Lyot Project & Gemini Planet Imager

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The Lyot project team

AMNH: Ben Oppenheimer, Anand Sivaramakrishnan, Remi Soummer, Sasha Hinkley, Jacob Mey,

STScI: Russell Makidon

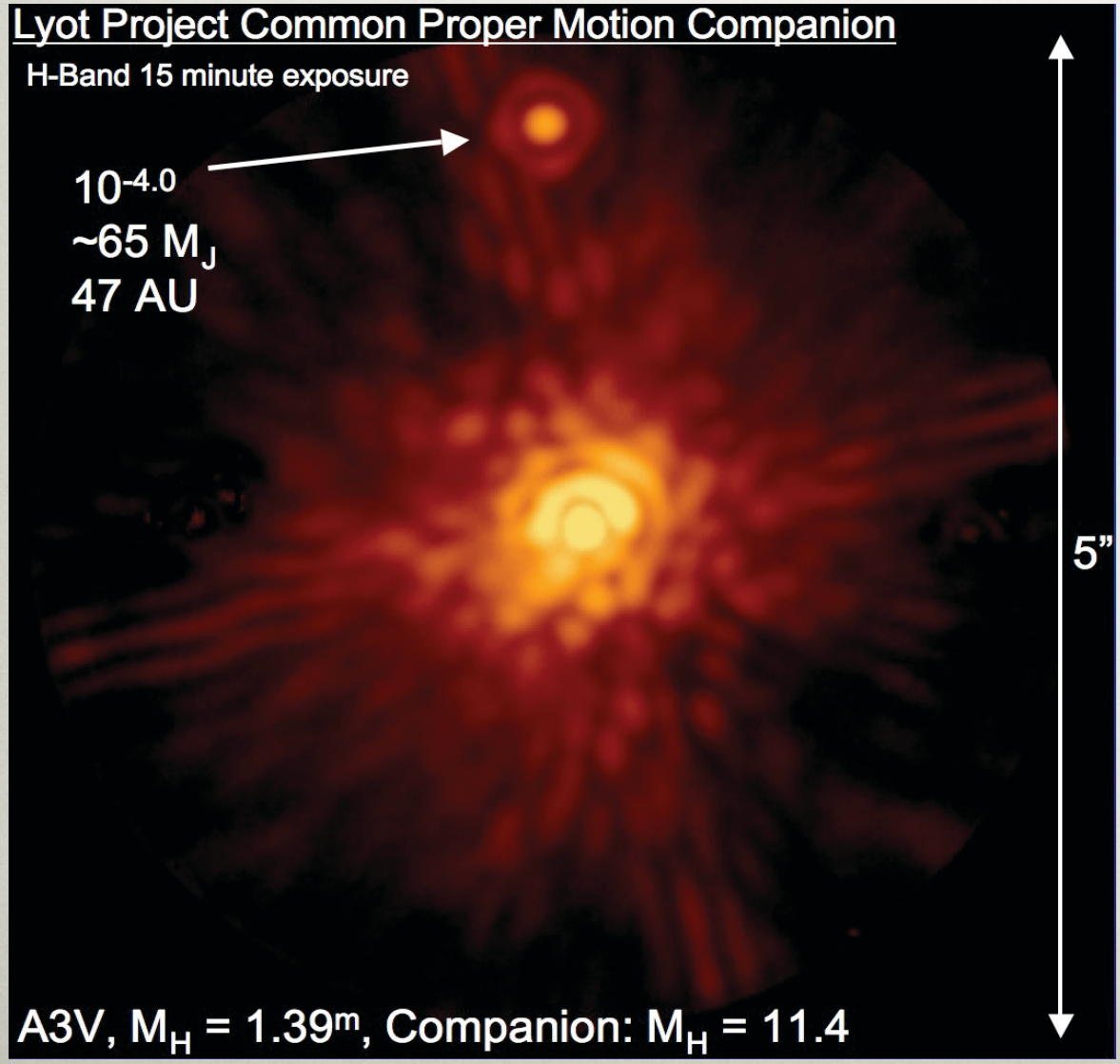
Berkeley: James Graham, Marshall Perrin

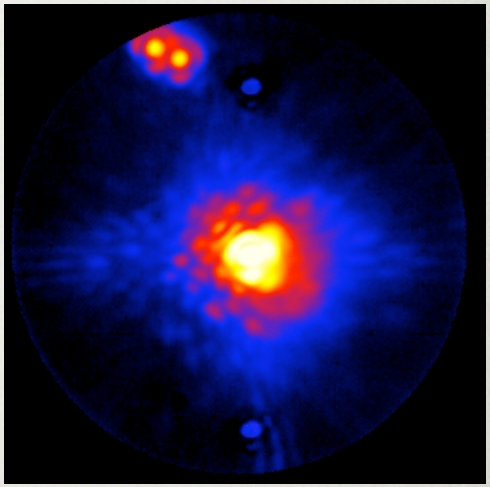
Cornell: James Lloyd

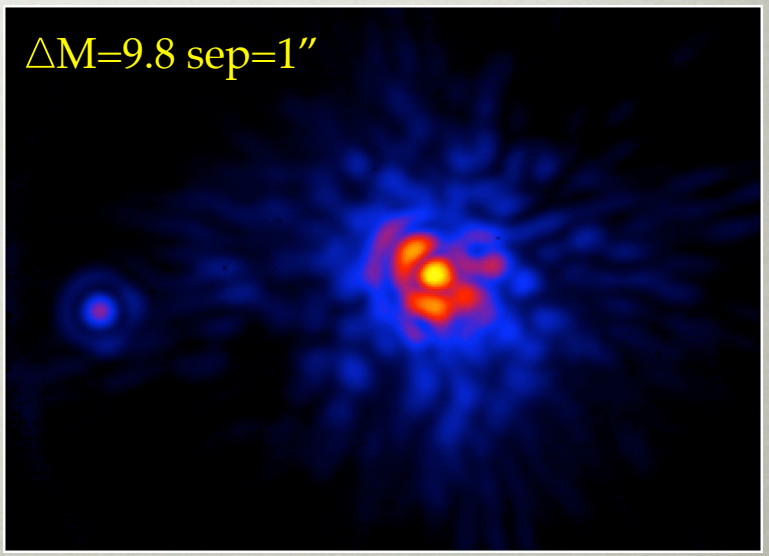
University of Hawaii: Jeffrey Kuhn

AEOS/Boeing: Lewis Roberts

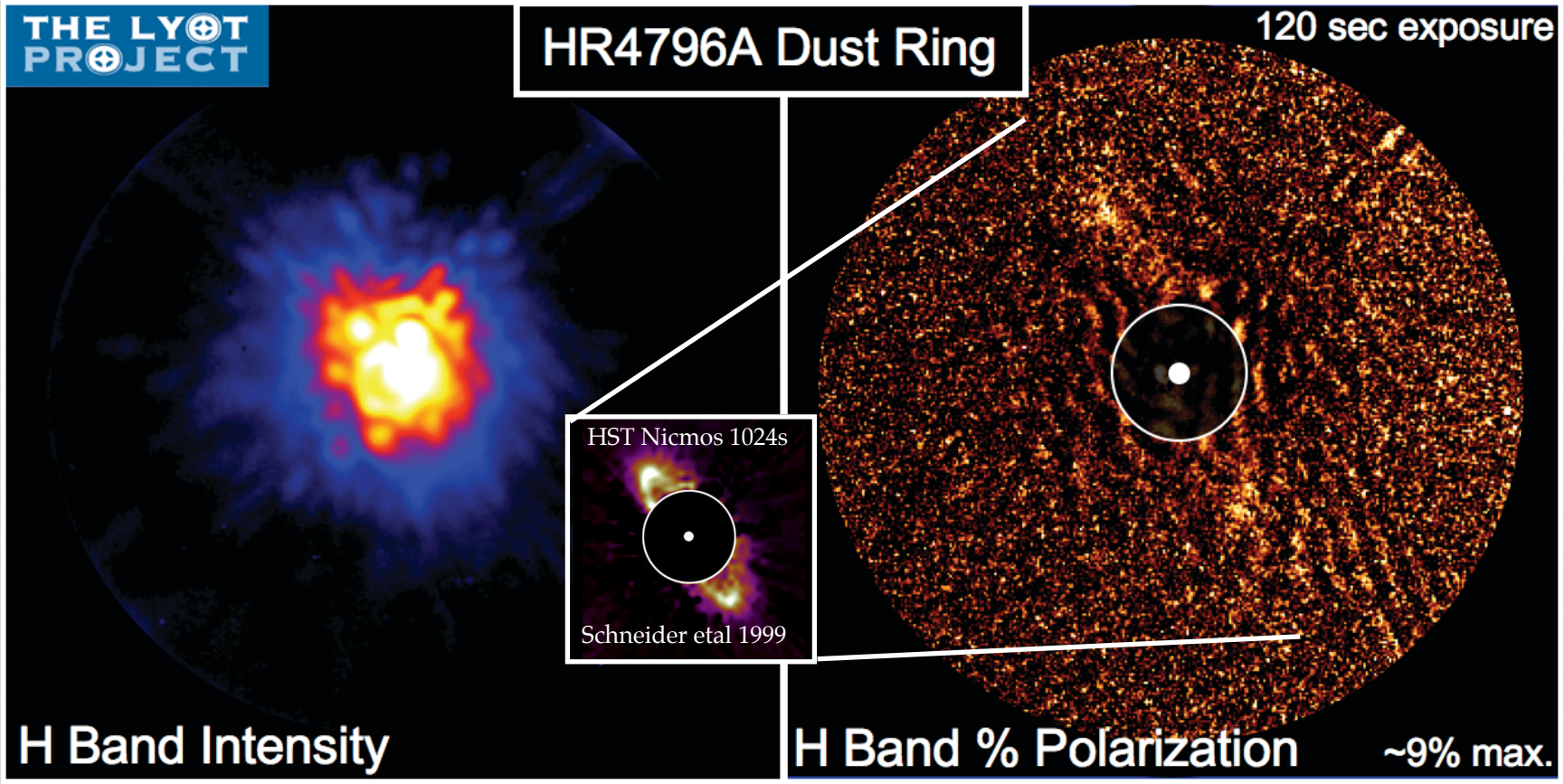
First Results



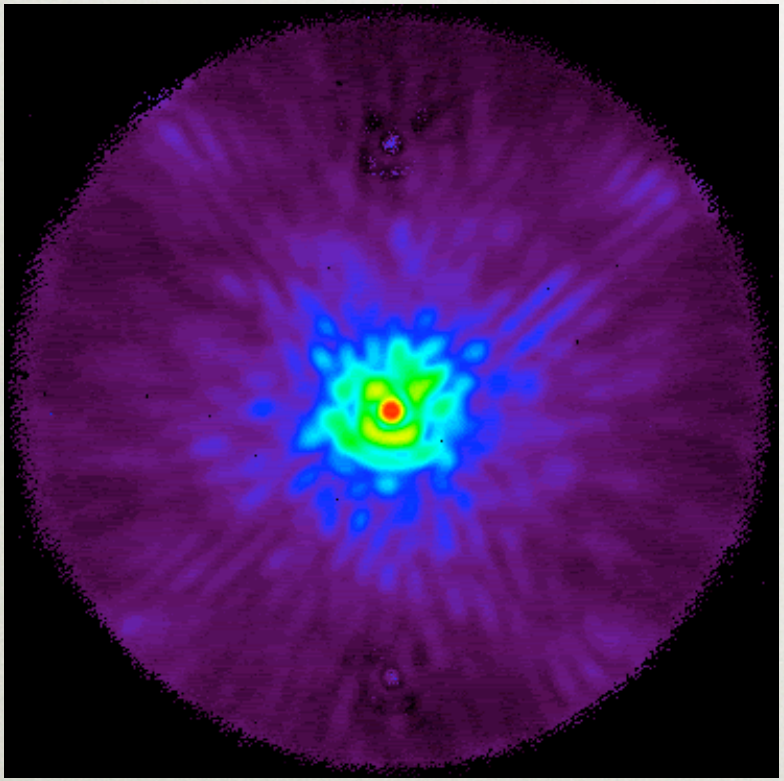




First Results



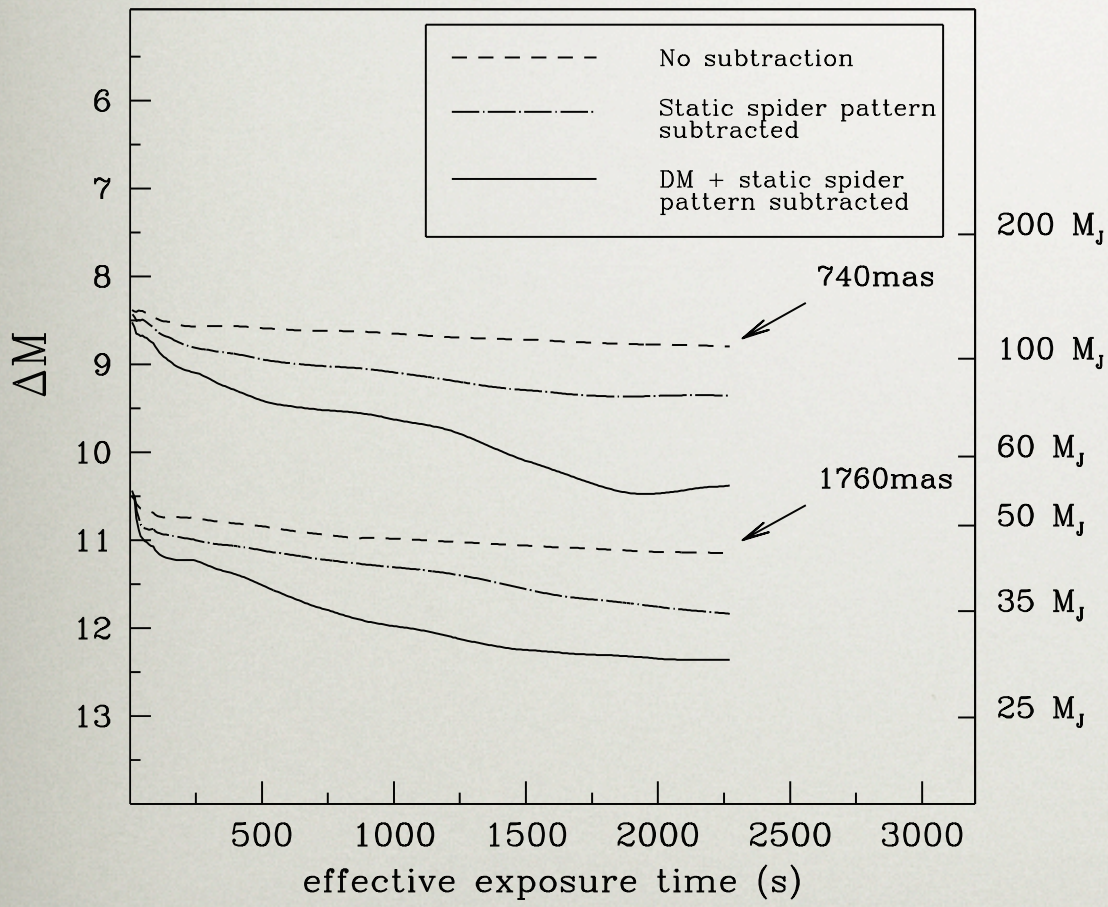
Residual speckles

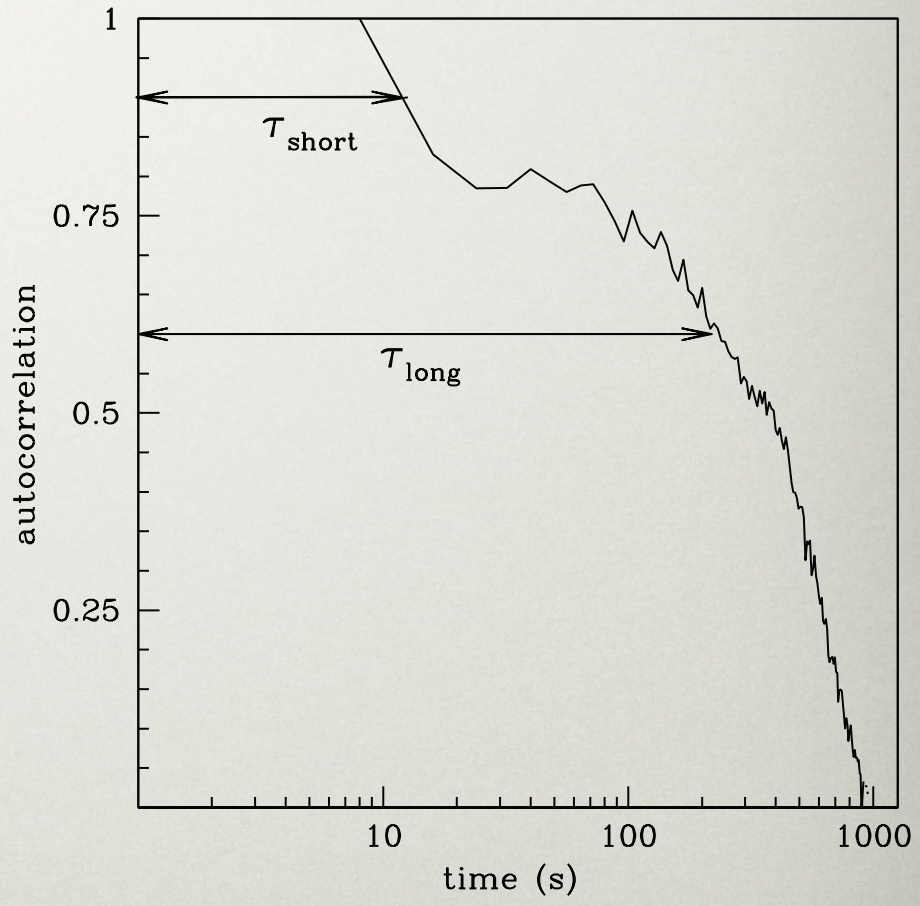


- Delta Herculis
- H Band 5 arcsec FOV
- 150 x 20sec images

- Use the rotations at the coude focus to remove some speckles Marois etal 2005 Angular Differential Imaging

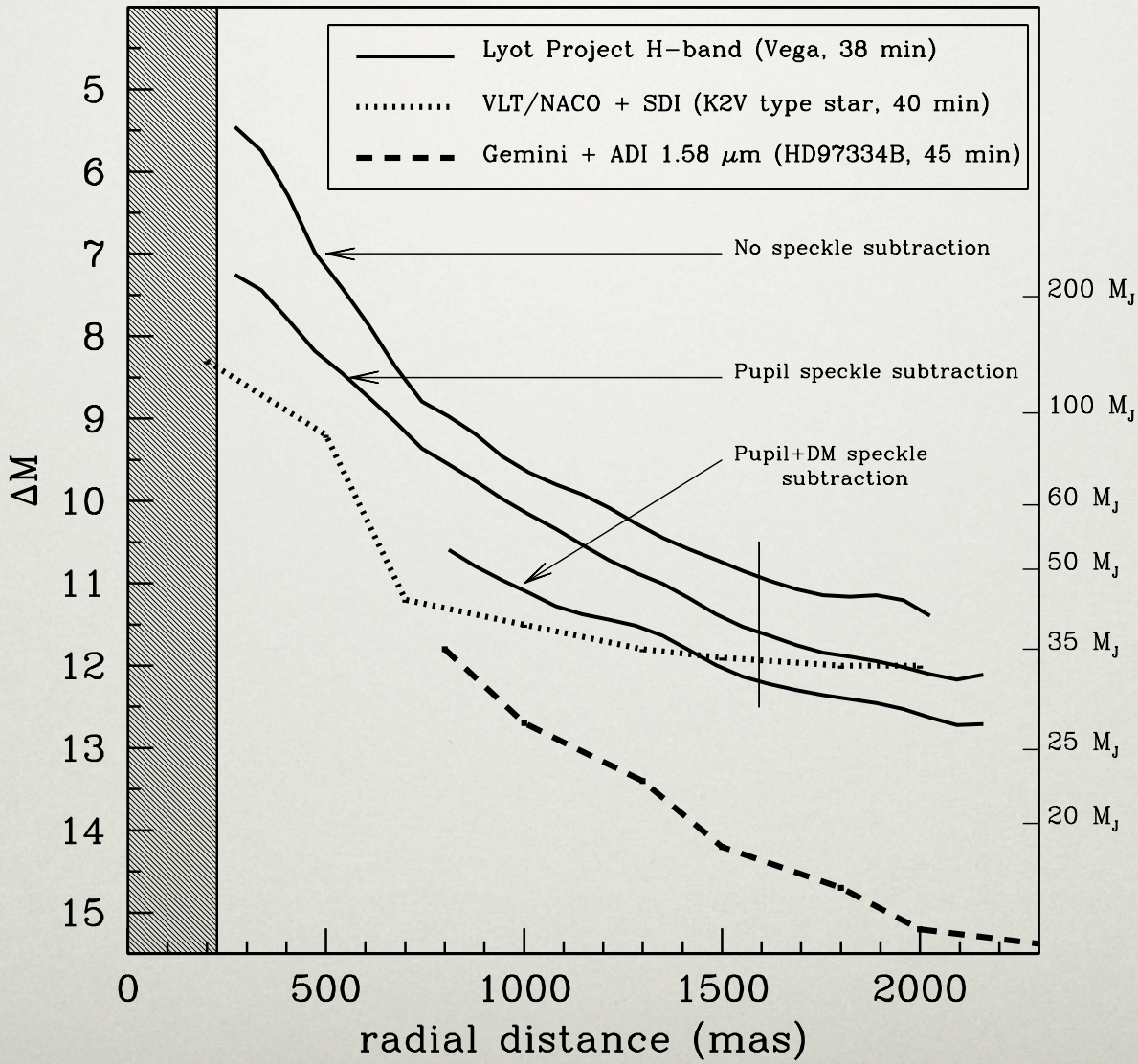
Temporal properties of speckles





Hinkley et al 2006 (astroph)

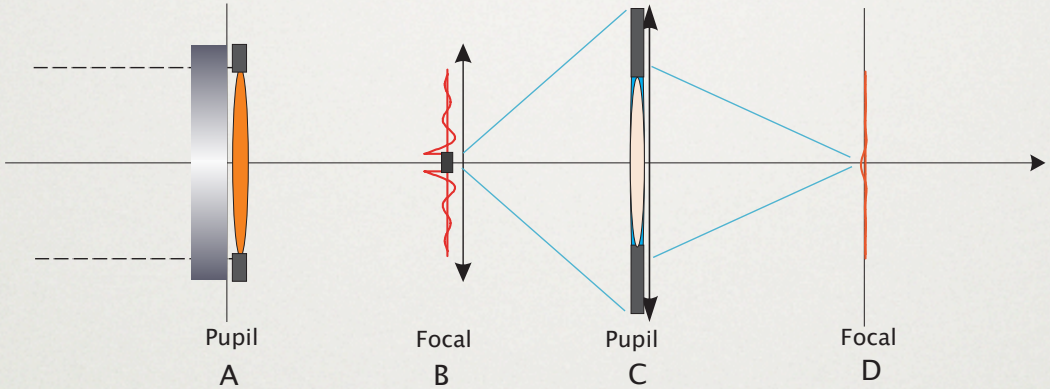
Performance comparison



Hinkley etal 2006 (astroph)

Apodized Pupil Lyot Coronagraph

- An APLC is a Lyot coronagraph with an upstream pupil apodization



- Theoretical ground: eigenvalue problem, prolate spheroidal solutions
- Solutions exist for any geometry
- Manufacturable in the infrared, several techniques identified
- Achromatization possible using chromaticity of material (HEBS glass)

Future plans

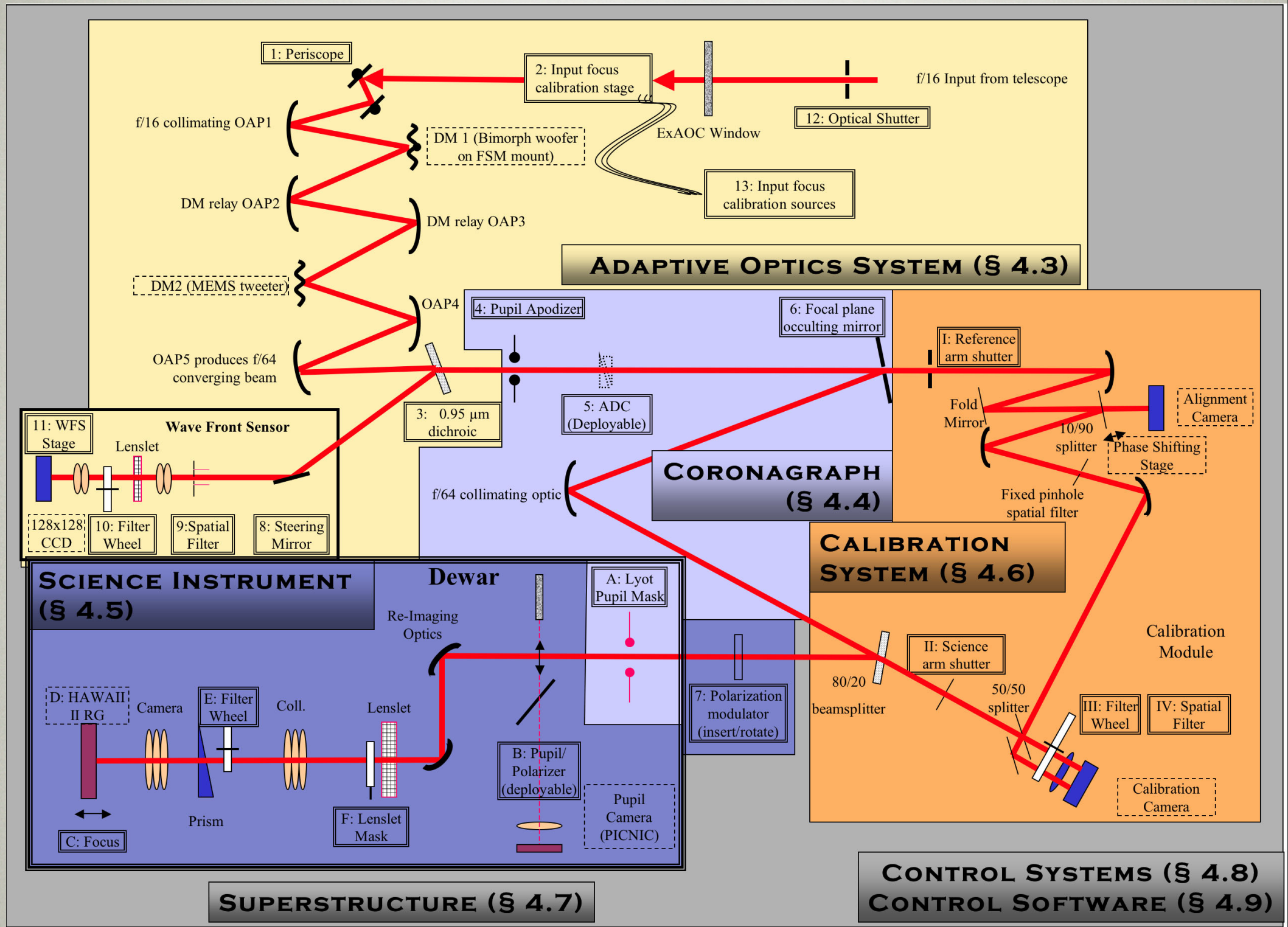
- USAF to upgrade the AO system
  - New DM
  - Improved reconstructors
  - SFWFS
- Astrometry grid (Sivaramakrishnan etal 06)
- APLC (Soummer 05)
- Next run in December

Gemini Planet Imager

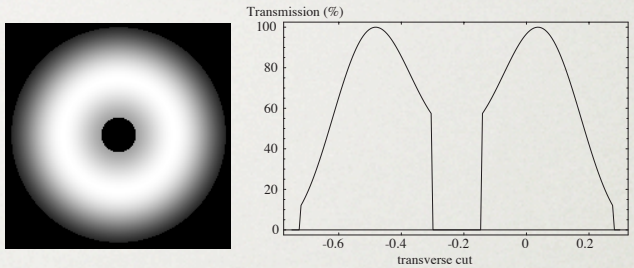
- Principal Investigator: Bruce Macintosh (LLNL)
- Project Manager: David Palmer (LLNL)
- Project Scientist: James Graham (Berkeley)
- System Engineer: Karla Hagans (LLNL)
- AMNH: Ben Oppenheimer, Anand Sivaramakrishnan, Remi Soummer
- HIA: Les Saddlemyer, Jean Pierre Veran, Darren Erikson, Jennifer Dunn
- JPL: Kent Wallace, Marty Levine
- LLNL: Lisa Poyneer, Brian Bauman, Don Phillion, Julia Evans, Christian Marois
- UCLA: James Larkin, Jason Weiss
- UCSC LAO: Don Gavel, Katie Morzinski, Daren Dillon, Scott Severson
- U. Montreal: Rene Doyon, Jean~Francois Lavigne

ExAOC / GPI history

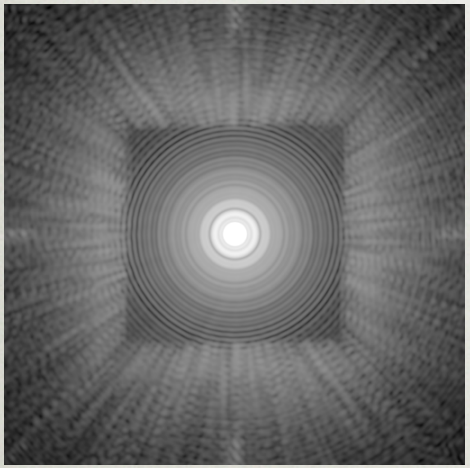
- 2003 Basic ExAO feasibility study and Keck Strawman
- 2004 Gemini Extreme AO Corongraph Conceptual design begins (cfao led)
- 2005 cfao team selected
- 2006 (june) project starts


1: Periscope
2: Input focus calibration stage
f/16 Input from telescope
12: Optical Shutter
ExAOC Window
13: Input focus calibration sources
f/16 collimating OAP1
DM 1 (Bimorph woofer on FSM mount)
DM relay OAP2
DM relay OAP3
DM2 (MEMS tweeter)
OAP4
OAP5 produces f/64 converging beam
Adaptive Optics System (§ 4.3)
4: Pupil Apodizer
6: Focal plane occulting mirror
I: Reference arm shutter
3: 0.95 µm dichroic
5: ADC (Deployable)
Fold Mirror
Alignment Camera
10/90 splitter
Phase Shifting Stage
Fixed pinhole spatial filter
11: WFS Stage
Wave Front Sensor
Lenslet
128x128 CCD
10: Filter Wheel
9:Spatial Filter
8: Steering Mirror
f/64 collimating optic
Coronagraph (§ 4.4)
Calibration System (§ 4.6)
Science Instrument (§ 4.5)
Dewar
A: Lyot Pupil Mask
Re-Imaging Optics
II: Science arm shutter
Calibration Module
80/20 beamsplitter
50/50 splitter
7: Polarization modulator (insert/rotate)
D: HAWAII II RG
Camera
E: Filter Wheel
Coll.
Lenslet
III: Filter Wheel
IV: Spatial Filter
B: Pupil/ Polarizer (deployable)
Pupil Camera (PICNIC)
Calibration Camera
C: Focus
Prism
F: Lenslet Mask
Superstructure (§ 4.7)
Control Systems (§ 4.8)
Control Software (§ 4.9)

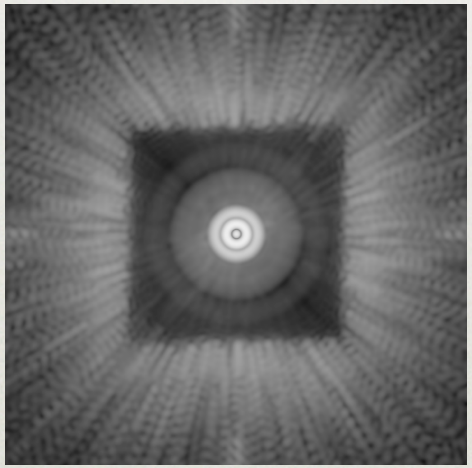
APLC for Gemini



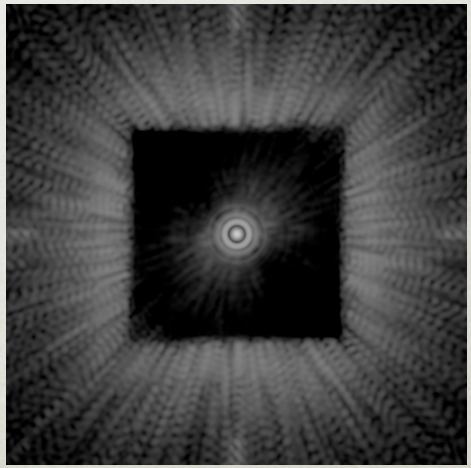
Apodizer transmission
Throughput 50%



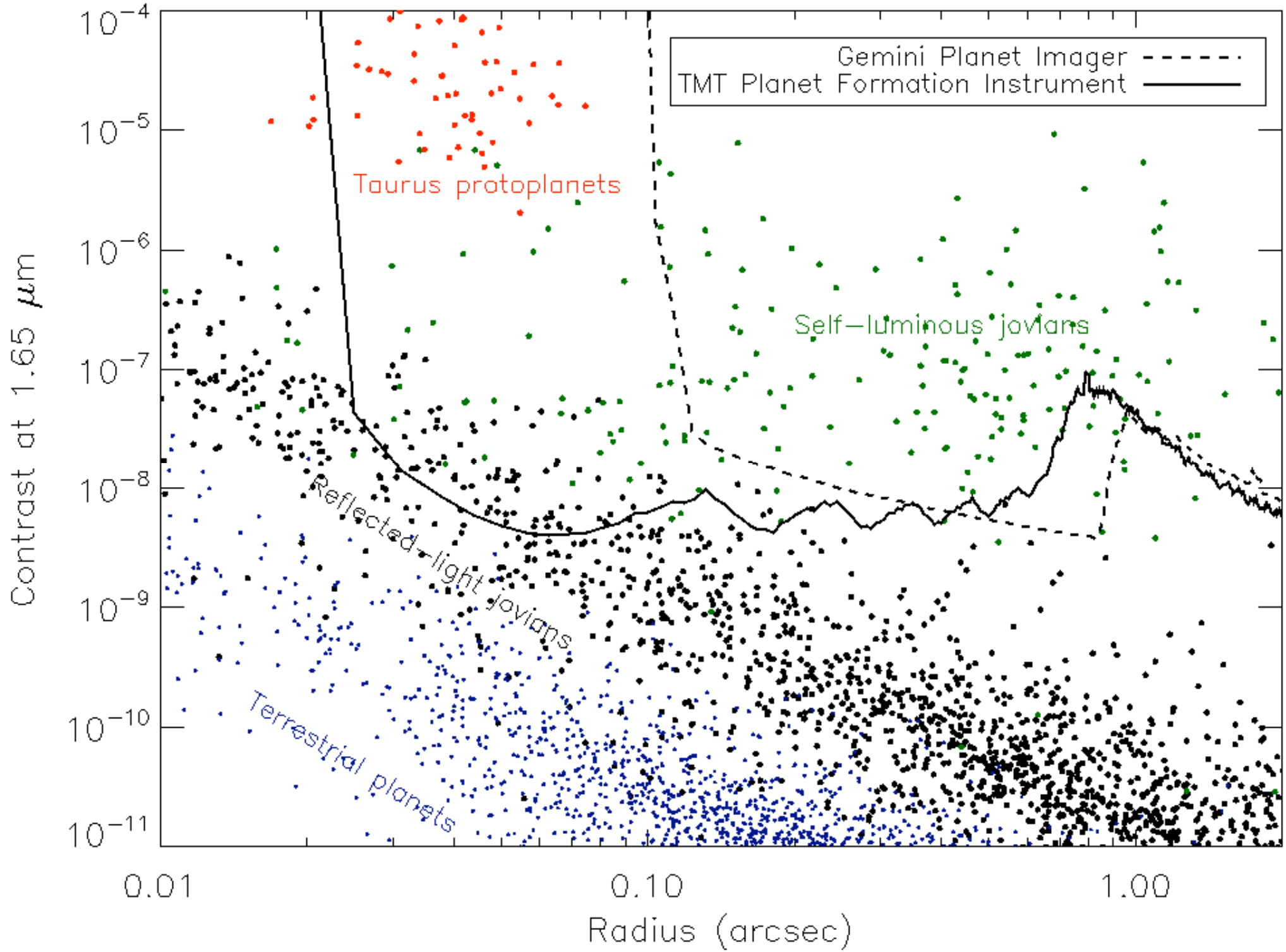
Direct Image PSF
(SFWFS 95% SR in H band)



Classical Lyot coronagraph
Throughput 50%



APLC mask 4λ/D
Throughput 60%


Gemini Planet Imager
TMT Planet Formation Instrument
Taurus protoplanets
Self−luminous jovians
Reflected−light jovians
Terrestrial planets
Contrast at 1.65 μm
Radius (arcsec)
10^−4
10^−5
10^−6
10^−7
10^−8
10^−9
10^−10
10^−11
0.01
0.10
1.00