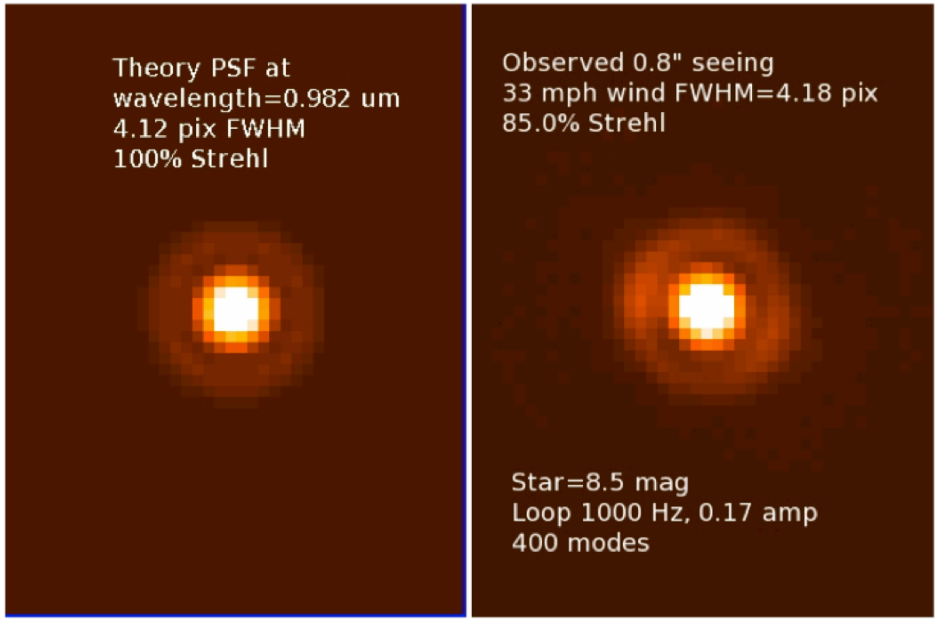
MagAO: Bringing AO to the Magellan Clay telescope



Katie Morzinski

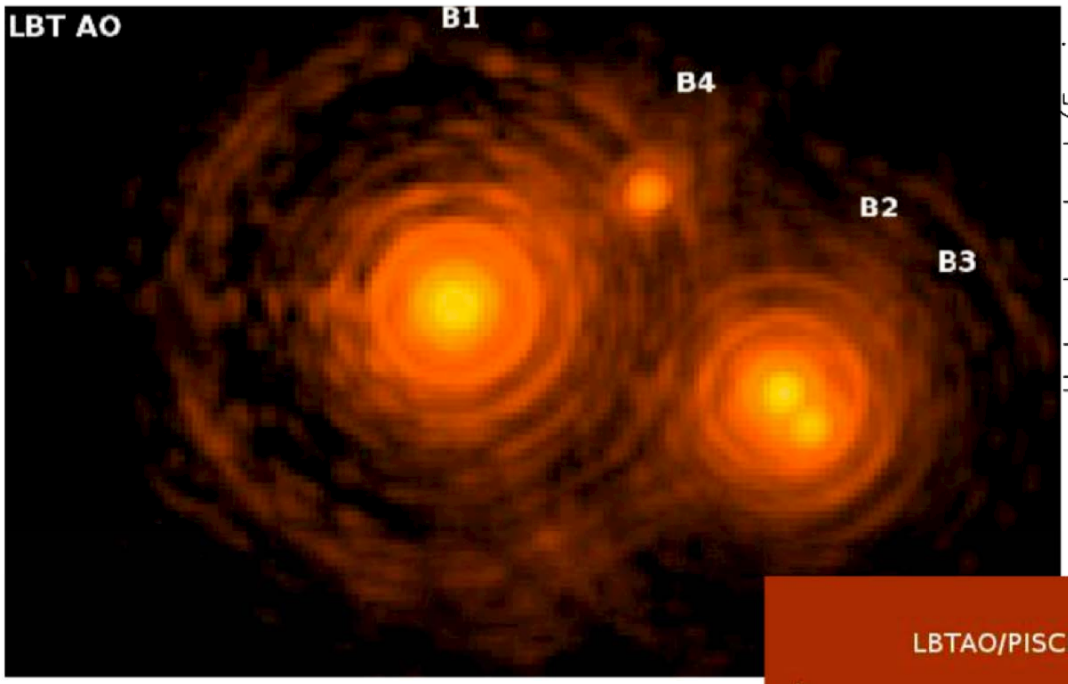
Laird Close, Jared Males, Derek Kopon, Kate Folette, Ya-Lin Wu, Phil Hinz, T.J. Rodigas, et al.

University of Arizona/Steward Observatory

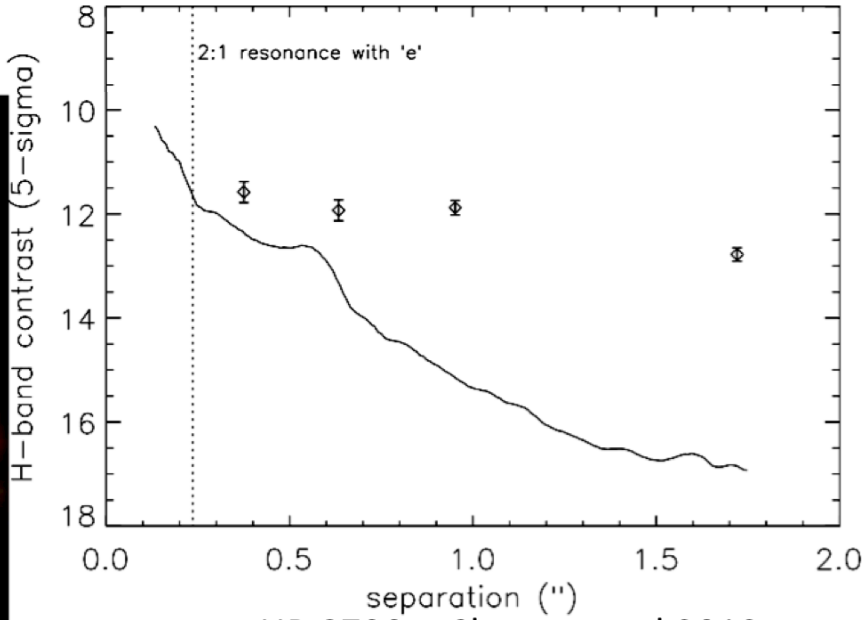
Sagan/Michelson Symposium

8 Nov 2012

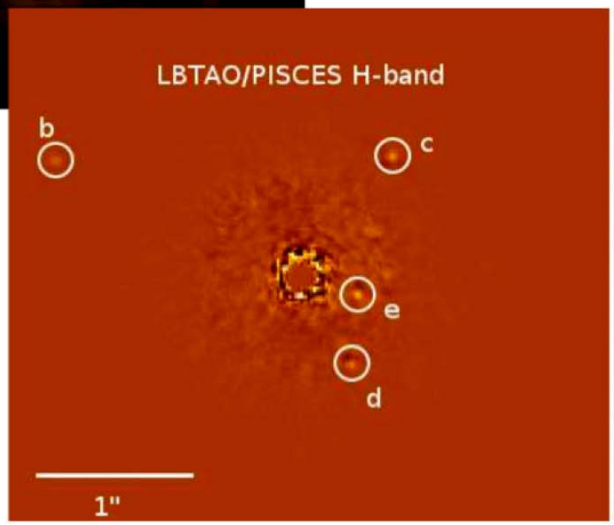
First-light LBT AO results: ~100 nm WFE

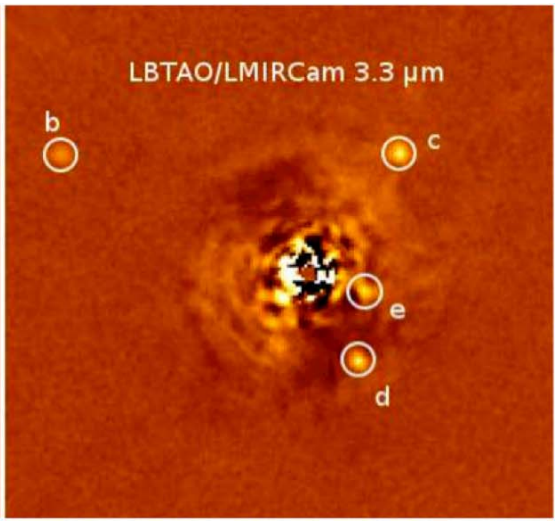


Tet1 Ori B -- Close et al 2012

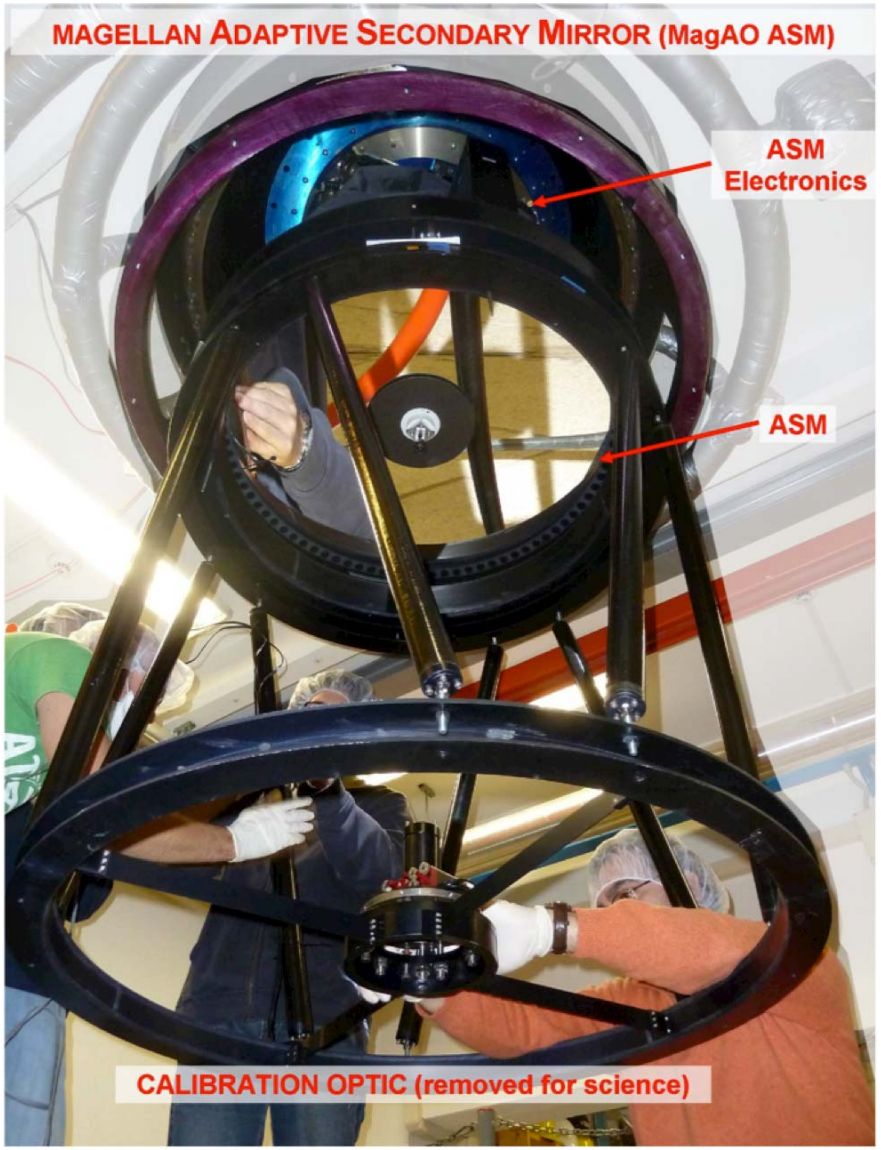


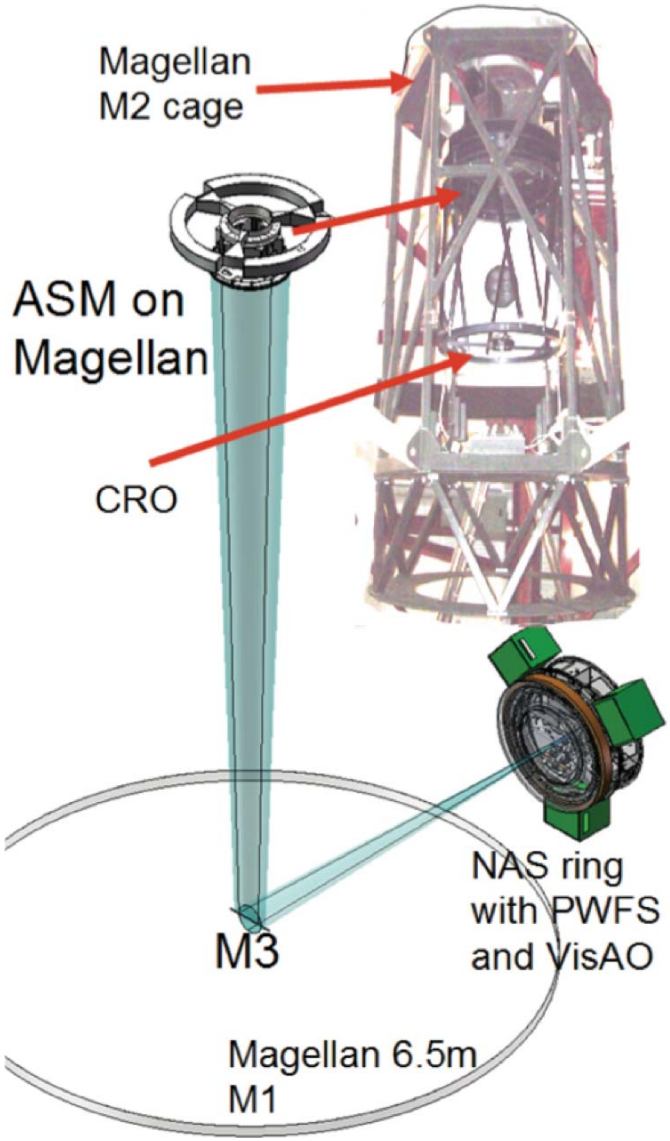
HR 8799 -- Skemer et al 2012





MagAO is a 585-actuator adaptive-secondary AO system for the Magellan Clay telescope in Chile





A Few Magellan AO Key Science Goals (two science cameras)

1. The detailed analysis of Exoplanet atmospheres in the thermal IR.

>> need very high Strehl imaging (hence super-resolution) and coronagraphy 2-5 μm (***Clio2 camera***).

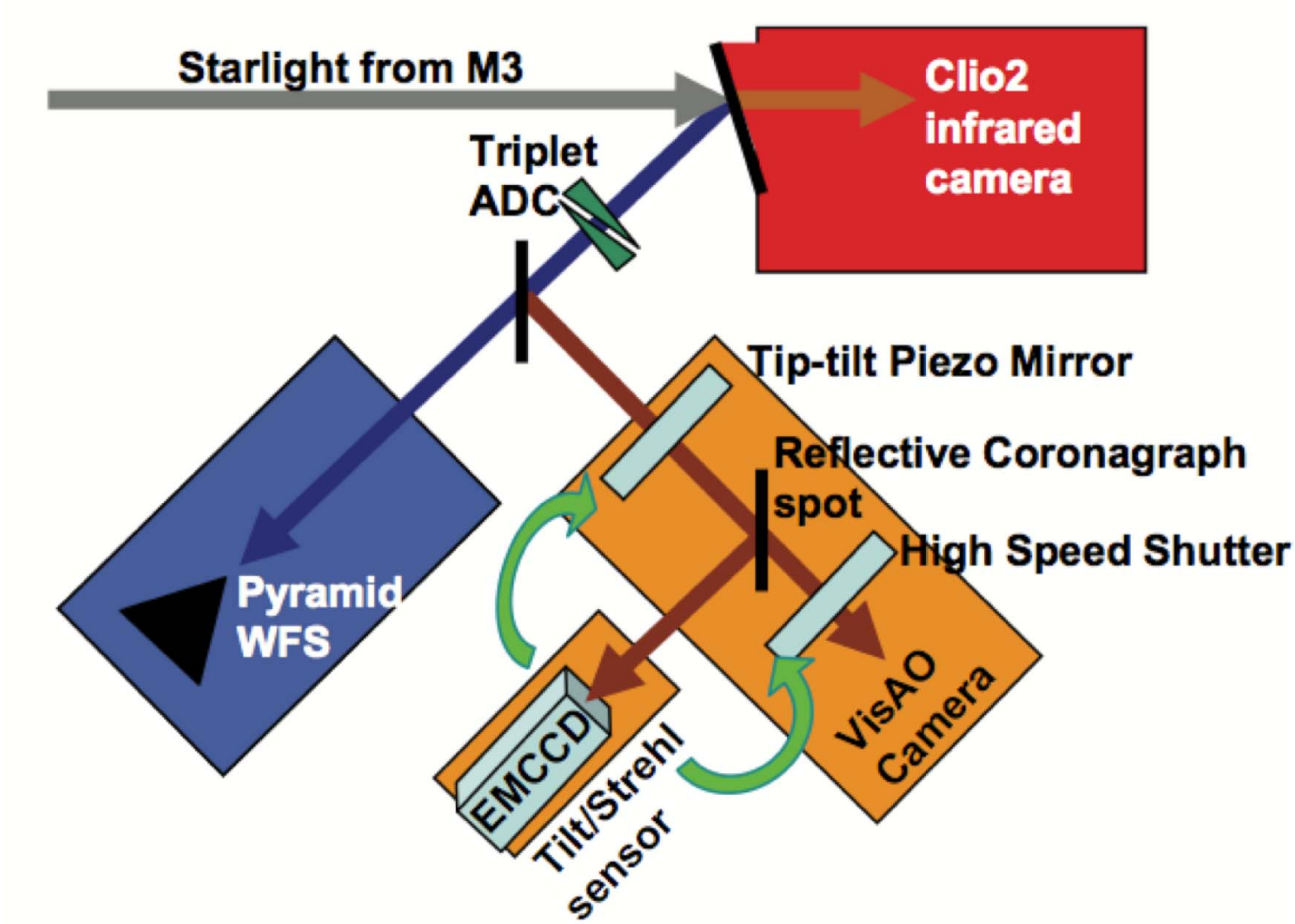
2. Extremely high resolution imaging of binaries, faint companions, asteroid surfaces, solar system moons, Hα/[SII]/Ca triplet line imaging etc. (0.65-1.05 μm science)

3. Very deep optical imaging of circumstellar and extragalactic environments

>> need broad-band far-red Visible 0.65-1.05 μm wavelength AO (***VisAO***) CCD camera & coronagraph

courtesy Laird Close

MagAO science -- VisAO cam: Strehl-selection, coronagraph, SSDI. Clio IR cam: coronagraph

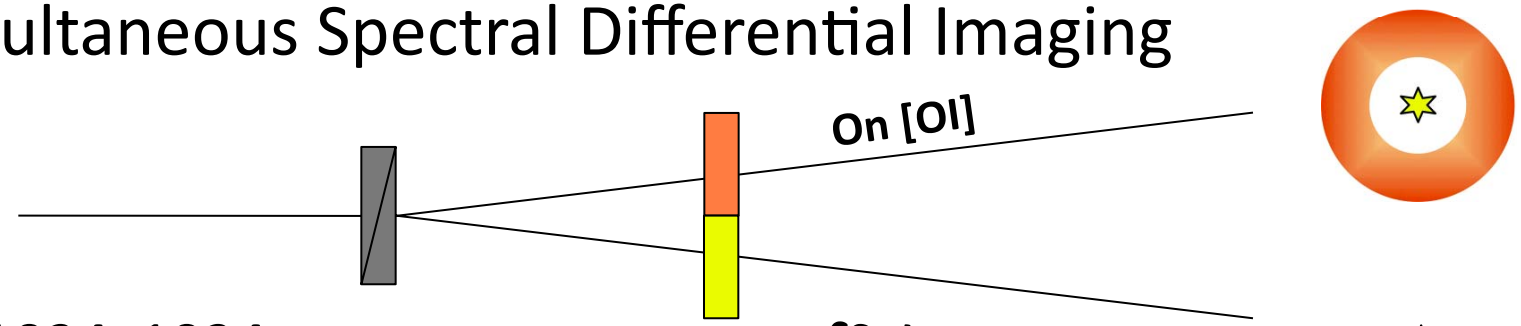


Clio2 Science

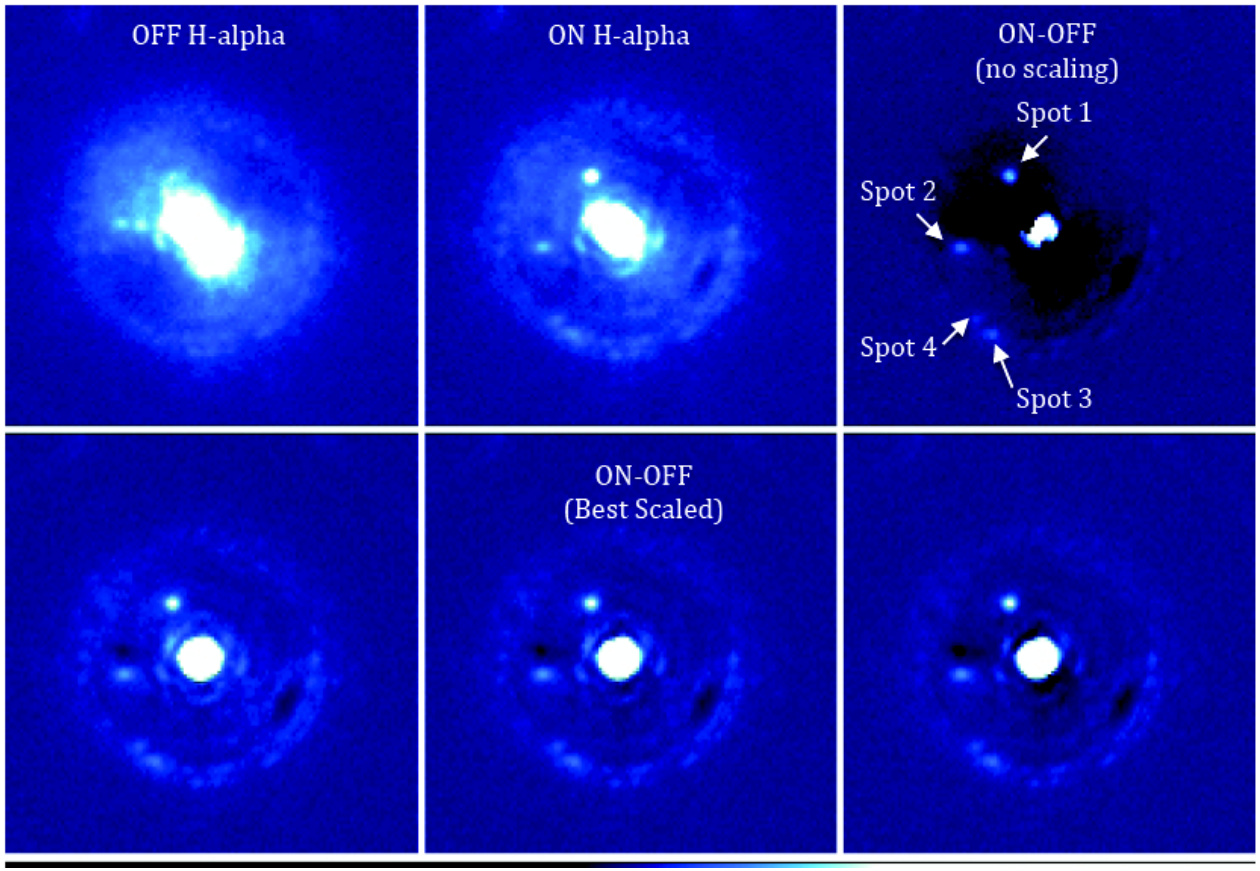
- 512x1024 1-5.3μm science camera
  - 18mas/pix - 18"x9" FOV
  - 36mas/pix - 30"x15" FOV
- Diff. Limit: J = 38mas, M = 168mas
  - J,H,Ks,L',3.1, 3.3, 3.4, 3.9, M
- NGS < 10 : H-band Strehl > 80%
- NGS = 13 : H-band Strehl ~40%
- Prism spectrograph
  - R~30 @K, R~130 @L
- APP Coronagraph

- Detailed analysis of exoplanet atmospheres
  - High contrast, requires high Strehl
  - Coronagraphy
- For $\lambda > 3\mu m$, Clio2 is unique in the South

VisAO - high-resolutional optical imaging, Simultaneous Spectral Differential Imaging

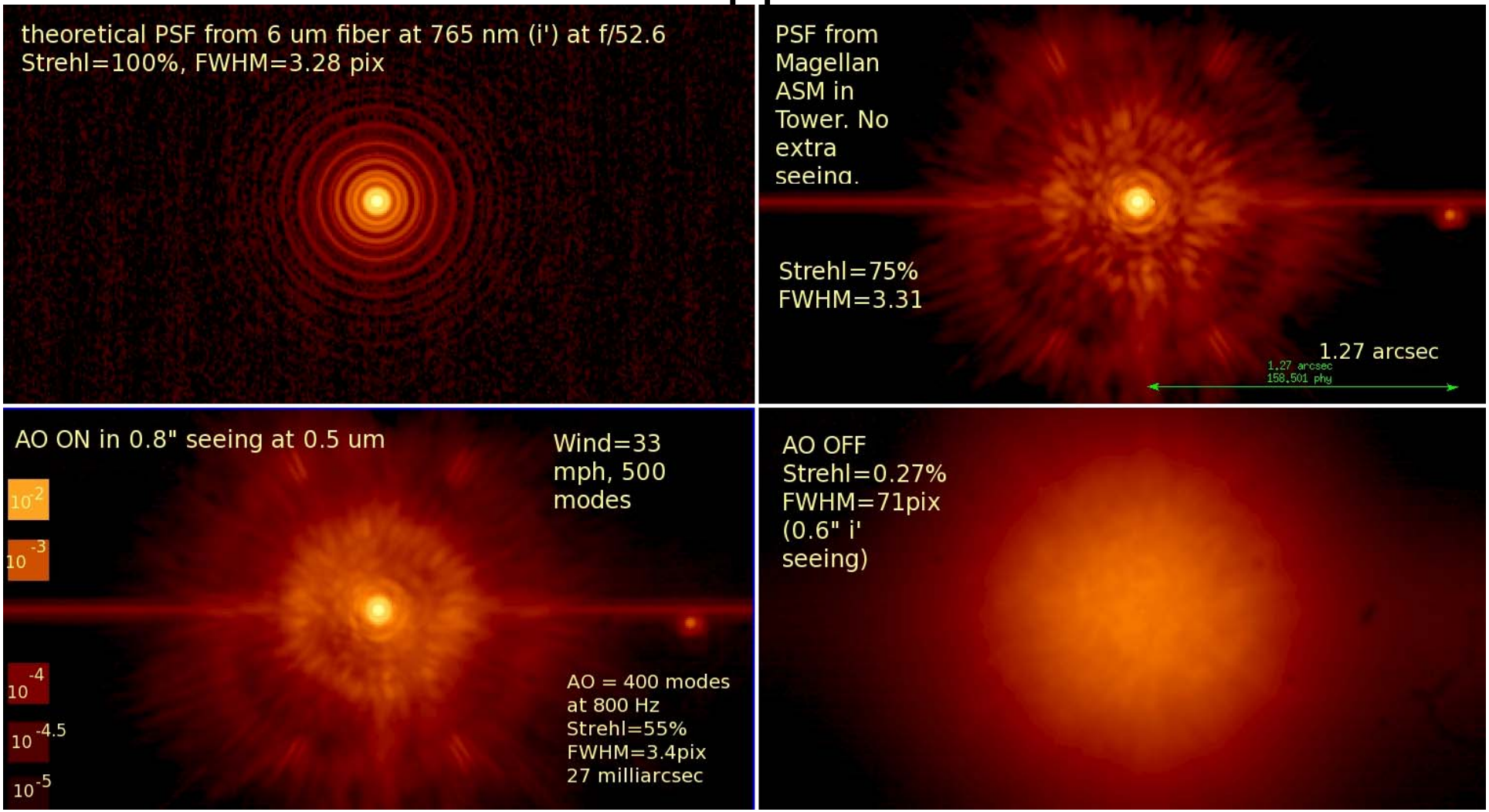


- 1024x1024
- 8"x8" FoV
- 8mas/pix
- Nyquist to ~0.55μm
- Triplet ADC (Derek Kopon et al., 2012)
- SDSS r', i', z', and VisAO y (950 LP)
- SSDI - Ha, [OI], [SII]

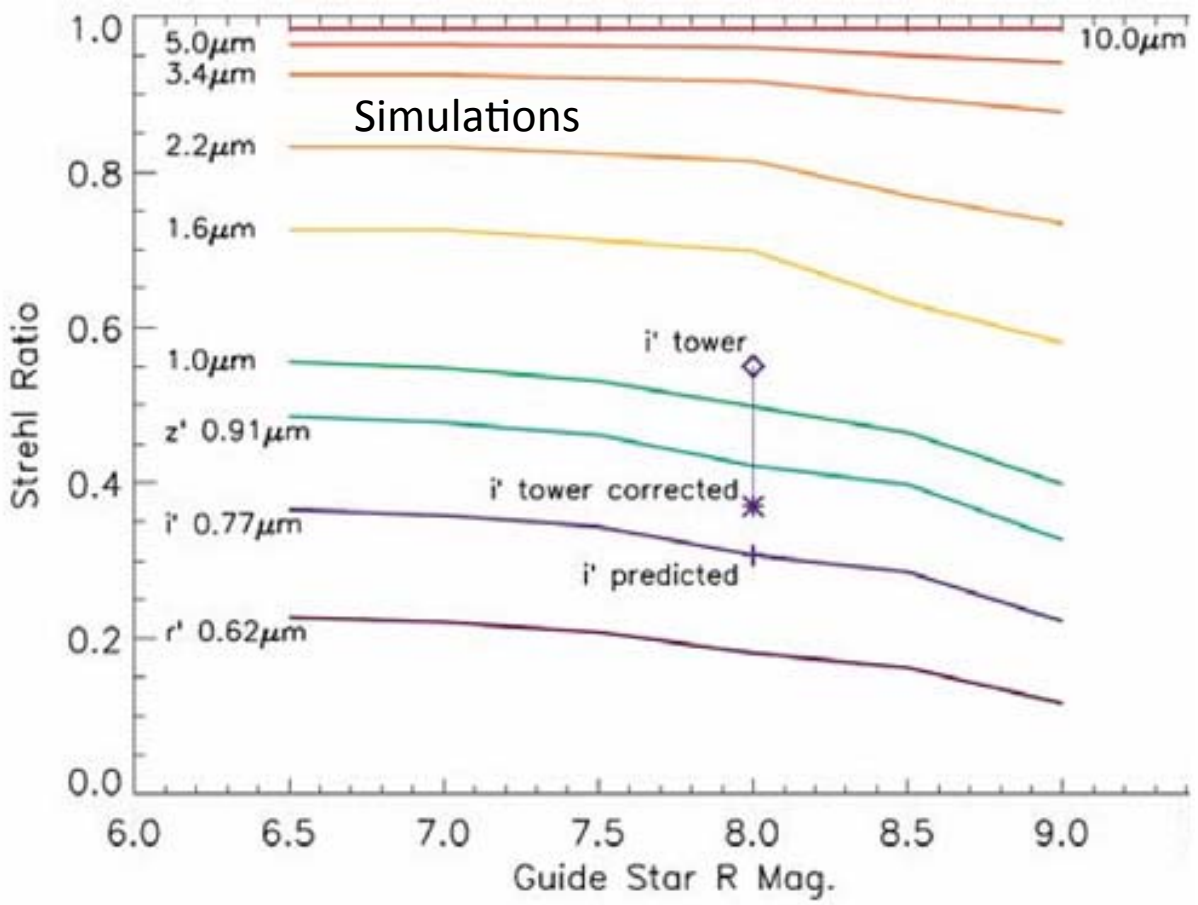


Courtesy of Kate Follette

MagAO performance in the lab with simulated turbulence applied to ASM



Tower Performance



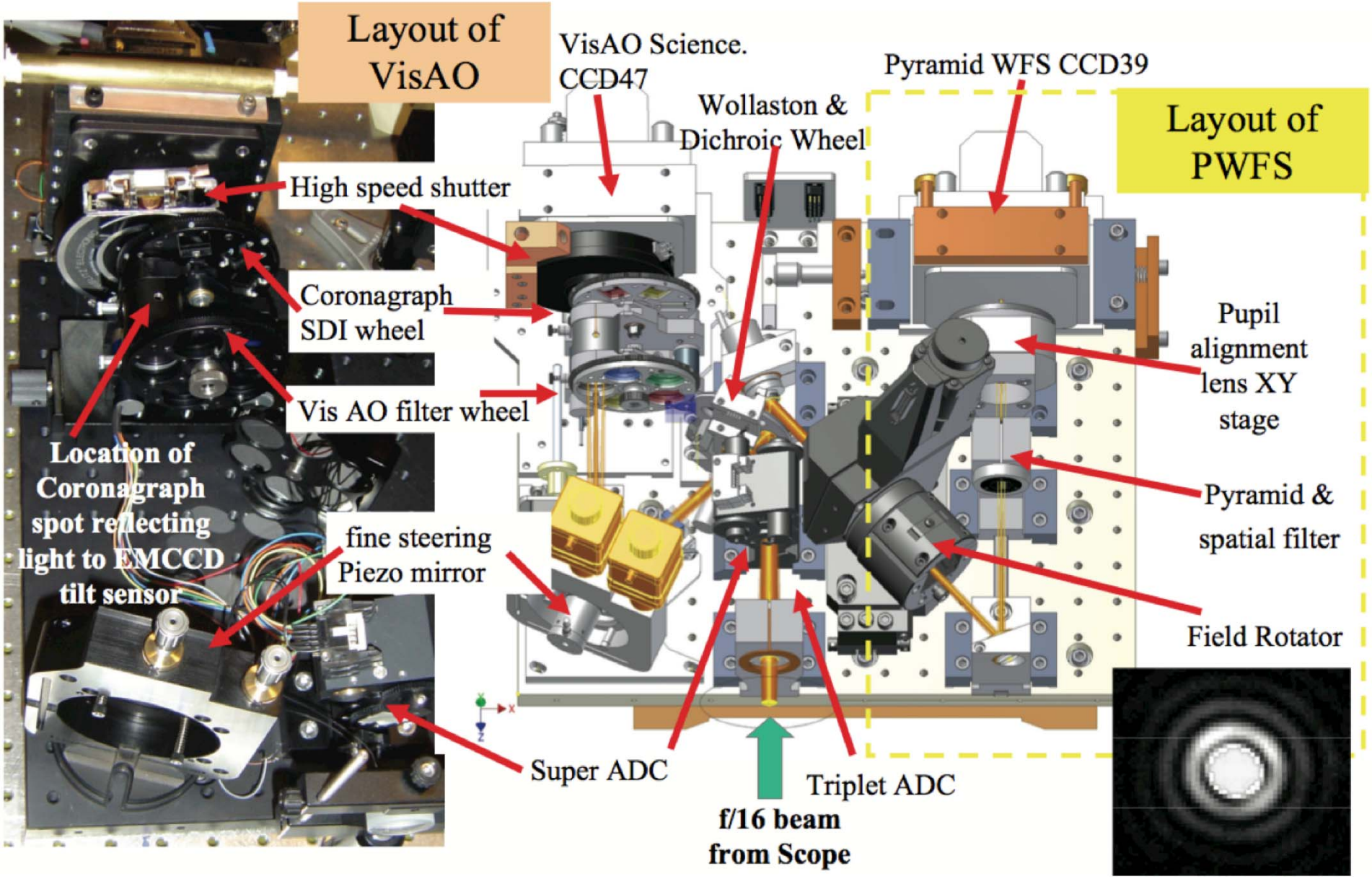
After correcting for limitations of tower turbulence simulation, SR = 37% at i'

Based on LBT FLAO, tower performance translates to on-sky performance

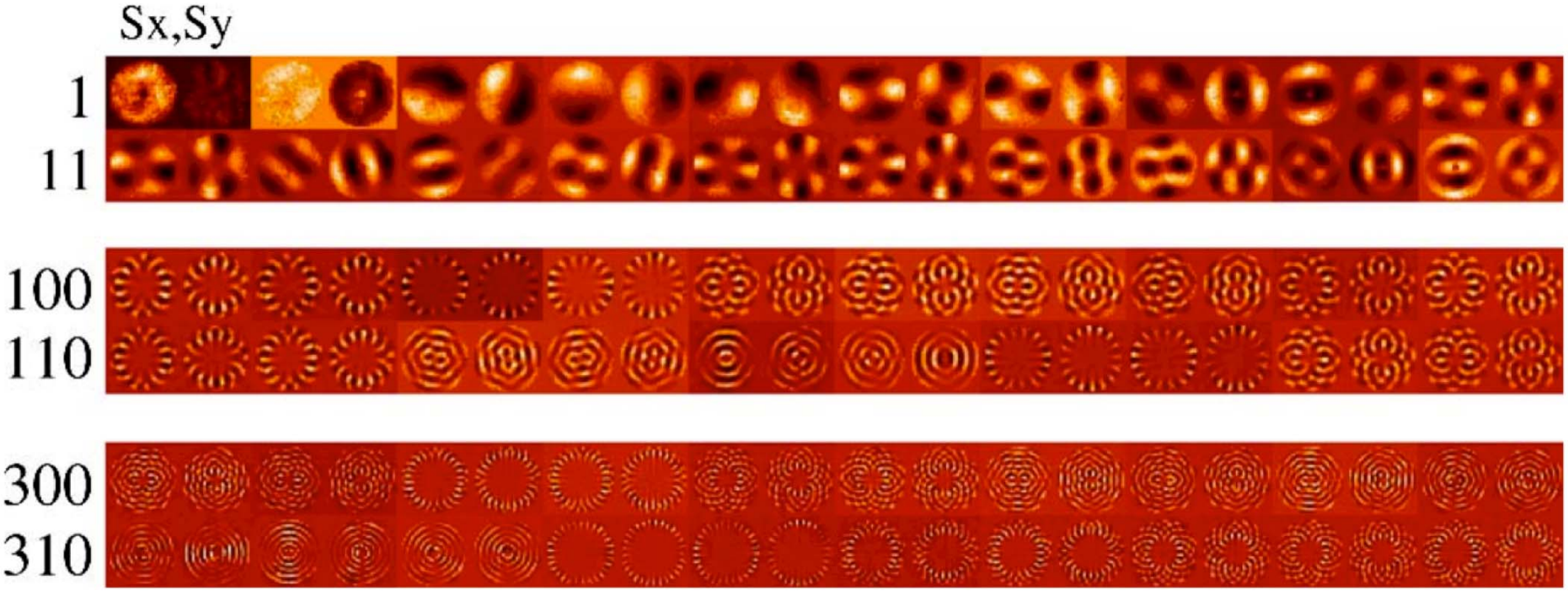
(Males et al., 2012, Esposito et al., 2010)

courtesy Jared Males

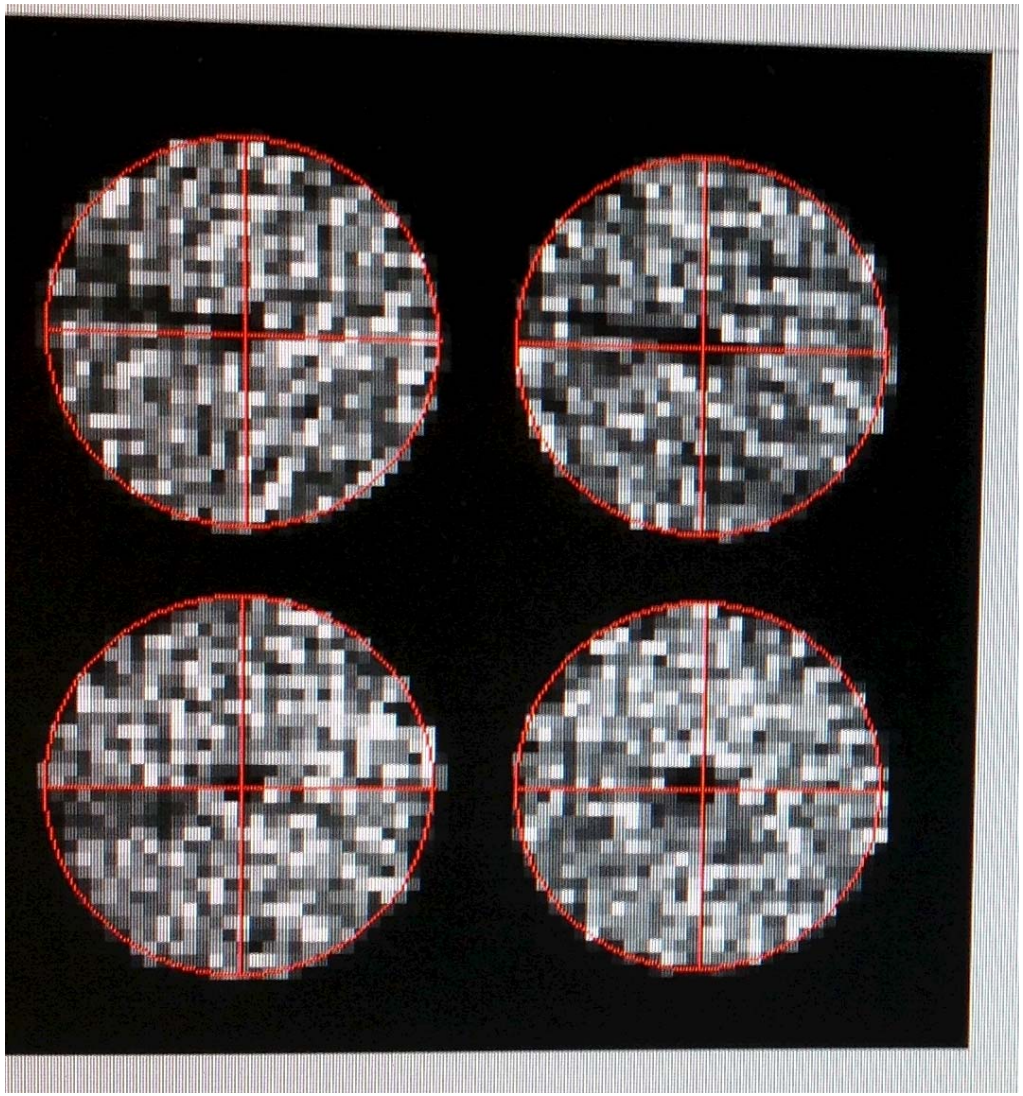
MagAO layout -- VisAO and Pyramid WFS



MagAO Pyramid WFS -- 500 modes interaction matrix calibrated



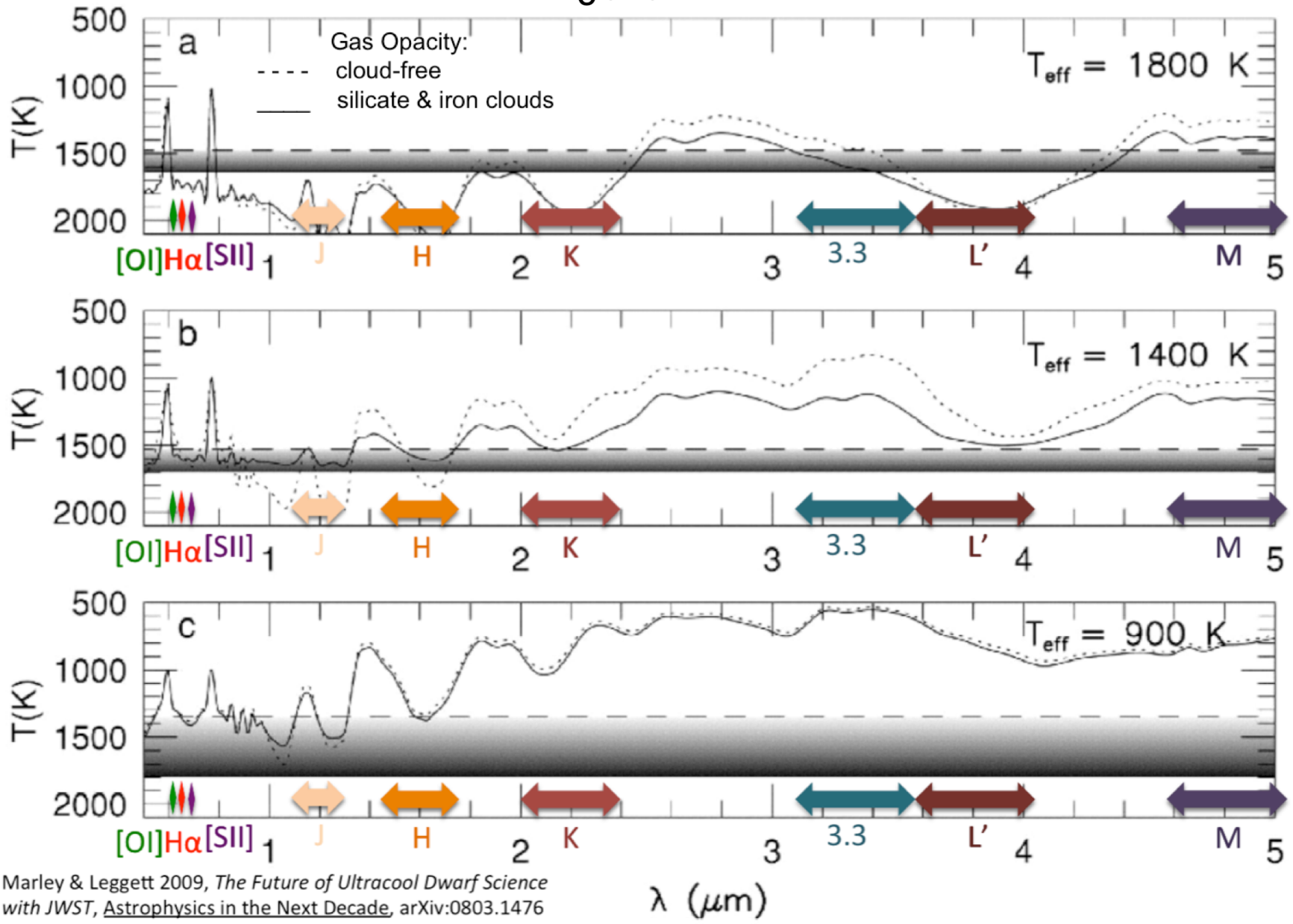
MagAO Pyramid WFS -- 1/10th pixel pupil camera lens loop



Adaptable to changing conditions:

- Binning mode (# subaps)
- Frame rate
- # modes corrected
- Pyramid modulation
- Modal gain

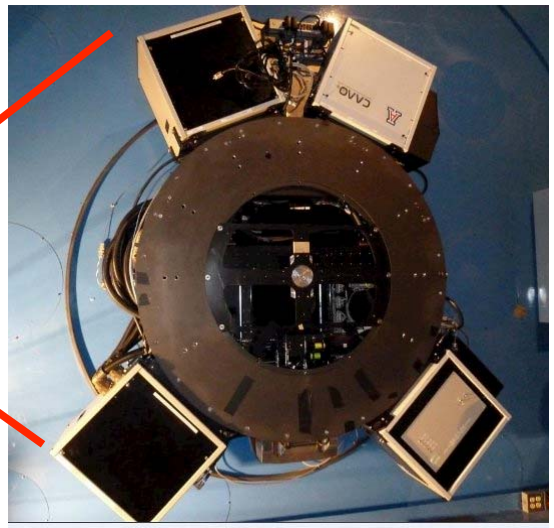
MagAO: O/IR spectral coverage (λ 0.5–5μm) with $0.2 \leq d/r_0(\lambda) \leq 1.5$



Marley & Leggett 2009, *The Future of Ultracool Dwarf Science with JWST*, Astrophysics in the Next Decade, arXiv:0803.1476

MagAO In Pictures - courtesy Jared Males

This **is going here** **with this**

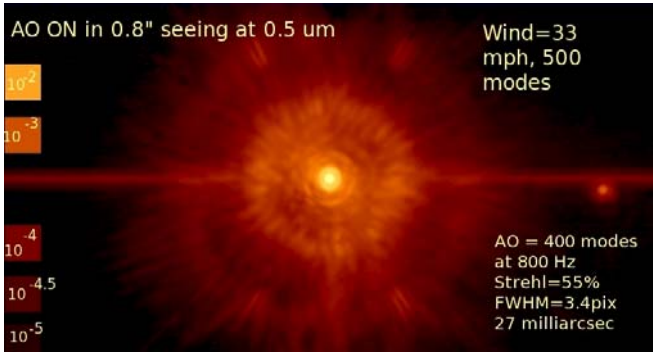


safely in Chile

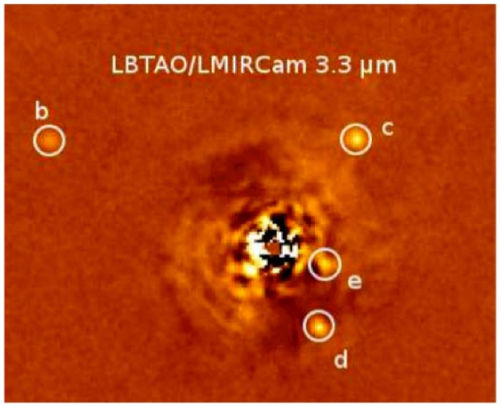
bolted to Clay

To do this:

On Nov. 16, 2012



VisAO i' (0.765μm) PSF, 37% "on-sky" Strehl (Close et al., 2012)



HR 8799 w/ LBTAO (Skemer et al, 2012)

MagAO

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