Gemini Instrumentation

Mauna Kea
- GMOS
- ALTAIR+LGS*
- NIRI*
- MICHELLE
- NIFS*
- GNIRS*
- GLAO*
- WFMOS

Cerro Pachón
- GMOS
- T-ReCS
- Phoenix
- NICI*
- FLAMINGOS-2*
- MCAO/Canopus*
- GSAOI*
- GPI*

*AO instrumentation
MCAO (aka GeMS)
GeMS Status

• Canopus (AO bench)
  o Under integration in La Serena instrument lab
  o Currently doing flexure test (1-axis)
  o Preparing tomography reconstruction,
  o 99% Strehl obtained in static mode using Non-Common Path Aberrations corrections
  o Transport to summit planned in March 2009
  o Installation on telescope in May 2009

• Beam Transfer Optics
  o Fabricating new modules required to simplify the beam path (5 beam splitting done at top end ring rather than on laser bench)
  o Internal fast beam jitter correction is critical path
  o Alignment on telescope scheduled for March 2009

• Laser
  o Power, wavelength and beam quality characterization at LMCT in Colorado. Overall difficulties with stability over time.
  o FAT scheduled for early November, delivery to Chile in December, highly subject to slippage
• Laser Infrastructure
  o Laser Service Enclosure (LSE) is built and will undergo control tests in November
  o LSE and Laser Bench support structures are critical path with completion in January 2009
  o Installation on telescope in March 2009
  o Telescope mount control test with dummy load done

• High-level and Operation software
  o Plan to have main elements needed for commissioning to be ready in next OT release

• Project critical path
  o Canopus, BTO and Infrastructure are running parallel with similar completion dates and paths.

• Commissioning
  o Technical: June-Sept 2009
NICI Recent Progress

- Latest commissioning run earlier this month
  - High level software tested
    - Acquisition, dithering and observing sequences tested
  - AO performance characterized—optimizing observing techniques for the campaign
    - Fainter guide stars
    - Angular differential imaging
    - Spectral differential imaging
- Array controller testing started
  - Reliability issues not fully resolved yet? Uncertain.
  - Larger number of Fowler reads still untested
  - Interference noise reduced but not yet fully resolved?
- Preparing to start planet search campaign
HD129642

Speckles are nearly identical in both cameras and subtract off very well

4.6″×4.6″, 27.5 min
NICI AO performance

HD129642

Known background star

4.6'' × 4.6'', 27.5 min
Current issues that must be resolved before science and campaign observations can begin:

- Array controller problems fixed:
  - Reliability
  - Readout noise/interference

- AO performance characterized for different conditions and guide star brightness
- Optimize observing procedures and improve integration of NICI in the queue
- Further software integration

Good progress on all fronts. We expect to begin the campaign in a couple of months.
NICI Campaign Schedule

🌟 Campaign team is basically ready to go as soon as NICI is ready
🌟 PI Mike Liu, (Hawaii); co-PIs Mark Chun (Hawaii) and Laird Close (Arizona)
🌟 GSC and Planet Finding Working Group will assess performance and ensure that the campaign is worth executing
🌟 Two primary criteria:
   1. Comparison of NICI performance with original campaign CfP estimates
   2. Comparison to NIRI+Altair contrast
NICI AO performance as good or better than expected at radii less than ~1.4 arcsec

Contrast at larger radii is limited by array controller issues, read noise, and short exposure times used for these tests (ADI)

Thanks to the NICI Campaign Team for the plots and data analysis
NICI Campaign Schedule

🌟 The NICI campaign: up to 50 n to be scheduled over ~2.5 years, with most time allocated in the middle year
🌟 Blocks of time need to be ~2× longer than the campaign time allocated
  ✴ Campaign observations stop when allocated time is reached, even if time remains in the block
🌟 Equivalent of 18 queue nights have been reserved for 12 NICI campaign nights in 2009A
🌟 Additional commissioning nights in 2009A as needed
  ✴ To support observing modes not needed for campaign
🌟 Regular PI programs:
  ✴ Will only be offered in 2009A in shared-risk coronagraphic imaging mode – i.e., the campaign mode
  ✴ Non-exoplanet proposals (d< 1 pc or d>200 pc) this time only
Aspen Program Update
Critical Design Review was held May 28-30

Issues we are tracking:
- Calibration test bed progress
- Detailed vibration and FEA modeling
- Risk management
- Apodizer technologies are being explored
- Gemini environmental issues:
  - Vibrations on the ISS
  - M2 vibrations and wind shake uncertainties
  - Dust and cleanliness requirements
  - Vibrations from cryocoolers

4096-actuator MEMS prototype

Apodized pupil mask
2h raw
H=5
I=6
4%BP

100 Myr K7V
10 pc
5 & 1 M_{Jup} at 4AU
630K & 310K
ΔH = 12 & 17.4
(T8 spectrum)
Mauna Kea ground layer monitoring project is now complete

Gemini AO Science Working Group is assessing the impact of the new MK data on the anticipated productivity of the baseline GLAO system in two weeks

GAOSWG recommendation to the GSC next month

GLAO conceptual design studies could start next year after a decision on WFMOS

GLAO design and construction wouldn’t start until after MCAO resources become available
Ground Layer Statistics

* Stable ground layer is not correlated with the free atmosphere seeing.
* Ground layer contribution to the total seeing is often comparable to the free atmosphere component.

\[
\frac{C_n^2 dh(<500m)}{C_n^2 dh(total)} \text{ is nearly always 50%}
\]

A GLAO system on MK should produce 20-percentile seeing 80% of the time.
GLAO concept

- Uses an adaptive secondary that’s a complete replacement for current secondary
  - Design fully “backwards compatible” with current top-end structure, ISS, instruments, etc.
- Uses modified MCAO laser projection system
- New A&G included that incorporates all the necessary WFS’s
- ASM can also feed high-Strehl mid-IR AO system
- Get 20% IQ 80% of the time!
- Myriad of science applications
Coming very soon:
- GNIRS
  - recommissioning 2009A
- NICI
  - Planet survey to start in about two months
- FLAMINGOS-2
  - Acceptance tests started
  - Expected delivery around the end of the year
- GMOS-N CCD replacement next year; GMOS-S to follow

New development:
- GPI
  - Passed CDR in May
  - Now entering the construction phase, scheduled completion in 2011
- WFMOS
  - designs studies under way; end date Feb. 2009
  - Gemini collaboration with Subaru
- GLAO
  - Ground layer monitoring study just finished