

211th AAS Meeting
January 7-11, 2008

~ADAPTIC OPTICS~



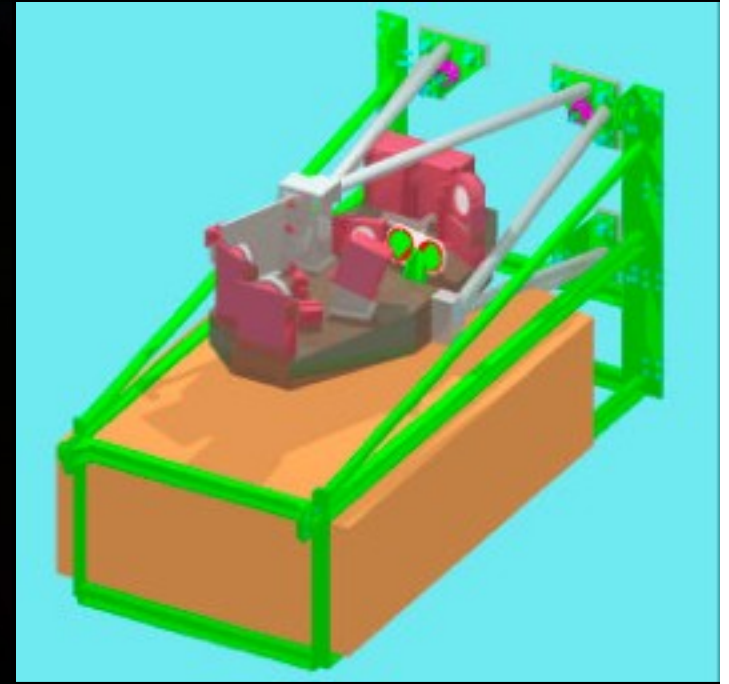
GEMINI
OBSERVATORY

Adaptive Optics Capabilities at Gemini

- **ALTAIR Natural Guide Star--NGS** (Gemini North)
 - [Operational since 2004A]
- **ALTAIR Laser Guide Star--LGS** (Gemini North)
 - [Operational since 2007A]
- **Near Infrared Coronagraphic Imager (NICI) Natural Guide Star** (Gemini South)
 - [Commissioning - 2007A-B, 2008A]
- **Multi-Conjugate Adaptive Optics System (MCAO)--Canopus** (Gemini South)
 - [Under development -- First telescope deployment in 2008B]

ALTAIR=ALTitude conjugate Adaptive optics for the InfraRed

- The facility natural/laser guide star adaptive optics system of the Gemini North telescope.
- It can feed a corrected beam to Gemini instruments NIRI and NIFS.
- Deploying ALTAIR is "transparent" for the science instrument, as it reproduces the telescope focal ratio (f/16), pupil size and pupil position.
- ALTAIR Natural Guide Star (NGS) function has been offered since 2004A.
- In 2007A, the ALTAIR Laser Guide Star (LGS) commissioning was completed.



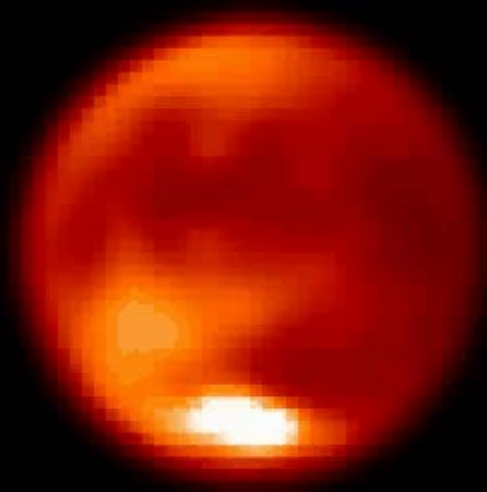
Guide Star Brightness Requirements for ALTAIR in NGS & LGS Modes

- Without a laser, a bright Guide Star is needed for full AO correction, as shown in the table below.
- The field of view is 25 arcseconds, so this guide star must fall within this range. Fainter guide stars can be used for partial correction.

Spectral Type	A0	G6	K7	M4			
V-R Color	-0.2	0.0	0.4	0.8	1.2	1.6	2.0
Limiting Mag. for full correction	11.0	11.1	11.4	11.7	12.0	12.3	12.6
Partial Correction	14.9	15.1	15.3	15.6	15.9	16.2	16.5

- With the laser, a much fainter NGS can be used (for tip-tilt corrections), with $R=15$ for full correction.
- For a lesser degree of correction, fainter guide stars can be used with the LGS: $R=18$ at full moon and $R=18.5$ at new moon.

“Weather” Monitoring on Titan using Gemini-N and
ALTAIR plus Gemini’s Queue Target-of-Opportunity Mode



1"

AO Examples from Gemini-N



Jupiter with NGS

Orion "Bullets" with LGS

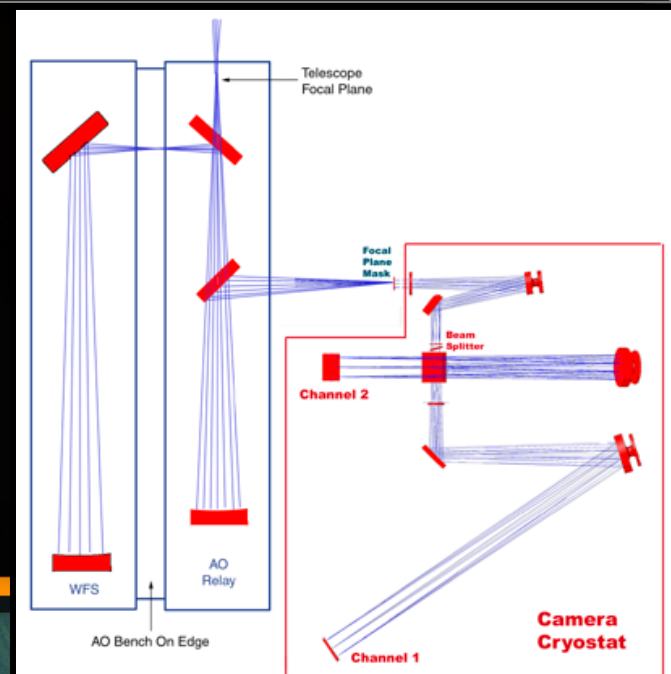
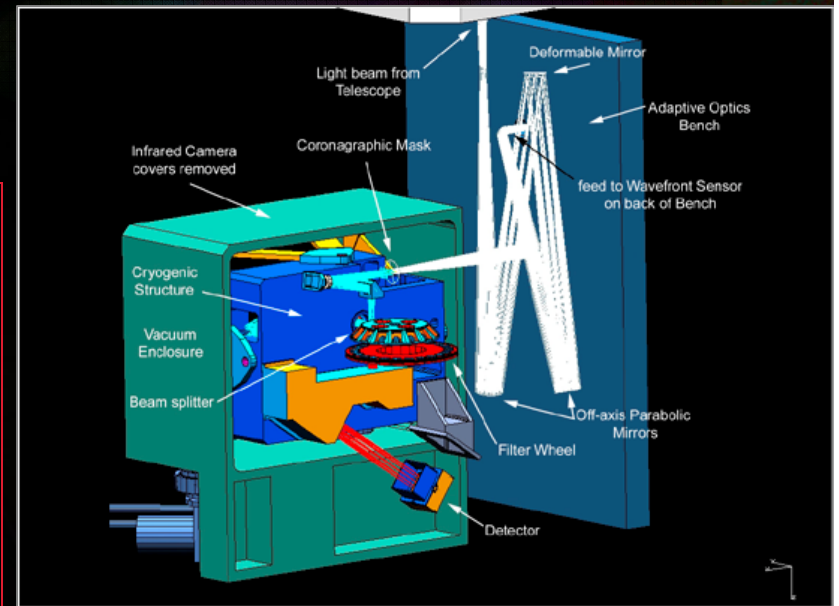


M31 Nucleus and inner star field

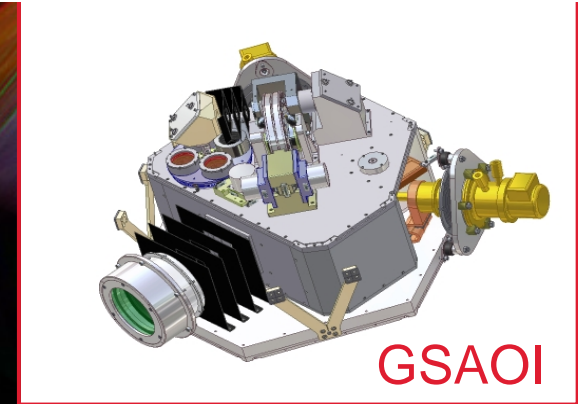
- The Jupiter image is 41" across.
- Orion shows a region 50" across.
- M31 covers 20" on a side.

Near Infrared Coronagraphic Imager (NICI)

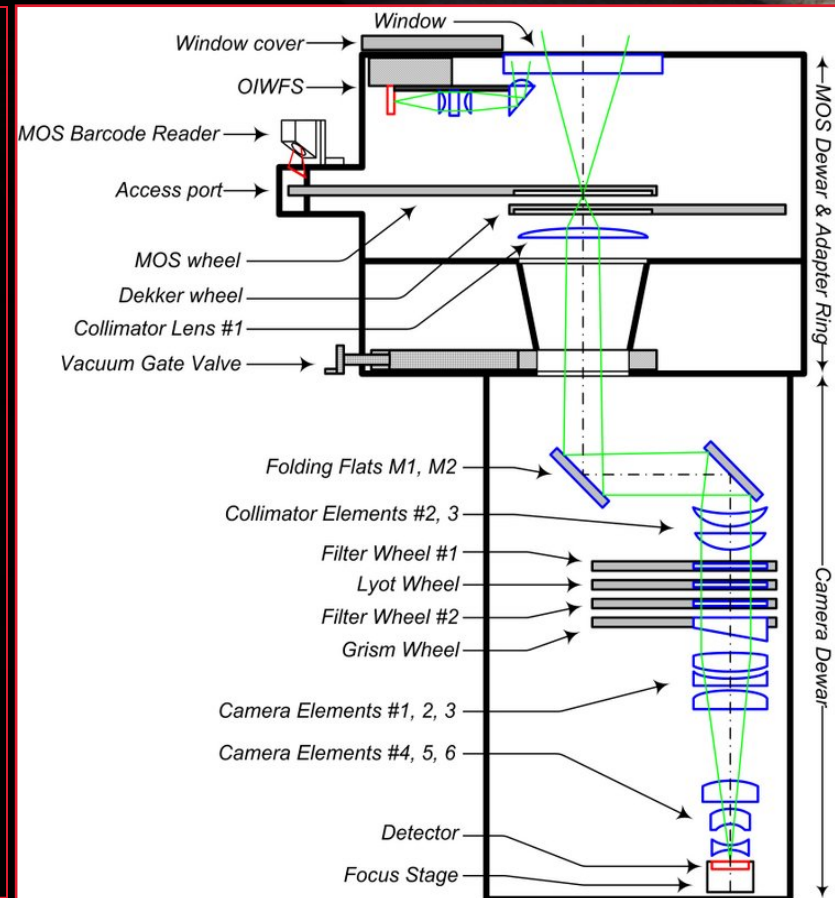
- NICI is a dual-channel, near-infrared (1-5 μm) coronagraphic imager for use on Gemini South.
- Currently undergoing commissioning, instrument performance characterization, and optimization, which continues into 2008A.
- NICI optimized for detection of faint, sub-stellar companions of stars by utilizing the Simultaneous Spectral Differential Imaging (SSDI) technique.



Multi-Conjugate Adaptive Optics (MCAO) System (Canopus) for Gemini-S



- The Gemini MCAO system Canopus delivers diffraction-limited images, with uniform image quality over a *one arc minute field of view*.
- When used with FLAMINGOS2 and GSAOI, Canopus provides a f/32 AO-corrected beam for either imaging or multi-object IR spectroscopy.
- In addition to the tenfold gain in angular resolution, MCAO also pushes the detection limit by 1.7 magnitudes on unresolved objects with respect to seeing limited images.
- **This instrument on Gemini will provide a unique way to explore JWST-class science as soon as its commissioning in 2009.**



FLAMINGOS2 Optical Path