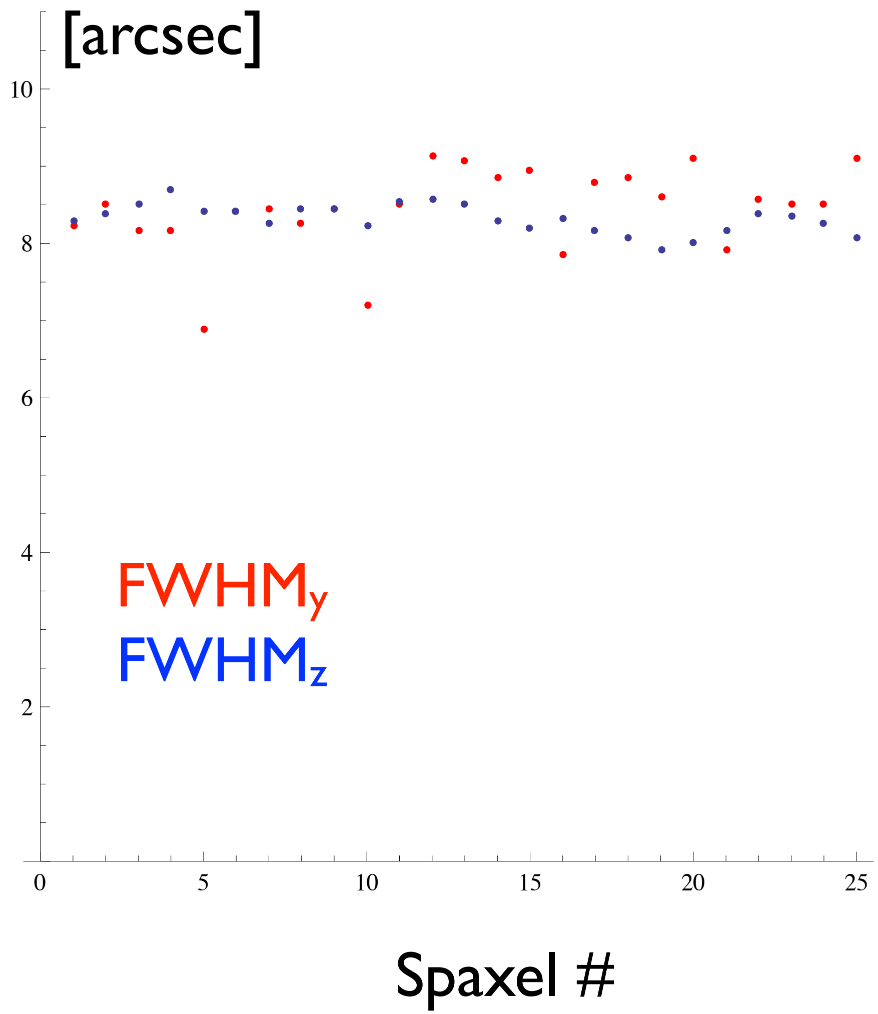
First Summary of Neptune Beam Measurements

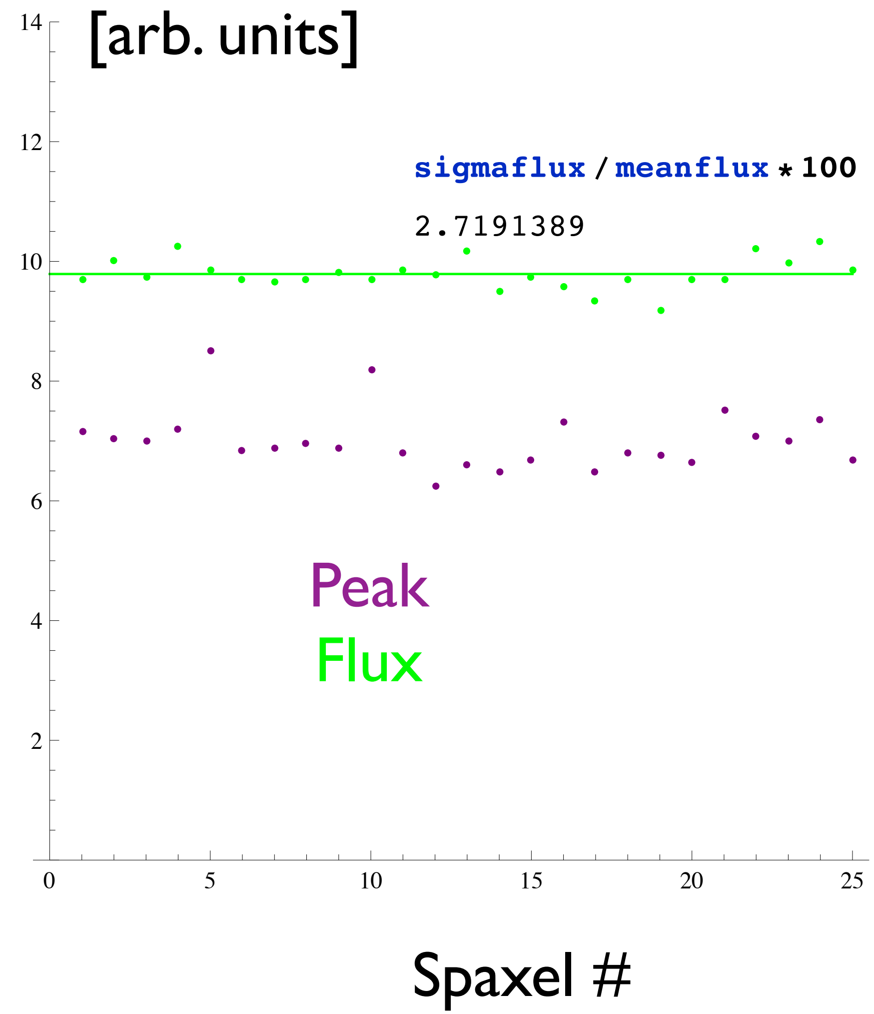
- Background subtraction with modified telescope normalization for asymmetric chopping sans nod works very well; offset in Gaussian fit is <0.001 of peak value in the blue and <0.004 in the red band
- S/N sufficient to analyze data per individual detector
- Relative pointing errors *of fitted peak position* between different OBSIDs (1σ): $2''$(y), $1''$(z)
- Relative pointing errors *of fitted peak position* within each raster (1σ): $0.4''$(y), $0.5''$(z)
- Pointing errors limit precision of derived beam parameters; combining all 7(6) rasters helps

Results for Spectrally Collapsed Data

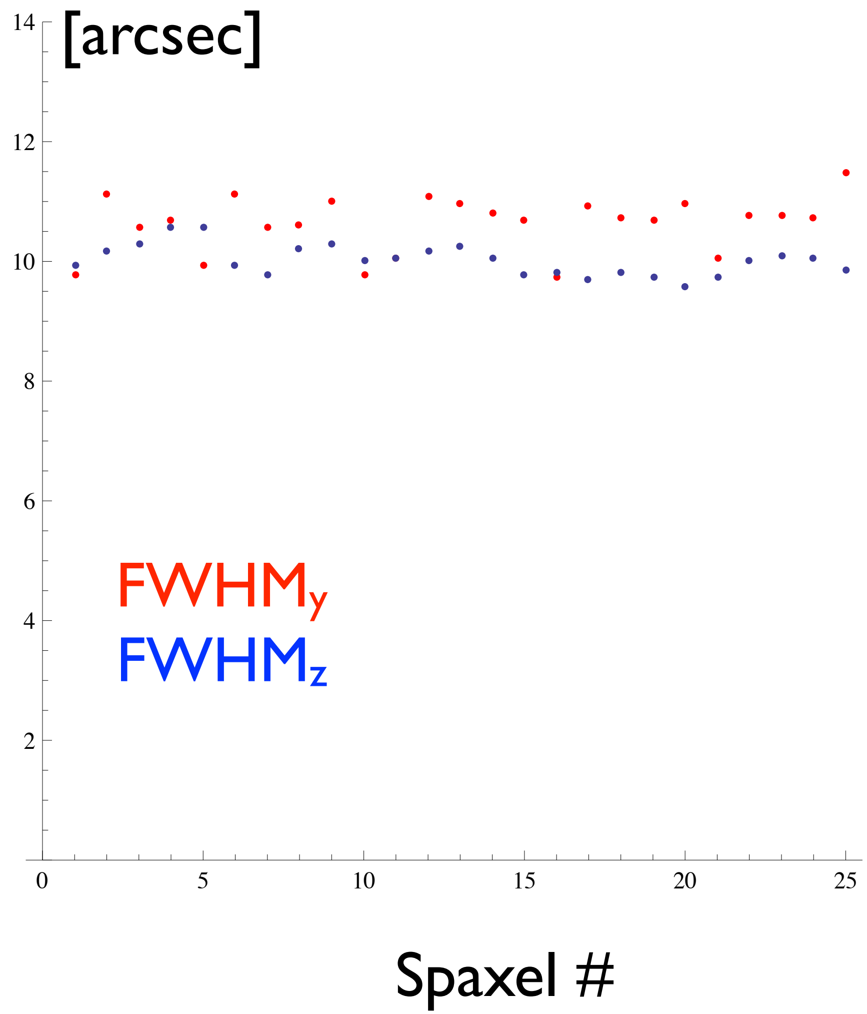
- Mean of "spectral" detectors within one spaxel, bad pixels discarded
- Fitted 2-d Gaussian to raster for each spaxel
- Peak is fitted flux for perfectly centered spaxel as fraction of telescope flux on spaxel
- "Flux" is peak × $FWHM_y$ × $FWHM_z$

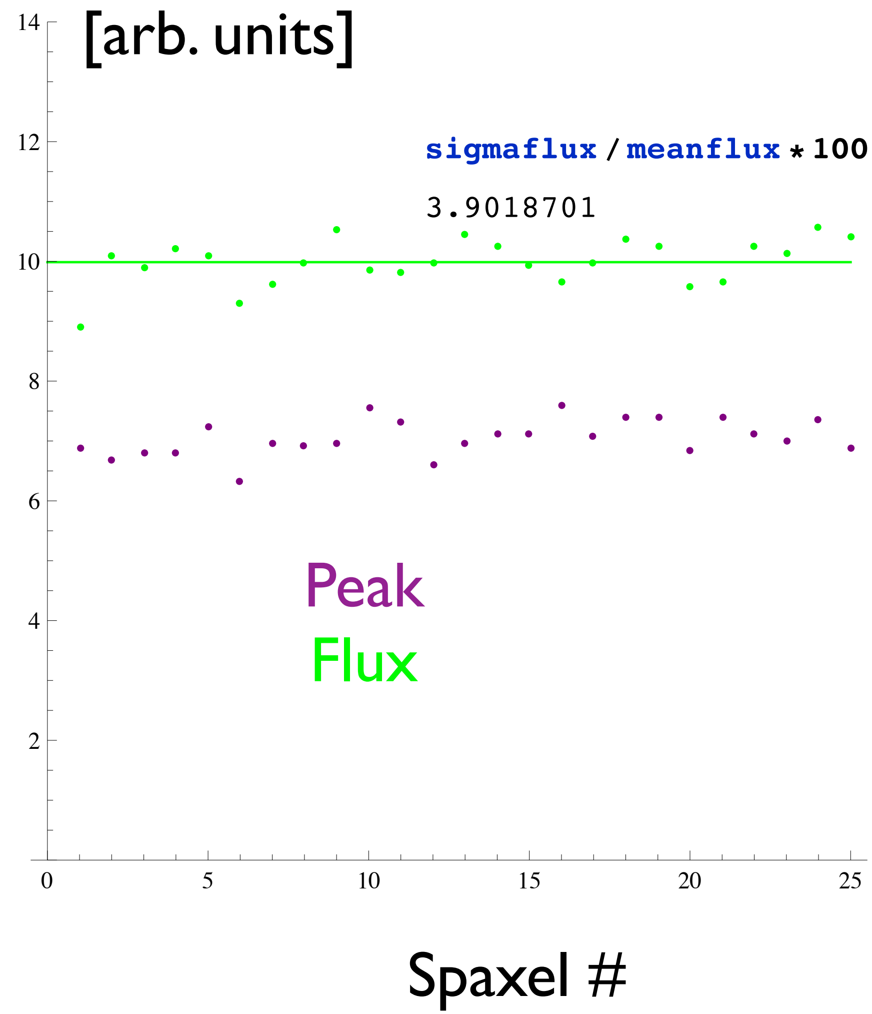
Beam Parameters per Spectrally Collapsed Spaxel, Averaged over 8 Blue Rasters



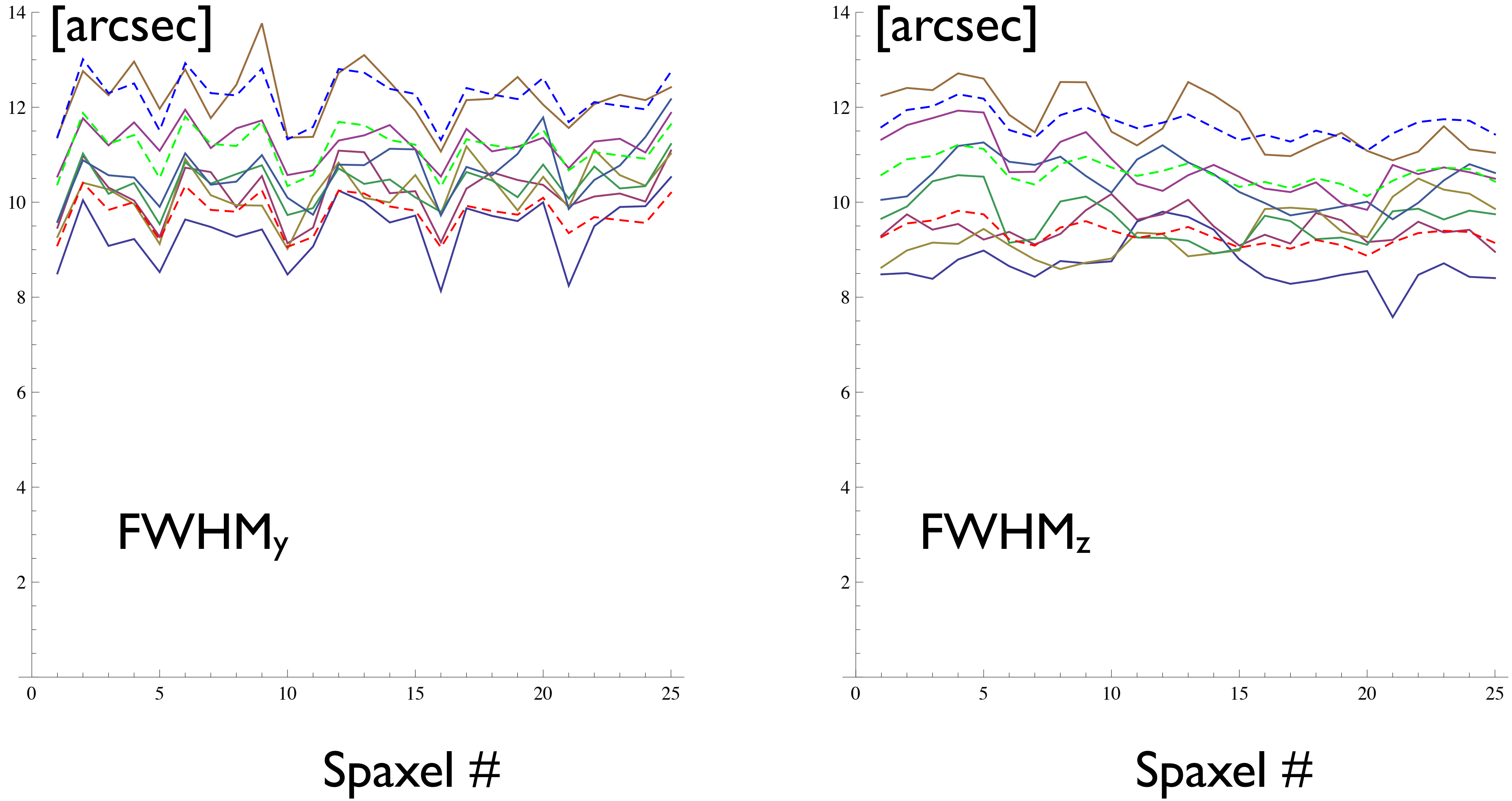


Beam Parameters per Spectrally Collapsed Spaxel, Averaged over 7 Red Rasters





Beam Parameters per Spectrally Collapsed Spaxel, Individually for 7 Red Raster Wavelengths

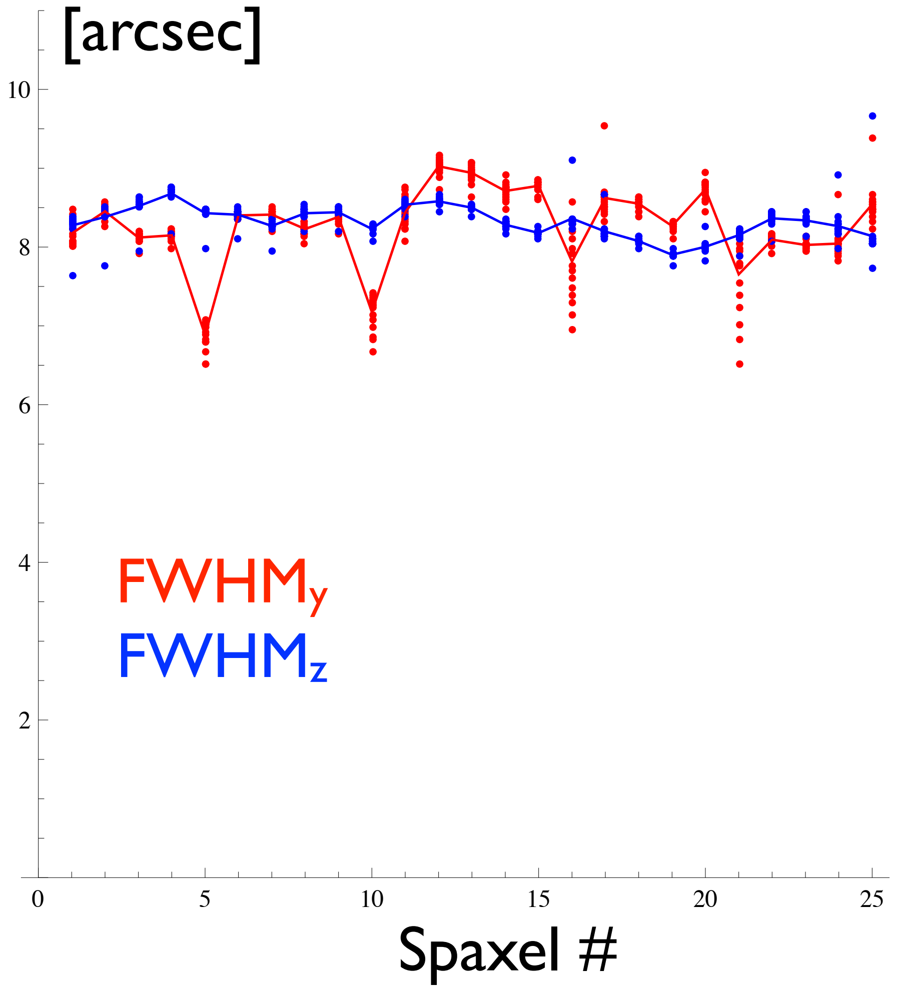


Solid lines: parameters for each collapsed spaxel at wavelengths 110, 125, 136, 145, 150, 168, 187 microns.
Dashed lines: scaled versions of mean (over all wavelengths) parameters for each collapsed spaxel. Scaling factors 0.92, 1.05, 1.15 (y) and 0.92, 1.05, 1.15 (z)

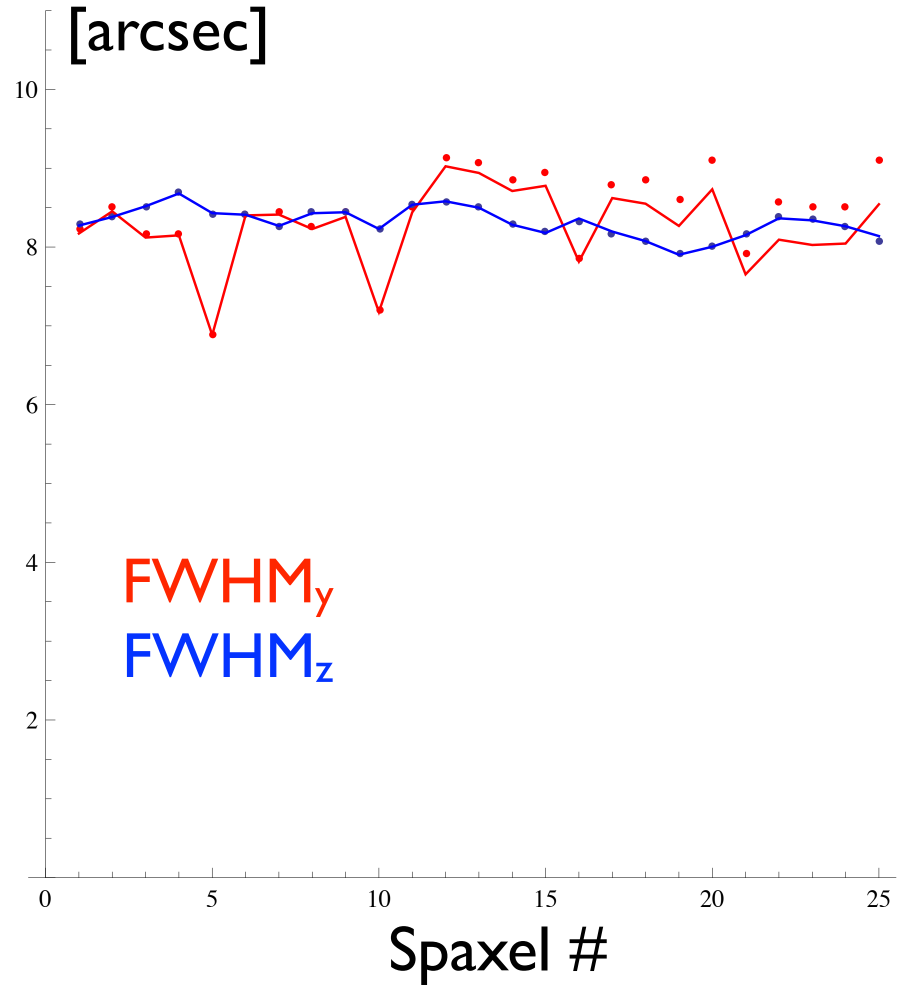
Results for Individual Detectors

- Data from each physical detector analyzed individually, including bad pixels
- Fitted 2-d Gaussian to raster for each detector
- For better S/N and reduction of pointing error effects, means taken over results from all 8(7) rasters. Not really justified in the red band where beams increase with wavelength!
- For detectors with little spread in y-direction, broadening of beam from spectral collapse (instead of individual treatment) negligible, but well visible in corner near spaxel 25 (a.k.a. spaxel 24, if you start counting at 0), particularly in the blue band. In the red band you may argue it's not worth the effort.

Beam Parameters for Individual Detectors - Blue

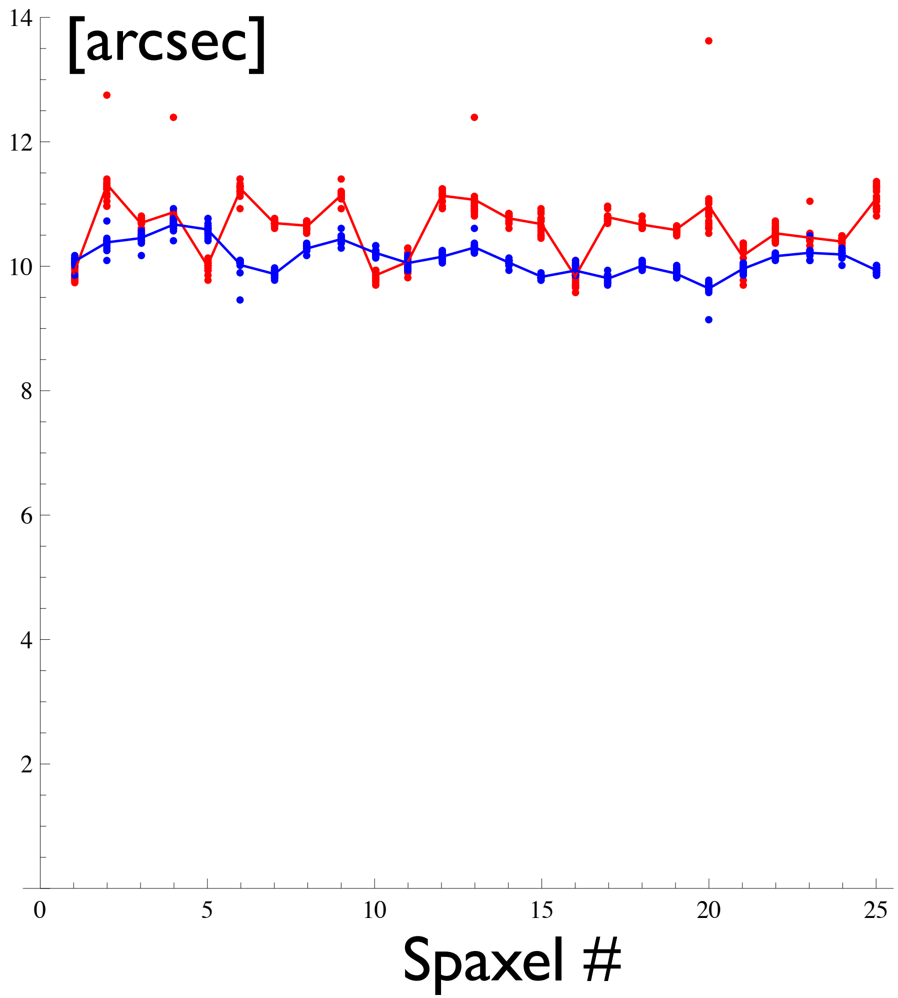


Dots: individual detectors, averaged over 8 rasters. Vignetted spaxels have largest scatter in y!
Lines: Means of individual detectors in one spaxel, averaged over 8 rasters

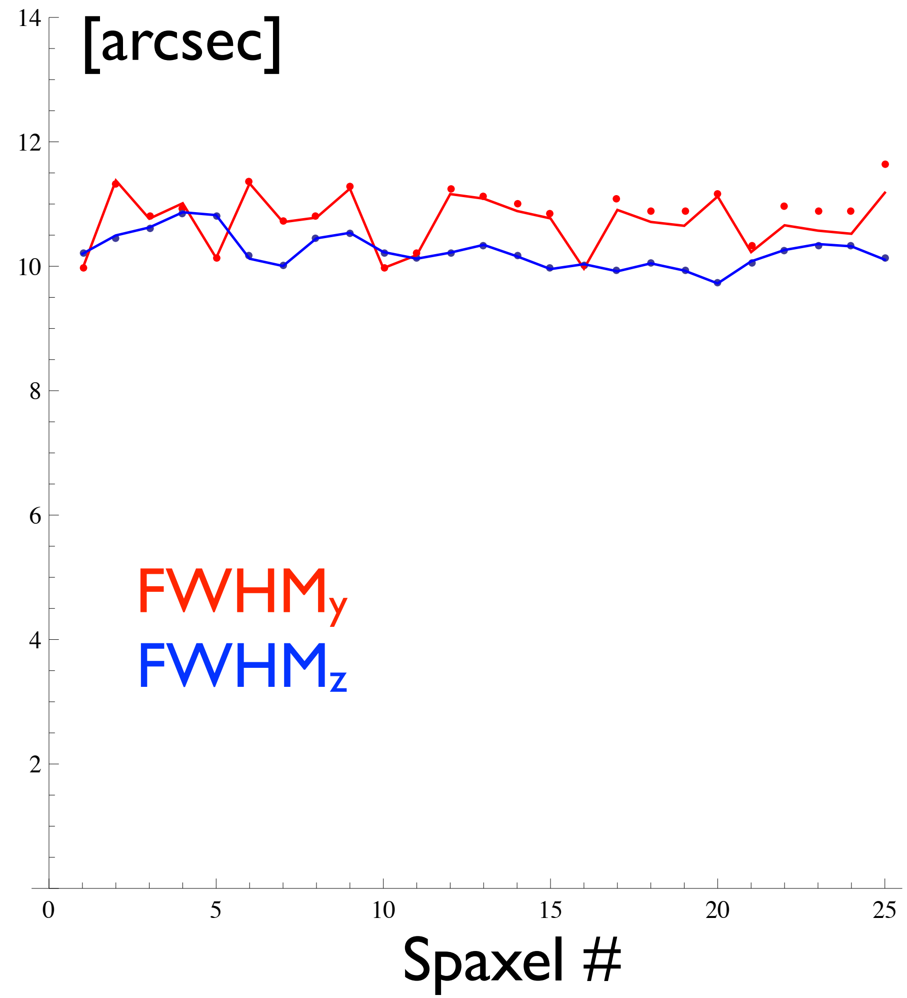


Dots: spectrally collapsed spaxels, averaged over 8 rasters.
Lines: Means of individual detectors in one spaxel, averaged over 8 rasters

Beam Parameters for Individual Detectors - Red

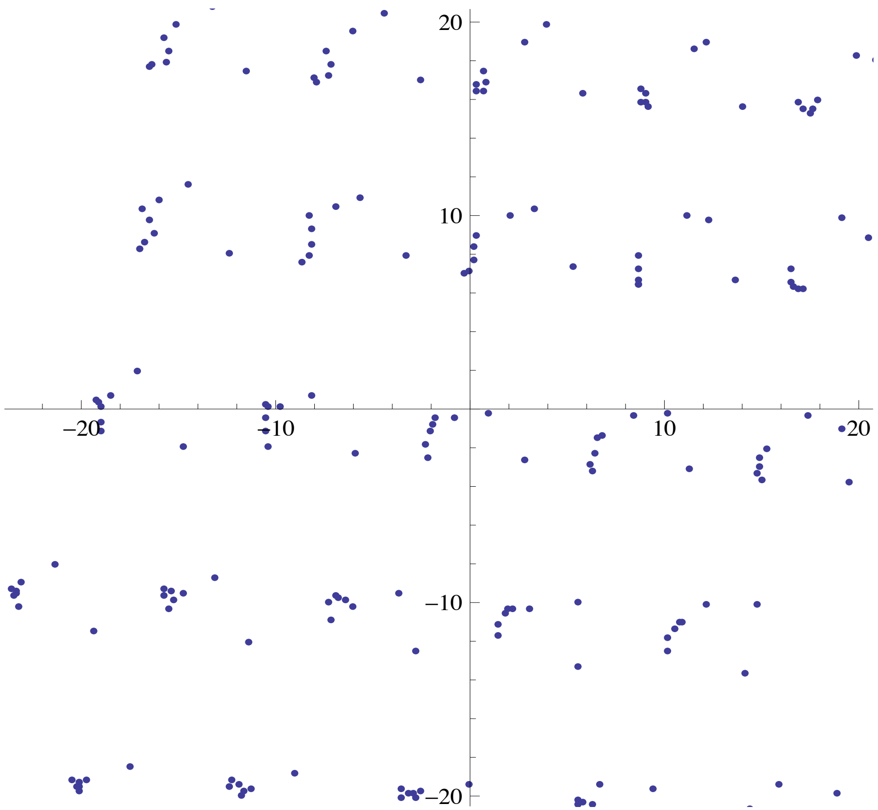


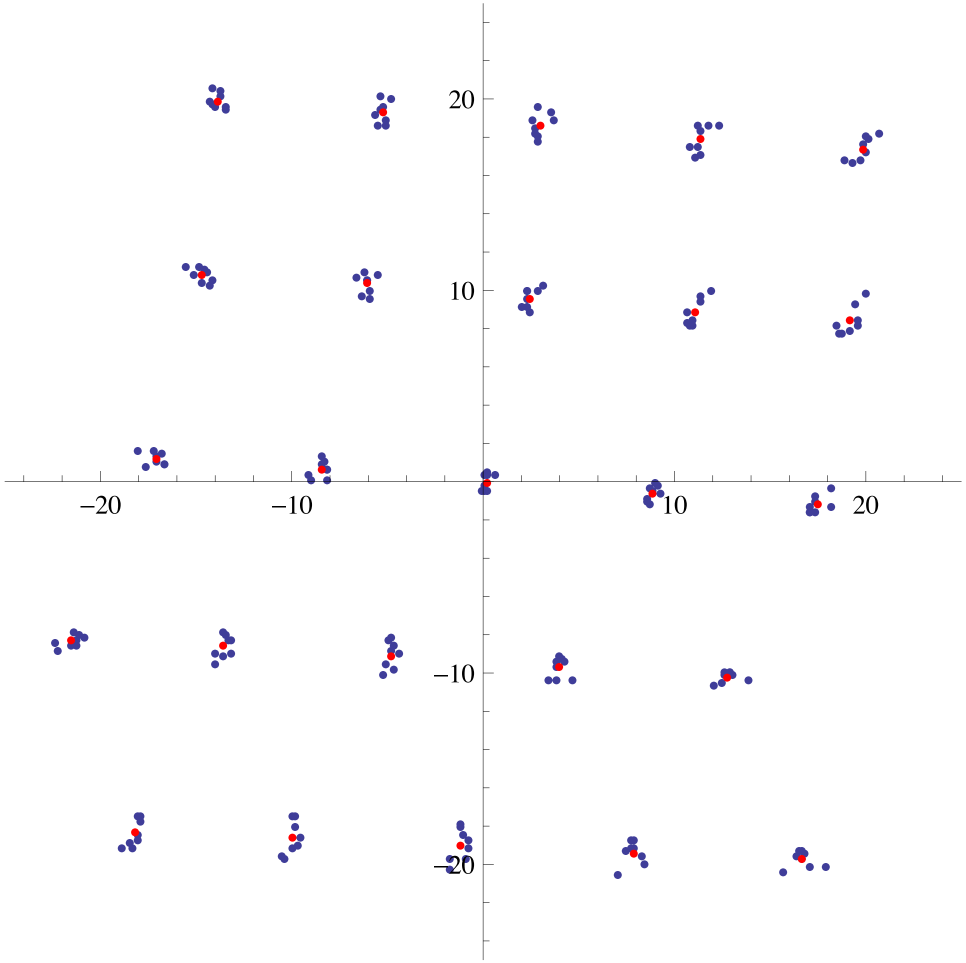
Dots: individual detectors, averaged over 7 rasters. Vignetted spaxels have less scatter in y than in blue band.
Lines: Means of individual detectors in one spaxel, averaged over 6 rasters



Dots: spectrally collapsed spaxels, averaged over 7 rasters.
Lines: Means of individual detectors in one spaxel, averaged over 6 rasters.
Difference less pronounced than in blue

Pointing - Blue

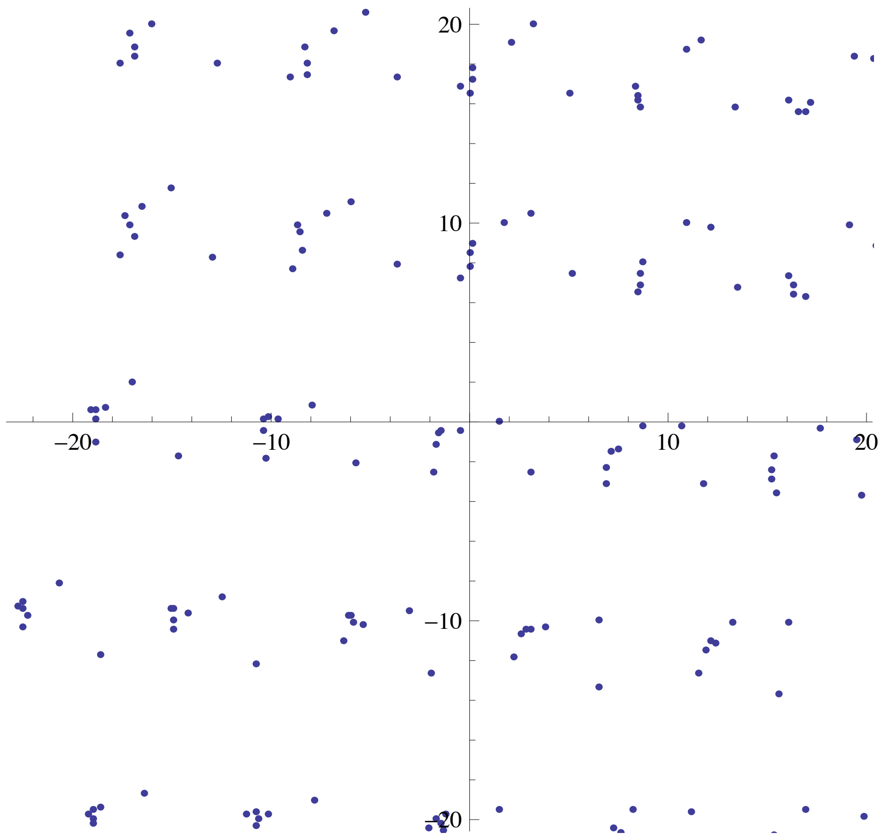




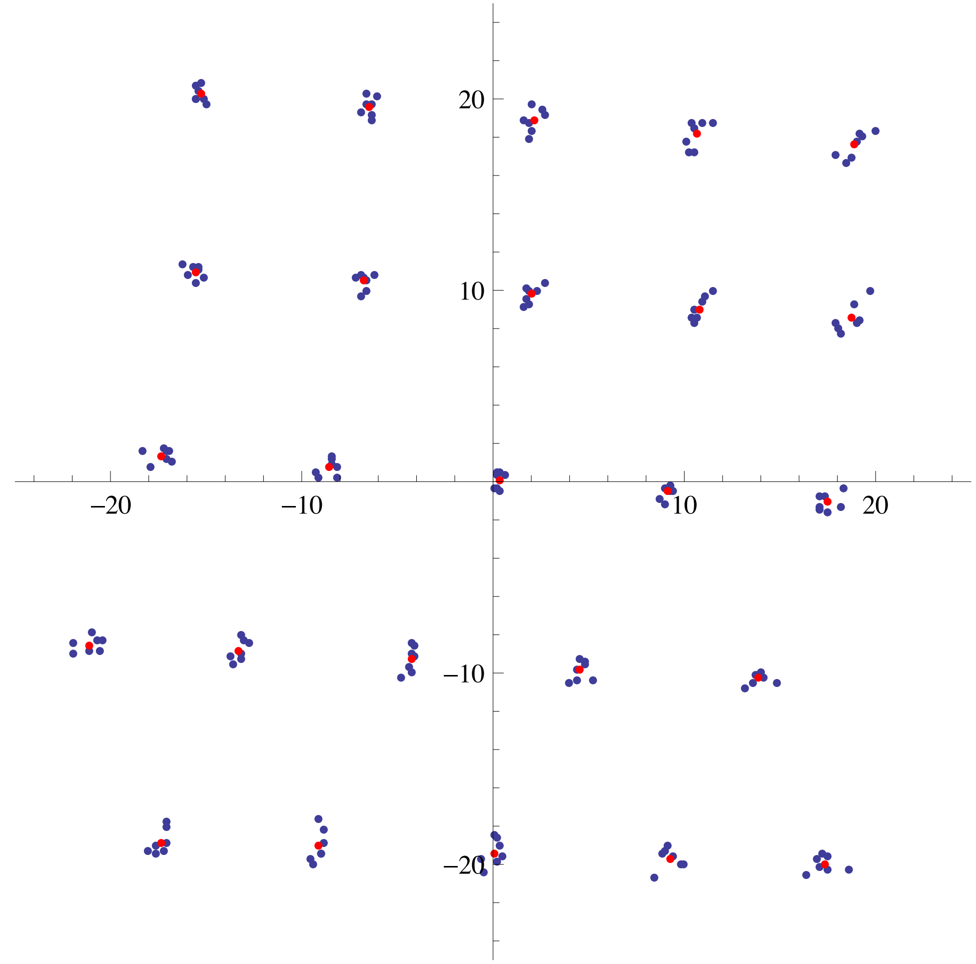
Absolute pointing of fitted peak position of collapsed spaxels for each of the 8 rasters

Blue: Relative pointing of fitted peak position of collapsed spaxels for each of the 8 rasters, shifted such that mean position of each raster is (0, 0).
Red: Mean of 8 rasters as best guess for focal plane geometry of PACS-S

Pointing - Red

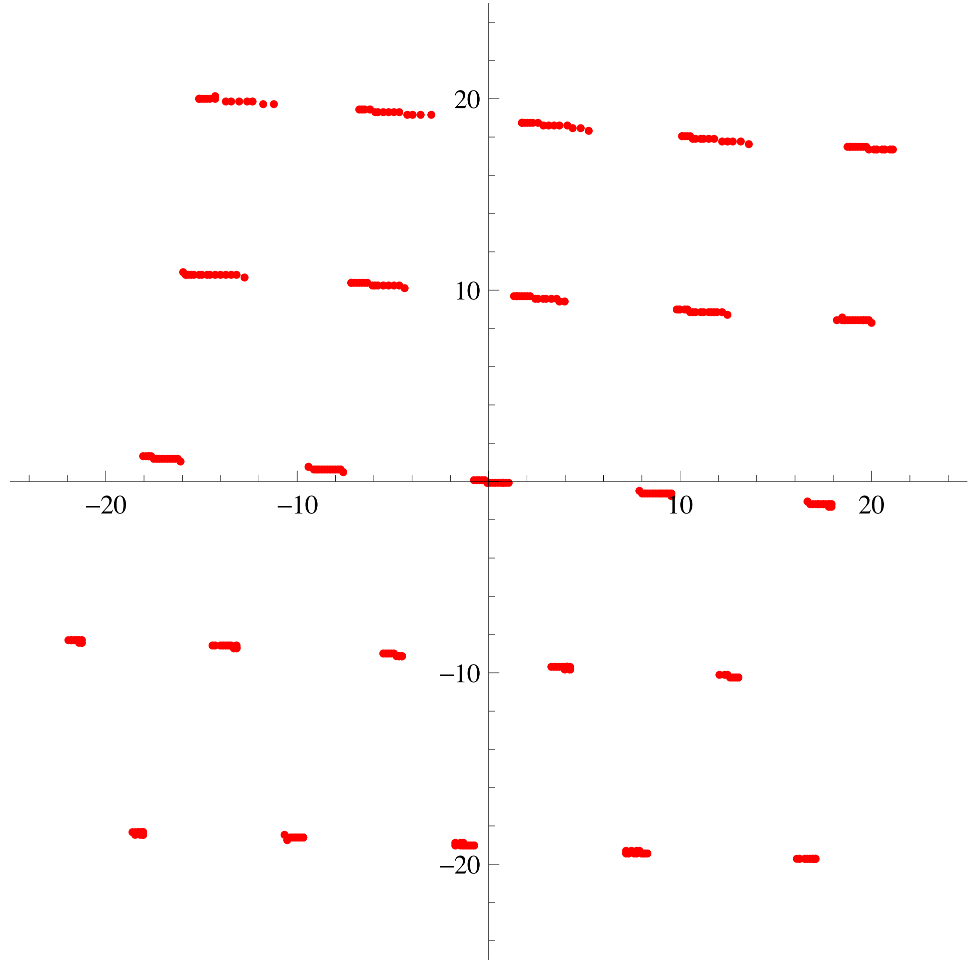


Absolute pointing of fitted peak position of collapsed spaxels for each of the 6 rasters



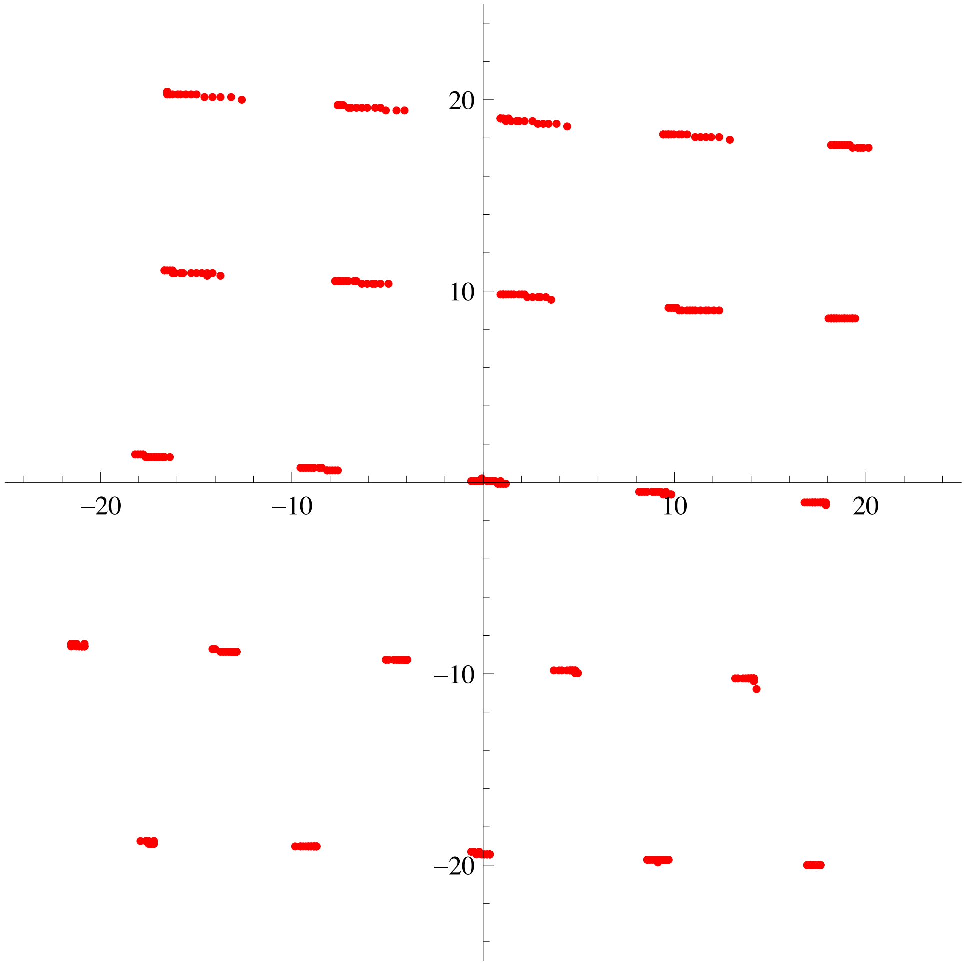
Blue: Relative pointing of fitted peak position of collapsed spaxels for each of the 6 rasters, shifted such that mean position of each raster is (0, 0).
Red: Mean of 6 rasters as best guess for focal plane geometry of PACS-S

Focal Plane Geometry per Detector - Blue



Relative pointing of fitted peak position of individual detectors, collectively shifted for each of the 8 rasters by the same vector as for collapsed spaxels, then averaged per individual detector over the 8 rasters.
Best guess for focal plane geometry of PACS-S per individual detector

Focal Plane Geometry per Detector - Red

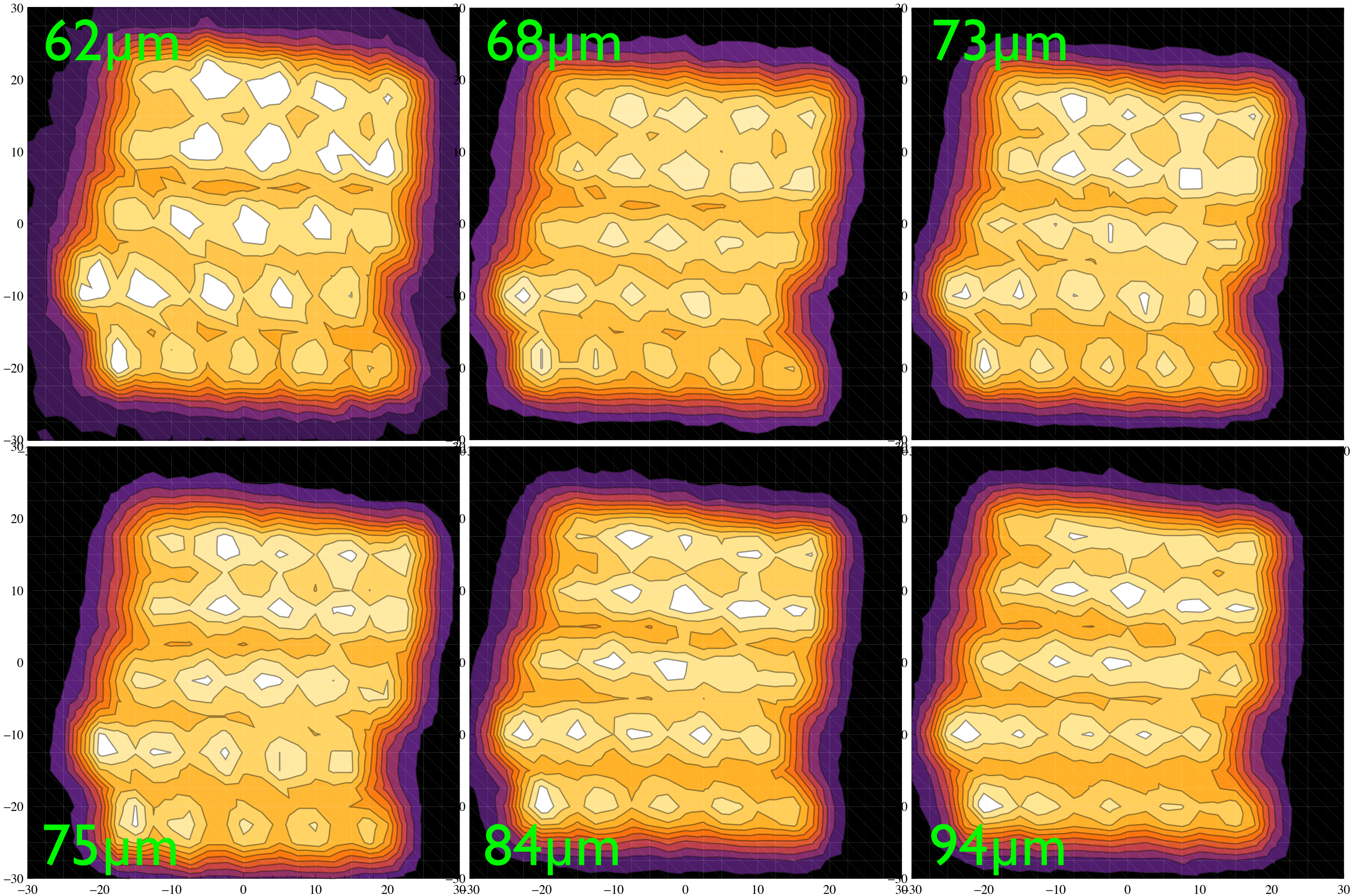


Relative pointing of fitted peak position of individual detectors, collectively shifted for each of the 6 rasters by the same vector as for collapsed spaxels, then averaged per individual detector over the 6 rasters.
Best guess for focal plane geometry of PACS-S per individual detector

FOV Homogeneity

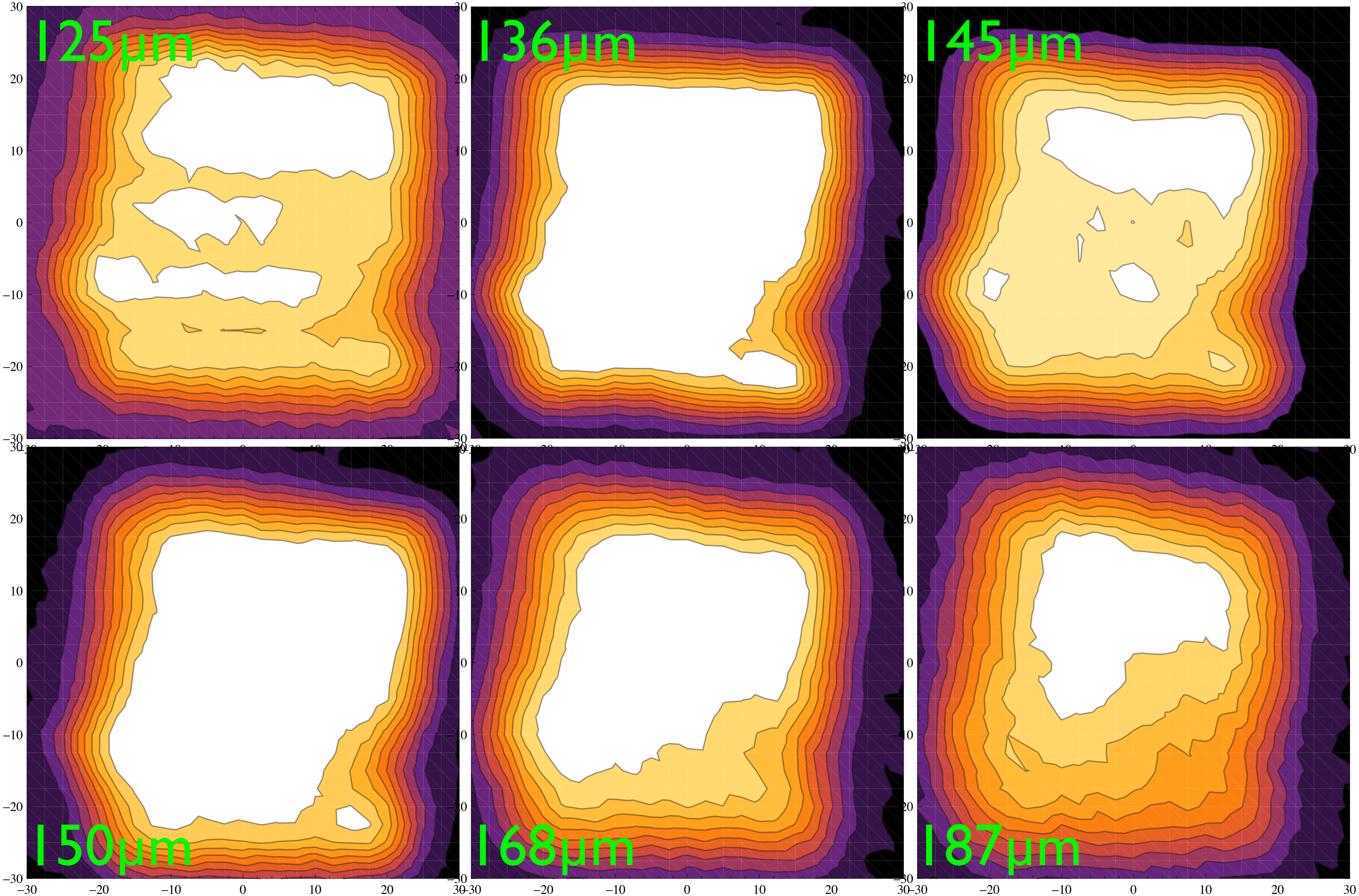
- To check whether the flux of a point source, collectively measured by the PACS IFU/detectors, is independent of the position of the point source within the IFU, we add up the normalized signals from all spaxels and plot the result as a function of raster pointing.
- The "flatness" of the response is best at medium wavelengths, where a point source is providing a sufficiently homogeneous illumination across a spaxel, while the wings don't fall off the IFU too badly, yet.
- At short wavelengths, the intra-pixel response becomes apparent, which drops off toward the edges.

FOV Relative Response Maps



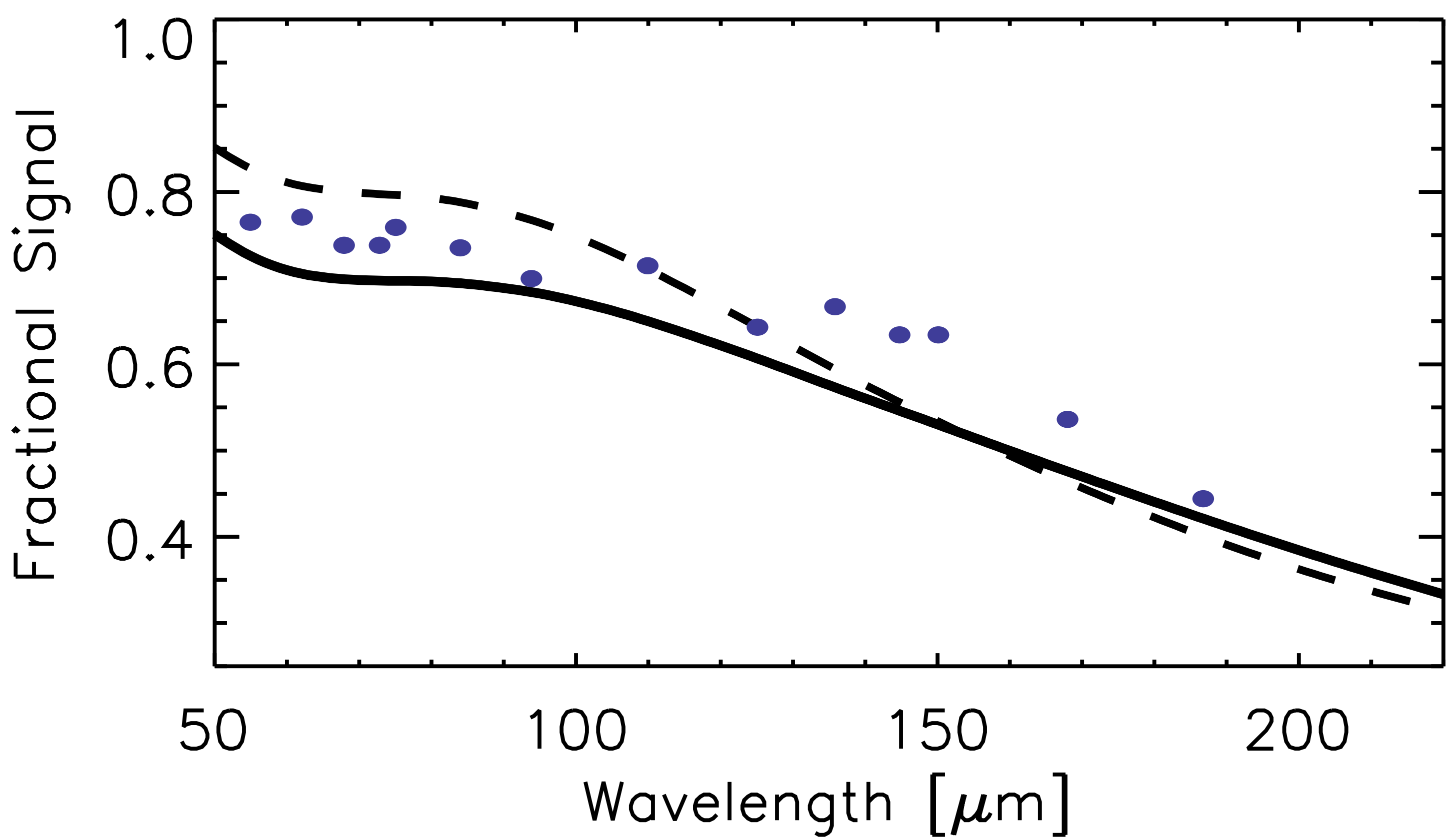
(contour levels 10% of peak value)

FOV Relative Response Maps



(contour levels 10% of peak value)

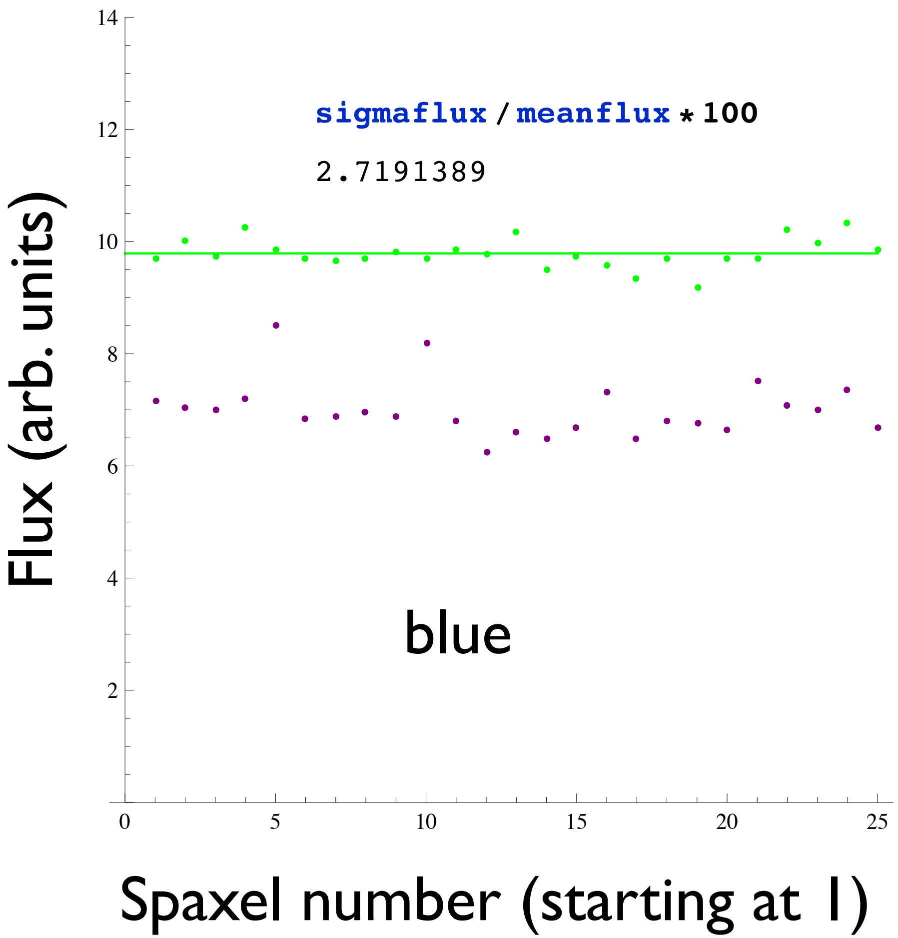
Point Source Correction Factor

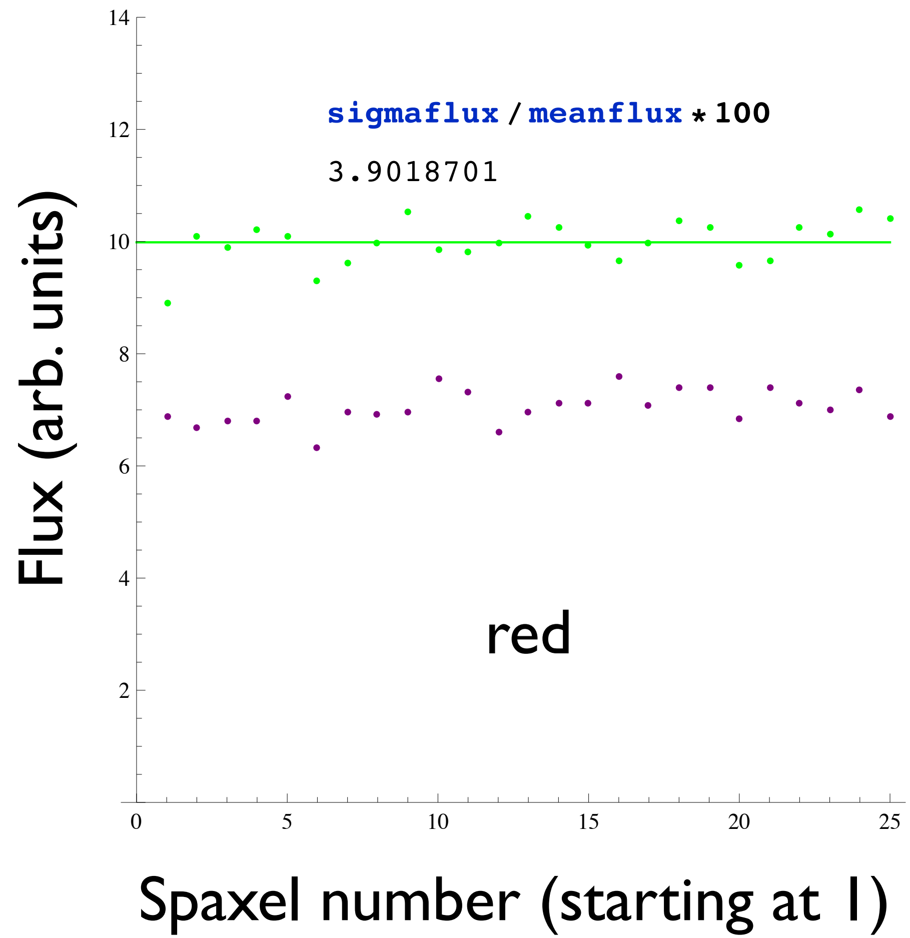


Lines: from A&A paper

Dots: from accumulated 3x3 and 5x5 spaxel fluxes vs. fitted peak flux on central spaxel. Question: why more discrepancy in red than in blue?

Inter-Spaxel Flatfield (Point Source Flux)





- Purple dots: fitted peak flux
- Green dots: fitted peak flux × $FWHM_y$ × $FWHM_z$

“Telescope” Background Flux Model

- Use point source correction from A&A paper to link observed Neptune peak flux on central spaxel to full Neptune flux from ESA_3 model
- Fit derived “telescope” signal (in Jy) on central spaxel with Fischer et al. dusty surface emissivity and telescope temperature + colder graybody term for “straylight” in cryostat
- Allow different response to chopped signal vs. static signal (time constants) on red vs. blue detectors