NGAO Split 20" Relay / 120" dNIRI Architecture

Optics

Concept Summary

Narrow-field optimized small relay on Keck 1 Left Platform feeding NIR Imager & IFS, Vis Imager & IFS, possible High-contrast instrument

> d-NIRI also on Keck 1 Left Platform feeding d-NIRI

Refractive Relay Narrow-field

20" unvignetted FoV

Maintained at -5C relative to ambient temperature

Wide-field dNIRI at native Nas focus Ambient temperature path to dNIRI

> (Some subsystems to be 'snouted' into El ring; possible strong package constraint on dNIRI)

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

1

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) > 0.71Top-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

Spatial pick-off in Nas focal plane (some field blocking okay)

Detectors TBD

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Patrolling camera(s)

or could be Built into dNIRI as d-Imager

Field Rotation

Lots of 'barrel rotators', for each sensor packages & instrument

The narrow-field relay could potentially use a 'tumble rotator' or small K-mirror (but is this a simplification?)

Laser Guide Star Asterism

Narrow-field 6 Na beacon asterism 1 @ field center, 5 on fixed pentagon of radius 12" 3 Na beacons for 2 TT, 1 TTFA

LOWFS LGS pointed toward LOWFS stars

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

Deformable Mirrors

Narrow-field relay

1 x 64 x 64 actuator MEMS DM 25.2 mm pupil diameter 400 micron pitch Hermetic seal DM window

N x 32 x 32 d-NIRI MEMS dNIRI

Modest stroke requirement - only handling isoplanatic component of wavefront

Tip/Tilt Correction

Narrow-field Fast tip/tilt mirror

25 mm pupil diameter

acquisition

dNIRI Tip/tilt control

within each d-IFU channel

HO Wavefront Sensors

Narrow-field 6 LGS asterism sensor package Full-field dichroic pick-off before relay

Full atmospheric linear range or Go-to MEMS correction in HOWFS

9 LGS asterism sensor package dNIRI

Full-field dichroic pickoff before dNIRI

LO Wavefront Sensors

Narrow-field or dNIRI 2 TT + 1 TTFA + TWFS

Spatial pick-off in Nas focal plane in annulus 10" < radius < 90" 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

Narrow-field 2k x 2k NIR camera

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

Above, plus dNIRI metrology system dNIRI