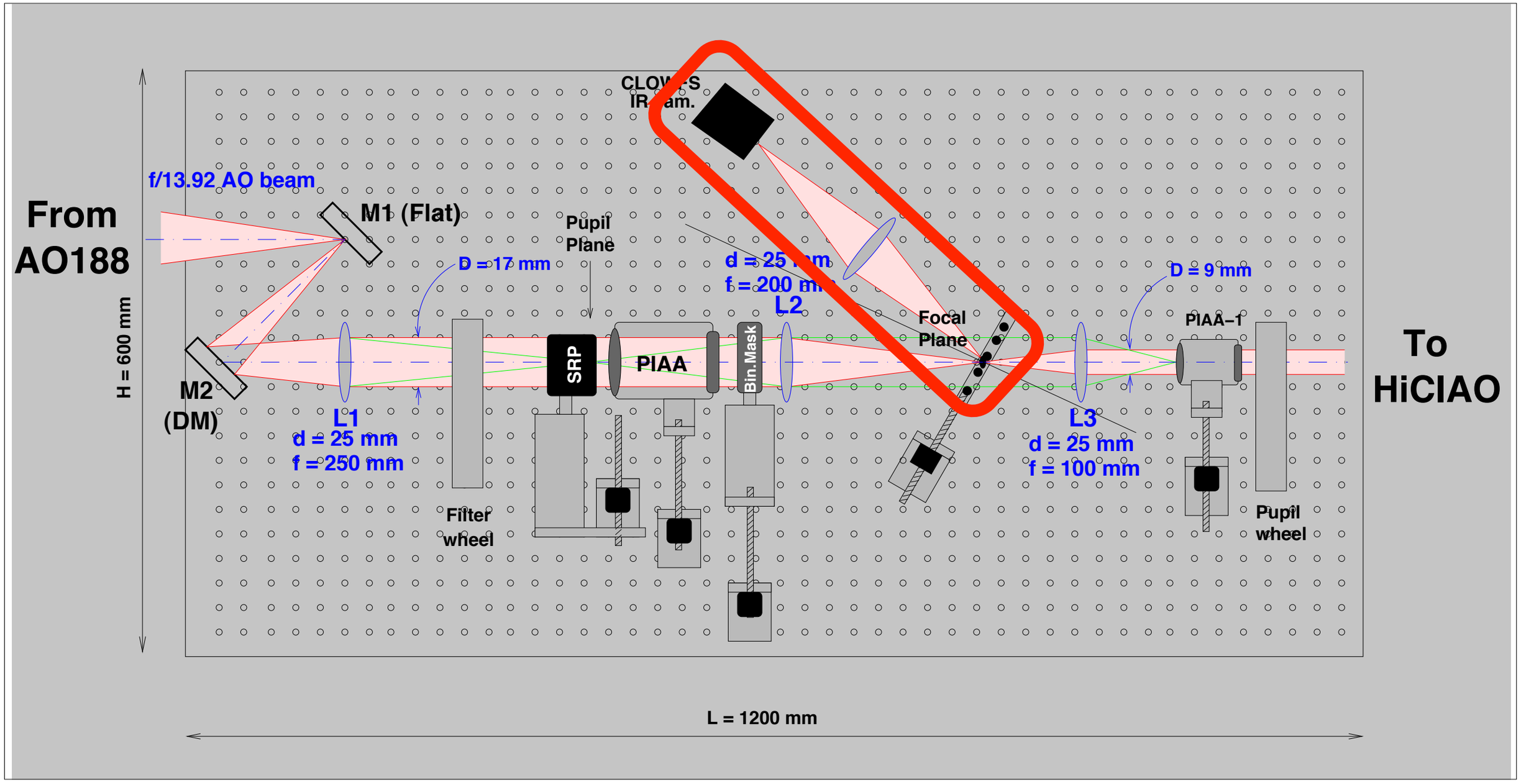
3rd generation PIAA optics



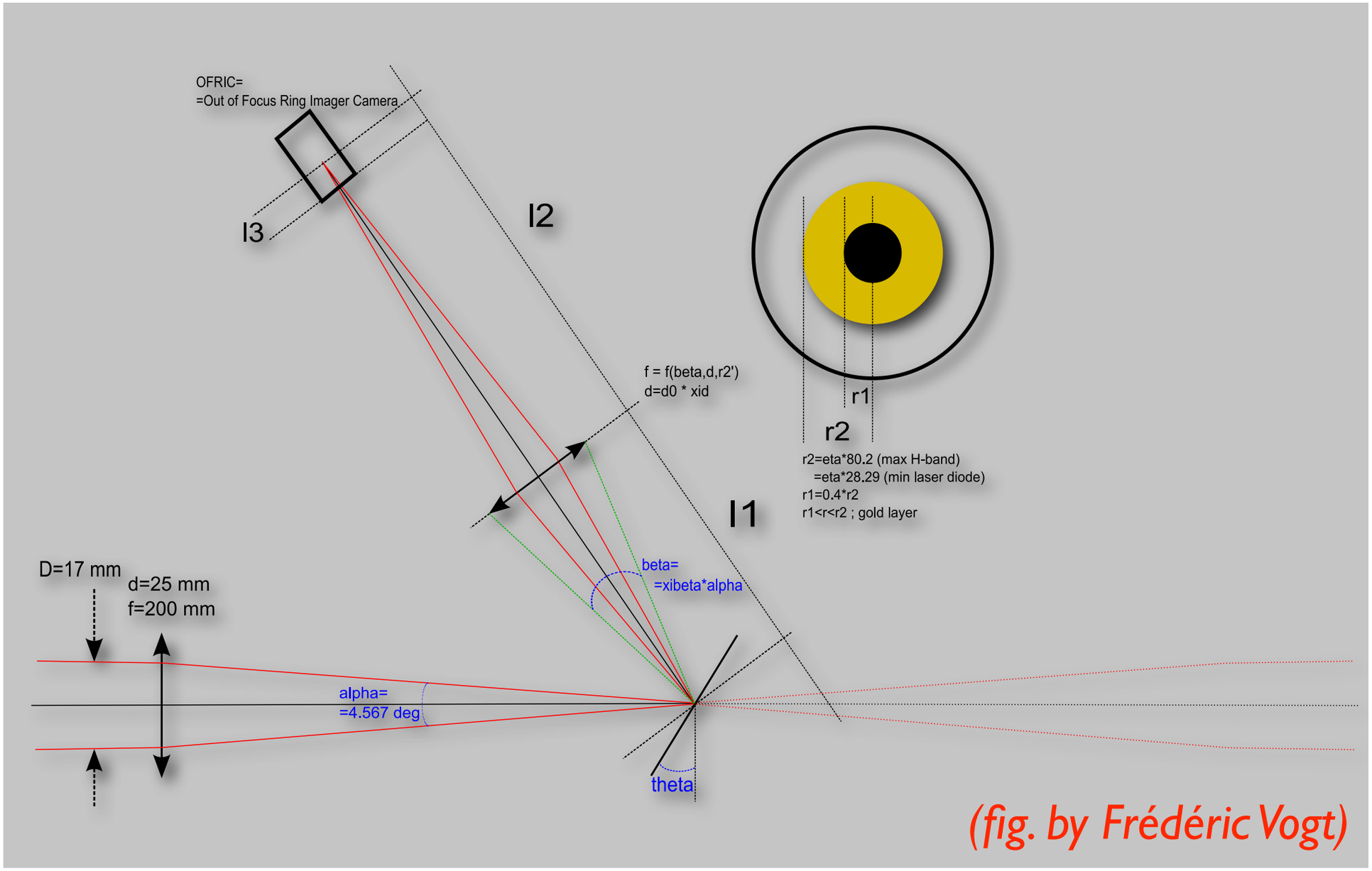
- On-axis lenses
- Lenses are 96 mm apart
- Apodize the beam
- Remove the central obscuration

Guyon et al, 2005, ApJ, 622, 744

Coronagraphic Low-Order WFS



Principles for CLOWFS



(fig. by Frédéric Vogt)

Simultaneously measure tip-tilt (rms~10^{-3} λ/D) and defocus (~2x10^{-3} λ) in the lab with a dual zone focal plane mask

Guyon et al, 2009, ApJ, 693, 75

Calibration of tip-tilt residuals with CLOWFS

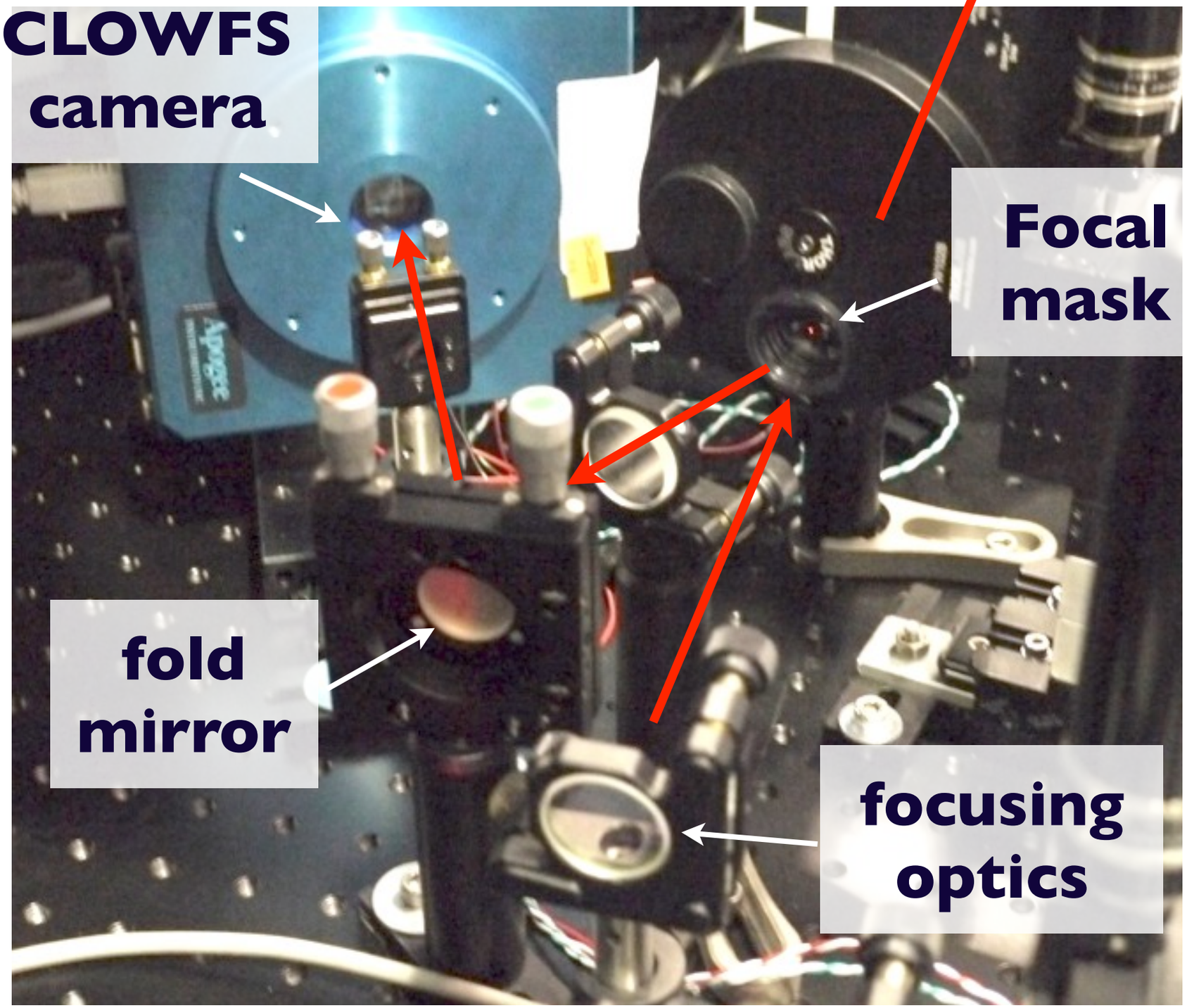
Single star: 1-to-1 correspondence
CLOWFS image ⇔ science camera image

Build a database of pairs of images on cal. stars and match with science targets images

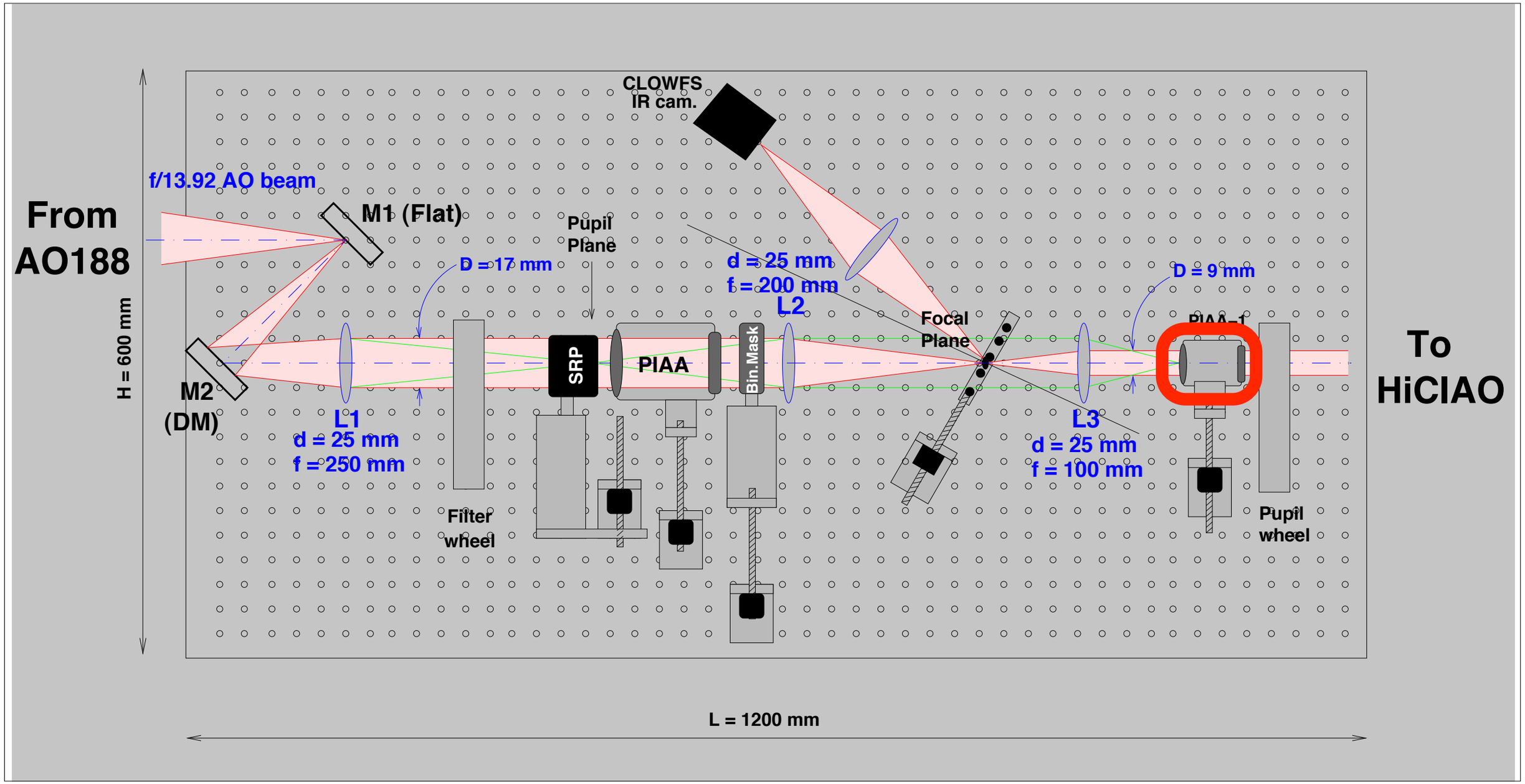
Validated in the visible
Currently testing in IR
with SCExAO

Xenics XS-119
Array : InGaAs
320x256 pixels
30 µm pitch
Exp. time 1µs - 20 ms
14-bit ADC
100 Hz full frame

Vogt et al, 2010, in prep

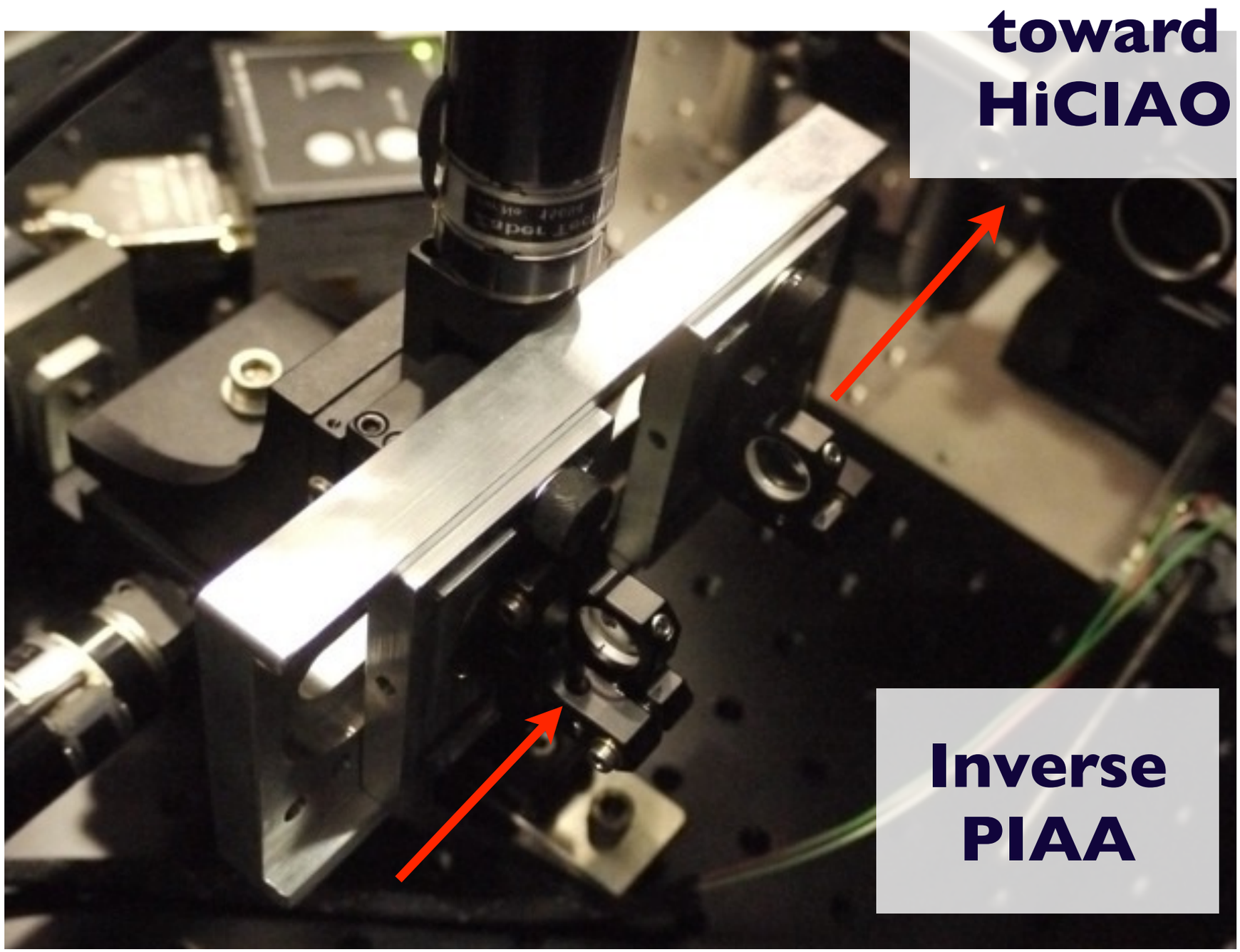

CLOWFS
camera
Focal
mask
fold
mirror
focusing
optics

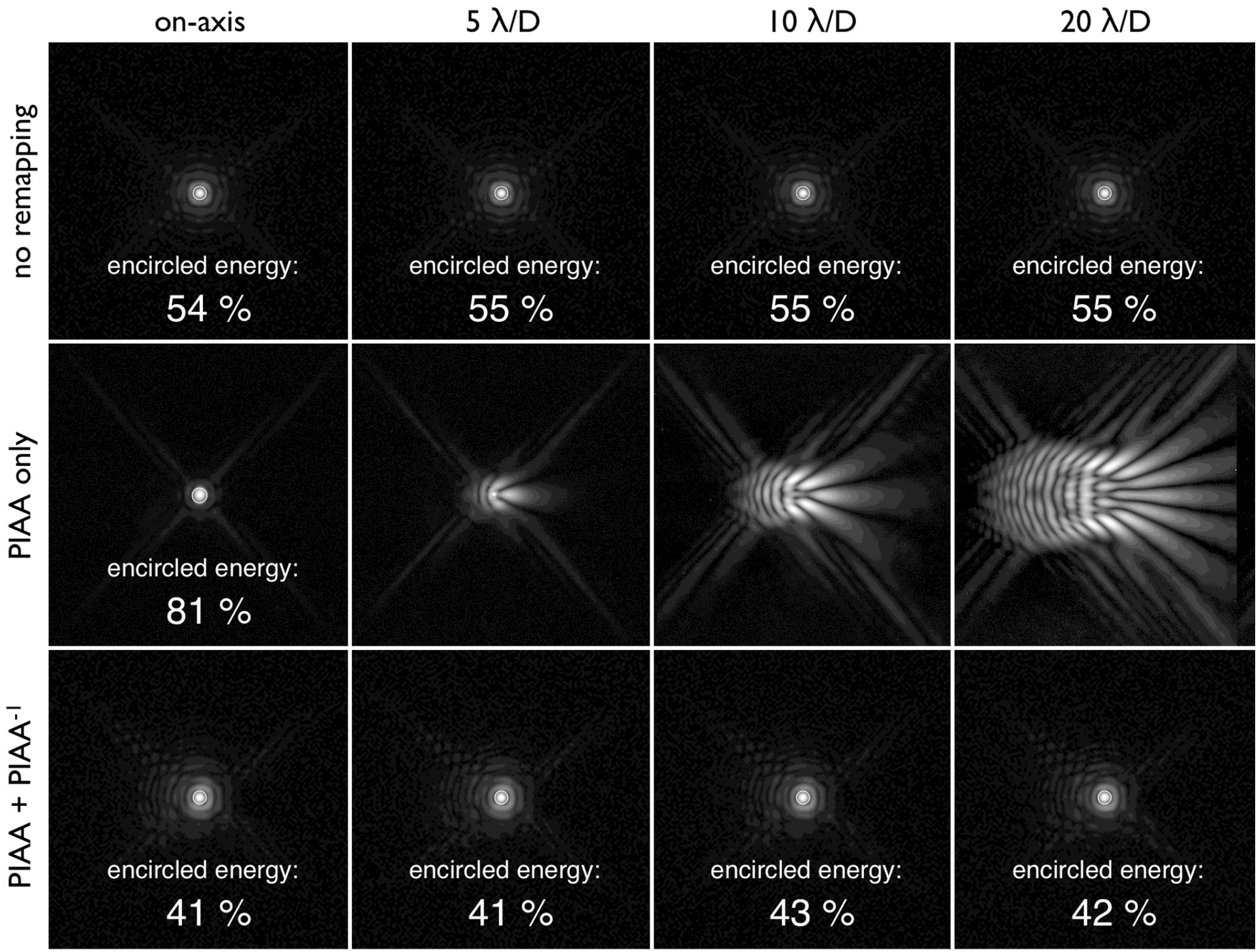
Recover the fov after coronagraphy



Lozi et al, 2009, PASP, 121, 1232L

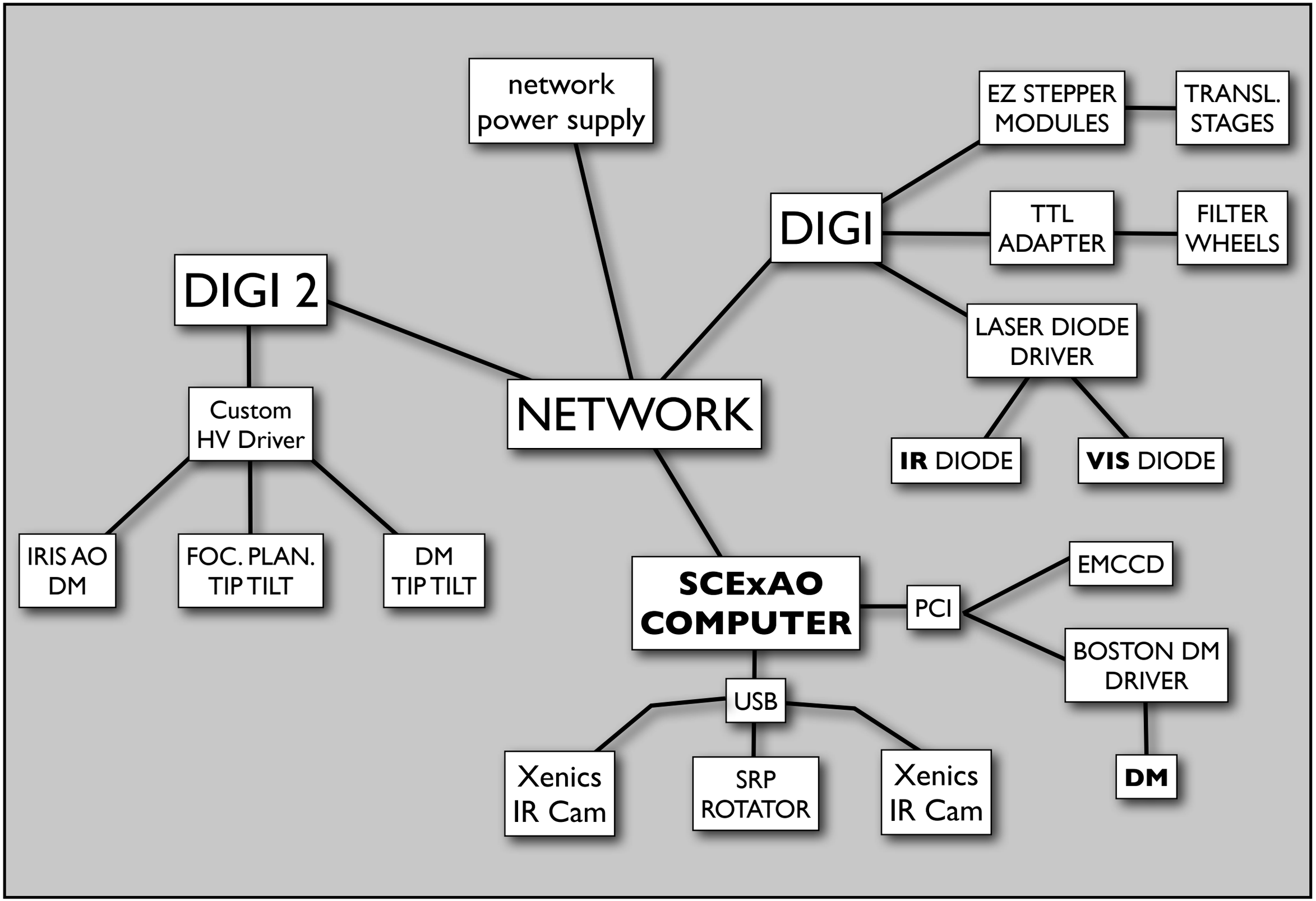
with an inverse PIAA



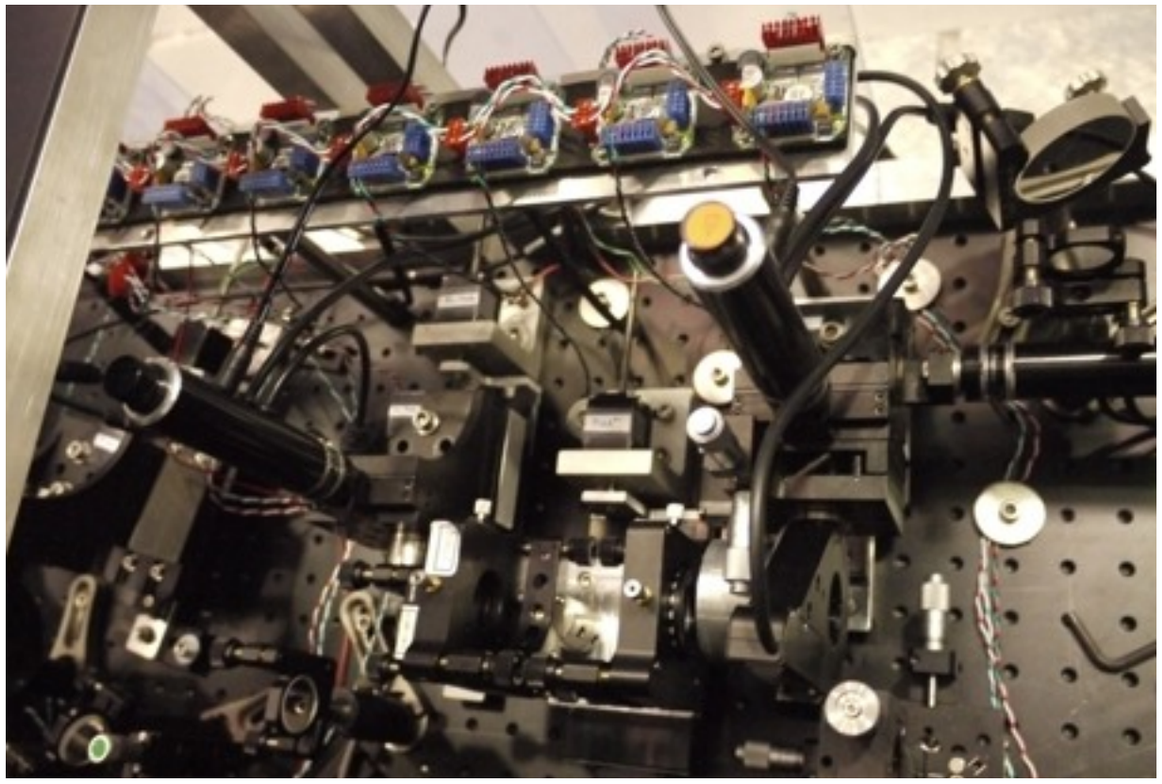


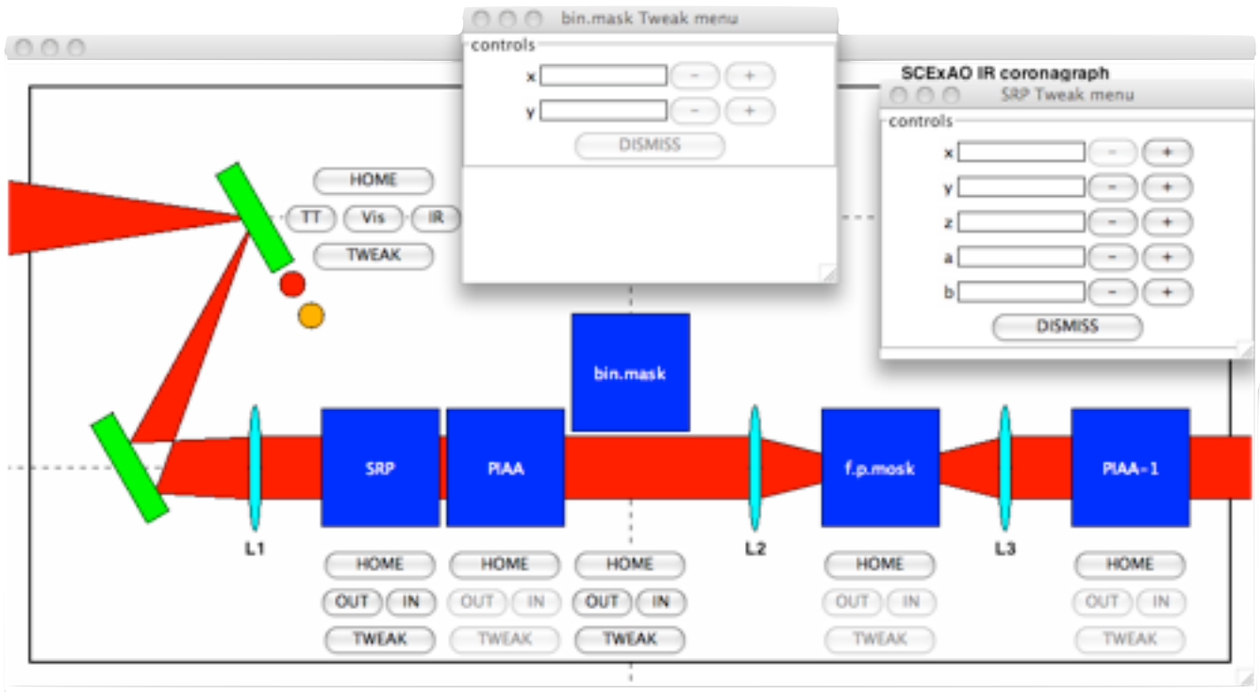
Lozi et al, 2009, PASP, 121, 1232L

System communication



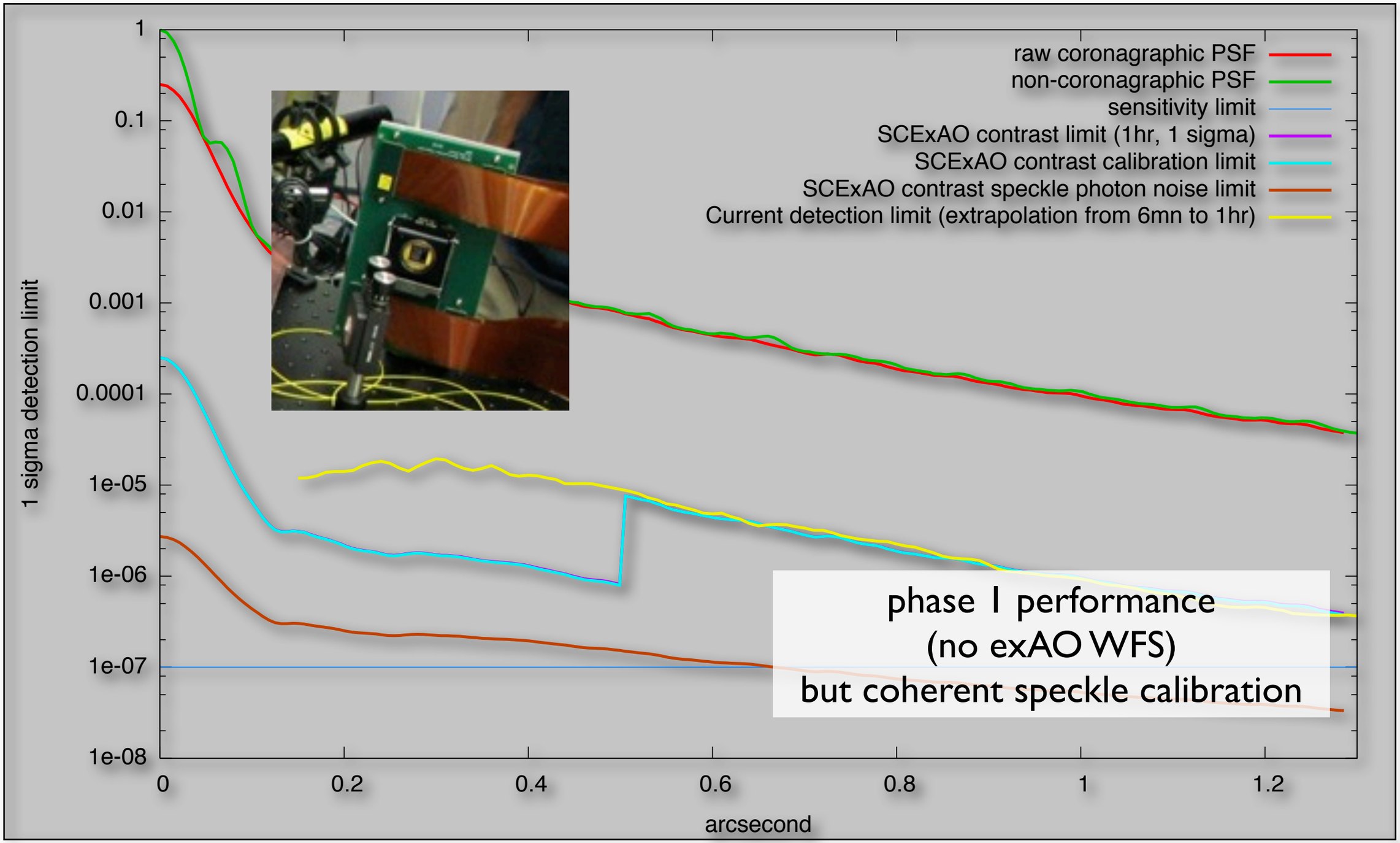
Computer control

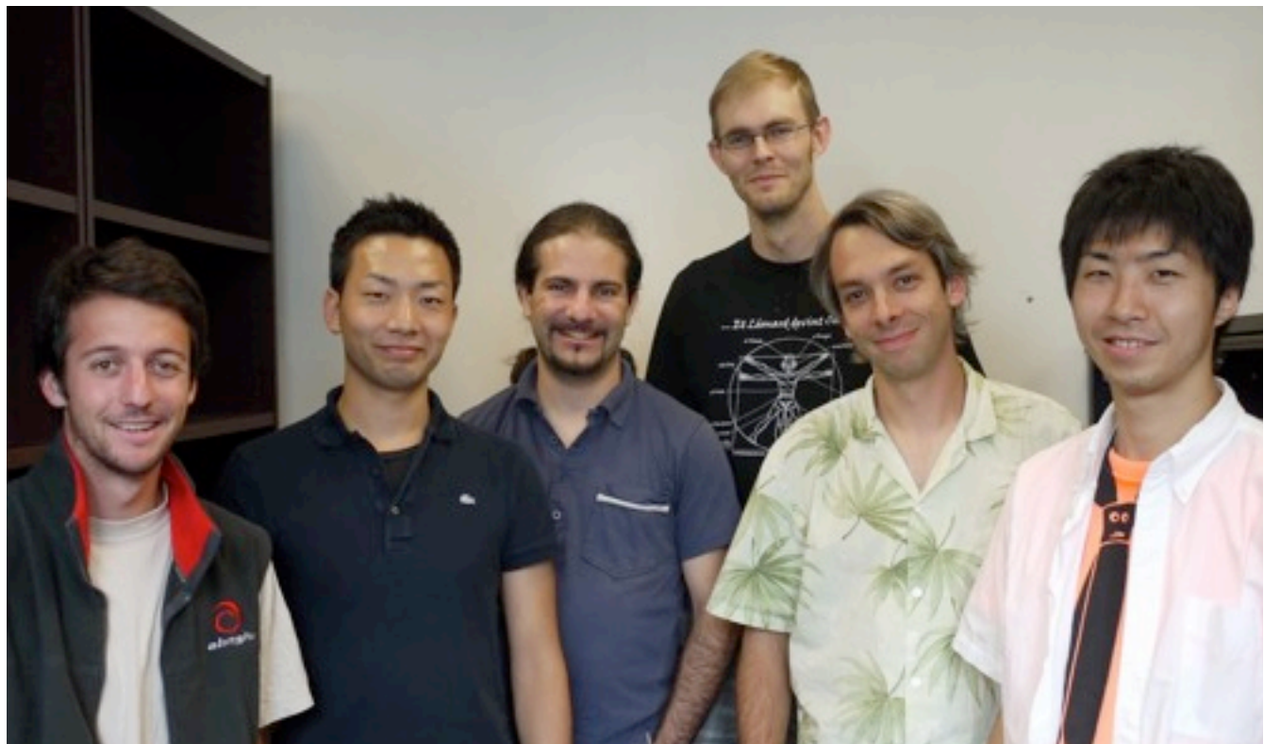


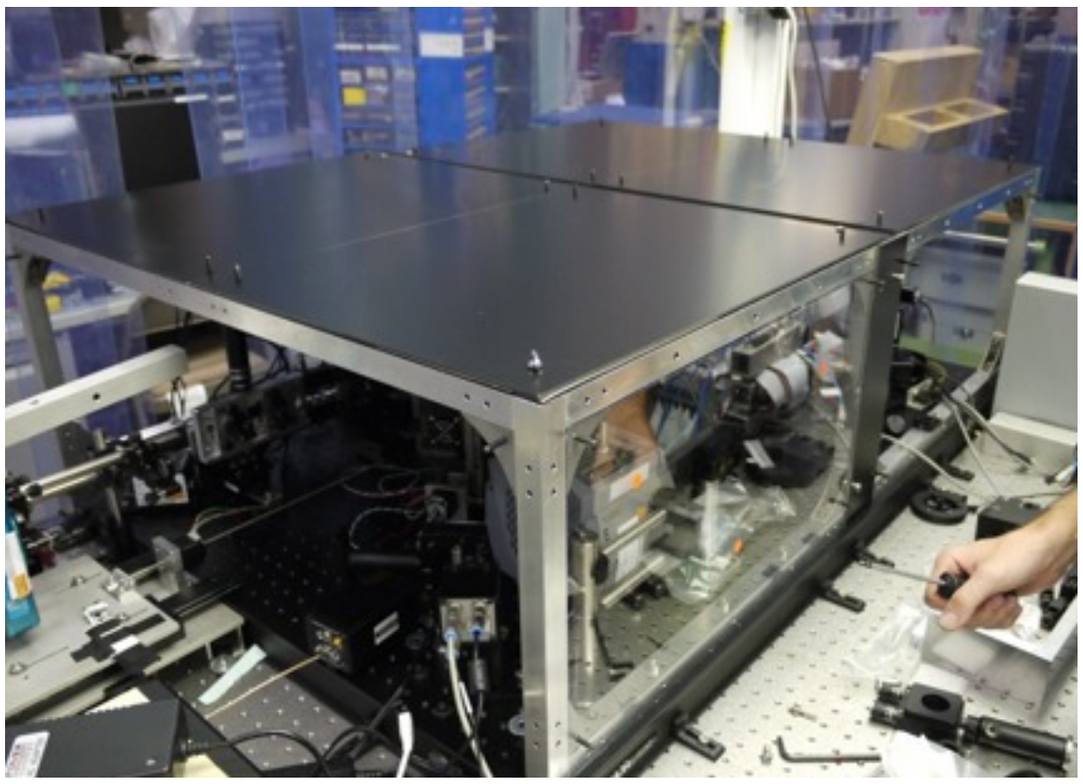


- One single Linux-based computer
- Powerful Cfits programming environment
- cmd line &/o Python GUI to drive the optics (80 %)
- cmd line &/o Python GUI to control cameras (80 %)

Objective: probe deeper at low angular resolution







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