L2-EASI

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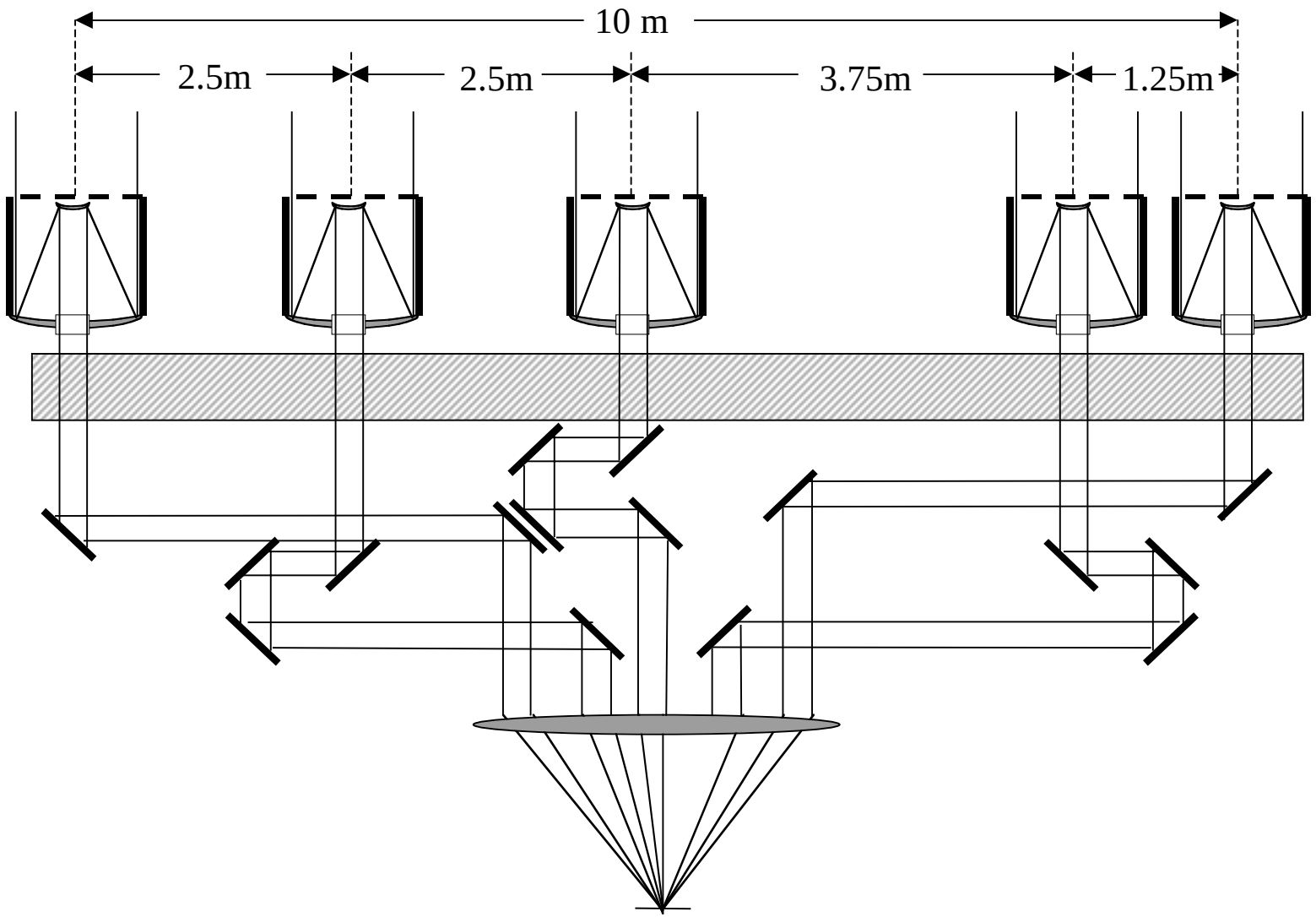

L2-EASI

Draft Optical Requirements

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- Fizeau Inteferometer Configuration
- 5 Telescopes => 9 non-redundant baselines
- Wavelengh range $\Delta\lambda$ = 1 - 5 microns
- Resolution at limb = 2 km = 0.275 arcsec
  - resolution = $(2.44\lambda/B)*z$
- Max baseline = 10 meters
  - $2.44\lambda/B$ = resolution/range
  - B = 1.83 m at λ = 1 um
  - B = 9.15 m at λ = 5 um
- FOV = +/- 15 arcsec = 200 km at Earth limb
  - FOV ~200 km/$1.5x10^6$ km ~ 30 arcsecs
- Need optical design of:
  - Telescopes
  - Active Optical Bench (delay lines & FSMs)
  - Imaging optics
  - Focal plane (filter wheels and/or dispersion method)

Also:

- Boom (dynamics)
- Pointing & Roll

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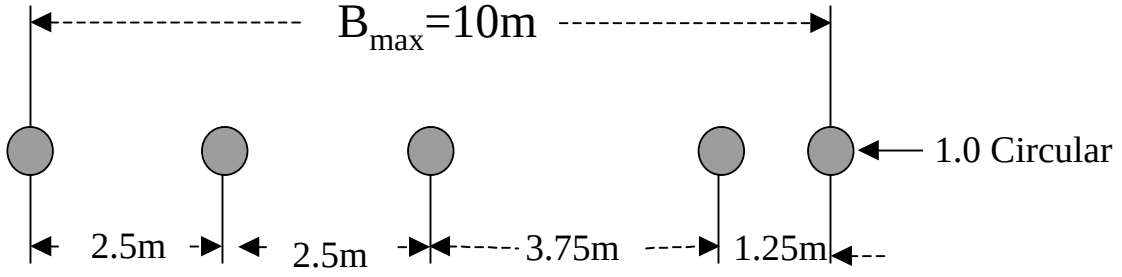
Linear Non-Redundant Hyper-telescope For *L2-EASI*



Gives 9 equally spaced non-redundant baseline pairs
Maximal information w/ minimal glass area

@ λ=1.0 micron

B (meters)	λ/B (arcsec)	Δx (km)
0.00	0.0000	0.00
1.25	0.1650	1.20
2.50	0.0826	0.60
3.75	0.0550	0.40
5.00	0.0412	0.30
6.25	0.0330	0.24
7.50	0.0276	0.20
8.75	0.0236	0.17
10.0	0.0206	0.15

PSF & PRF

CO2 line λ=1.6 um, Δλ =20 nm

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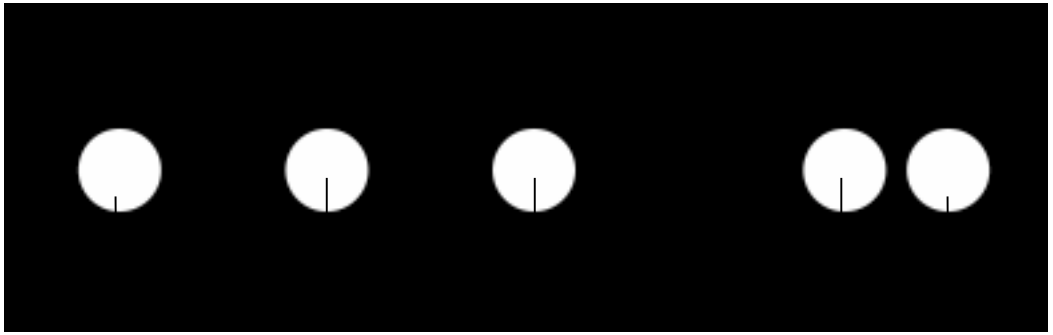
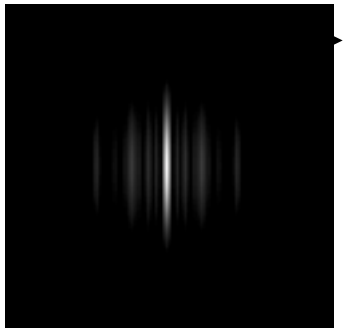
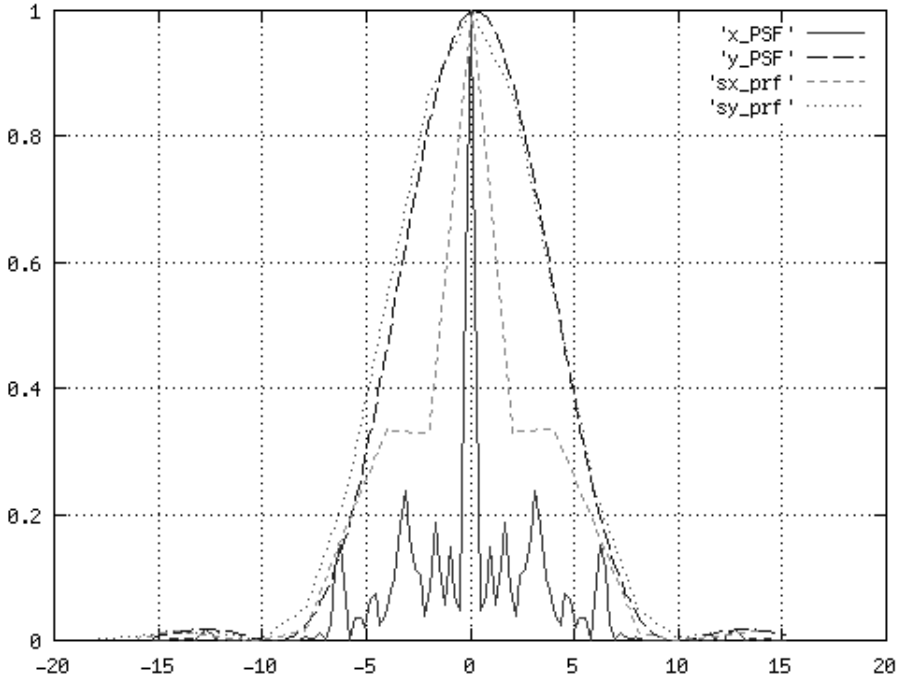


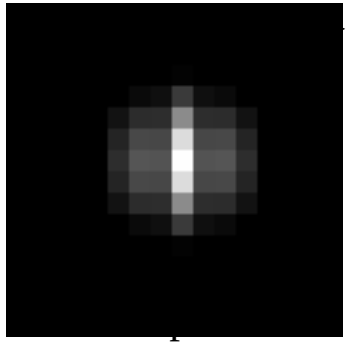
PSF





Km at Earth Limb

PRF



λ=1.6 um
Δλ =20 nm

Radiometry

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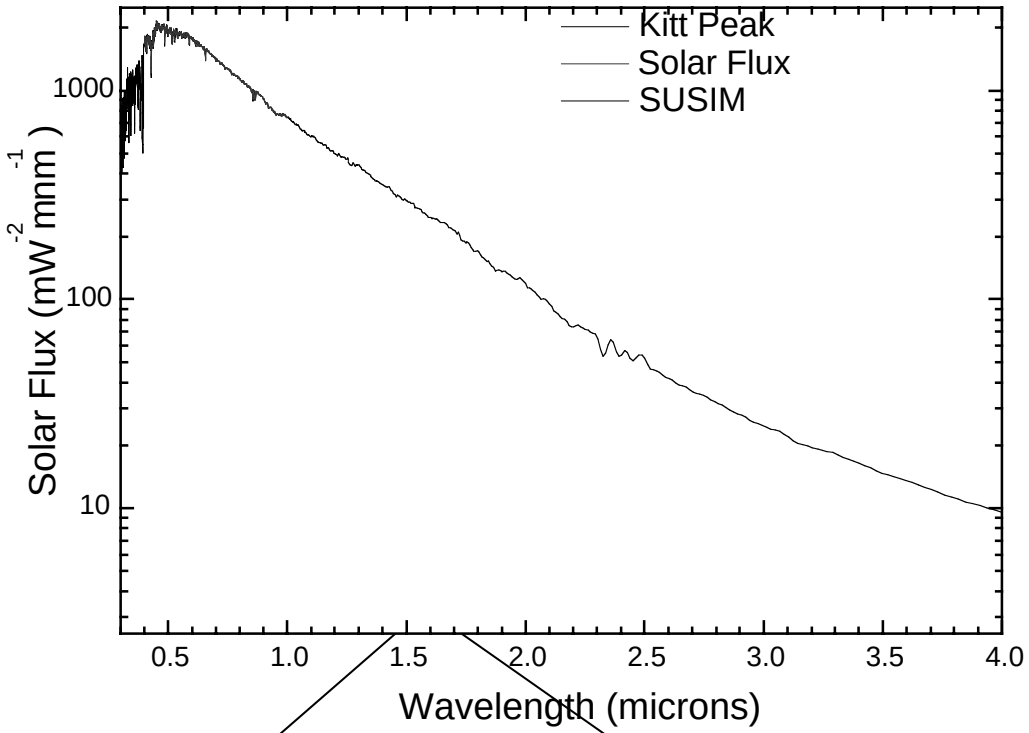
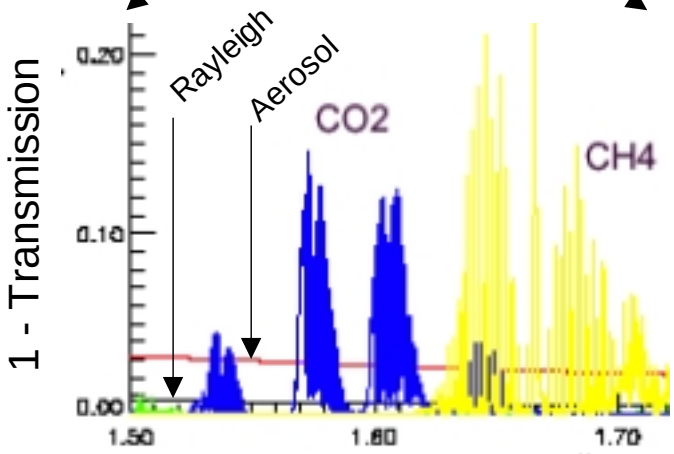


Solar Irradiance
at 1 AU



Atmospheric
Asorption

Imaging Model

Spatial Distribution of flux on detector

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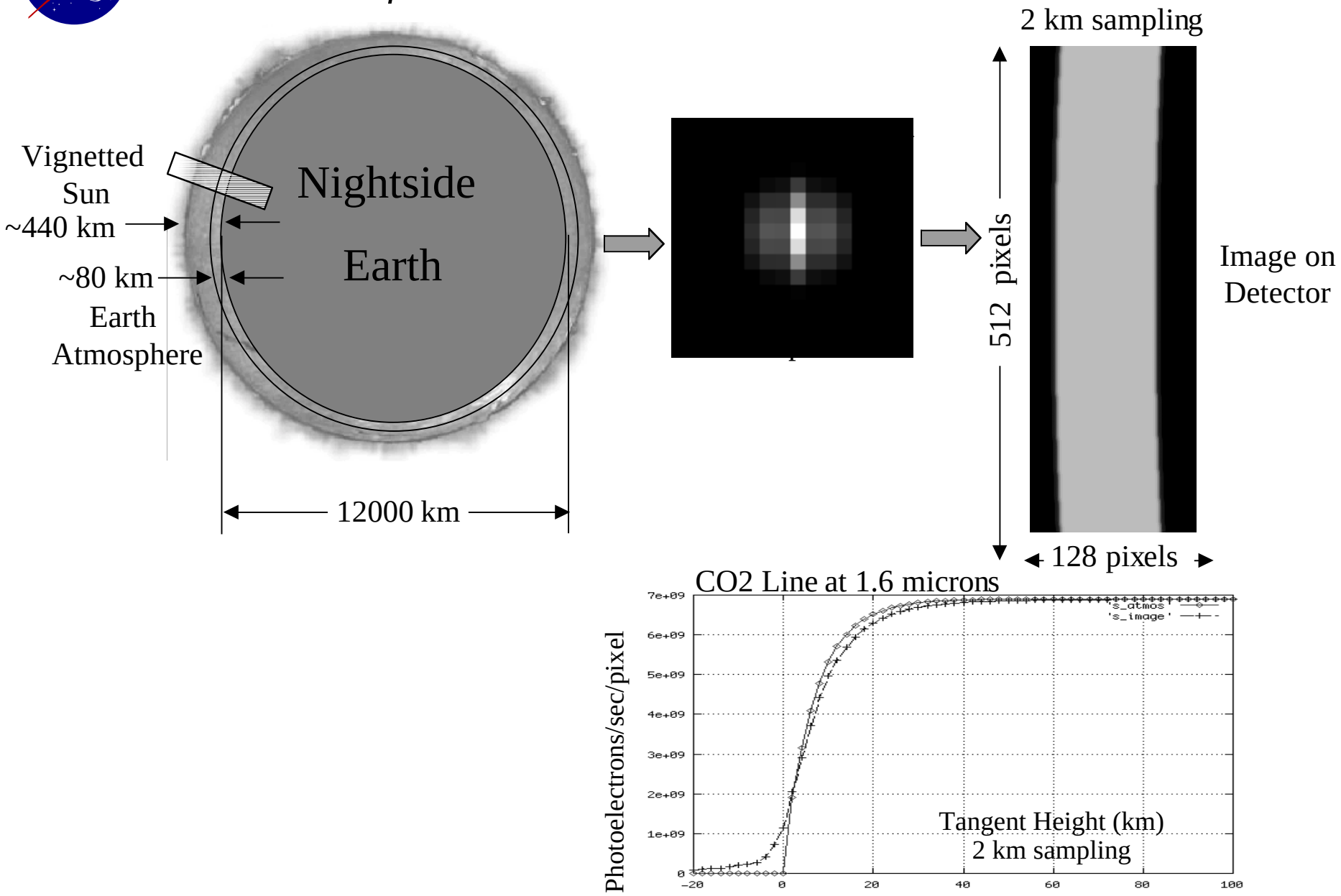

Detection Model (1)

Photo-electrons per pixel

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$$\frac{e^-}{pixel} = \int \frac{r_0^2}{(r_0 + \Delta r)^2} F_s(\lambda) G_f T_a(\lambda, h) F(\lambda, \Delta\lambda) T_o(\lambda) q.e.(\lambda) \frac{\Delta\Omega_{pix}}{\Delta\Omega_{sun}} \frac{\lambda}{hc} d\lambda \Delta A \Delta t + \eta_e$$

Te^- = Photo-electrons in 2km pixel at tangent height "h"

r_0 = 1 AU = 148.8x10^6 km

Δr = 1.5x10^6 km

$F_s(\lambda)$ = Solar Irradiance at 1 AU (Watts/m^2/um)

G_f = Geomtetric Solar/Earth Vignetting factor (15%-20%)

$T_a(\lambda, h)$ = Atmospheric Transmission at tangent height "h"

$F(\lambda, \Delta\lambda)$ = Spectral Filter Transmission

$T_o(\lambda)$ = Optics Transmission

$q.e.(\lambda)$ = Detector quantum efficiency (electrons/photon)

$\frac{\lambda}{hc}$ = Photons/Joule ΔA = Aperture Area (meters)

$\Delta\Omega_{pix} / \Delta\Omega_{sun}$ = ratio of pixel sterance to solar sterance

Δt = Detector Integration Time (secs)

η_e = Photon & Readnoise (photo-electrons)

Piston Sensitivity

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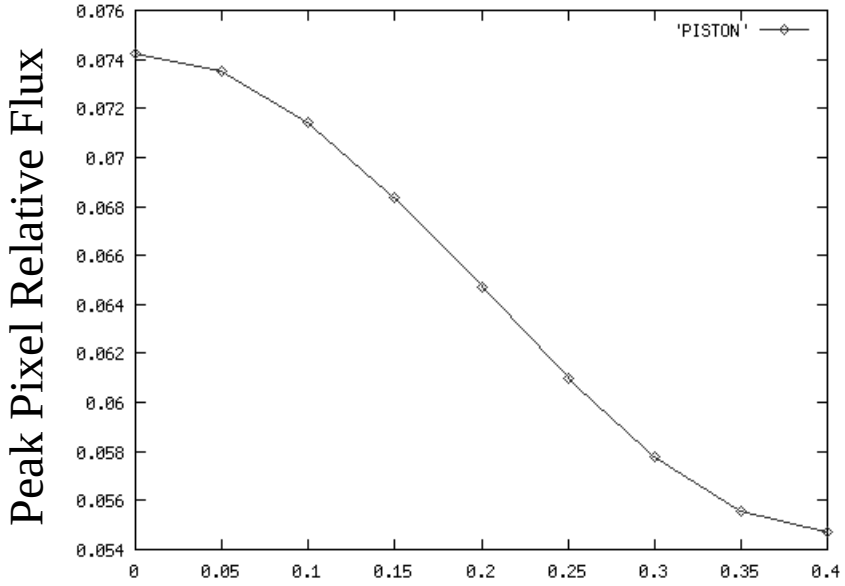
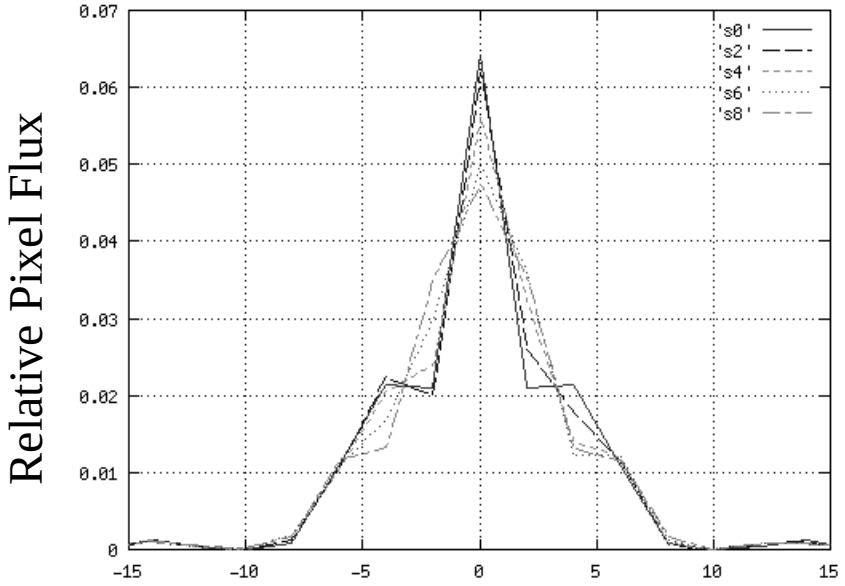
32 Km

Piston Sensitivity at λ=1.6 um, Δλ=0.02 um



PRF as function of Piston



Tilt Sensitivity

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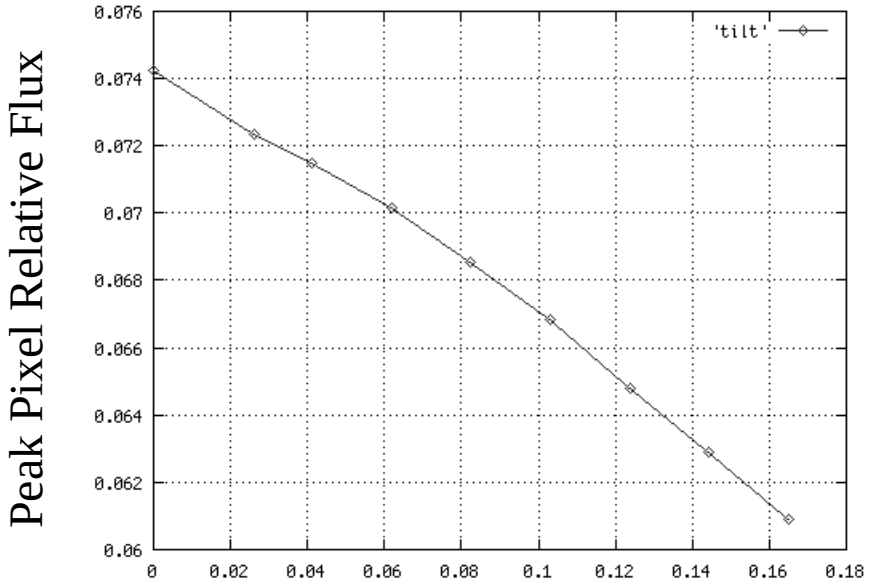
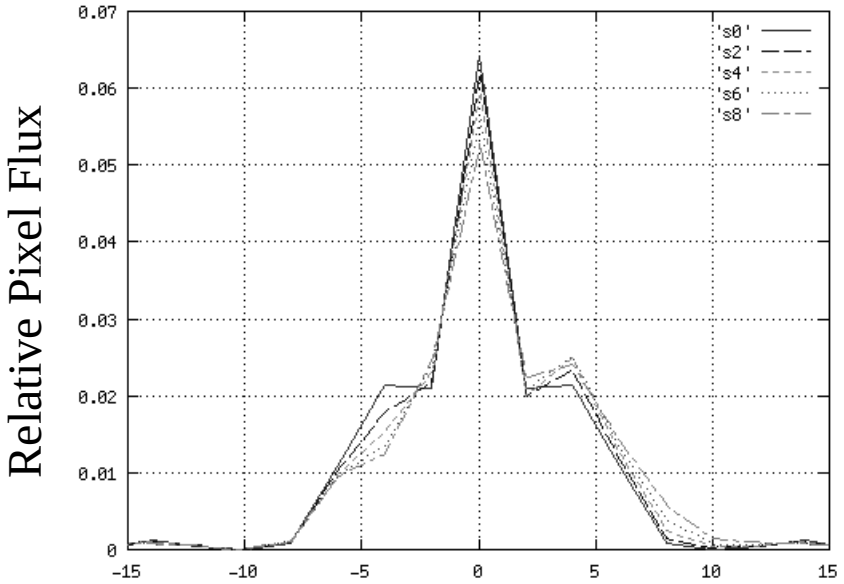
Tilt Sensitivity at λ=1.6 um, $\Delta\lambda$=0.02 um



PRF as function of Tilt



MTF vs SupAperture Size

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