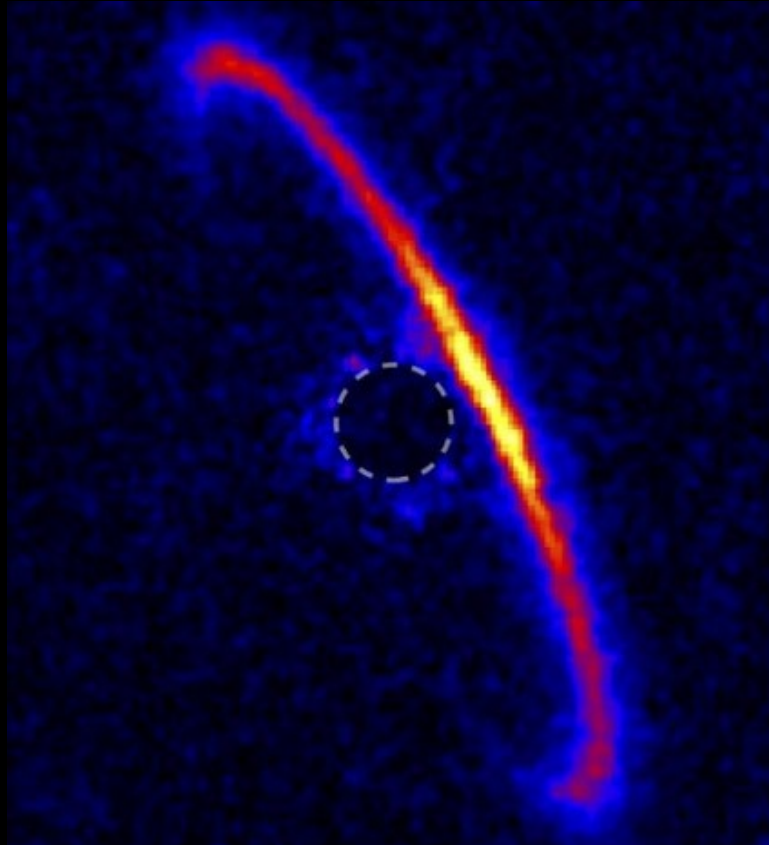


The Shape of Light

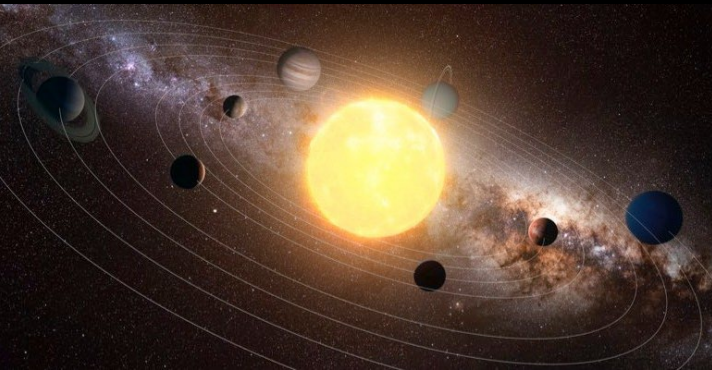
Modeling the Gemini Planet Imager's Point-Spread Function



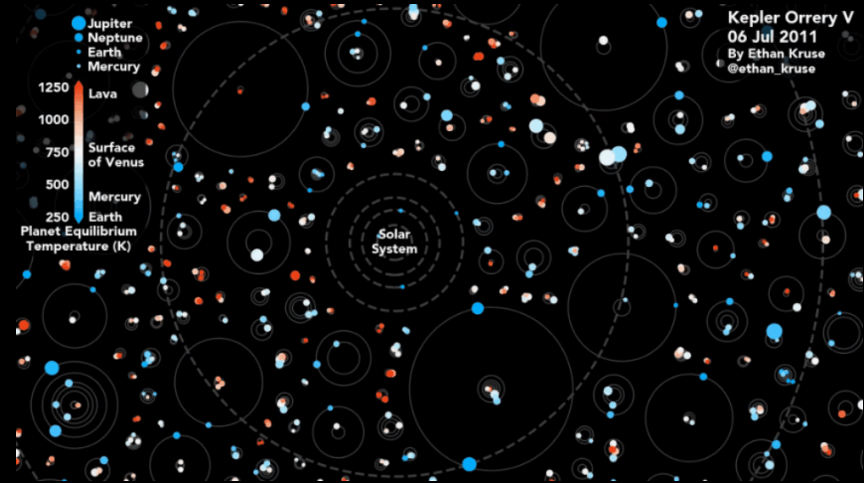
Beck Dacus, Professor Max Millar-Blanchaer, Skyler Palatnick

UCSB Physics REU 2021

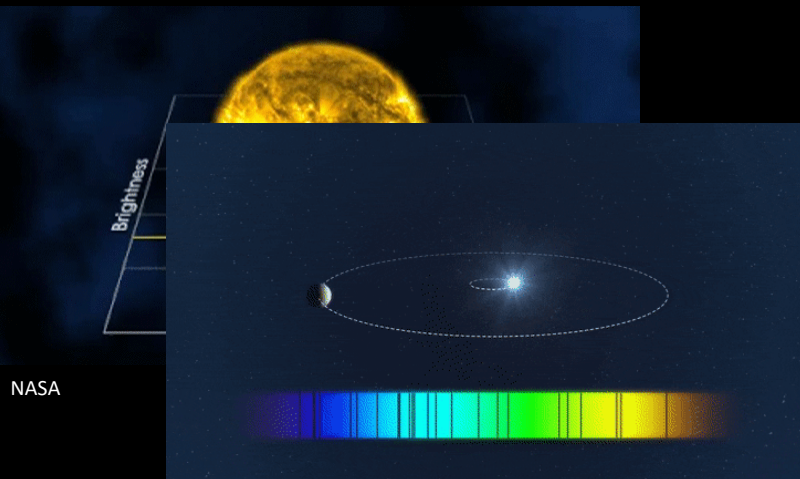
Finding Exoplanets and Disks



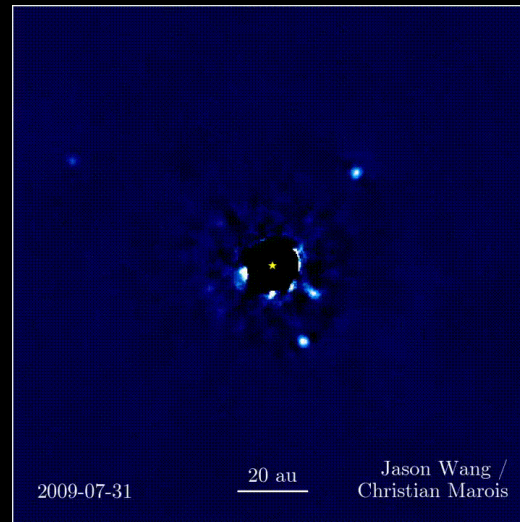
Getty Images



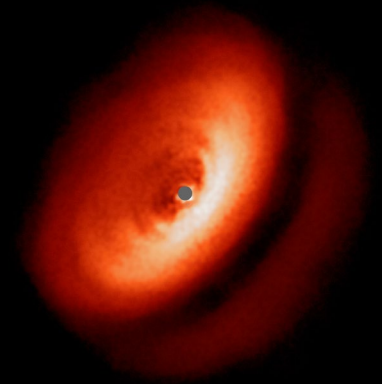
Ethan Kruse



ESO/L. Calçada

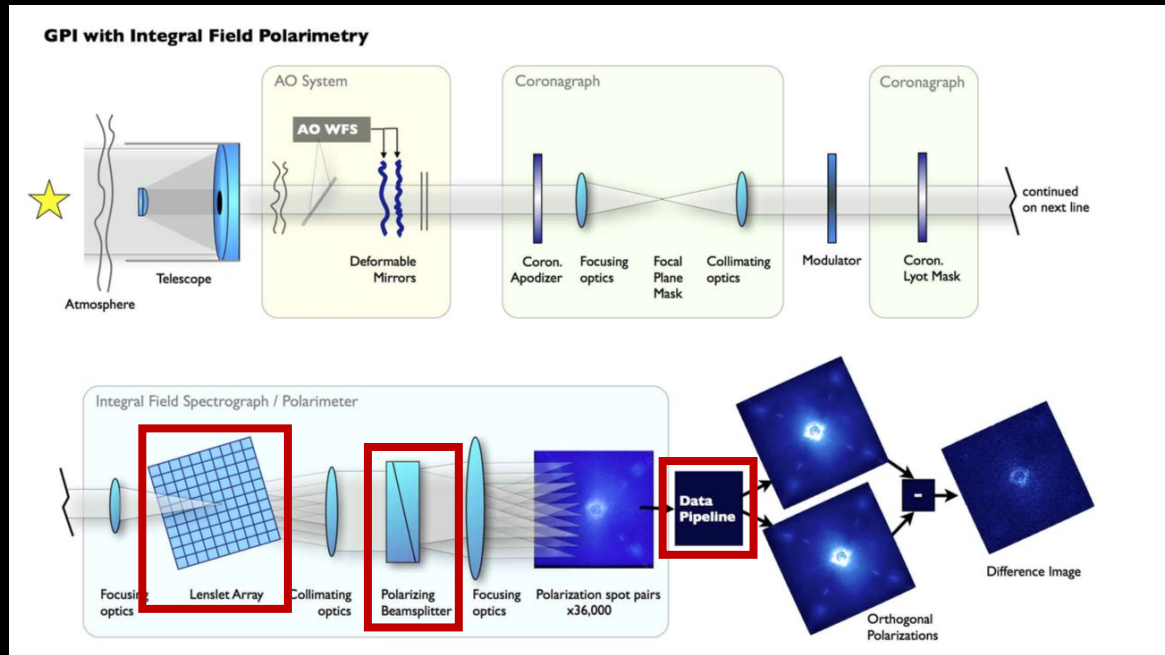
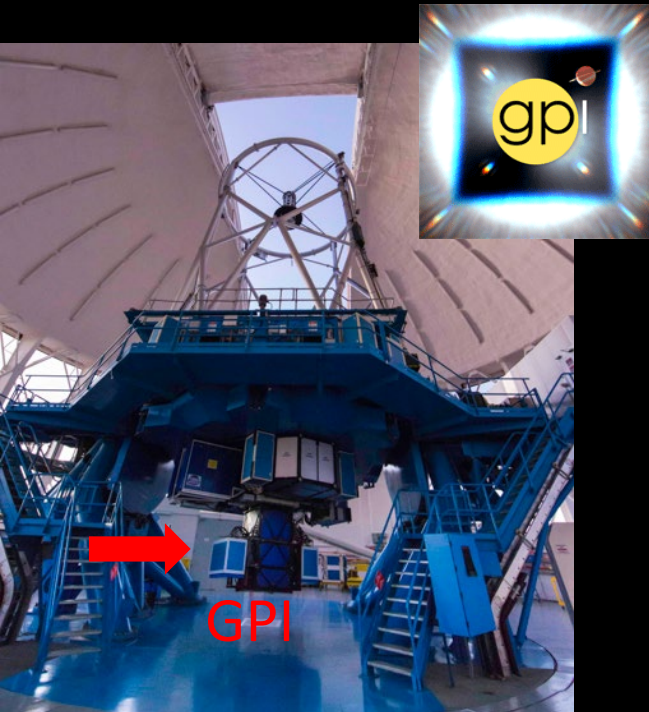


Jason Wang /
Christian Marois



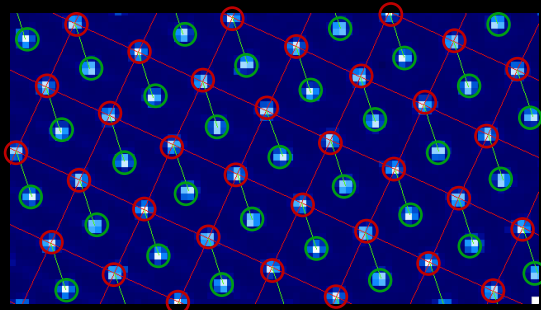
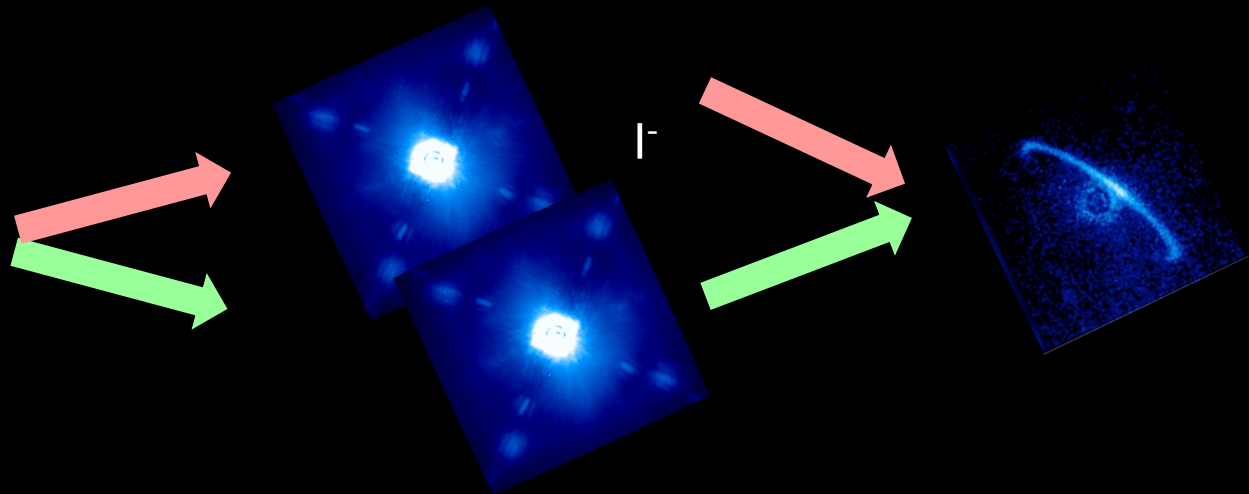
Avenhaus et al. (2018)

Polarimetry with GPI



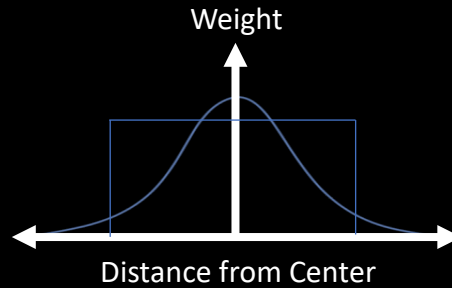
I^+

I^-



http://www.gemini.edu/images/pio/News/2014/pr2014_01/Photos/gpi_10.jpg

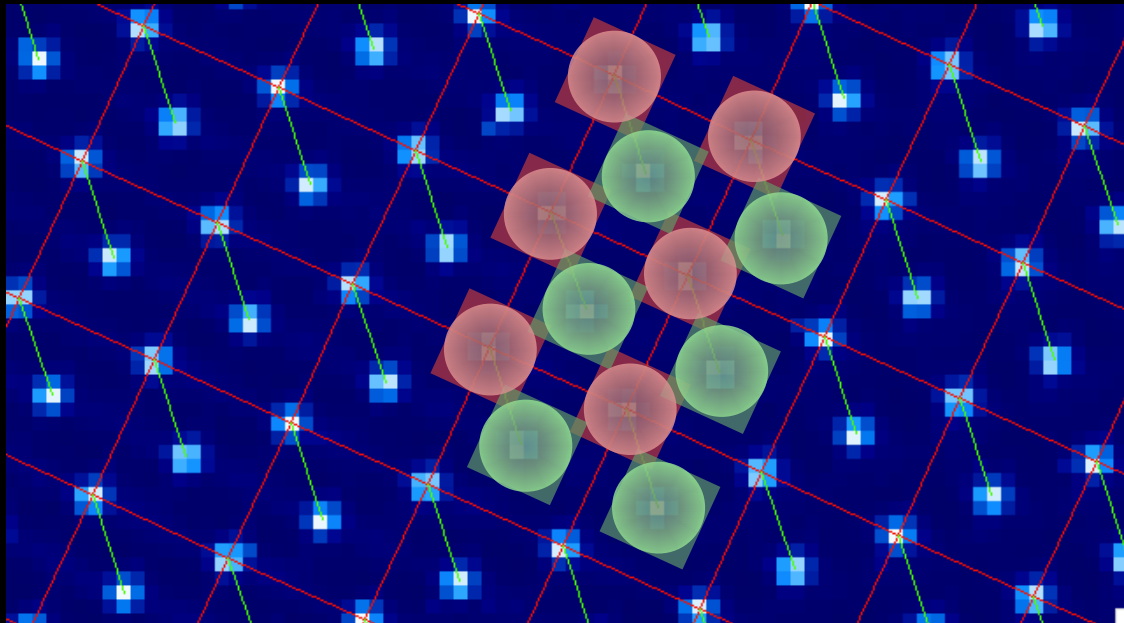
Counting Photons



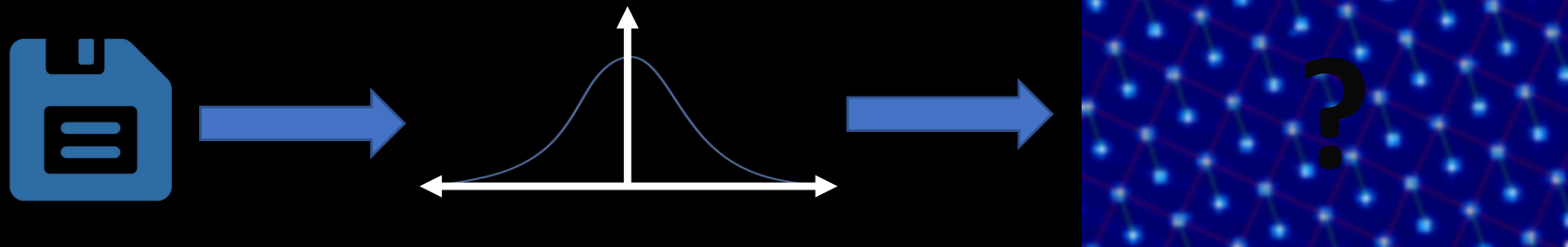
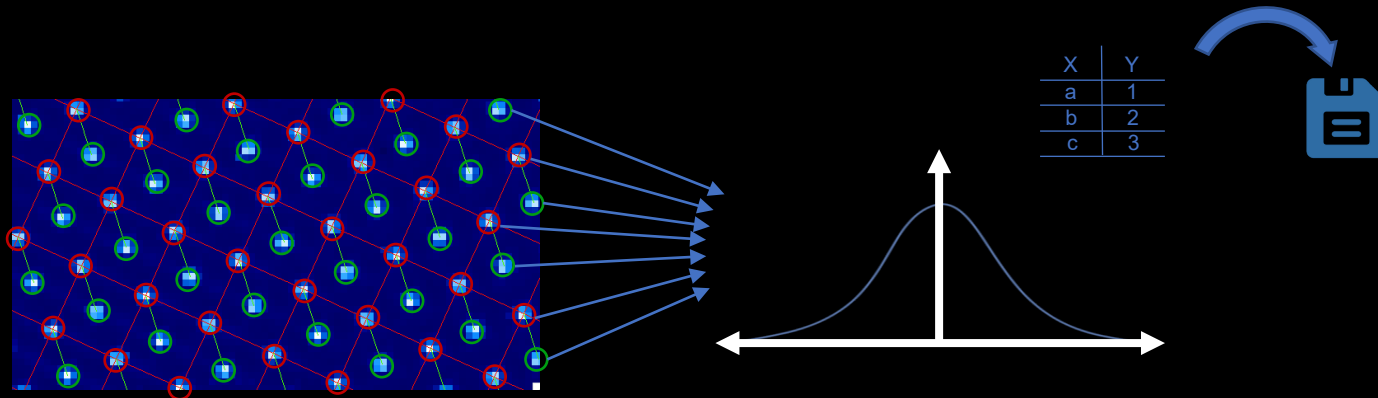
Box PSF



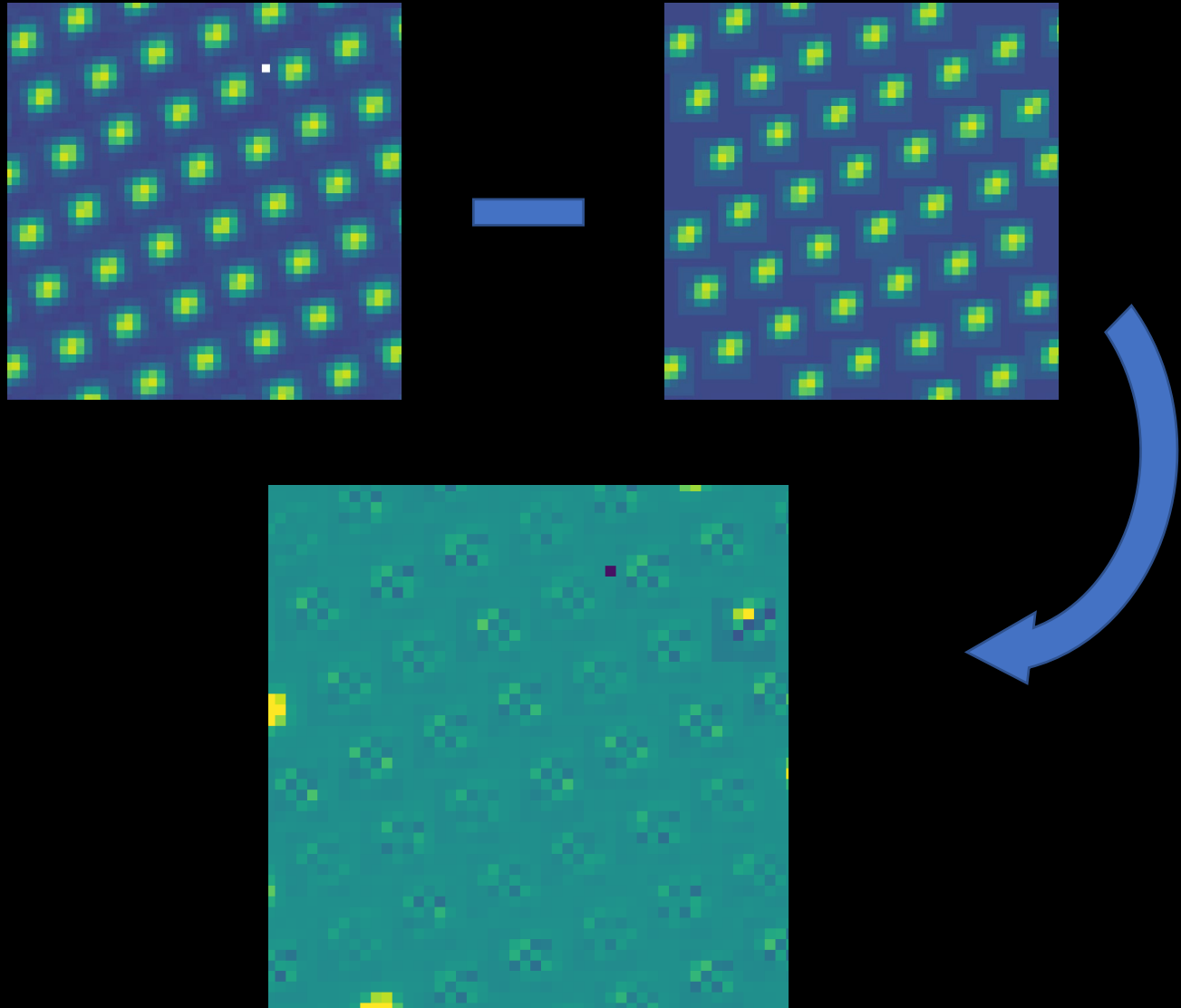
Weighted PSF



But Weight Them *How*?

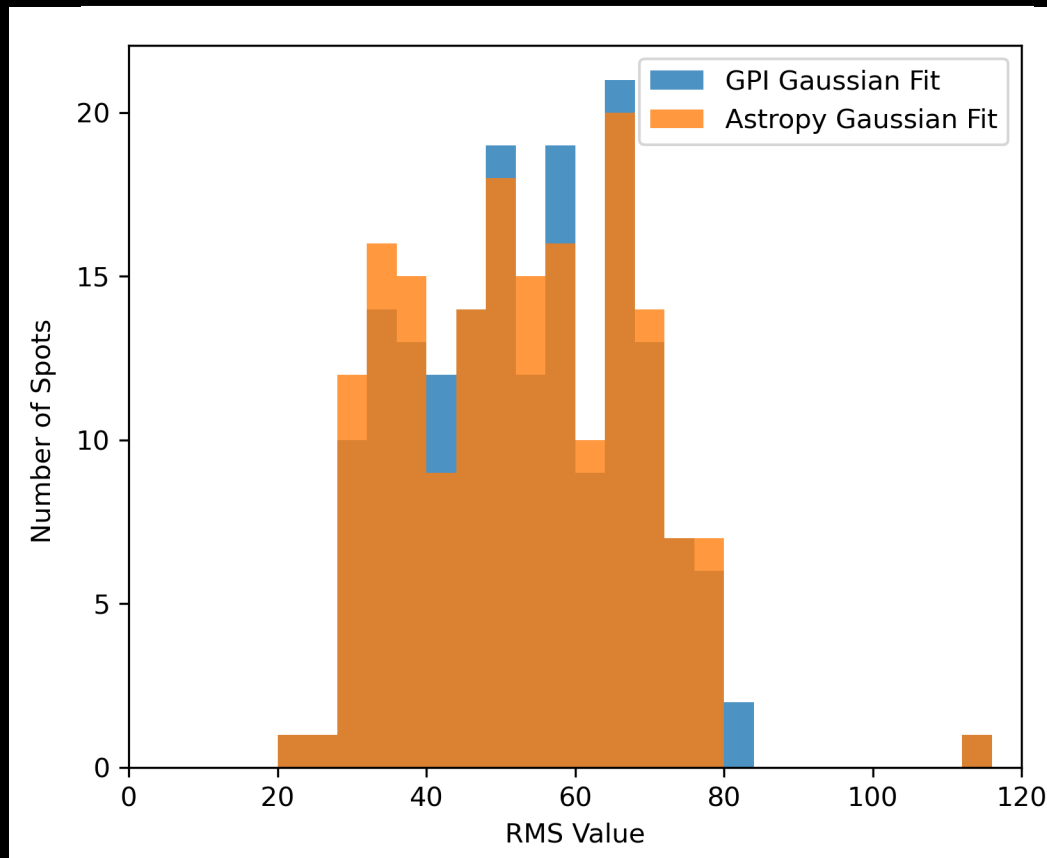


GPI's Gaussians

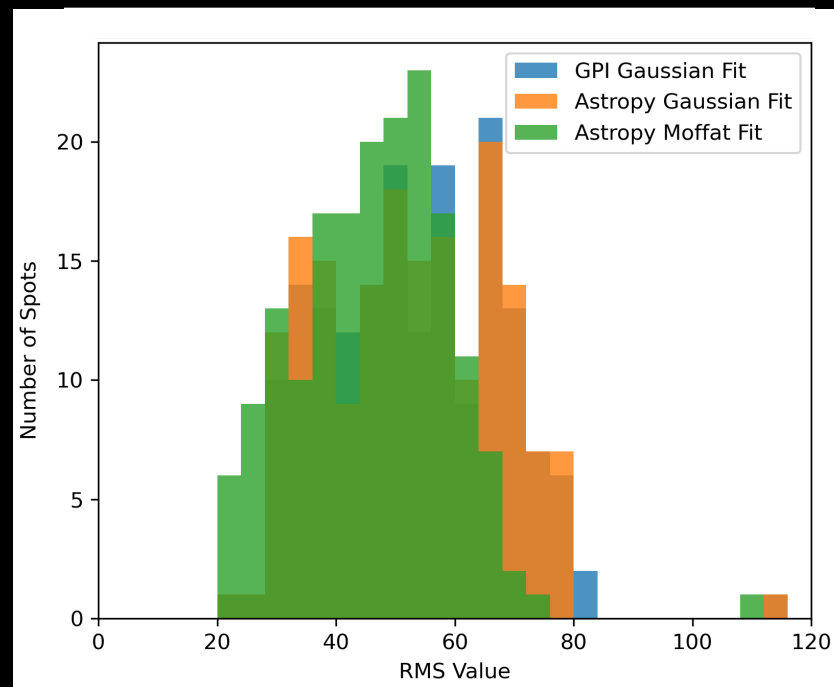
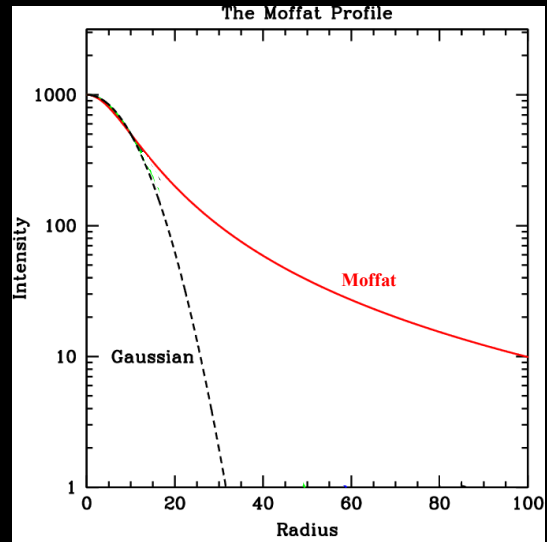


Root Mean Square Distributions

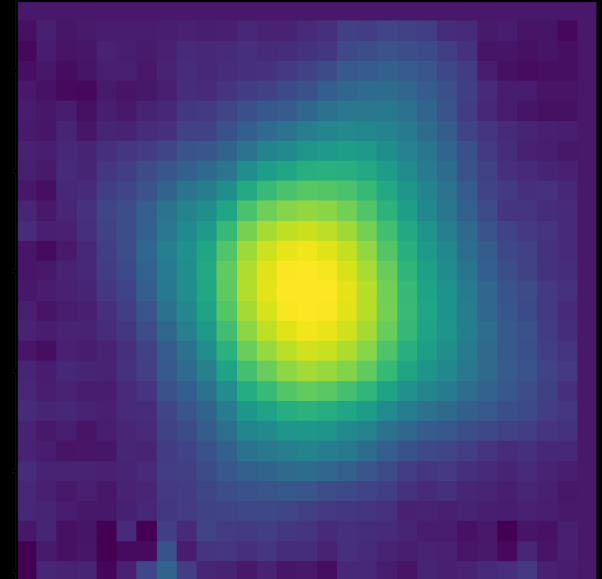
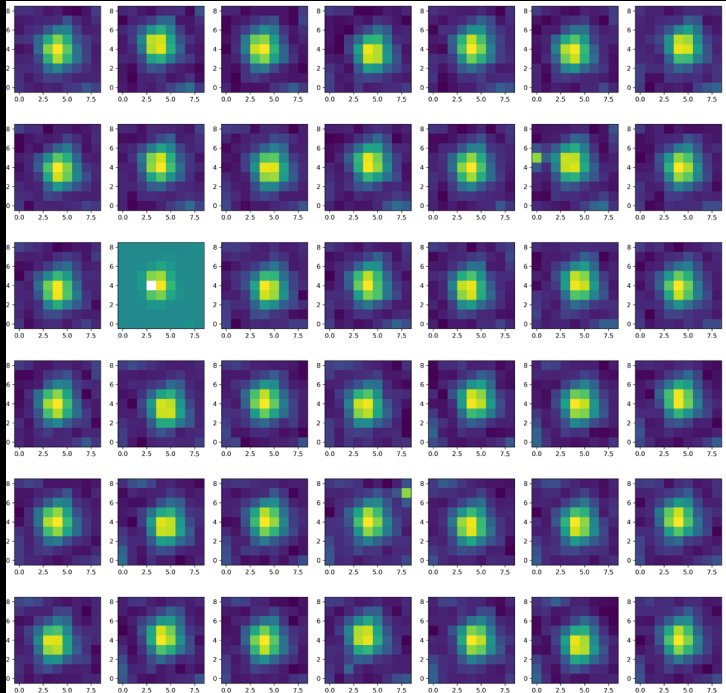
$$RMS = \sqrt{\text{mean}(x^2)}$$

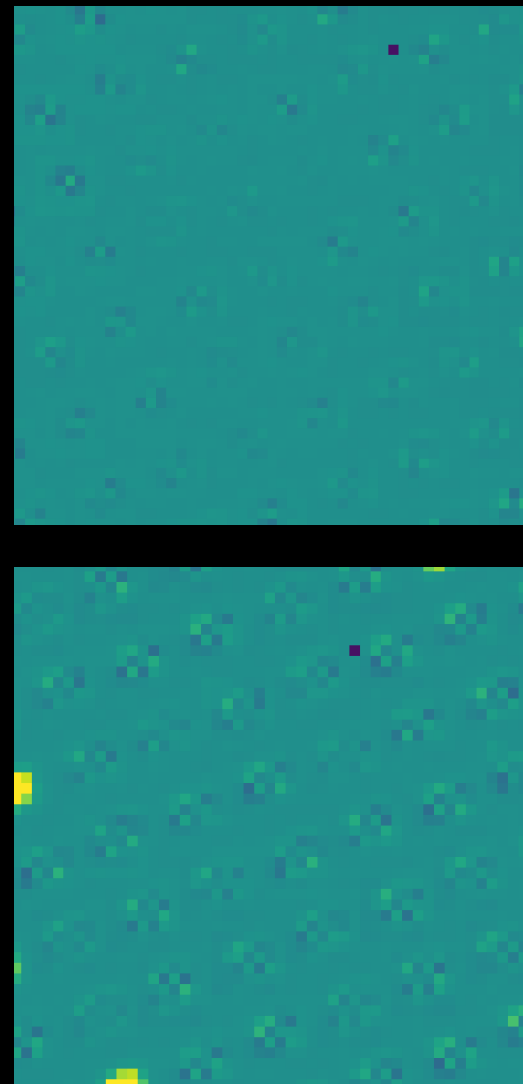
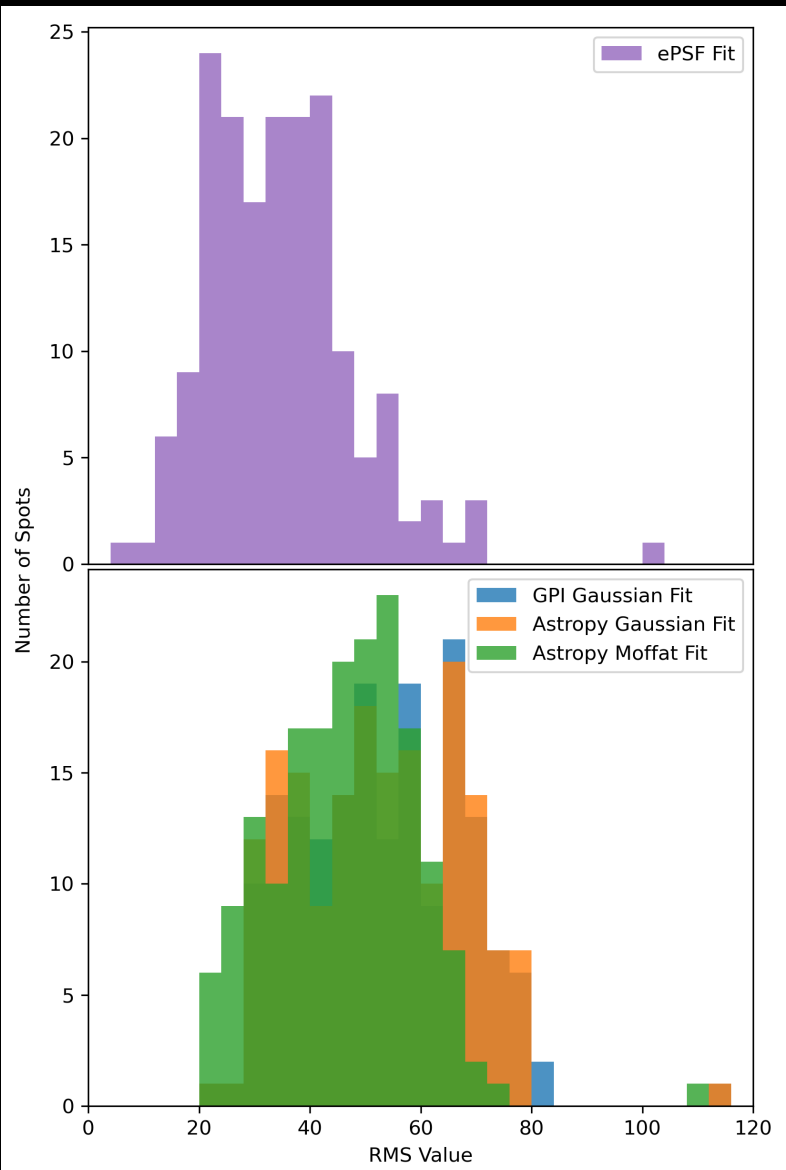


Moffat Profiles

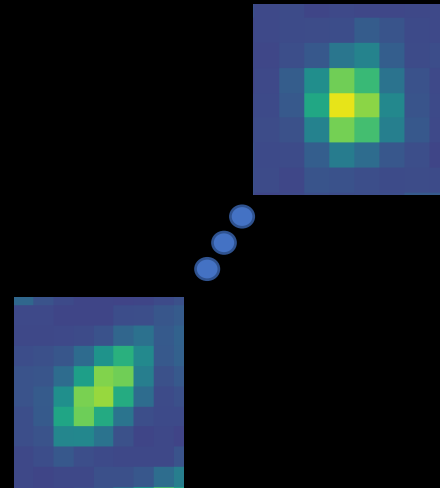
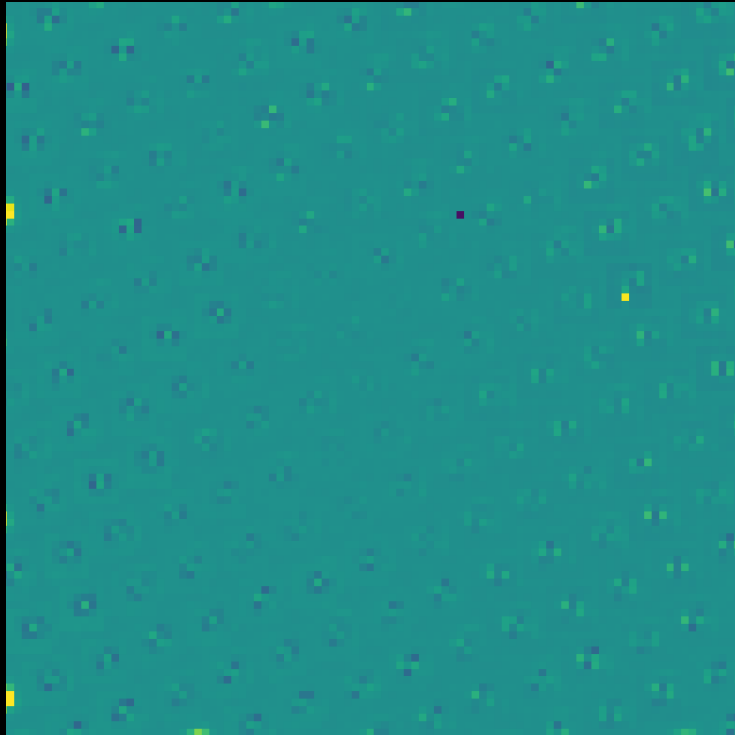


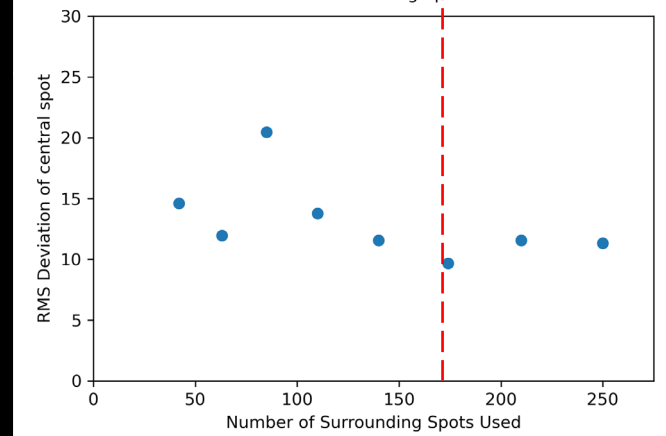
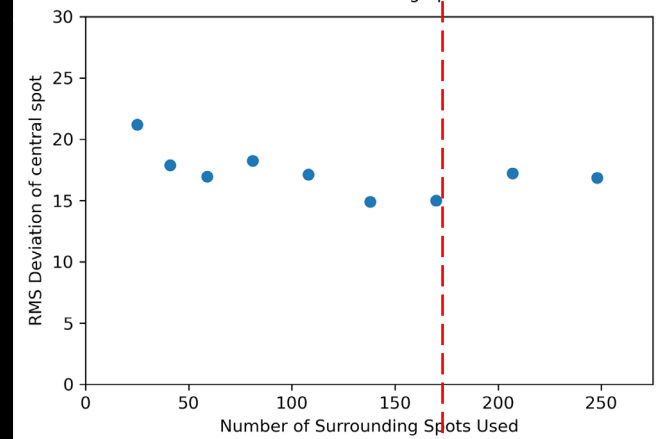
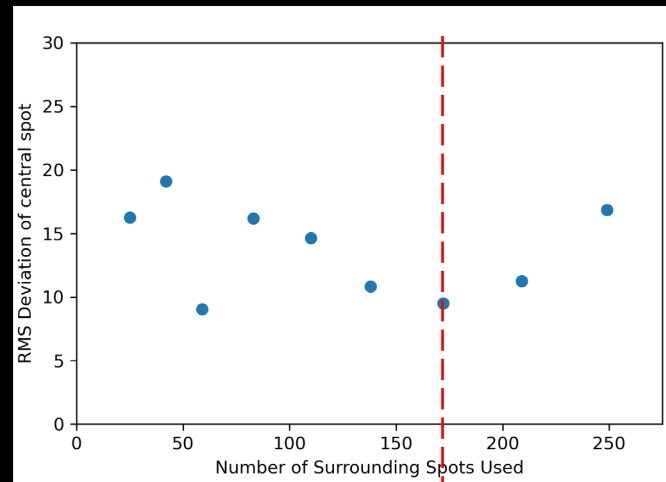
Effective Point Spread Function (ePSF)





How Many Spots Per Model?





Conclusions

- Weighting pixel values of GPI spots can reduce noise in extracted polarized images
- Empirically modelled “**effective point-spread functions**” (ePSFs) are a compelling candidate for a GPI pixel-weighting scheme
- The optimum number of nearby spots to incorporate into a single model is **~170**

Next Steps

- “Recycle” individual models and parallelize image generation to improve runtime
- Run our artificial image through the GPI pipeline to see if we can “fool” it

Thank You!



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