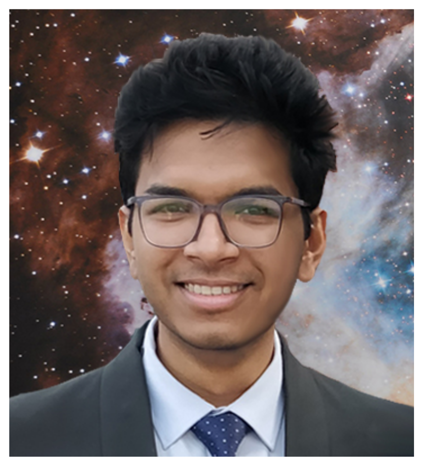

Python Simulation of Target Acquisition using HST/COS (PySTAcC)

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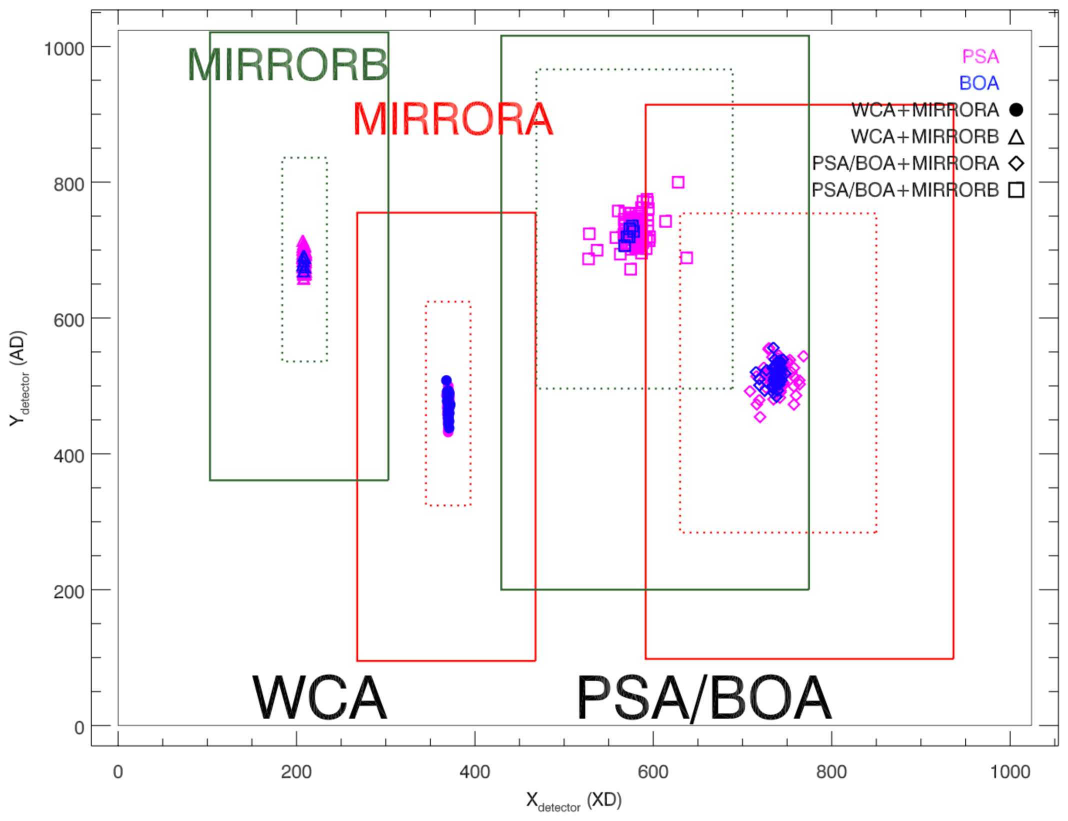
STScI

The Cosmic Origins Spectrograph (COS) was installed on the Hubble Space Telescope in 2009 during the Servicing Mission 4. It performs high-sensitivity medium and low resolution spectroscopy in the far-UV (900–2500 Å) and near-UV (1700–3200 Å) wavelength regimes. The instrument has two circular science apertures (2.5" in diameter), the Primary Science Aperture (PSA) and the Bright Objects Aperture (BOA). COS performs target acquisition either in imaging (NUV channel only), or by using dispersed light (NUV & FUV channel). All of the acquisition strategies are optmized for isolated point sources acquisitions. We developed a python simulation tool (PySTAcC) that reproduces the exact operations and algorithms performed by the onboard flight software (FSW) during the **NUV imaging acquisition**. This will help us predict the behavior of target acquisition in case of extended sources and/or crowded fields.

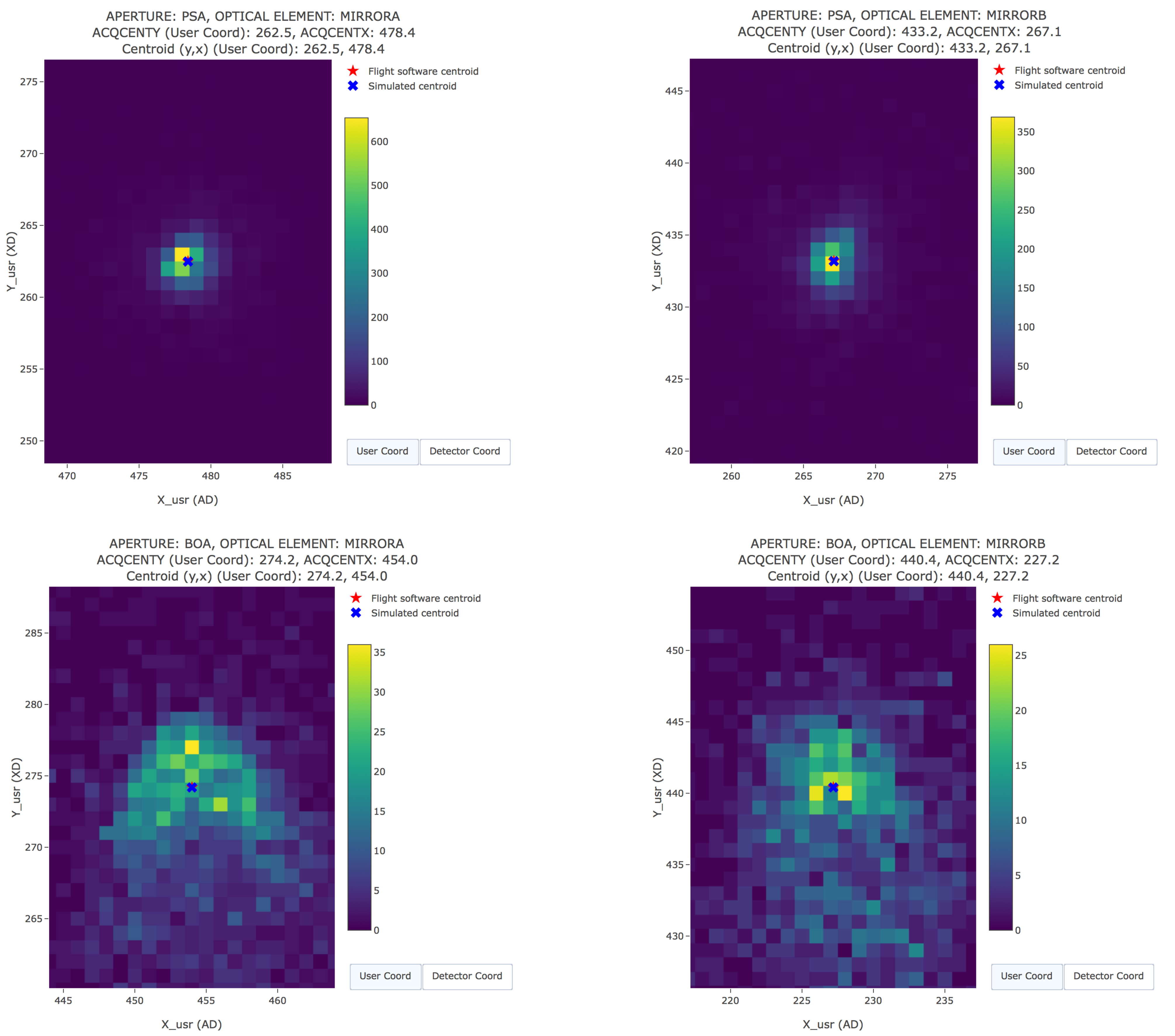
ACQ/IMAGE

During ACQ/IMAGE procedure, an exposure of the Pt-Ne lamp is first taken through the Wavelength Calibration Aperture (WCA), in order to determine location of the Science aperture on the detector. A NUV image is then obtained, and the position of the target on the detector is calculated by the FSW. The telescope is then slewed to center the target in the science aperture. Finally, a NUV confirmation image is obtained. Depending on target's brightness, the acquisition can be performed with (PSA or BOA) + (MIRRORA or MIRRORB). The figure shows the positions on the detector of both WCA and science apertures for a sample of COS NUV imaging acquisitions, as well as the sub-arrays used to measure the respective centroids.



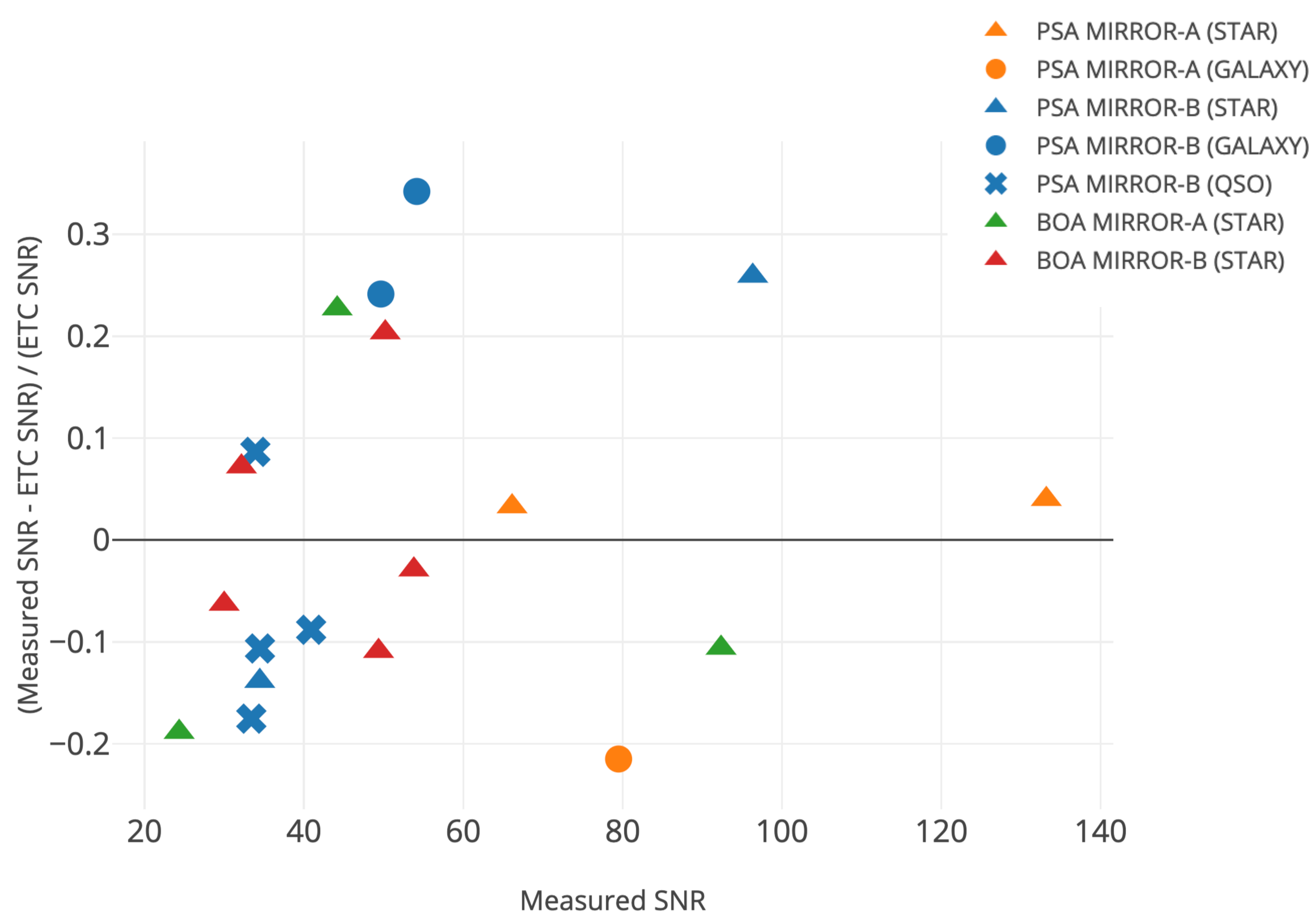
Simulated Centroid

The figures show real ACQ/IMAGE data. The overplotted symbols mark the centroid positions measured by the FSW and computed by PySTAcC. The two centroid measurements are in perfect agreement, even when the PSFs are more distorted (MIRRORB case) and the signal to noise ratio is low (bottom panels).



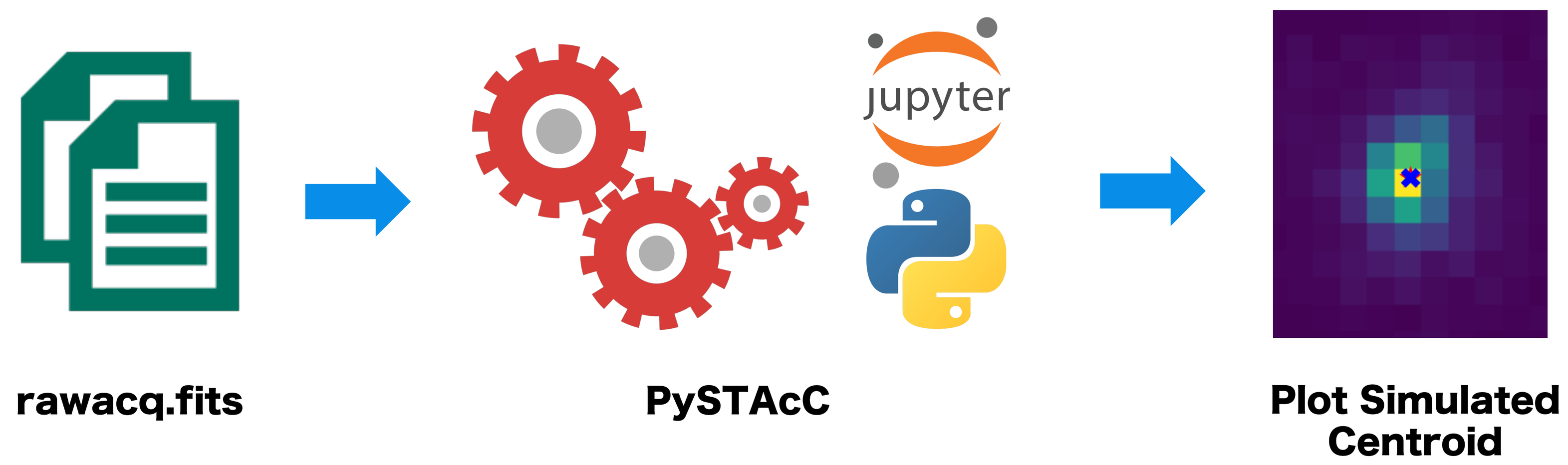
Signal to Noise Comparison

To determine the exposure time needed to have an accurate centroid determination, we estimate the signal to noise using the detected counts in the raw acquisition images. Our signal to noise estimates are in good agreement with the ones obtained with the COS Exposure Time Calculator (ETC). All the identified outliers are either variable sources (e.g. planet transits, pulsating stars, AGNs) or sources for which the adopted ETC models are not fully accurate.



Process

PySTAcC works on raw acquisition FITS files of NUV acquisition images. It will be made available both as a Jupyter notebook as well as a python script. It produces an interactive plot of the simulated centroid and the FSW centroid on the flux heatmap.



Further information

Please see https://tinyurl.com/PySTAcC for more information.

I'm available at manan.101d@gmail.com if you have any question or comment.