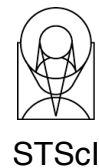
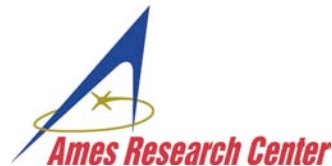




# Kepler Science Operations Center Pipeline

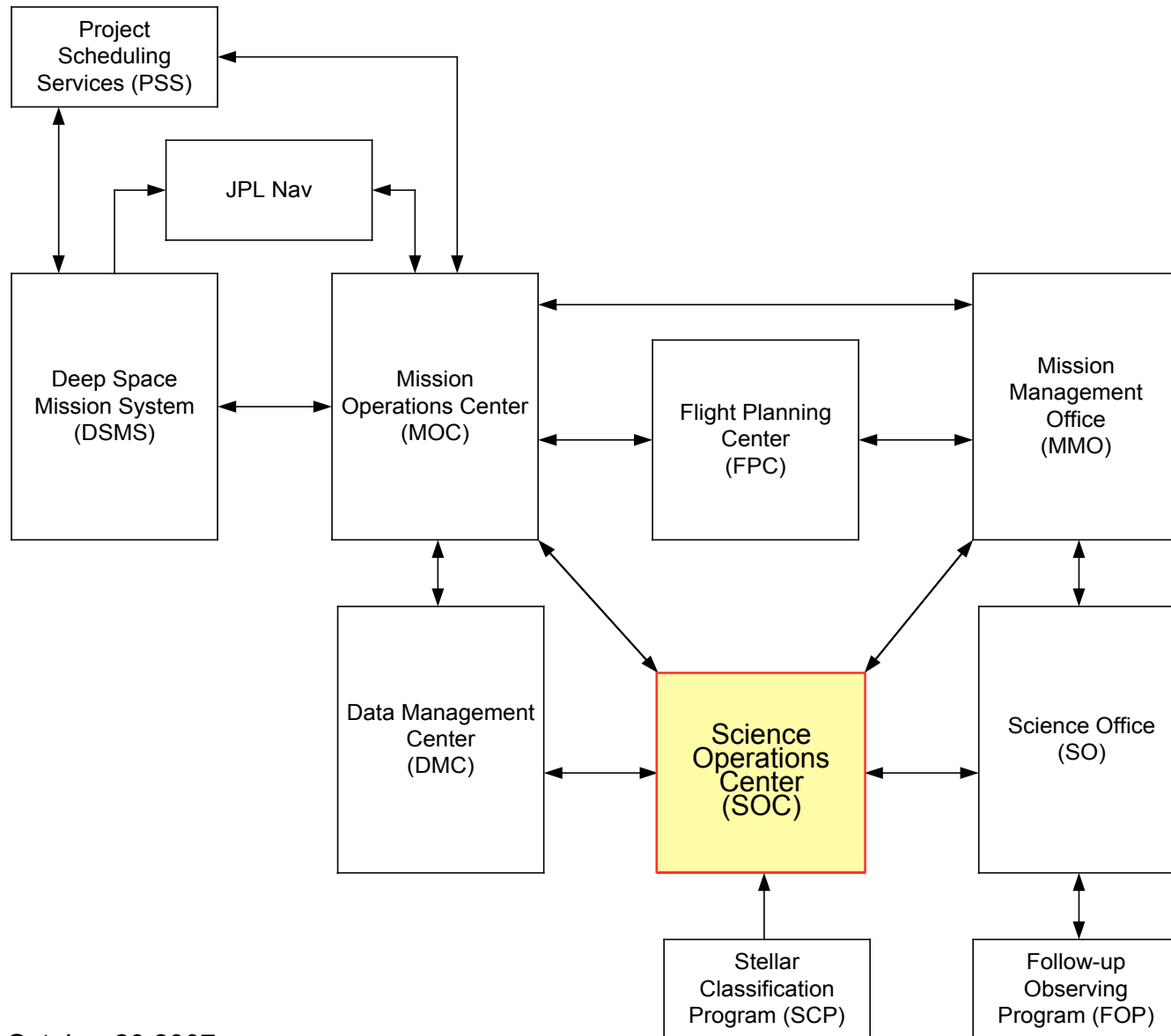
Jon Jenkins

SETI Institute/NASA Ames Research Center





# GS High-Level Architecture





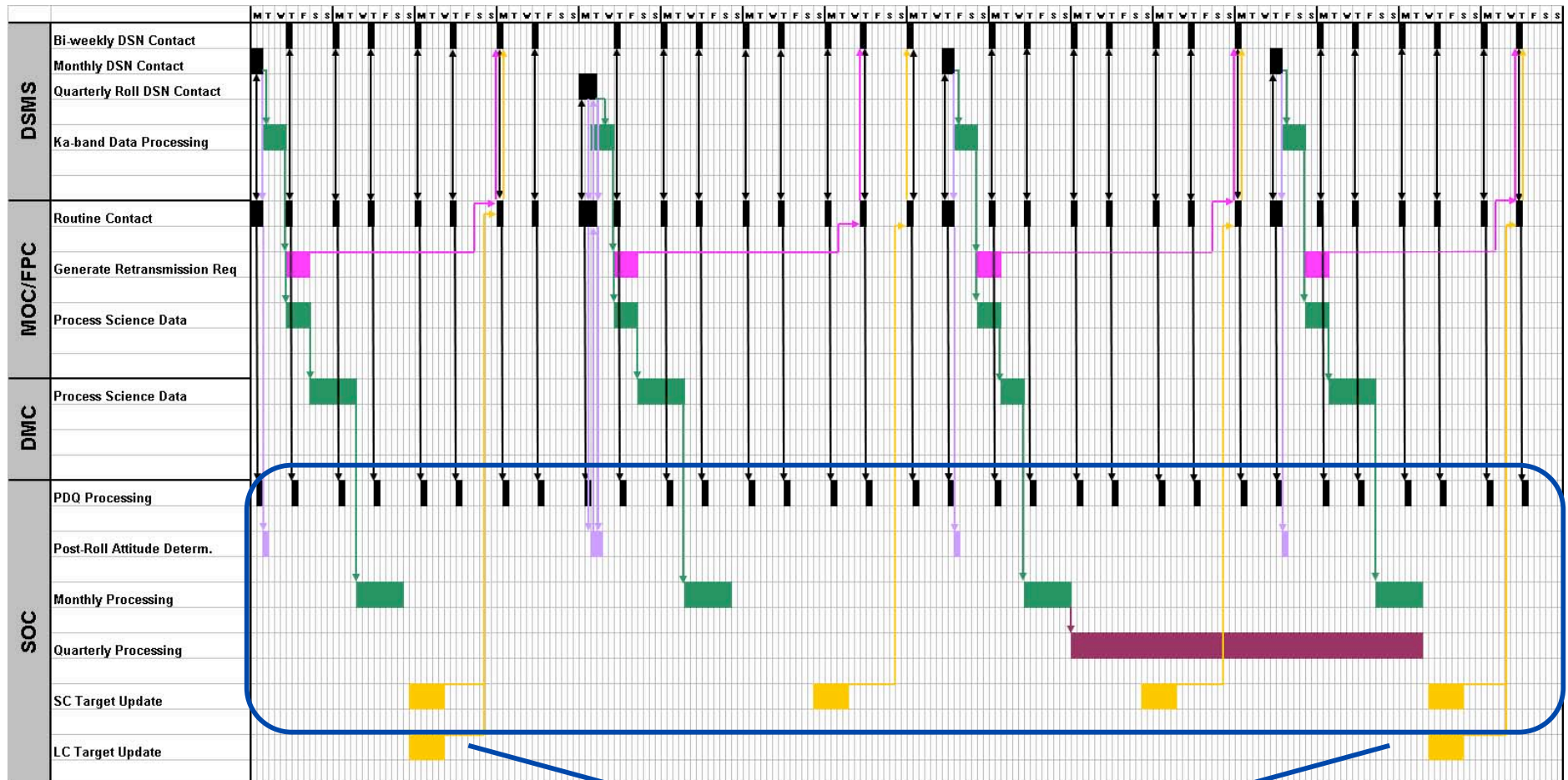
# Science Data Processing



- DMC reconstructs pixel values & transfers all pixel data to the SOC
- SOC performs science processing steps:
  - Pixel Level Calibrations
  - Generate flux time series (Ap Photometry & DIA)
  - Remove systematic errors from flux time series
  - Search for planets
    - Transiting planet search
    - Reflected-light planet search
  - Validate candidate detections
    - Candidate planet validation with *Kepler* data
    - Follow-up observations to eliminate astrophysical false positives
- DMC maintains science data archive, including
  - Original and calibrated pixel data
  - Flux time series data
  - Catalogs



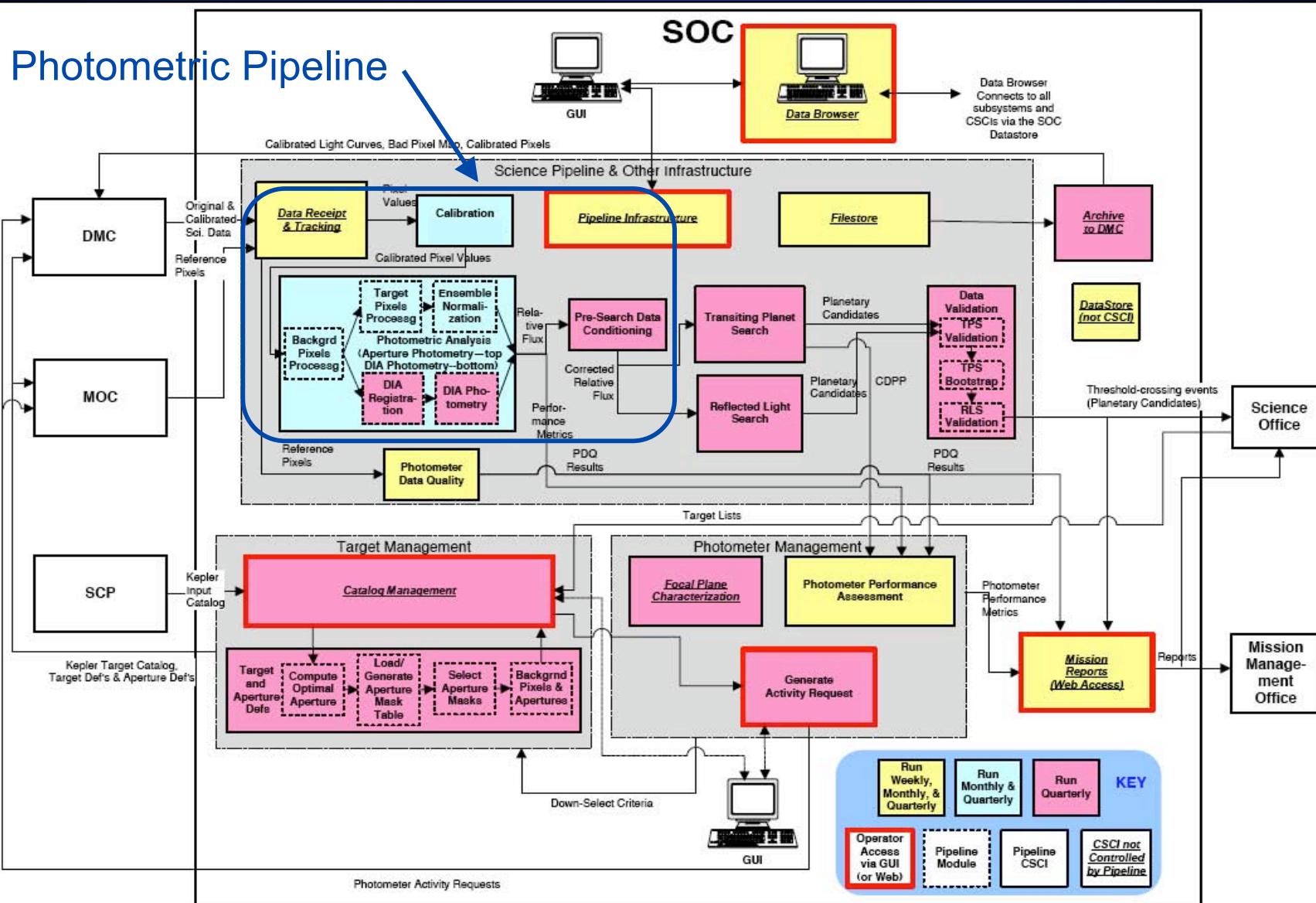
# Science Operations Mission Cycles



SOC Processing



# SOC Architecture

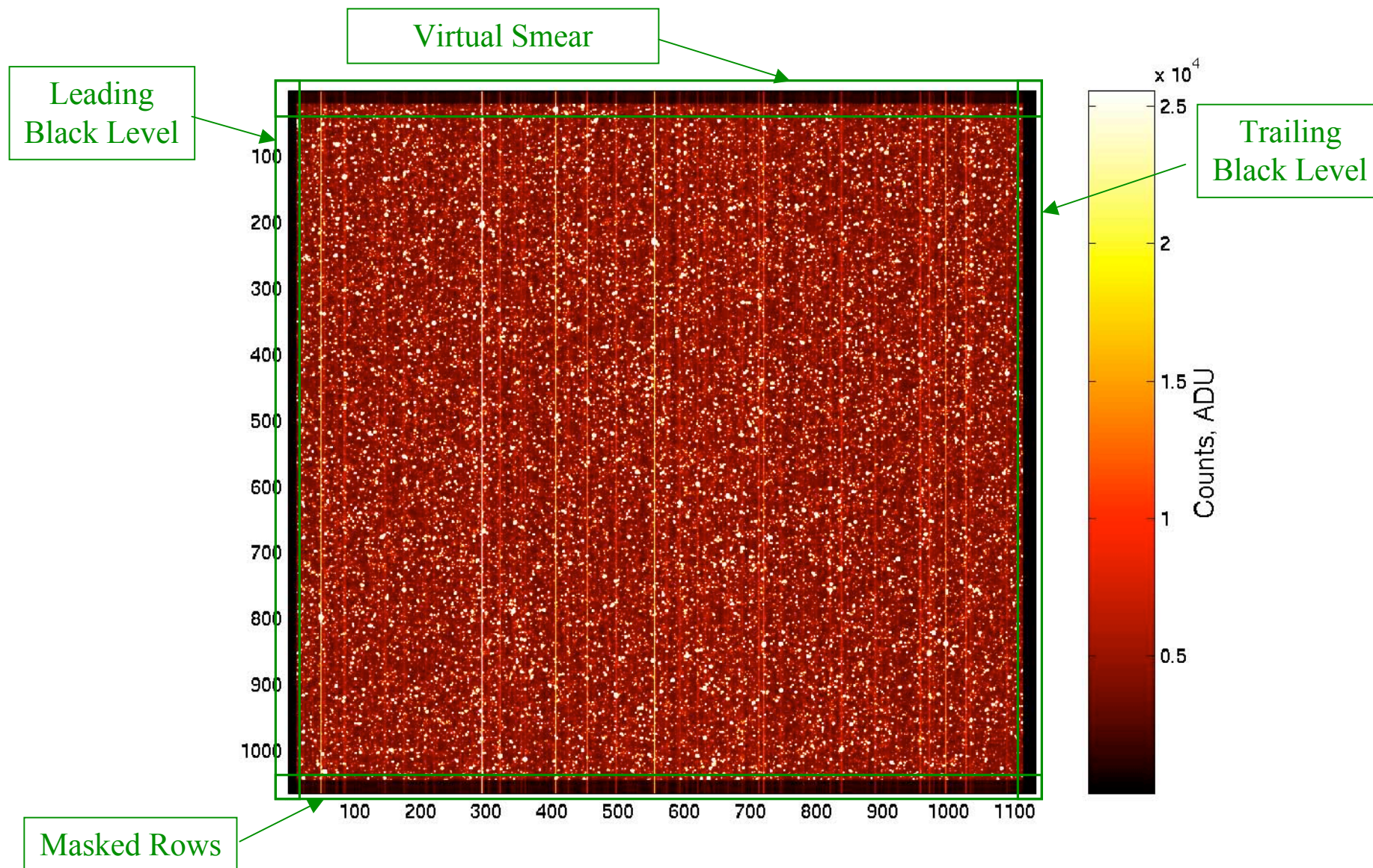






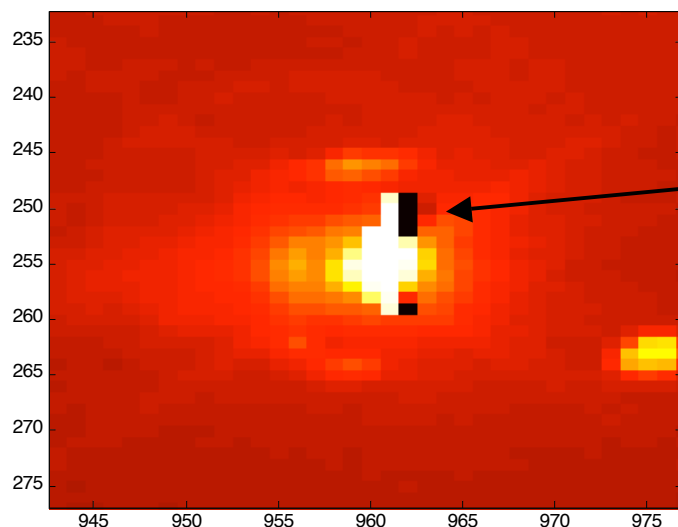
# Pixel Level Calibrations

*Kepler*



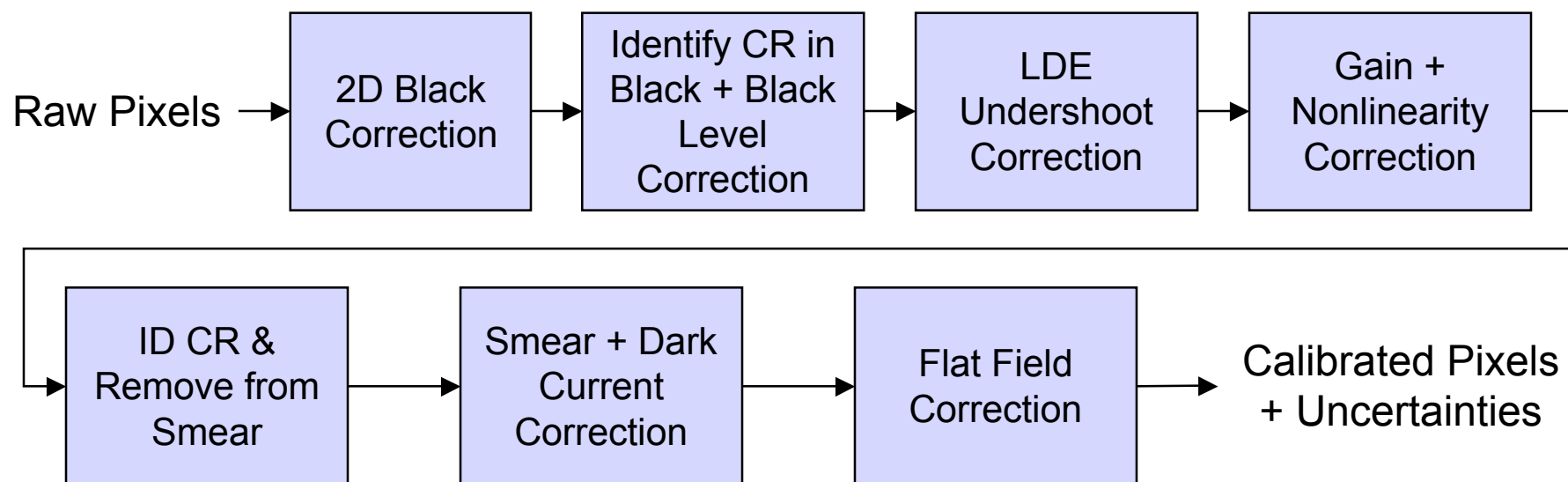
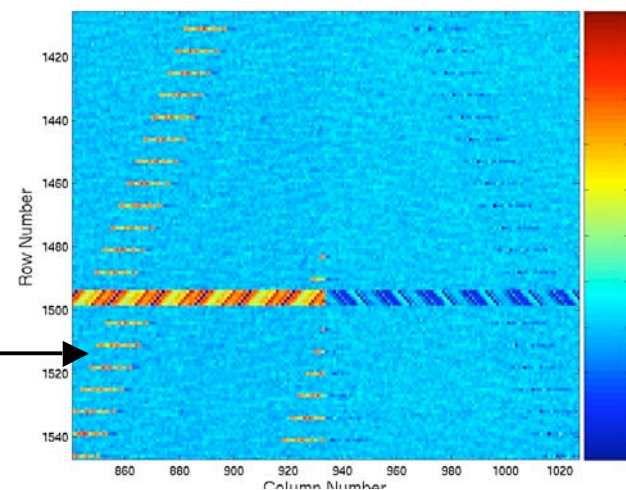


# Pixel Level Calibrations



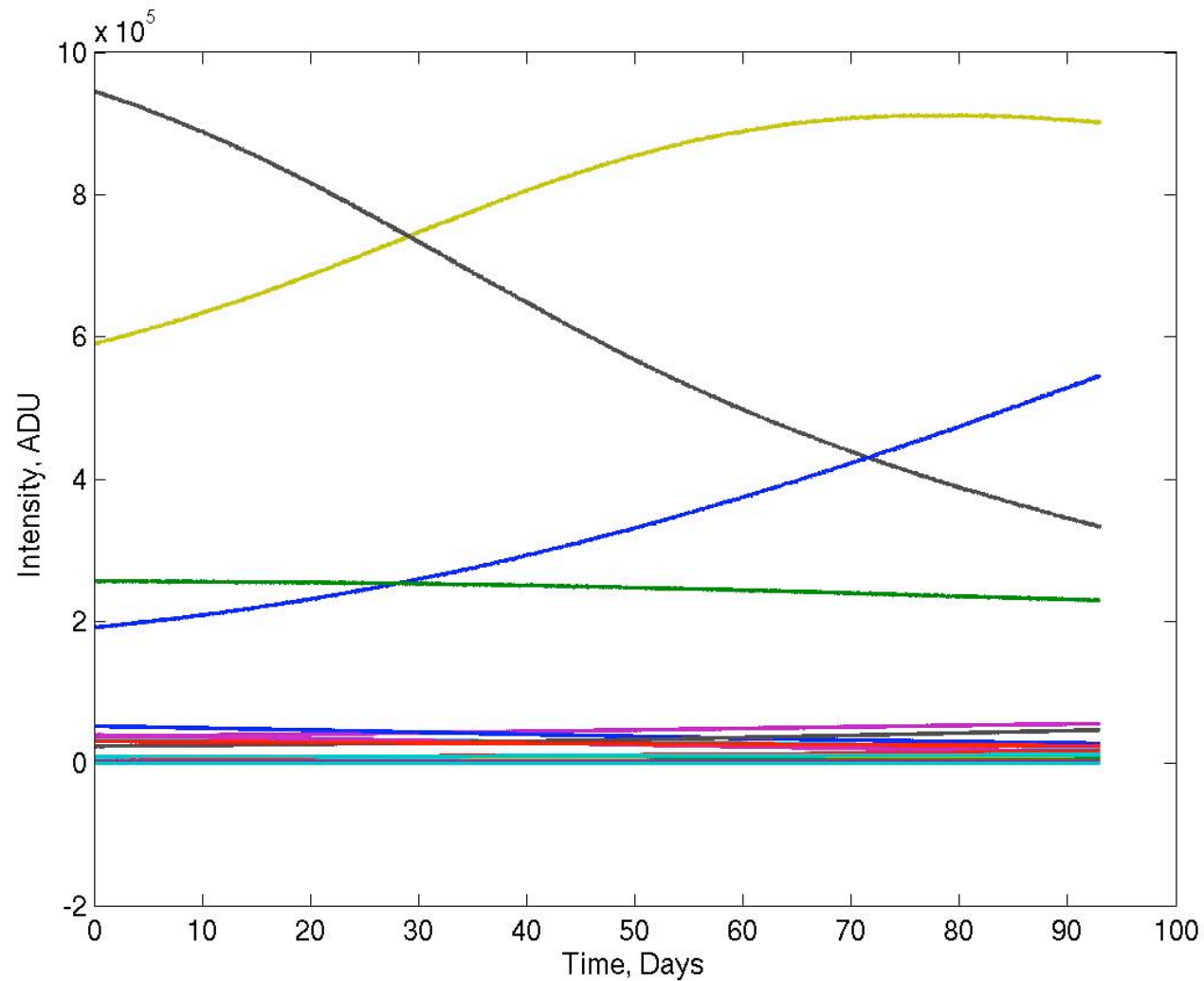
LDE Undershoot

FGS Clocking  
Crosstalk





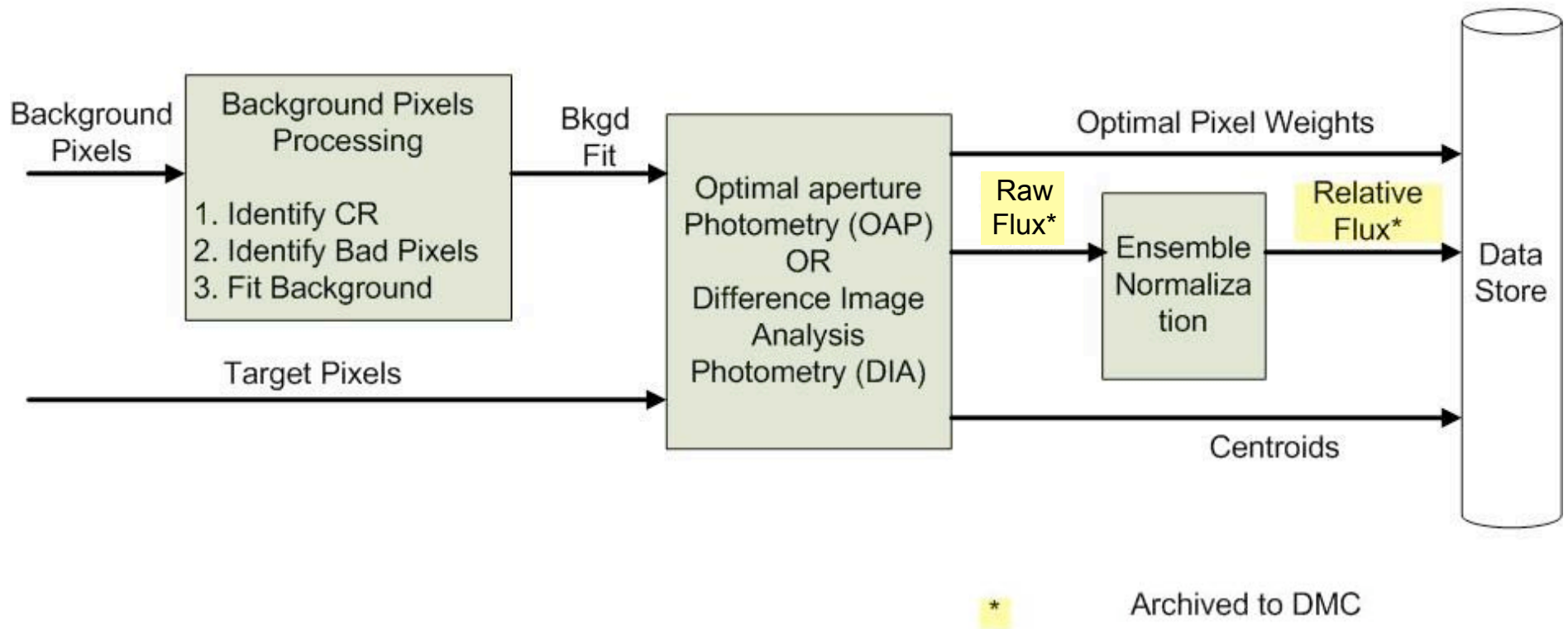
# Pixel Flux Time Series







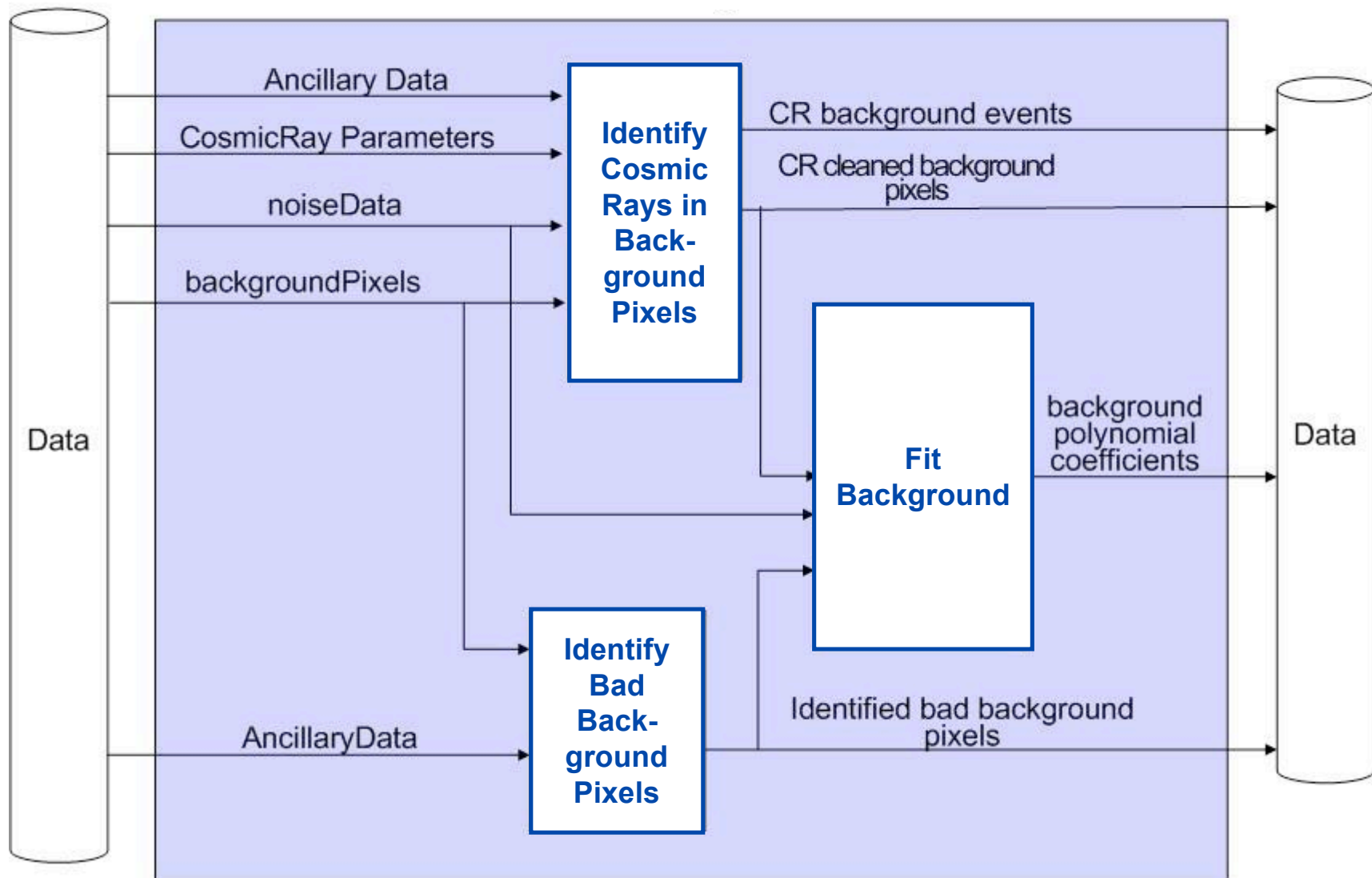
# Photometric Analysis Overview





# Background Subtraction

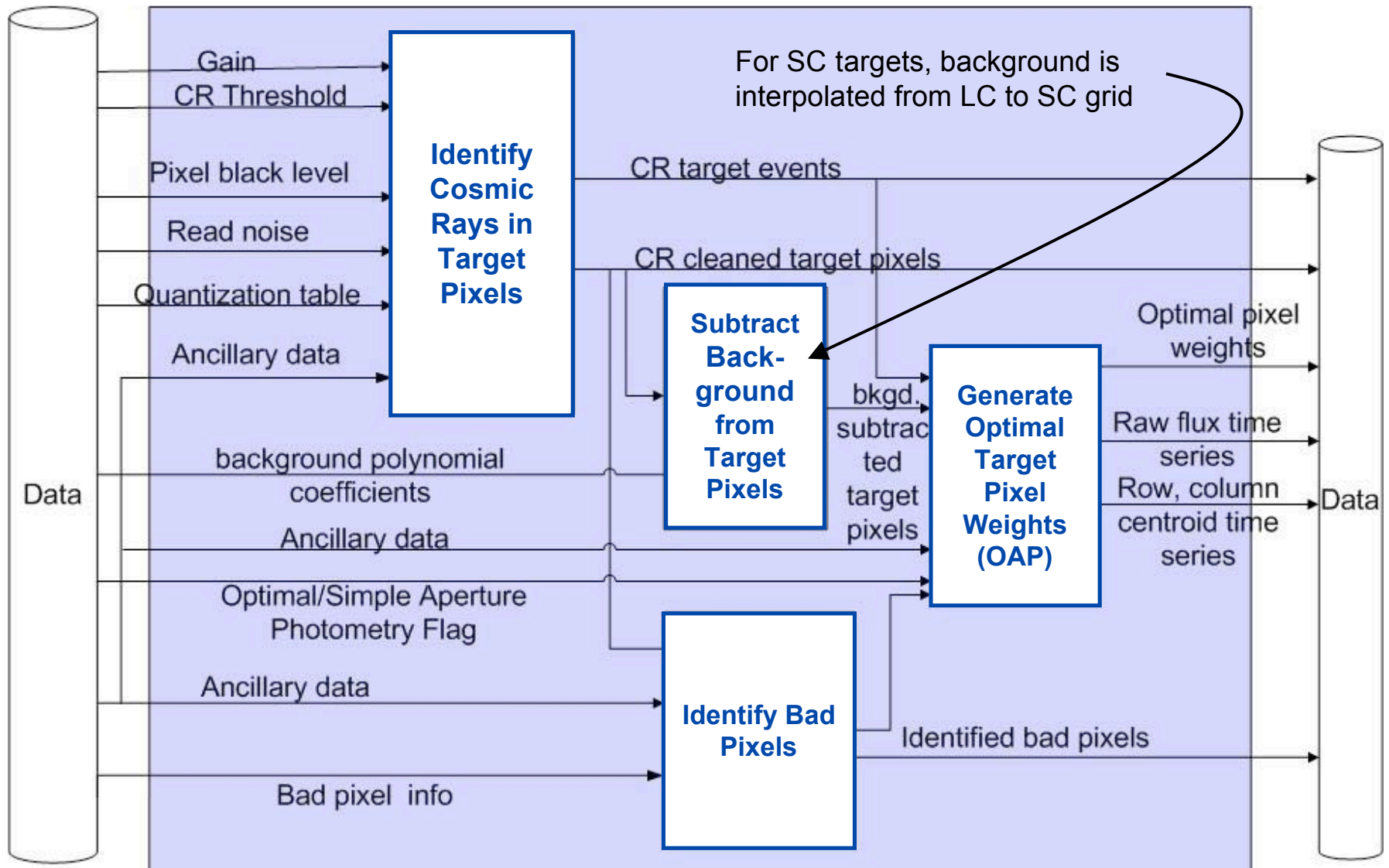
*Kepler*





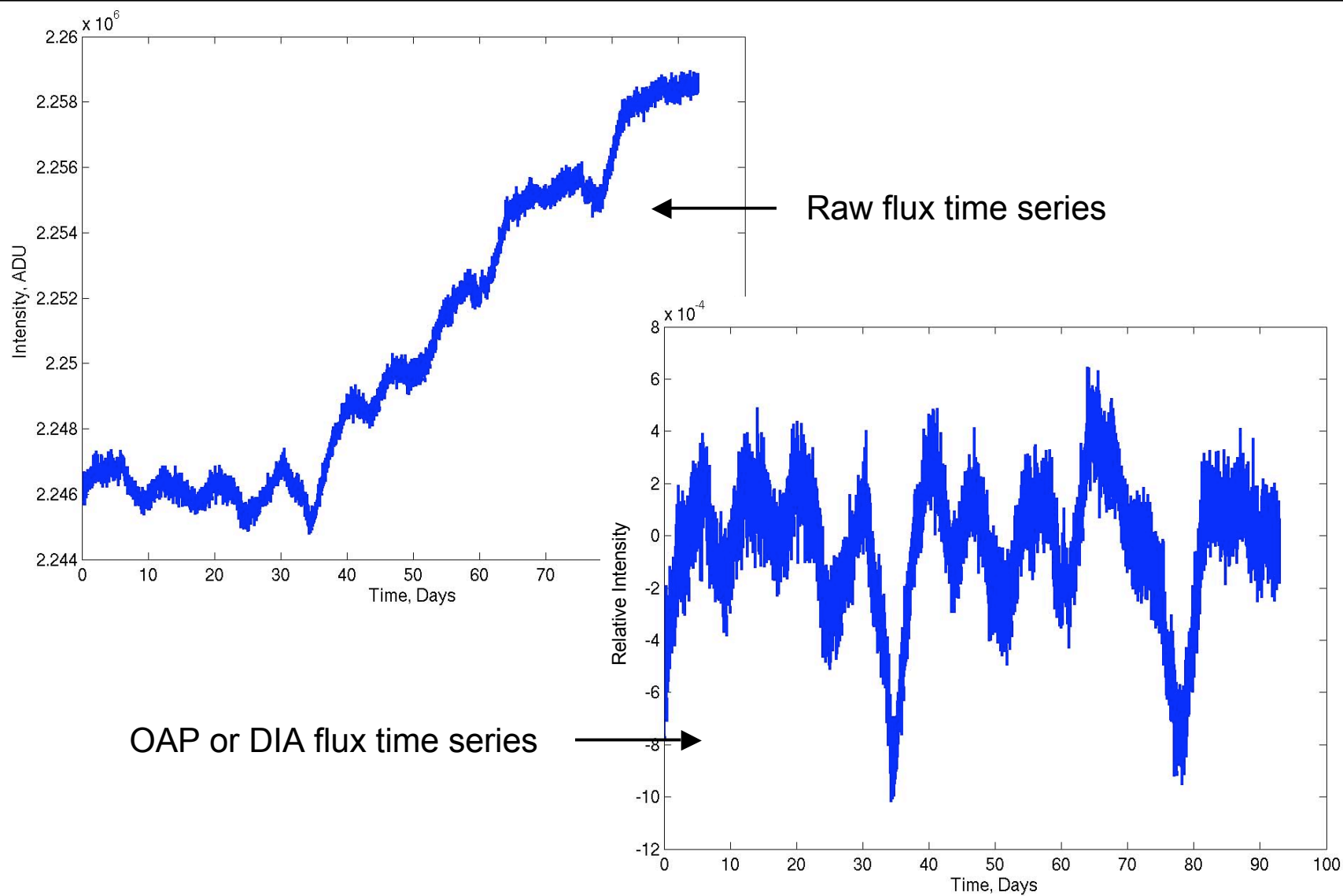
# Optimal Aperture Photometry\*

Kepler



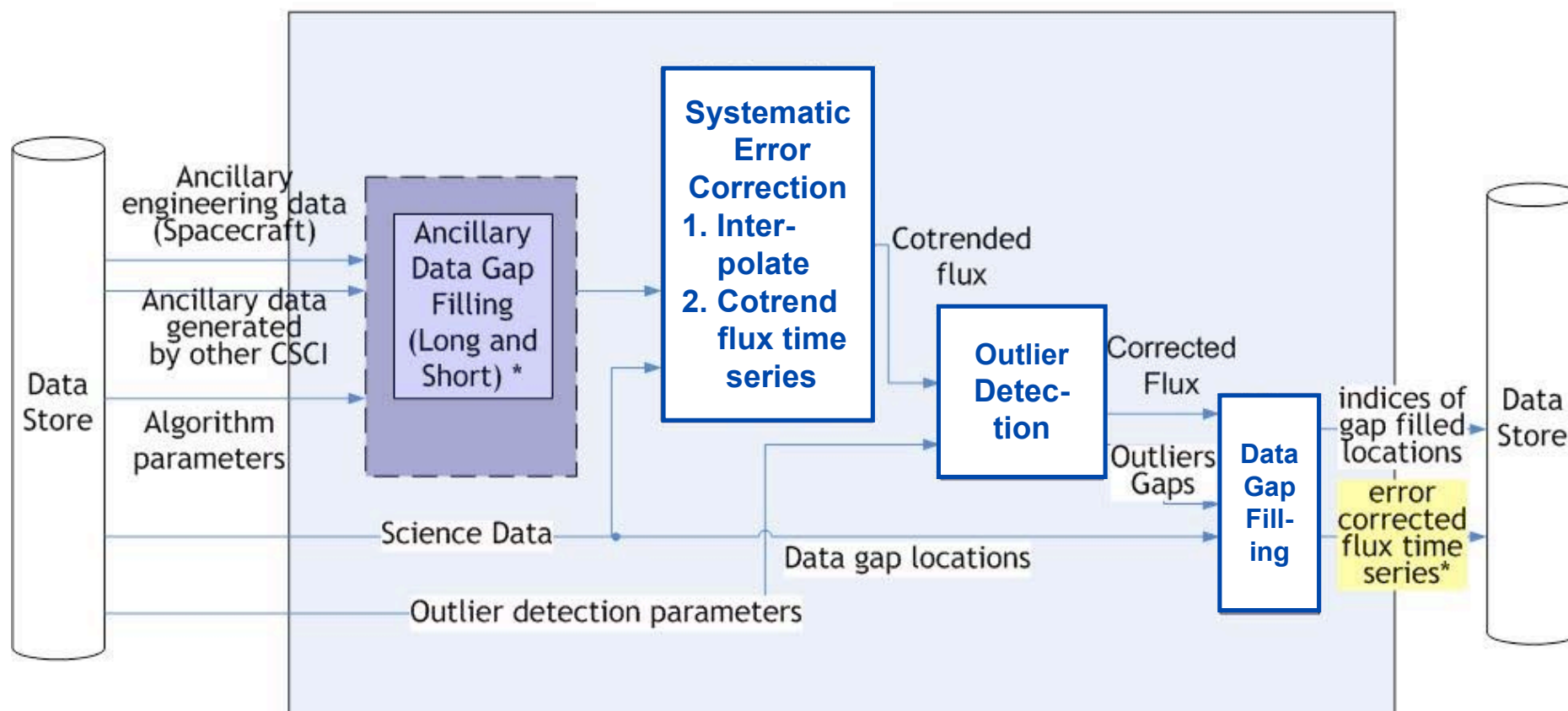


# Flux Time Series





# Systematic Error Removal



\* Ancillary data gaps are filled if they are not coincident with flux time series data gaps



Archived to DMC (gap filled values are not stored)





# Conclusions



- SOC calibrates & extracts photometry from Kepler pixel data
- SOC Photometric Products archived at the DMC:
  - Calibrated Pixels
  - Raw flux time series (DIA & OAP)
  - Ensemble Normalized Flux Time Series (DIA & OAP)
  - Systematic Error Corrected Flux Time Series
  - Centroids of Stellar Targets

+ Associated Uncertainties

512 Targets are Short Cadence Targets, sampled at ~1 min intervals

- These can change each month

The processing of SC targets is essentially the same as for Long Cadence targets (with exceptions for background removal)

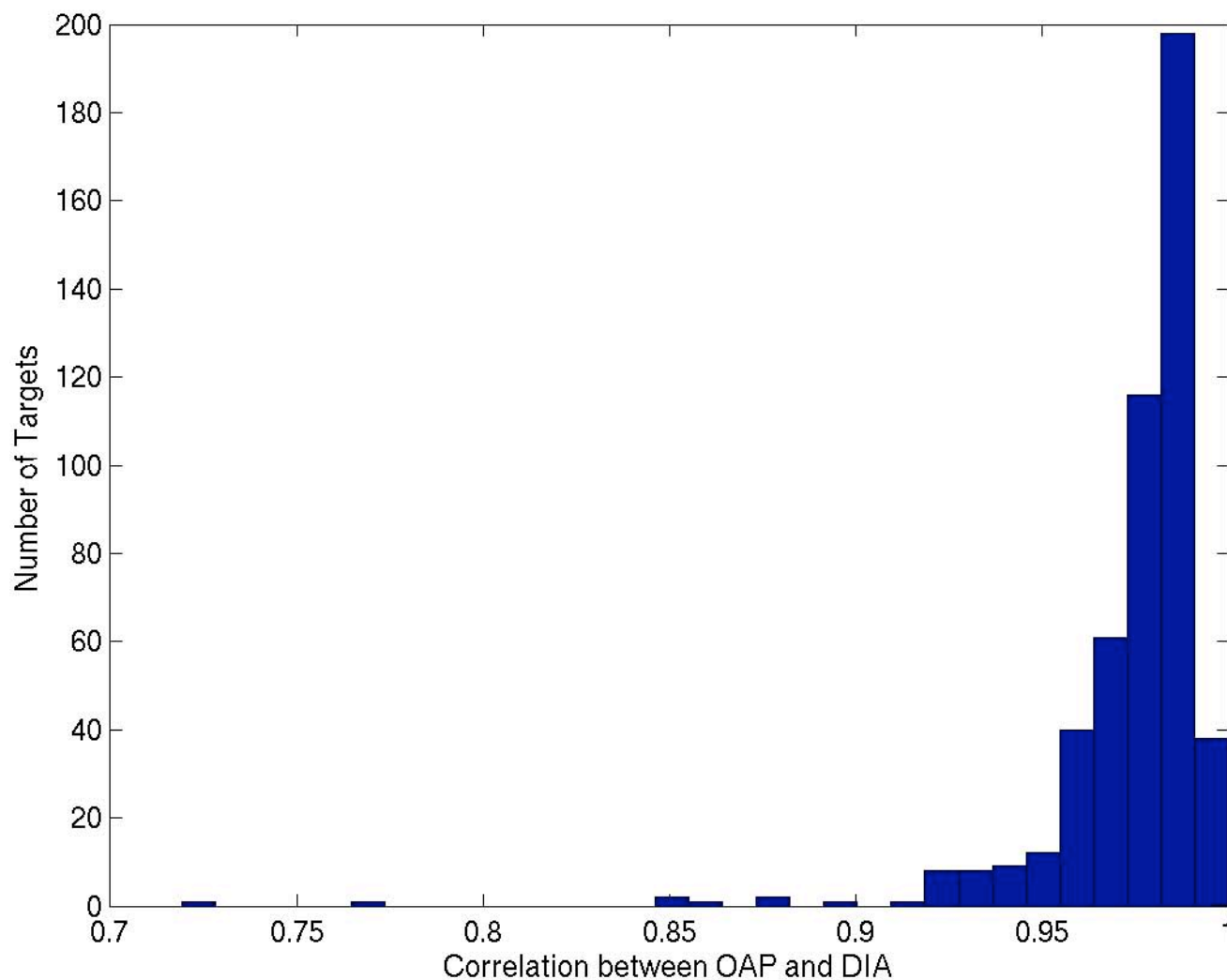


*Kepler*

## Backup Slides



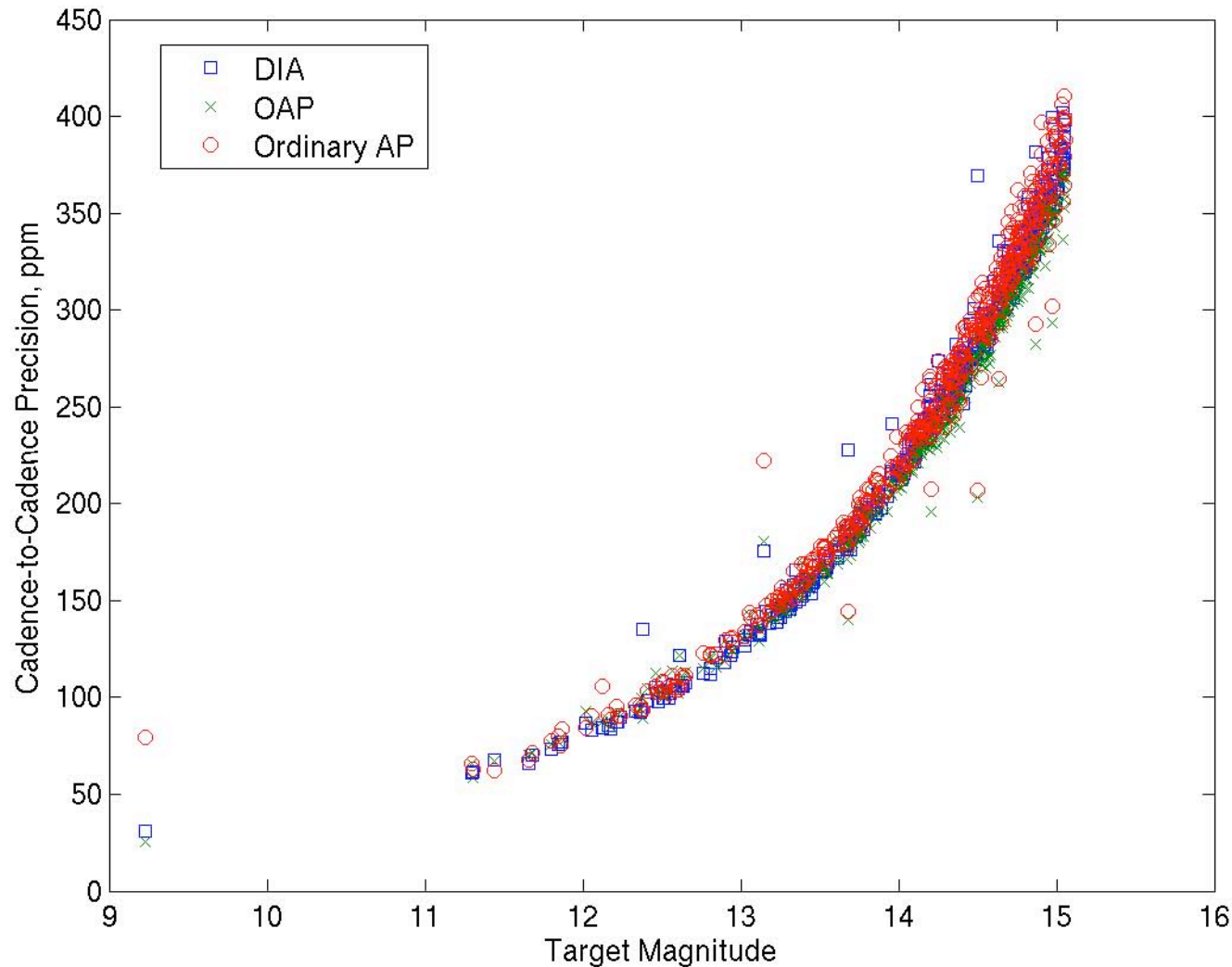
## Comparison of DIA and OAP (1)



DIA and OAP are Yield Extremely Similar Results



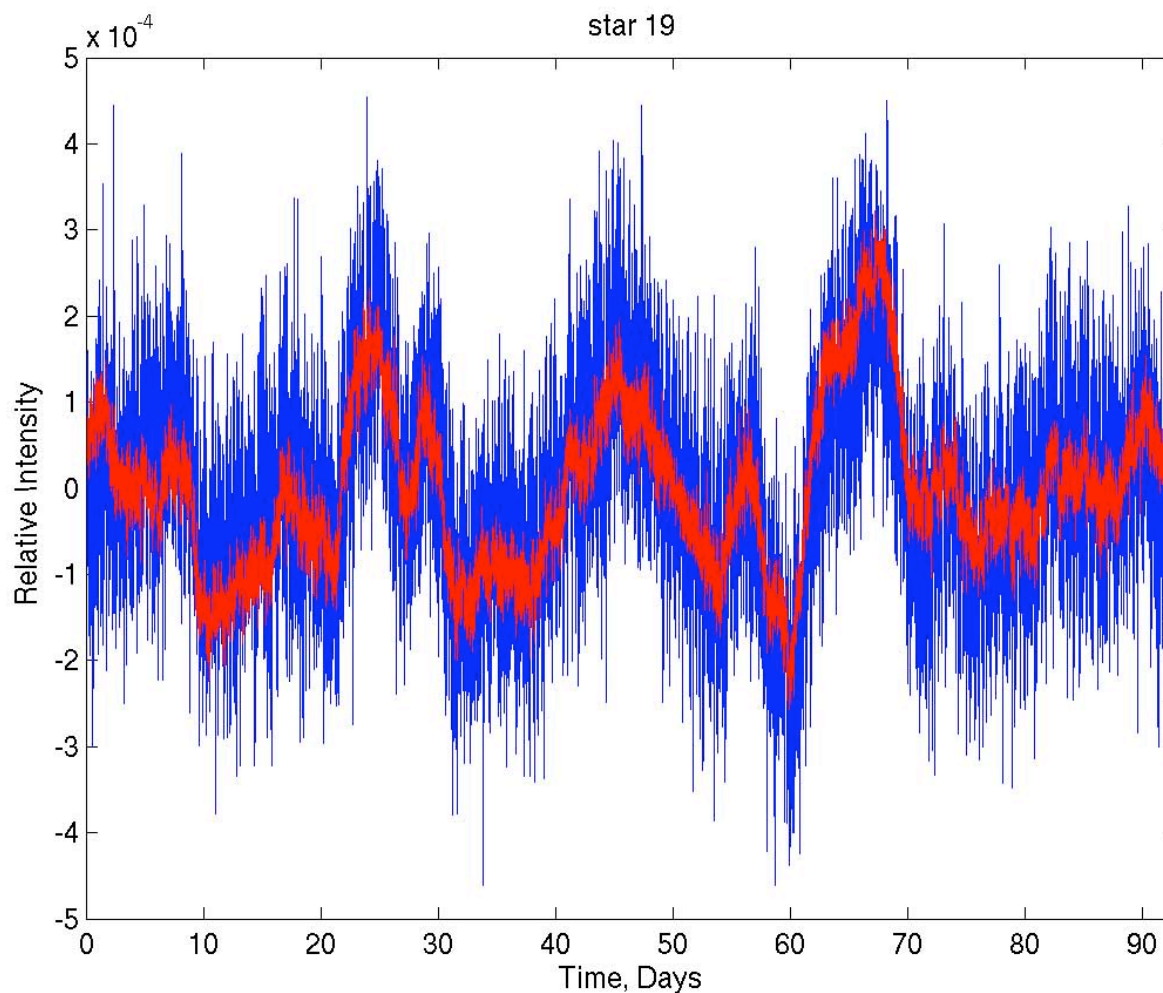
## Comparison of DIA and OAP (2)



DIA and OAP are Yield Extremely Similar Results



## Photometric Errors (1)

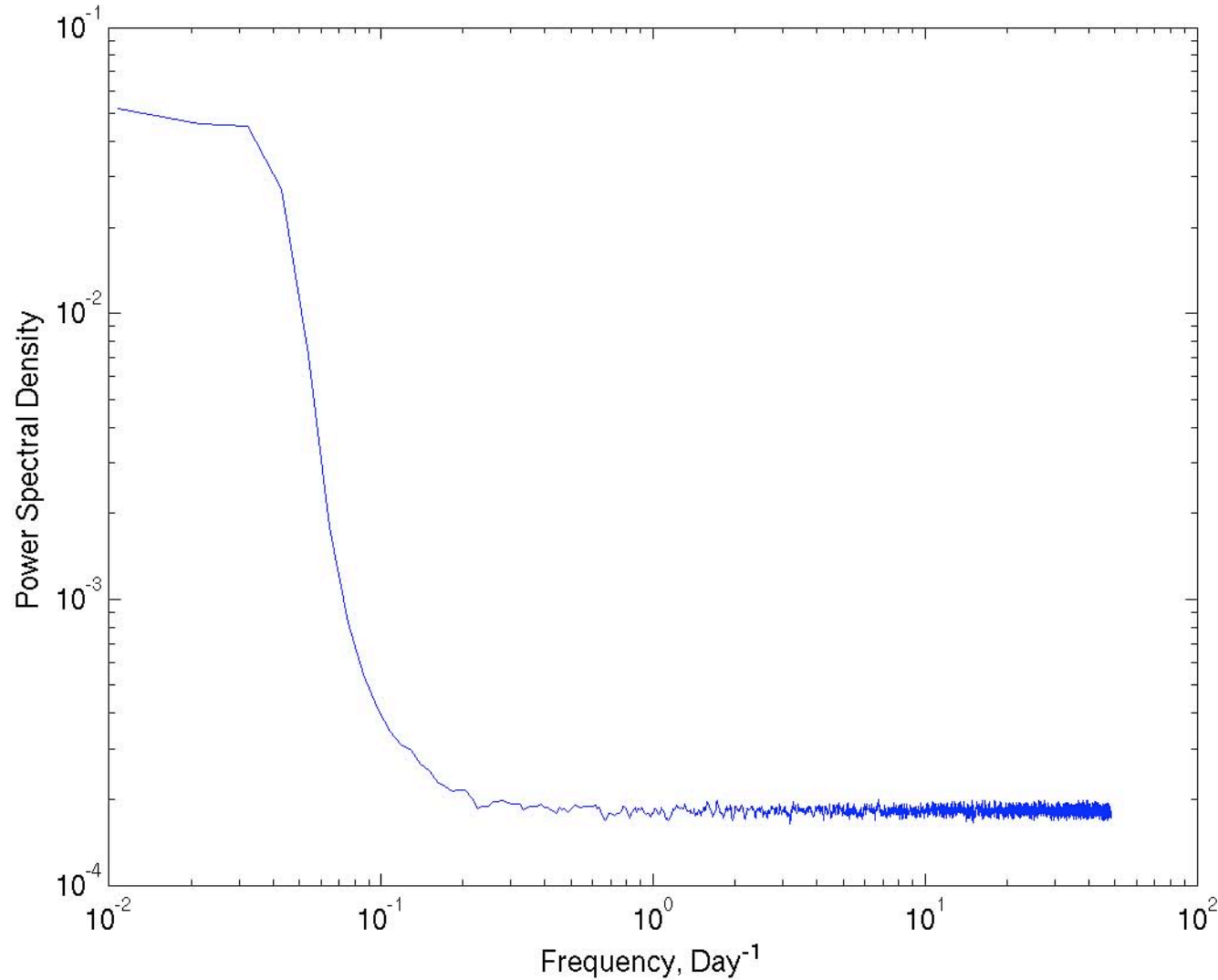


Intrinsic Stellar Variability on Timescales  $< 10$  days Recovered





## Photometric Errors (2)



Intrinsic Stellar Variability on Timescales  $< 10$  days Recovered