

NGAO 180" Relay Architecture

Concept Summary

A new, large pupil relay for Keck 1 AO system feeding NIR Imager & IFS, Vis Imager & IFS, possible High-contrast instrument, and d-NIRI as potentially co-mounted instruments (fed by a dichroic switchyard)

Interferometer Support

Repackage the existing AO systems into a new Nasmyth basement on each of Keck 1 and Keck 2

Lasers

Single laser lab with 9 20 W CW Na D2 line lasers (w/ arbitrary # of d-NIRI IFU channels)

Laser Launch Telescopes

On-axis projection
50 cm diameter
On-axis RC telescope design
Two-mirror transmission > 0.85
Asterism counter-rotates on the sky to negate field rotation

Beam Transfer System

1 Hollow-core photonic crystal fiber per laser beam
Bundle run of 15 fibers (w/ spares)
Approx. 30 m run
Transmission (589 nm) > 0.71
Top-end laser diagnostics package

Real-Time Controller

Single Tomograph RTC
Must handle up to 9 x 64 x 64 HOWFS input and (4+N) x 64 x 64 DM cmd outputs (more if HOWFS have MEMS DM's)

PSF Calibration System

Patrolling camera(s)
Spatial pick-off in 180" Relay Output focal plane (some field blocking okay)
Detectors TBD

or could be Built into dNIRI as d-Imager
Detectors TBD

Field Rotation

Large out-front K-mirror derotates field
Pupil allowed to rotate, reconstructor updated continuously (system cooled modestly, to -15C w.r.t. ambient to control emissivity)

Optics

Relay passes has unvignetted FoV of at least 180" (TBC)
Pupil size 315 mm diameter

Space for WFS packages and certain instruments (e.g. dNIRI) may be a strong restriction on the design

Laser Guide Star Asterism

Narrow-field
4 LGS on a 12" radius square (for good science path), 5 LGS on a 50" pentagon (for good TT/TTFA sensing)
(similar to KAON 429 asterism 8b)

Wide-field
9 Na beacon asterism
Evenly distributed over 180" diameter FoR

Deformable Mirrors

Narrow-field
1 x 64 x 64 actuator MEMS DM
315 mm pupil diameter
5 mm pitch

dNIRI
N x 32 x 32 d-NIRI MEMS
Modest stroke requirement - only handling isoplanatic component of wavefront

Tip/Tilt Correction

Narrow-field
and
Tip/Tilt a lightweighted OAP1
Fastest TT correction w/ DM

dNIRI
Tip/tilt control
within each d-IFU channel

HO Wavefront Sensors

9 LGS asterism sensor package
Full-field dichroic pick-off after 180 relay
Anisoplanatic linear range or Go-to MEMS correction in HOWFS (if different narrow and dNIRI asterisms, then HOWFS reconfigurable)

LO Wavefront Sensors

Narrow-field or dNIRI
2 TT + 1 TTFA + TWFS
Full field dichroic pick-off after 180" Relay
NIR TT ROI Trackers
NIR 2x2 subap Pyramid
64 x 64 MEMS correction in TT, TTFA WFS
8 x 8 subap (slow) visible S-H Truth WFS (20 sec exposure)

Wavefront Sensor ACQ

General
2k x 2k NIR camera
and 2k x 2k CCD
Calibrated offset to sci instruments allow use of same cameras for sci acquisition

dNIRI
Above, plus dNIRI metrology system