DECam Data Processing Splinter Session Summary

Adam Bolton, NOAO

Motivation

- "Data Processing" broadly defined
  - Calibration, image pipelining, catalog generation, image differencing, …
- Discussion and networking among folks with common interests
  - Take advantage of co-location here in Tucson
- Identify significant needs for the future

- **What are the priorities for NOAO/NCOA support of DECam data processing over the next 10 years?**
- **How should these priorities be coordinated with other efforts?**

Presenters

- Eric Morganson & Michael Johnson
  New DECam processing initiatives at NCSA

- John Moustakas
  Advocacy for uniform reprocessing

- Douglas Tucker
  Photometric calibration methods and ancillary calibration equipment

- Sahar Allam
  On-the-fly nightly calibration and zero-point estimation

- David Nidever
  NOAO Source Catalog processing and development

- Annalisa Calamida
  Managing time-series data reduction for variability studies

- William Dawson
  Dense-field differential photometry in MW Bulge and LMC/SMC

- Ian Dell'Antonio
  Shear measurement from CP and LSST-DM processed data

NCSA Processing of DECam Data
E. Morganson & Michael Johnson

Why Reprocess DECam Data?

- DECam: accidental Southern Survey
- Process all grizY exposures with one (single epoch) pipeline
- Using DES Pipeline which has improvements in
  - Calibration files (as instrument changes)
  - Sky background
  - Streaks/bleed trails
  - PSF Magnitudes
- Work with DES calibration team
- Get data in DES framework
  - Coadd Processing
 - Advanced Photometry (MOF/Tractor)
  - Difference Imaging?
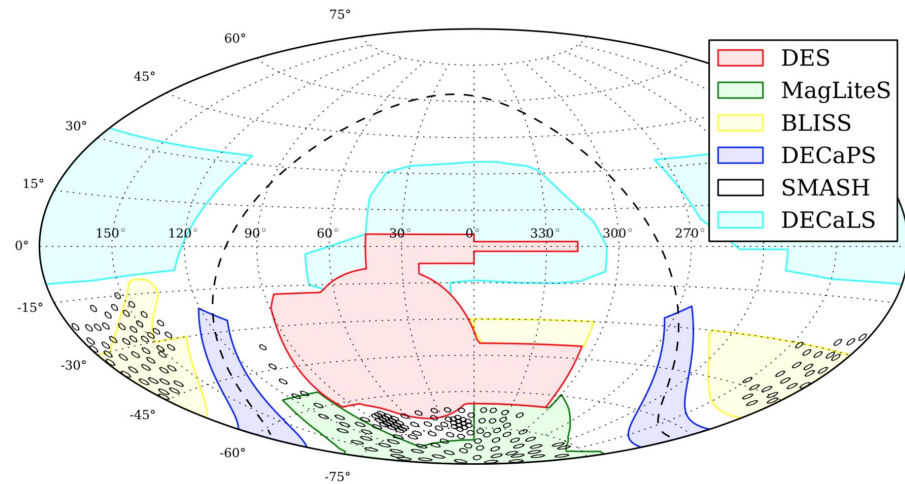
DECam surveys as of a year ago.

NCSA Processing of DECam Data
E. Morganson & Michael Johnson

Plan Going Forward

- DECam processing team is:
  - Don Petravick (Manager)
  - Eric Morganson (Astronomer)
  - Michael Johnson (Processing, Framework Software)
  - Doug Friedel (Data Transfer/Storage)
- Examining test fields and download raw grizY data (2 months)
- Single Epoch Processing (8 months)
- Calibration (2 months)
- Coaddition/advanced photometry (12 months)
- Data delivered to NCOA as ready
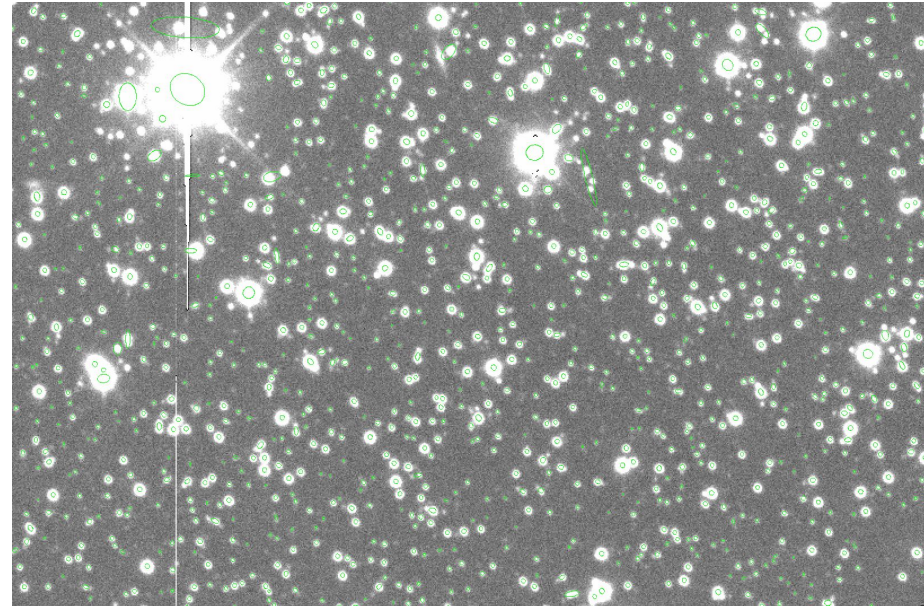
DES Processing on Crowded, b = 0 field.

John Moustakas (& discussion)

- Application: DESI target selection, to be finalized soon!
- Challenge: want the most uniform processing of DECam images to maximize homogeneity for large-scale structure cosmology
- Requires capacity for automated reprocessing at scale
- Requires management of multiple reduction versions
- Potential storage-volume challenge

There's a lot more that can be done with aTmCam!
(e.g., perhaps estimating
hourly DECam ugriz extinction coefficients from aTmCam mags?)

DARK ENERGY
SURVEY
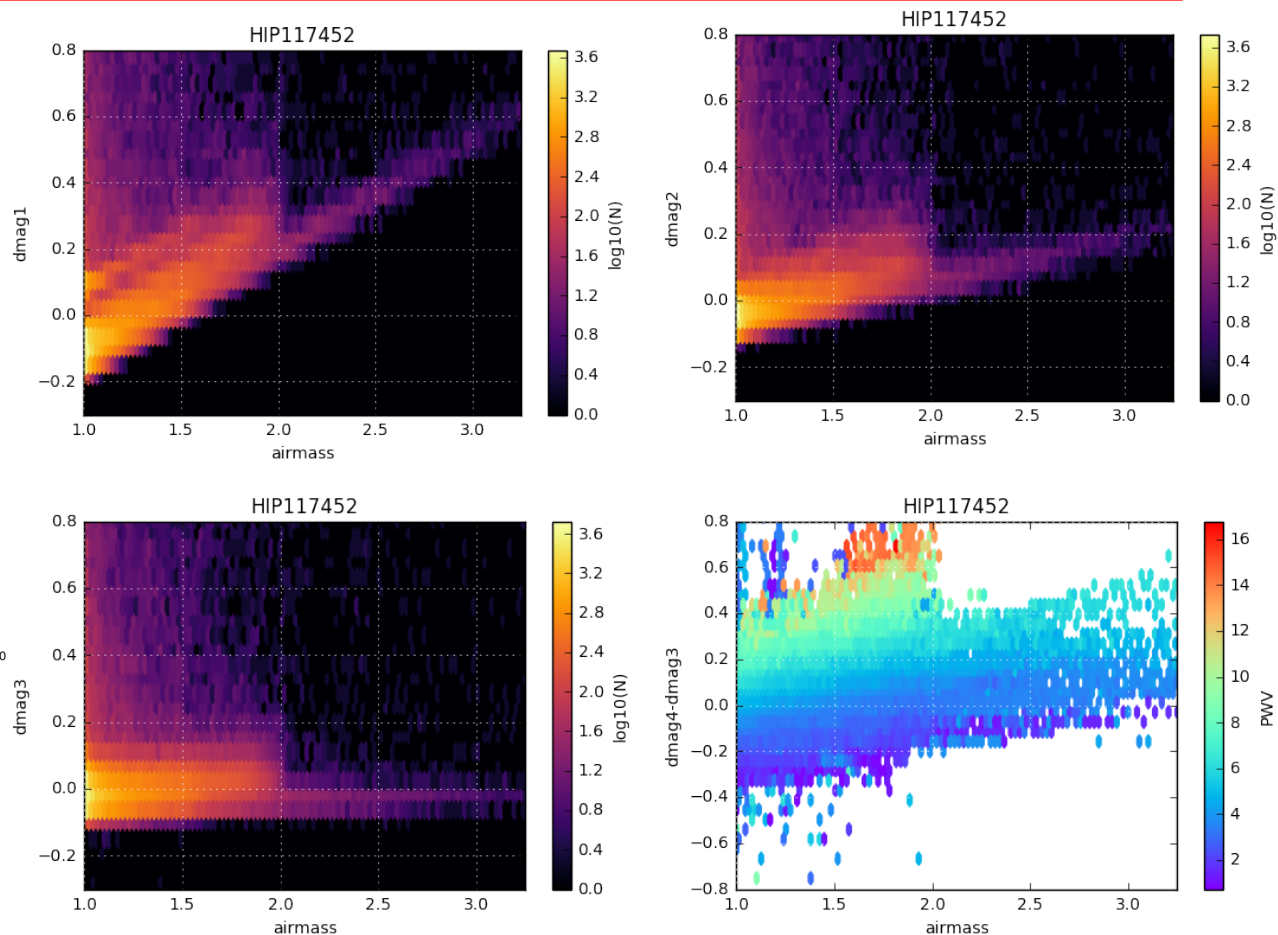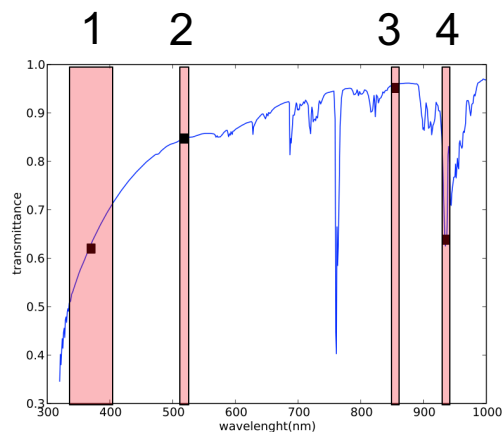
D. Tucker

D. Tucker

On-the-fly nightly Calibration and Zero-point estimation
Sahar Allam (Fermilab)

DARK ENERGY SURVEY

S. Allam

What is expCalib?
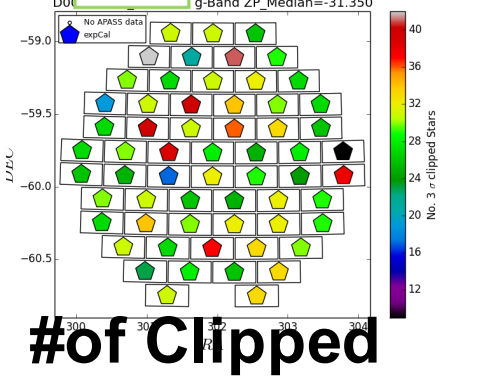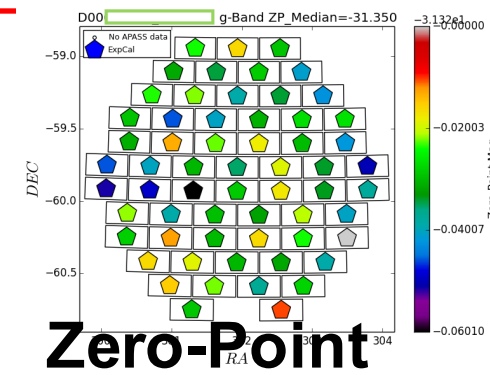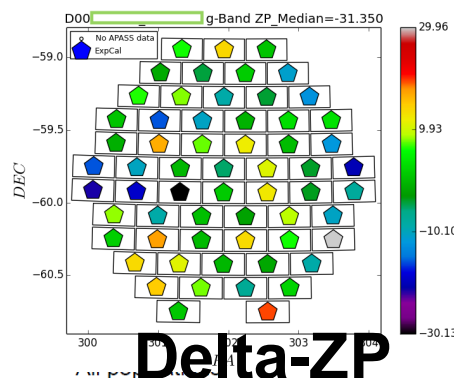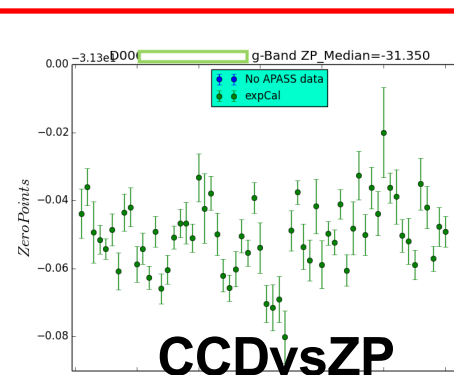
- Very Fast & quick zero points estimate for single epoch exposures (FIRSTCUT and/or FINALCUT)

- Useful for on-the-fly calibration.

- Can easily identify ZP gradient over an exposure.

- Currently use Full sky APAS+2mass transformed to DES {u,g,r,i,z,Y}

- Find outlier ZP for each exposure via scikilearn Local Outlier Factor (LOF**)

- Estimated ZP for:- DES, DES-Sne, CalSpec, DECam Engineering, DESGW, IceCube, BLISS, MagLiteS, BLIN, and others

CCDvsZP

Zero-Point

Delta-ZP

#of Clipped

**http://www.dbs.ifi.lmu.de/Publikationen/Papers/LOF.pdf

Local density in Multi-dimensional Feature Space
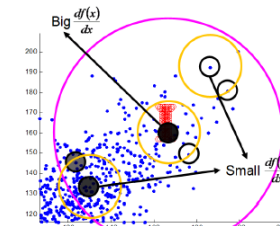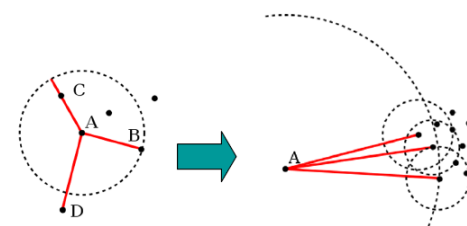
Comparing with Self or others: change of local-density

NOAO Source Catalog

Object Density

2.9 billion objects   34 billion measurements

D. Nidever

4.0 ▬▬▬▬▬▬▬▬ 6.7 Log (objects/deg²)
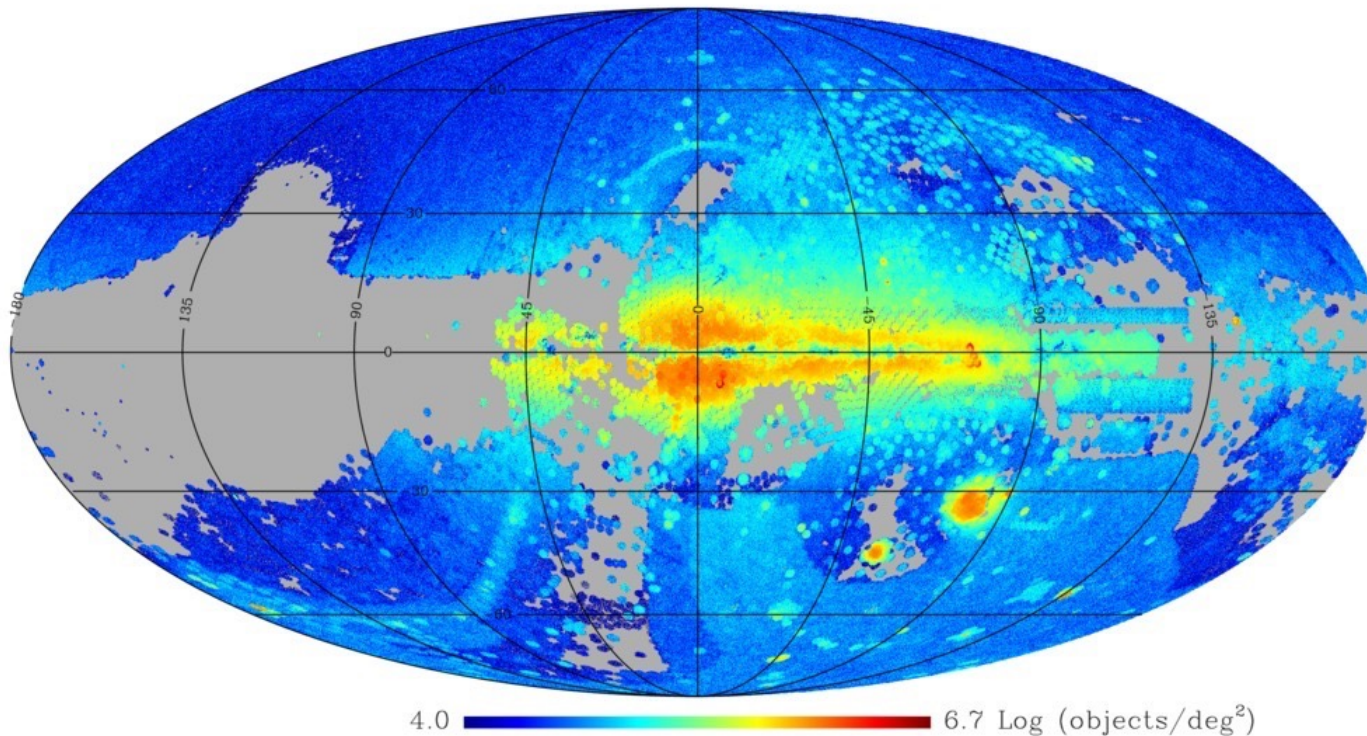
Summary

- Depth: ~23rd mag (ugrizY)
- Coverage: 3/4 of sky
- Photometric calibration accuracy: ~2%
- Astrometric accuracy: ~20 milliarcsec
- Number of exposures: ~255,000
- Epochs: 10s to 1000s
- Data from DECam, Mosaic-3 and 90Prime
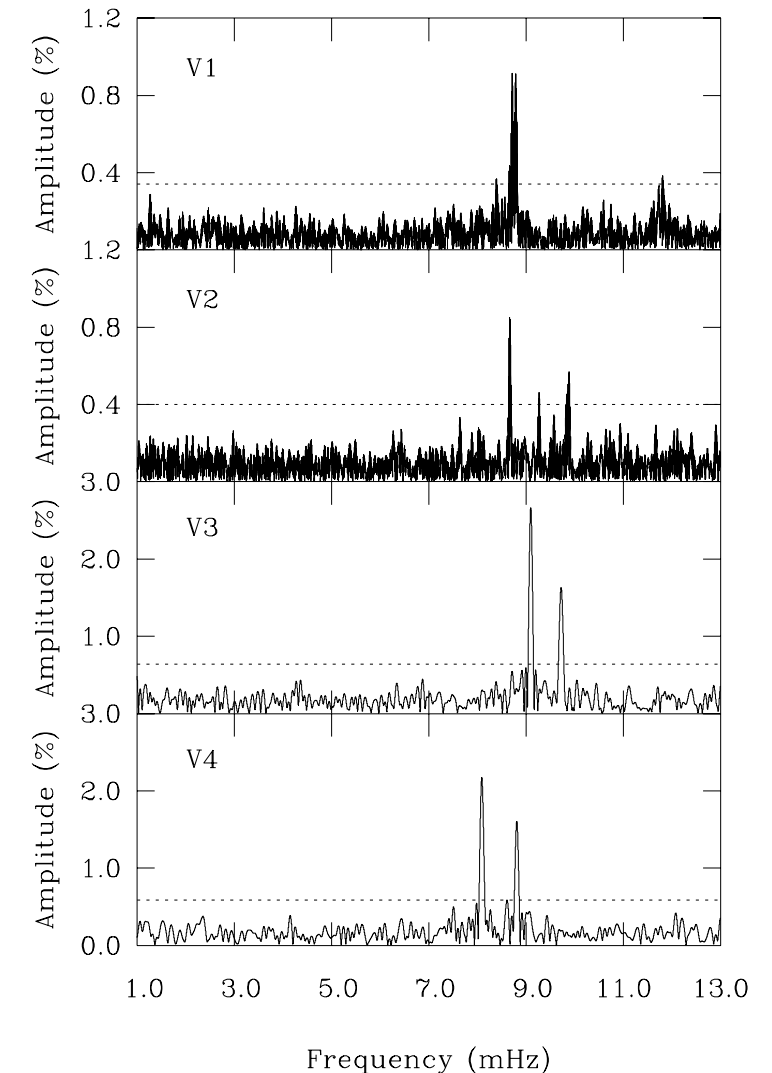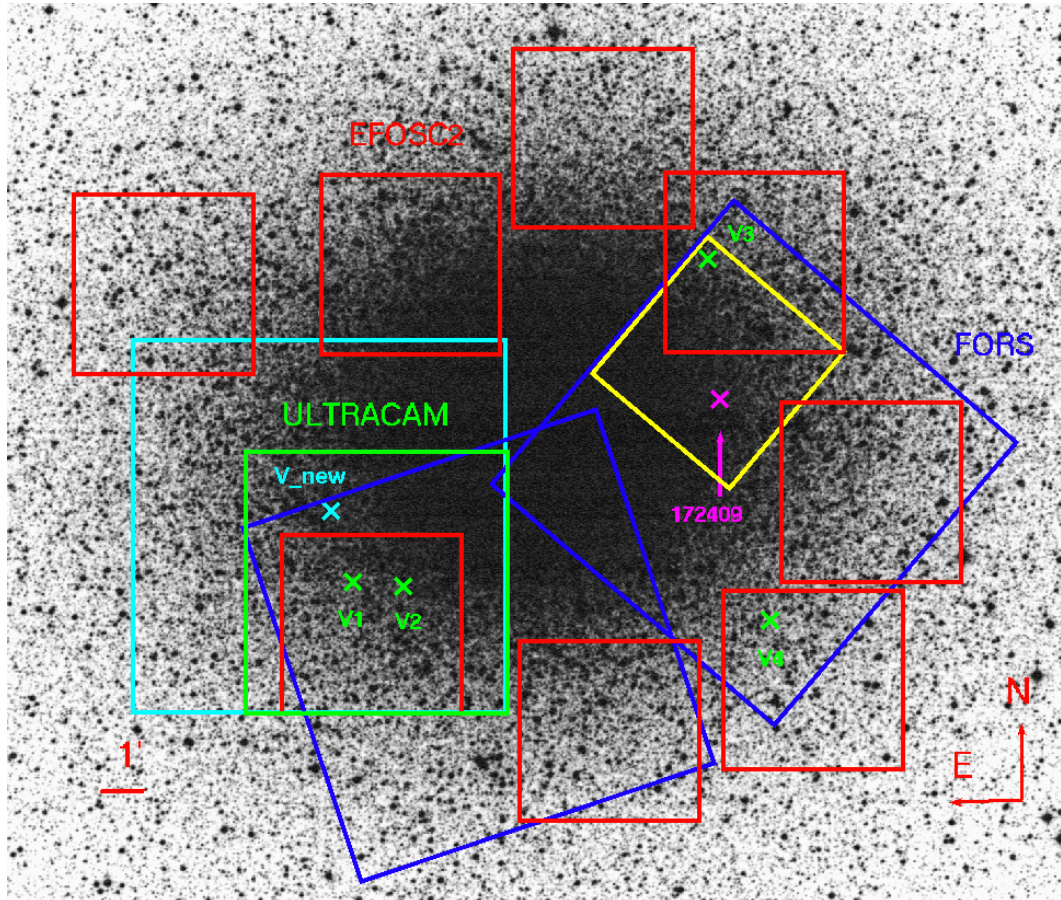- PSF photometry coming next year

Nidever et al. (2018a)

Time series photometry

We identified **5 extreme horizontal branch pulsators** in ω Cen based on EFOSC2 & **ULTRACAM on 4m NTT ESO telescope photometry** (Randall et al. 2009, 2011)

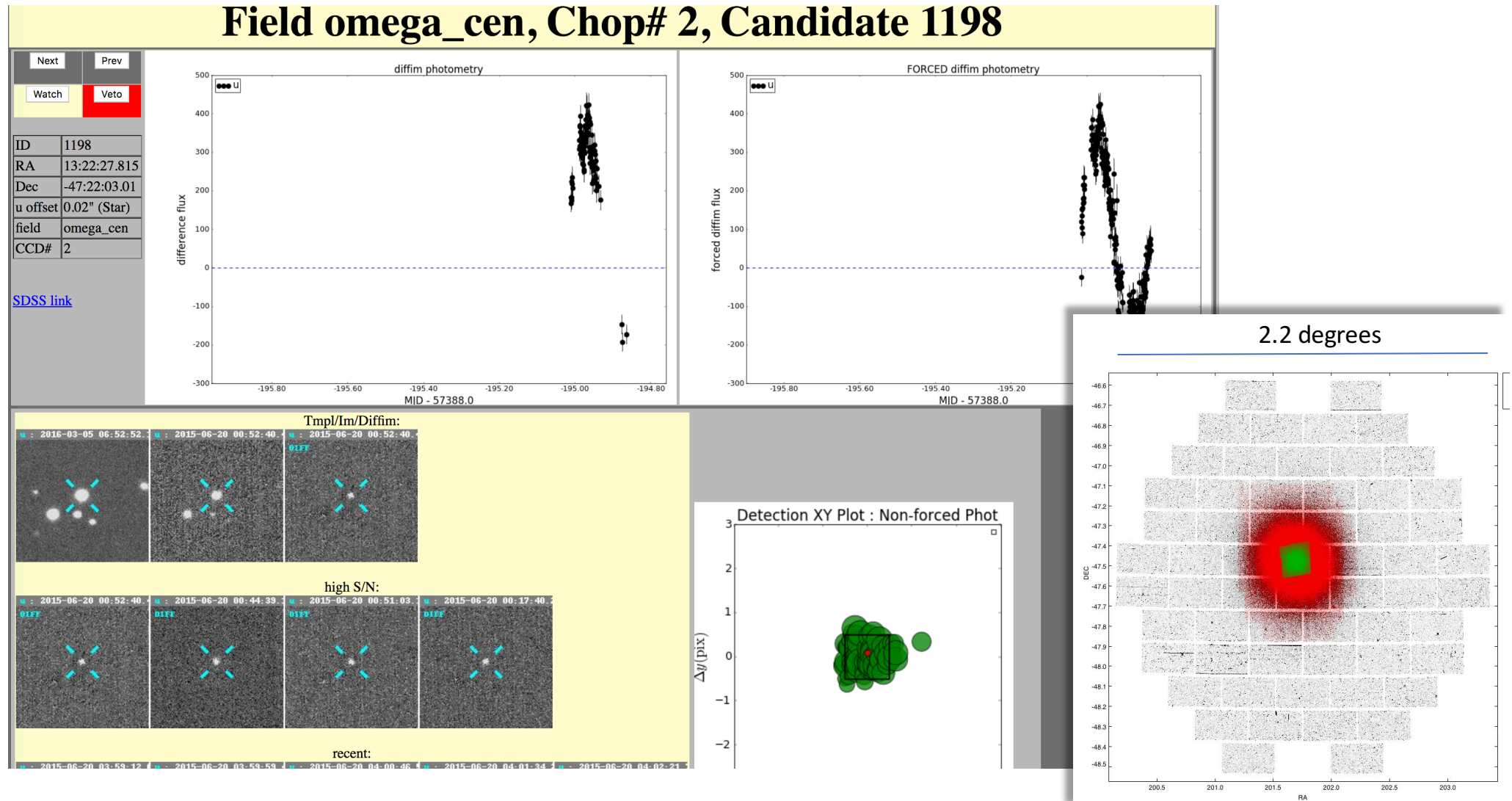A. Calamida

Time series with DECam on Blanco Telescope

Difference Image photometry with Photpipe (DECam pipeline from A. Rest at Space Telescope)

A. Calamida

William Dawson (& discussion)

- Application: microlensing survey of galactic bulge
- Open question: find best method for difference imaging in crowded-field photometry (PSF-based? Or kernel-based?)
- Potential to leverage LSST approach
  - But very crowded-field photometry is beyond scope for LSST?
- Challenges:
  - Astrometry
  - PSF matching
  - Sky background estimation
  - Airmass-bandpass variation coupling (dipoles)
- What is the best metric for comparing methods?

Ian Dell'Antonio (& discussion)

- Application: weak lensing by low-z clusters
- Open question: How to achieve uniform analysis across many different cameras?
  - Current state of the field is to re-invent process for each new camera
- Working to leverage "generic" imaging data hooks in LSST pipeline, fed by CP-processed images
- Significant archival science opportunities if technical challenge can be met

Likely community science priorities for DECam data processing in the next 10 years

- Support for crowded fields
- Support for difference imaging
- Support for management of data-analysis workflows
- Support for multiple calibration methods
- Support for flexible, scalable processing (and reprocessing)
  - Different applications want different processing cadence
  - PI science wants rapid turn-around a la Community Pipeline
  - Different calibration choices for PI vs. Survey science
- Support for application of LSST software to DECam