Infrared Wave-Front Sensors for Adaptive Optics

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G2000 Mar 23, 2016

Adaptive Optics

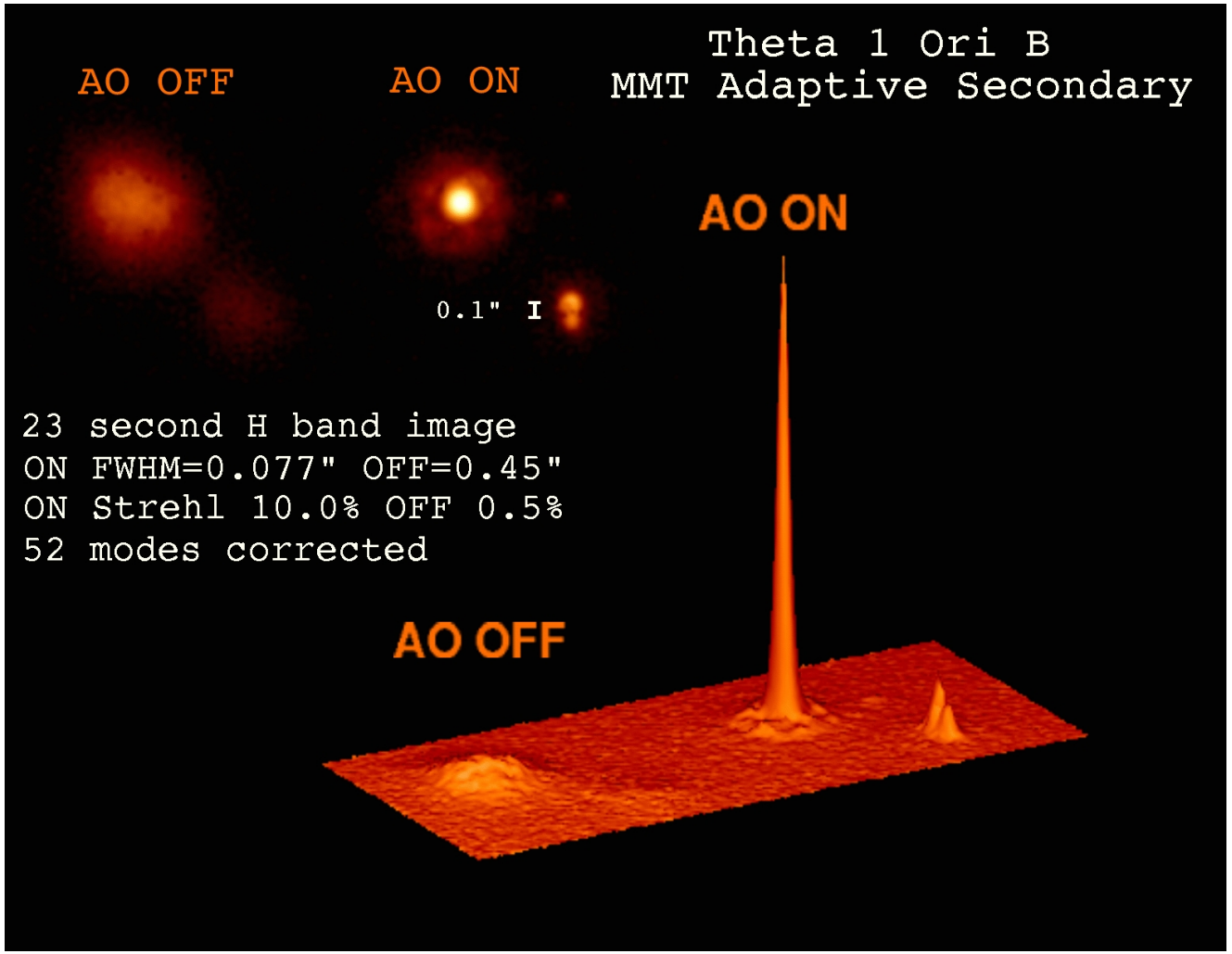
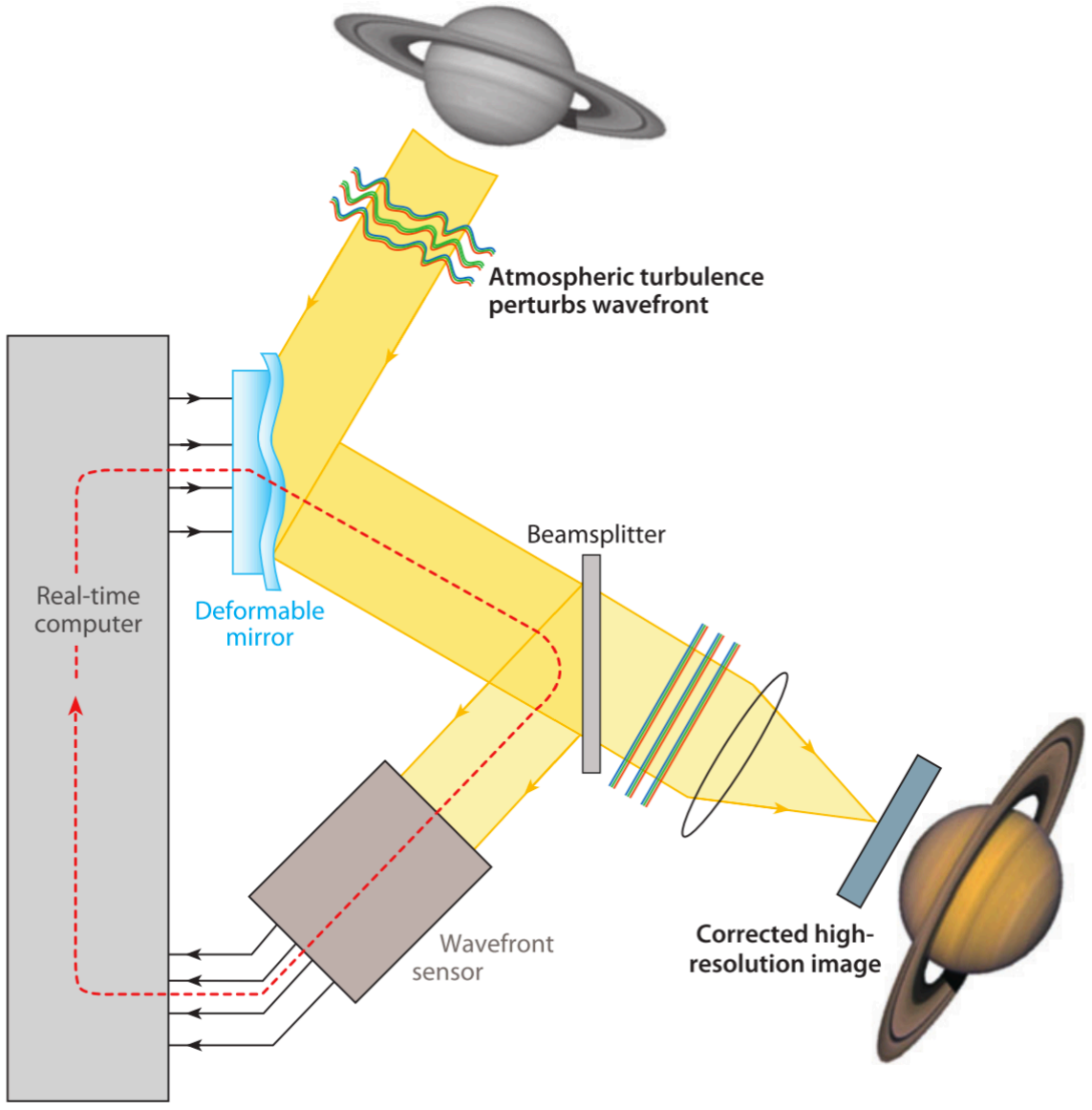


Photo Credit: Laird Close, CAAO, Steward Observatory

Why are we doing this?

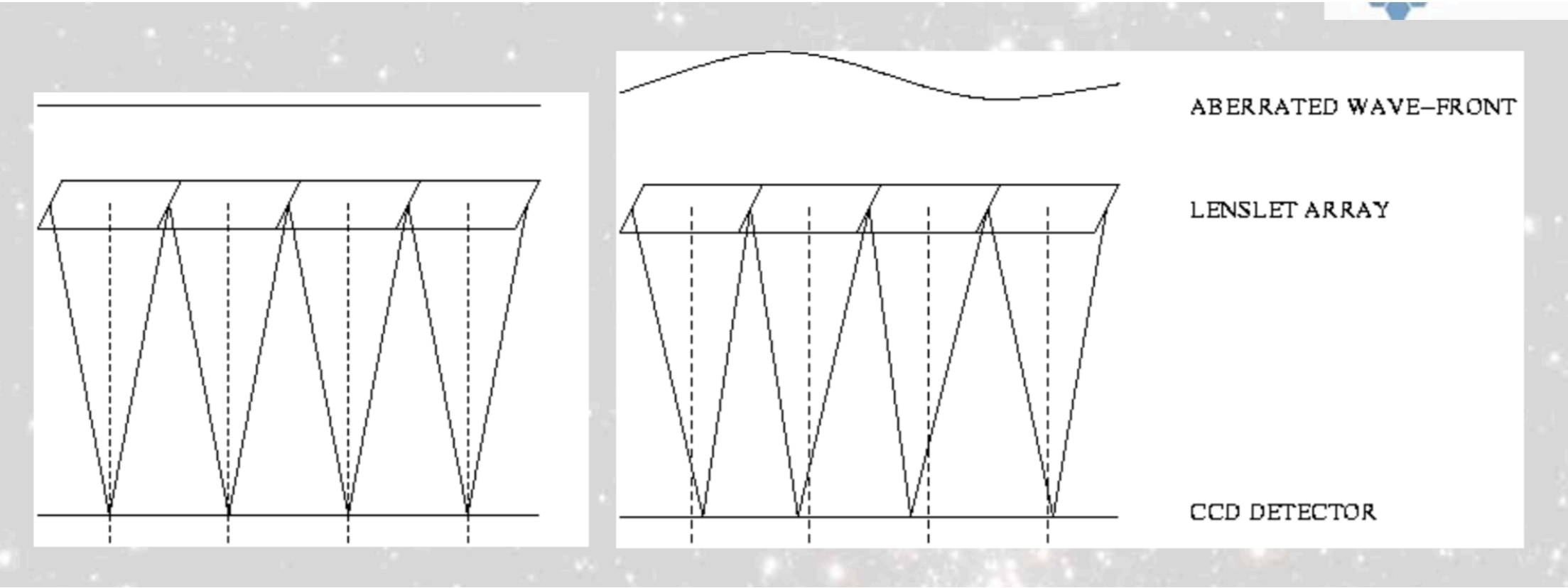
- Better correction for redder objects
  - e.g. late-type stars, obscured objects, and AGN
- Increased sky coverage
  - more M type stars being detected (more commonly existed)→ more guide stars → better sky coverage (The fraction of the sky which the system provides a useful level of compensation.)

Adaptive Optics



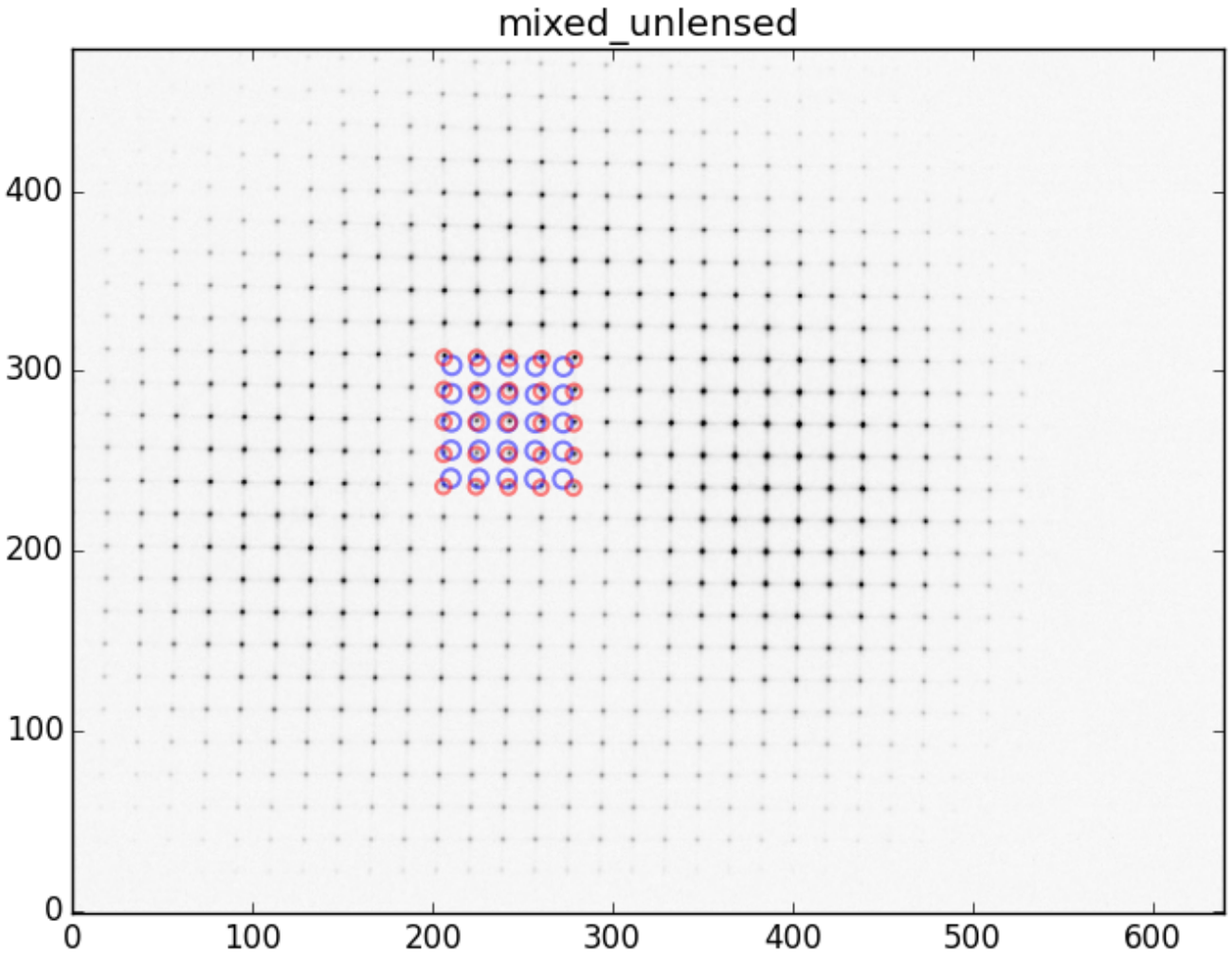
(Davies and Kasper, 2012)

Shack-Hartmann Wave-Front Sensor



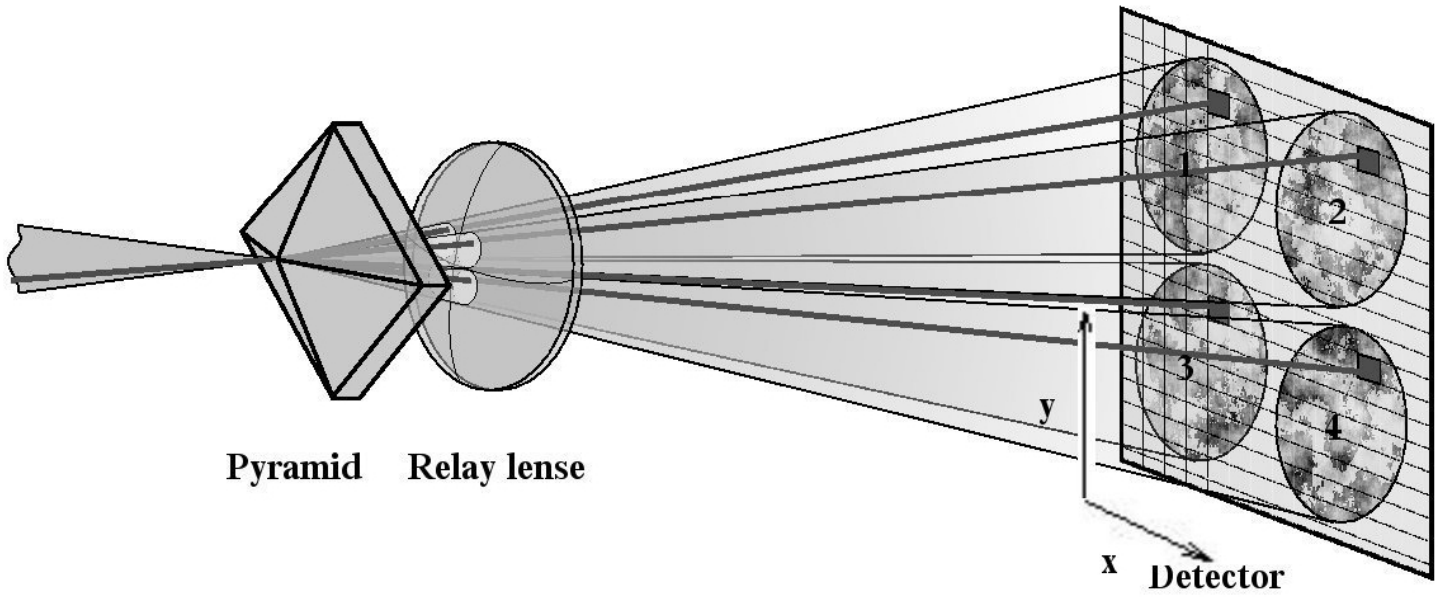
(MARCOS VAN DAM and RICHARD CLARE, 2007)

Lab images of the SH Wave-Front Sensor



Red dots: unlensed
Blue dots: lensed

Pyramid Wave-Front Sensor

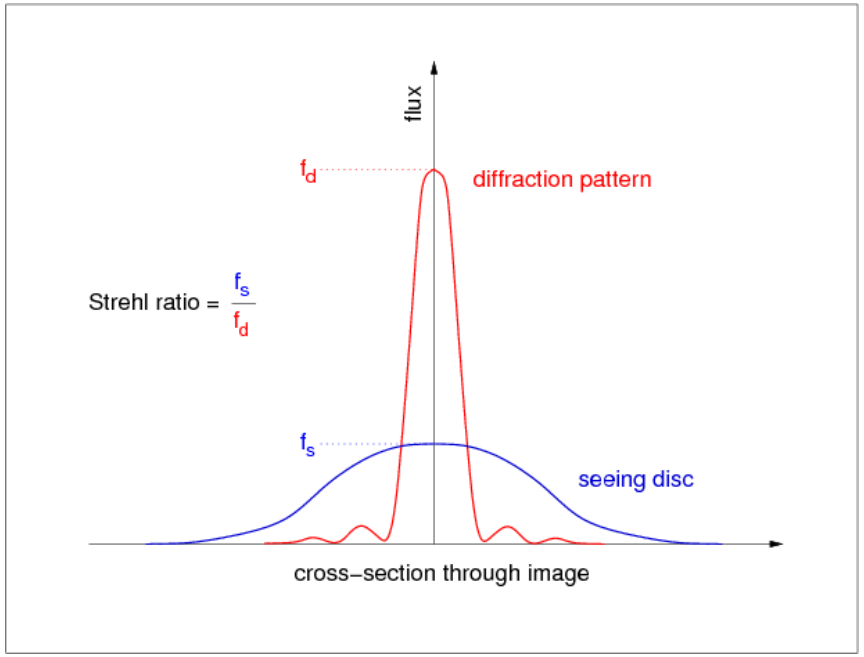


Courtesy of S. Egner

Lab Results

Performance of the Best Strehl Ratio of 2 wavefront sensors

Strehl Ratio



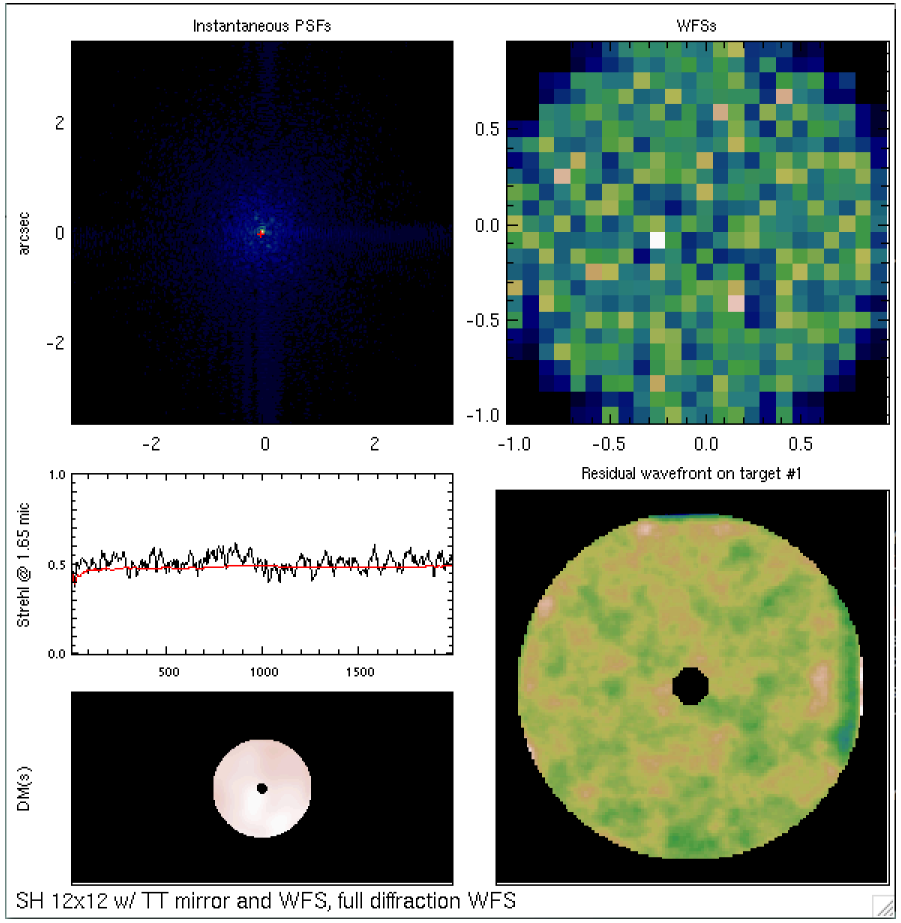
Reproduced from Fig 68 in http://www.vikdhillon.staff.shef.ac.uk/teaching/phy217/telescopes/phy217_tel_adaptive.html

Observational Band	Shack-Hartmann Wave-Front Sensor	Pyramid Wave-Front Sensor
H band (1.65 microns)	0.487	0.55
K band (2.2 microns)	0.65	0.728

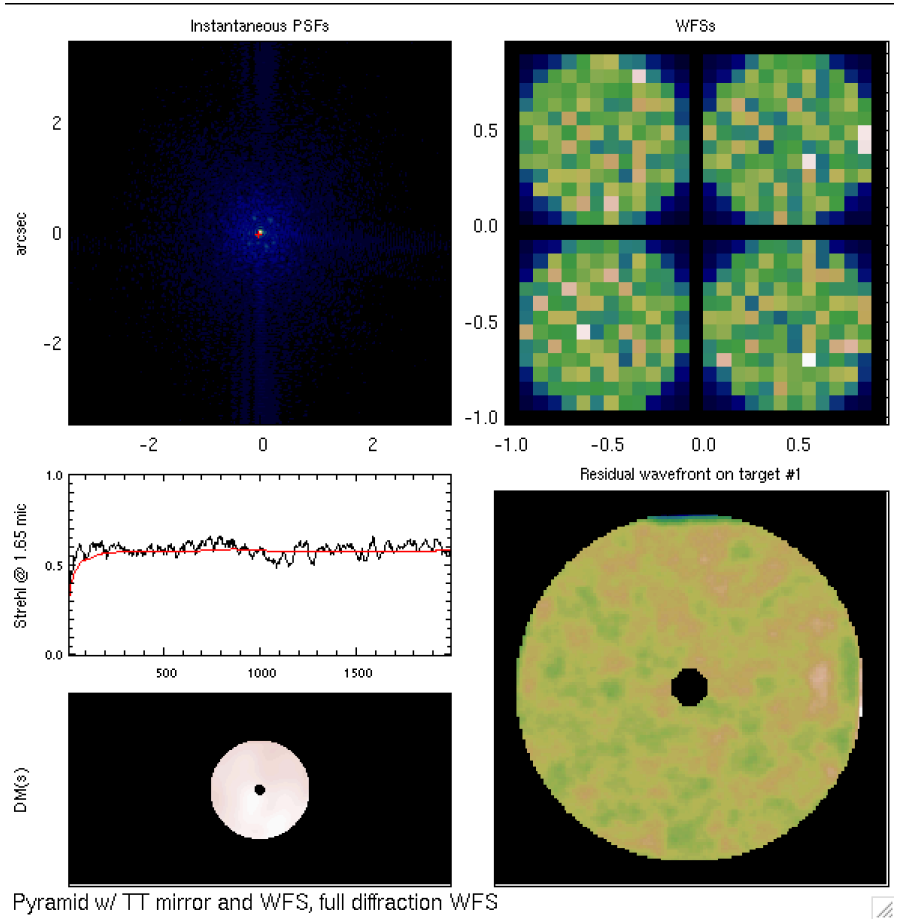
With the setup of the same number of pixels of the detector and a 5 mag star.

Simulation display

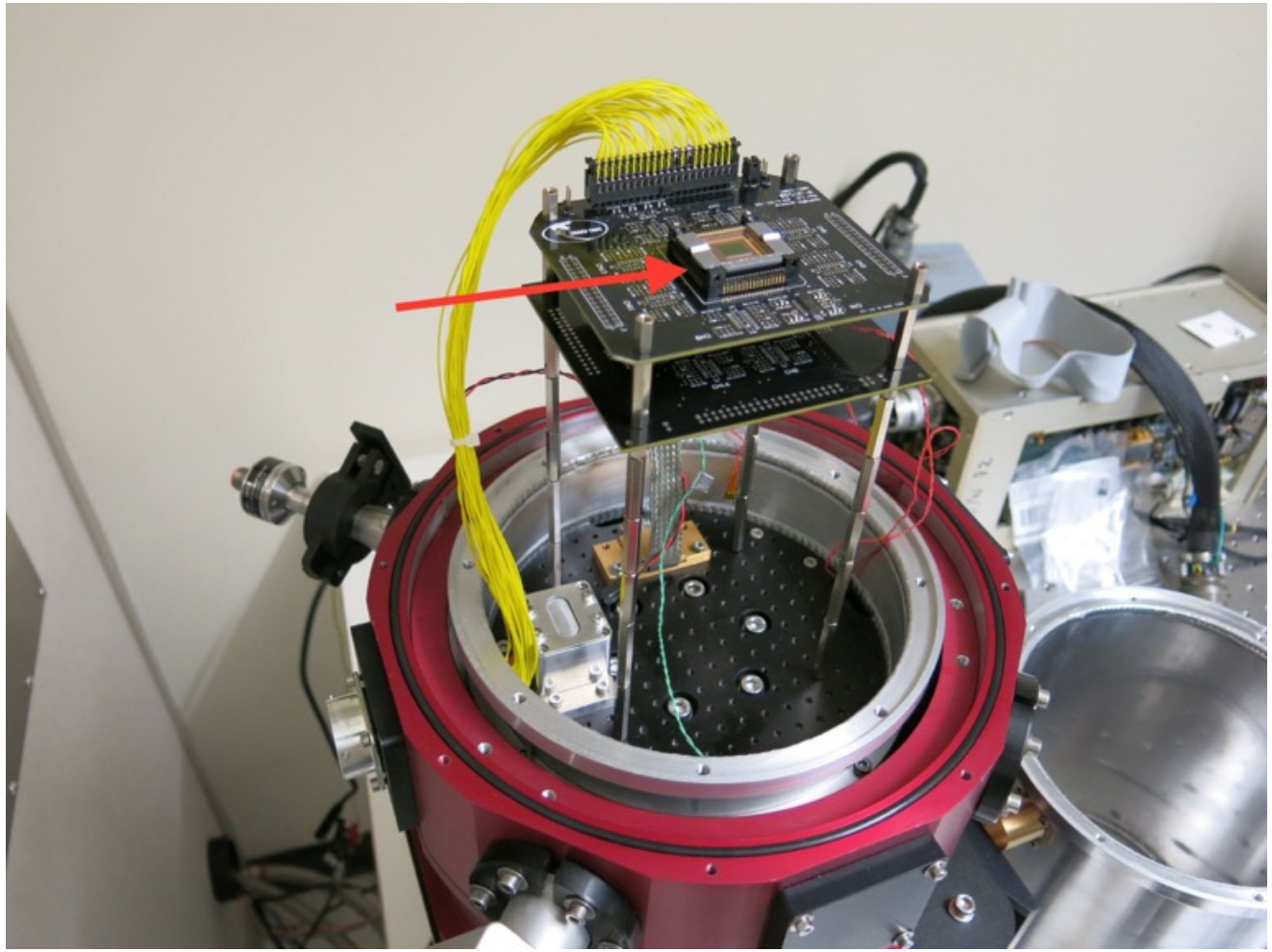
Shack-Hartmann WFS



Pyramid WFS



Our detector



Less than 1e read out noise.