Coronography

Jorge Melendez

AGA5802

Finding the firefly next to the lighthouse

http://w.astro.berkeley.edu/~gduchene/

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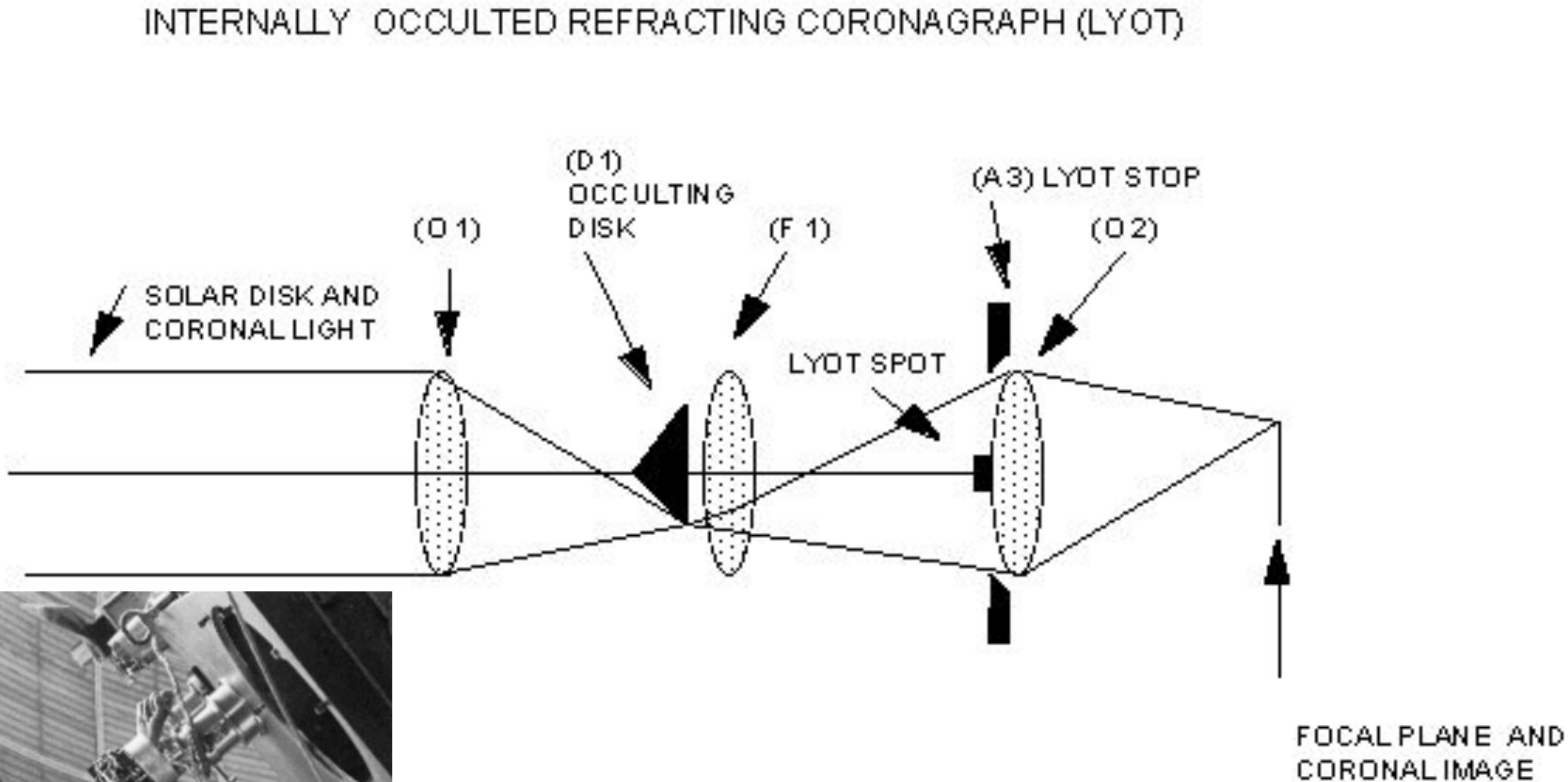
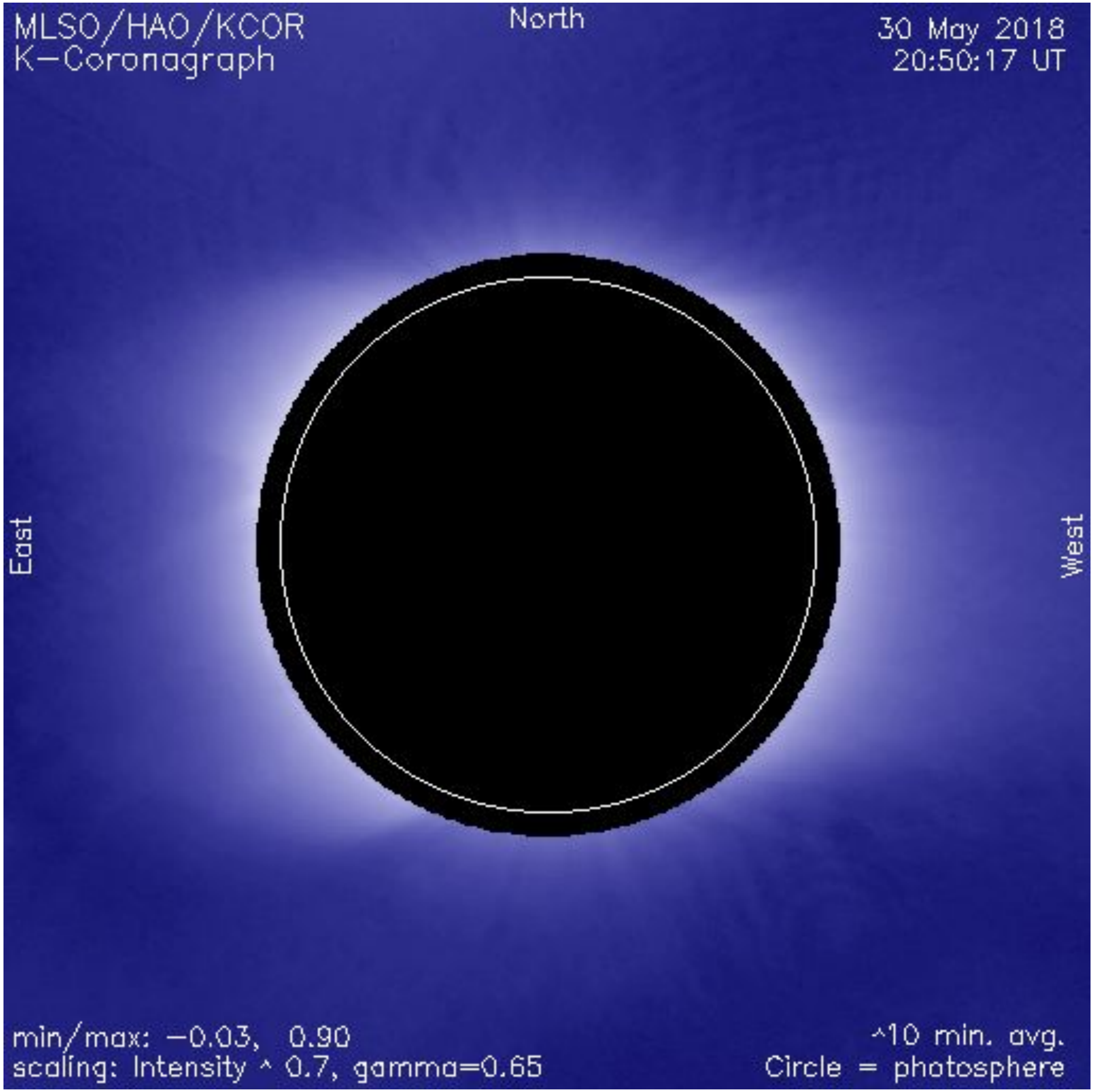
21/8/2017

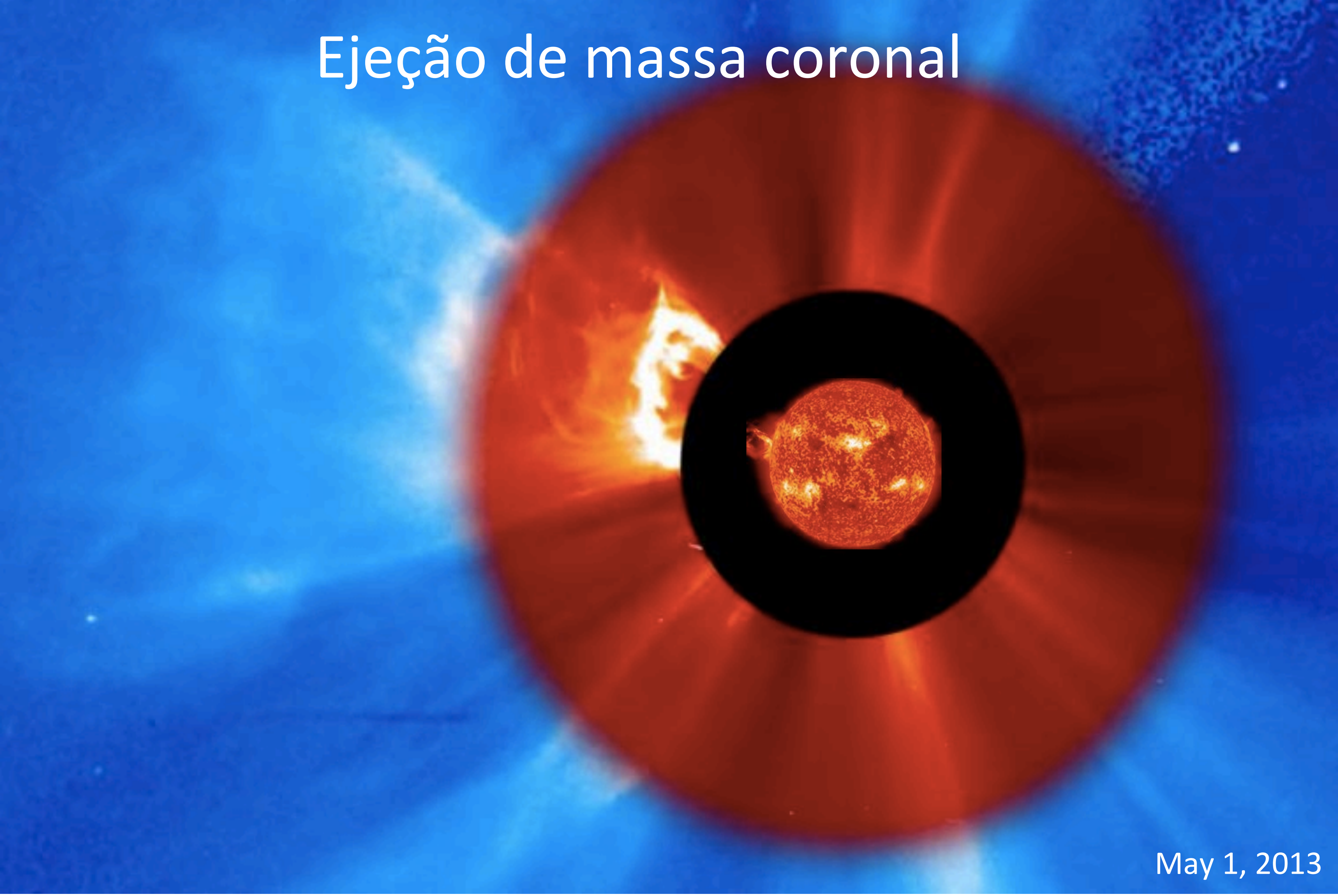


Lyot Coronograph

Bernard Lyot at Pic du Midi (1939)

Solar corona, High Altitude Observatory, 30/5/2018





Besides the SDO images, the CME was also observed by SOHO using 2 coronagraphs where the bright sun is blocked by a disk so it does not overpower the fainter corona.

Ejeção de massa coronal

Máximo do ciclo de atividade solar: ~ 3,5 por dia

Mínimo: aprox. 1 cada 5 dias.

5×10^{12} kg a 5×10^{13} kg

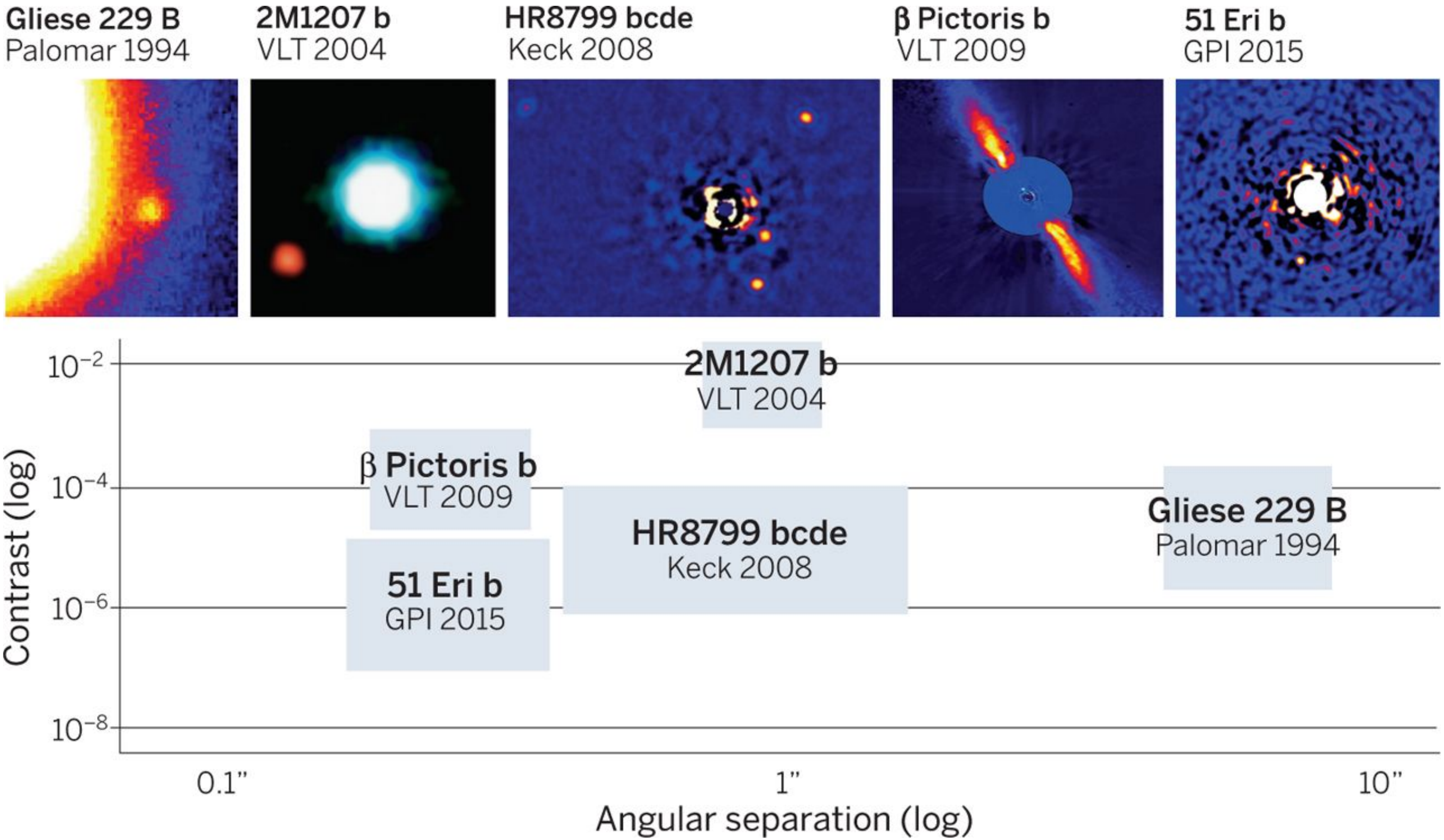
v ~ 400 km/s a 1000 km/s

Com *flares*: 40%

Com proeminência solar eruptiva: 70%

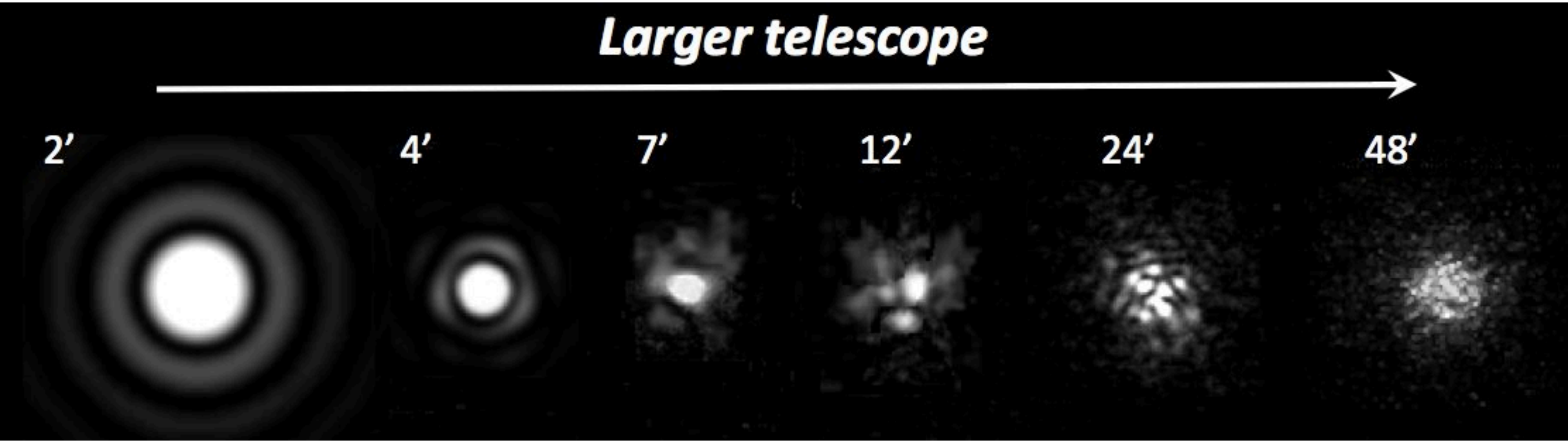
http://www.esa.int/Our_Activities/Space_Science/The_Sun_has_a_great_idea

What about coronography in stars?



http://science.sciencemag.org/content/350/6256/39.full

Larger telescopes are limited by the Earth's atmosphere



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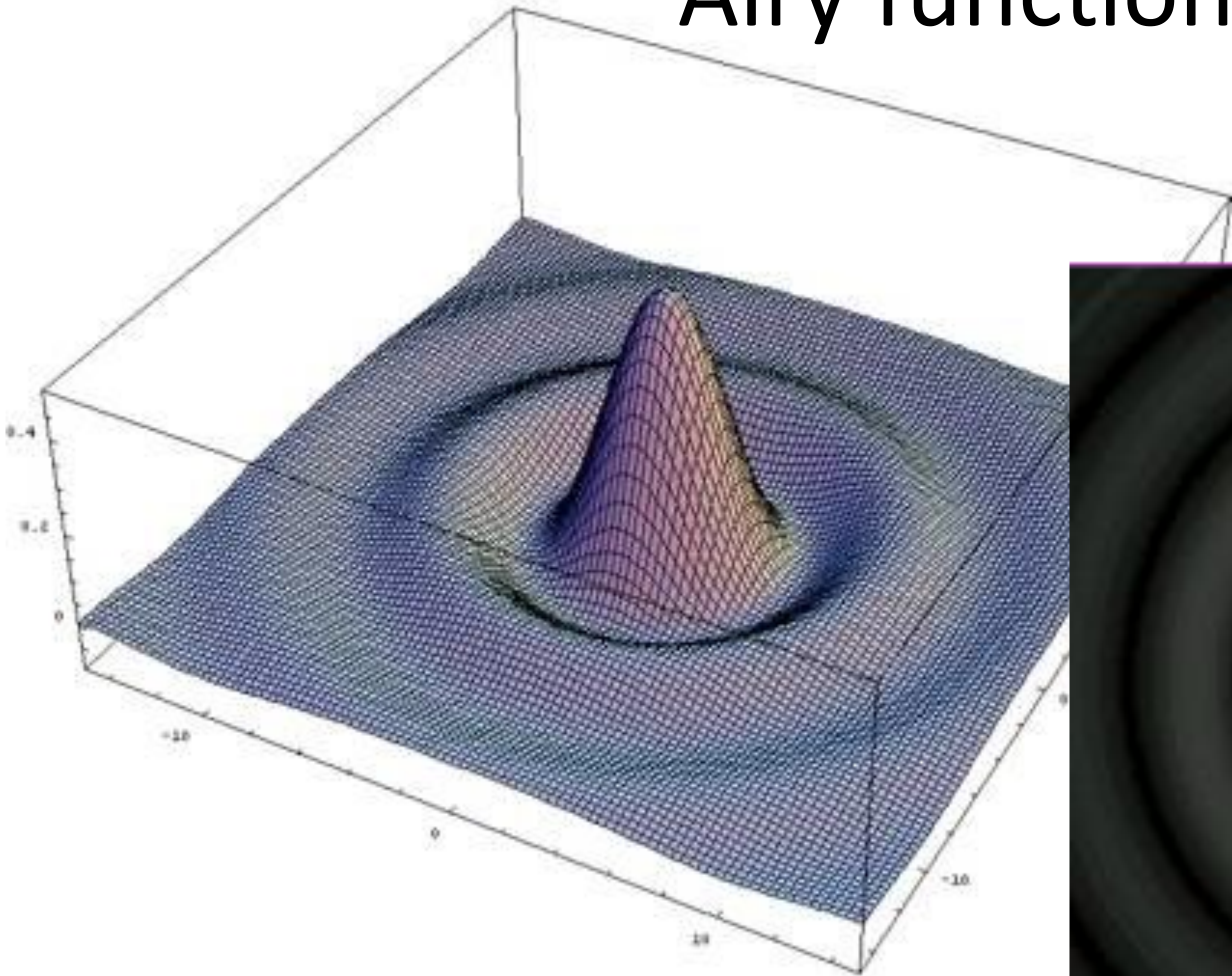
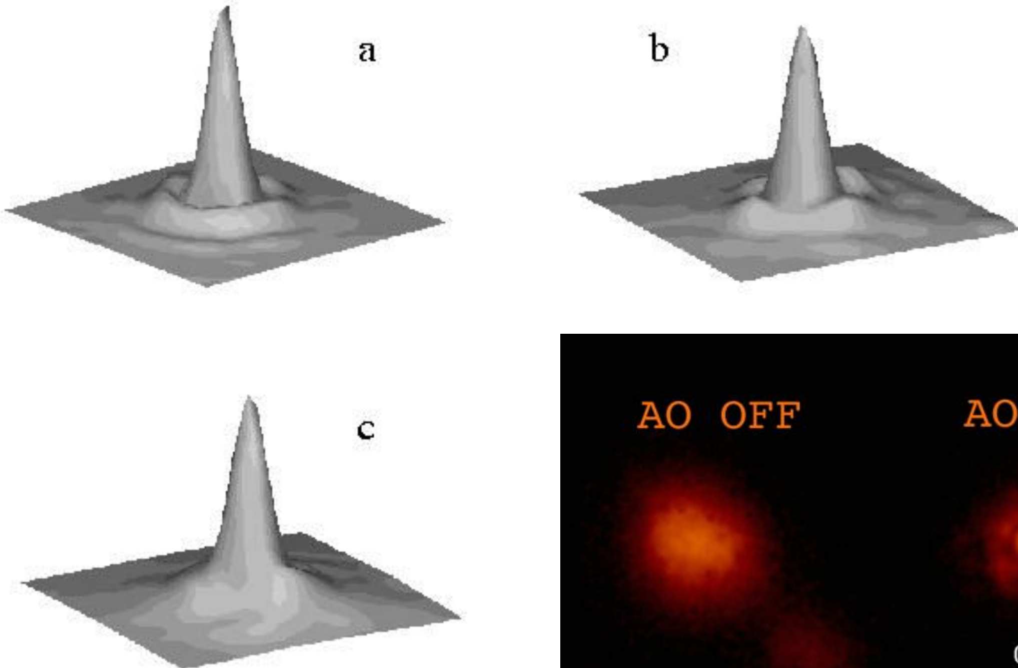
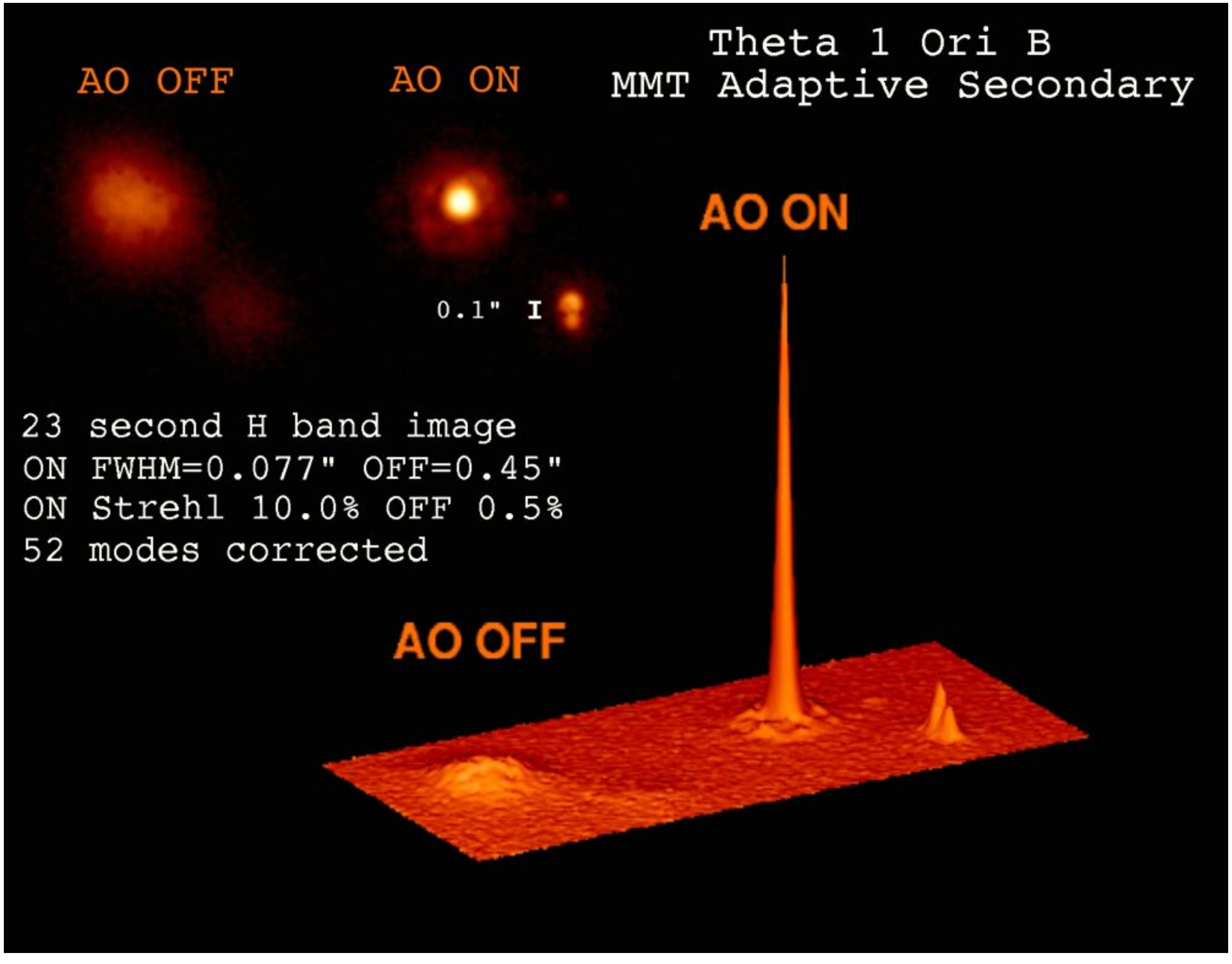
First we need to apply Adaptive Optics!

Image of a point source by a circular aperture (telescope) due to diffraction: Airy function

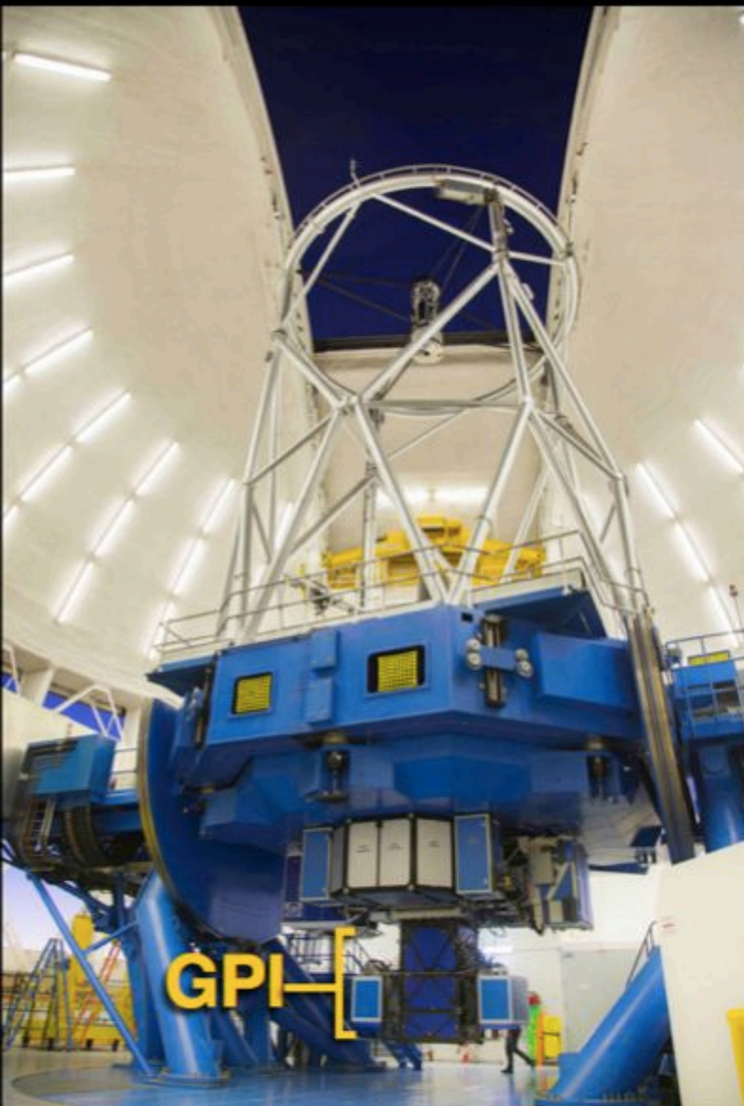


Corrections with Adaptive Optics

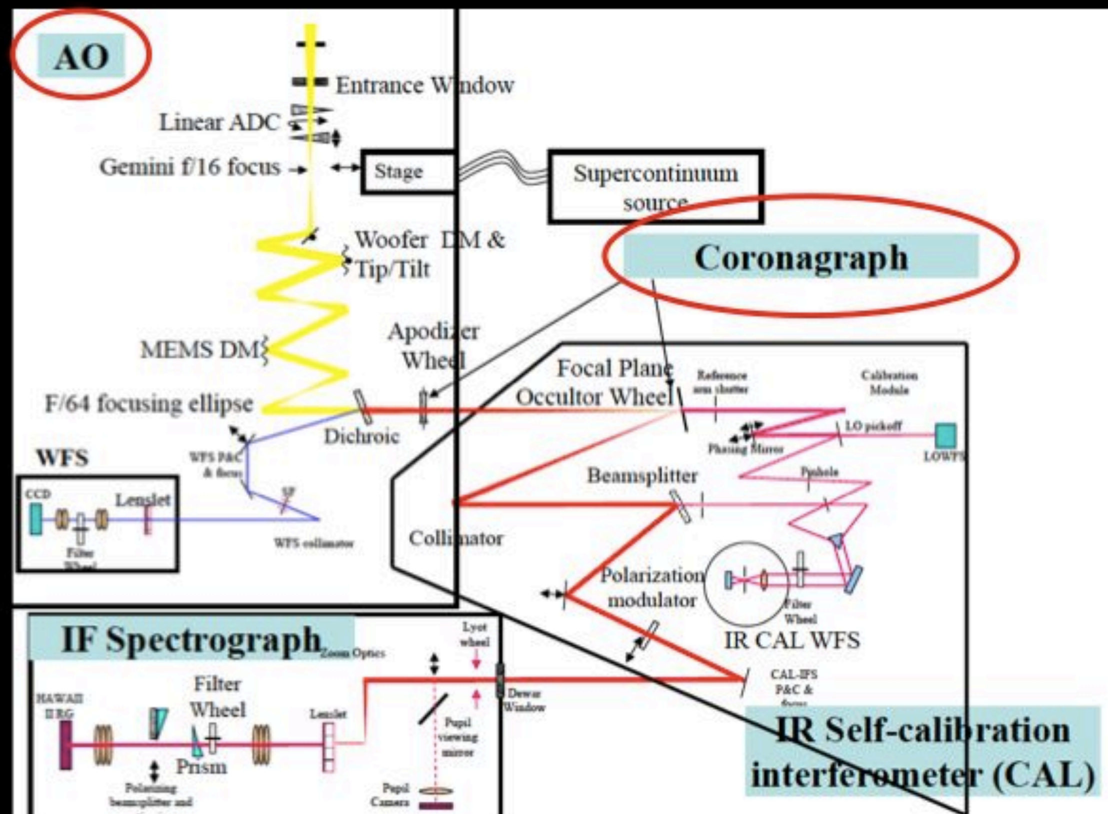




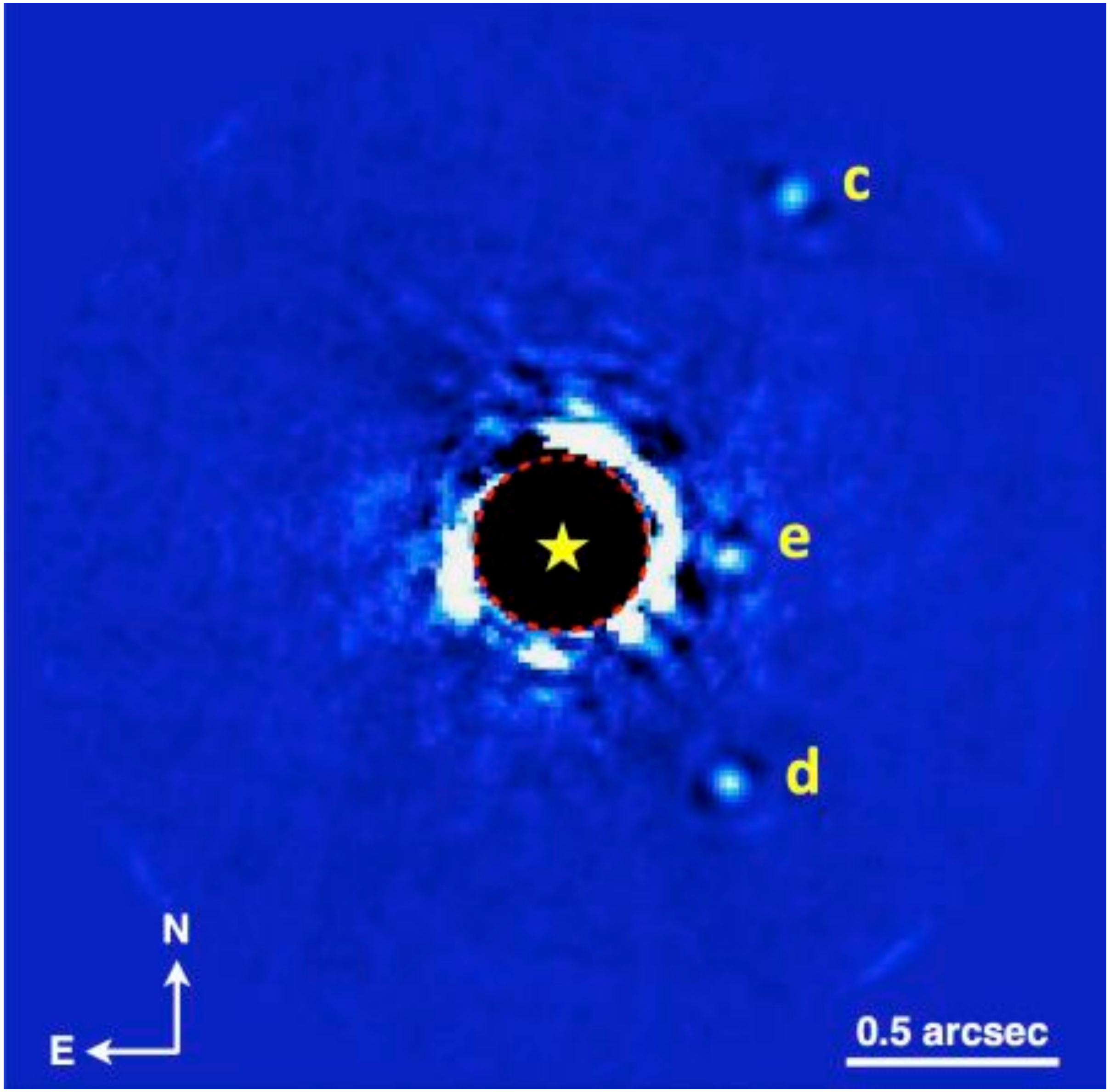
The state of the art



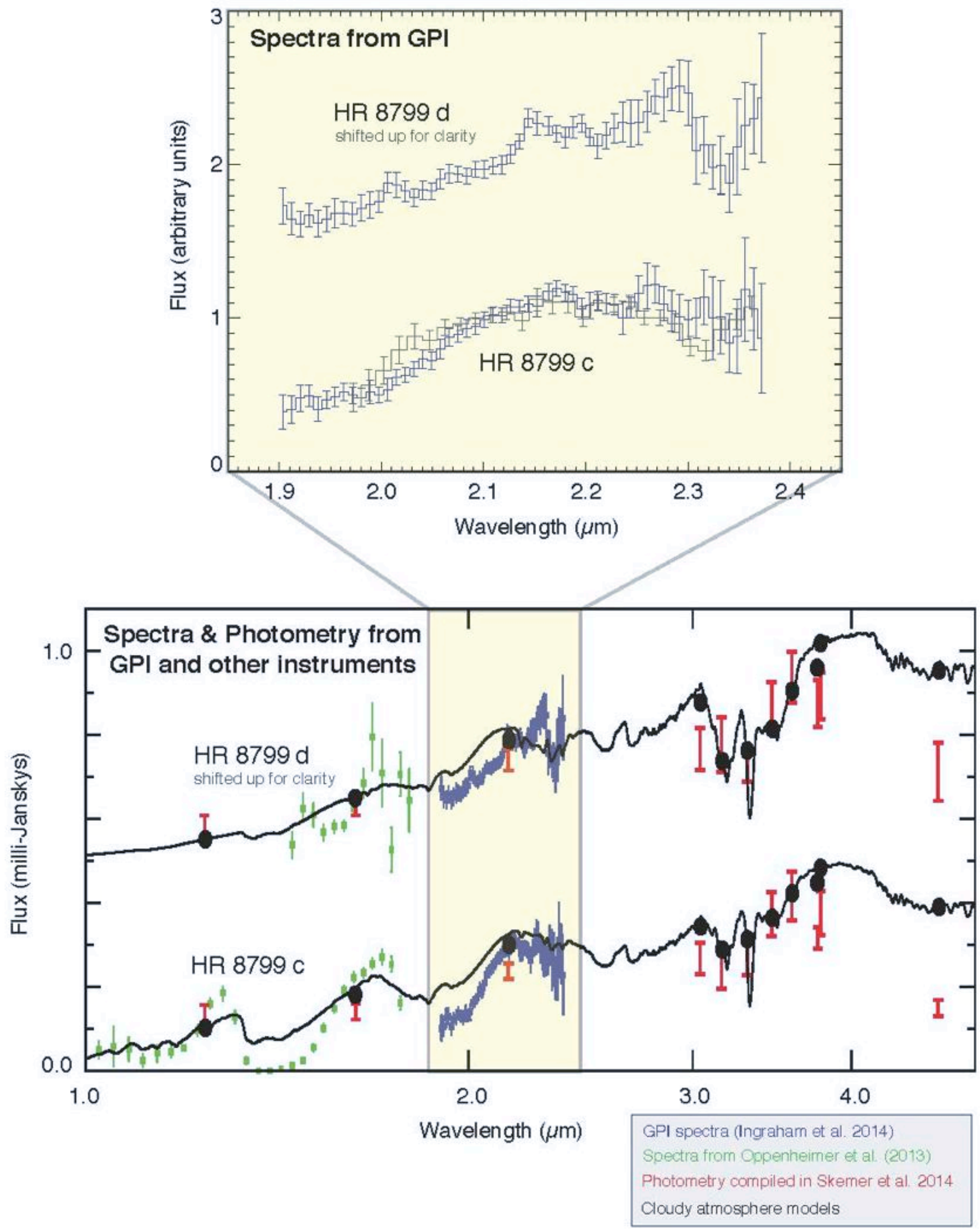
Gemini Planet Imager



http://w.astro.berkeley.edu/~gduchene/



GPI imaging of the planetary system HR 8799 in the near-infrared K band, showing 3 of the 4 planets. (Planet b is outside the field of view shown here, off to the left.) These data were obtained on November 17, 2013 during the first week of operation of GPI and in relatively challenging weather conditions, but with GPI's advanced adaptive optics system and coronagraph the planets can still be clearly seen. Credit: Christian Marois (NRC Canada), Patrick Ingraham (Stanford University) and the GPI Team.



GPI spectroscopy of planets c and d in the HR 8799 system. While earlier work showed that the planets have similar overall brightness and colors, these newly-measured spectra show surprisingly large differences. The spectrum of planet d increases smoothly from 1.9-2.2 microns while planet c's spectrum shows a sharper kink upwards just beyond 2 microns. These new GPI results indicate that these similar-mass and equal-age planets nonetheless have significant differences in atmospheric properties, for instance more open spaces between patchy cloud cover on planet c versus uniform cloud cover on planet d, or perhaps differences in atmospheric chemistry. These data are helping refine and improve a new generation of atmospheric models to explain these effects.

Sphere at the VLT

First light of the VLT planet finder SPHERE

III. New spectrophotometry and astrometry of the HR 8799 exoplanetary system ★

A. Zurlo[1,2,3,4], A. Vigan[3,5], R. Galicher[6], A.-L. Maire[4], D. Mesa[4], R. Gratton[4], G. Chauvin[7,8], M. Kasper[9,7,8], C. Moutou[3], M. Bonnefoy[7,8], S. Desidera[4], L. Abe[10], D. Apai[11,12,13], A. Baruffolo[4], P. Baudoz[6], J. Baudrand[6], J.-L. Beuzit[7,8], P. Blancard[3], A. Boccaletti[6], F. Cantalloube[7,8], M. Carle[3], J. Charton[8], R.U. Claudi[4], A. Costille[3], V. de Caprio[14], K. Dohlen[3], C. Dominik[15], D. Fantinel[4], P. Feautrier[8], M. Feldt[16], T. Fusco[3,18], E. Gascone[14], P. Gigan[6], J.H. Girard[5,7,8], D. Gissler[17], L. Gluck[7,8], C. Gry[3], T. Henning[16], E. Hugot[3], M. Janson[19,16], M. Jacquet[3], A.-M. Lagrange[7,8], M. Langlois[20,3], M. Llored[3], F. Ma
Meyer[17], J. Milli[5,7,8], O. Moeller-Nilsson[16], D.
Quanz[17], P. Rabou[8], J. Ramos[16], A. Roux[8], B. Salas
Stadler[8], M. Suarez[5], M. Turatto

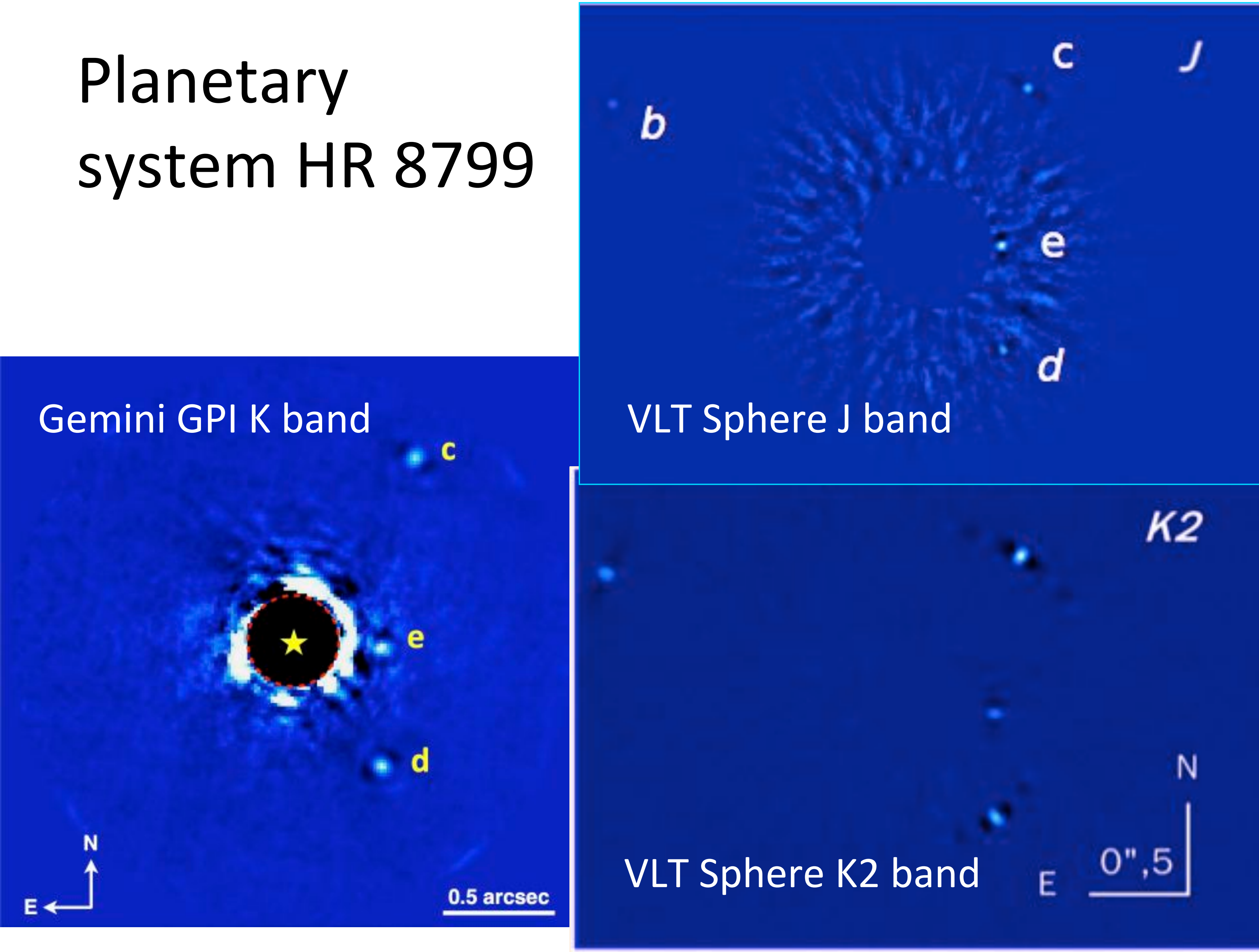
Jorge Melendez
@DrJorgeMelendez

Experts on high resolution exoplanet imaging at #exoar1

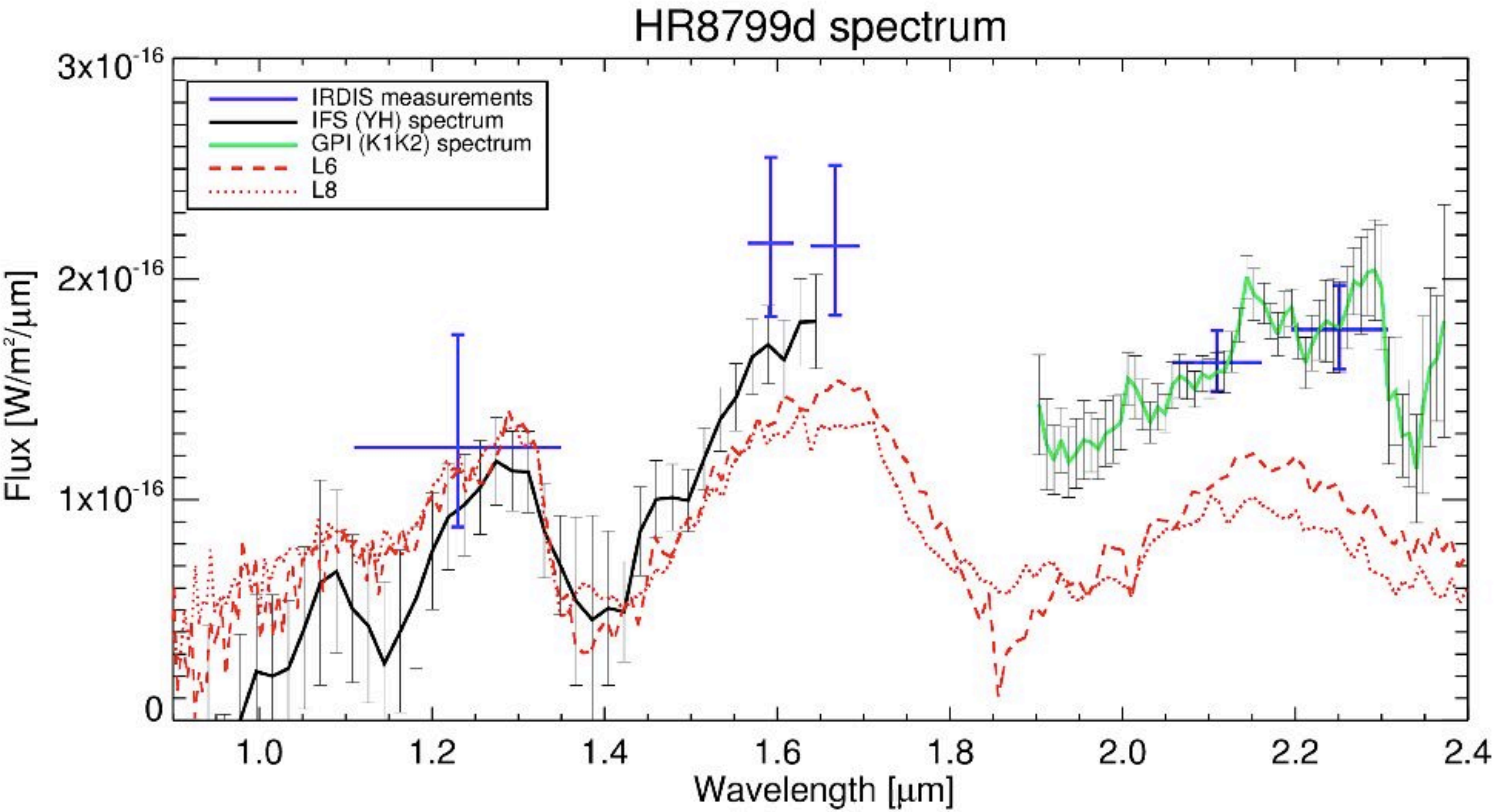
Alice Zurlo (Sphere @ESO) & Luciano García (GPI @GeminiObs)

46 - 8 de nov de 2017

Planetary system HR 8799



Spectrum of the planet HR 8799d (Y, J, H bands with Sphere/VLT; K band with GPI/Gemini)



Title: **Characterization of solar twin blue straggler candidates: towards improved stellar ages for field stars**

Principal Investigator: **Thayse Pacheco**

GEMINI OBSERVATORY

observing time request summary

		PI Request	
Partner	**Lead**	**Time**	**Min**
Brazil	Pacheco	4.0 hr	2.0 hr

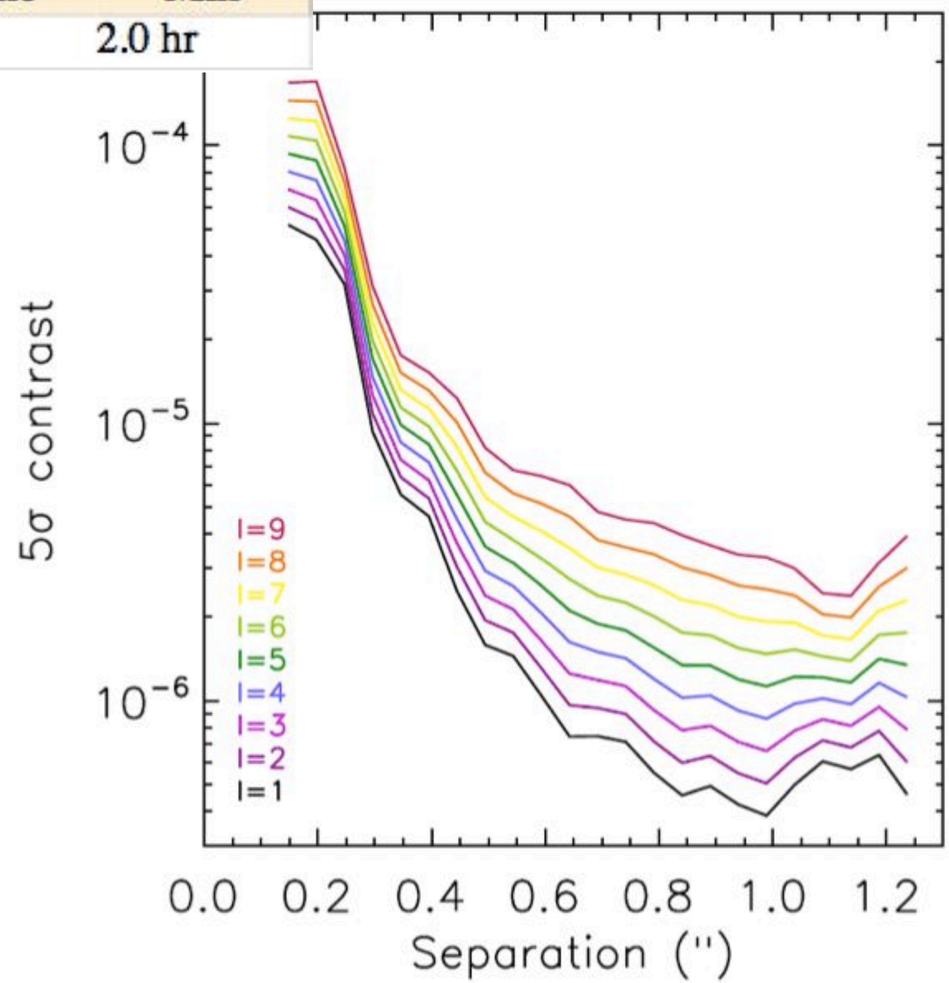


Figure 2: Typical GPI constrasts in function of target separation for different I magnitudes in a 1 hour exposure.

Gemini / GPI configurations

Only 1 band at a time:

- Non-coronographic mode: imaging or polarimetric imaging
- Coronographic mode: spectroscopy or polarimetric imaging

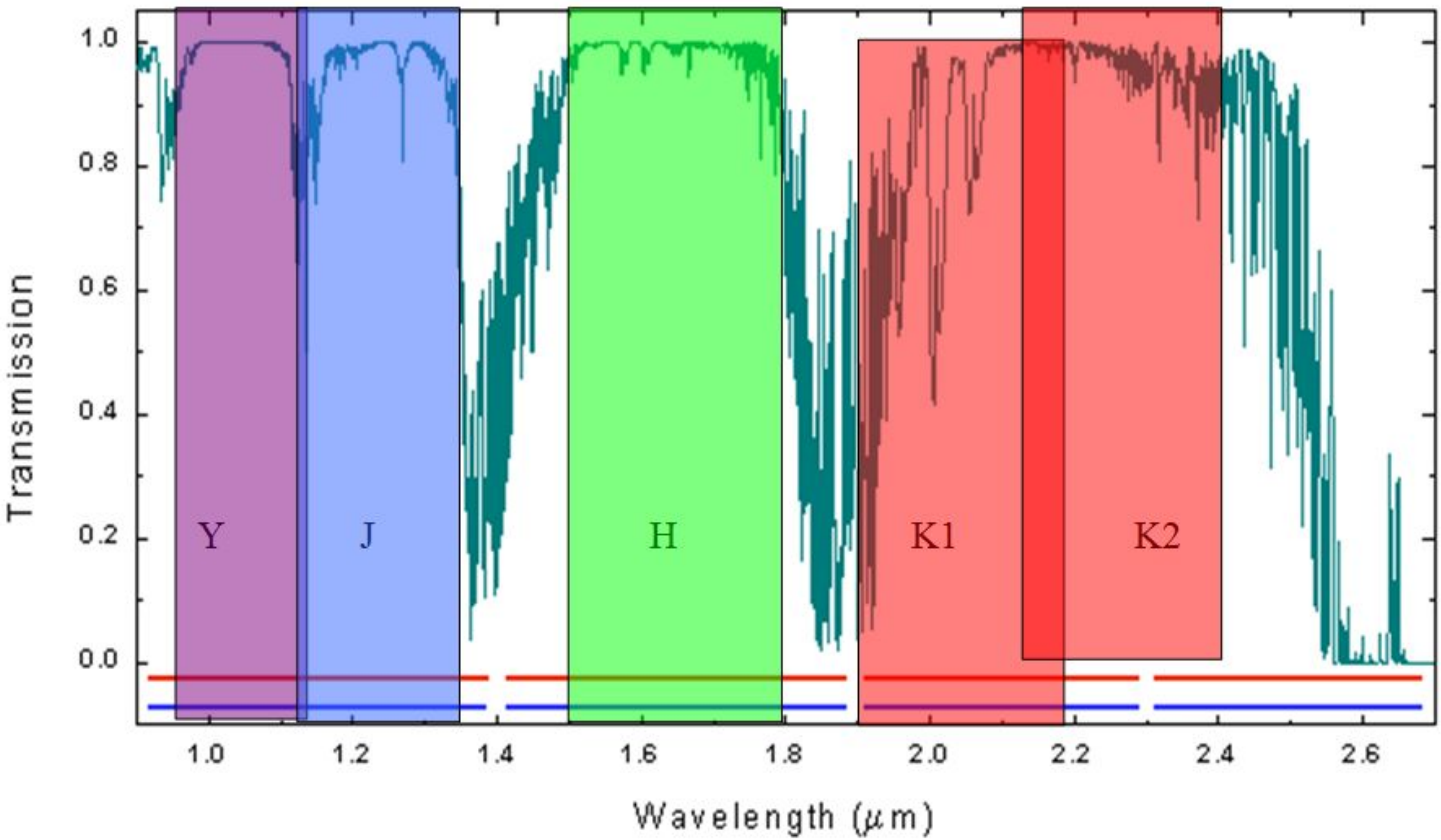
Resolving power

Configuration	Filter	Wavelength range (1/2 power bandpass, microns)	Spectral resoluti (per 2 pixels)	Coronagraph focal plane mask diameter (mas)
Y-coron	Y	0.95 - 1.14	34-36	156
J-coron	J	1.12 - 1.35	35-39	184
H-coron	H	1.50 - 1.80	44-49	246
K1-coron	K1	1.9 - 2.19	62-70	306
K2-coron*	K2	2.13 - 2.4	75-83	306

*K2 throughput is significantly lower than K1 and with significantly higher skies the performance in K2 can't be guaranteed, i.e. **ANY** K2 observations is in shared risk mode with no guarantee of performance.

Must select 1 band at a time: Y, J, H, K1 or K2

Have to select one mode: 1) non-coronographic imaging, 2) non-coronographic polarimetric imaging, 3) coronograph+spectroscopy, or 4) coronograph + polarimetric imaging

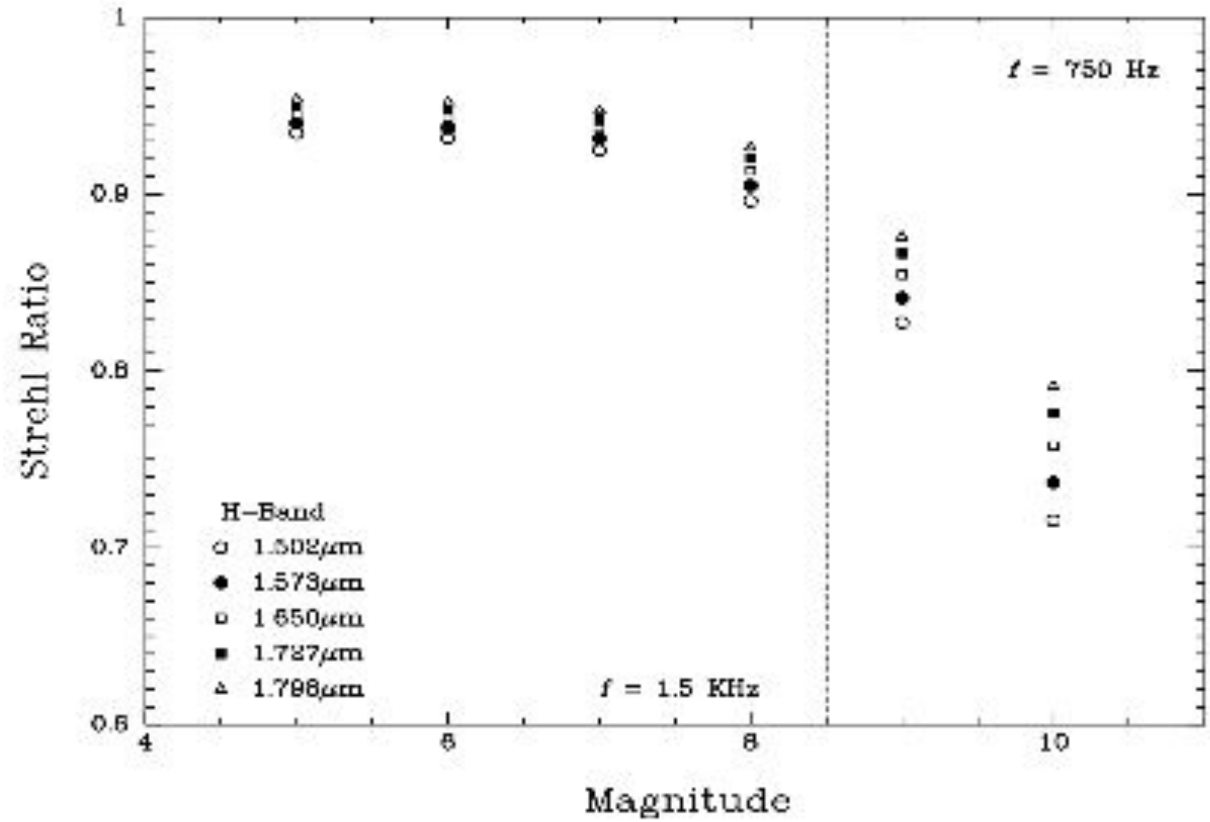


https://www.gemini.edu/sciops/instruments/gpi/instrument-performance/strehl-0

GPI Strehl

GPI PSFs

With coronagraph (top)
W/O coronagraph (bottom)

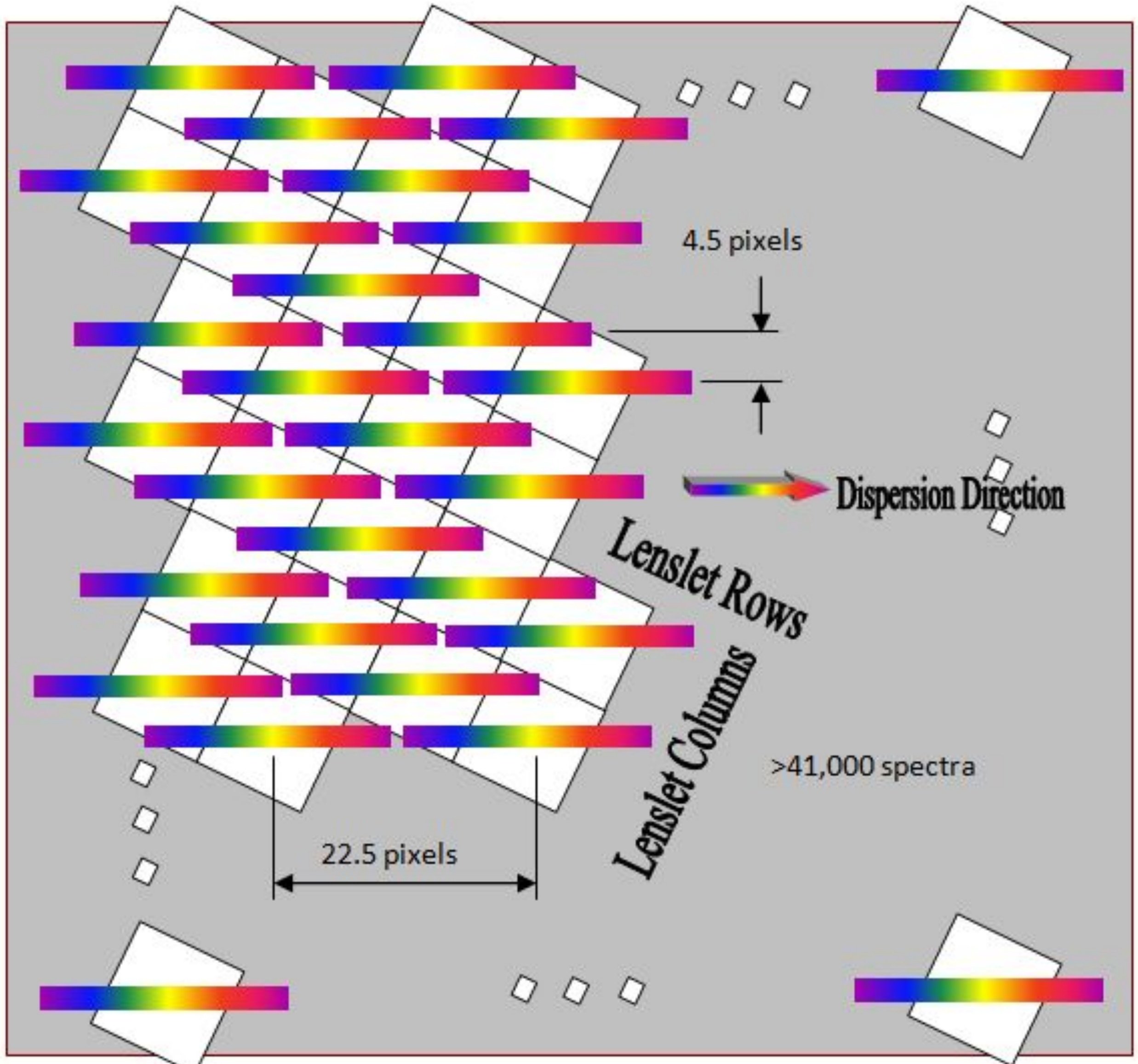


Plot of the simulated GPI H-Band Strehl performance as function of AO Guide Star I magnitude

Spectroscopy at GPI is IFU

Data product of the IFS is a data cube consisting of slightly more than 200x200 spatial locations, each with typically 18 spectral channels in spectroscopy mode and two spots in each positions for the polarimetric mode.

The FOV is 2.8” on a side, with 14 mas sampling.



European Organisation for Astronomical Research in the Southern Hemisphere

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APPLICATION FOR OBSERVING TIME

PERIOD: **101A**

Important Notice:

By submitting this proposal, the PI takes full responsibility for the content of the proposal, in particular with regard to the names of CoIs and the agreement to act according to the ESO policy and regulations, should observing time be granted.

1. Title

Category: **D–1**

Characterization of blue straggler candidates: towards improved stellar ages and mass loss for field stars

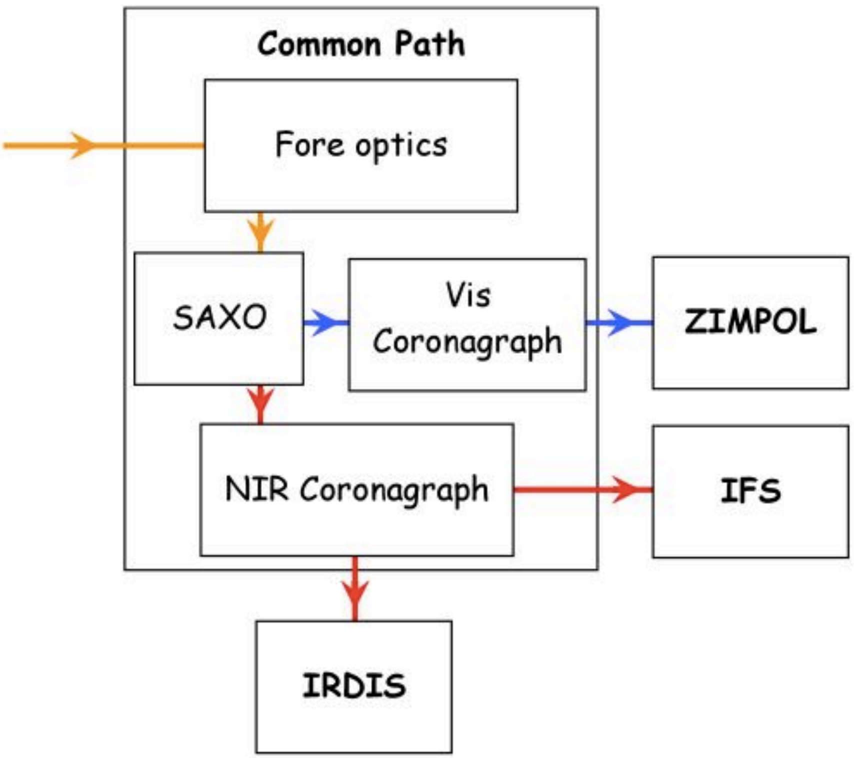
3. Run	Period	Instrument	Time	Month	Moon	Seeing	Sky	Mode	Type
A	101	SPHERE	2.3h	any	n	0.8	CLR	s	

6. Principal Investigator: Thayse Pacheco, thayse.pacheco@usp.br, BR, Universidade de Sao Paulo,Institu de Astronomia, Geofisica e Ciencias Atmosfericas,Department of Astronomy

6a. Co-investigators:

J.	Meléndez	Universidade de Sao Paolo,Instituto de Astronomia, Geofisica e Ciencias Atmosfericas,Department of Astronomy,BR
L. A.	dos Santos	Observatoire Astronomique de l'Universite de Geneve,CH

Sphere at VLT: SAXO (Adaptive Optics), IFS (IFU spectroscopy in Y, J, H bands), IRDIS (imaging + spectroscopy), ZIMPOL (polarimetry)



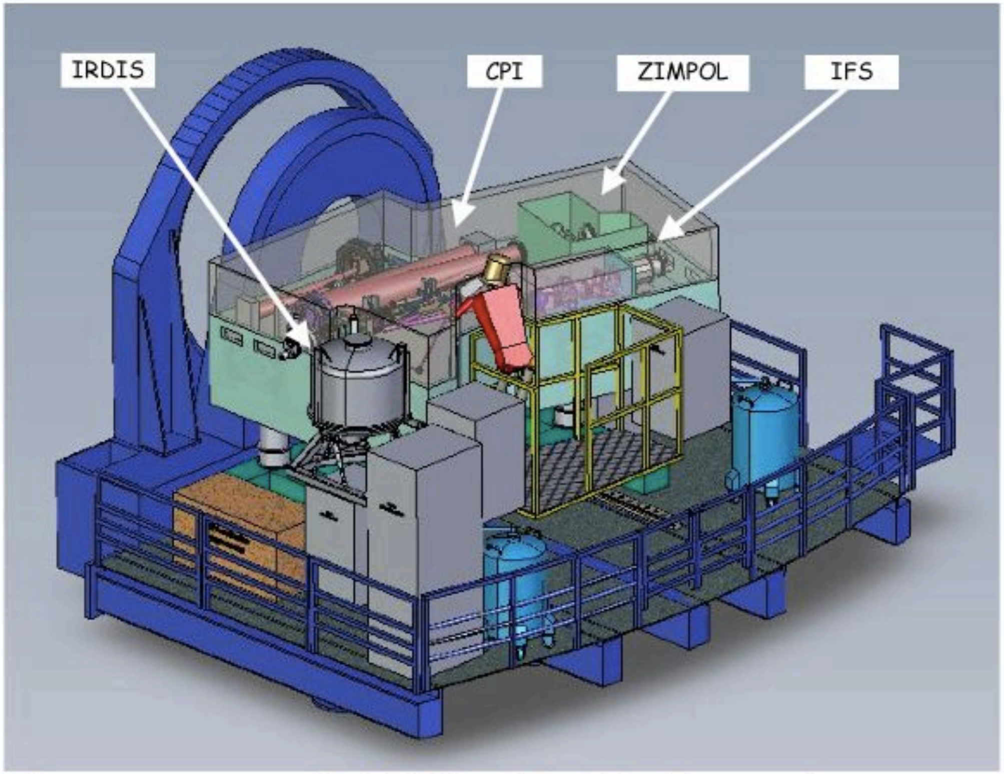


Figure 1: SPHERE sub-systems (left) including the common path (CPI) with adaptive optics system SAXO, coronagraphs, and sub-instruments IRDIS, IFS and ZIMPOL. Left: schematic view of the instrument on the Nasmyth platform.

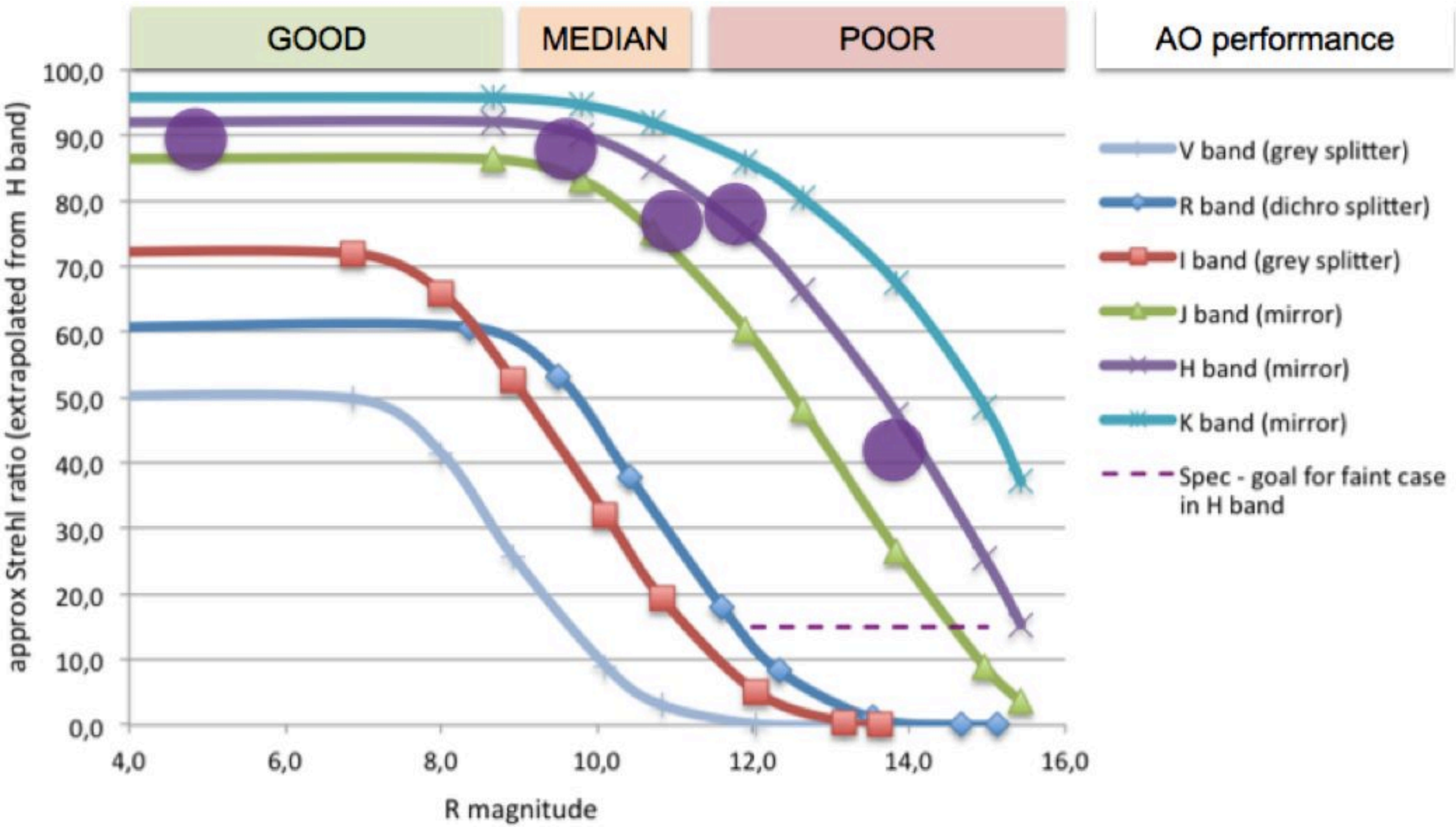


Figure 11: Theoretical and measured (purple circles) SPHERE-SAXO Strehl ratio as a function of R magnitude for good seeing conditions and different wavelength ranges from V to K (see Table 9 and Table 10 for details).

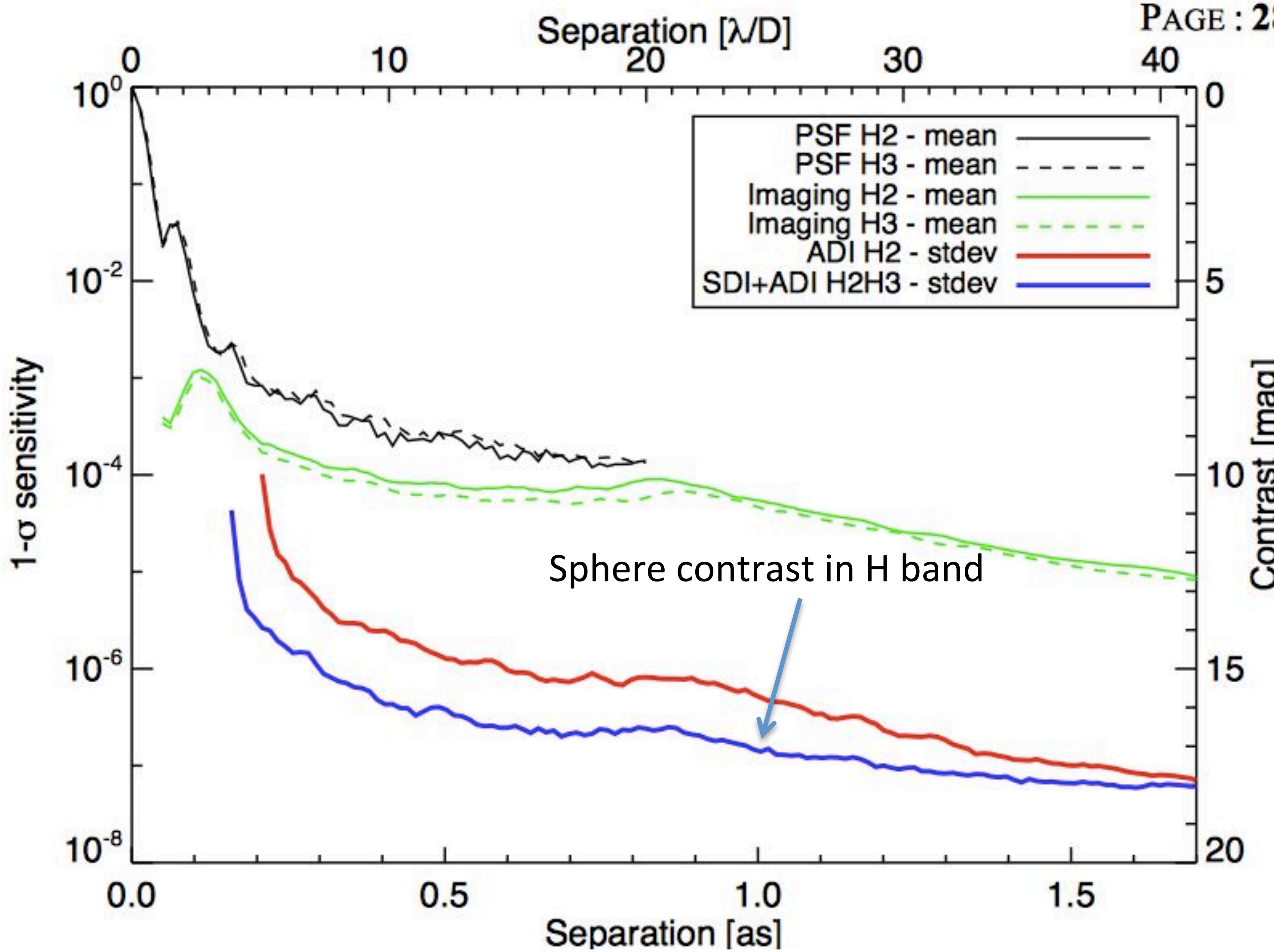
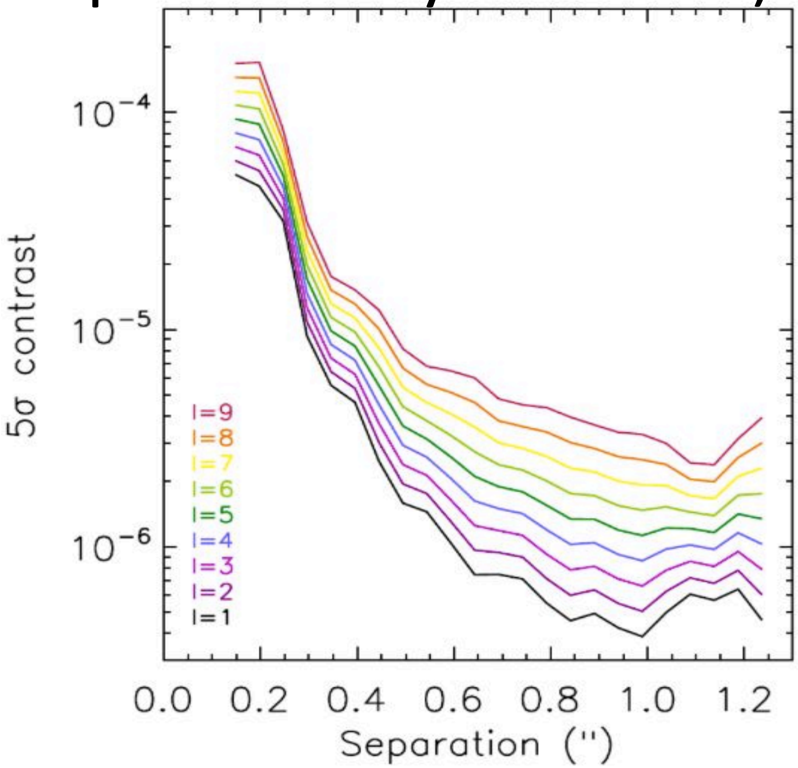
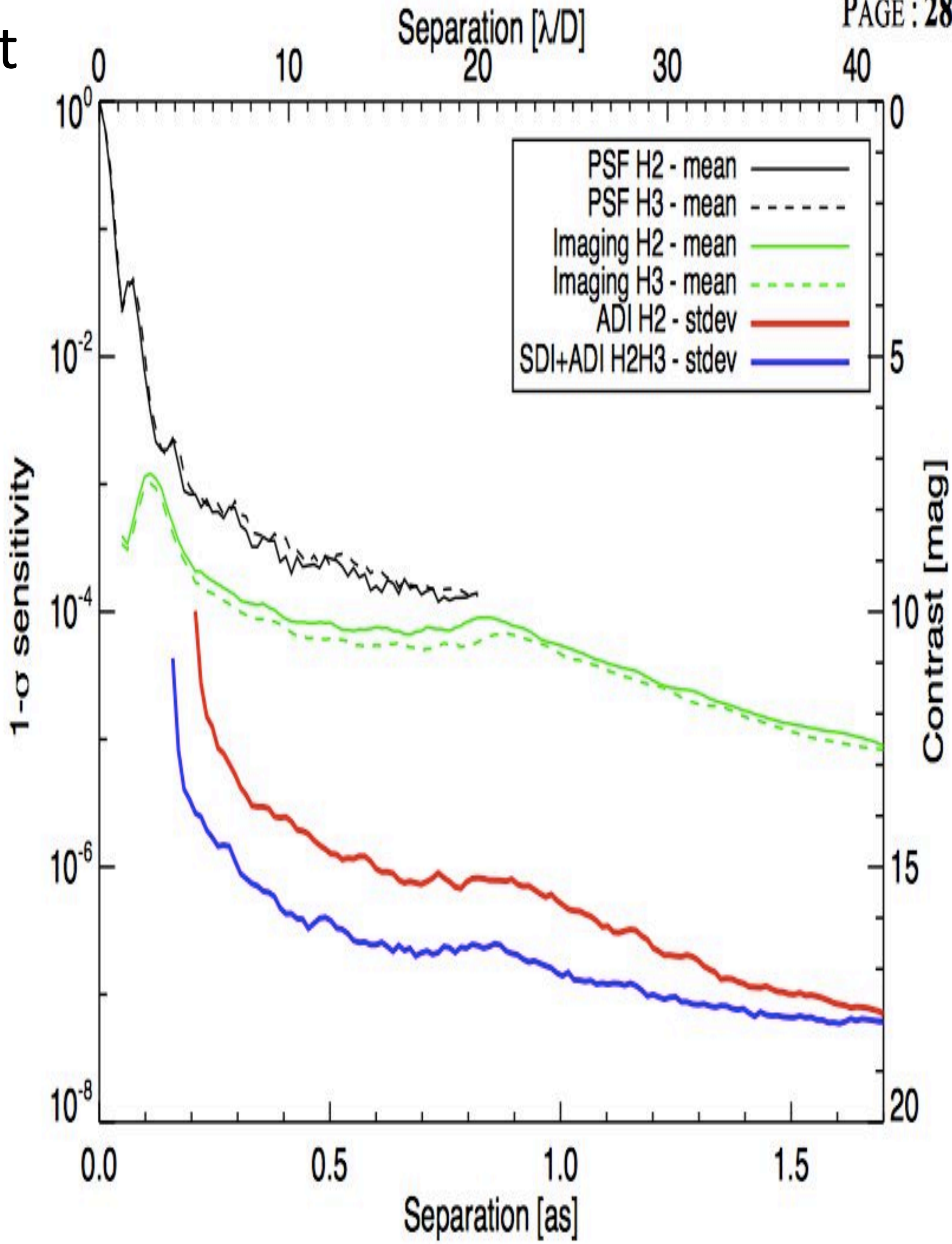


Figure 15: IRDIS DBI H2H3 contrast curves obtained on-sky for a bright target (H=0.2), in average conditions (seeing ~1.0"), with an ADI field rotation of 30 degrees. The plot shows the PSF profiles (black) and coronagraphic profiles (green) in the H2 and H3 filters, the 1σ contrast curve for ADI on the H2 data (red), and the 1σ contrast curve for SDI+ADI on the H2 and H3 data. For the ADI and SDI+ADI analysis, the algorithm throughput is taken into account and compensated, assuming a T8 spectral-type for the planet in SDI.

- Both are state-of-the art powerful instruments
- Sphere is faster (in 1 shot Y, J, H spectra AND photometry in K band)





GPI vs Sphere