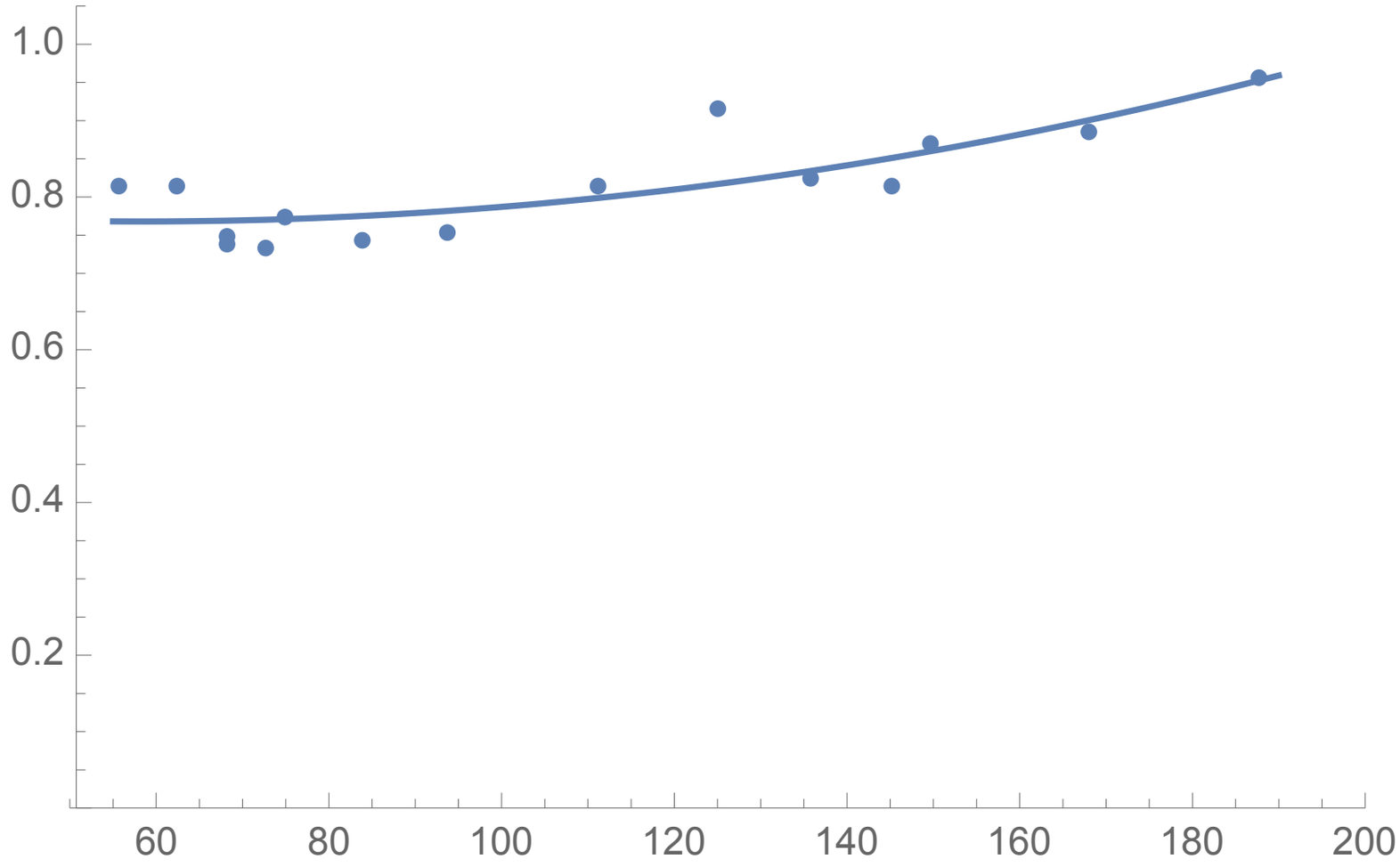
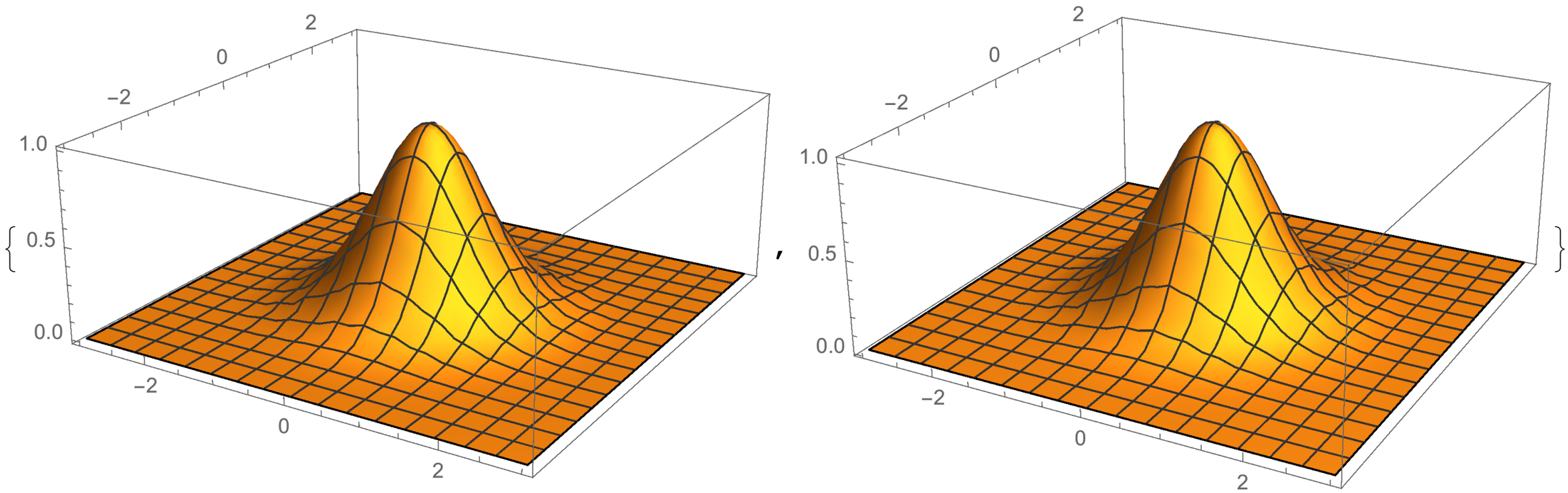
Scatter in Extended vs. Point Source Calibration



- $S[y,z]=1/9.4^2$, $\int S[y,z]\ \mathrm{Beam}_{13}[y,z]\ dy\ dz$ over area >> beam width
  - nominal spaxels should collect/detect 1Jy from this surface brightness

Robustness Against Offset (or Lack Thereof)

```
Table[Plot3D[e^-(x^2+y^2) + d, {x, -3, 3}, {y, -3, 3}, PlotRange → All, ImageSize → Medium],
 {d, 0, 0.01, 0.01}]
```



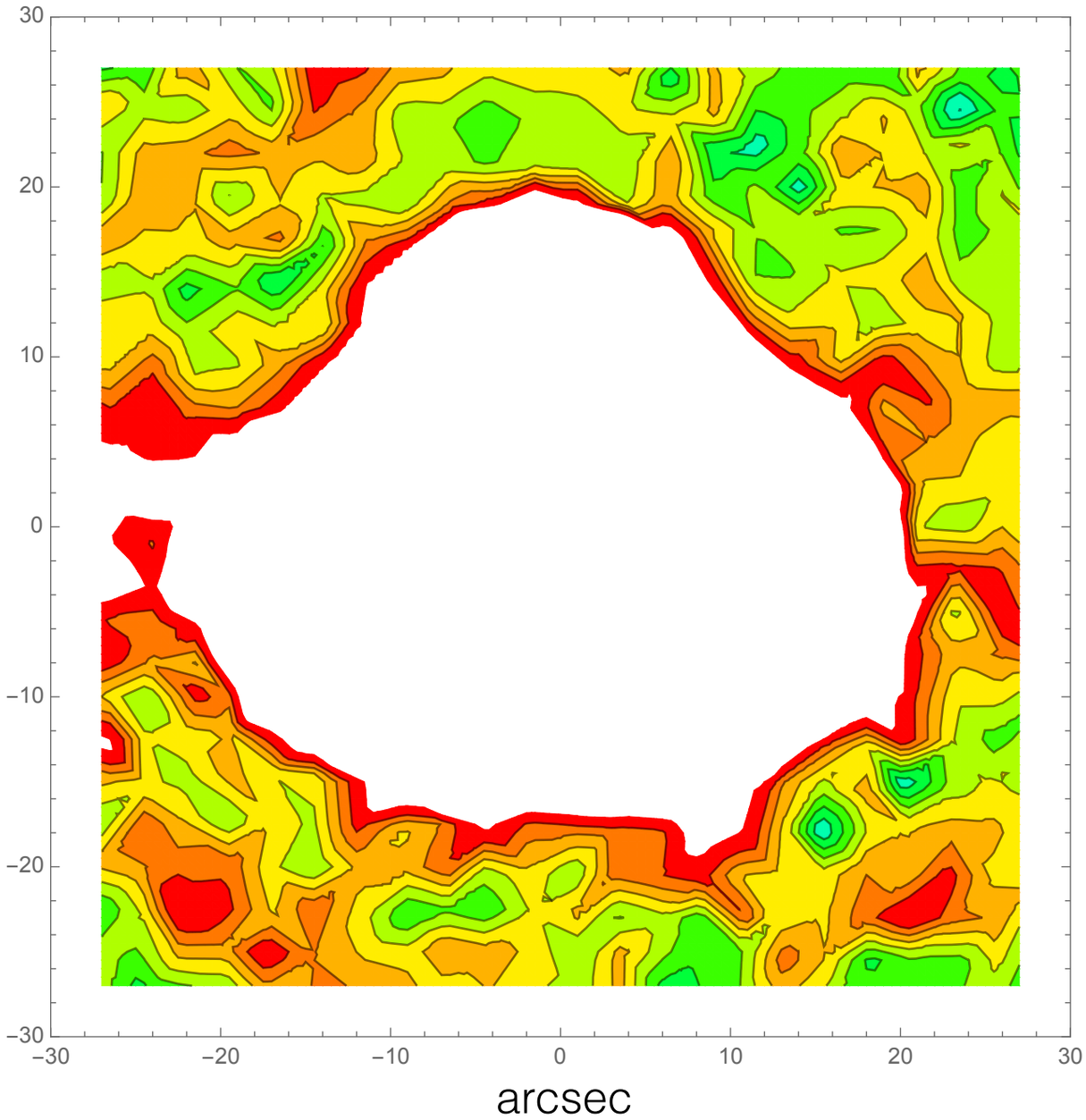

```
Table[NIntegrate[e^-(x^2+y^2) + d, {x, -3, 3}, {y, -3, 3}], {d, 0, 0.01, 0.01}]
```

```
{3.14145, 3.50145}
```

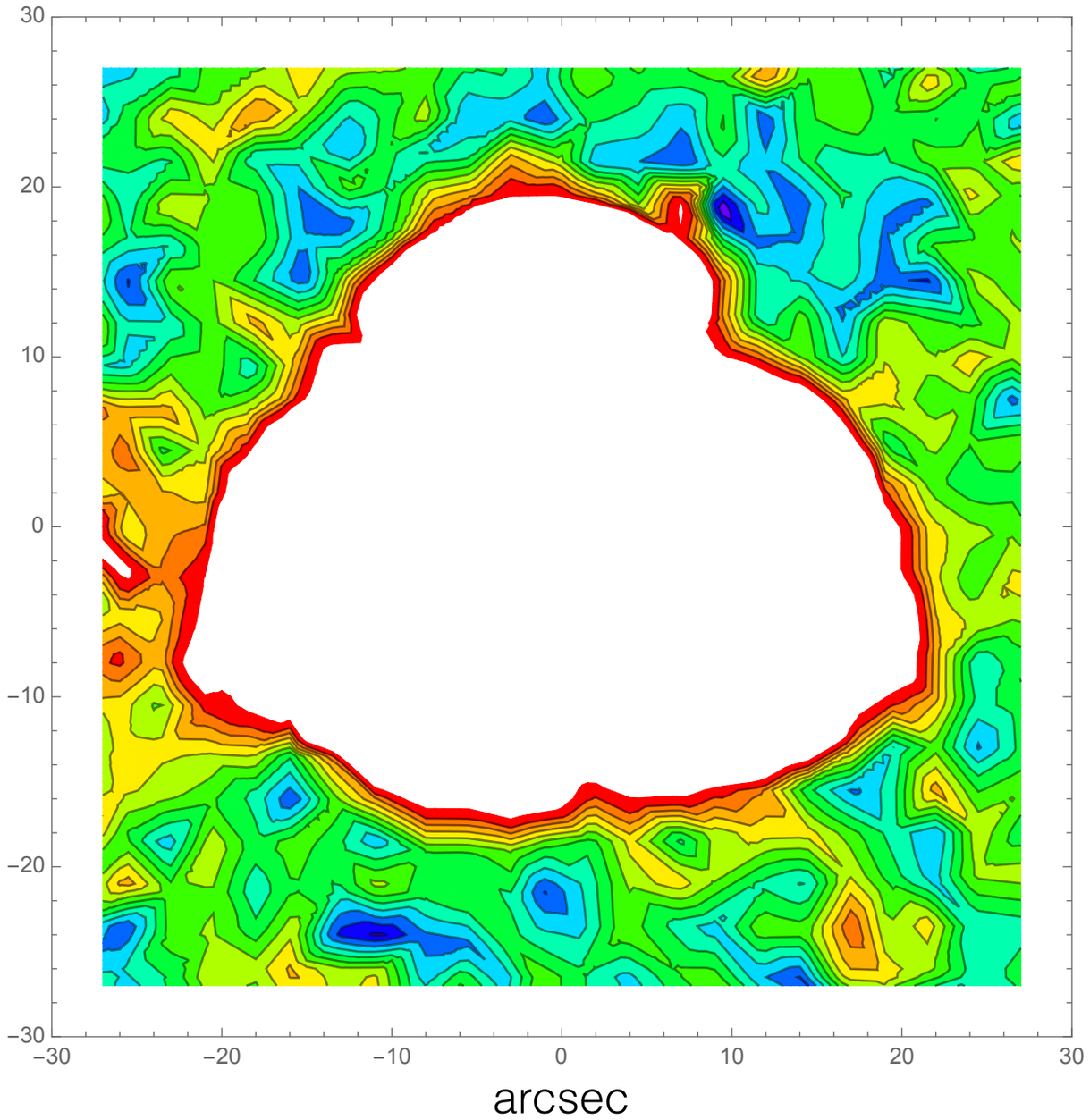
1% offset → 15% effect on integrated flux!

Offset in Beam Wings?

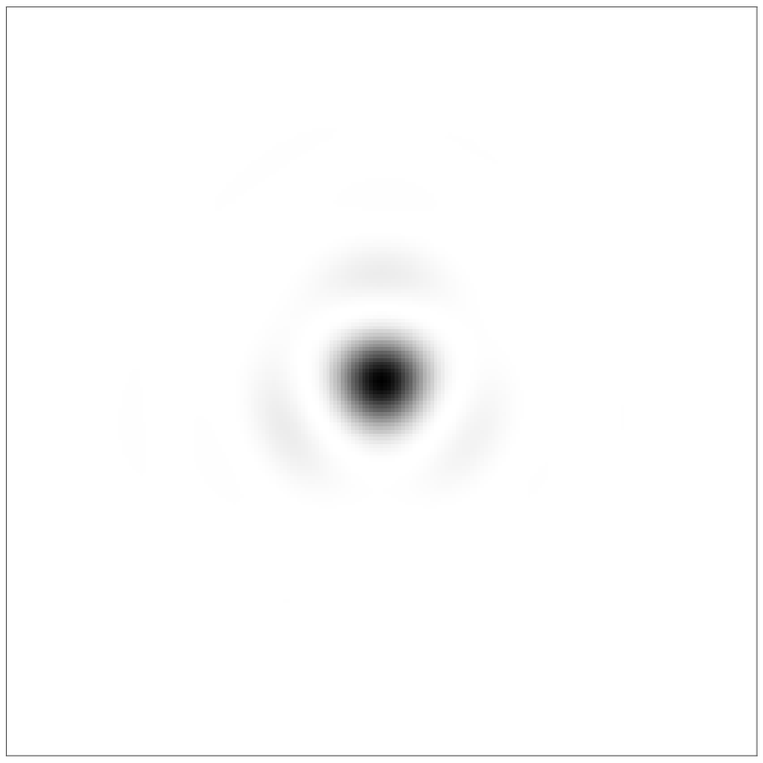
Neptune raster 125μm



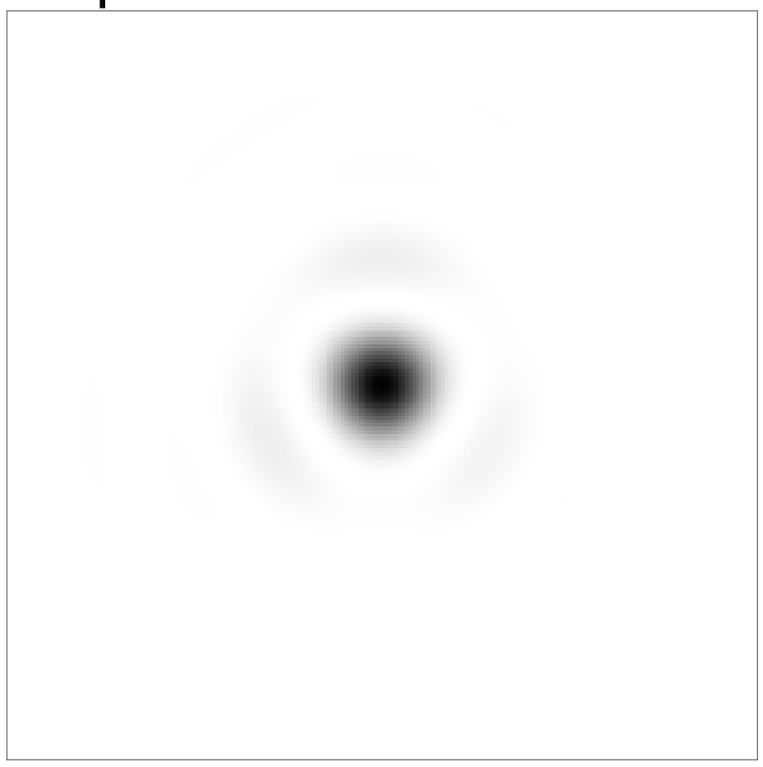
Neptune raster 136μm

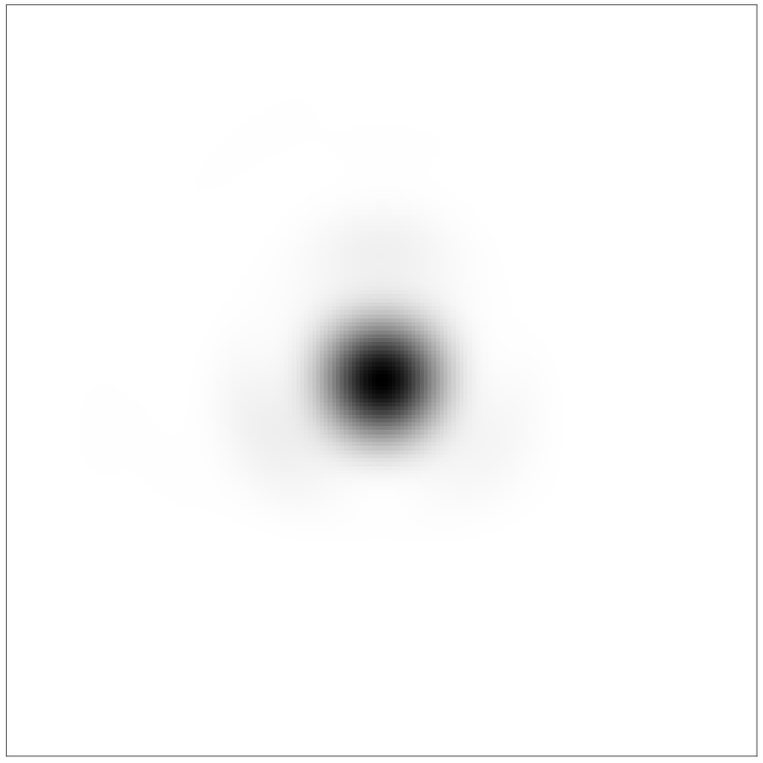


Norbie's Calculated Telescope PSFs

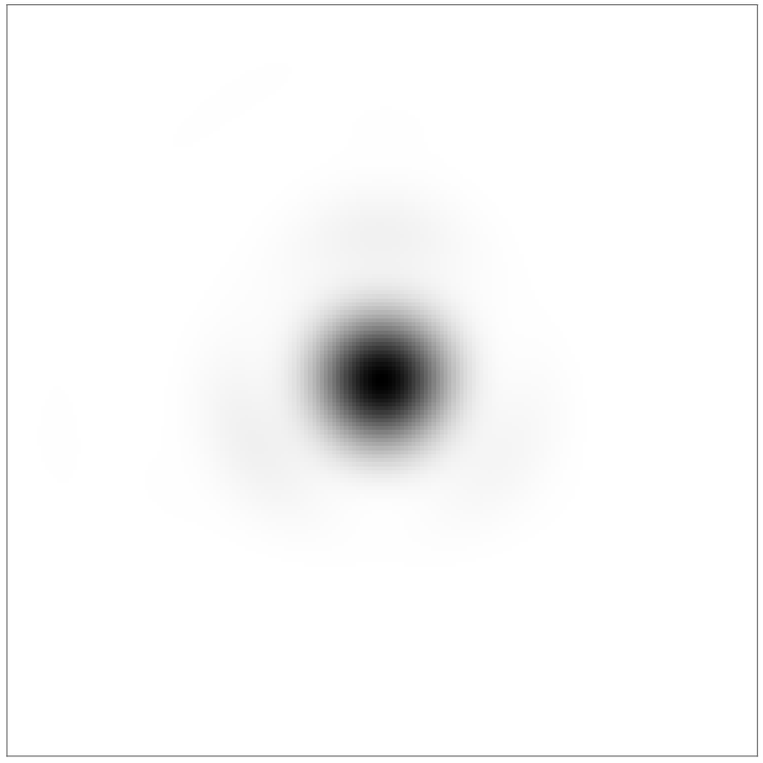


Telescope PSF





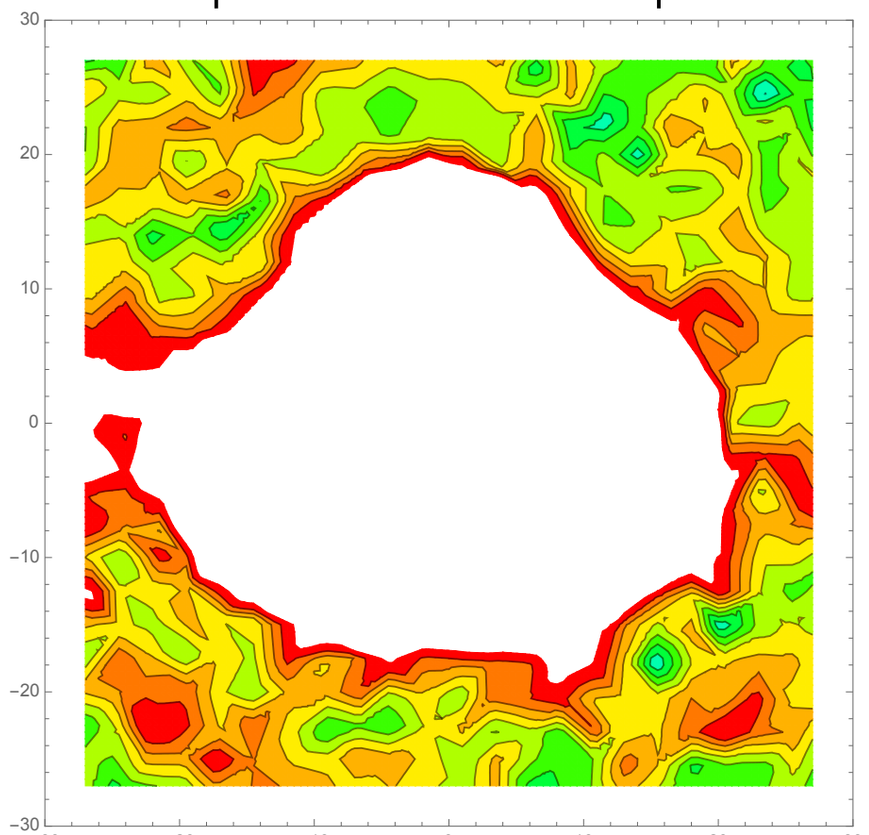
Telescope PSF
⊗ 8"x8" spaxel



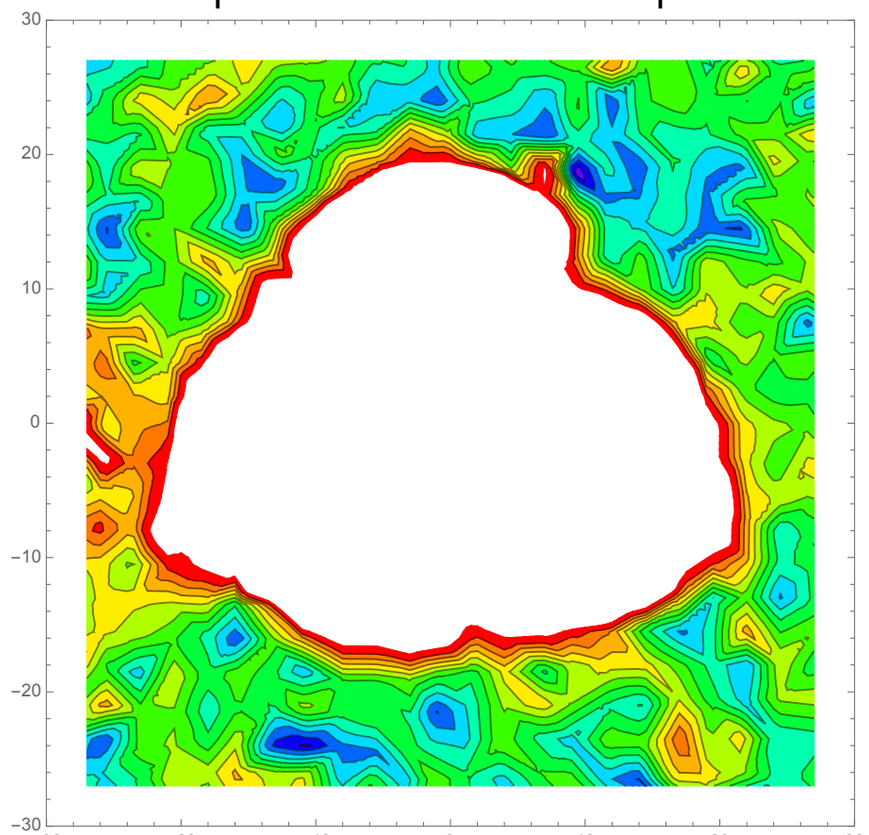
120μm

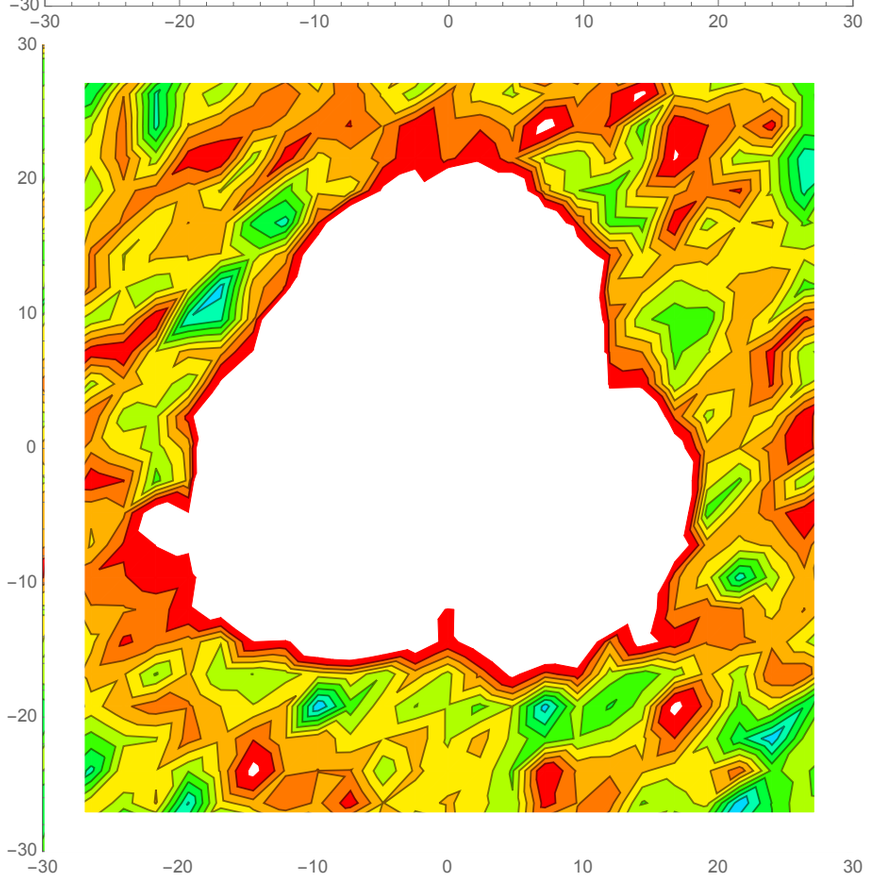
140μm

Neptune raster 125μm

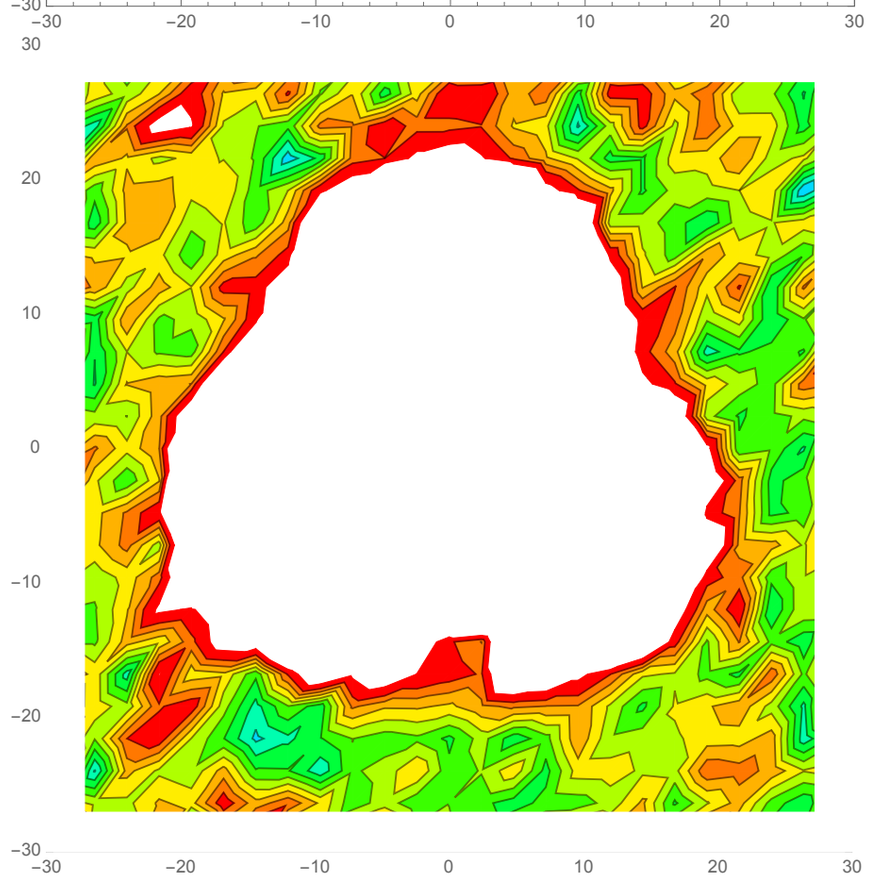


Neptune raster 136μm



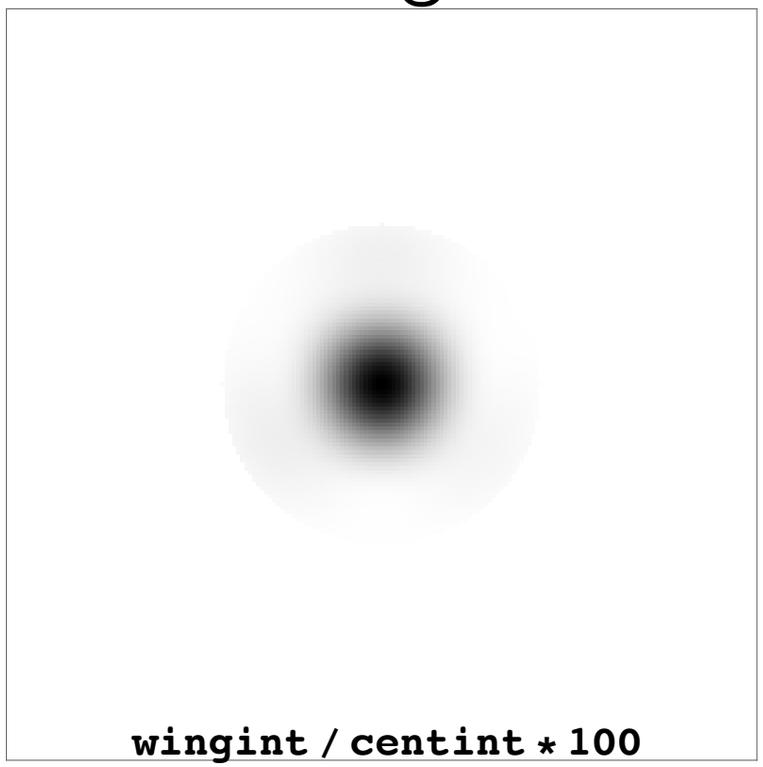


simulated raster 120μm (noise added)

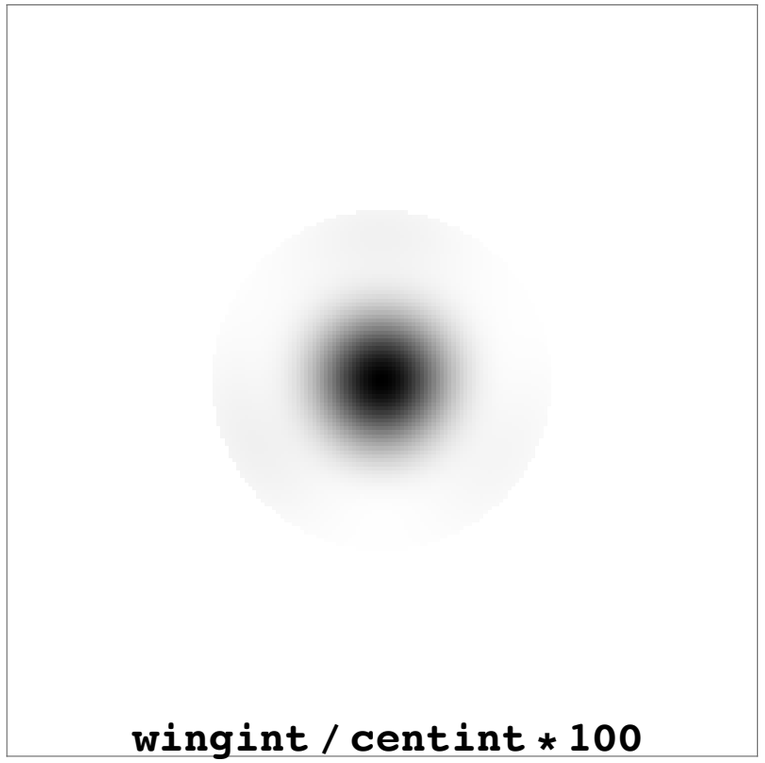


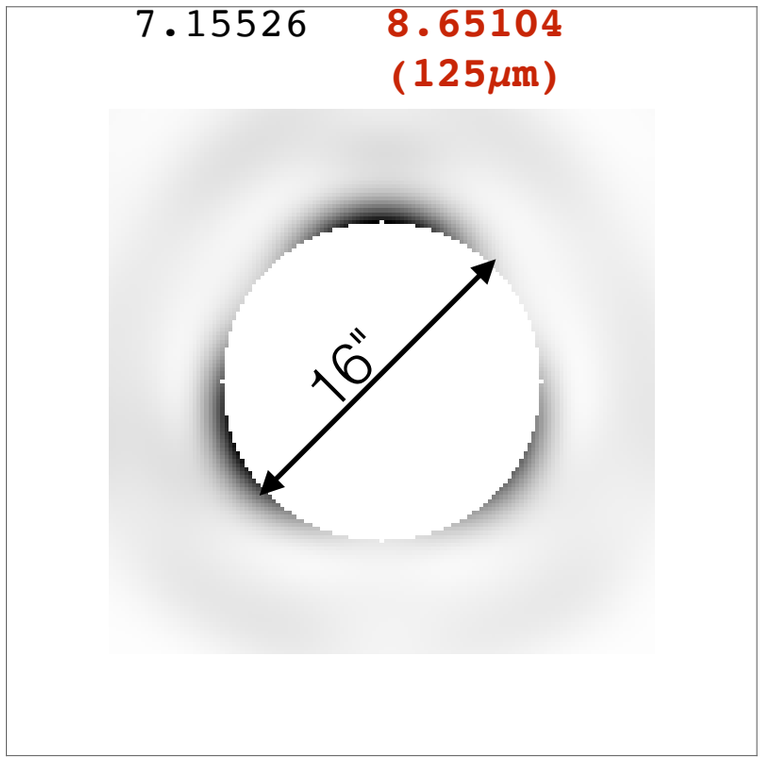
simulated raster 140μm

Integrated Flux in Wings vs. Central Peak



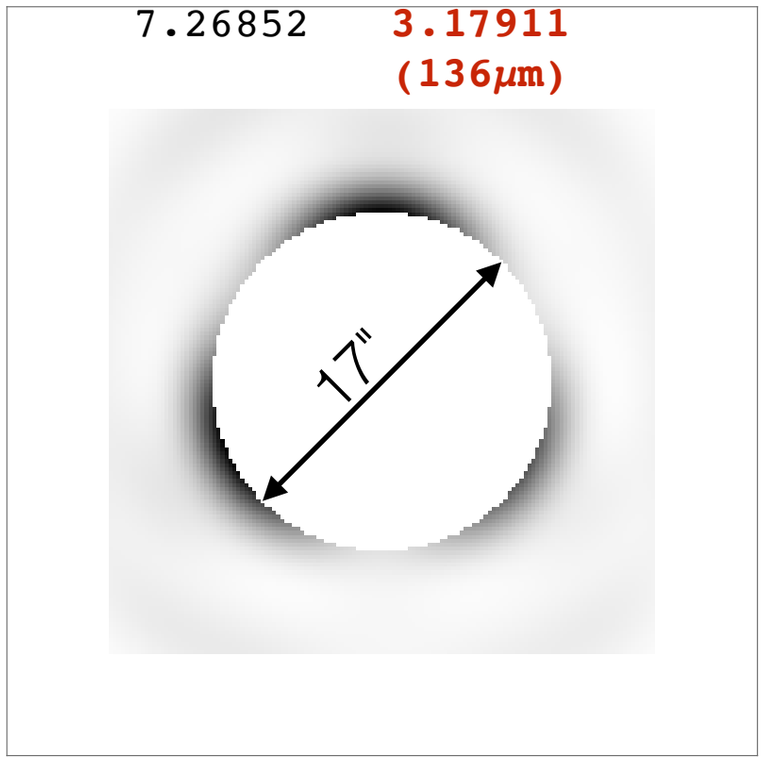
Telescope PSF
⊗ 8"x8" spaxel
peak region





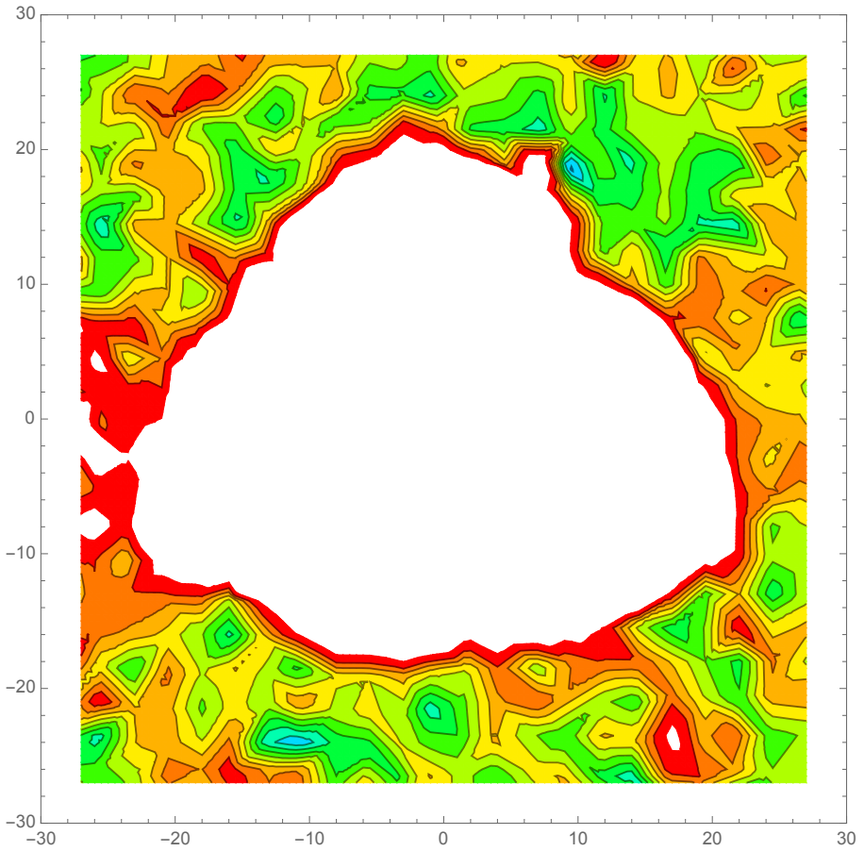
observed beams

Telescope PSF
⊗ 8"x8" spaxel
wings



120μm

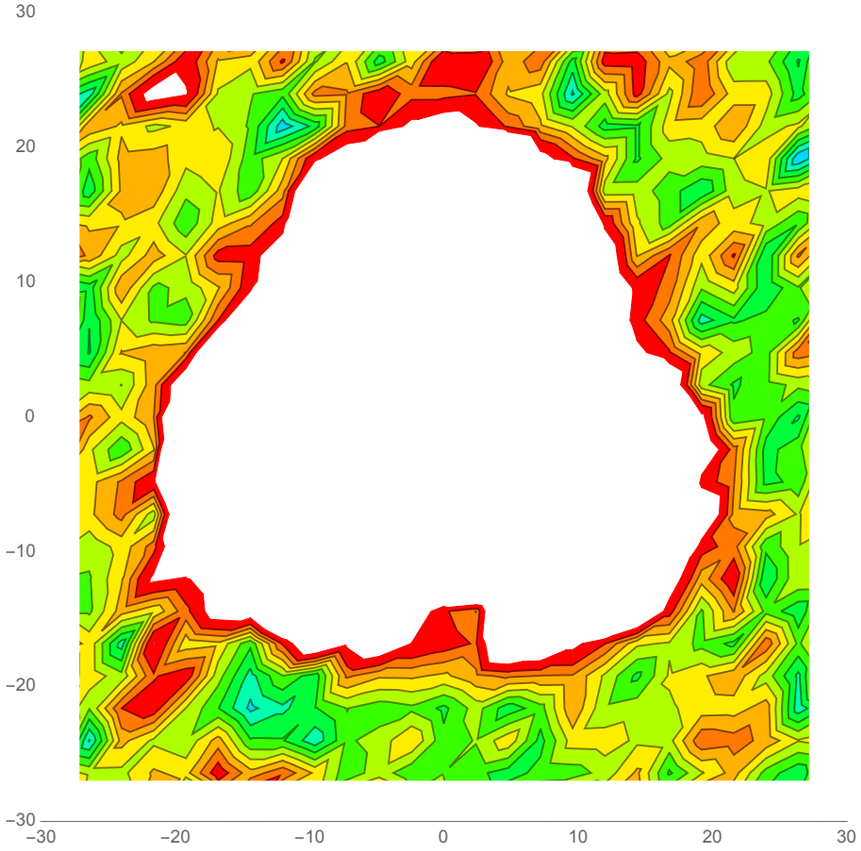
140μm



Offset to tweak **`wingint/centint`** of raster observation to value obtained with diffraction model

Neptune raster 136μm
+0.0015 offset

…but changes ESCF only by 4%
- not enough to explain scatter!

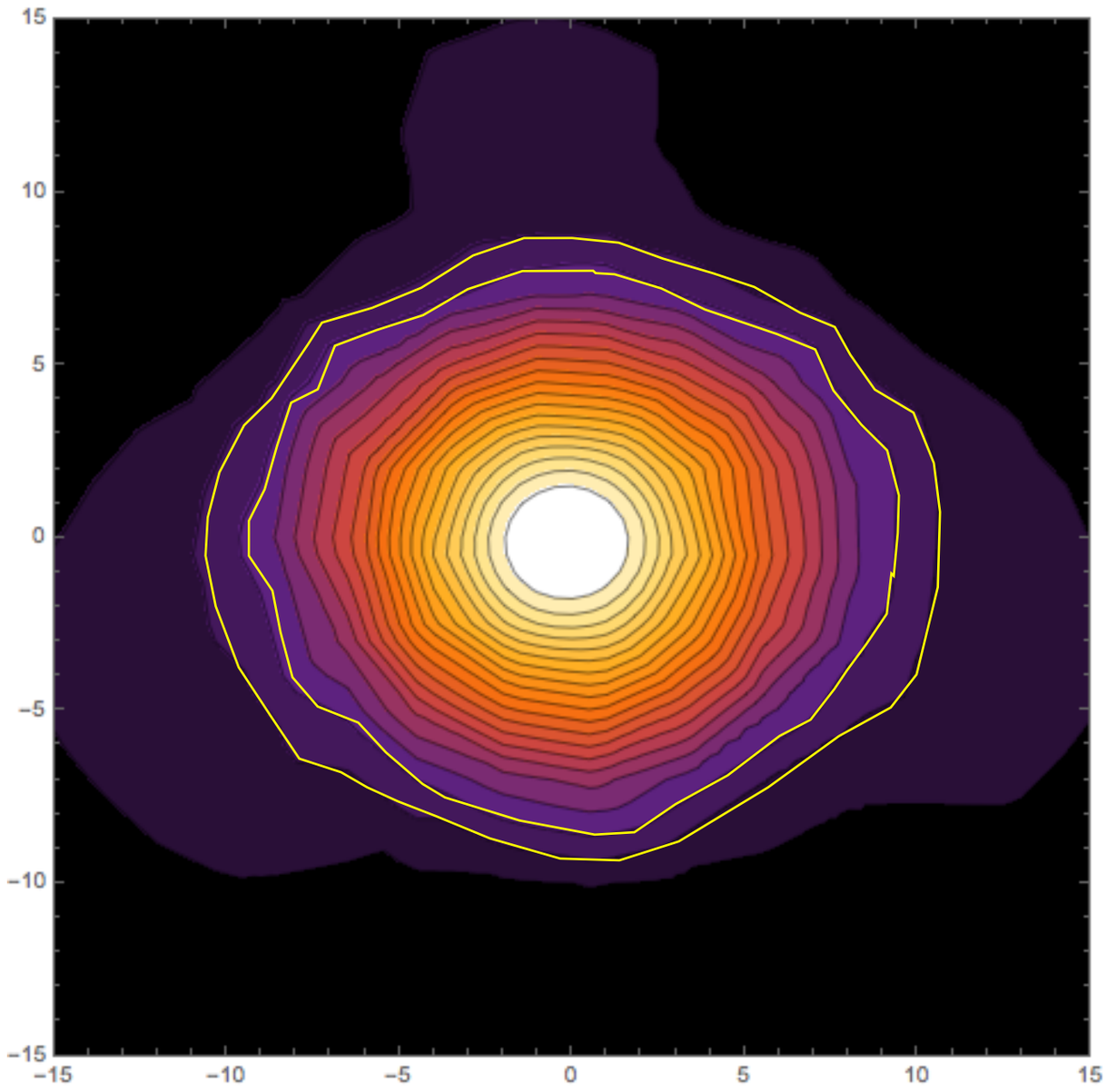


simulated raster 140μm (noise added)

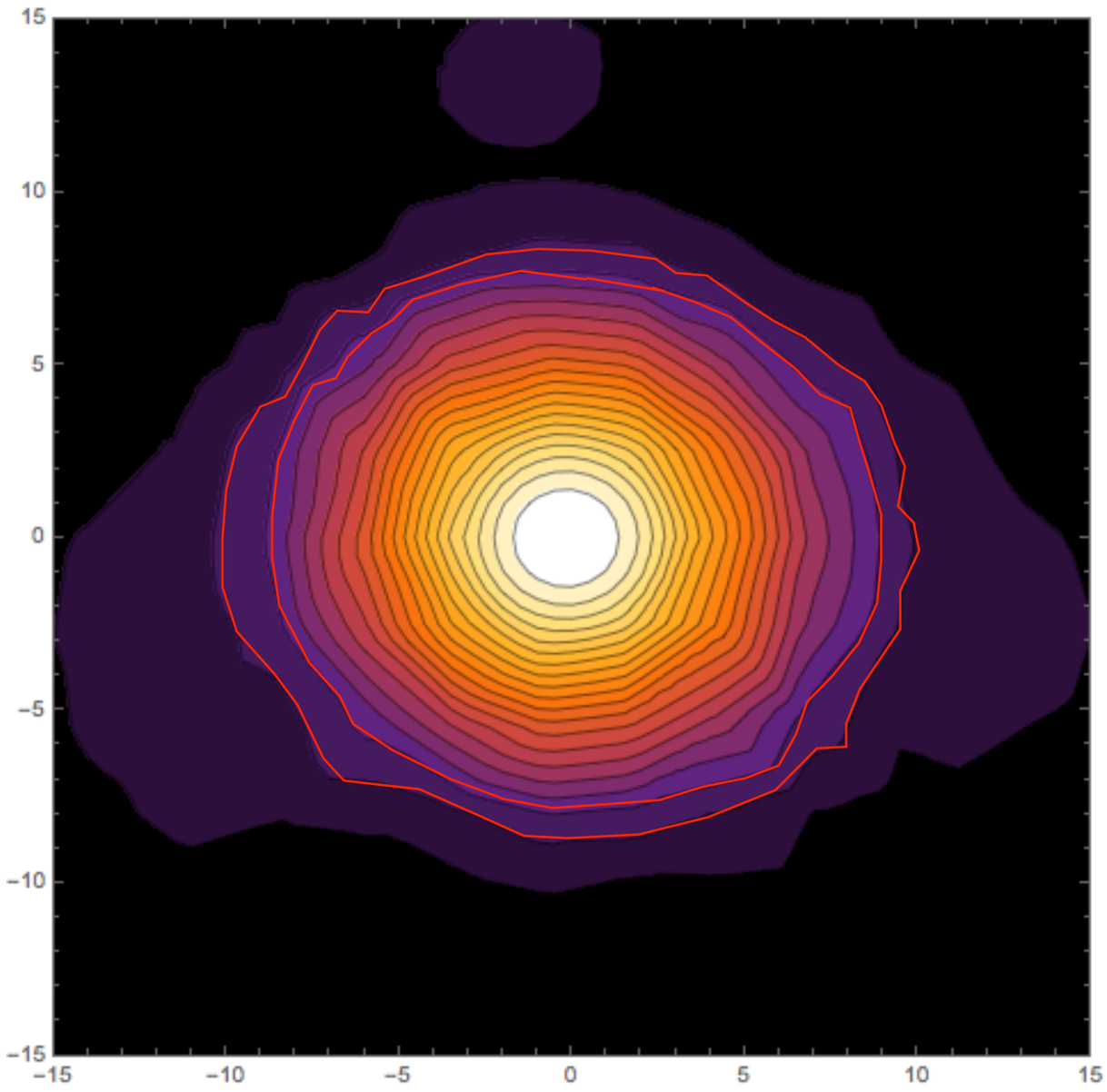
ESCF from Different “Flavours” of Beam

- For central spaxel, we have
  - Coarse raster (2.5 arcsec) [for all spaxels] `0.919082`
  - “Synthetic" Beam (2.5 arcsec raster / Gaussian model peak) [for all spaxels] - these are the nominal beams `0.924654`
  - Combined Beam 2.5 / 1 arcsec [only central spaxel] `0.903464`
- No big difference - and Fine Raster was done independently!
- Central part of beam doesn’t seem to be main culprit

Could 125μm Map Be “Smeared Out”?

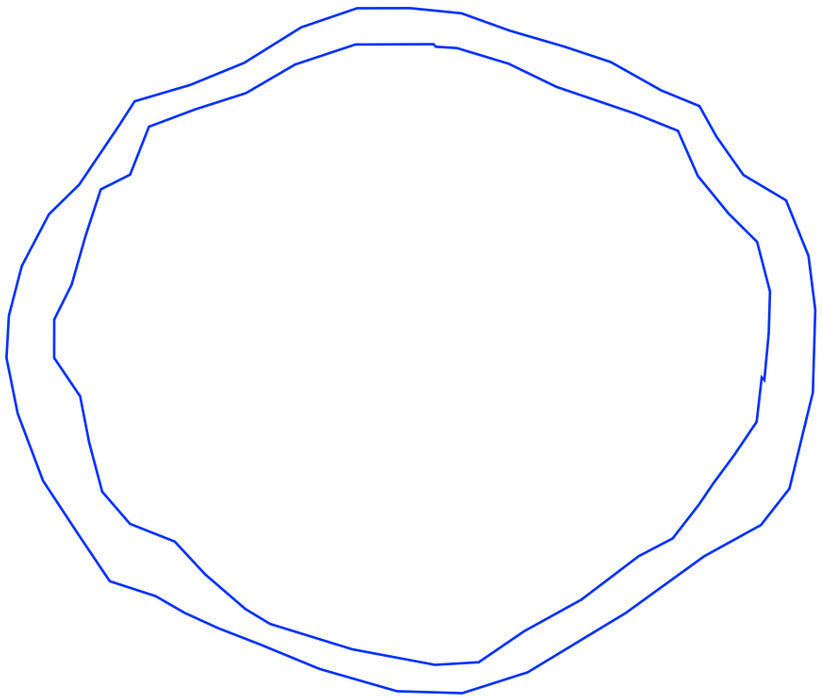


Neptune raster 125μm

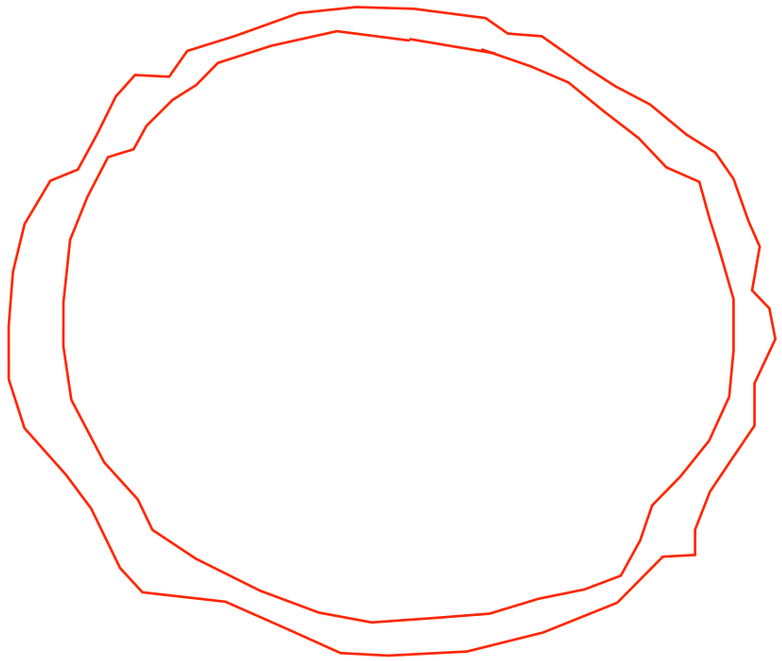


Neptune raster 136μm

Could 125μm Map Be “Smeared Out”? Maybe…



Neptune raster 125μm

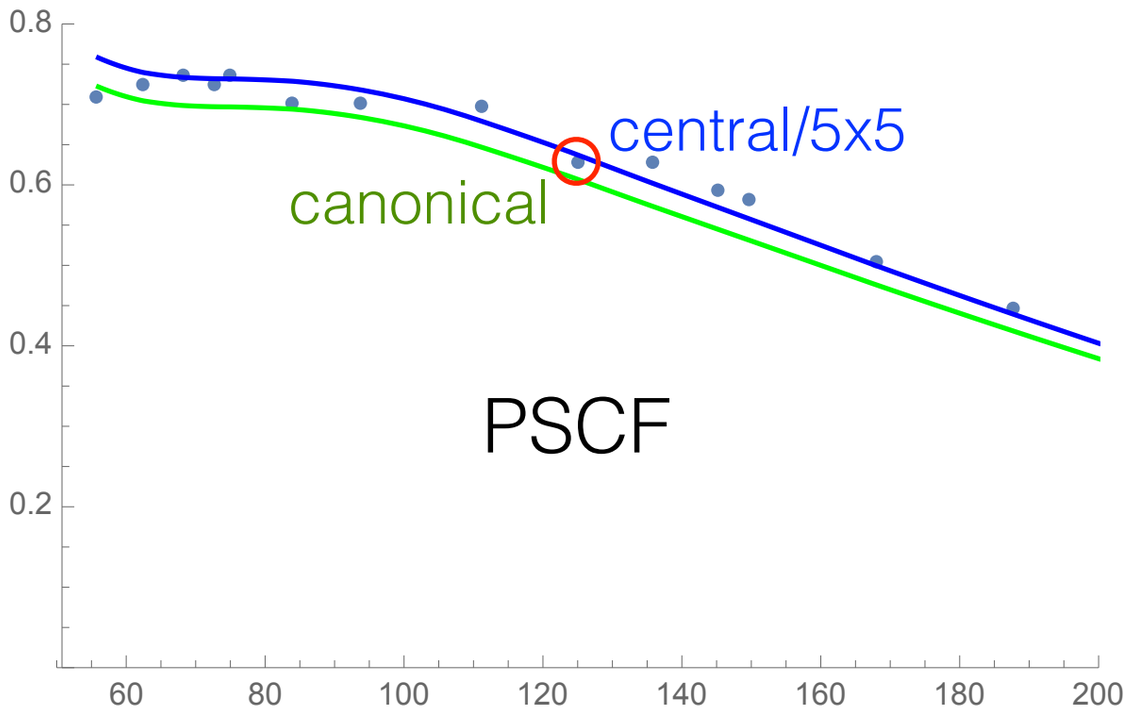


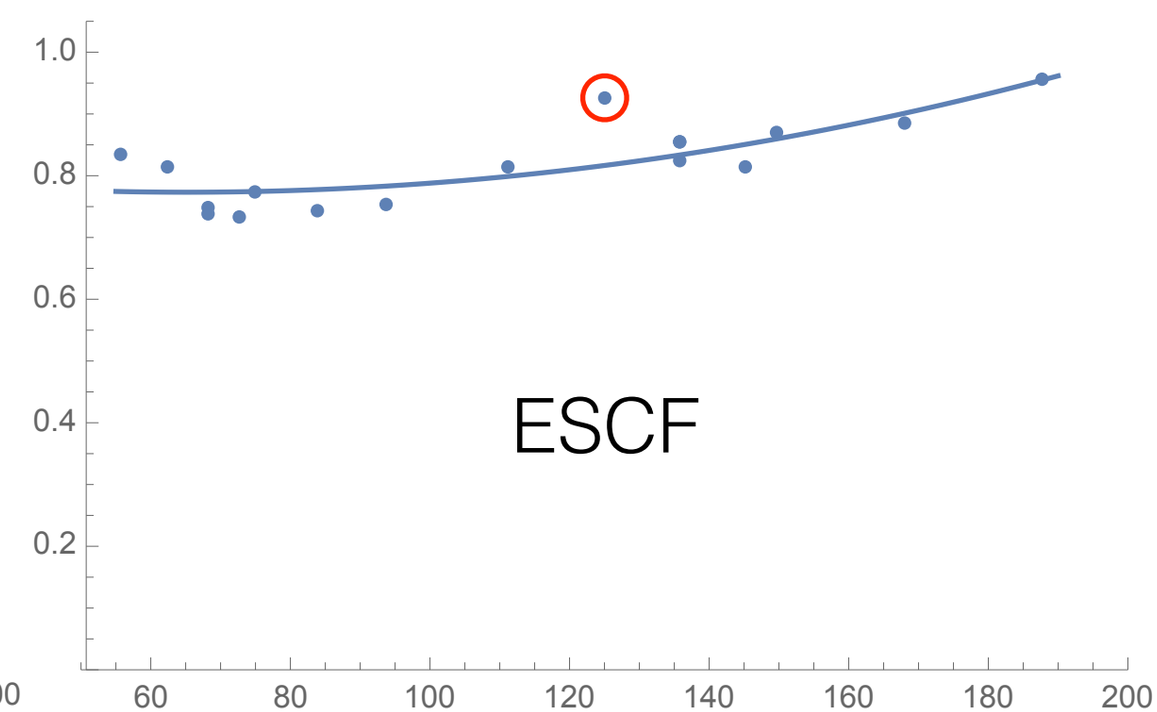
Neptune raster 136μm

Not clear whether this is sufficient to explain "anomaly"

Beam Normalisation?

- Beam normalisation linked to PSCF
- If that number were “wrong” at 125μm, the ESCF would have an “outlier” at that wavelength, too, to make up for it
- A smooth fit function for the ESCF would then be truly wrong at that particular wavelength
- But…





Central / 5x5 (120 or 125μm)

```
ifu = Table[compo[[n]][0, 0], {n, 1, 25}]

ifu[[13]]/Total[ifu]
0.627405



ifusim = Table[compo[[13]][x, y], {x, -2*9.4, 2*9.4, 9.4}, {y, -2*9.4, 2*9.4, 9.4}]

ifusim[[3, 3]]/Total[Flatten[ifusim, 1]]
0.608616   0.711828
```

same, but with calculated PSF instead of measured central spaxel beam

- There is a substantial discrepancy between central/5x5 or equivalent samples of measured central beam, on the one hand, and the same exercise on the calculated, convolved PSF, on the other!
- Problem may not be in peak *or* (far-off) wings but in “ring/ears” around central peak (???)

Central / 5x5 (136 or 140μm)

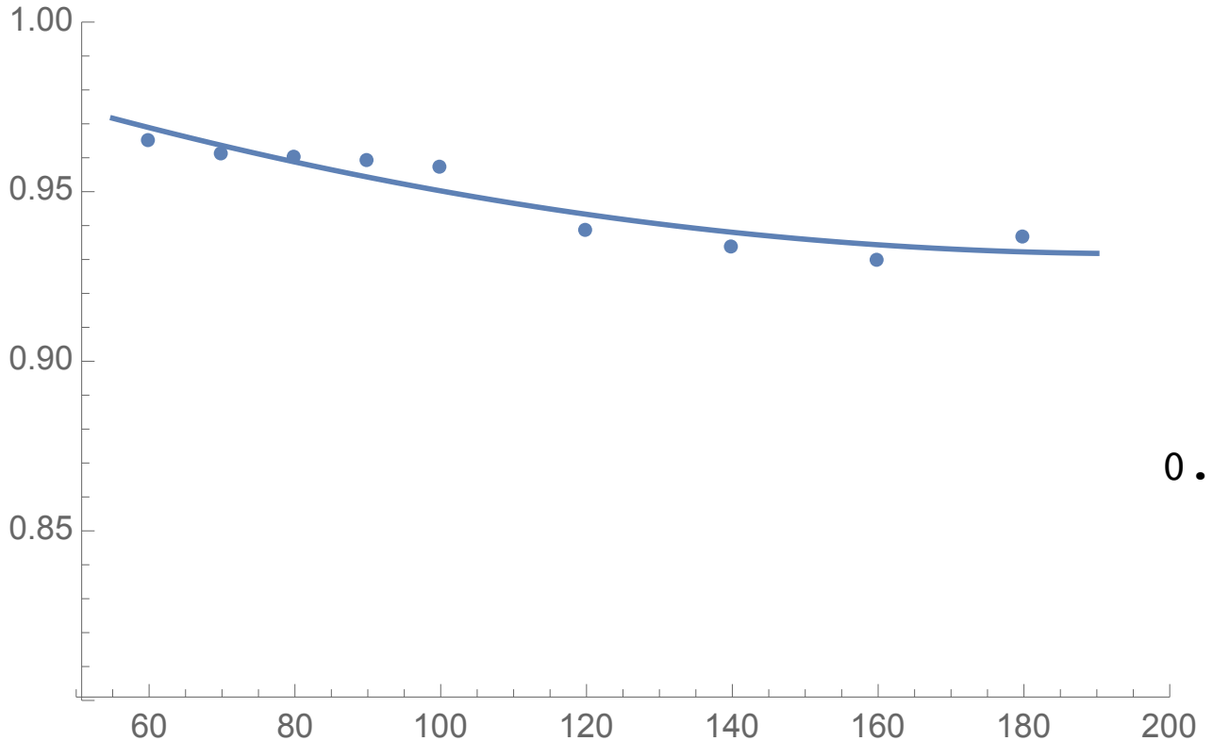
```
ifu = Table[compo[[n]][0, 0], {n, 1, 25}]

ifu[[13]]/Total[ifu]
0.629335  0.630961(with offset correction)



ifusim = Table[compo[[13]][x, y], {x, -2*9.4, 2*9.4, 9.4}, {y, -2*9.4, 2*9.4, 9.4}]

ifusim[[3, 3]]/Total[Flatten[ifusim, 1]]
0.656373   0.643934
```

same, but with calculated PSF instead of measured central spaxel beam

- Almost perfect agreement!
- Should check other wavelengths…
- Maybe the 125μm measurement is “odd”, after all
- Could imply change in shape of PSCF to produce “smooth” ESCF

PSCF Re-Derived

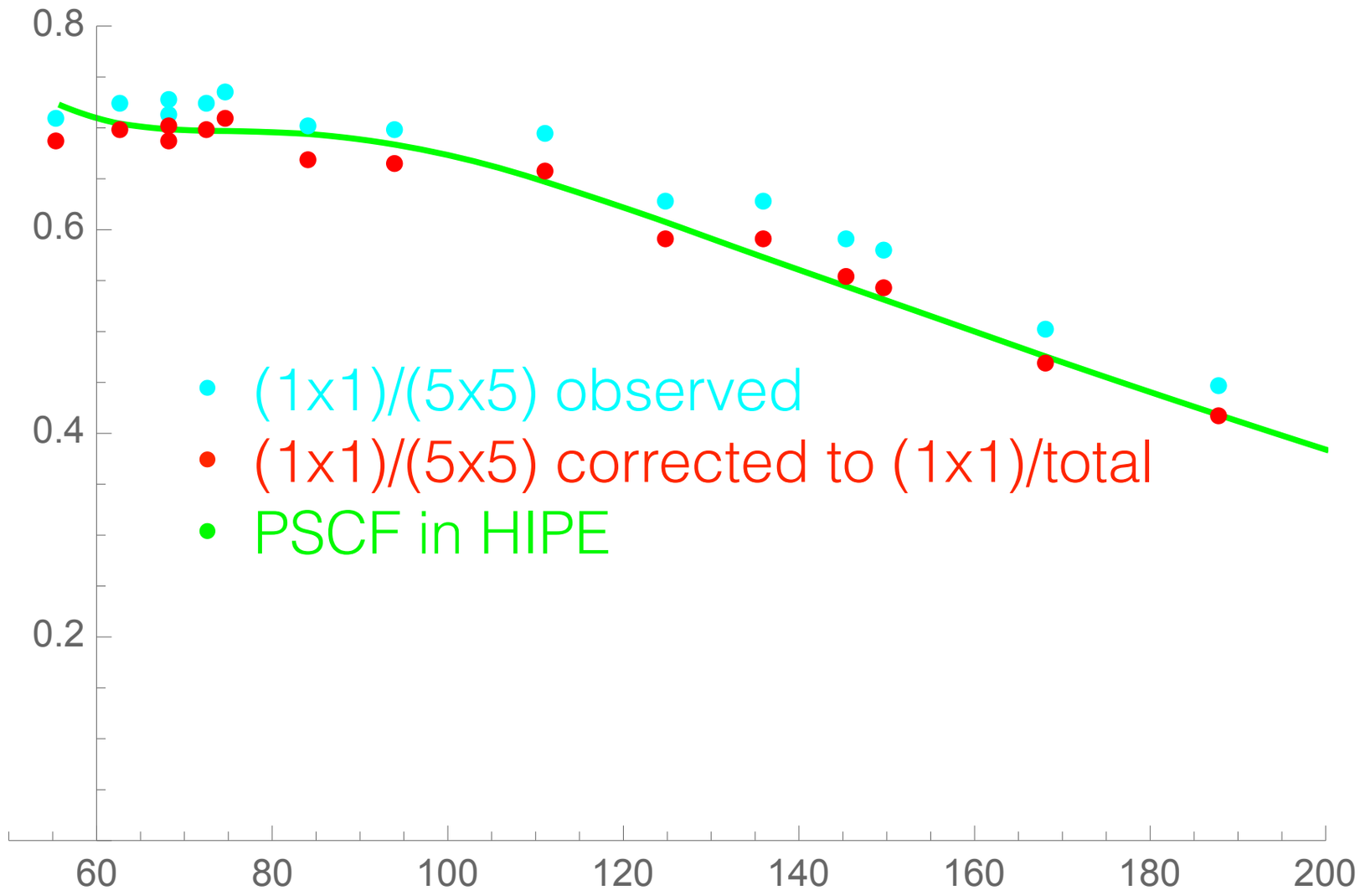
- Use Norbie's PSFs, convolved with 8"x8" spaxel aperture, to calculate ratio of energy in 5x5 spaxels to energy in >>FOV area (total)
  - Sample convolved PSFs on regular 9.4" grid; Σ(5x5)/Σ(all)
- Calculate (central spaxel[0,0])/Σ(25 spaxels[0,0]) from the raster observations
- Correct from (1x1)/(5x5) to (1x1)/total with above ratio



$$\frac{(1x1)/(5x5)}{(1x1)/\text{total}}$$

$$0.993321 - 0.000470098\,x + 7.25007 \times 10^{-7}\,x^2$$

PSCF Re-Derived



- Good news: no need/motivation to change existing PSCF!
- Need to check (central) beams leading to outlier in ESCF
  - Idea for “fix” of “odd” beam(s) not clear