Questions for NGAO Science Workshop held 3/28/07 - R. Dekany

▼ Number and Type of Switchable Instruments

▼ 1) The optical design of some NGAO candidate architectures may be driven by the number of concurrent output instrument ports and instrument back focal distance. Please prioritize the top two of these statements as best reflecting the Keck community's science requirement?

A NGAO shall have a single instrument output port. NGAO instrument exchanges will only occur on a daily basis, with individual instruments scheduled for contiguous runs to minimize Observatory effort.

B NGAO shall have a single narrow-field output port and a concurrently available wide-field deployable IFU capability. Switching time (close shutter to open shutter) between these instruments in either direction shall be less than 20 minutes. Exchange of the narrow-field instrument will occur on a daily basis.

C NGAO shall have two concurrent narrow-band instrument ports, directing light to either one or another at any given time. Pairwise combinations of instruments will be scheduled, with switching time in either direction less than 20 minutes. Some combinations of instruments may not be possible.

D NGAO shall have two simultaneously fed instrument ports, one outputting NIR light, the other outputting shorter wavelengths, allowing, for example, simultaneously imaging of the same science field.

E All NGAO instruments shall be concurrently mounted and kept 'hot' every NGAO night. Light will be output to a single instrument at a time, switchable (close shutter to open shutter) in less than 20 minutes.

▼ Throughput

▼ 2) To obtain the highest sky coverage, NGAO is likely to sense tip/tilt using NGS at NIR wavelengths (typically J and H simultaneously). Which of the following statements best reflects the Keck community's science requirement?

A Ultimate sensitivity is absolutely essential. We must be able to send all J, H, and K band light (in any combination) to a science instrument, even if this means significant limitation of sky coverage (e.g. 3% of the sky vs. 30%)

B Signal-to-noise ratio in a diffraction-limited area of the detector is the

best science metric. One should optimize the tradeoff between good tip/tilt performance (NIR photons to the T/T sensor) and good transmission (NIR photons to the science camera) to obtain the best SNR in a diffraction-limited area.

C Same as the previous statement, but diffraction-limited isn't always the right area. The division of light between T/T sensor and science instrument should be variable to allow optimization of the SNR within a user-defined area of the focal plane. We accept that this increases complexity and cost, but are willing to accept a reduction in H-band Strehl ratio from 50% to 40% *for all observations* because finite resources for NGAO had to be redeployed to meet this requirement.

▼3) In many cases, wavelength division between NIR T/T sensors and NIR science instruments (or between optical NGS wavefront sensors and optical science instruments) may occur through the use of discrete choices between beamsplitters. Which of the following statements best reflects the Keck community's science requirement?

We need to finely tune the division of NGS light between sensors and science instruments, which beamsplitter choices a least as fine as 20/80, 40/60, 60/40, and 80/20. Although conditions can change rapidly, we're committed to switching between these configurations often during a night to maximize SNR.

Some science programs will emphasize sensitivity over sky coverage (typically because a good NGS star is available near the target field), while for others we'll be struggling for NGS starlight in our wavefront sensors (and will be willing to accept whatever reasonable transmission we can get). We'll know the situation before our run and can specify whether we want a 25/75 or a 75/25 beamsplitter in the system well in advance.

All this talk of exchanging beamsplitters is terrifying. I only want to calibrate one beamsplitter in the NGAO system (I'll have enough problems with instrument filters and the like). Simply provide a single, unchangable 50/50 beamsplitter between WFS path and science path. We accept this may sometimes squander photons (e.g. sending too many one way or the other), but since seeing is so variable anyway any attempt at splitter optimization isn't worth the trouble.

4) True or False? There is a lot of interesting science below H-alpha (656 nm), even if Strehl ratios are only 8% in V-band and less in B-band. We'd be very excited about partial compensation to the bluest bands (for example improving seeing from 0.6 arcsec to 0.4 arcsec), even if the degree of improvement was variable on time scales of several minutes. Definitely make light shorter than H-alpha available to the optical imager instrument (even if half this light needs to be split off to the NGS wavefront

sensors).

▼ Background

5) Maintaining NGAO (AO + Instrument) K-band emissivity to a small fraction of the Telescope+Sky background is a major engineering challenge. What is the quantitative science impact of NGAO contributing background equal to Telescope+Sky background in K-band?

▼ Multiple tip/tilt stars

▼ 6) NGAO LGS mode is likely to benefit from the use of multiple NGS NIR tip/tilt stars, but the selection of these stars from the field of regard poses some engineering challenges. Which of the following statements best reflects the Keck community's science position?

A Extending NGAO sky coverage to provide better than 240 nm equivalent wavefront error over more than 80% of the sky is essential. I'm willing to deal with the complexity of having to identify a 2nd and 3rd tip/tilt star in my field, typically down to mV = 19-20, when preparing my science program (I'll have PANSTARRS and LSST astrometry to make this easier), or I'll accept an additional 3 minutes setup overhead for every faint target (needed to first establish astrometry via NIR imaging).

B Almost every program can be executed with 20% sky coverage. It would be best to optimize the system to give best SNR per unit observing time over this fraction, taking into account acquisition overheads and performance gains. If this consistently means using 2, 3, or N tip/tilt stars, well, that's just a detail that doesn't interest me.

C I'm still adamant that NIR photons not be shared with the tip/tilt sensor. It would be better to use visible light photons from multiple NGS for tip/tilt, even if that meant considerably larger tip/tilt errors, perhaps as much as 100 mas blurring at 80% sky fraction, worse for some diabolical targets.