

A long-exposure photograph of a night sky showing numerous curved star trails in shades of blue and white. In the foreground, the dark silhouette of a mountain or hill is visible, with a white telescope dome structure partially illuminated and visible against the starry background.

HiCIAO as a new tool for young binary searches on the Subaru Telescope

2007.5.16 @ Toronto

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NAOJ

on behalf of HiCIAO development team
HiCIAO is a collaboration with University of Hawaii, Hilo

Subaru has an AO Coronagraph since 2001

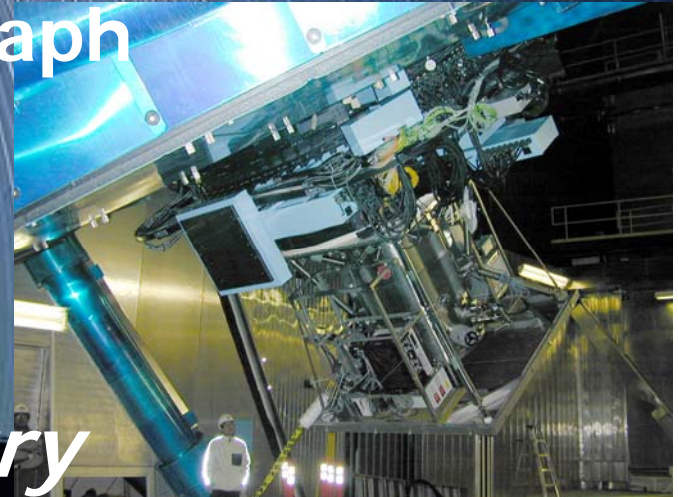
◆ 36-act. AO + CIAO at CS

- ★ First dedicated IR coronagraph on 8-m telescopes

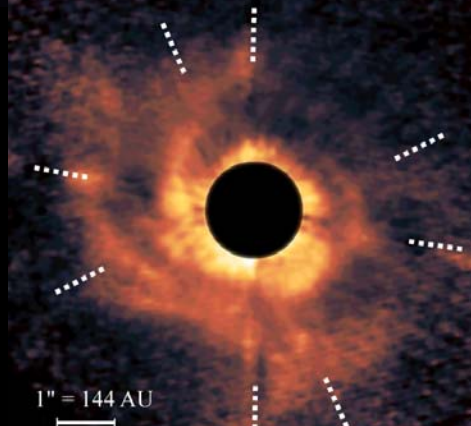
◆ *Disk Morphology*

◆ *Companion searches*

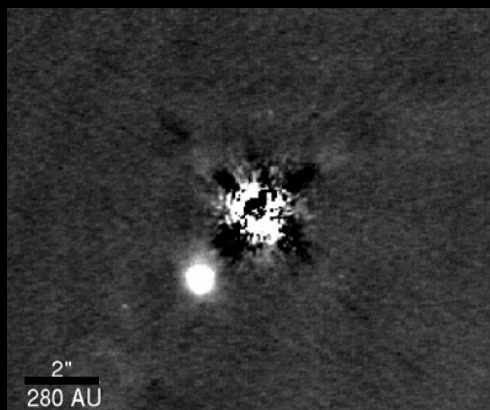
◆ *High-resolution Polarimetry*



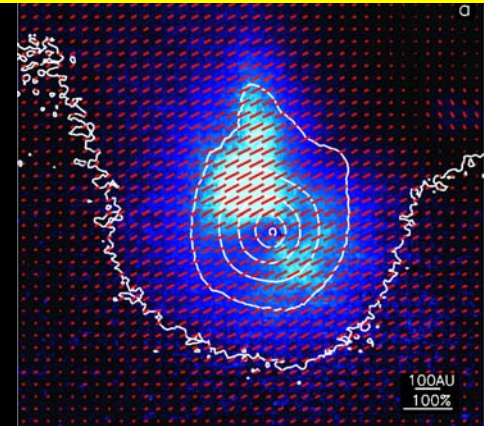
Diversity of proto-Planetary disks



Young very low-mass Companion

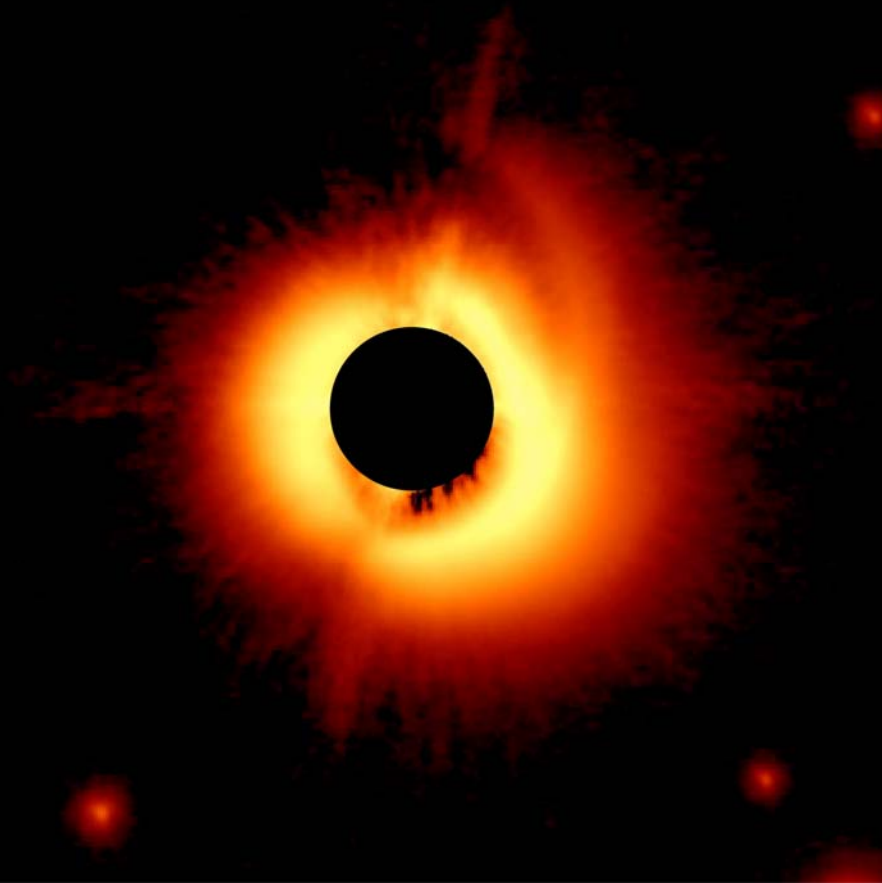


Compact disk around massive YSOs (BN)

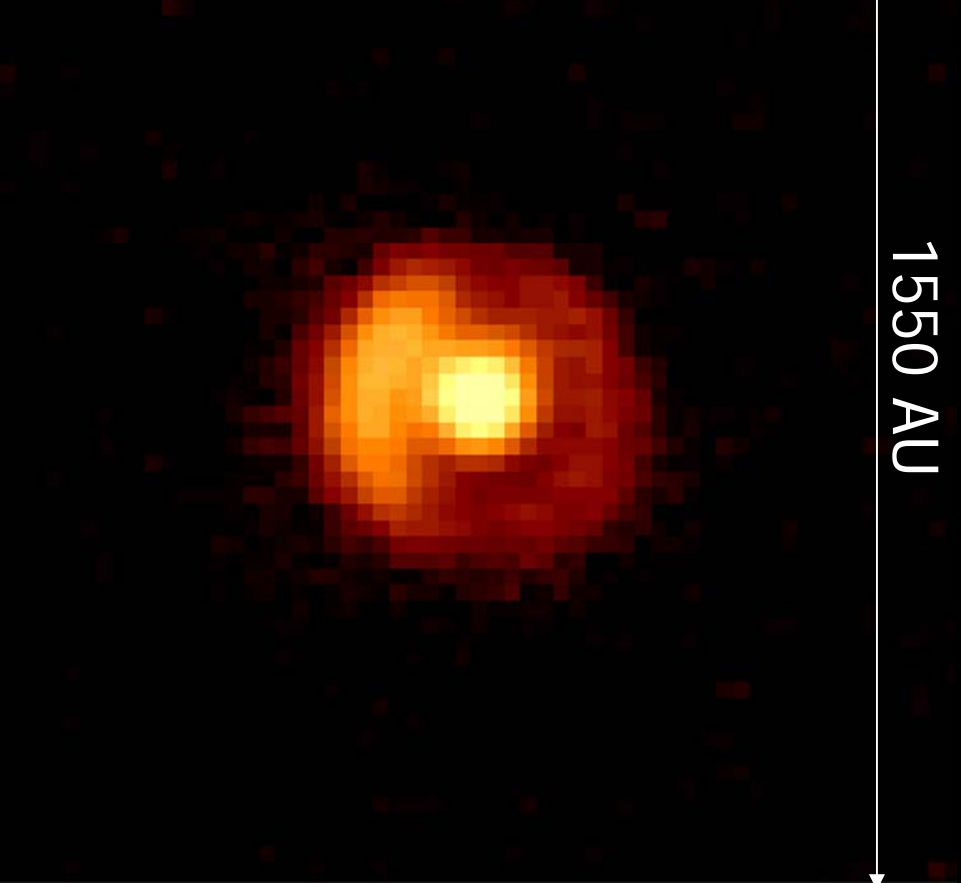


NEW type of disk: HD142527 – banana split

Herbig Ae star in Lupus (d=200pc)



$\lambda = 1.65$ micron
Subaru/CIAO



$\lambda = 24.5$ micron
Subaru/COMICS

1550 AU

HiCIAO has three observation modes. Occulting masks and Lyot stops are available in all the observation modes.

1. Direct Imaging Mode

Direct Imaging mode covers 20'' x 20'' FOV with 0.010''/pix. HiCIAO+AO188 will provide sharp imaging capability with Strehl Ratio of 0.6 (J), 0.7 (H), and 0.8 (K). The simple optics configuration realizes high throughput.

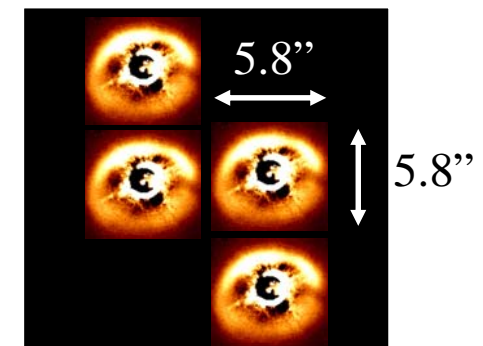
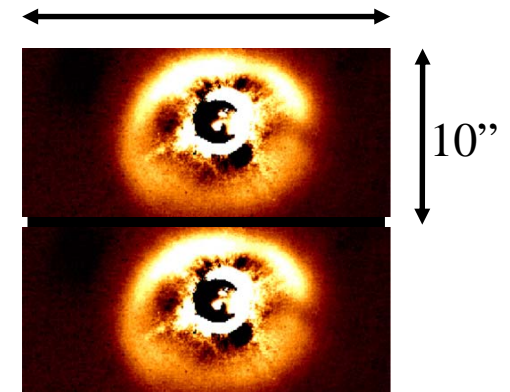
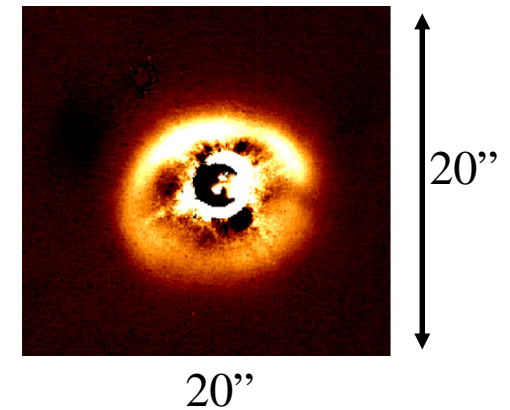
2. Polarimetric Differential Imaging Mode

Polarimetric Differential Imaging mode provides two images which correspond to ordinary and ex-ordinary lights simultaneously on the detector using a Wollaston prism. By subtracting one image from another, the objects with polarimetric feature will show up. Normal polarimetric observation with waveplates is also available.

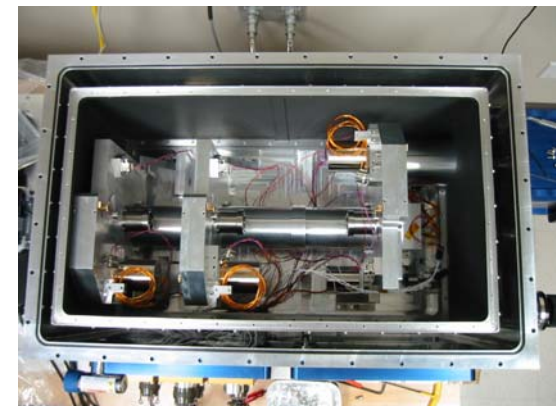
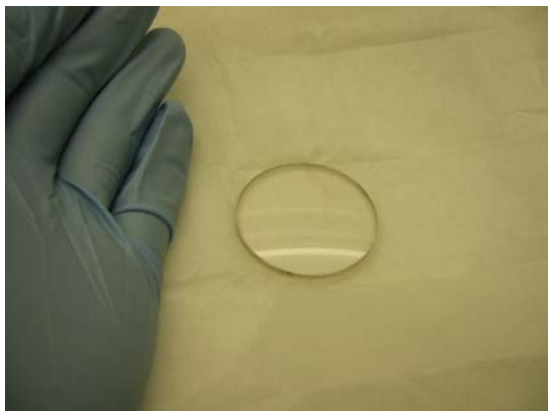
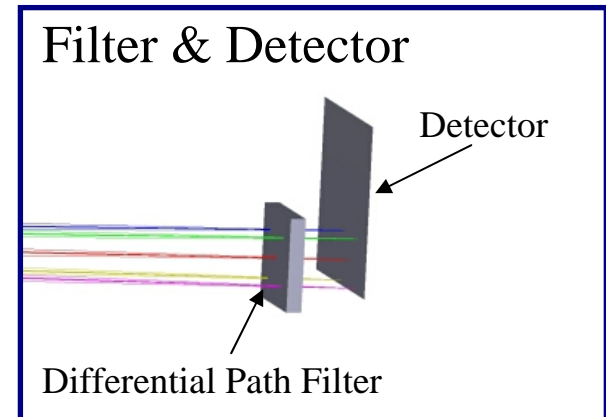
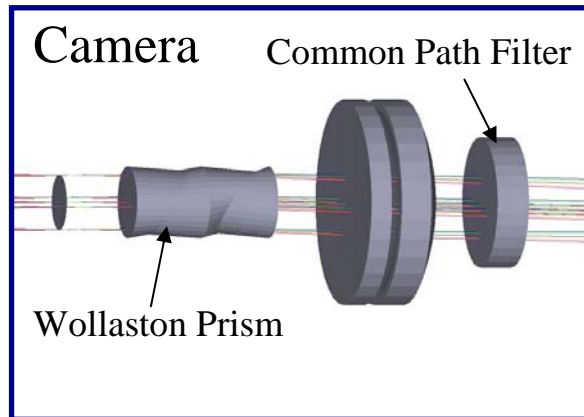
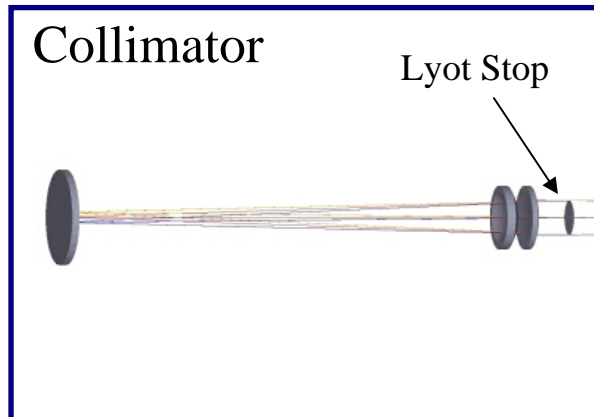
3. Spectral Differential Imaging Mode

Spectral Differential Imaging mode produces four images simultaneously using two Wollaston prisms. Each of these images is recorded through individual filters which are designed to match a spectral feature of the object. High contrast imaging will be achieved by subtracting images with one another, because the speckles from the atmosphere, the telescope, and the instrument are identical (but scaled by wavelength) among four images.

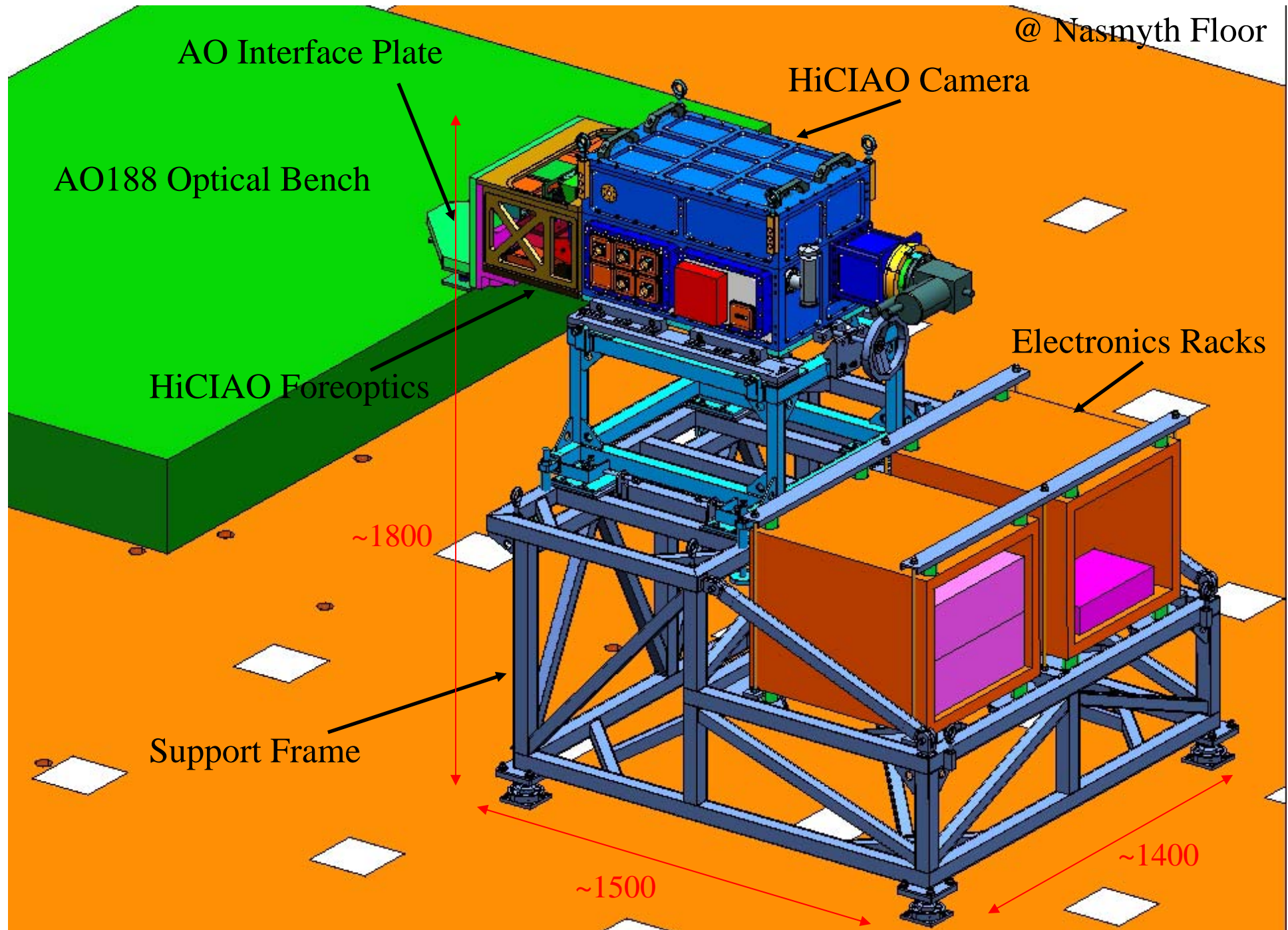
SDI has been used at CFHT/MMT/VLT.



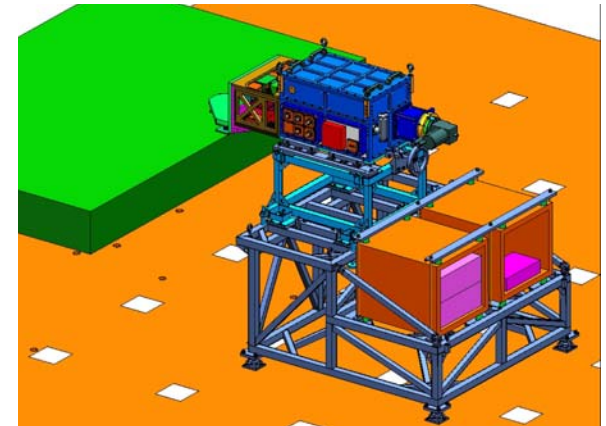
HiCIAO Optics



@ Nasmyth Floor



HiCIAO



Most recent
Image.

Expected performances of HiCIAO/A0188

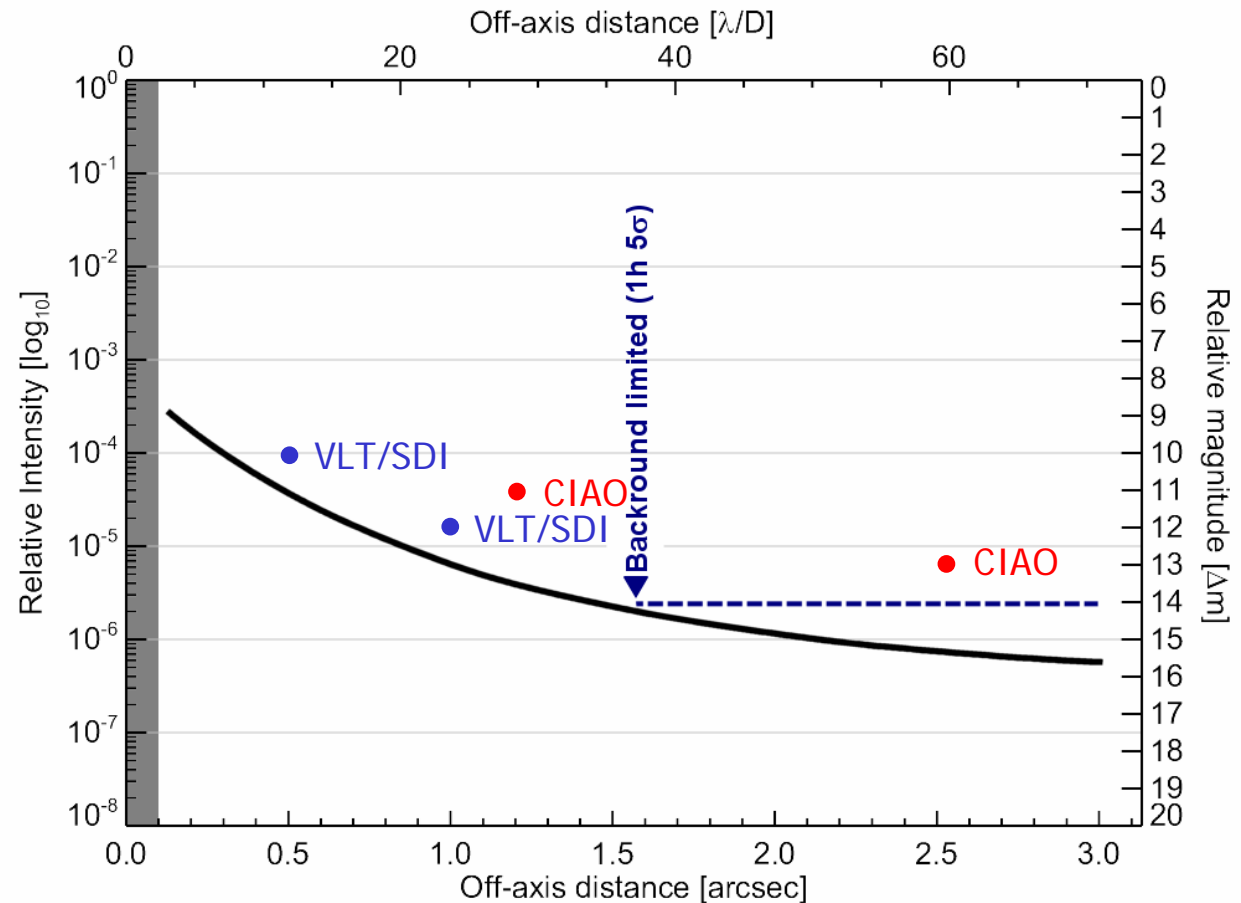
- Resolution (FWHM): From $\sim 0.1''$ to $0.03'' \sim 0.05''$!
- Contrast: >One order better (13 mag @ $1''$)

sensitivity

Band	5σ (1 hour)
J	24.28
H	24.16
Ks	23.84
CH ₄ low	23.27
CH ₄ high	23.47
[FeII]	24.28

resolution

Wavelength (μm)	FWHM (mas)
1.020	27.1
1.200	31.8
1.600	41.8
2.200	57.2



Schedule and Operation Plan

◆ Development: quick (FY2004-2007)

- ★ 2004 Concept design fixed
- ★ 2005 Sept PDR
- ★ 2006 Feb CDR
- ★ At present final assembling
- ★ 2007 June Complete assembling
- ★ 2007 Sep First Light

◆ (near) Future upgrades

- ★ 2nd-stage MEMS-DM for Extreme AO (~1000 elements equivalent), already lab. demonstrated

◆ Extensive Surveys for exoplanets and disks

- ★ Strategic observations 2008-2012 (100 nights)
 - ★ Being proposed now

Application to binary studies

◆ SDI speckle imaging

- ★ Binary methane brown dwarf imaging
 - ★ w/ methane SDI filters
 - ★ imaging & rough spectral information, simultaneously
- ★ Jets/outflows from young brown dwarfs
 - ★ w/ [Fe II] or H₂ SDI filters
 - ★ spatial resolution higher than HST

◆ binary disk polarization differential imaging

◆ Future upgrades (in 3-4 yrs?)

- ★ IR wave front sensor (MPI group/Subaru collab.)

- ★ We welcome collaboration proposals for Subaru!