DECam Study of El Gordo

DES-LSST Workshop
March 24, 2014

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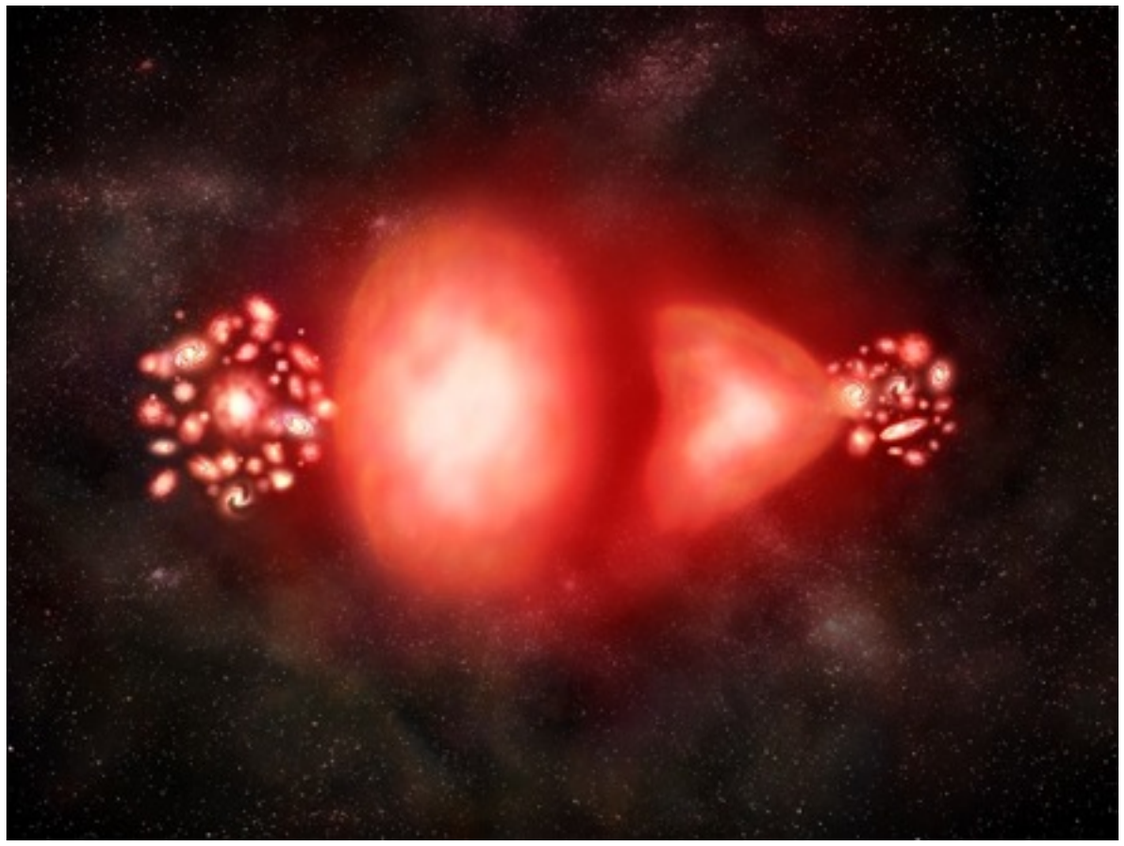
What is El Gordo?

Why is “El Gordo” Interesting?

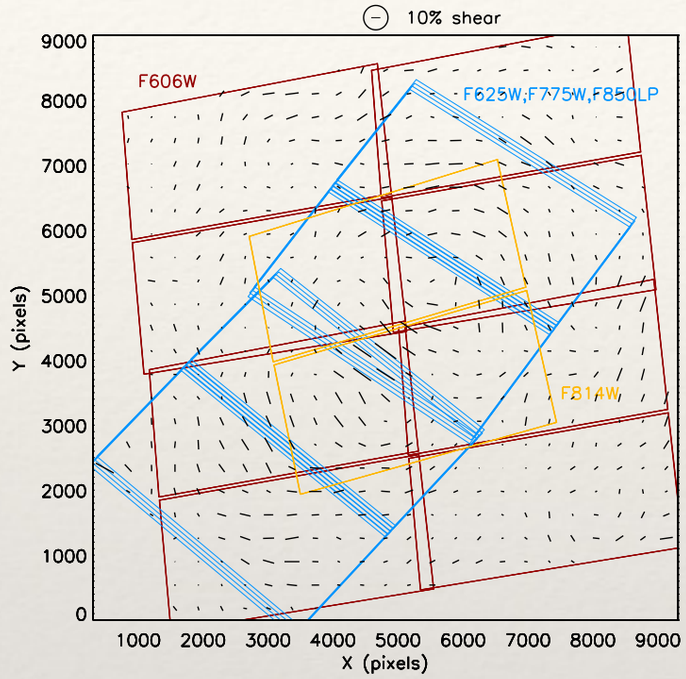
A pink elephant?

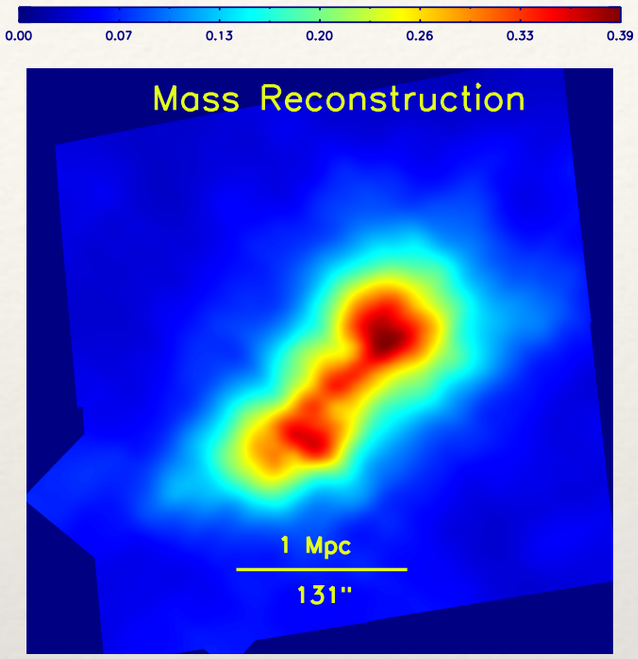
Another “bullet”?

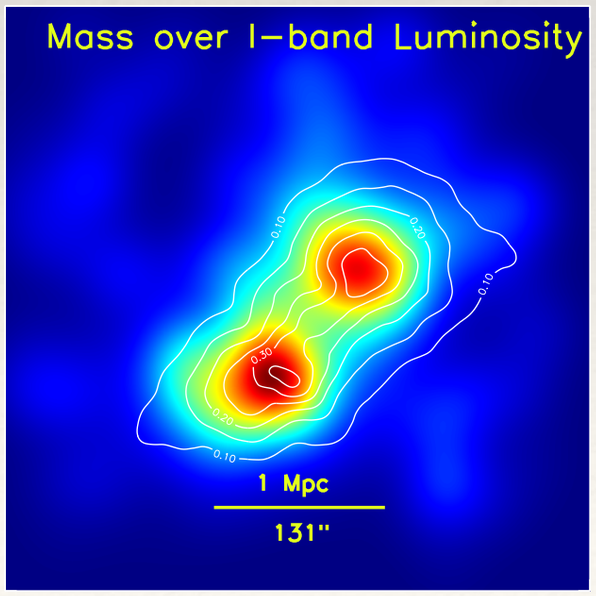


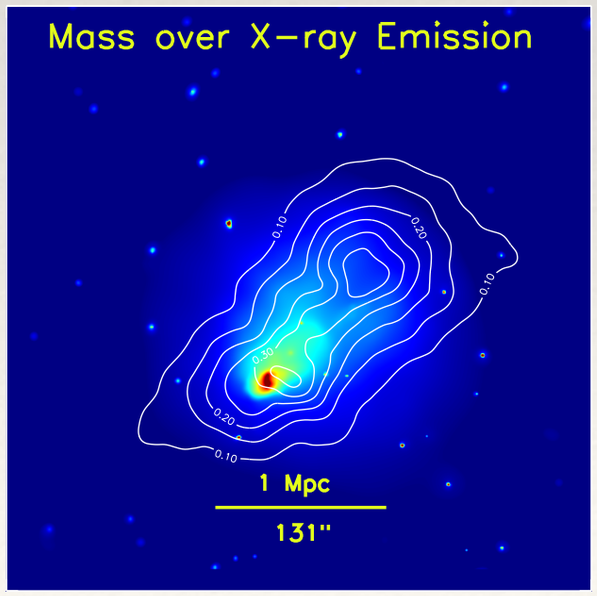
We need to know where and how much dark matter is.

HST Weak-Lensing

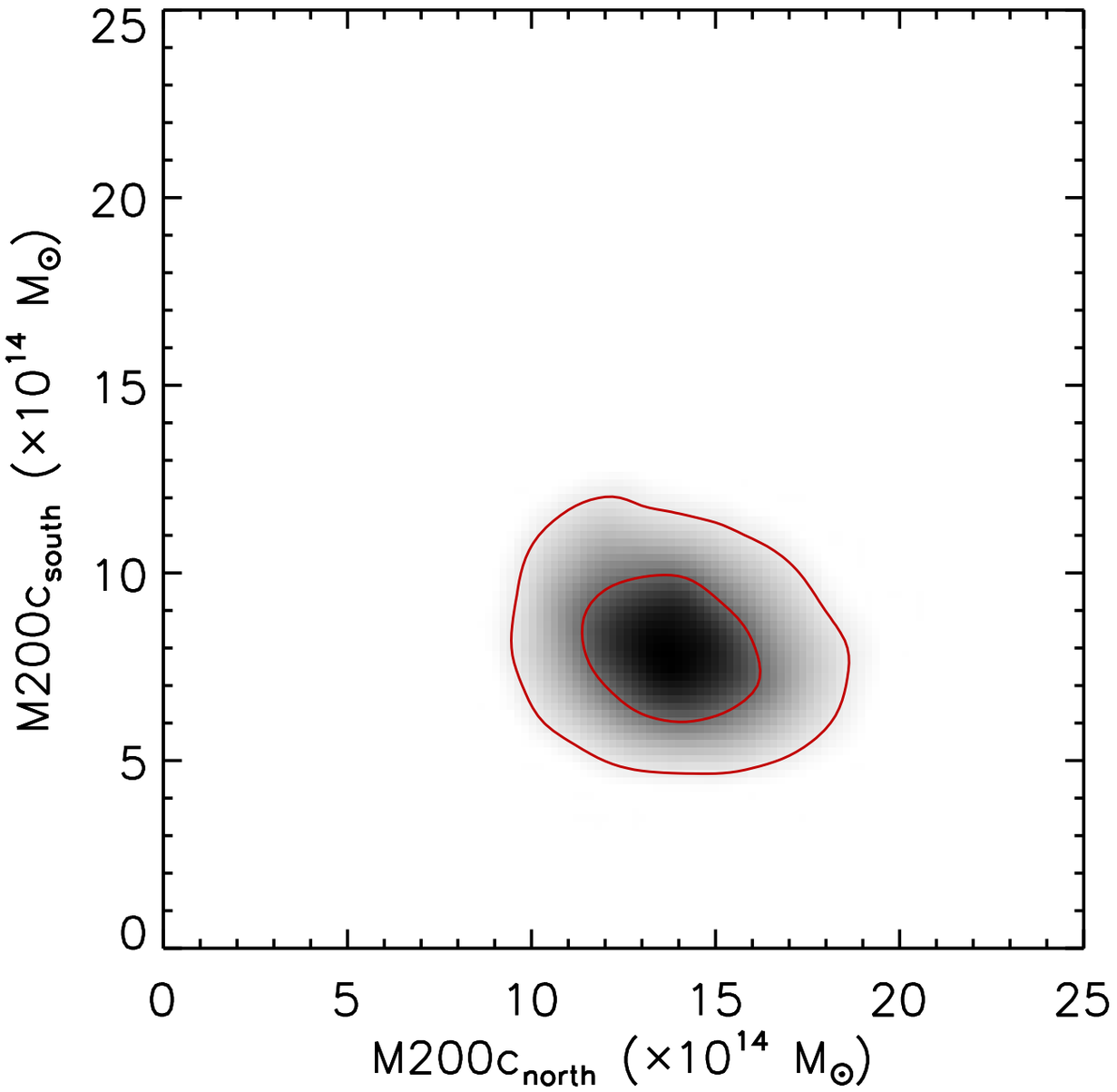








How Fat is El Gordo?



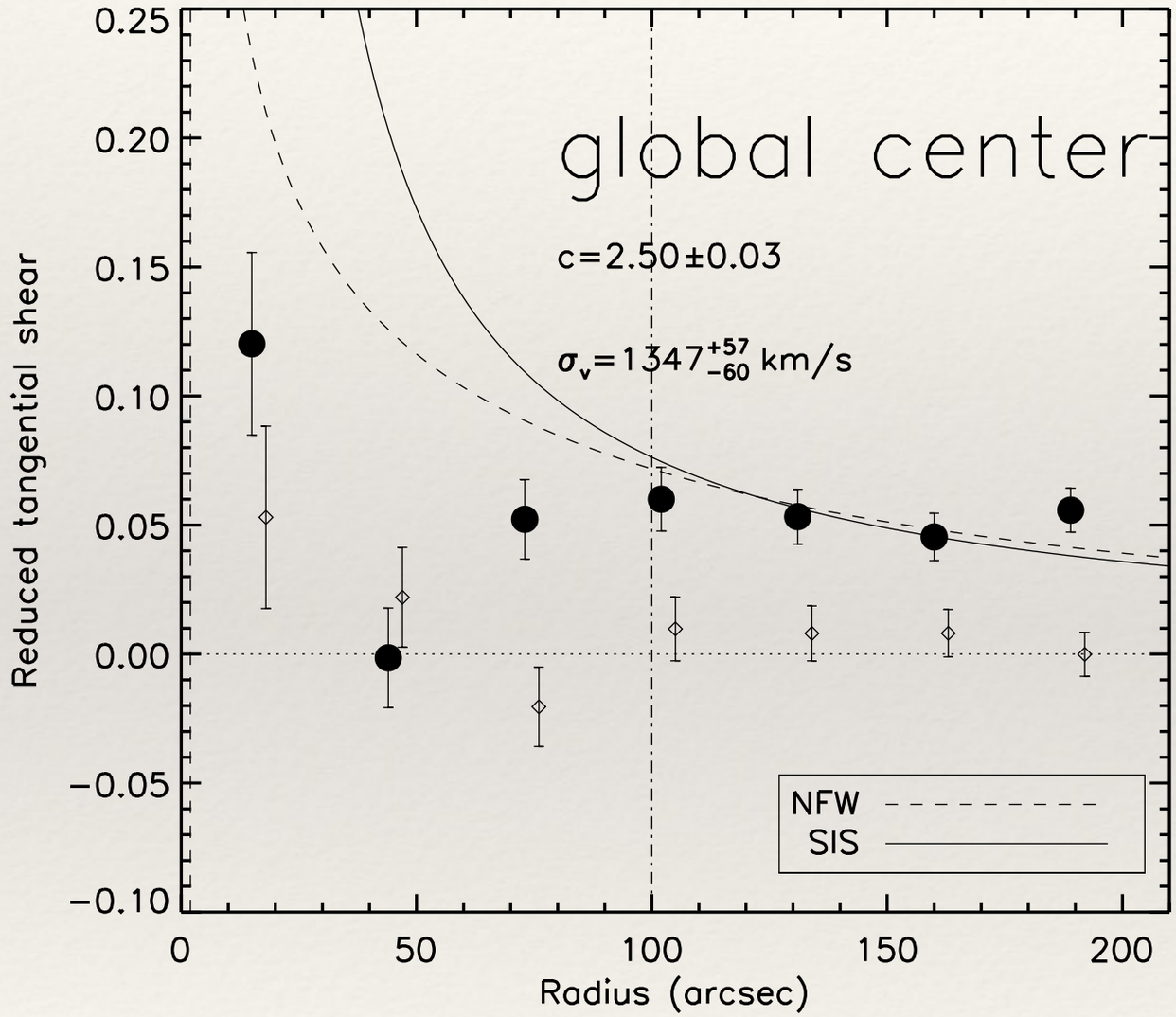
NW Halo: $(1.6\pm0.2)\times10^{15}\,M_\odot$

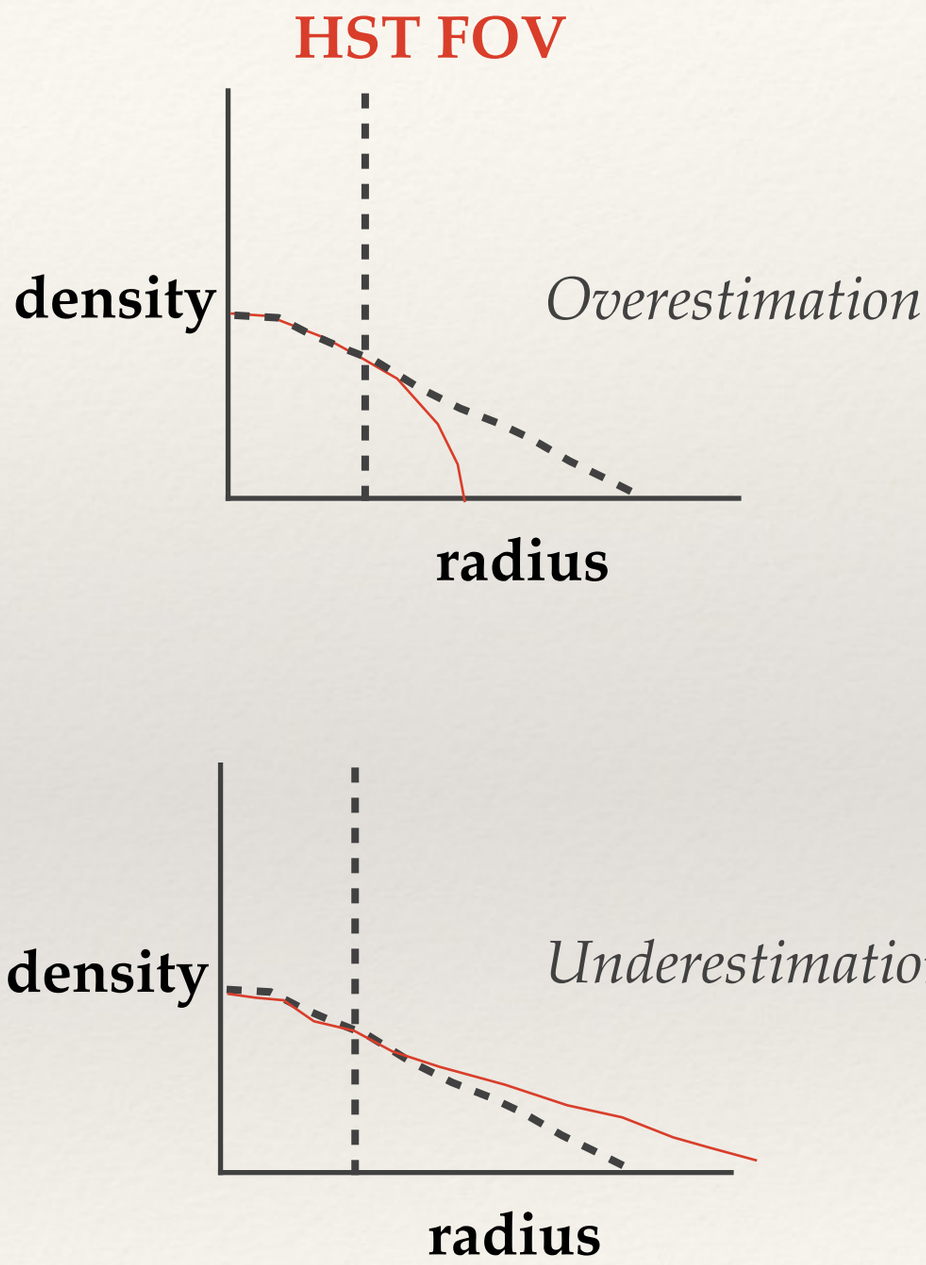
SW Halo: $(0.9\pm0.2)\times10^{15}\,M_\odot$

Together: $(3.1\pm0.6)\times10^{15}\,M_\odot$

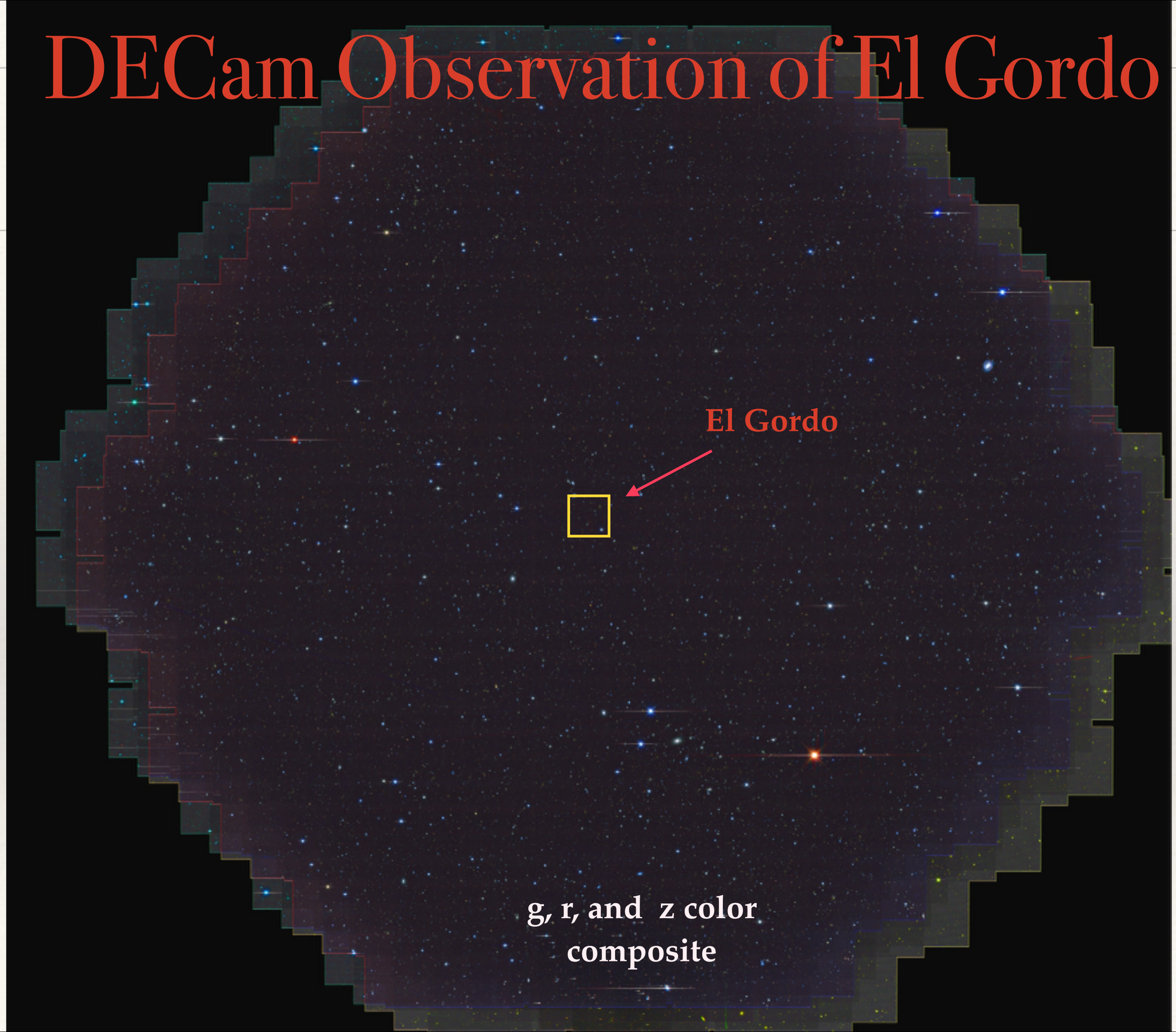
Consistent with velocity dispersion and X-ray temperature

Limitation of HST WL





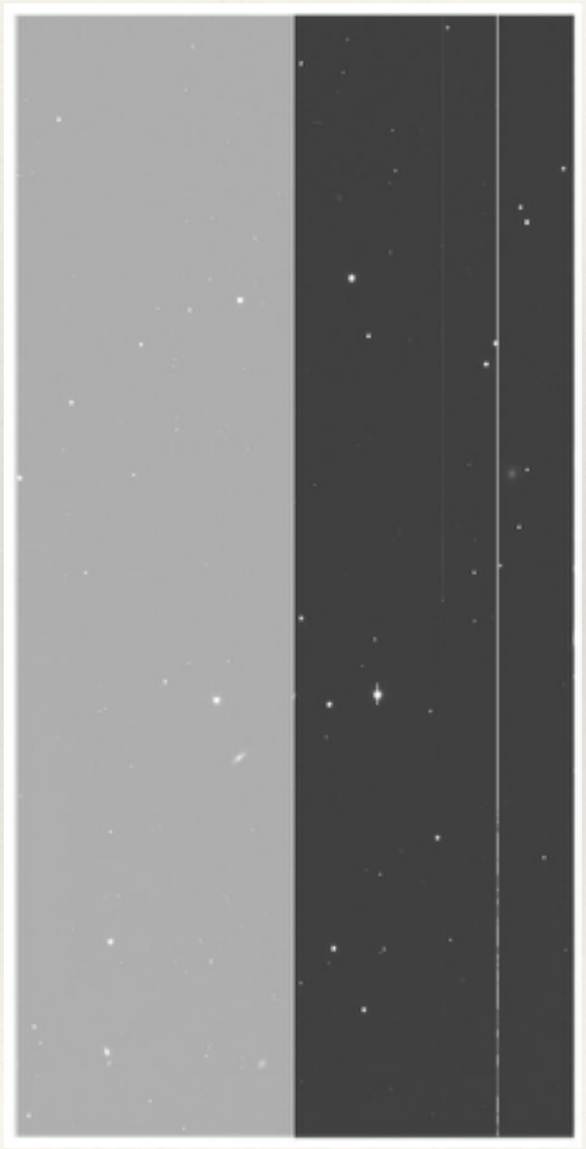
DECam Observation of El Gordo



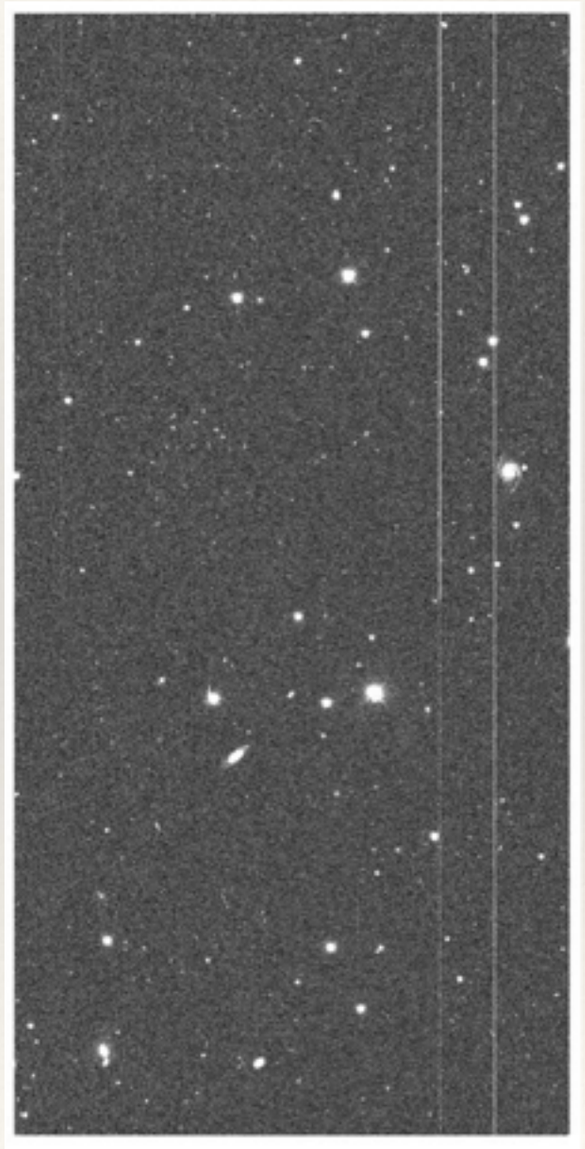
DECam Data of El Gordo

	Exp Time	Seeing
g	900 s	~1.05″
r	1800 s	~0.94″
i	900 s	~0.87″
z	900 s	~0.85″
y	1400 s	~0.84″

DECam Image Reduction - Bias Subtraction/Trim

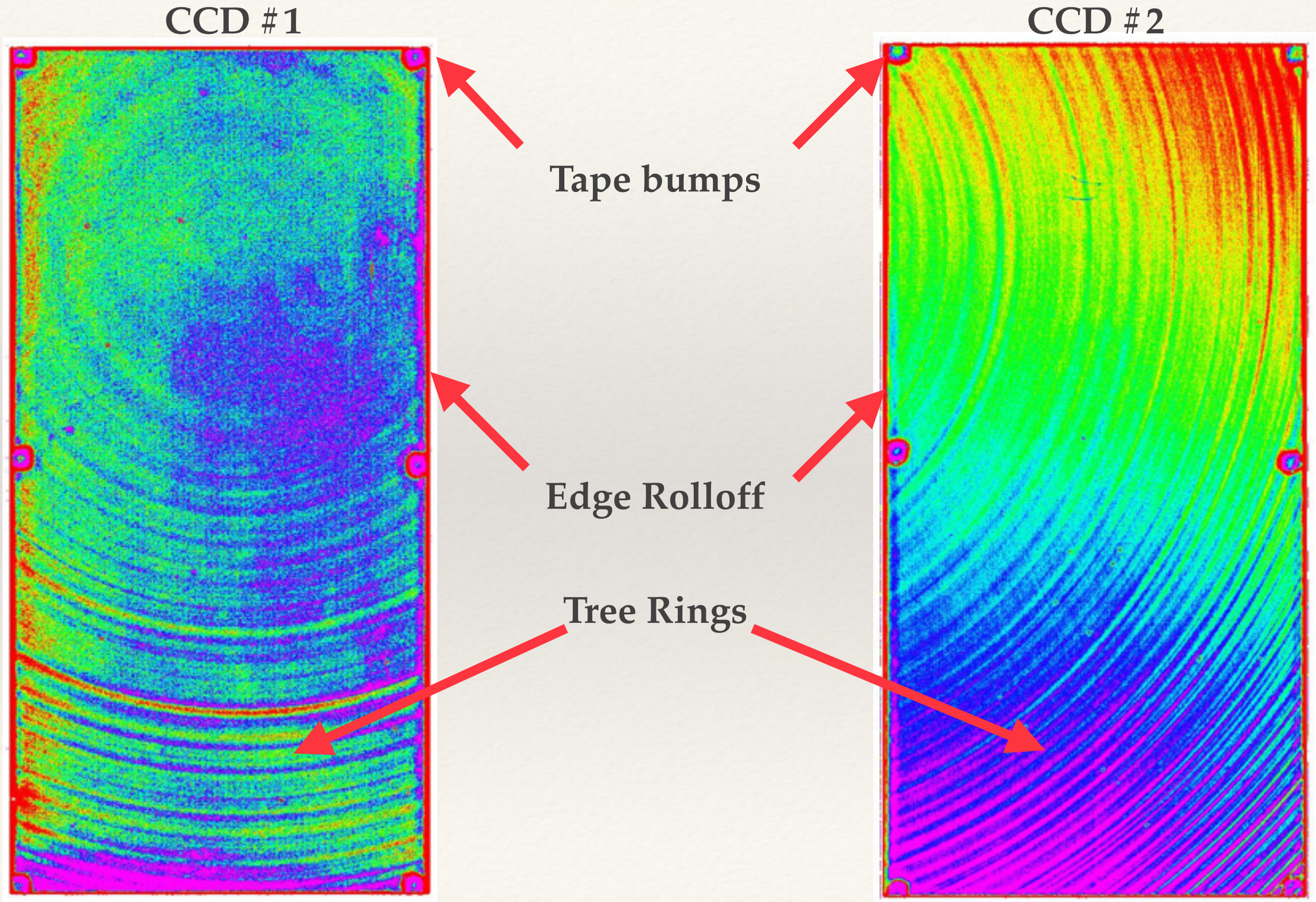


Bias Subtraction



Residual Bias Subtraction

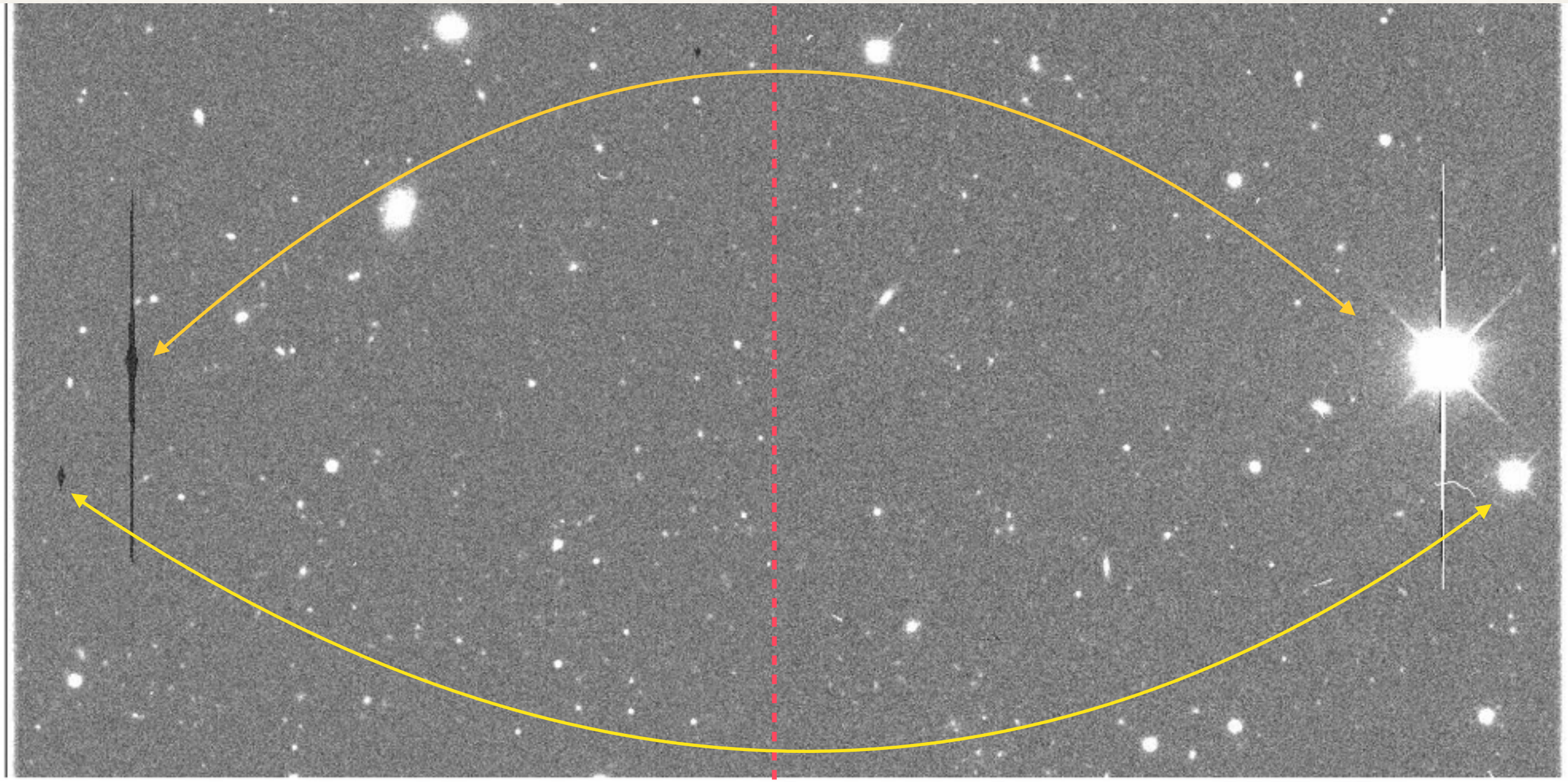
DECam Image Reduction - Sky Flat



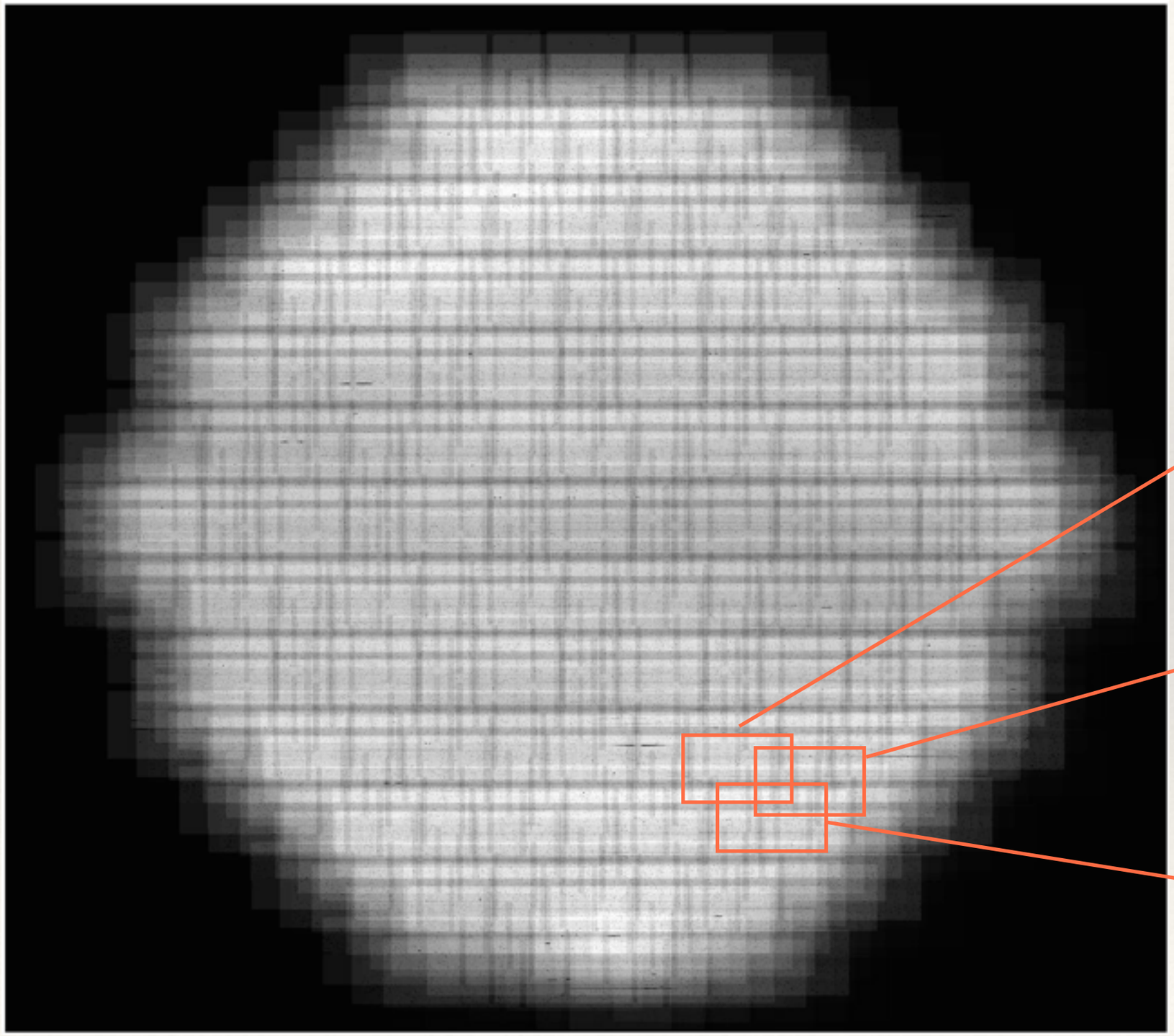
DECam Image Reduction - Distortion Correction

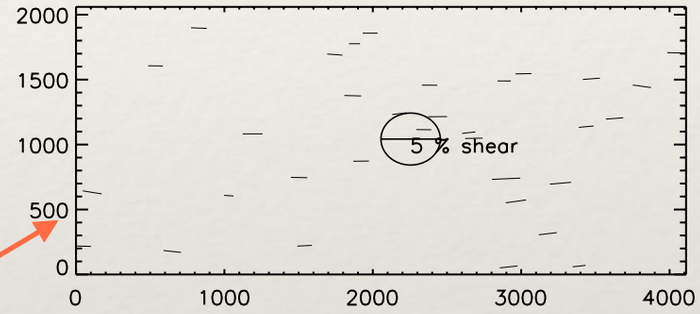
- **Reference star catalog: 2MASS.**
- **Third order polynomial.**
- **Assume that the frames from the same CCD share identical geometric distortion. However, each frame is allowed to shear and rotate.**
- **Photometric calibration is done with matching stars.**

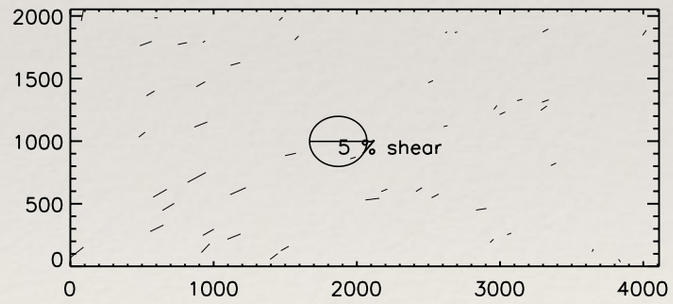
DECam Image Reduction - Crosstalks

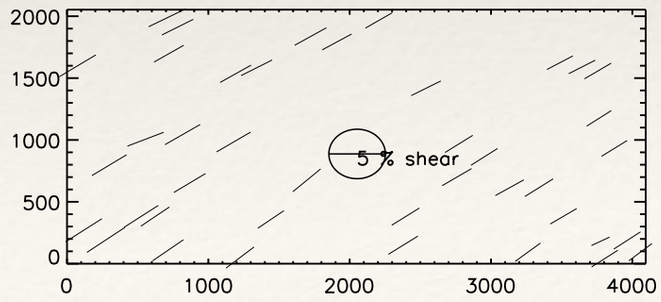


PSF Modeling Through PCA

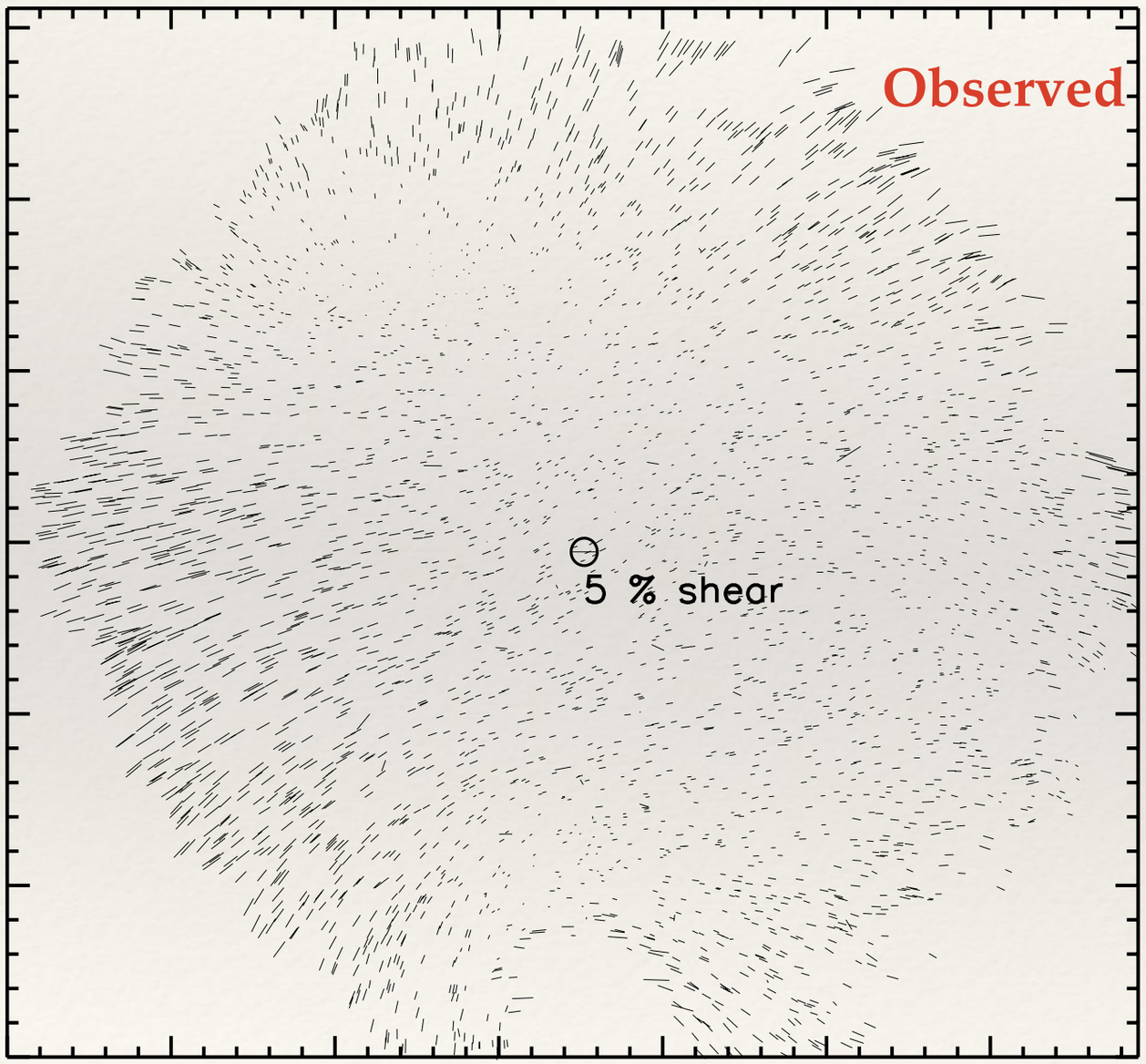


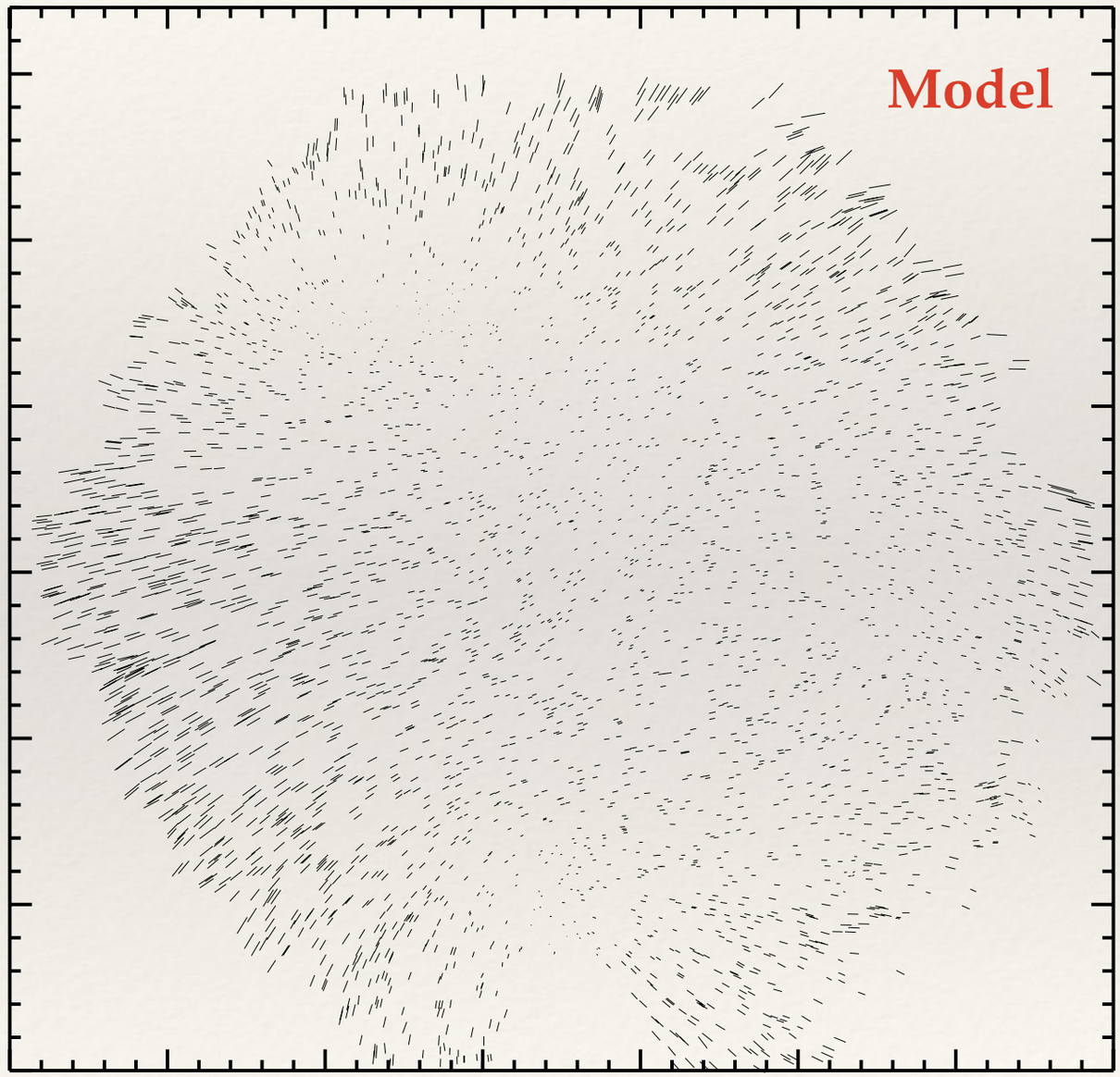




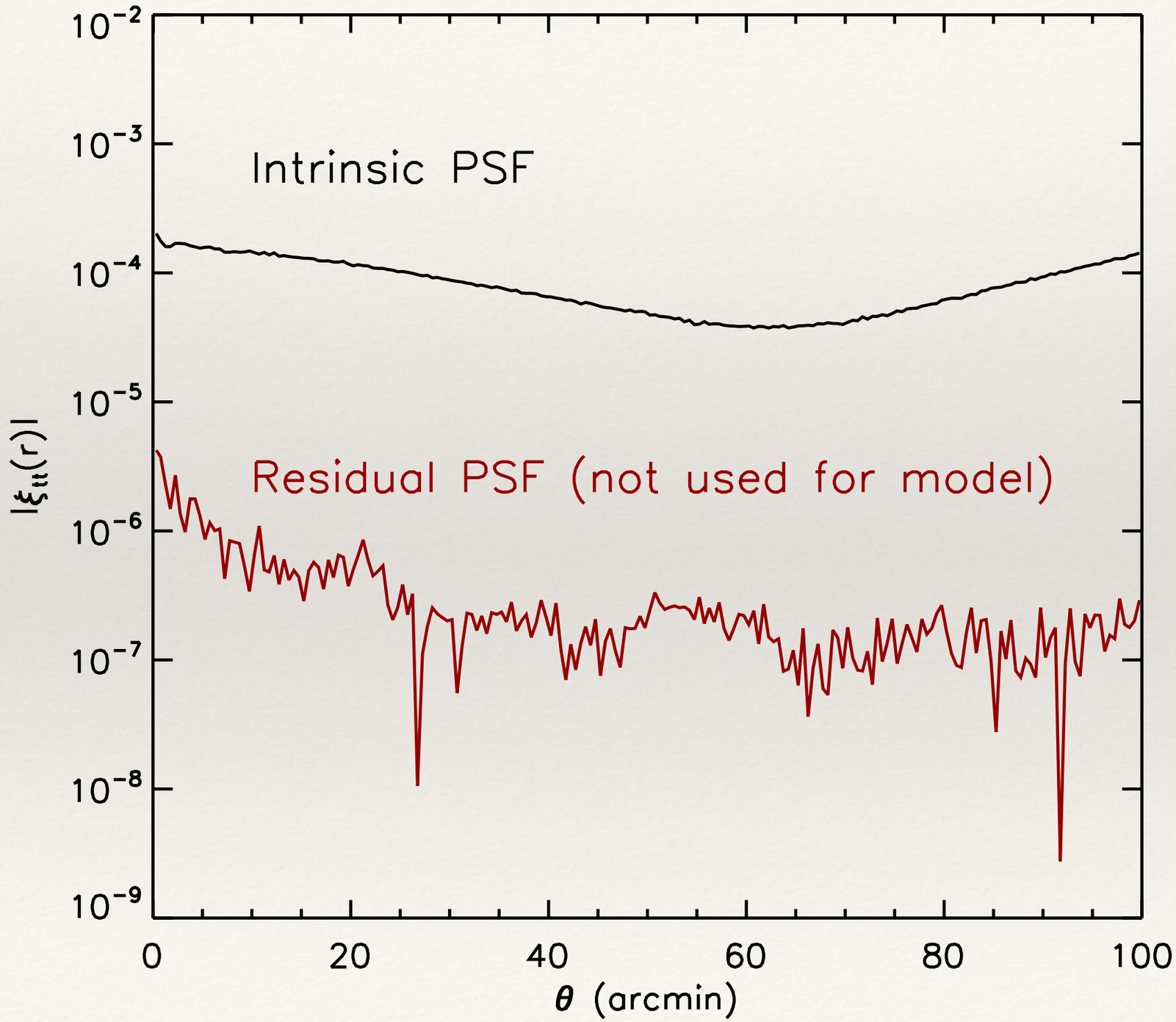


PSF Modeling - Continued

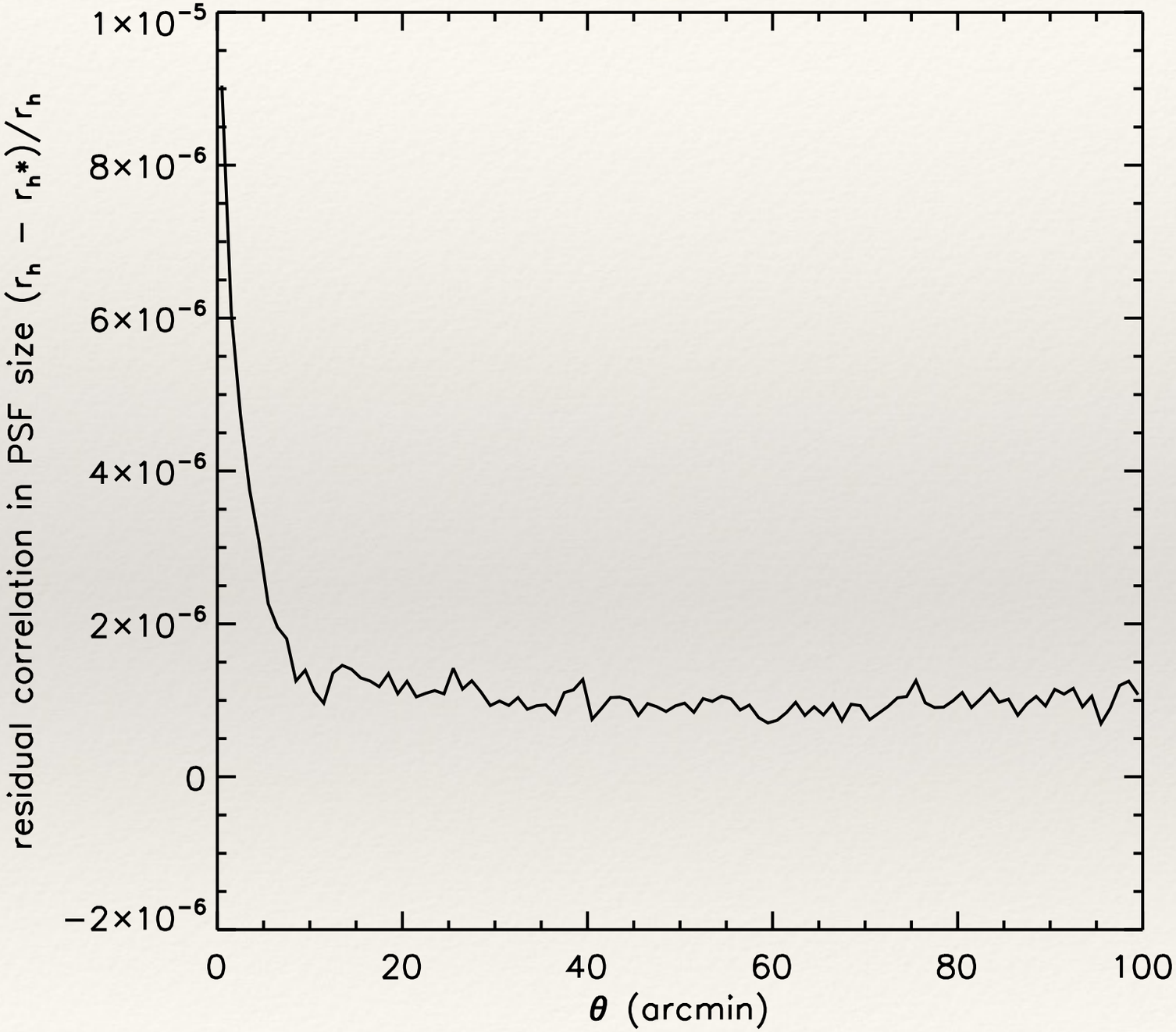




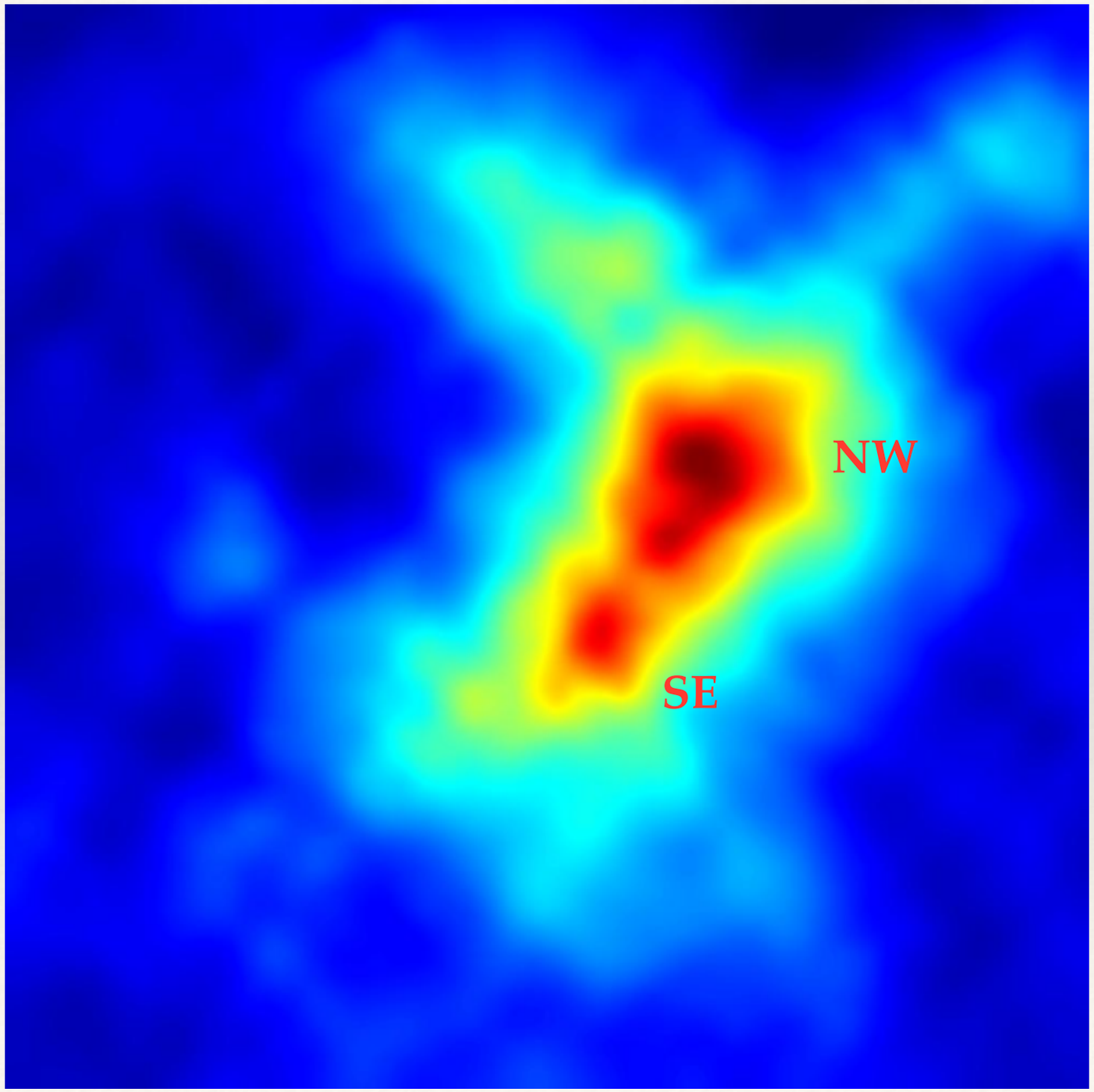
PSF Ellipticity Correlation



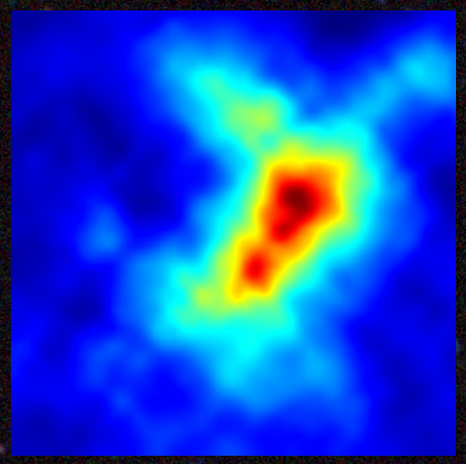
RESIDUAL PSF SIZE



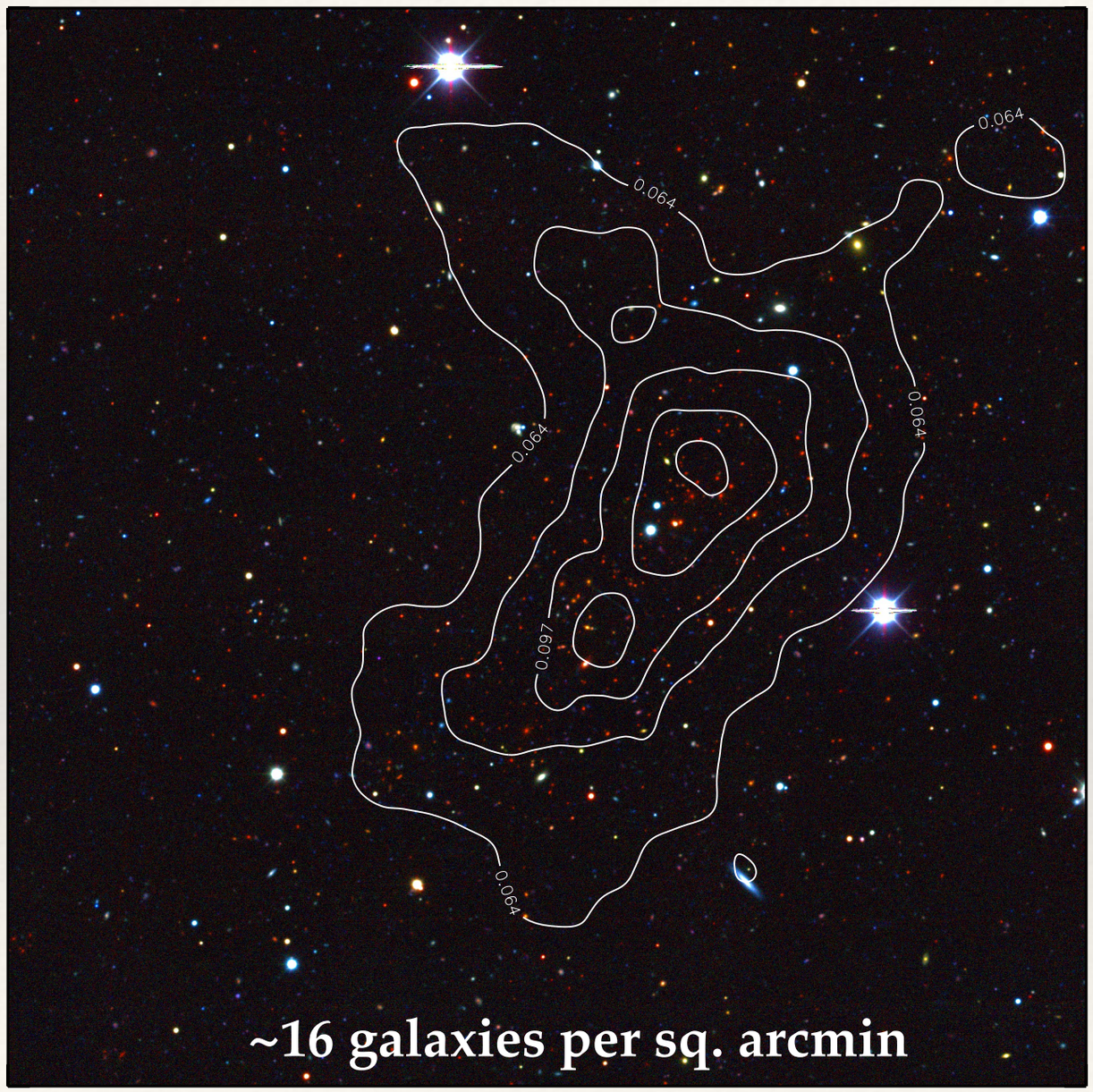
Mass Reconstruction



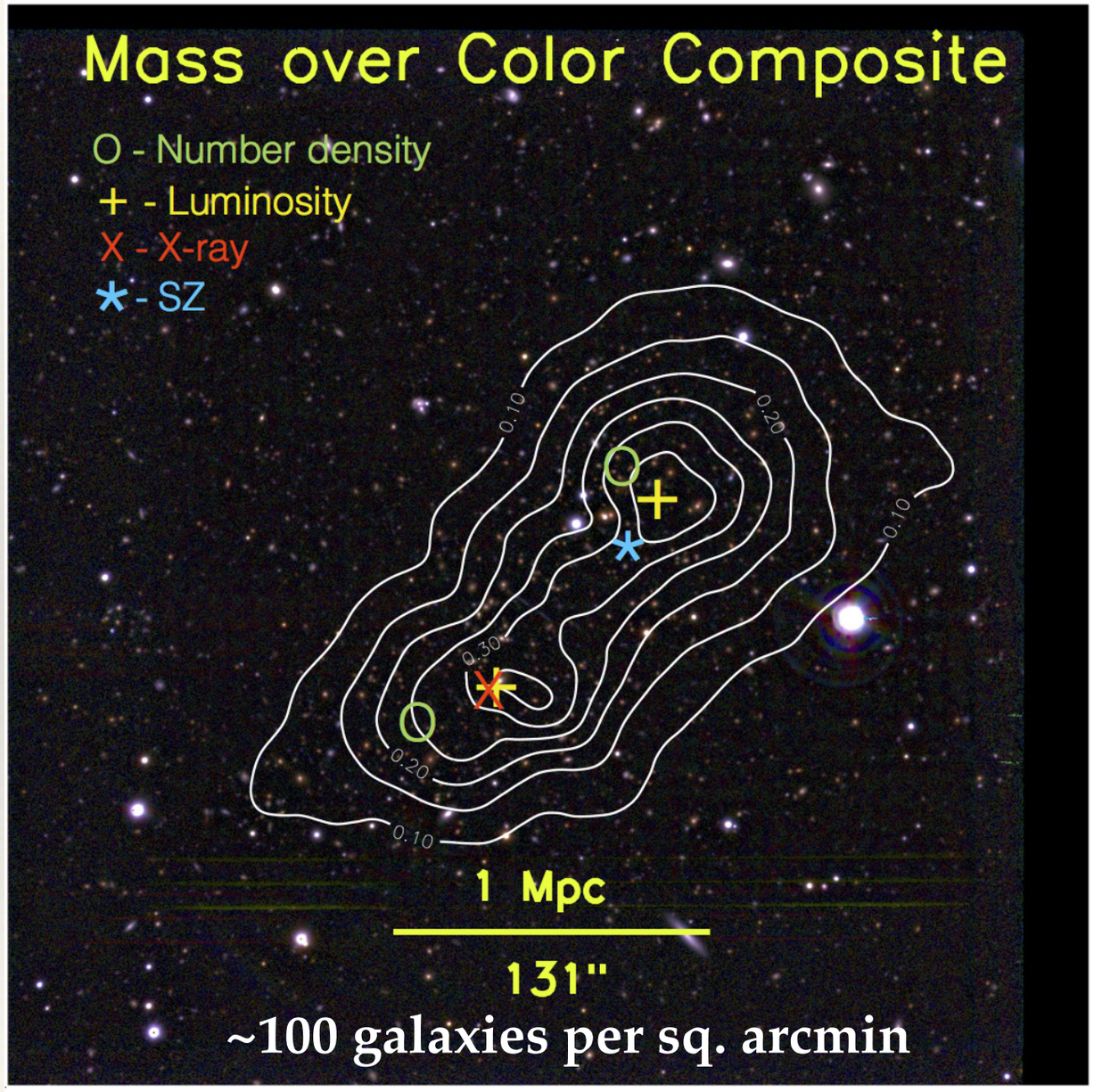
Mass Reconstruction with DECam



DECam vs. HST



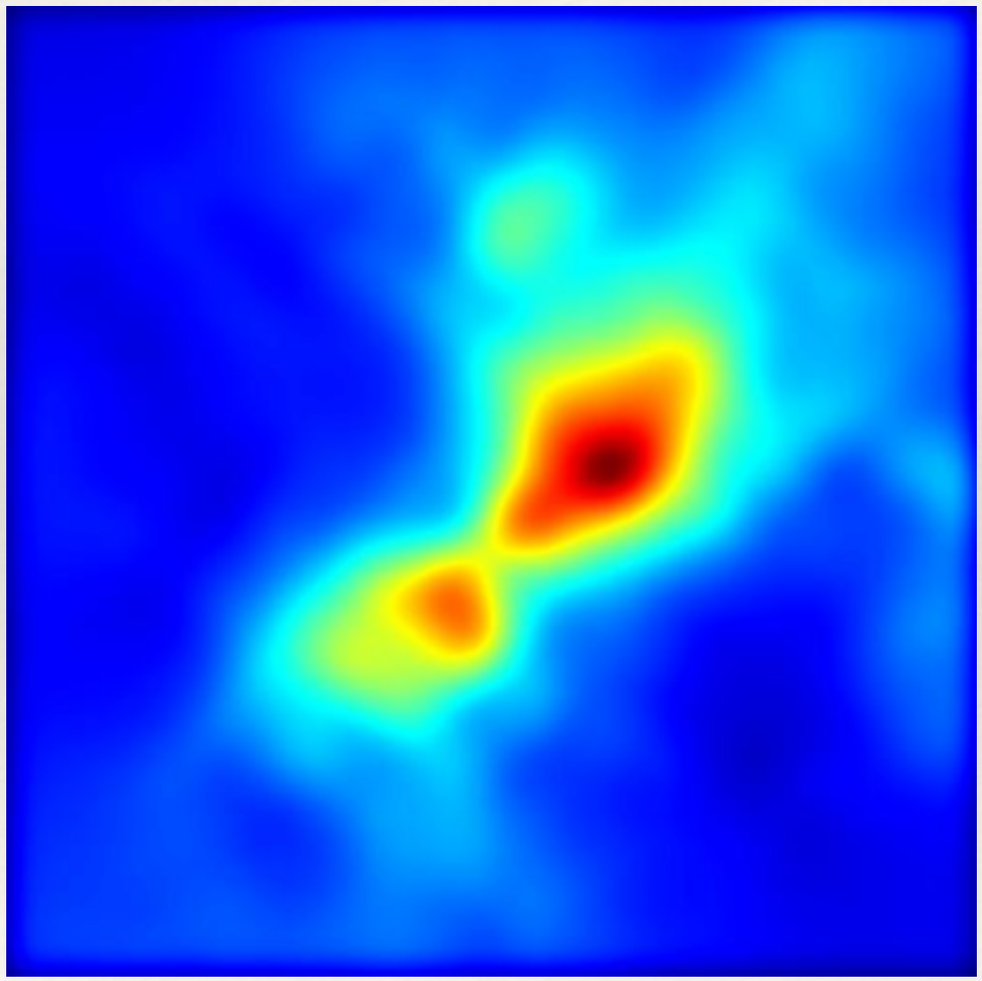
~16 galaxies per sq. arcmin



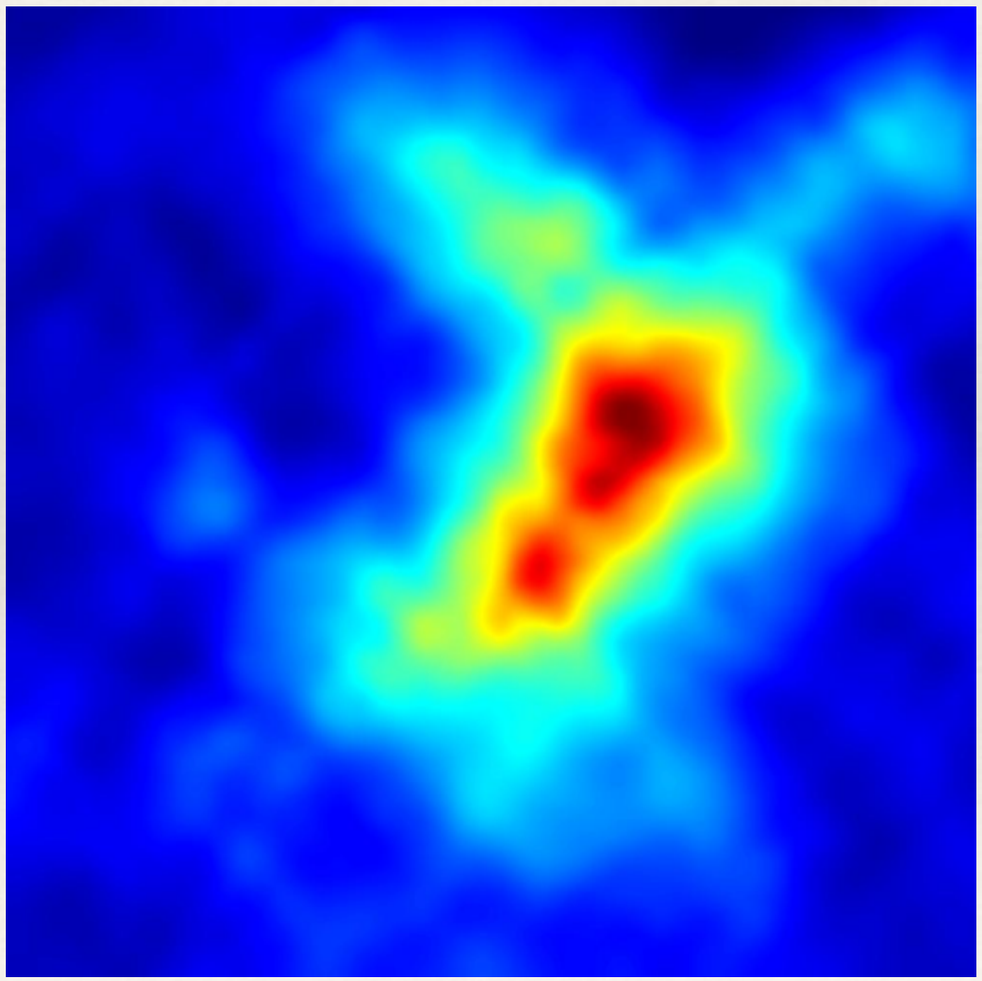
~100 galaxies per sq. arcmin

After Throwing Away ~80% of Galaxies from the HST Sources

Degraded HST
(~16 galaxies per sq. arcmin)

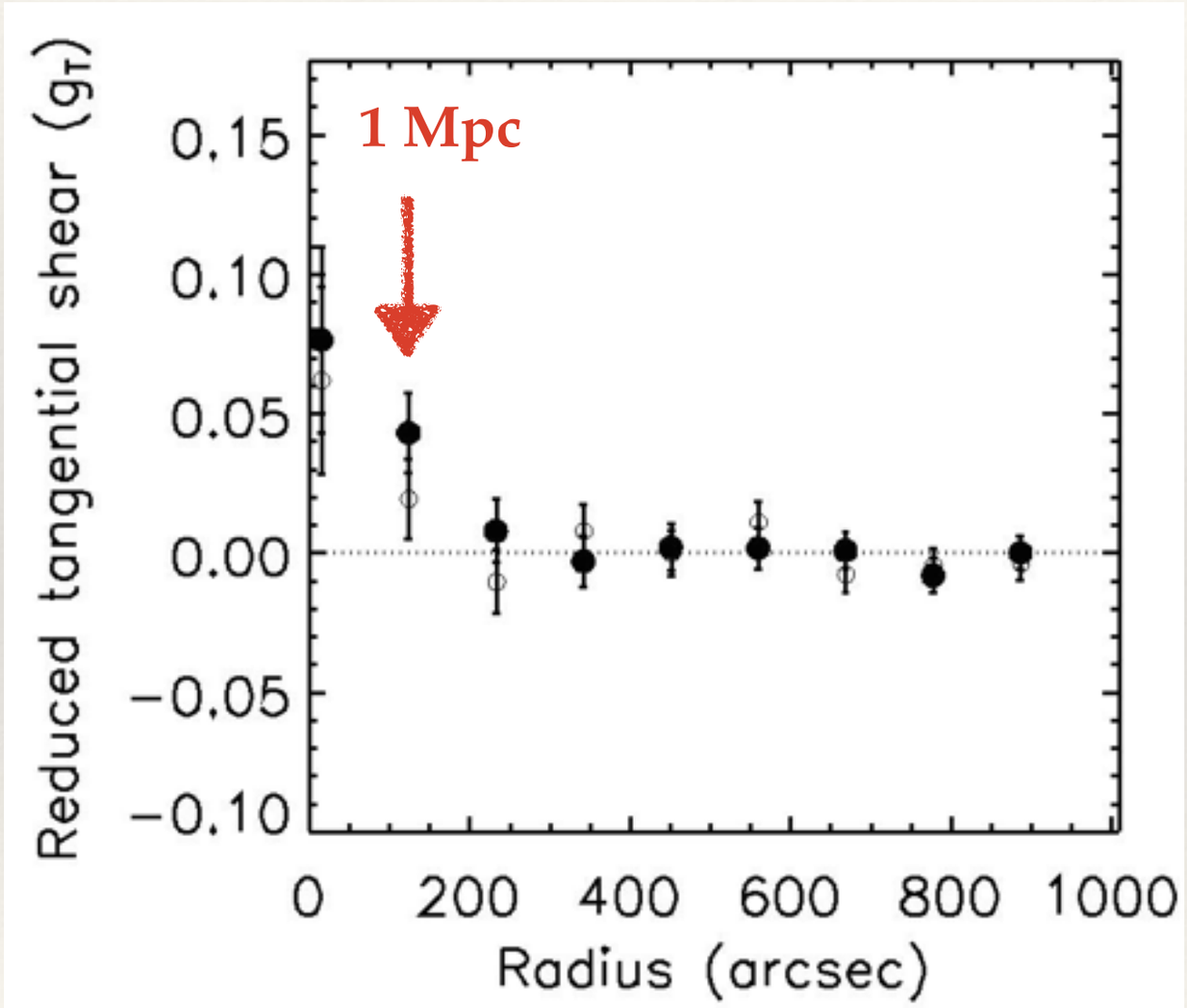


DECam

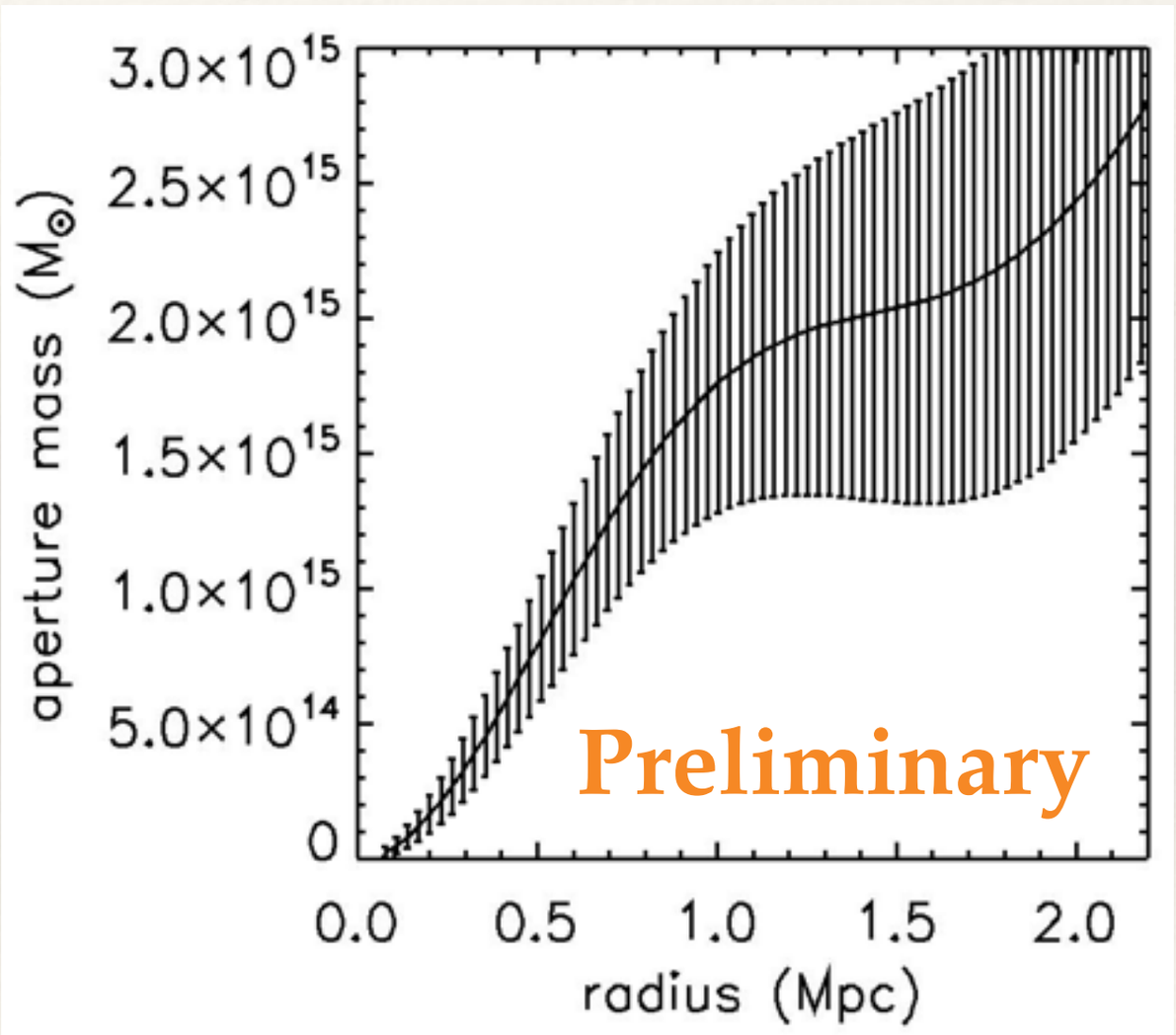


Mass of El Gordo

Tangential Shear



Aperture Mass Densitometry



Things to Address

- Depth variation due to lensing
- Astrometric effects of tree rings and tape bumps
- Crosstalks
- Shear calibration

Conclusions

- Lensing signal of El Gordo at z=0.87 is clearly detected by DECam.
- The DECam mass reconstruction resolves the two mass clumps of El Gordo, consistent with the HST study.
- No significant lensing signal is seen beyond r>1 Mpc, perhaps due to either Truncation of mass profile or lensing-induced depth variation.
- The projected mass within r<1 Mpc with DECam WL is consistent with the HST parametric model.