

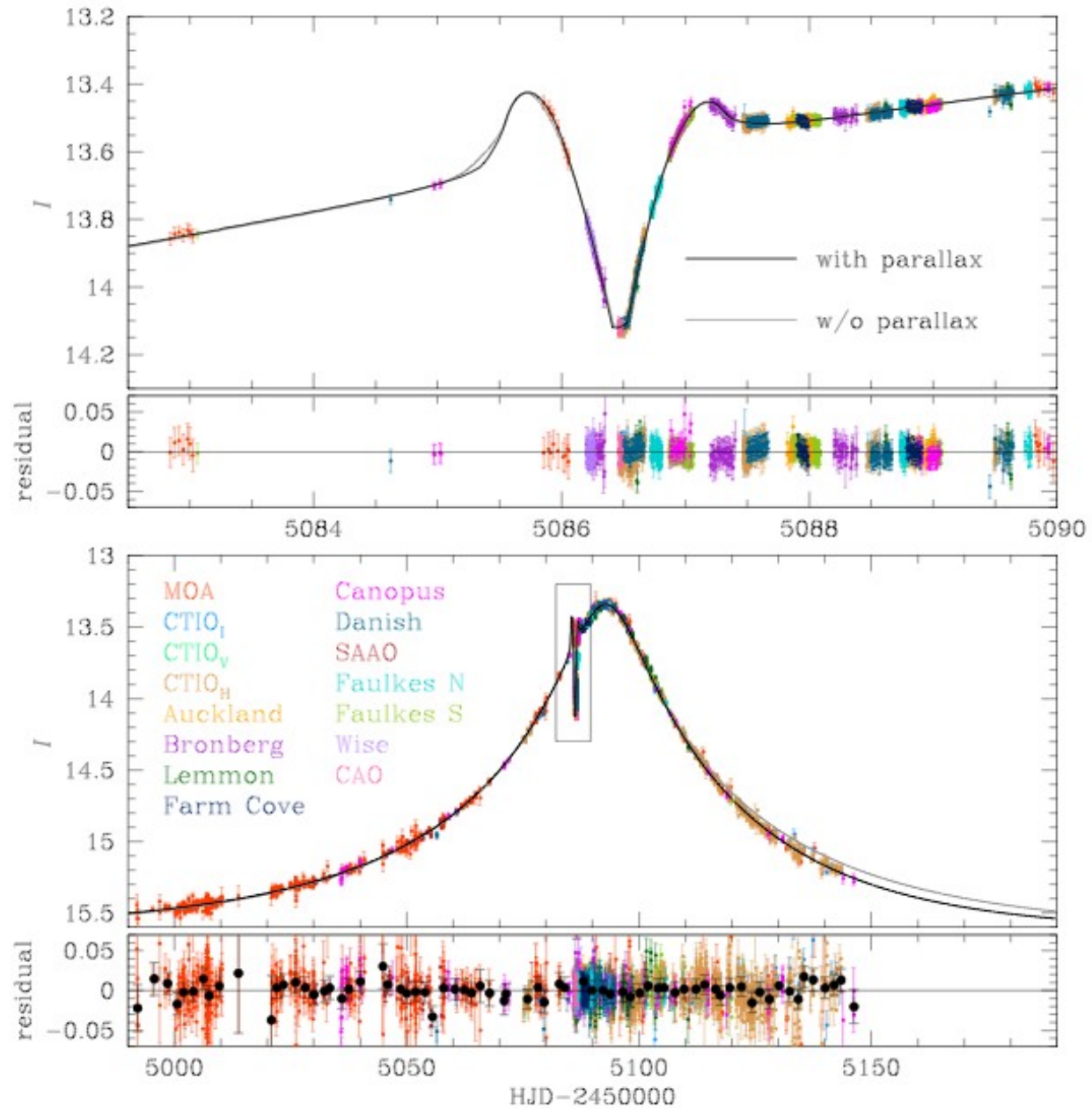
Reduction of Crowded Field EPOXI Images

A. Becker & P. Kundurthy (U.Washington)

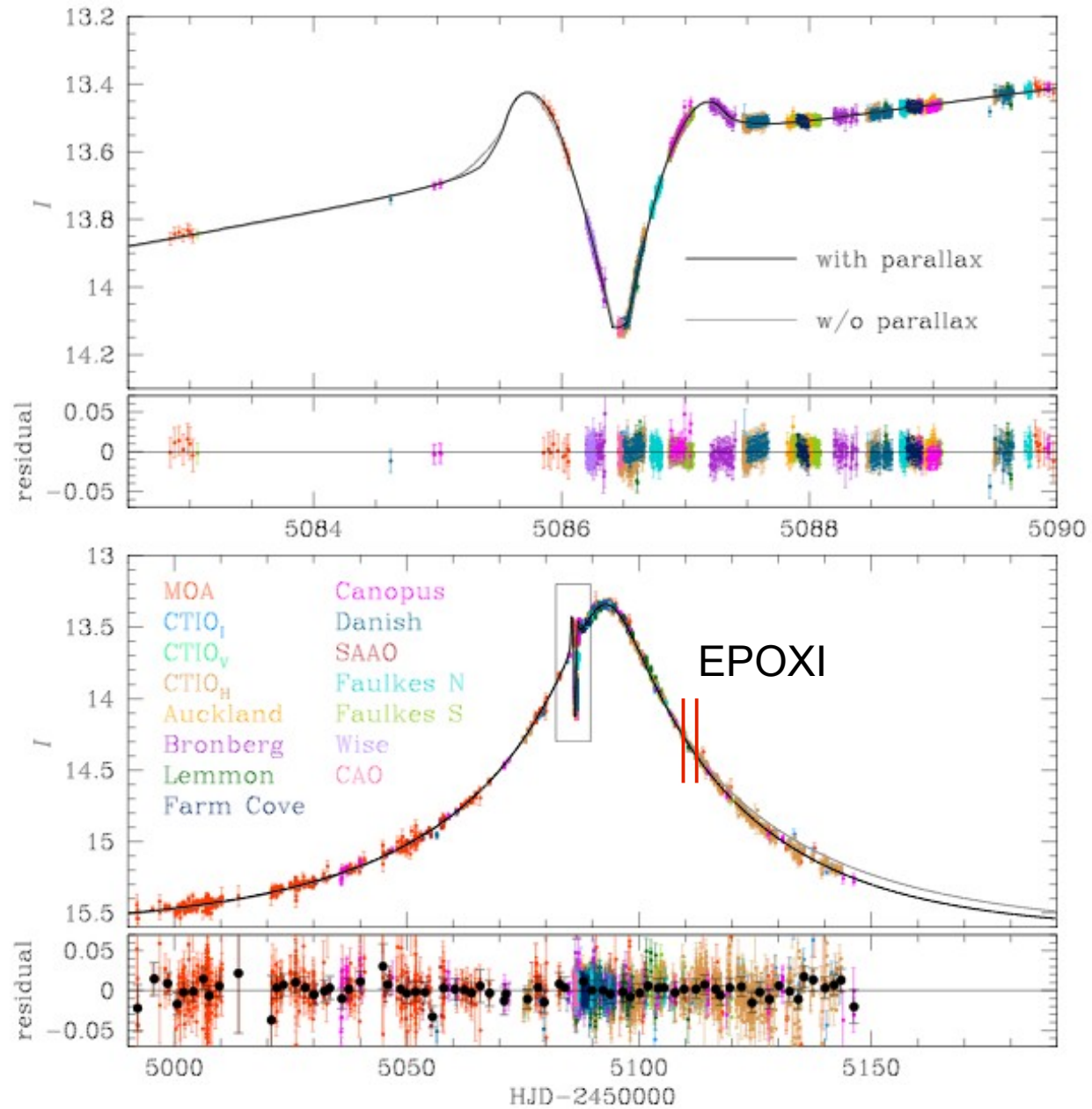
with

D. Bennett & MOA/ μ -fun/PLANET/Robonet
Collaborations

MOA 2009 BLG 266



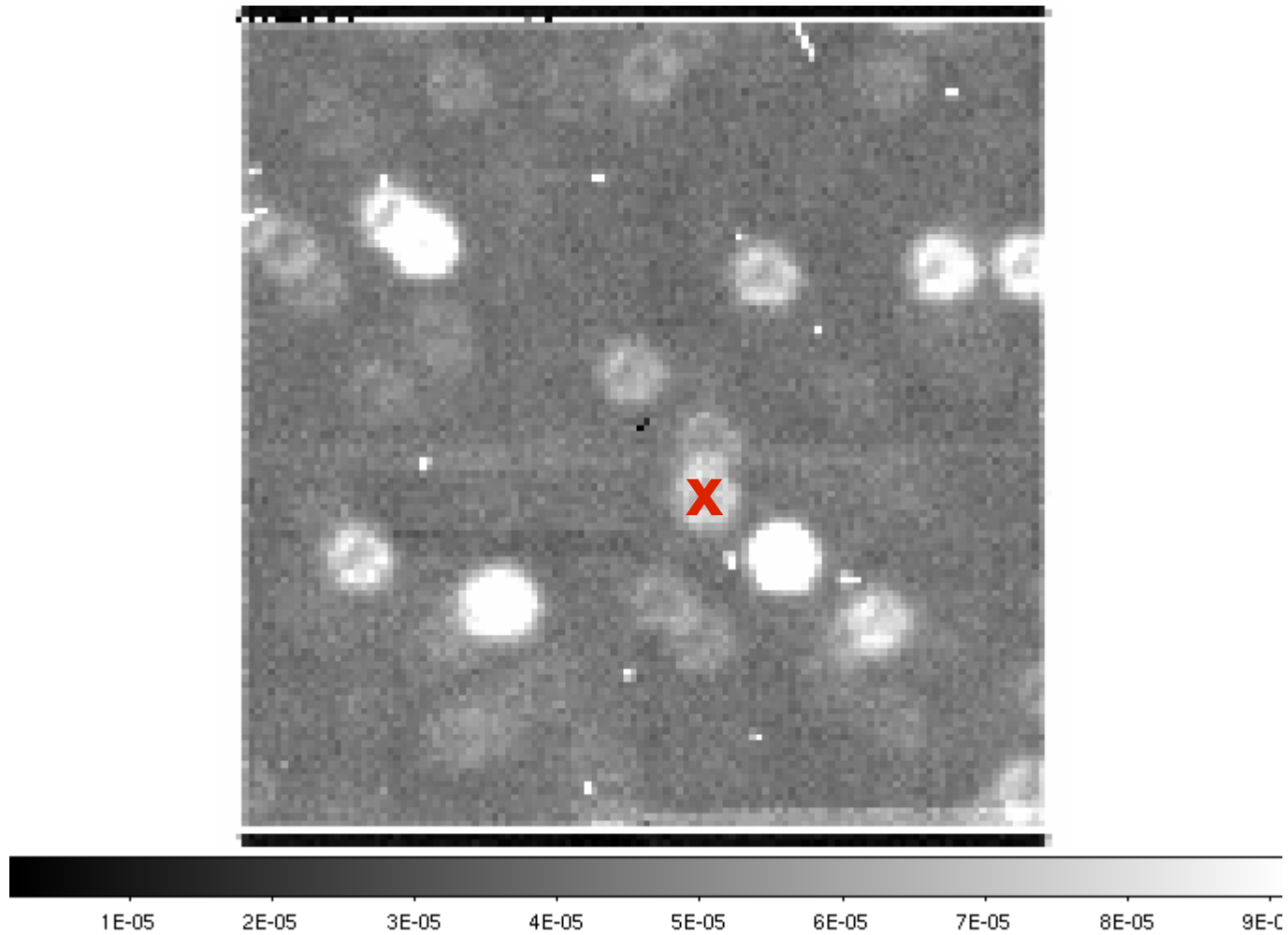
MOA 2009 BLG 266



EPOXI Observations

- Deep Impact High Resolution Visible CCD (HRIV)
- 4127 images over ~2 days
- Resolve degeneracy in microlensing fit
 - $q = 5.3 \times 10^{-5}$; $M_p = 9.2 \pm 0.7 M_E$
 - $q = 5.7 \times 10^{-5}$; $M_p = 12.4 \pm 1.2 M_E$
- Expect ~7% difference in brightness (magnification)
 - Calibration is essential
- Similar difference in slope
 - Time of peak magnification different by ~days

EPOXI Images of MOA 2009 BLG 266



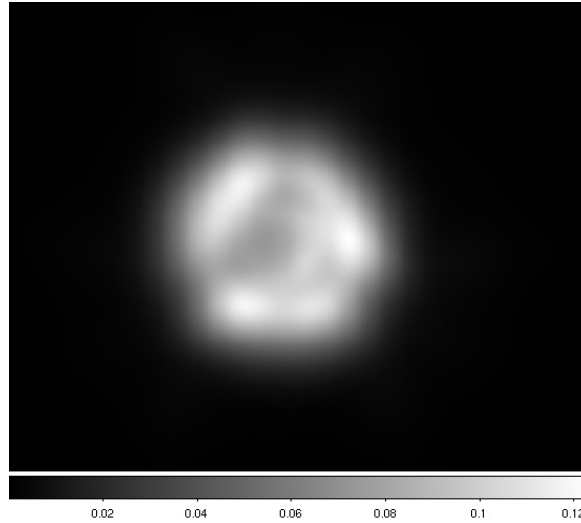
Issues

- High fraction of cosmic rays
 - Contaminate target/comparison stars
- Pointing not stable
 - Short exposure times (50s)
 - Samples known sensitivity variations (Ballard et al.)
- Out of focus
 - Psf model difficult
 - R. Barry x10 oversampled empirical models
- Crowded field
 - Psf photometry necessary due to blending

EPOXI Psf is SED Dependent

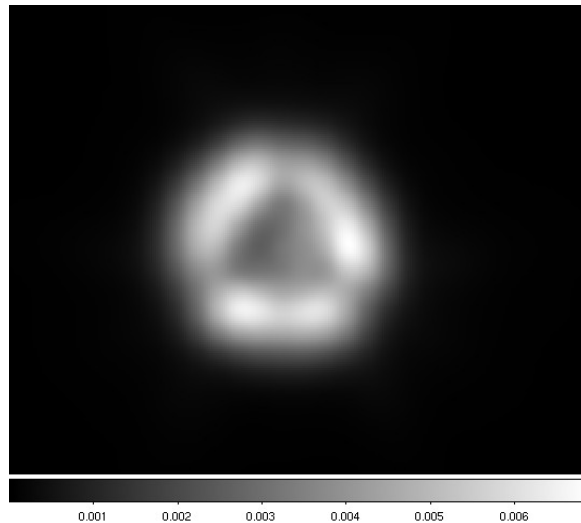
- GJ 436:

- $V - I = 2.44$



- XO-2

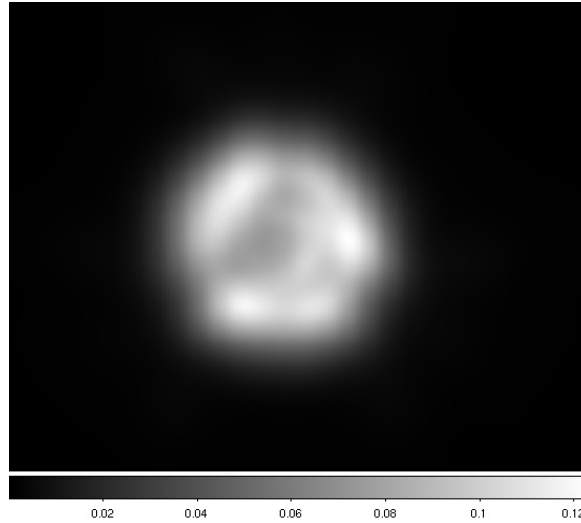
- $V - I = 0.75$



EPOXI Psf is SED Dependent

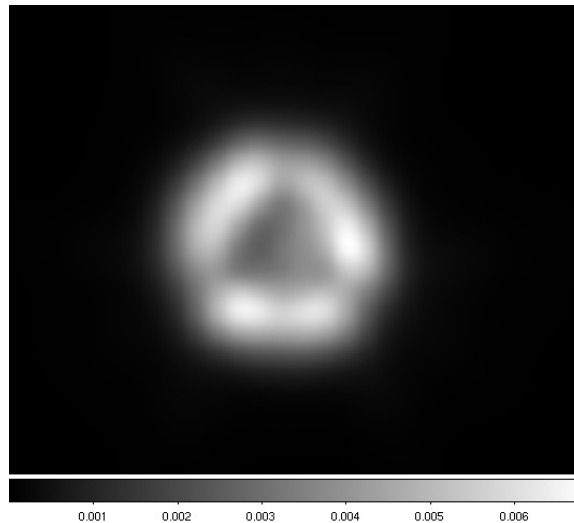
- GJ 436:

$$- V - I = 2.44$$



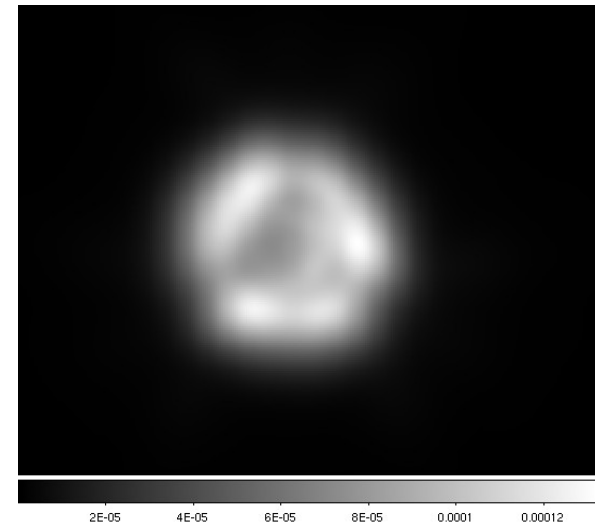
- XO-2

$$- V - I = 0.75$$



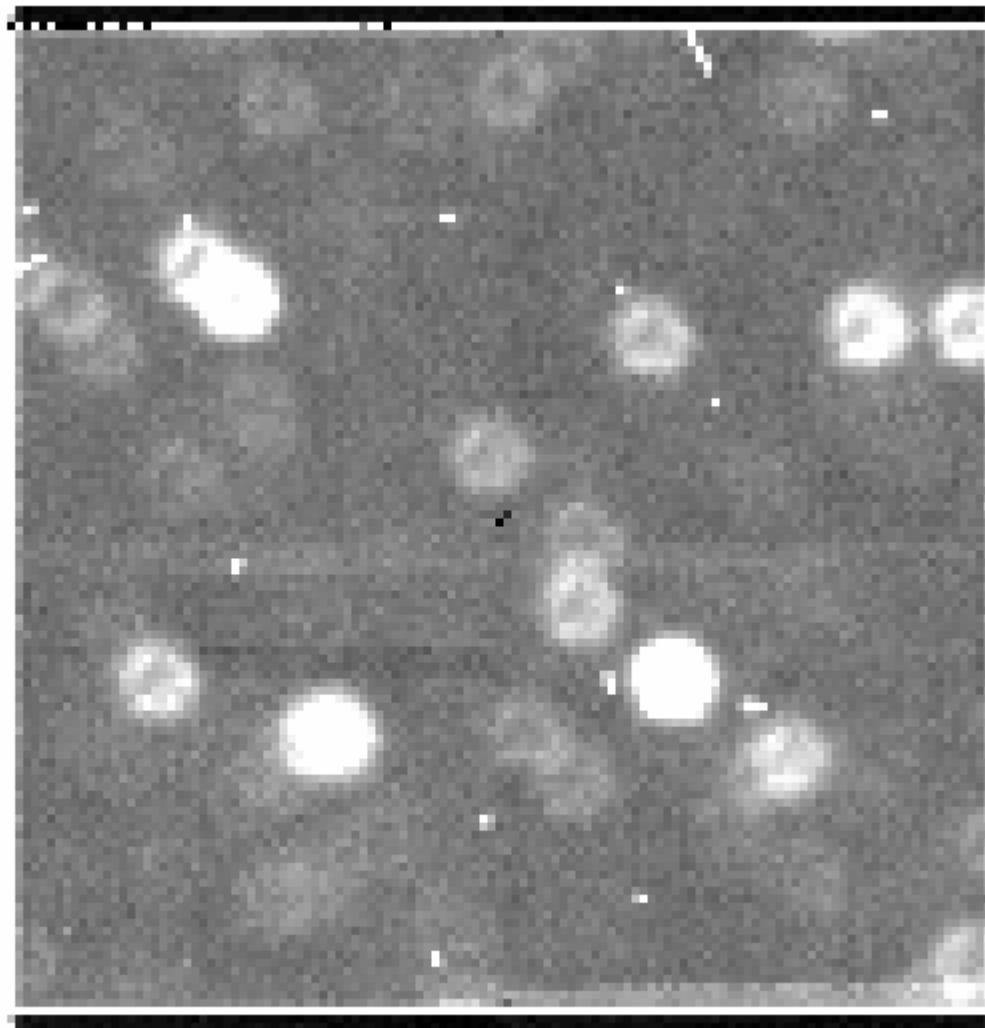
- MOA BLG 266

$$- V - I = 1.82$$

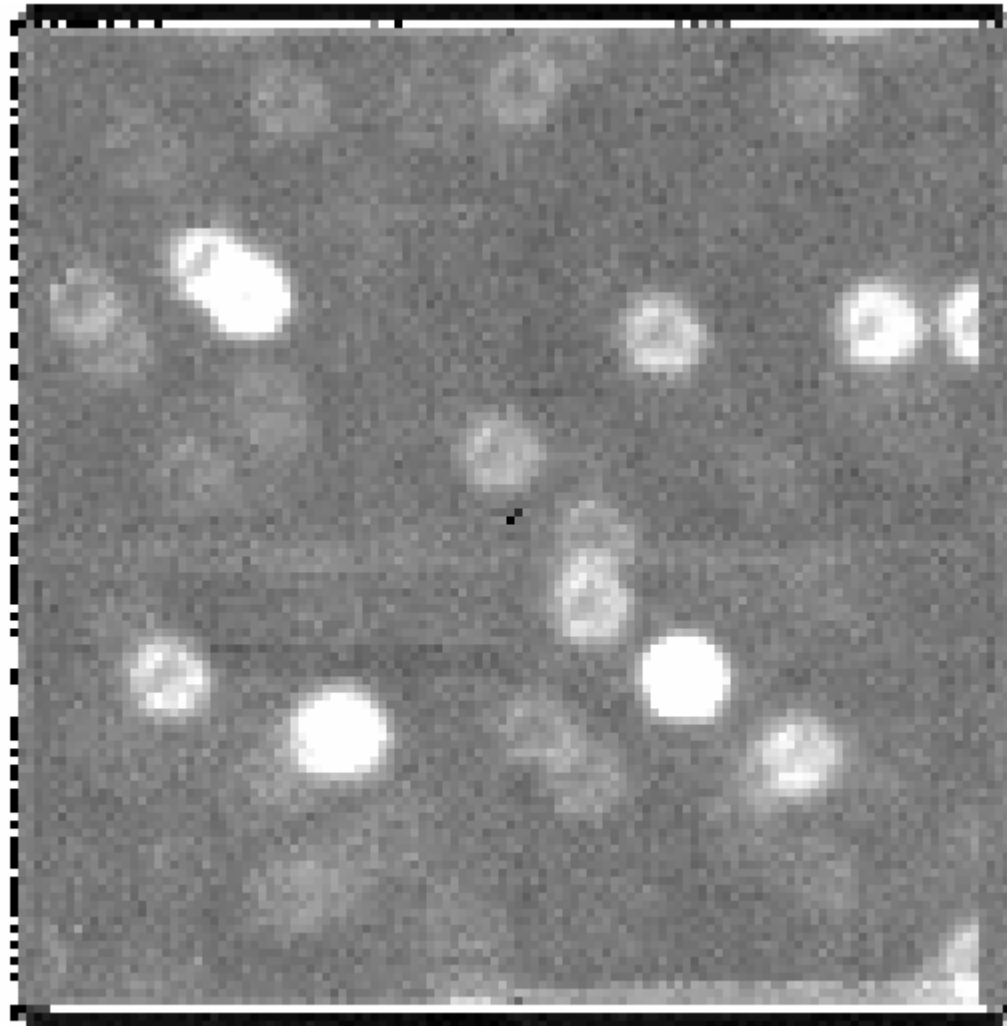


$$- 0.8 * \text{GJ436} + 0.2 * \text{XO-2}$$

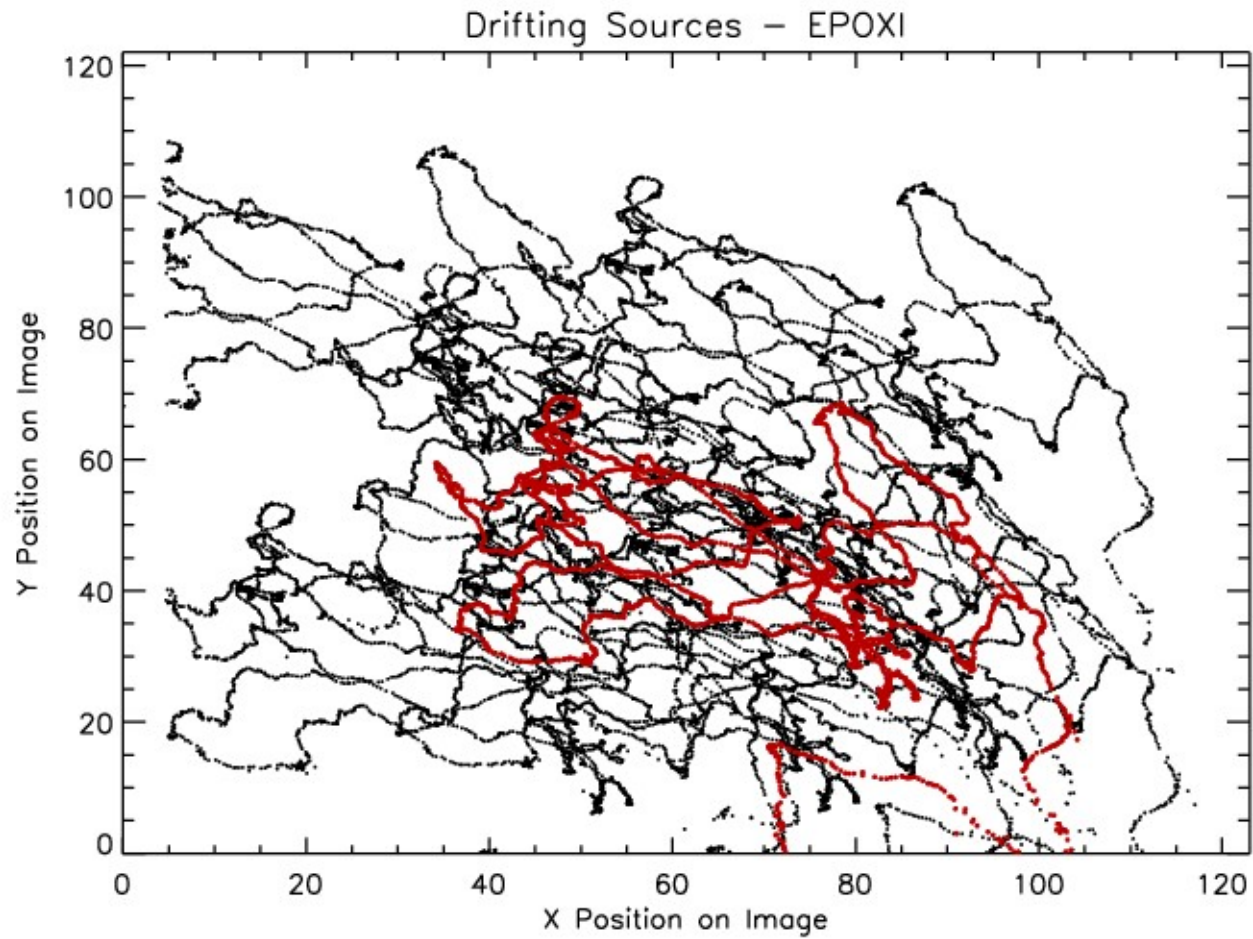
Cosmic Rays



Cosmic Rays



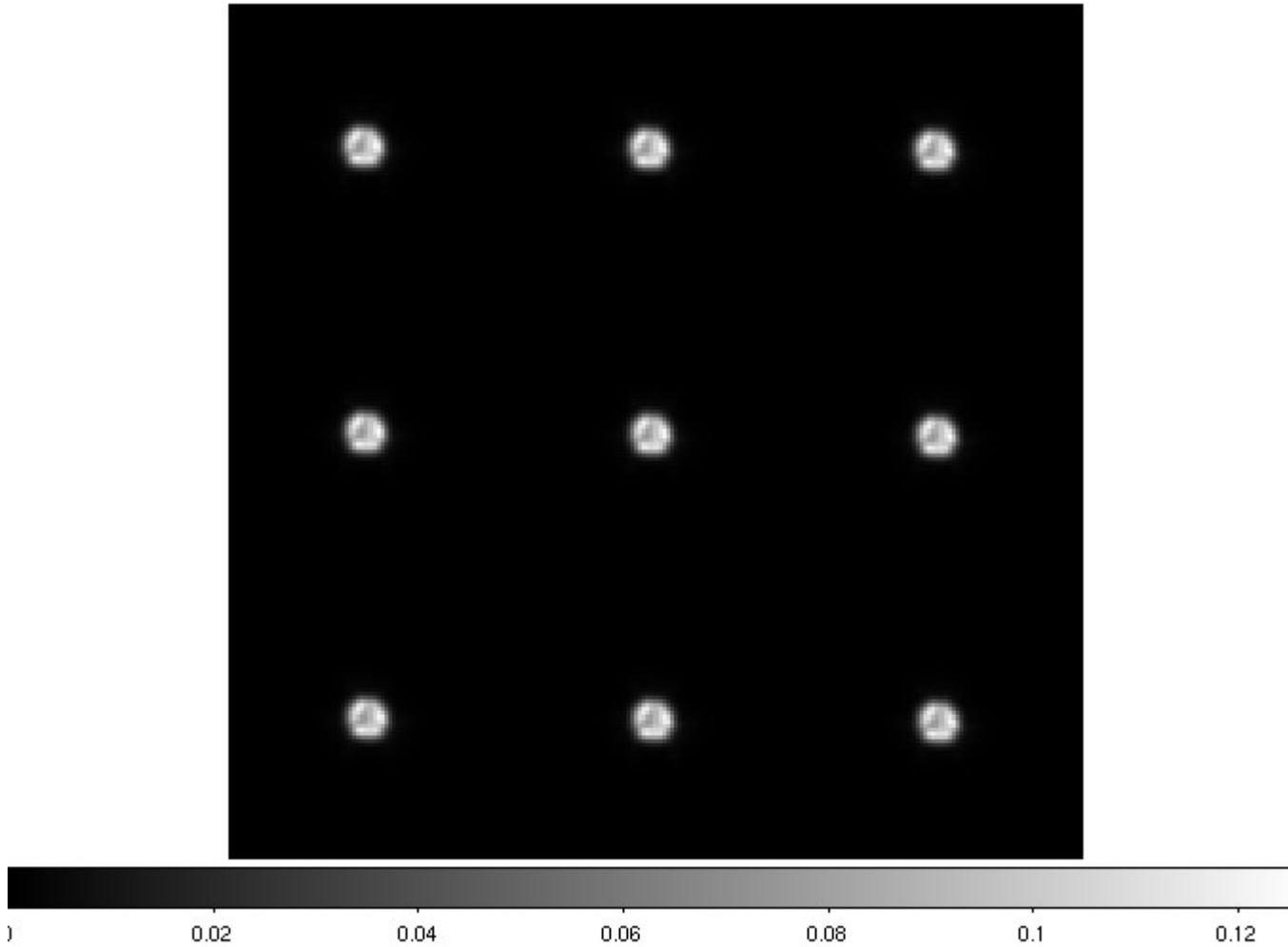
Pointing



Building Psf Model

- EPOXI PSF models are 600 x 600 pixels
 - Represents a 60 x 60 image region
- Shift model 5 pixels left/right/up/down
 - Downsample to 60 x 60 pixels
 - Create single Psf model using 9 images as constraints
- Use *daophot* / *allstar* / *allframe*
 - Uses lookup table

Building Psf Model



Running Daophot

- Find & phot
- Use detections to find geometric x-form
 - *daomatch*, *daomaster*
- Run *allframe* on all images simultaneously
 - Better centroiding / deblending
 - Consistent across all frames
 - Include ground-based data?

Making Lightcurve

- Don't have full focal plane sensitivity model
 - Ballard et al. 2009
- Use detrending model for relative calibration
 - Linear regression $f(x,y)$
 - Currently incomplete
- Absolute calibration done w.r.t. CTIO V,I data
 - Currently preliminary
 - Include griZY

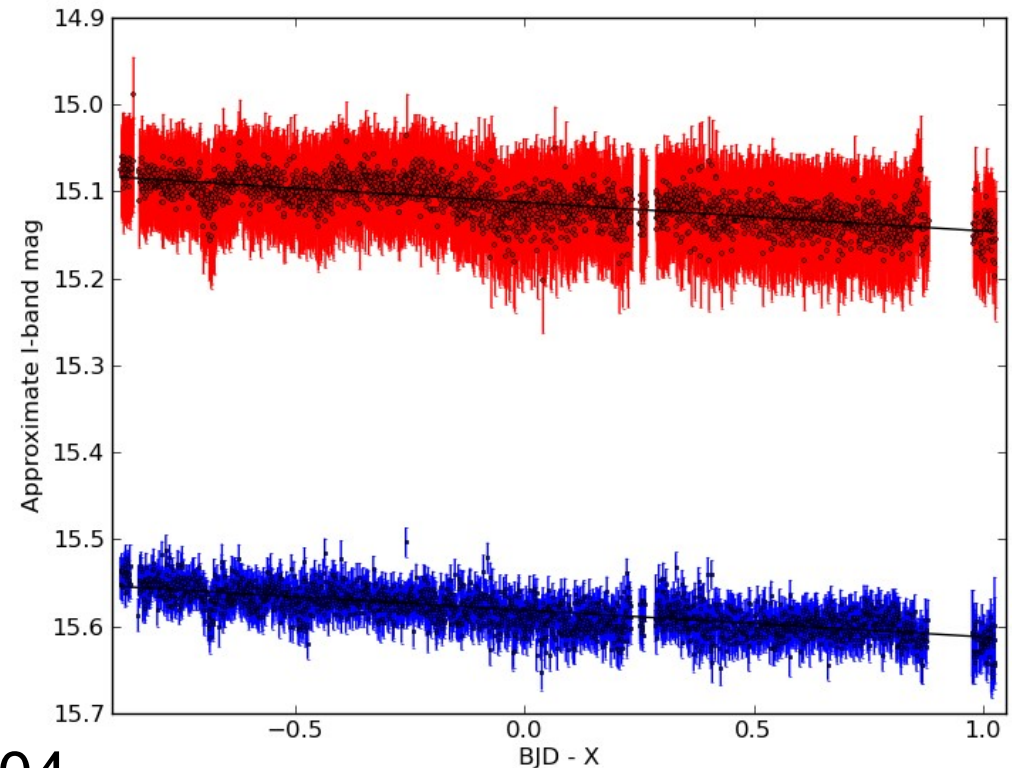
Lightcurve Fits

- Aperture

- Avg error bar = 0.05 mags
- Slope = 0.033 ± 0.002
- Intercept = 15.113 ± 0.001

- Psf

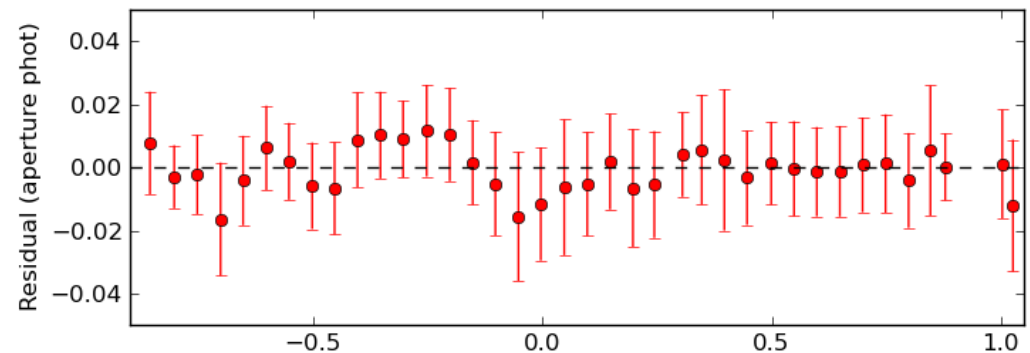
- Avg error bar = 0.02 mags
- Slope = 0.0309 ± 0.0007
- Intercept = 15.5816 ± 0.0004



Lightcurve Fits

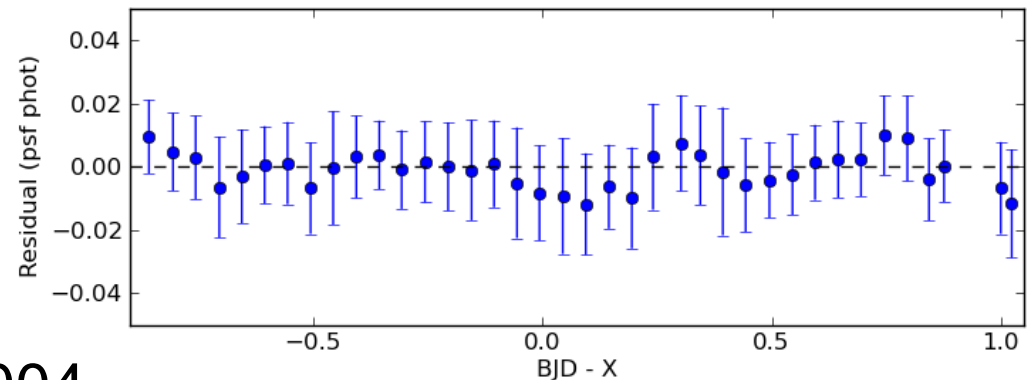
- Aperture

- Avg error bar = 0.05 mags
- Slope = 0.033 ± 0.002
- Intercept = 15.113 ± 0.001



- Psf

- Avg error bar = 0.02 mags
- Slope = 0.0309 ± 0.0007
- Intercept = 15.5816 ± 0.0004



Summary

- EPOXI photometry of Galactic Bulge microlensing events feasible
 - Crowded field
 - Defocussed images
 - Poor tracking
 - SED-dependent Psf
- General issues include
 - Pointing stability
 - Building focal plane calibration models
 - Response time to alerts
 - Returning to event