



SEEDS

The Subaru Coronagraphic Extreme AO Project

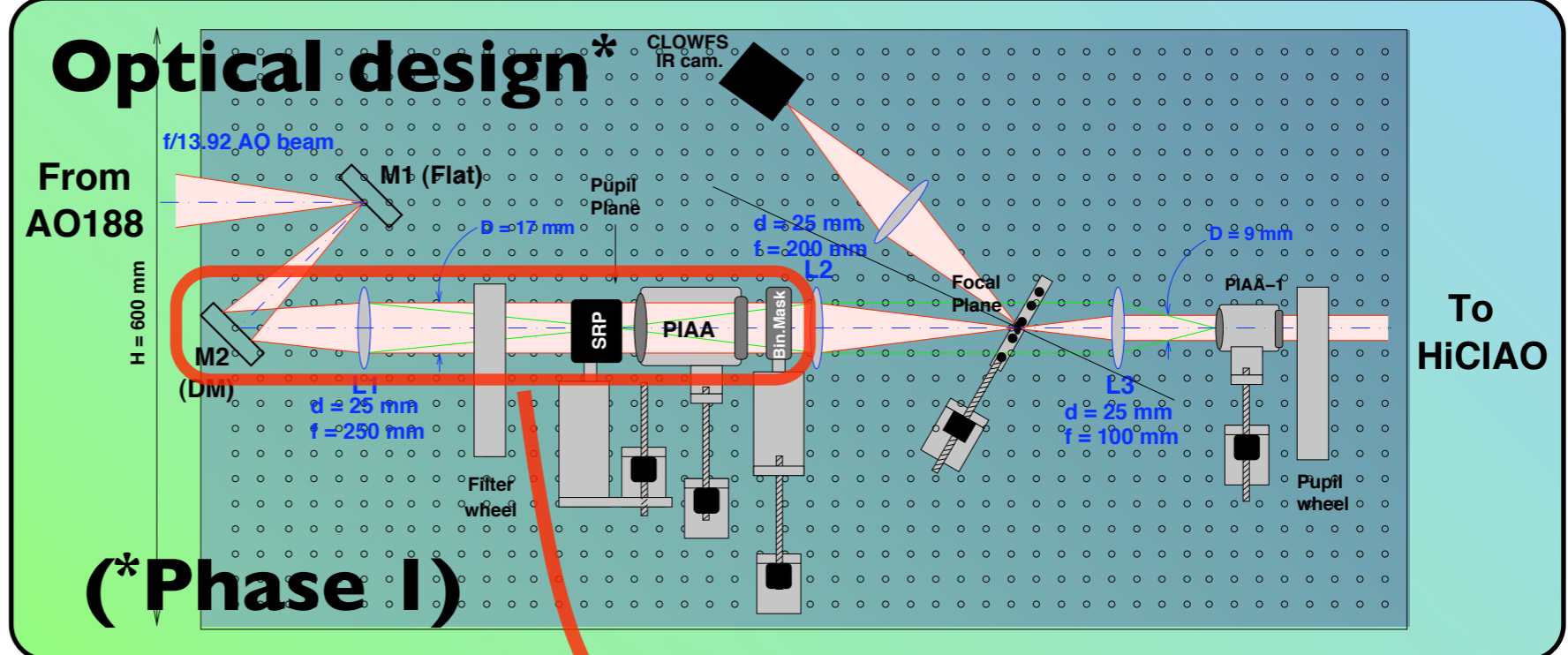
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Project URL: <http://www.naoj.org/Projects/SCEXAO/>

Abstract:

The Subaru Coronagraphic Extreme AO (SCEXAO) Project is an upgrade to the newly commissioned coronagraphic imager HiCIAO for the Subaru Telescope, in the context of a massive survey for exoplanets and disks called SEEDS. SCEXAO combines a high-performance coronagraph PIAA coronagraph and non-redundant aperture masking interferometry to a MEMS-based wavefront control system to be used in addition to the 188-actuator Subaru Adaptive Optics (AO188) system. The upgrade is designed as a flexible platform with easy access to both pupil and image planes to allow quick implementation of new high-angular resolution techniques, using a combination of interferometry and coronagraphy. The SCEXAO system will enhance SEEDS by offering access to smaller separations and improved PSF calibration, and will therefore allow high quality follow-up observations of challenging SEEDS candidates. SCEXAO will also enable new science investigations requiring high contrast imaging of the innermost (< 0.2 arc second) surrounding of stars.

- Subaru IR Nasmyth platform
- Warm optics for easy access
- **Evolvable** architecture with new **adaptive frame**
- SCEXAO DM and AO-188 are independent
- Optical combination provides **high contrast @ $1\lambda/D$**
- SCEXAO DM cancels static aberrations and probes the speckle coherence
- Low-order WFS calibrates tip-tilt residuals at the $10^{-3} \lambda/D$ level



Lossless Pupil apodization

(a) Subaru pupil (b) After SRP (c) After PIAA

A SRP to remove the spiders and a PIAA to apodize the beam and suppress the central obscuration: to **preserve throughput and angular resolution**

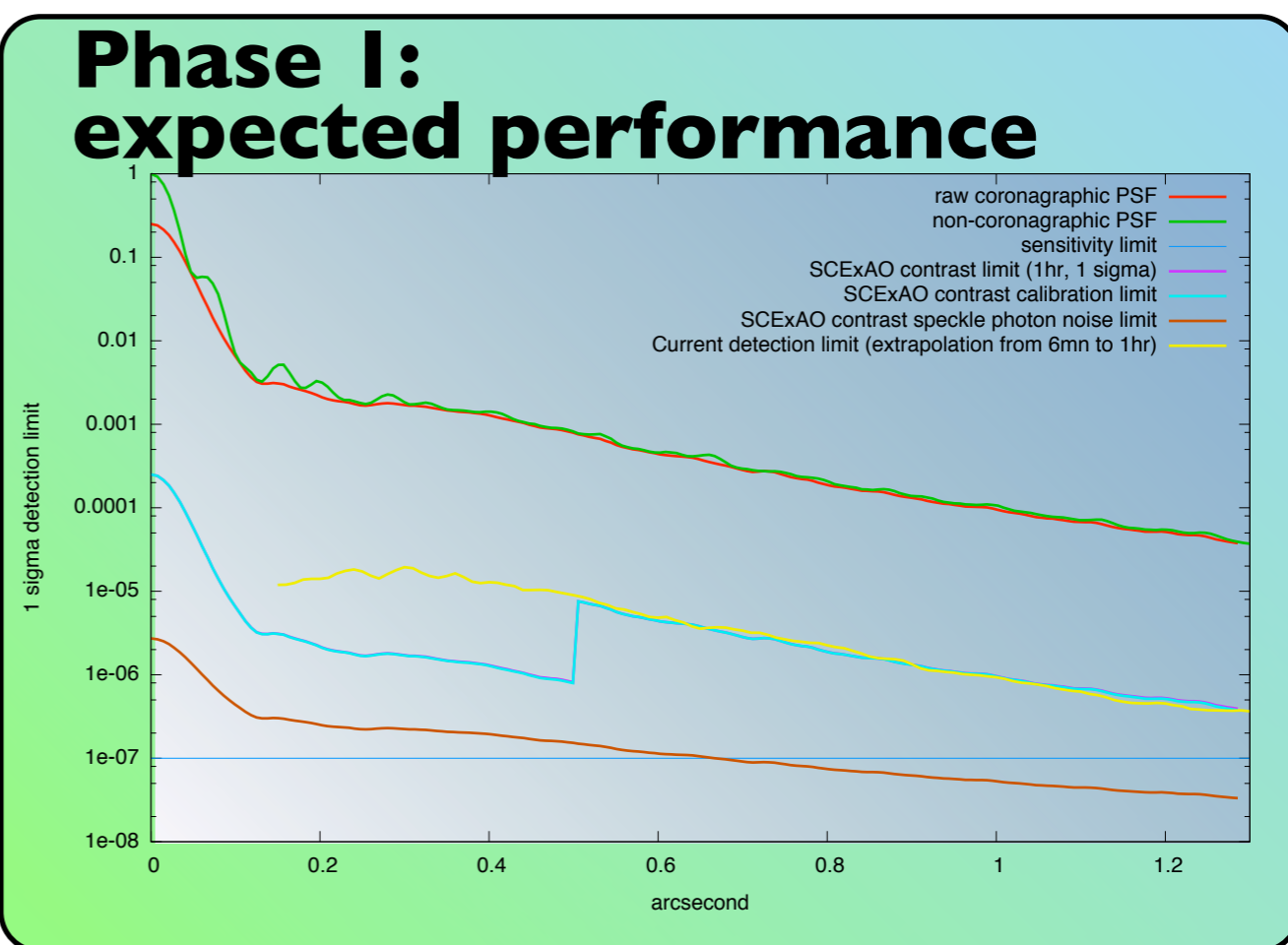
Beam shaping module

DM SRP bin. mask PIAA 1st focusing optics

off-axis imaging: lab results

	on-axis	5 λ/D	10 λ/D	20 λ/D
no remapping	encircled energy: 54 %	encircled energy: 55 %	encircled energy: 55 %	encircled energy: 55 %
PIAA only	encircled energy: 81 %			
PIAA + PIAA ⁻¹	encircled energy: 41 %	encircled energy: 41 %	encircled energy: 43 %	encircled energy: 42 %

First successful implementation of an inverse PIAA to recover "wide" field of view



Project status

Currently implementing wavefront control system
Commissioning scheduled for February 2010

Lozi et al, 2009, PASP subm., arXiv0903.5001L
Guyon et al, 2009, submitted to PASP
Martinache et al, 2009, AIPC, 1158, 329
Martinache & Guyon, 2009, SPIE, 7440-22