

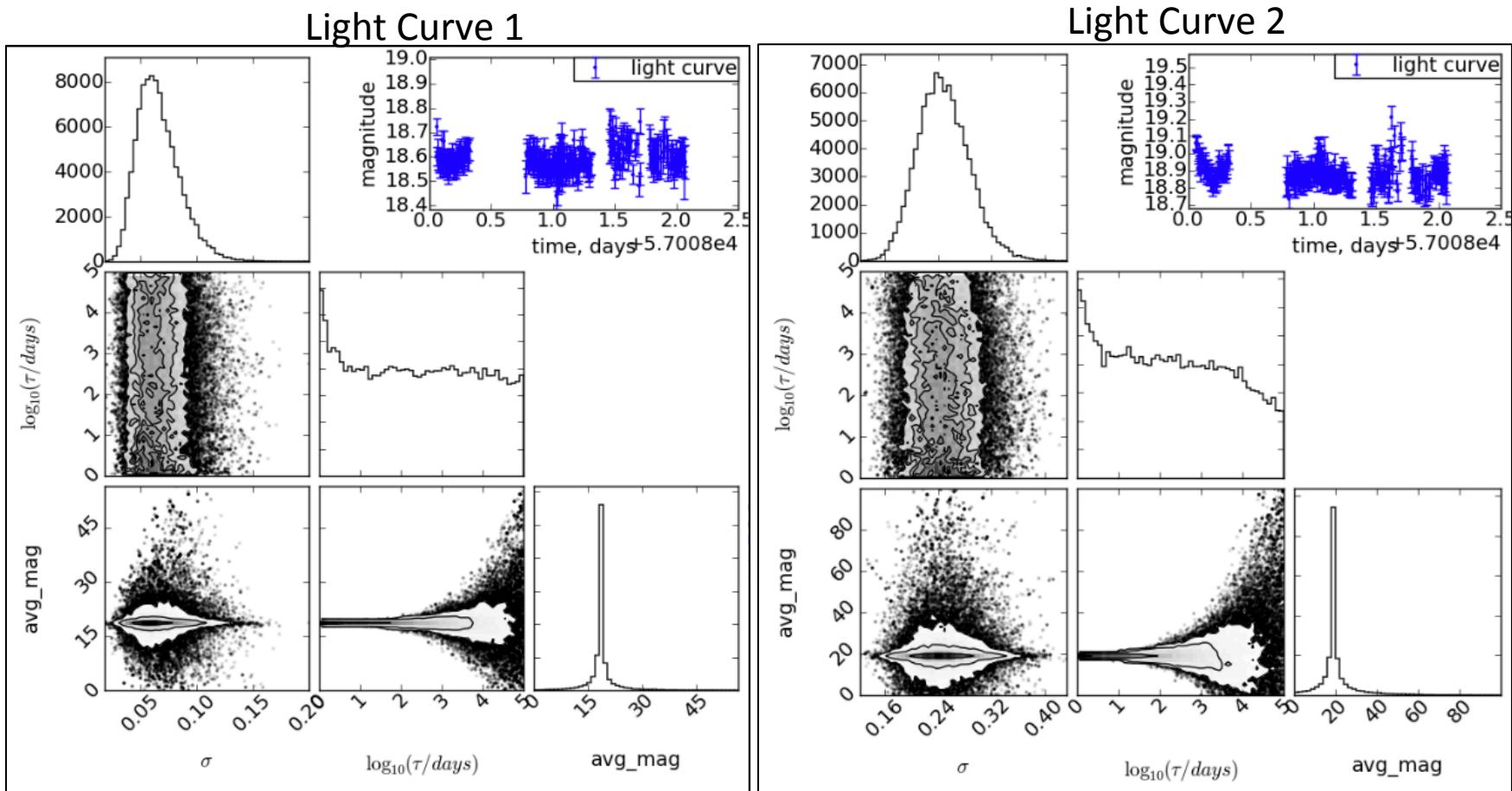
Updates on LCOlens Photometry, Quasar Magnitude, and Delay Extraction

A. Romero-Wolf

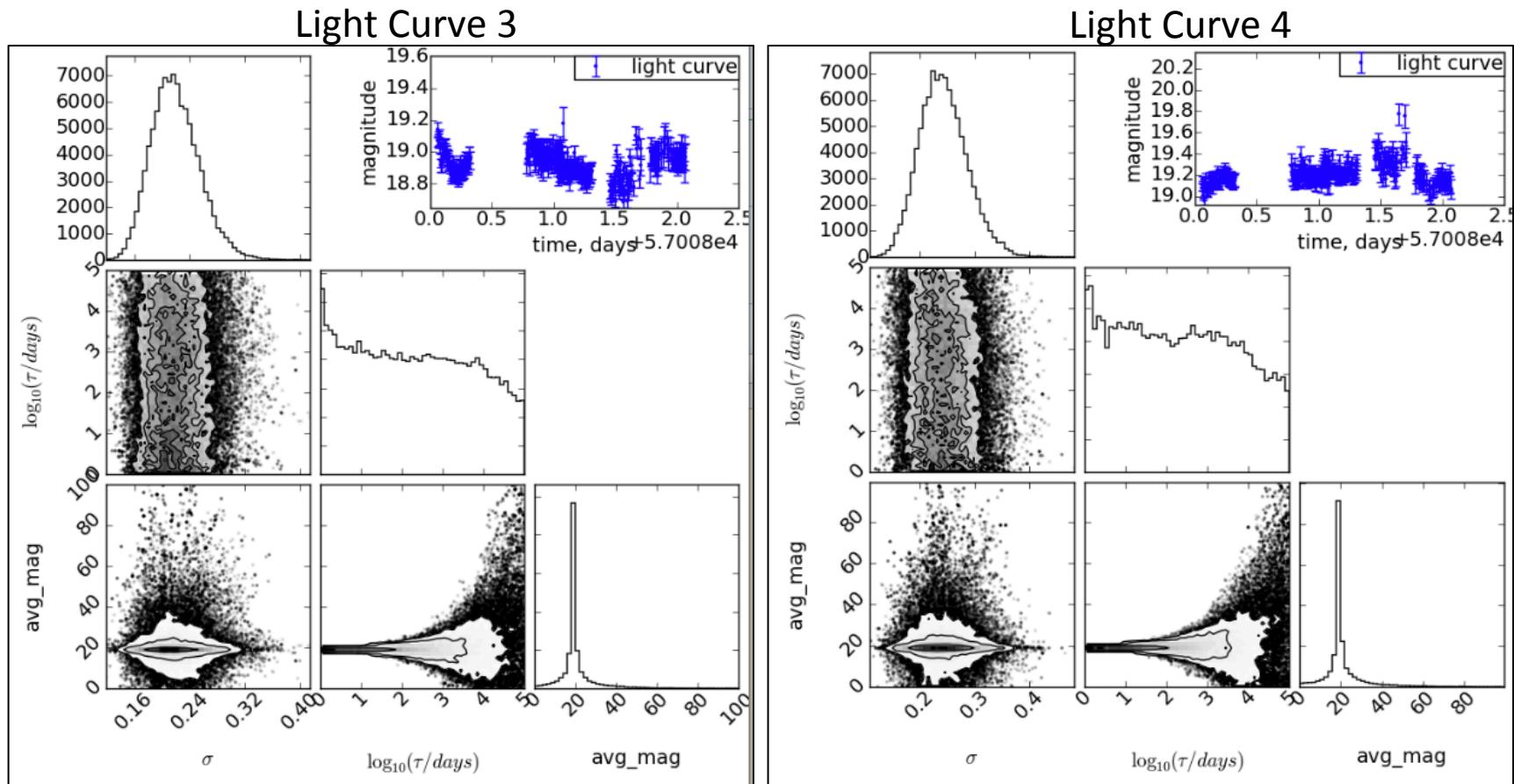
JPL

March 25, 2015

Damped Random Walk Characterization of LCOGT HE0435-1223 Light Curves

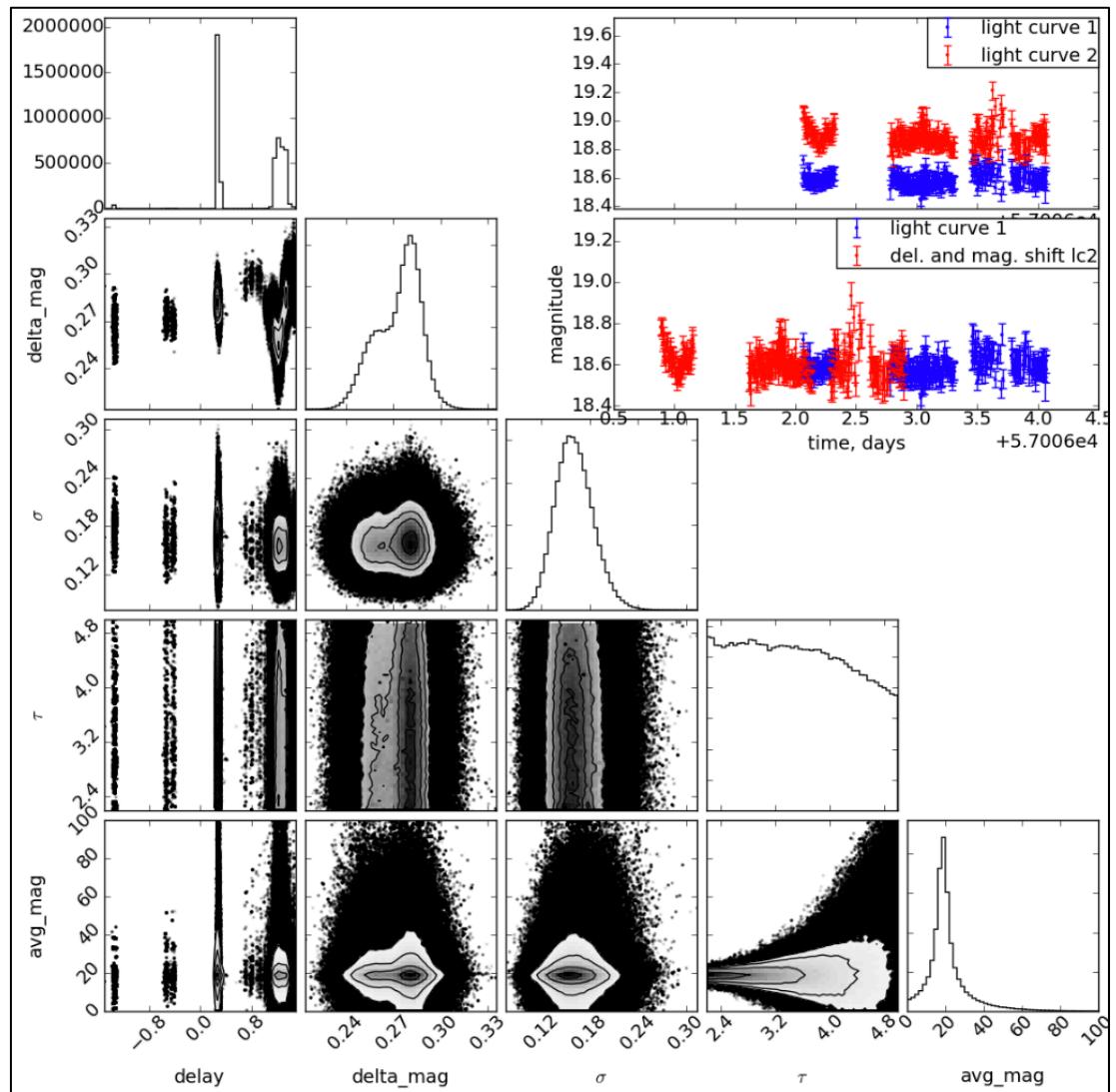
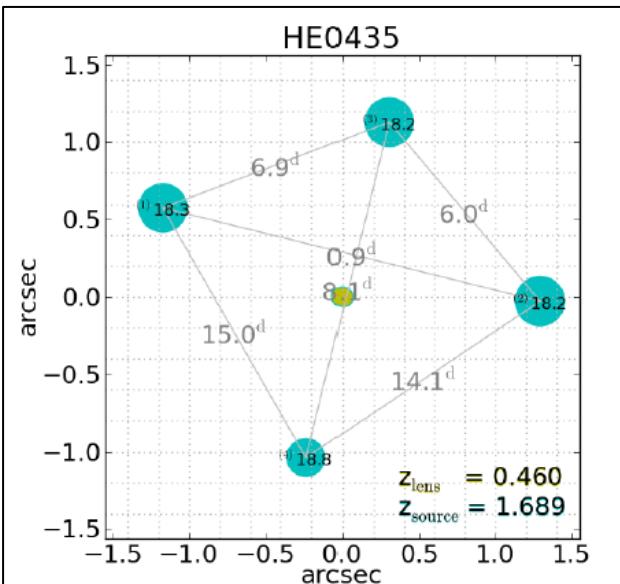


Damped Random Walk Characterization of LCOGT HE0435-1223 Light Curves

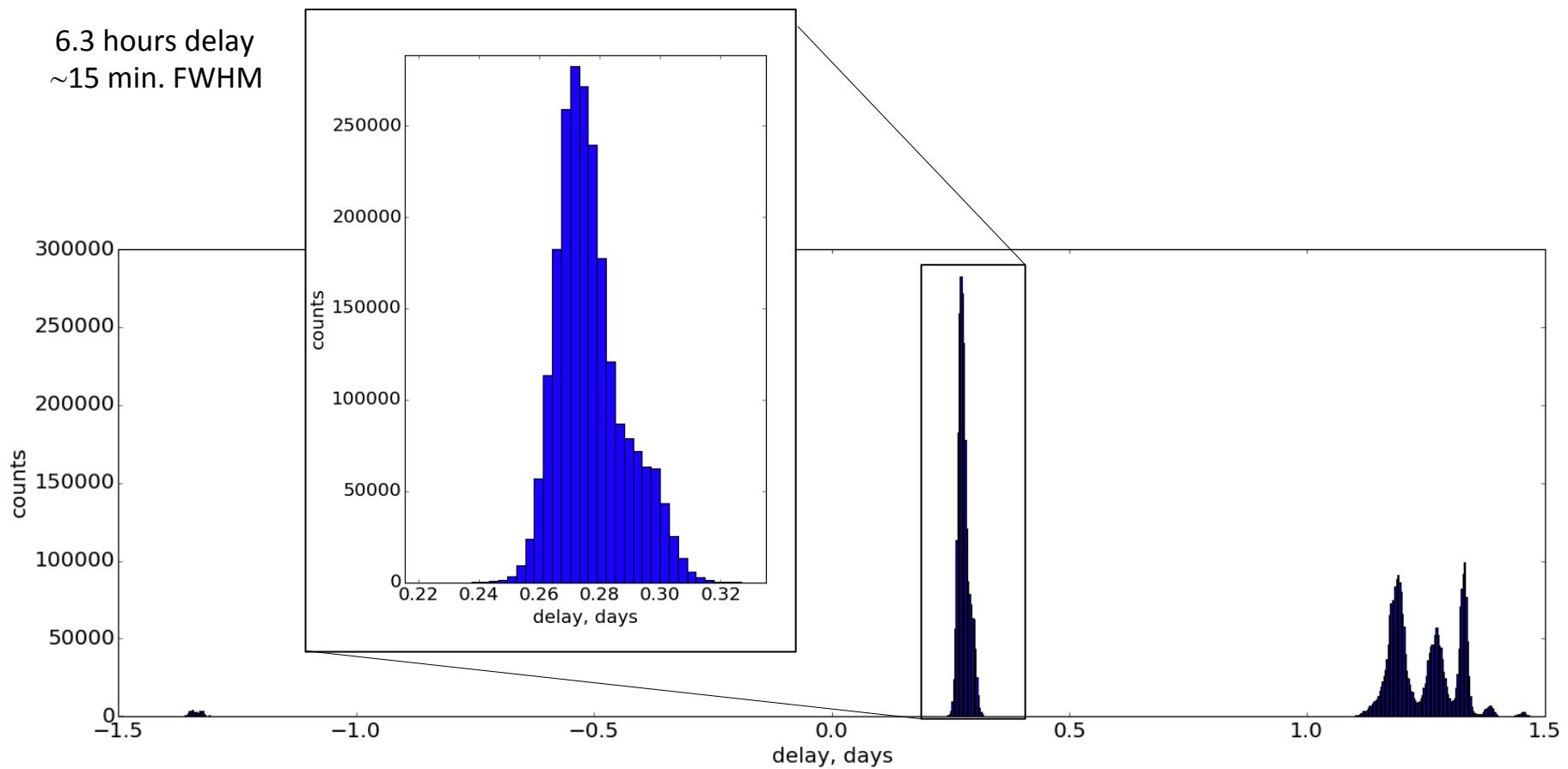


Delay Estimation

Delay between light curves 1 and 2.

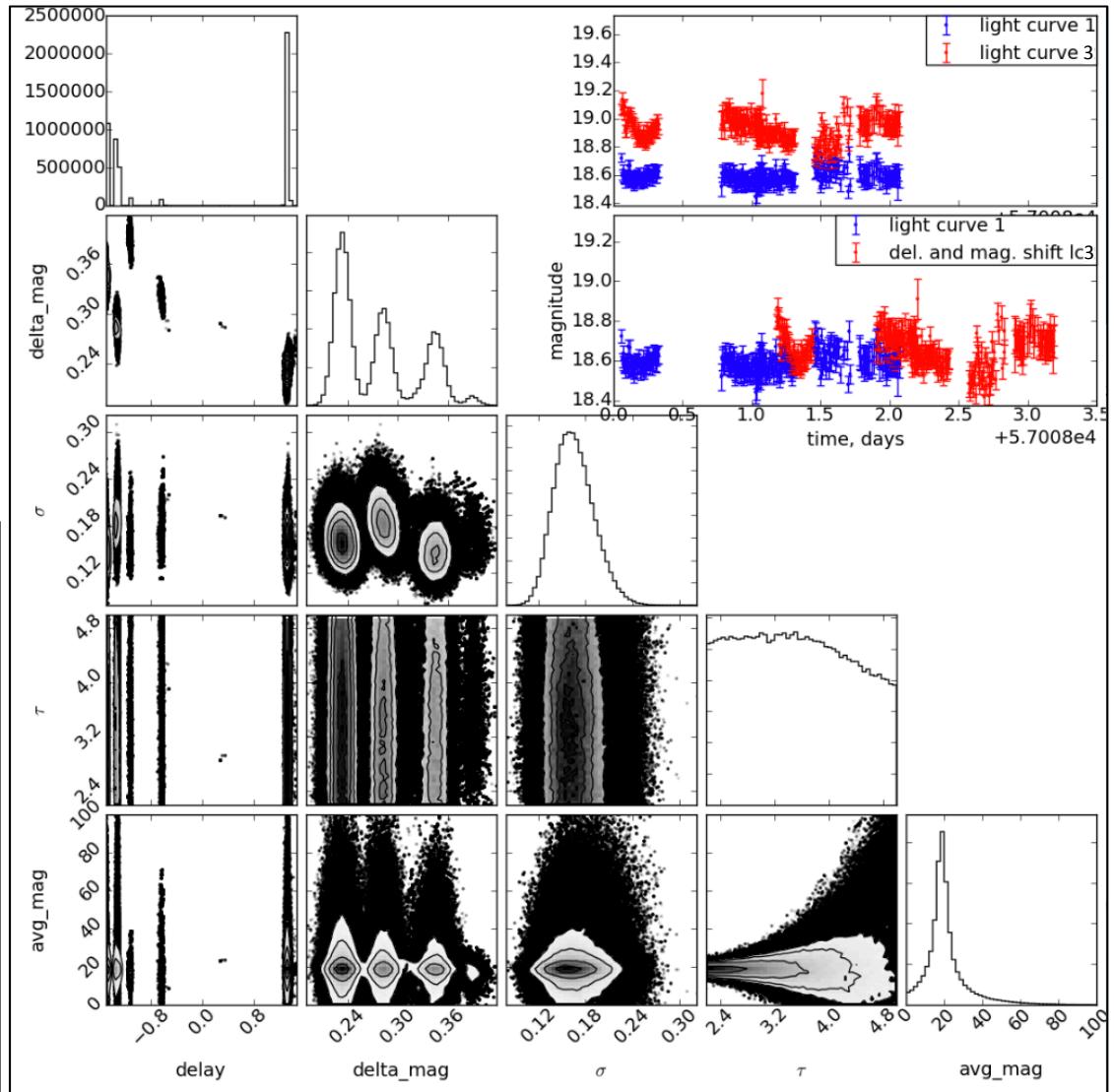
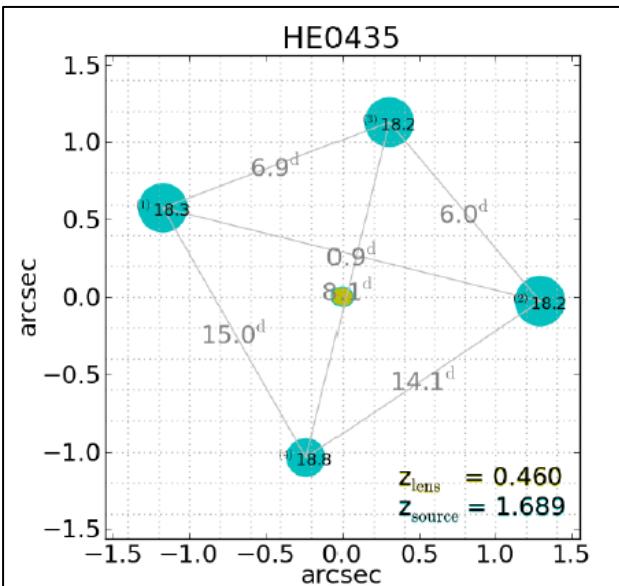


Light Curve 1 and 2 delays.

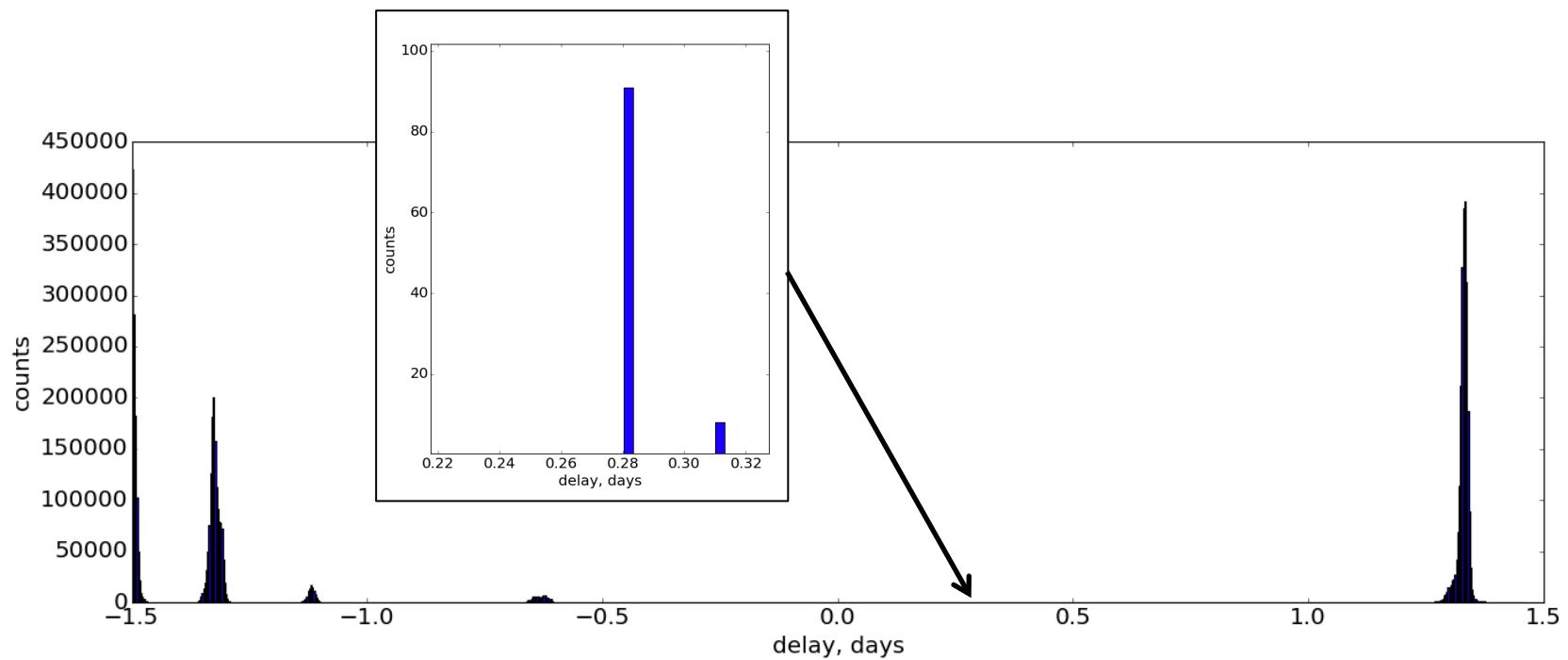


Delay Estimation

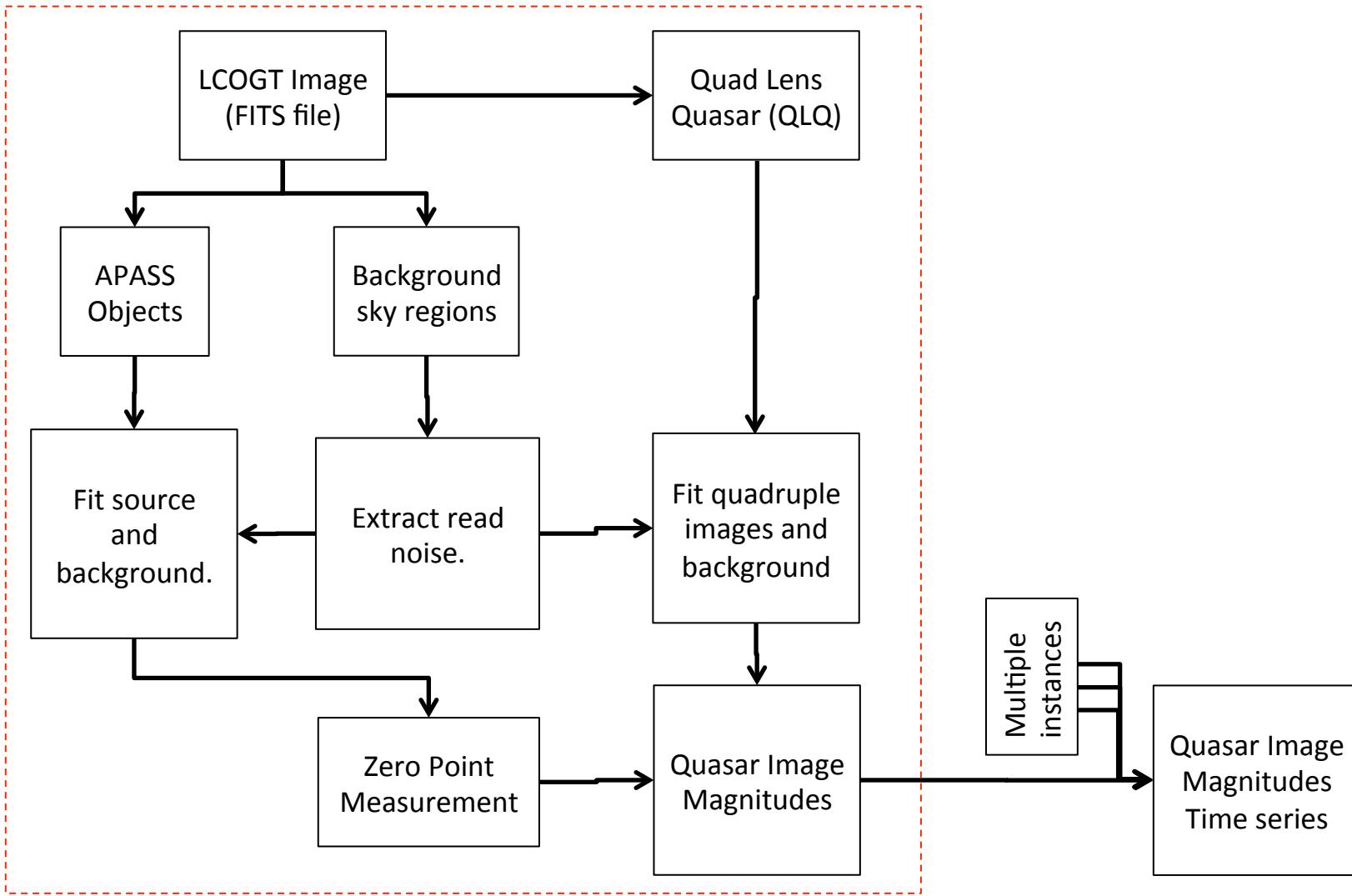
Delay between light curves 1 and 3.



Light Curve 1 and 3 delays

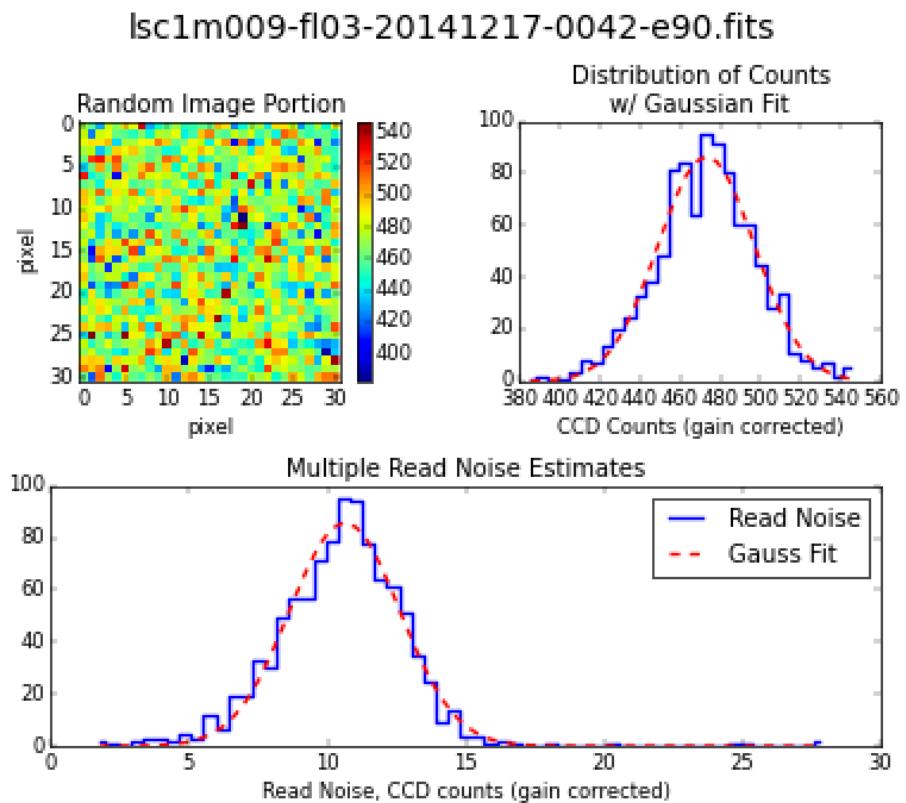


More LCOLens Analysis



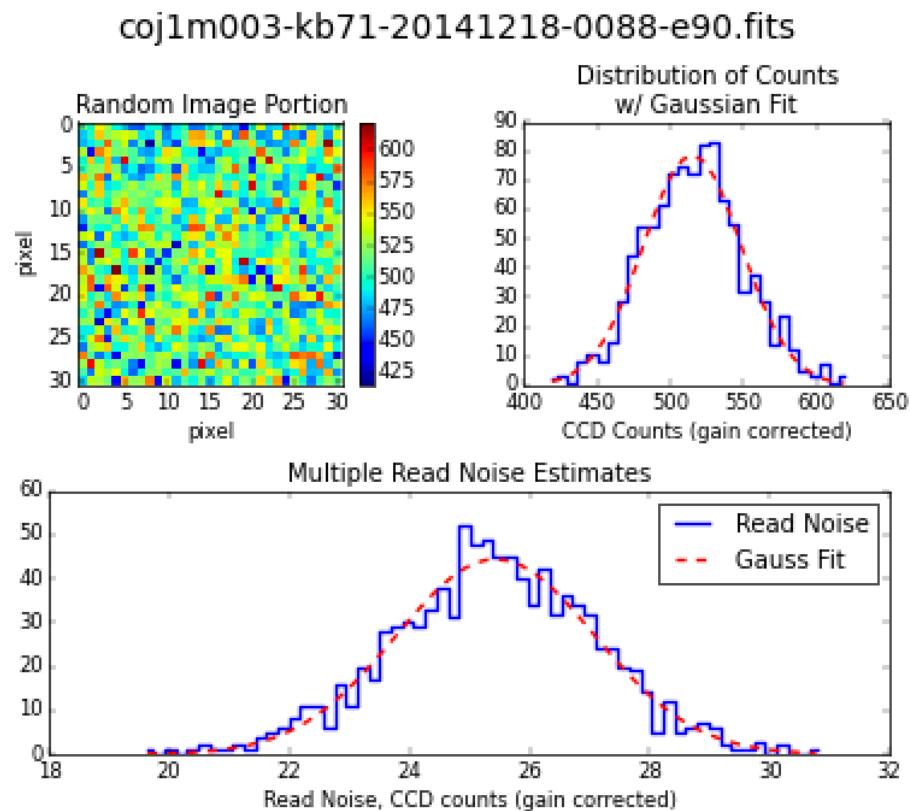
Read Noise Estimation

- The CCD counts are gain corrected before estimating read noise.
- For the count distribution to follow \sqrt{N} , the statistics has to be on photons, not electrons.
- Added Gaussian Fit to the distribution of read noise estimates.



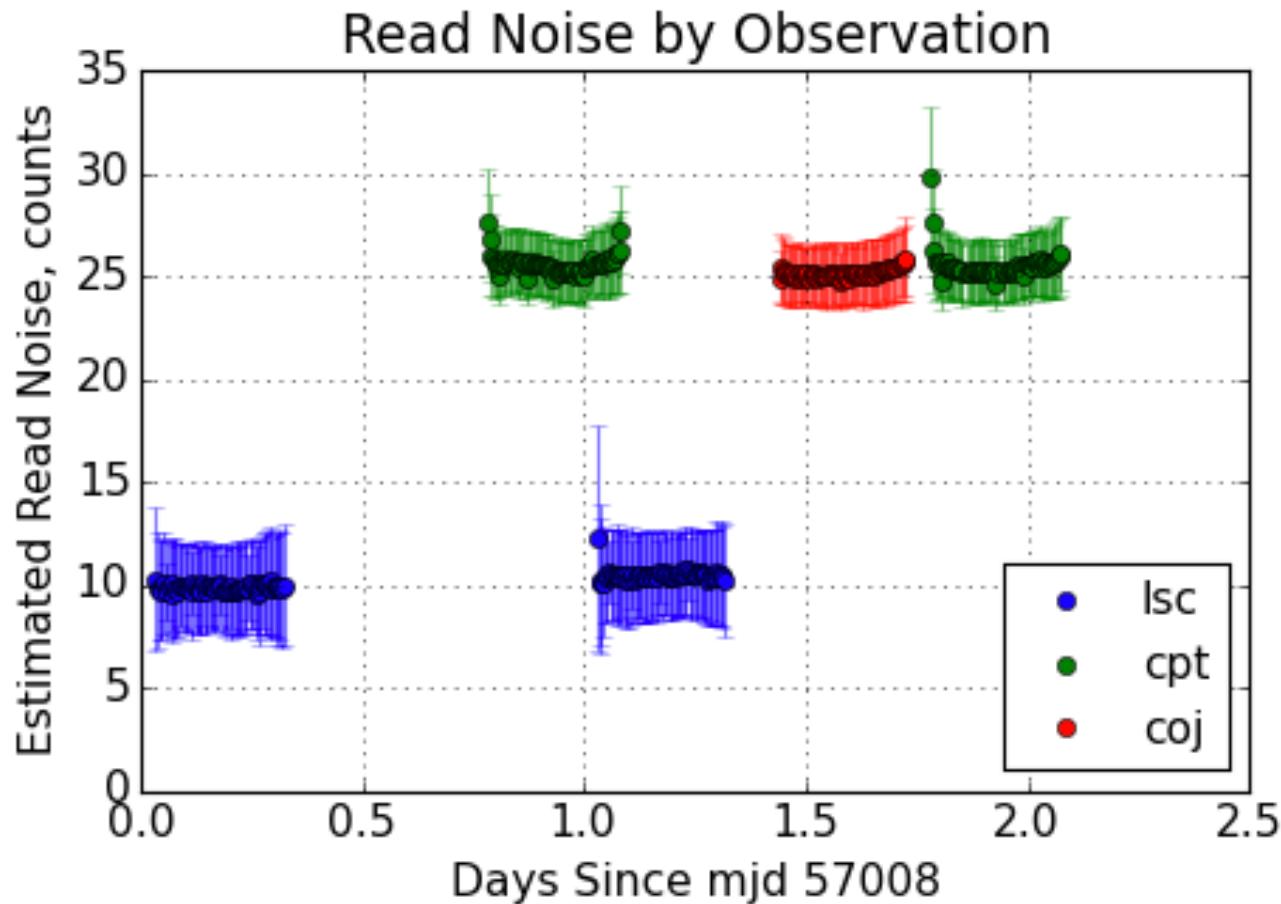
Read Noise Estimation

- Last time it was pointed out that a read noise of 25 counts for COJ and CPT was excessive.
- Here are the distributions. No obvious anomalies observed here.



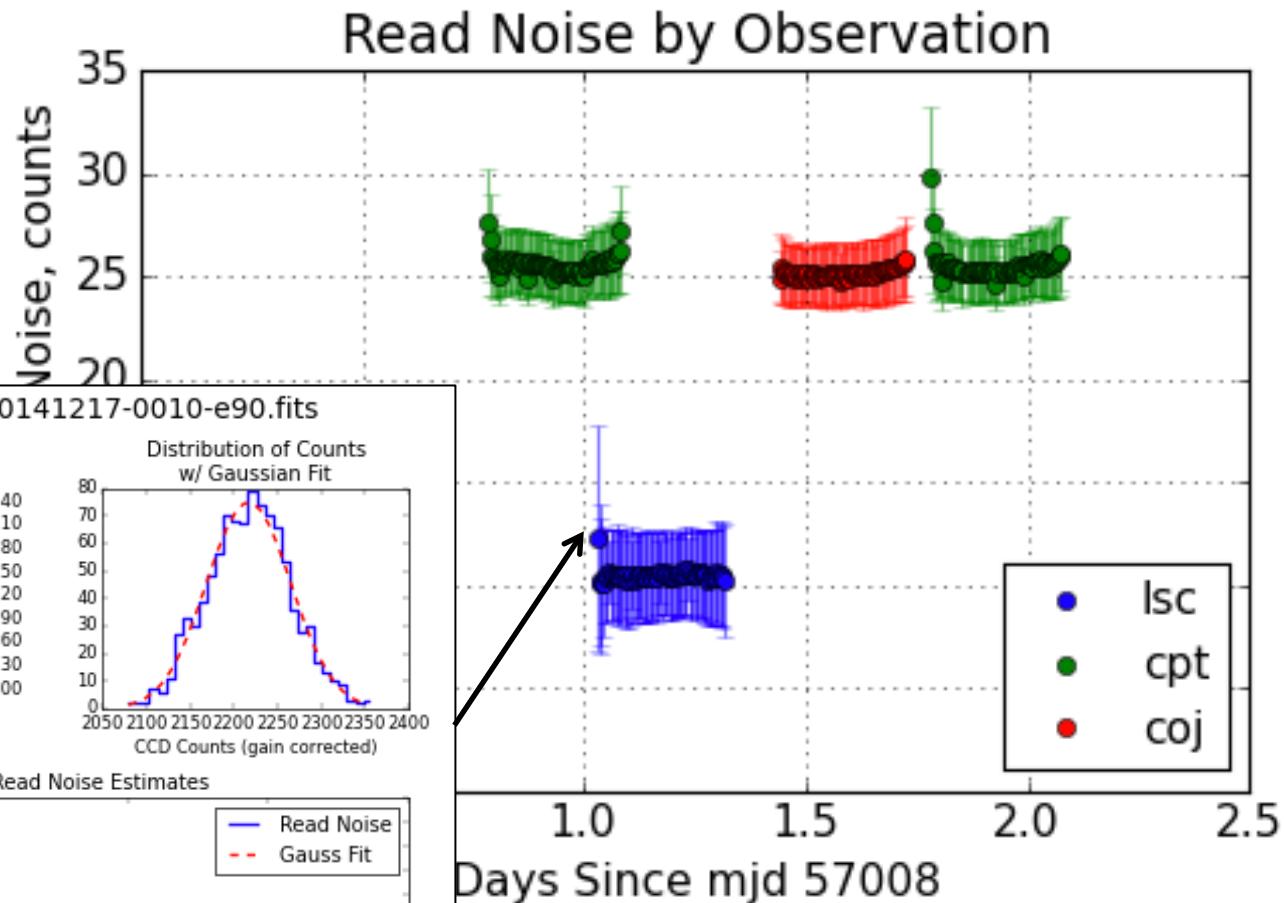
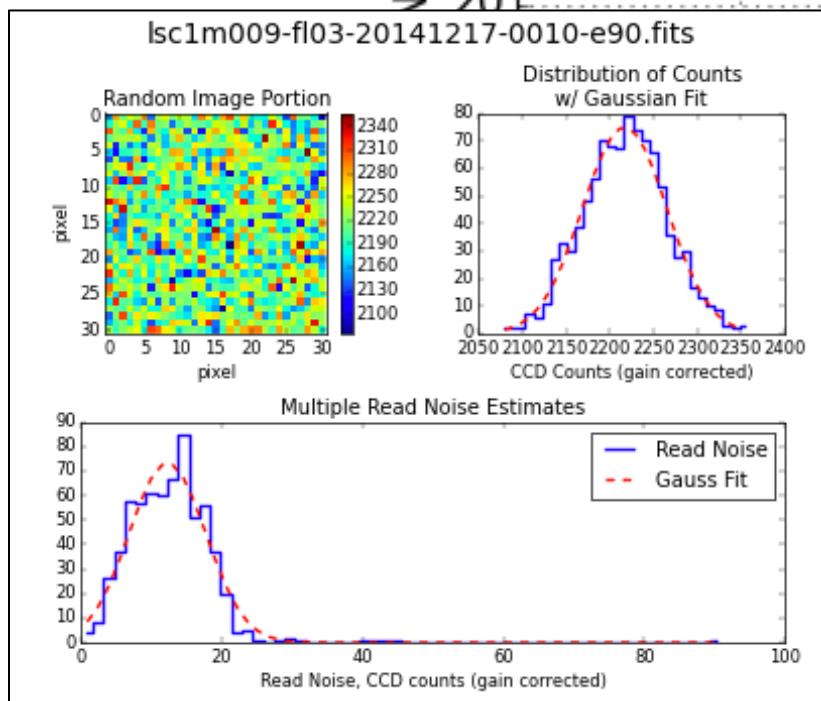
Read Noise

Read noise by observation,
now with estimation
uncertainties!



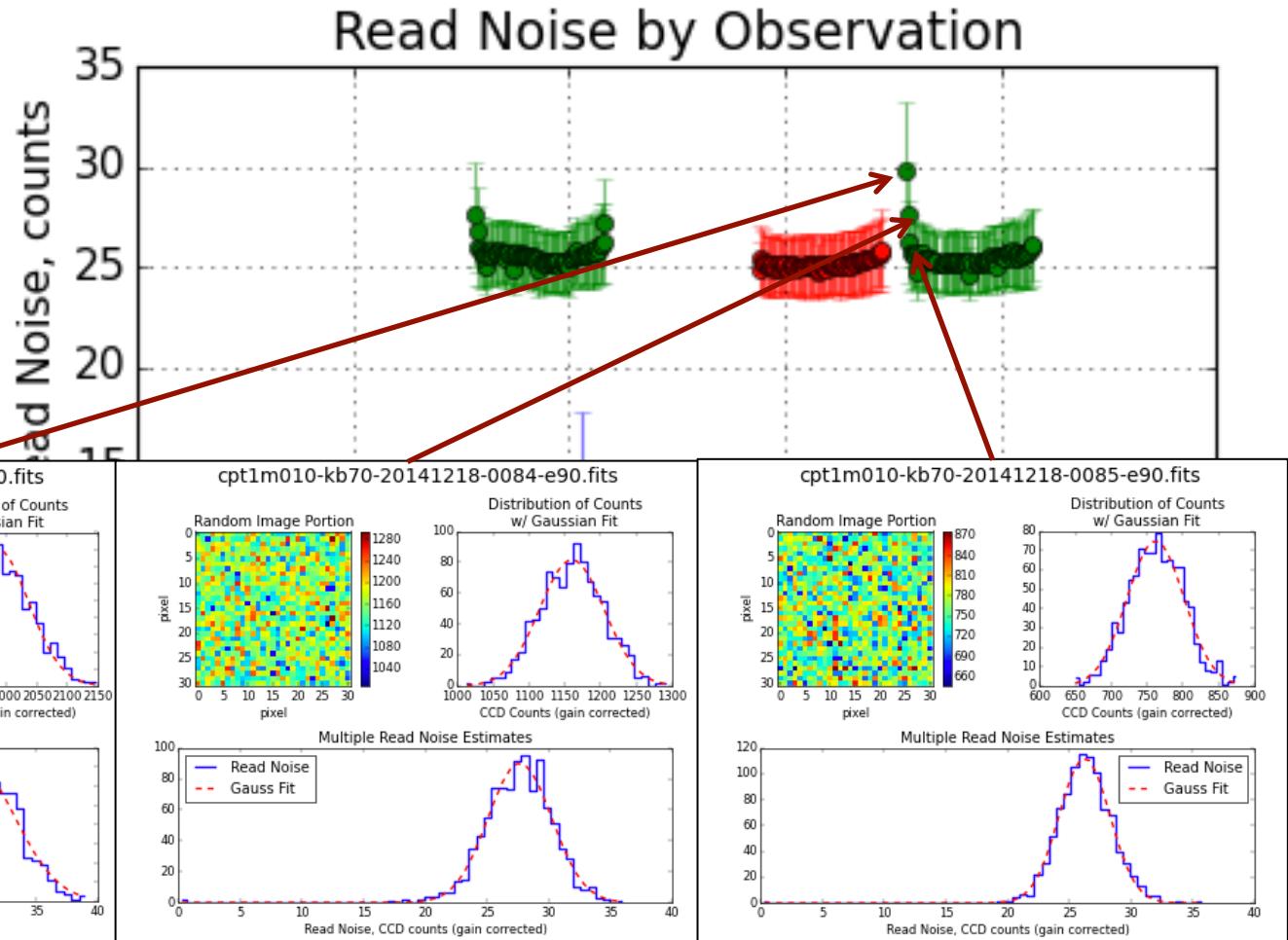
Read Noise

Read noise by observation, now with estimation uncertainties!

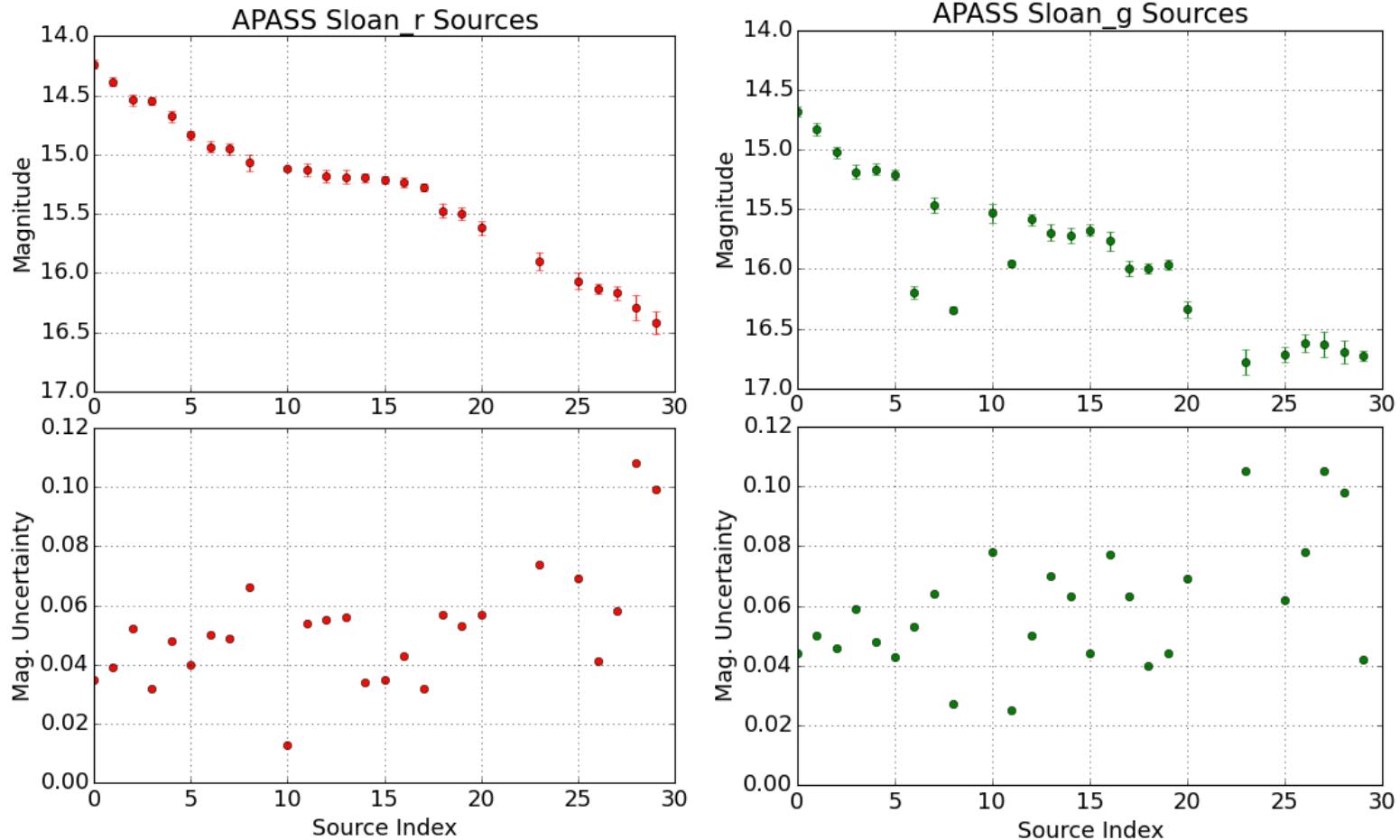


Read Noise

Read noise by observation,
now with estimation
uncertainties!



APASS Catalogue



Propagation of Zero Point Uncertainties

Zero point estimated in flux for each APASS source k .

Uncertainty of each estimate is added in quadrature.

Zero point for FITS image estimated as a weighted mean.

Which uncertainty to use? Uncertainty on the mean or wrms?

Zero
point

$$z_k = \frac{f_{A,k}}{f_{I,k}}$$

APASS flux
Instrument flux

Uncertainty for each zero point

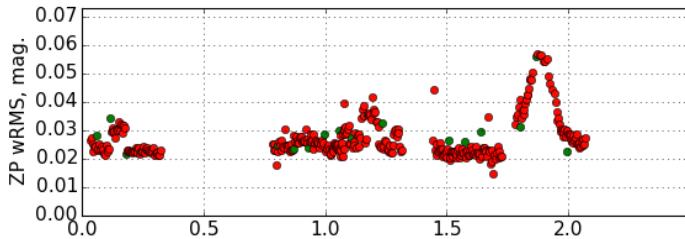
$$\sigma_k = \sqrt{\sigma_{A,k}^2 + \sigma_{I,k}^2}$$

$$z = \sum_{k=1}^N w_k z_k \sqrt{\sum_{k=1}^N w_k} \quad w_k = 1 / \sigma_k^2$$

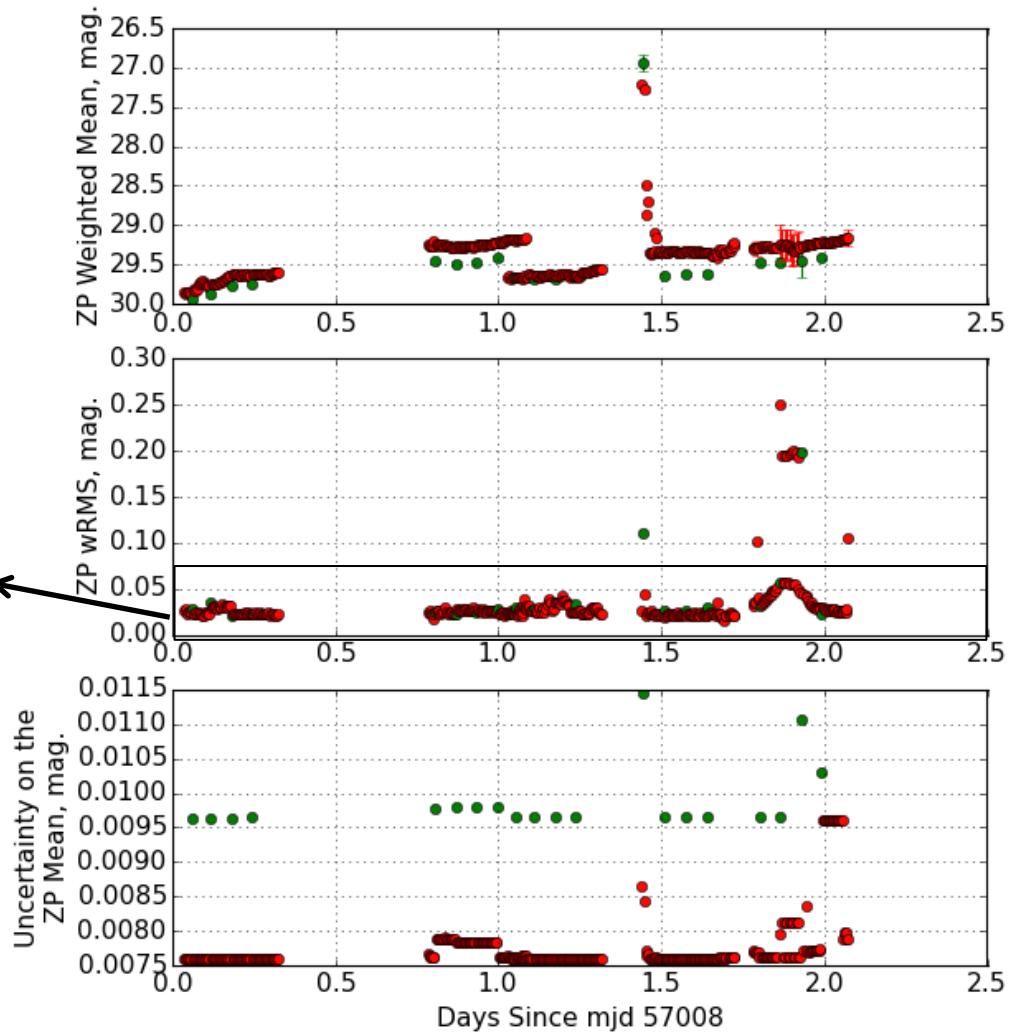
$$\sigma_{wAv} = \frac{1}{\sqrt{w_k}} \quad \sigma_{wRMS} = \sqrt{\sum_{k=1}^N w_k (z_k - z)^2} \sqrt{\sum_{k=1}^N w_k}$$

Zero Point Uncertainties

wRMS between 2-4% on good measurements.

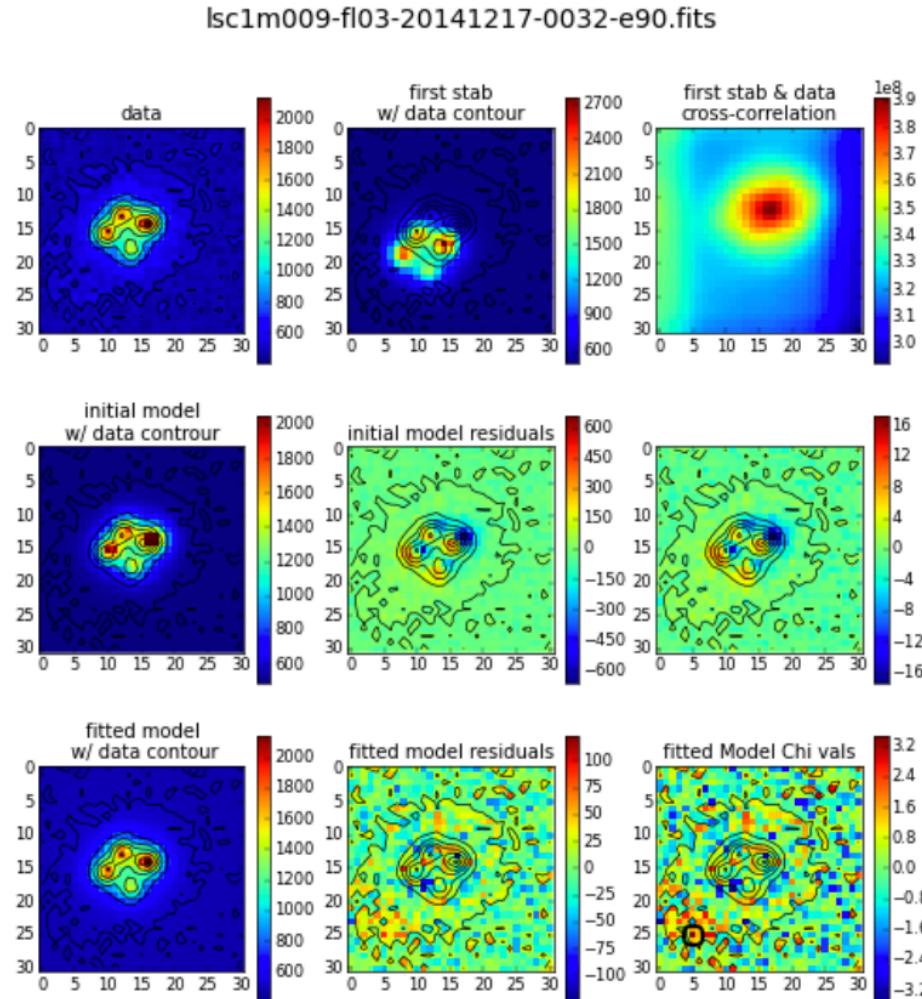


Uncertainty on the mean between <1% on most measurements.

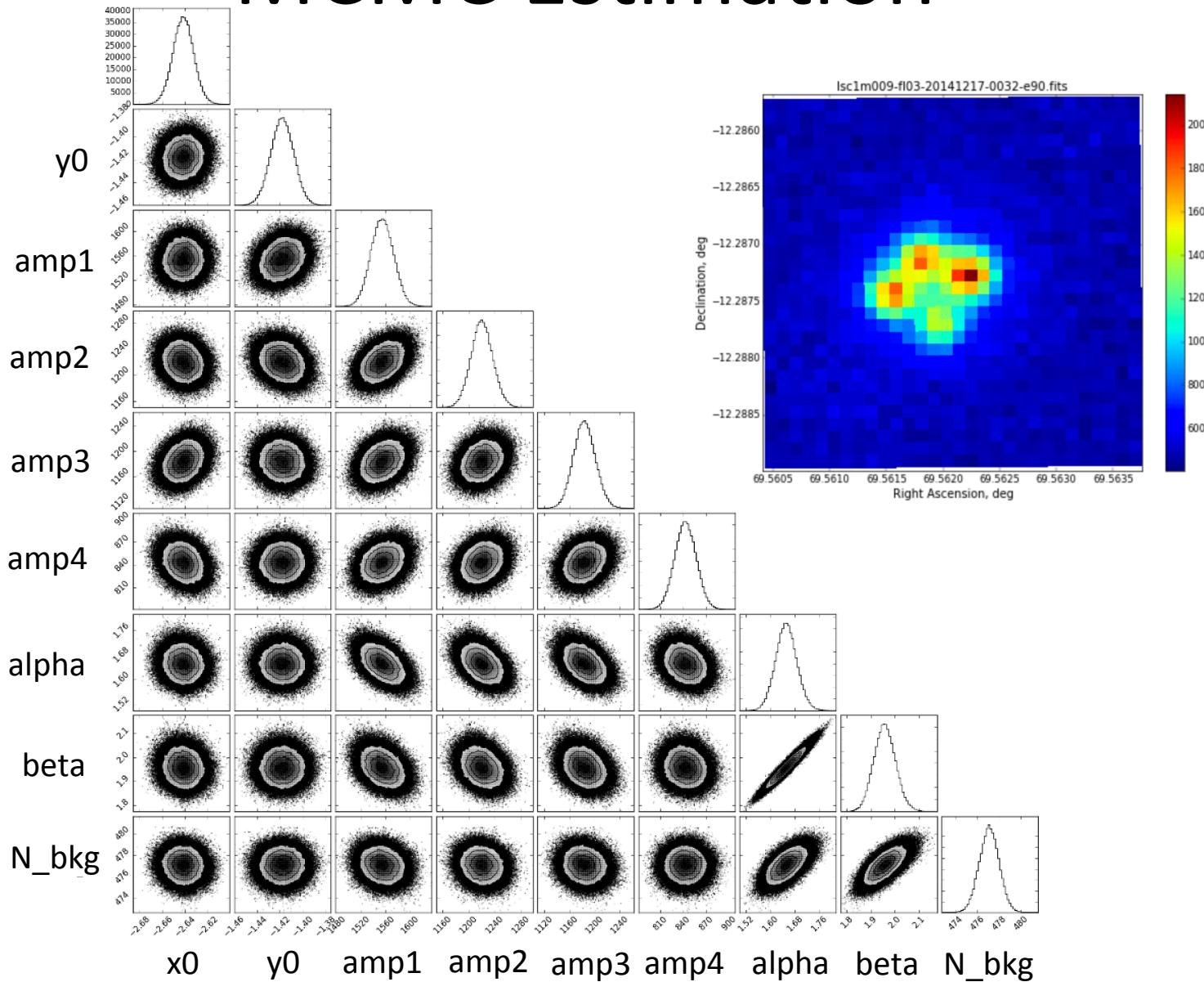


Multiple Quasar Image Fitting

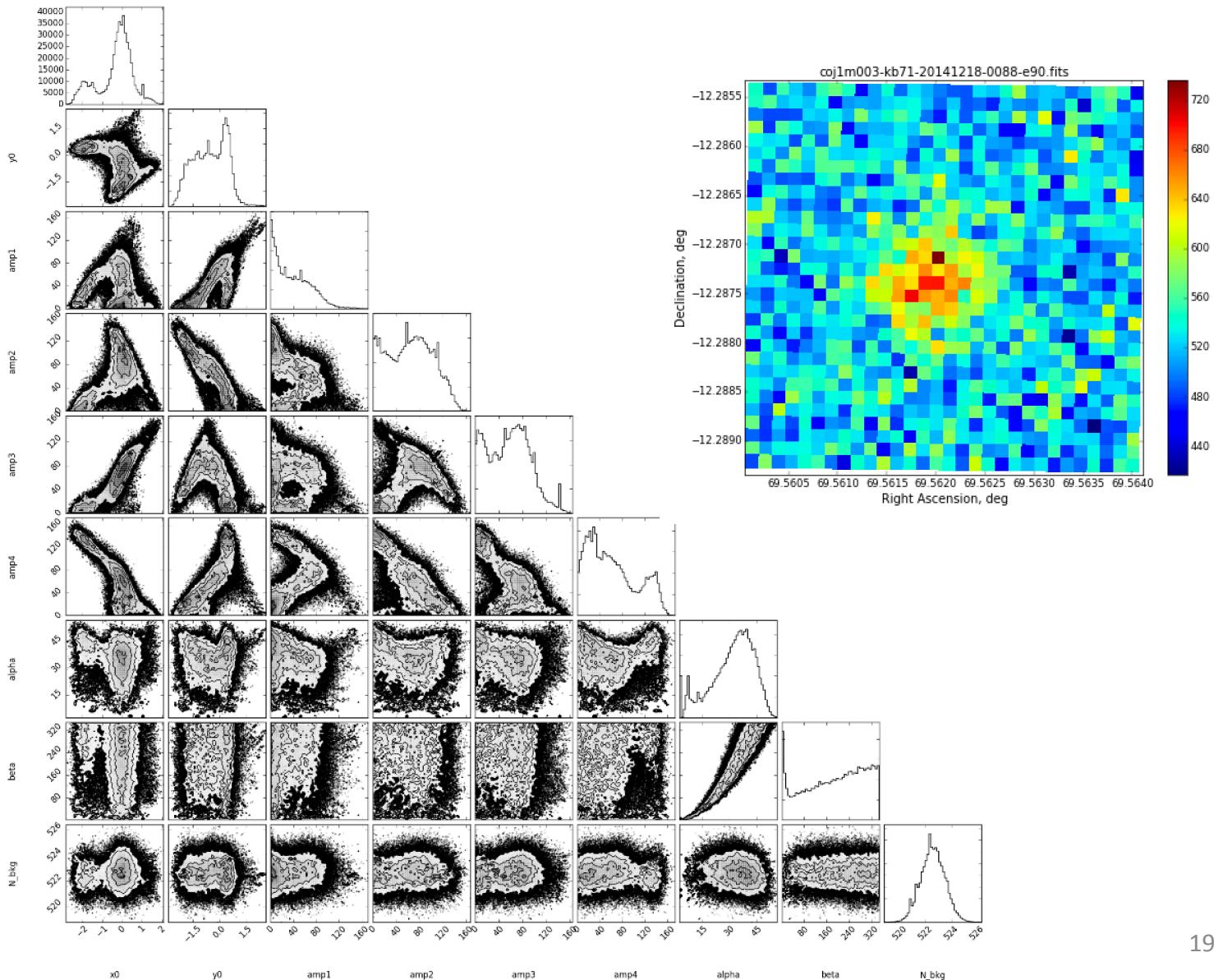
1. Start with a model of the points fixed to a cross and amplitudes.
2. Cross-correlate the model to the data to align the source.
3. Fit a quadruple circular Moffat profile. Free parameters are:
 - Position of the system.
 - Four amplitudes
 - Background
 - moffat alpha and beta.Fit Moffat profiles on set points on the cross.



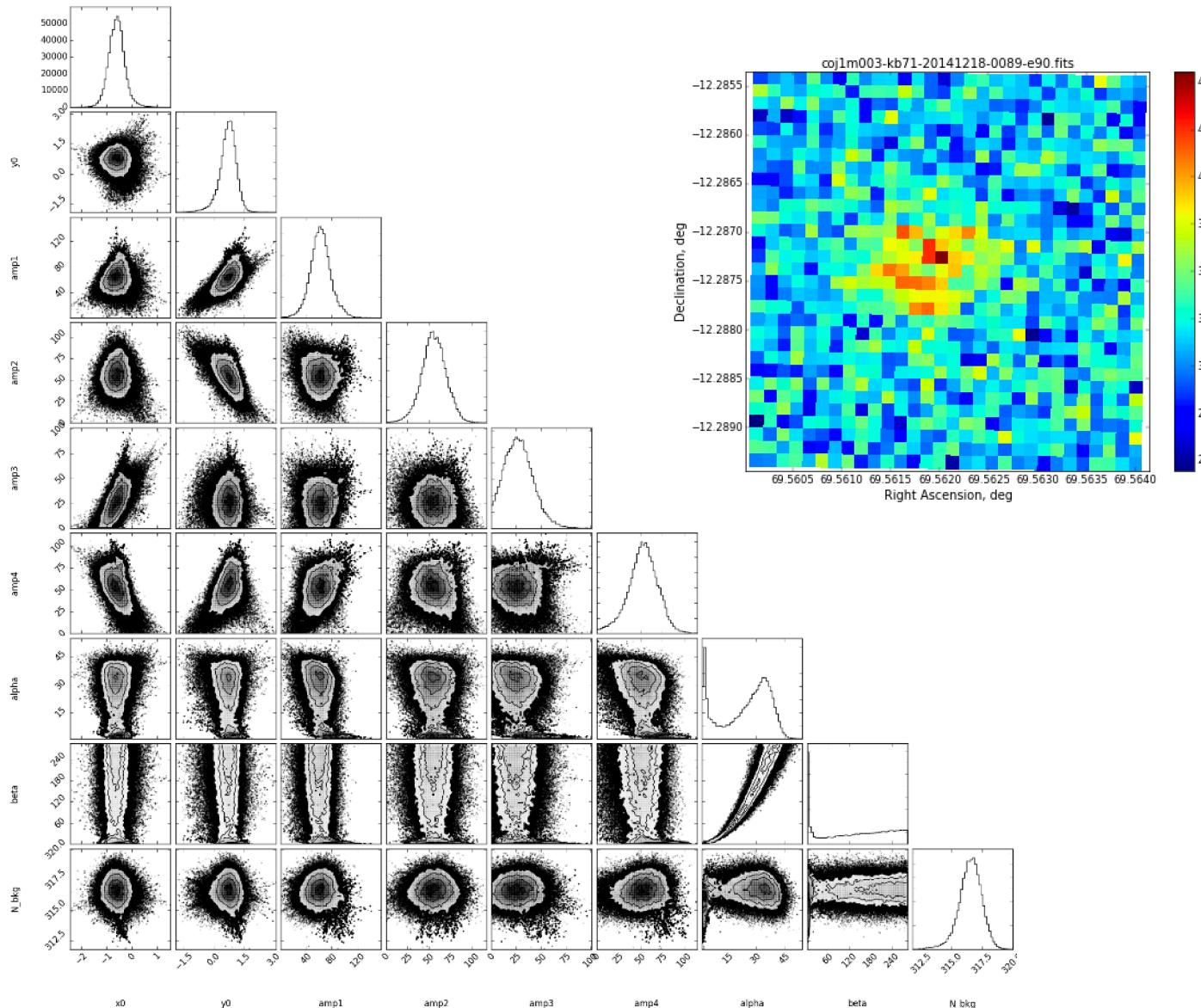
MCMC Estimation



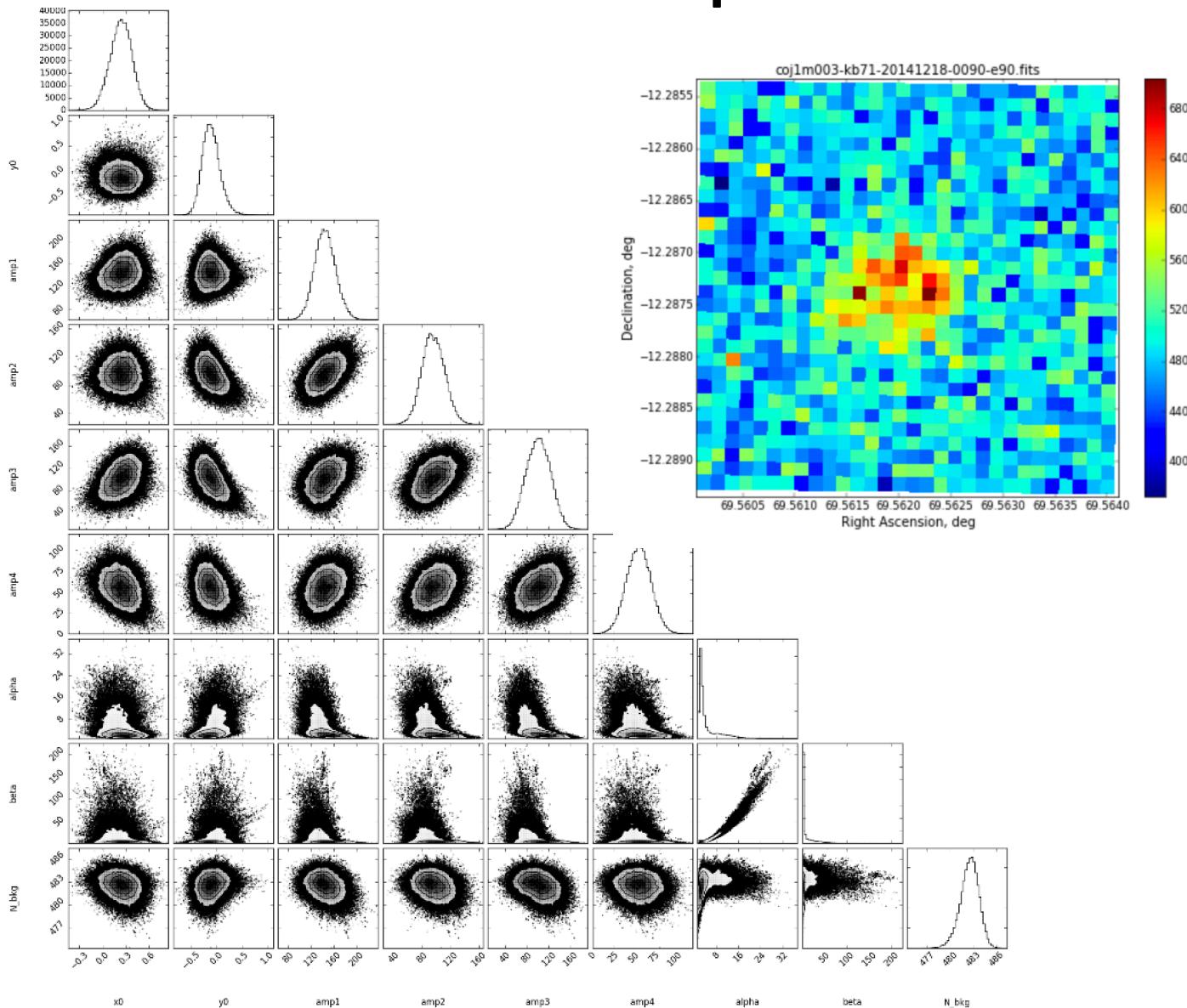
Worst case



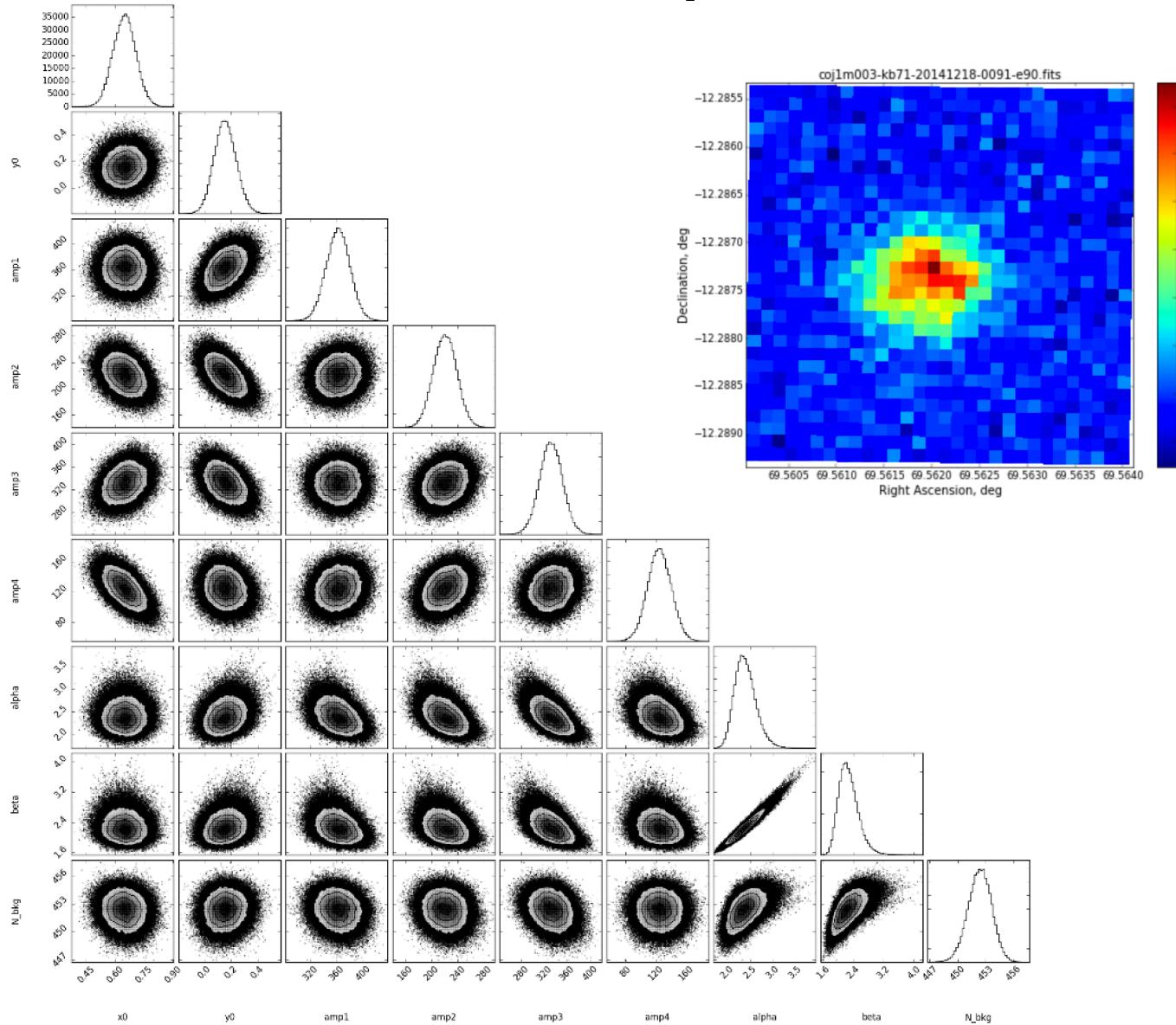
Next in the Sequence



Next in the Sequence



Next in the Sequence

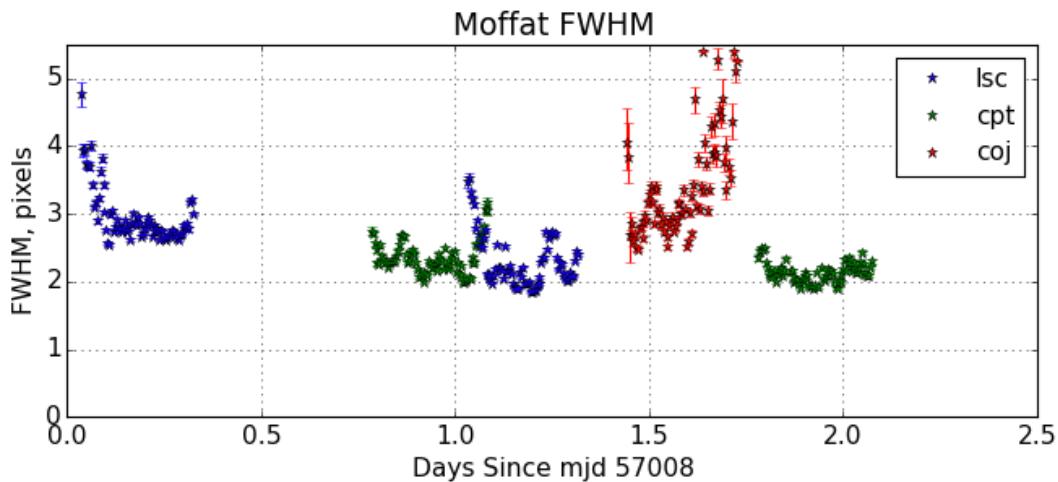
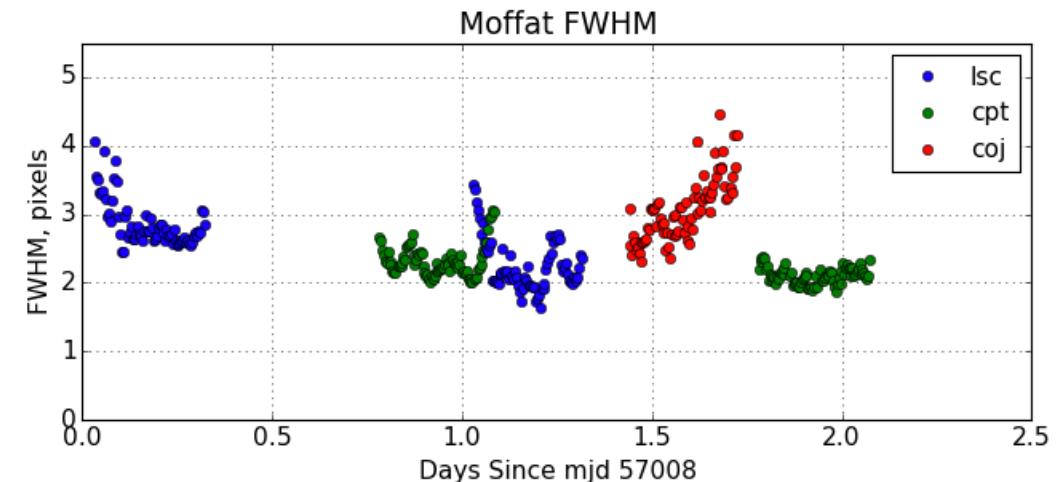


Seeing APASS Avg. and MCMC Estimated

FWHM from weighted average of α and β estimated from APASS sources.

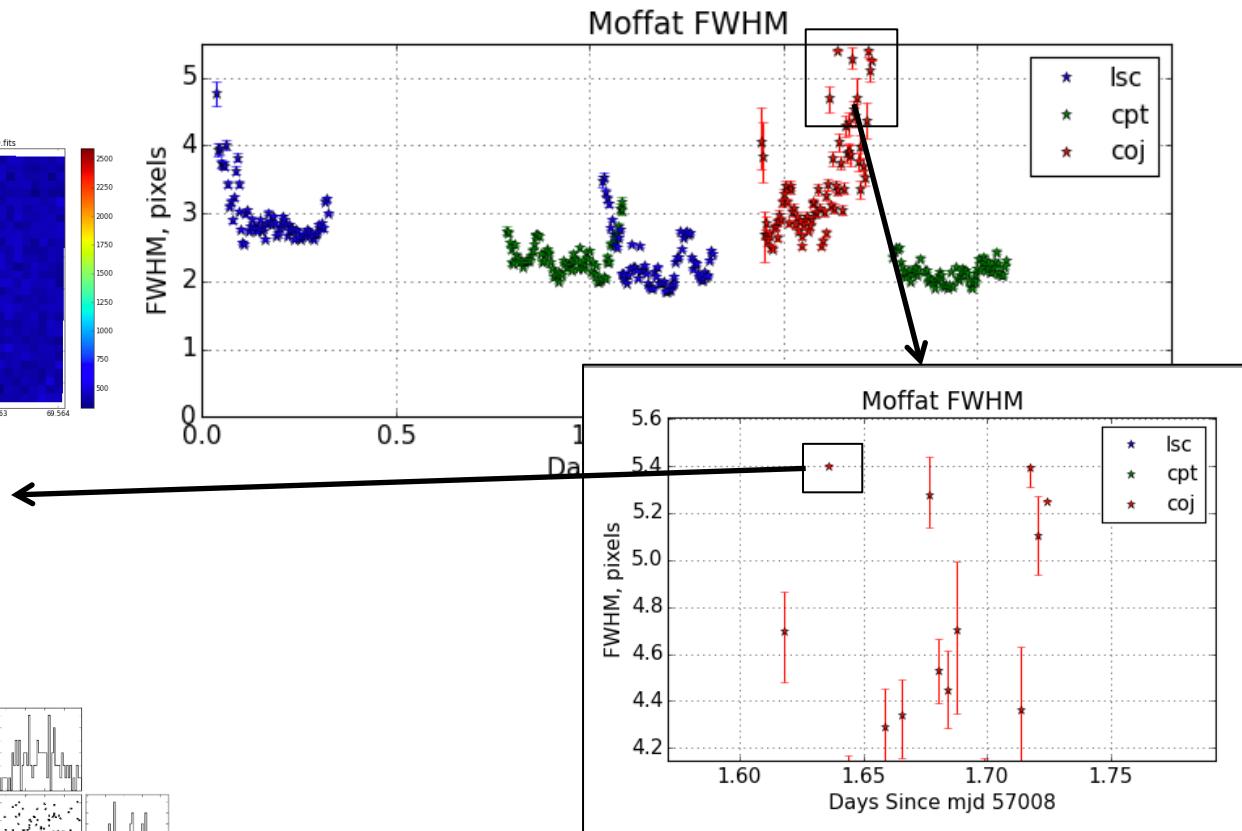
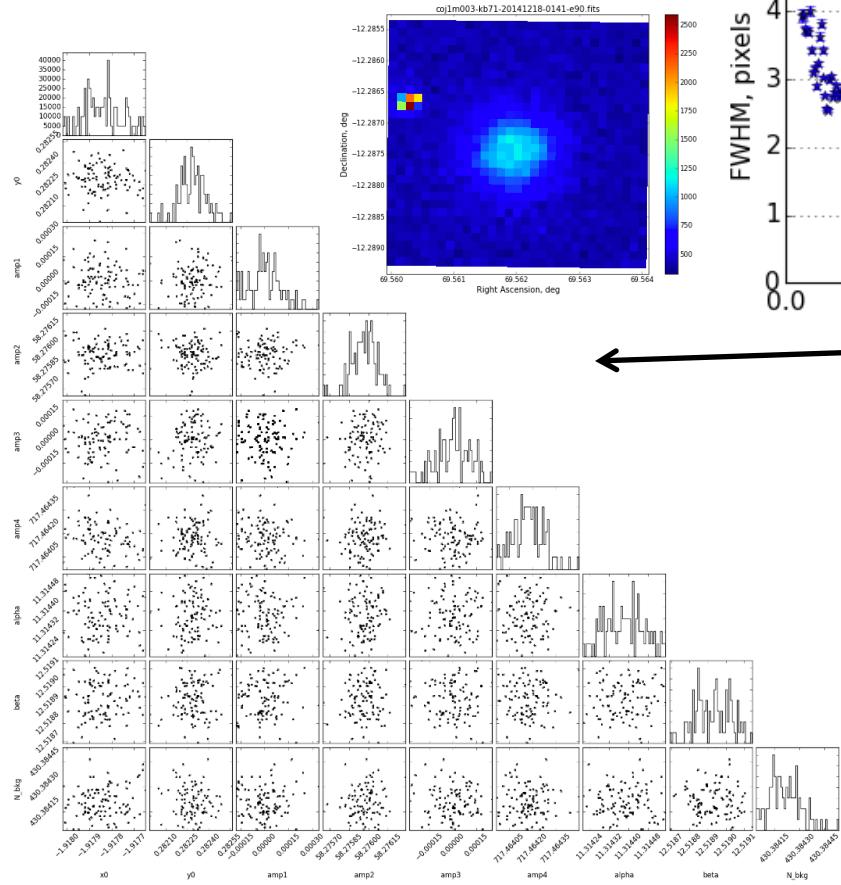
FWHM estimated from emcee fit to the quasar images.

Values are the 16-84 percentile intervals of the emcee derived distributions.



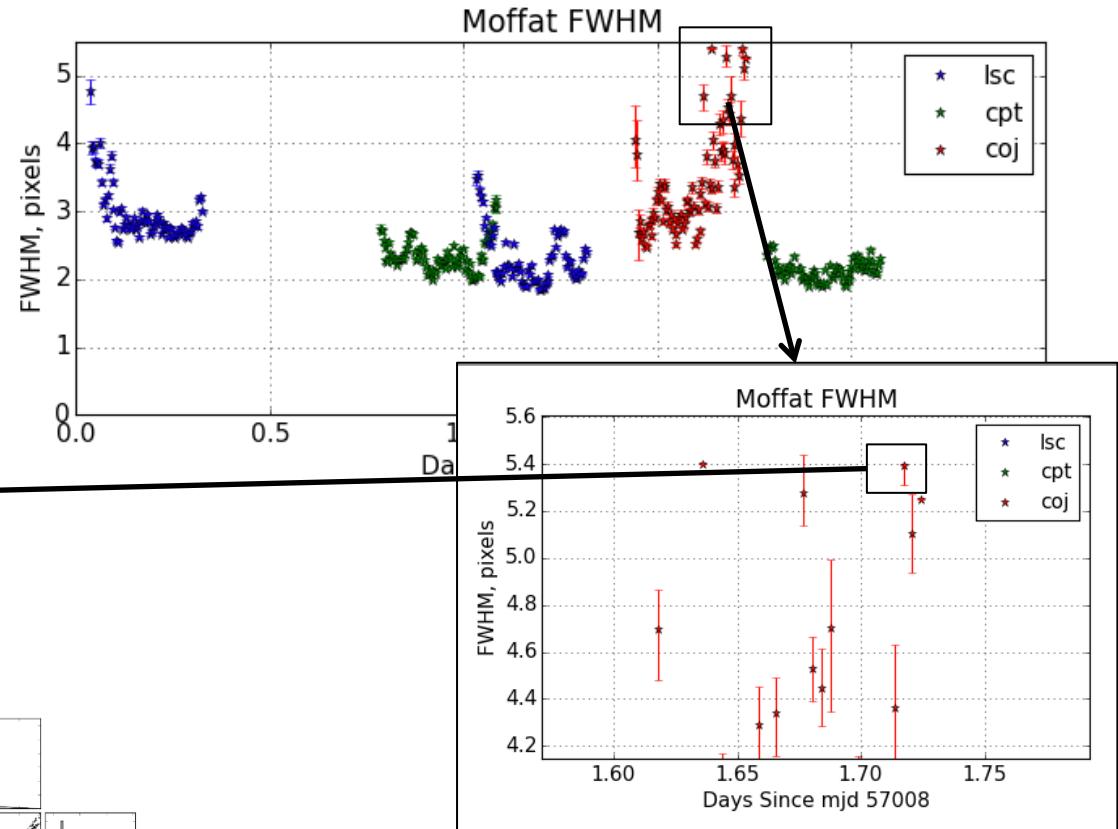
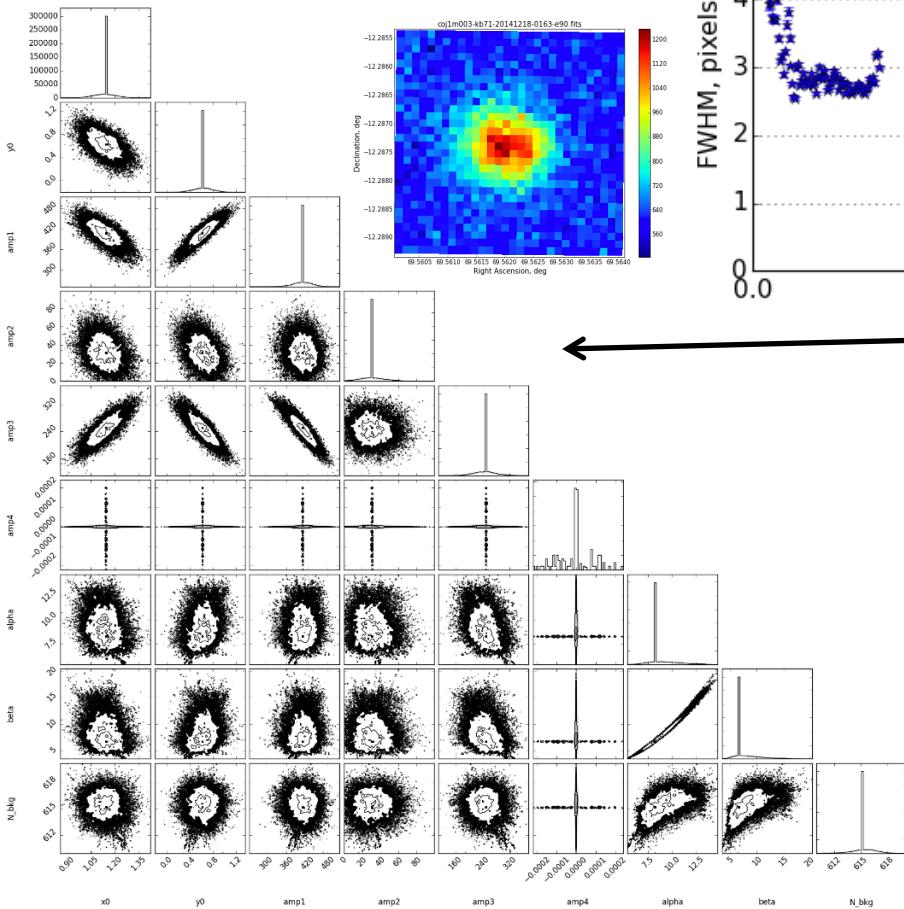
Seeing MCMC Estimated

Some convergence issues.



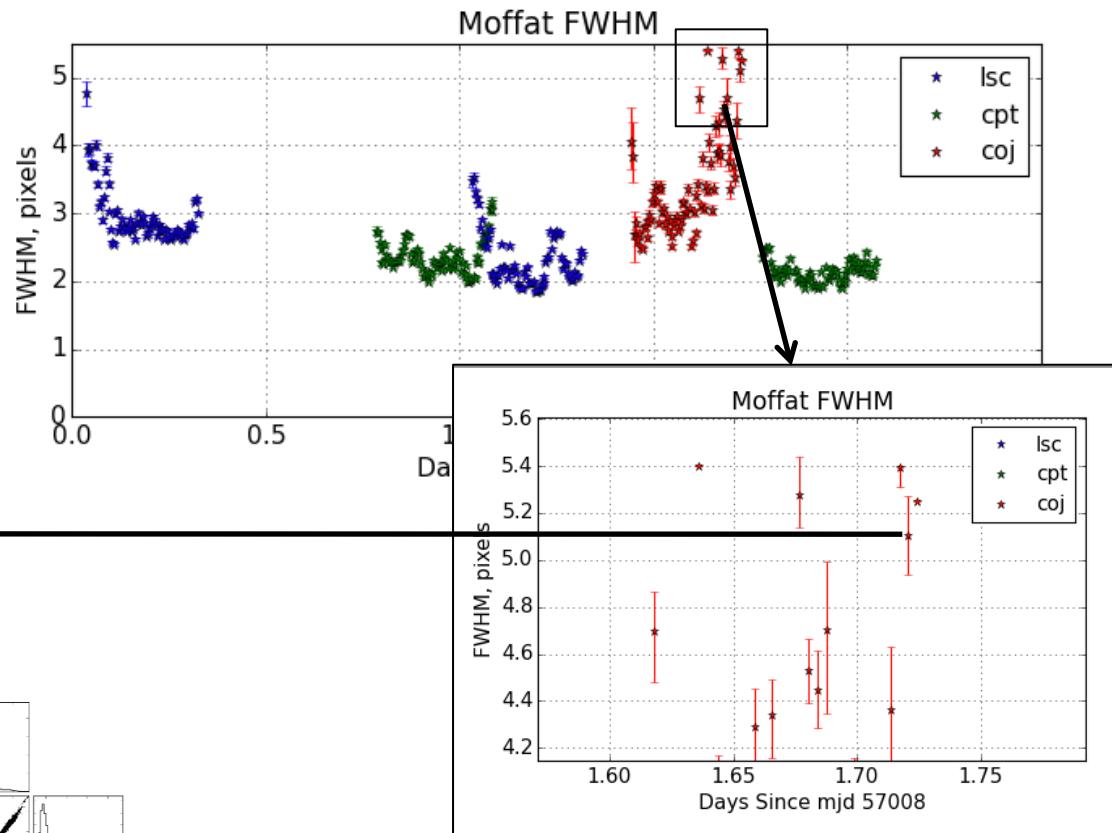
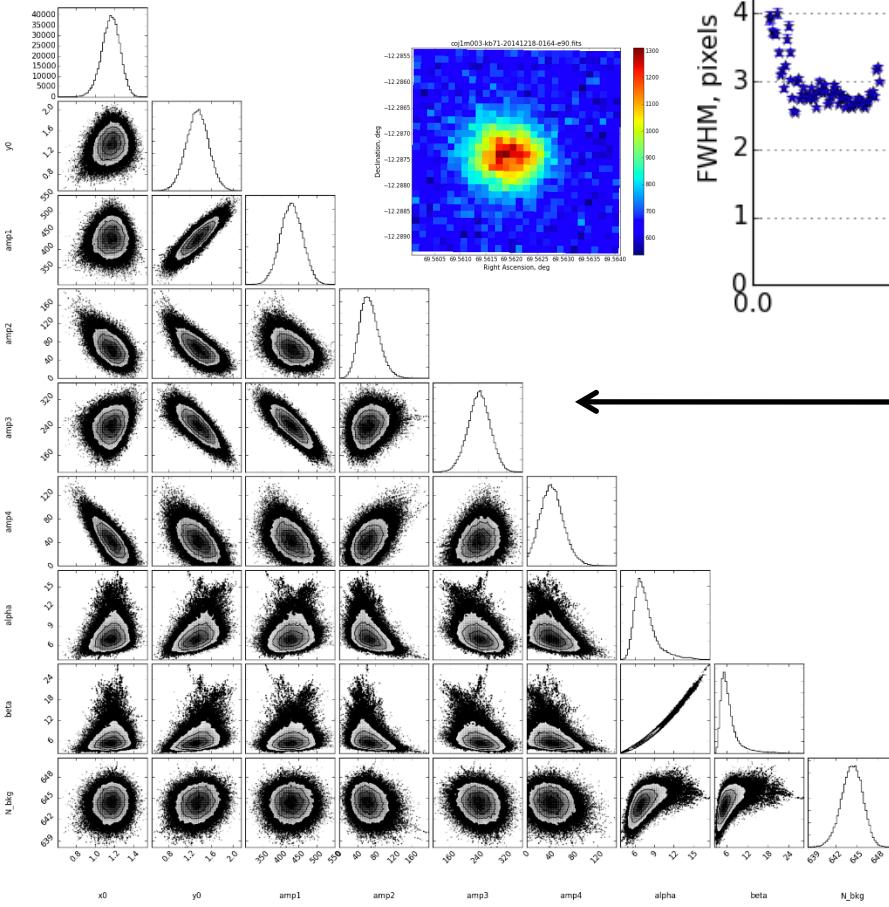
Seeing APASS Avg. and MCMC Estimated

Some convergence issues.



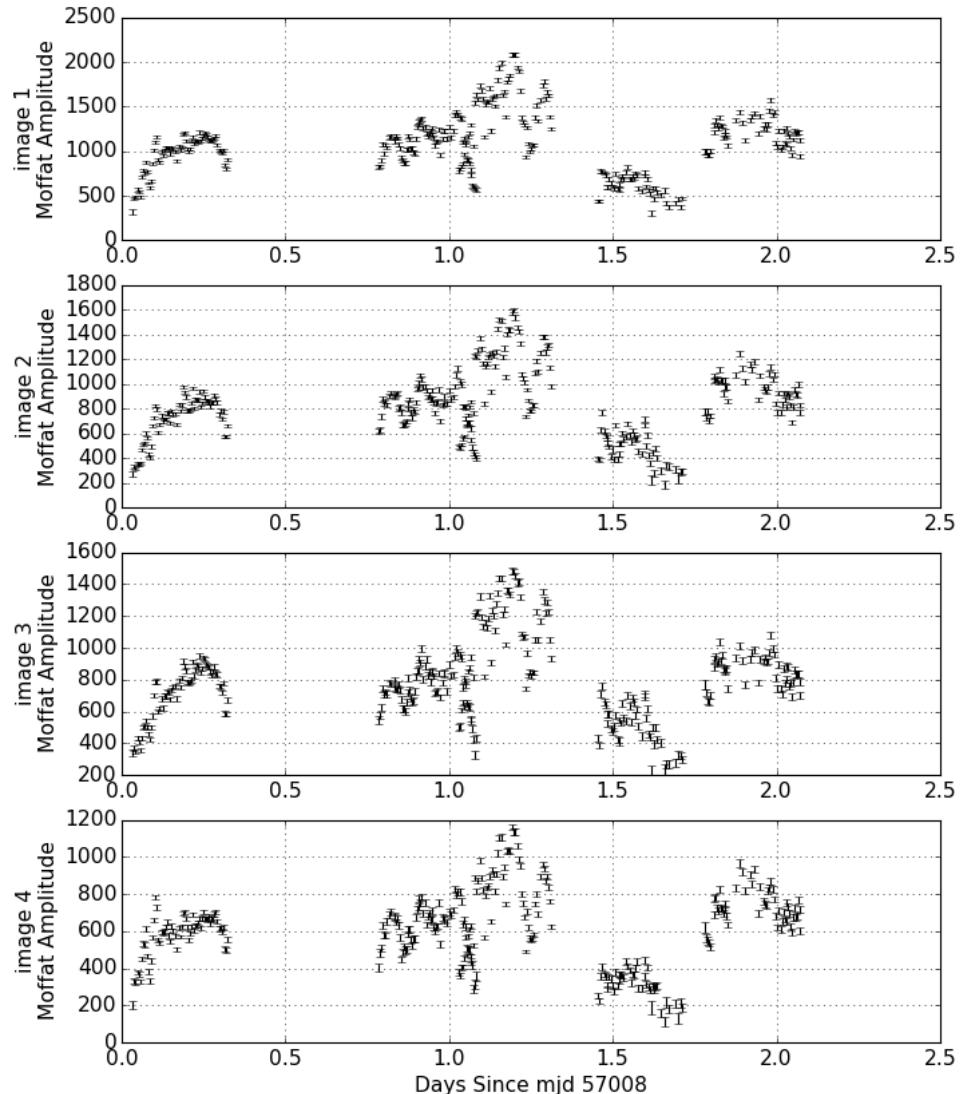
Seeing APASS Avg. and MCMC Estimated

But they are rare.



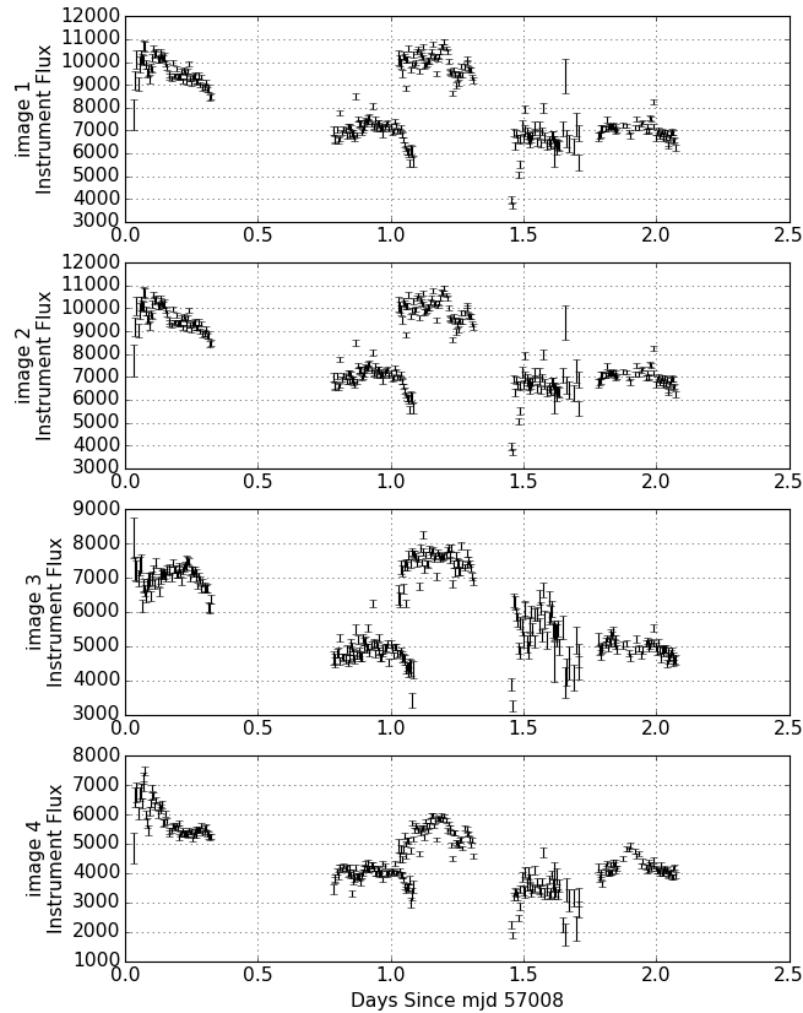
Emcee Quasar Amplitudes

Fit to the amplitudes of the quasar image Moffat profiles.



Emcee Quasar Image Instrument Fluxes

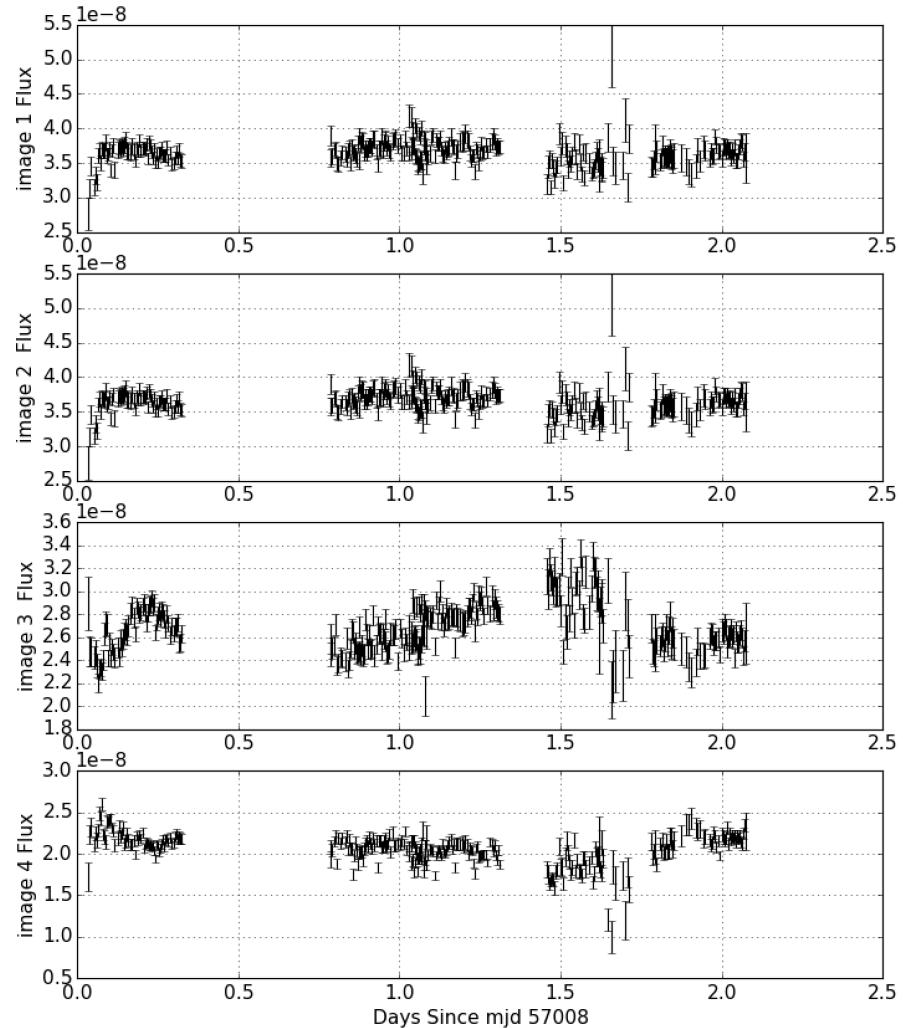
Integrate the Moffat profiles on a 31x31 pixel grid to estimate their total light contribution.



Emcee Quasar Image Zero Point-Corrected Fluxes

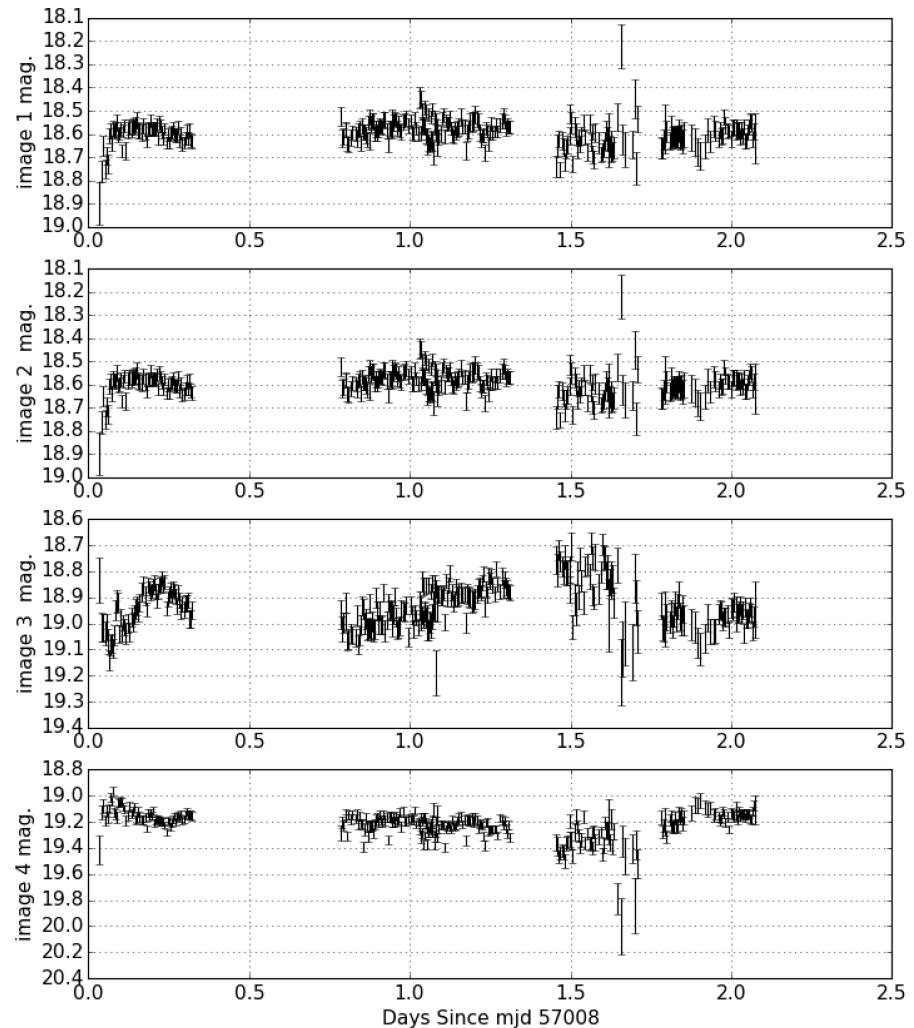
Zero point flux corrections

$$f = \left\langle \frac{f_{A,ref}}{f_{A,I}} \right\rangle f_I$$



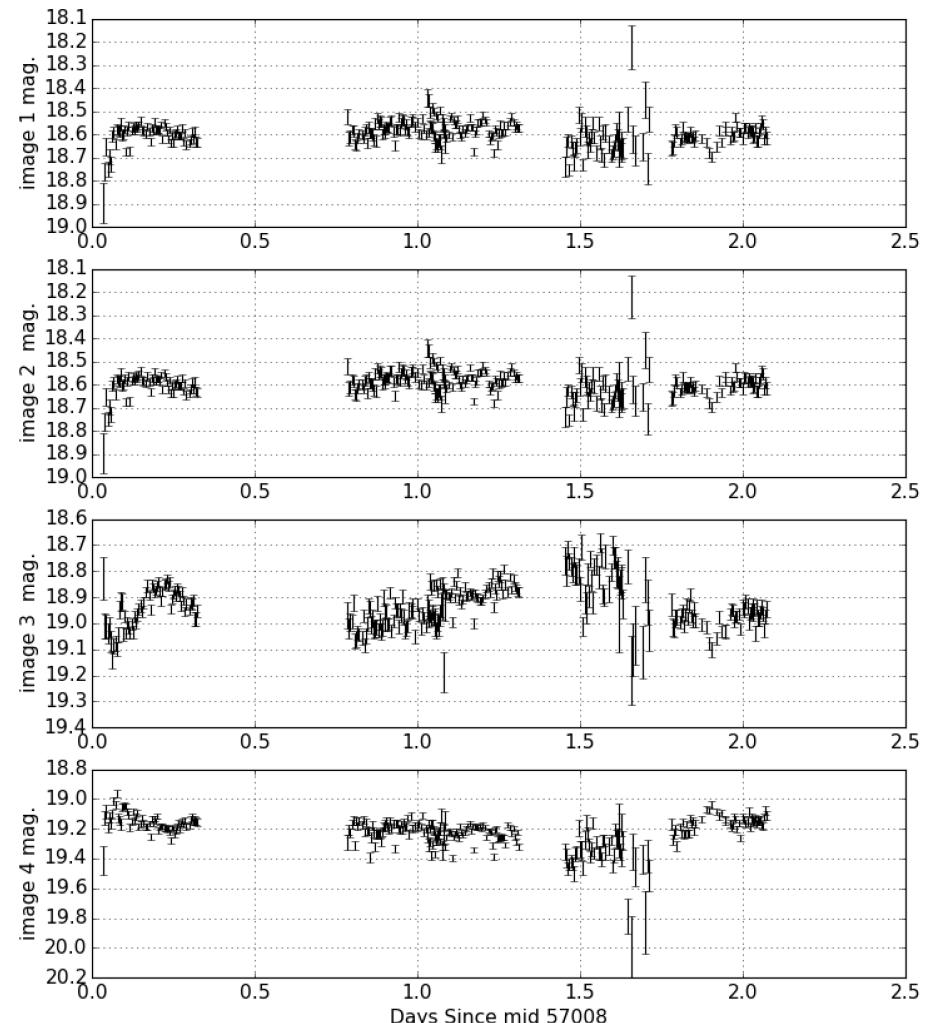
Emcee Quasar Image Zero Point-Corrected Magnitudes

Propagating Zero Point wRMS
as the uncertainty.

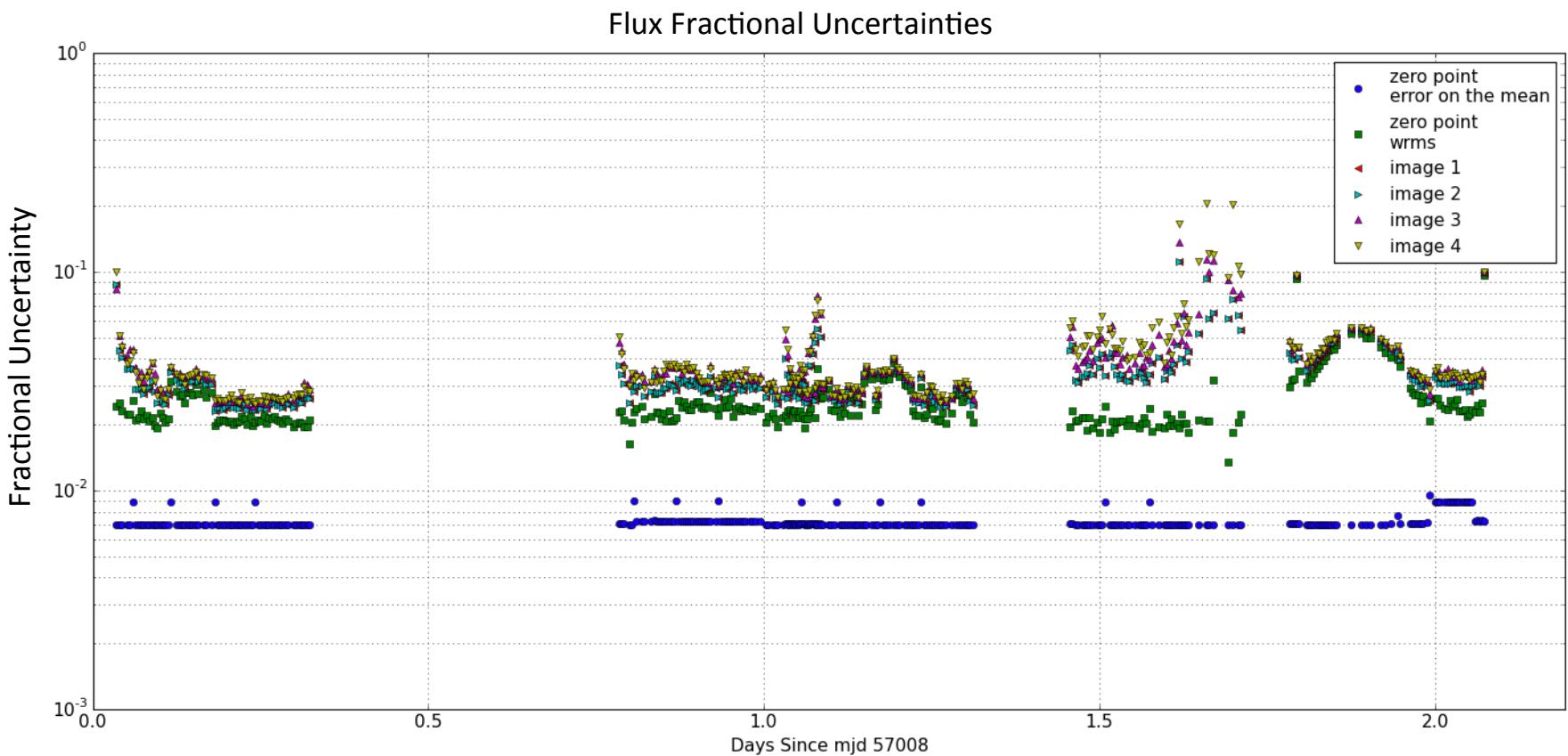


Emcee Quasar Image Zero Point-Corrected Magnitudes

Using the error on the mean rather than wRMS for zero point uncertainties.



Uncertainties



Next Steps

- Rewrite the analysis pipeline in a clean way.
- Need to work on a development plan for pipeline structures, PSFs, photometry, zero points etc.