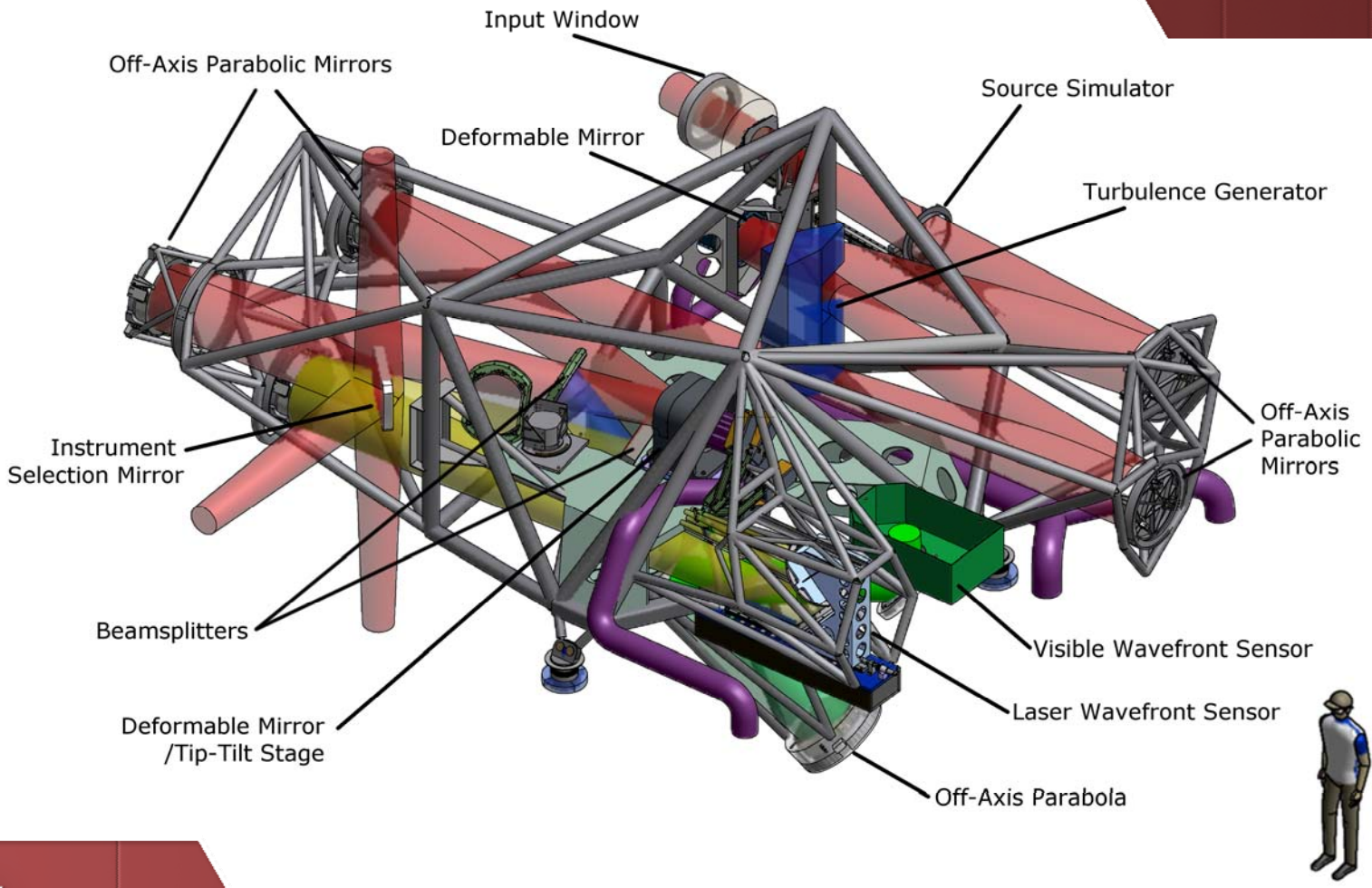
Thirty Meter Telescope - First Light Instrumentation

The Narrow Field Infra-Red Adaptive Optics System (NFIRAOS)



30 m 望遠鏡
三十米望远镜
तीस मीटर दूरबीन
Thirty Meter Telescope
Télescope de Trente Mètres

Significant funding provided by the Gordon and Betty Moore Foundation

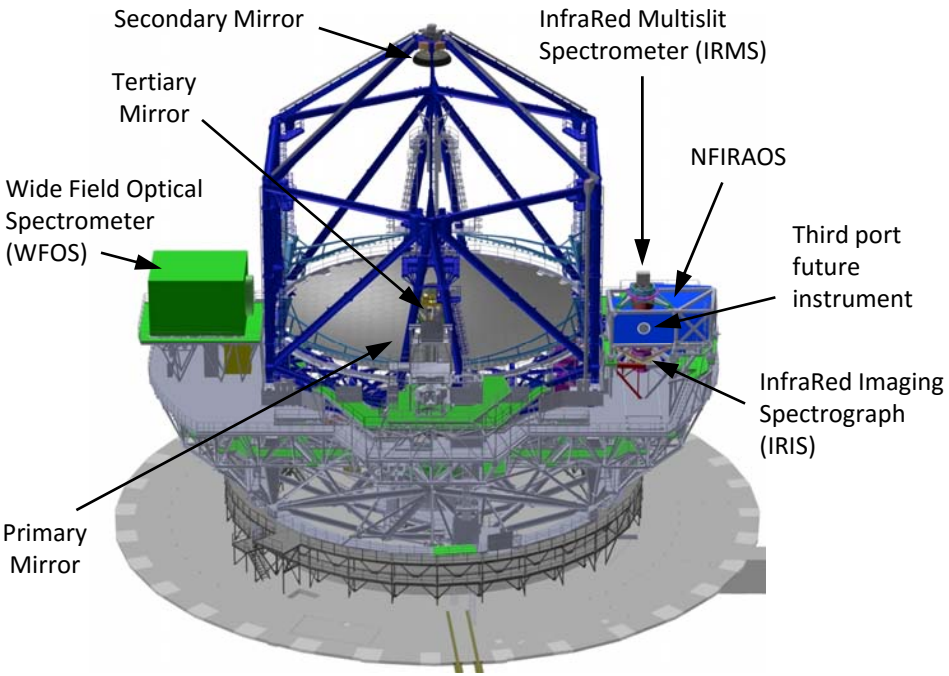
The Narrow Field Infra-Red Adaptive Optics System (NFIRAOS)

Pronounced "Nefarious" (ni-FAIR-ee-us)

NFIRAOS is TMT's Multi Conjugate Adaptive Optics system which will feed two instruments at first light: IRIS and IRMS.

Cooled (-30C) optical system for reducing thermal emission
High order (60x60) wavefront compensation for high wavefront quality
Multi-conjugate AO (MCAO) with 6 laser guide stars and 2 deformable mirrors over a 2 arcmin field-of-view
Laser guide star (LGS) AO for increased sky coverage
Tip/tilt and tip/tilt/focus NGS wavefront sensing in the near IR with up to 3 on-instrument wavefront sensors over a 2 arc min patrol field and up to 4 on Detector Guide Windows (in IRIS only) serving as truth tip/tilt sensors
Pyramid WFS Natural guide star (NGS) AO for on-axis observations such as high contrast imaging.

Right (blue): NFIRAOS with IRMS on top and IRIS below.
Left (green): Wild Field Optical Spectrograph (not an AO instrument).



Requirements	Values
High throughput	85% over 0.8-2.5μm
Low Thermal emission	15% of ambient sky + telescope
Diffraction limited	Wavefront error of 187 nm RMS on axis or 208nm RMS over a 34arcsec x 34arcsec field of view
High sky coverage	50% at galactic pole
High photometric accuracy	2% over 30 arcsec at 1 μm for a 10 minute exposure
High astrometric accuracy	50 μarcsec over 30 arcsec in H band for a 100 second exposure
High observing efficiency	No more than 5min between AO observing sequences
Deformable mirrors	63x63 and 76x76 actuators at 5mm spacing, 10 μm stroke, 15% hysteresis and operating at -30C
Tip/tilt stage	500 μrad stroke with 0.05 μrad noise, 80 Hz bandwidth
NGS WFS detectors	256x256 CCD, 96x96 virtual sub-apertures, 0.8 quantum efficiency, ~1 electron at 100Hz frame rate
LGS WFS detectors	60x60 sub-apertures with 6x6 to 6x15 pixels each ~0.9 quantum efficiency, 3 electrons at 800Hz
Low-order IR NGS WFS detectors	1024x1024 pixels (sub-array readout on ~8x8 windows), ~0.6 quantum efficiency, 3 electrons at 10-200Hz
Real time controller	Solve 35k x 8k reconstruction problem at 800Hz
Sodium lasers	25W, $M^2 < 1.17$ Coupling efficiency of 130 photons-m^2 /s /W/atom