DARK ENERGY
SURVEY

PreCam and Global Calibrations

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DES-Calib/PreCam Telecon

28 October 2011

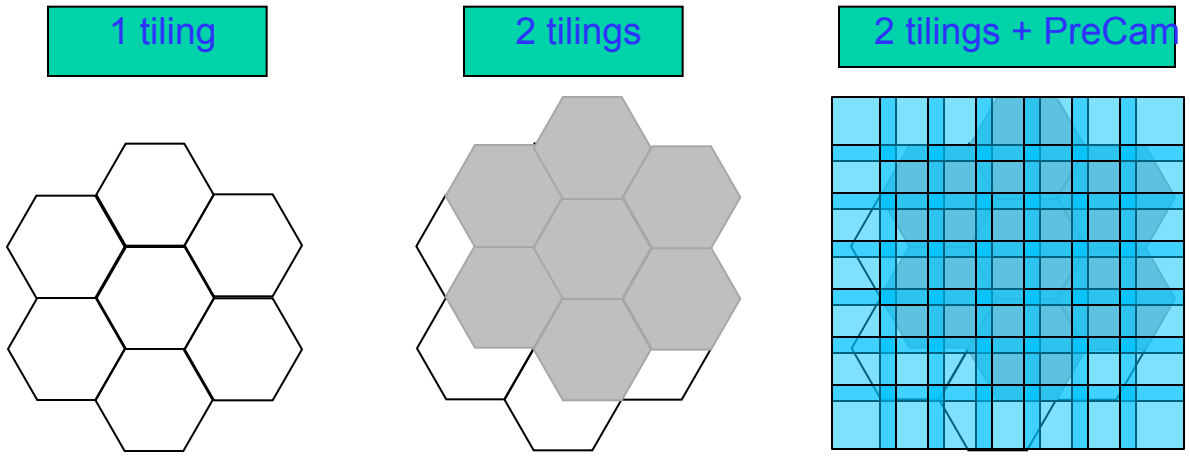
Global (Relative) Calibrations Module (GCM)

DARK ENERGY SURVEY

- Use overlapping images to measure relative photometric offsets.
- Big matrix inversion problem (uses algorithm of Glazebrook et al. 1994).

Example of PreCam Full Footprint Strategy + First Year of DES

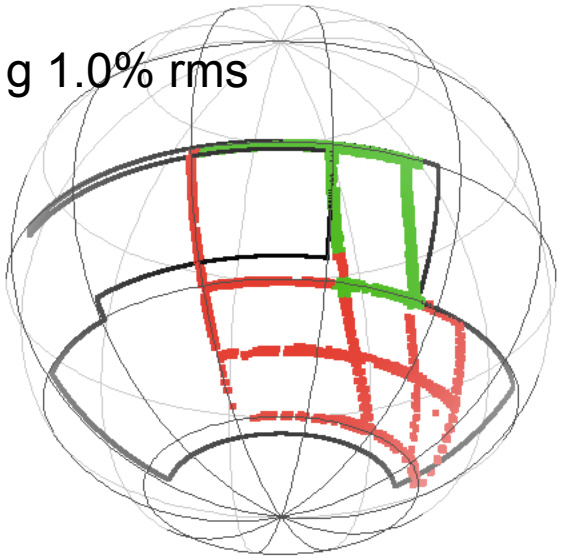
From DES-doc #3610



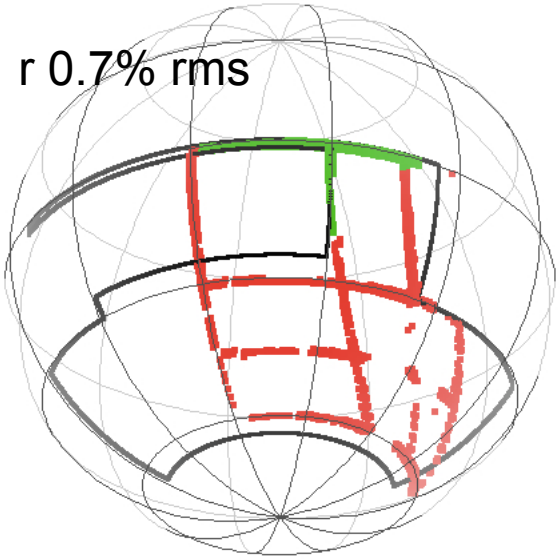
From the UPenn Collaboration Meeting: Global Relative (Internal) Calibrations

DARK ENERGY SURVEY

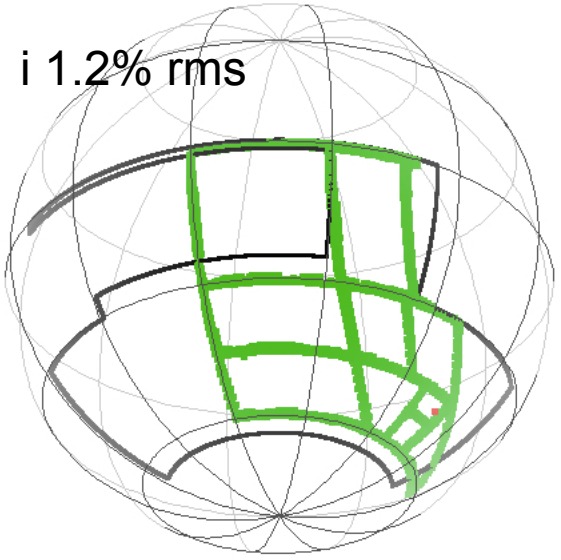
g 1.0% rms



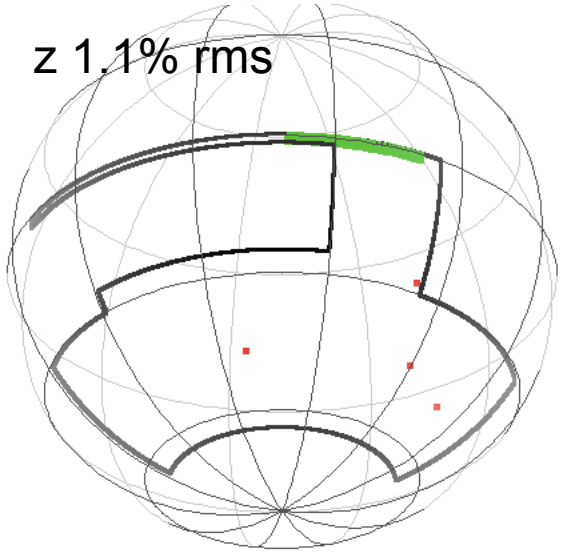
r 0.7% rms



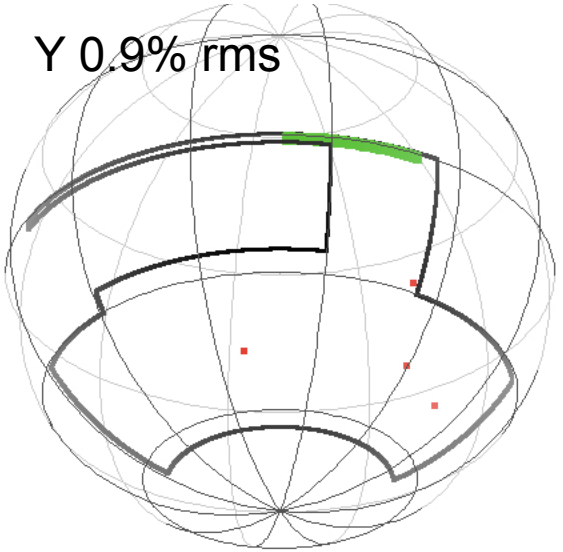
i 1.2% rms



z 1.1% rms



Y 0.9% rms



First Attempt: Tie Everything to a Single Fiducial PreCam Field

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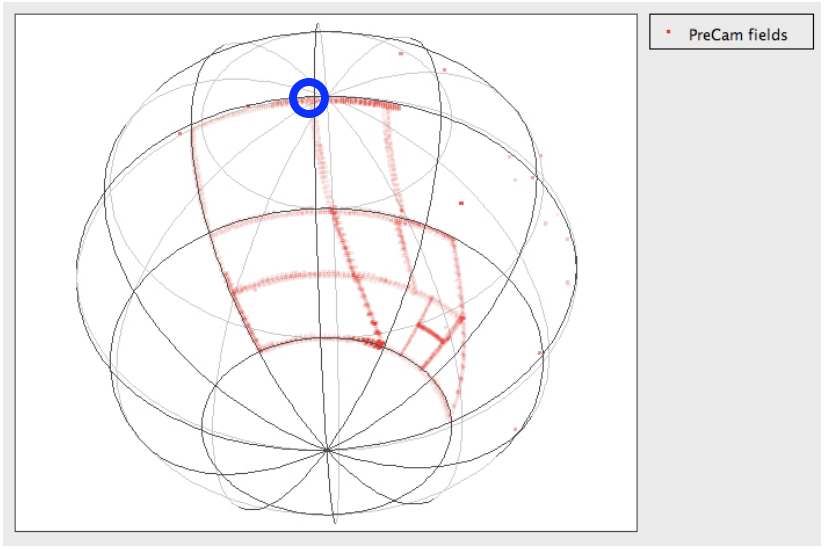

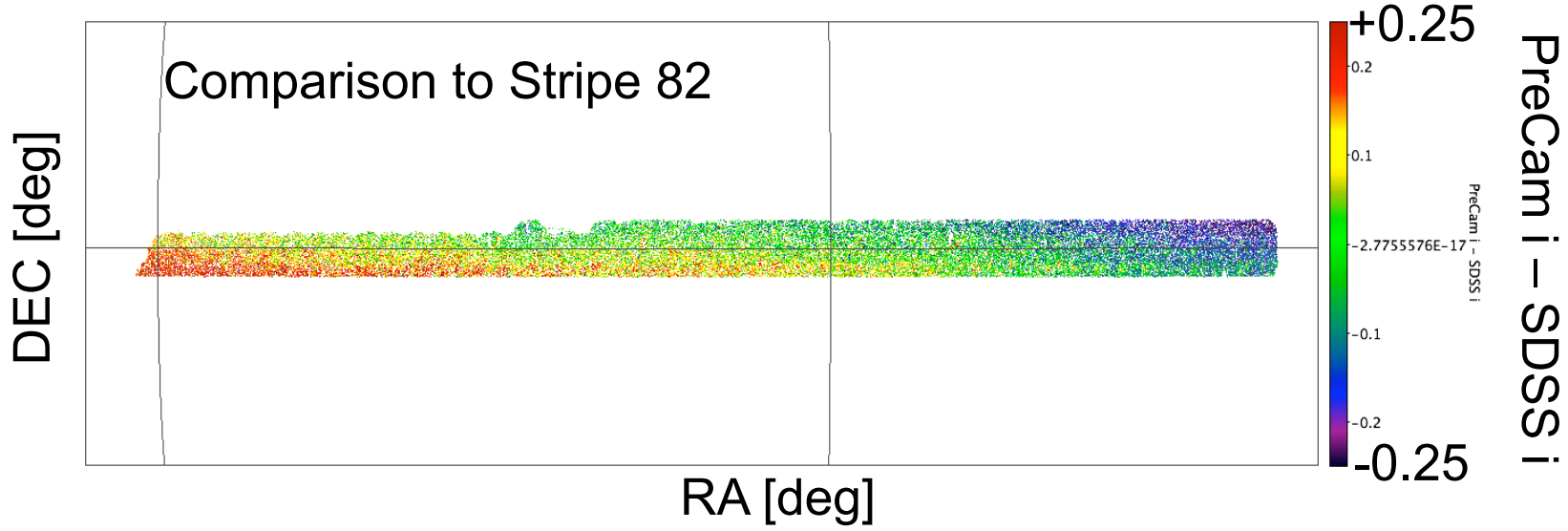

First Attempt: More Comparisons with Stripe 82

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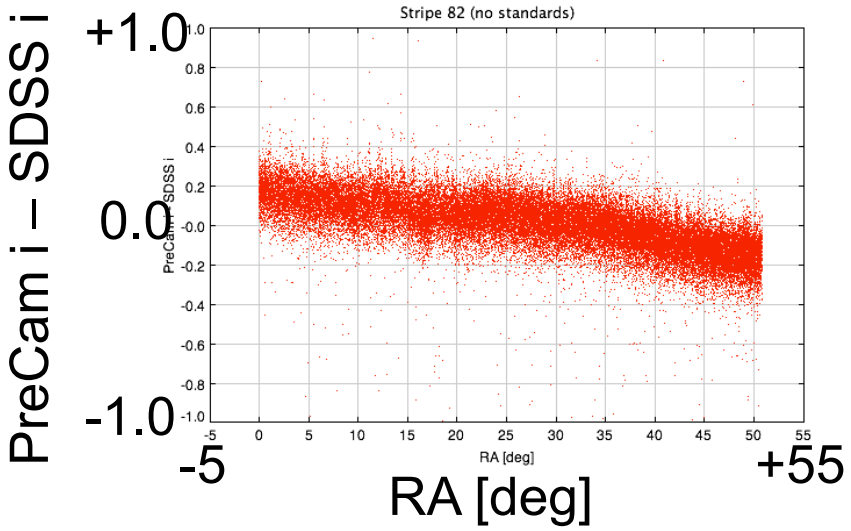

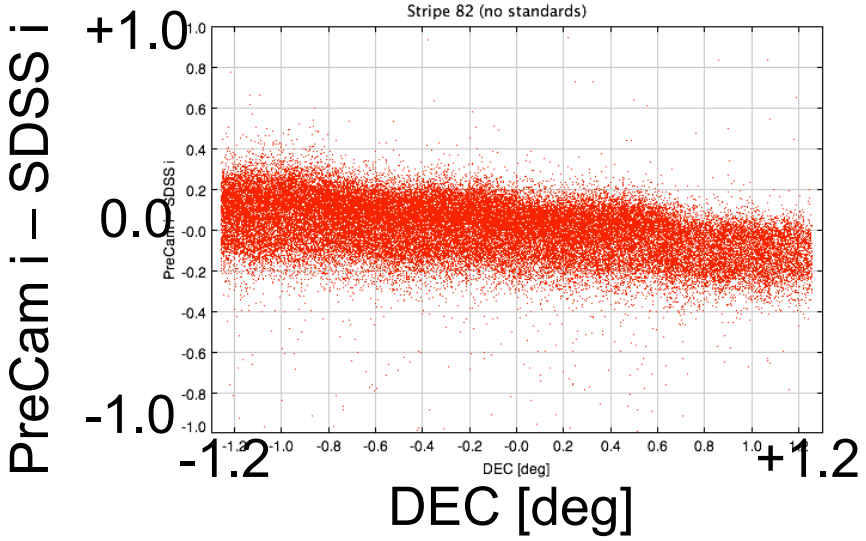

Statistical vs. Systematic Errors

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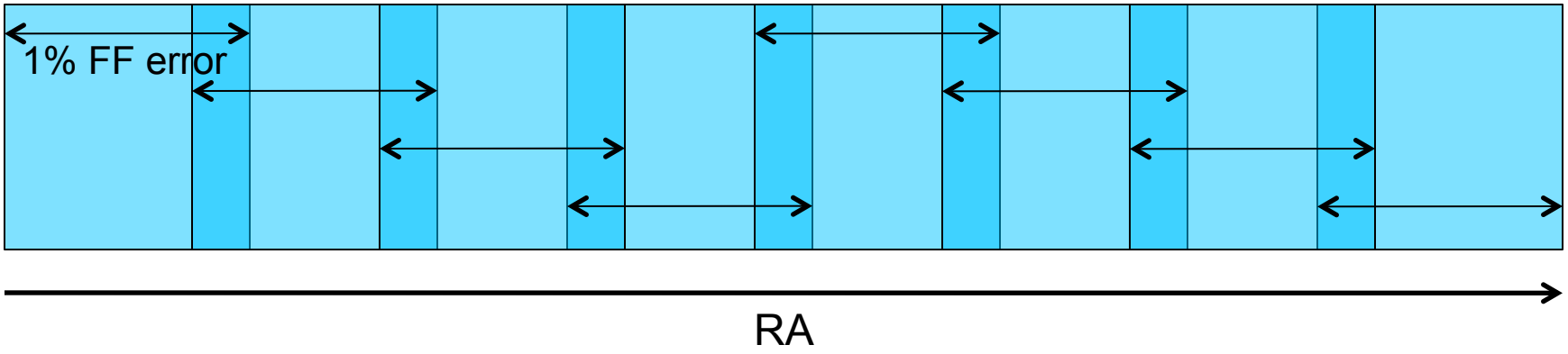
- It is possible to get a statistically good solution from GCM but still have large systematic errors.

- Consider the a long, thin strip in RA, with a 1% flat fielding error (edge-to-edge) from West to East:



- One could still get a statistically tight offset between fields from the overlaps, but still end up with large systematic errors.

Second Attempt: Use Stripe 82 and Southern Standards as Fiducial "Field"

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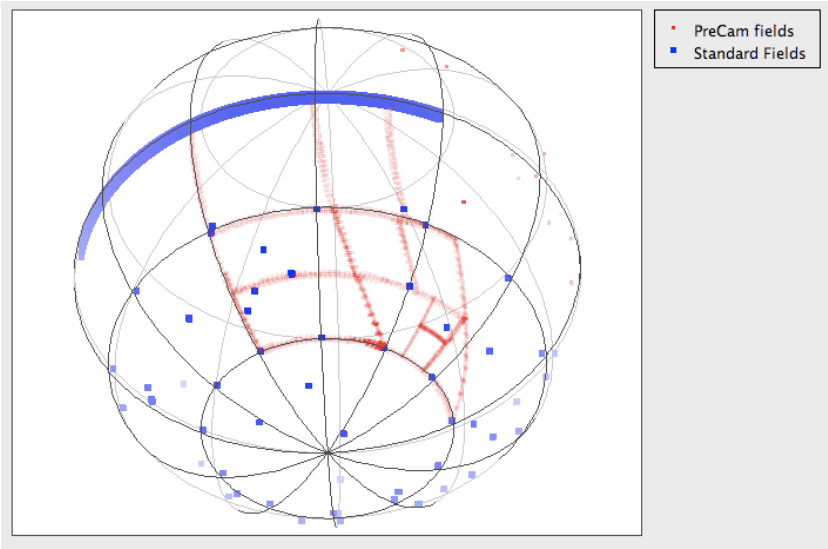

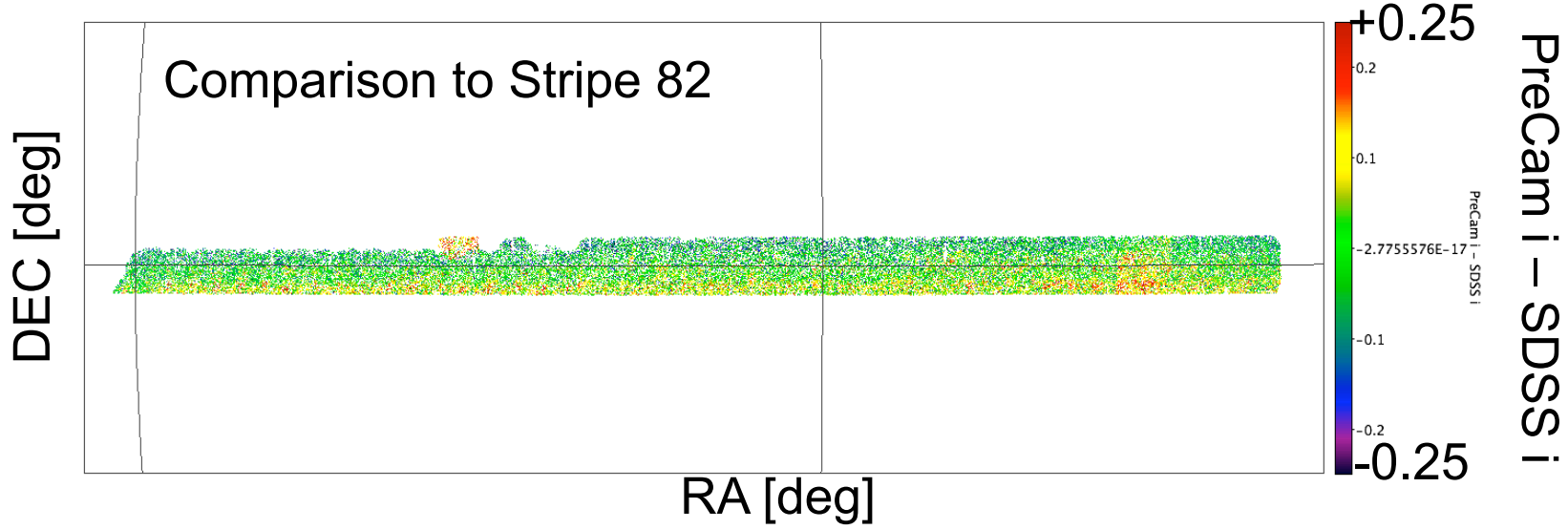

Recap:
First Attempt vs. Second Attempt

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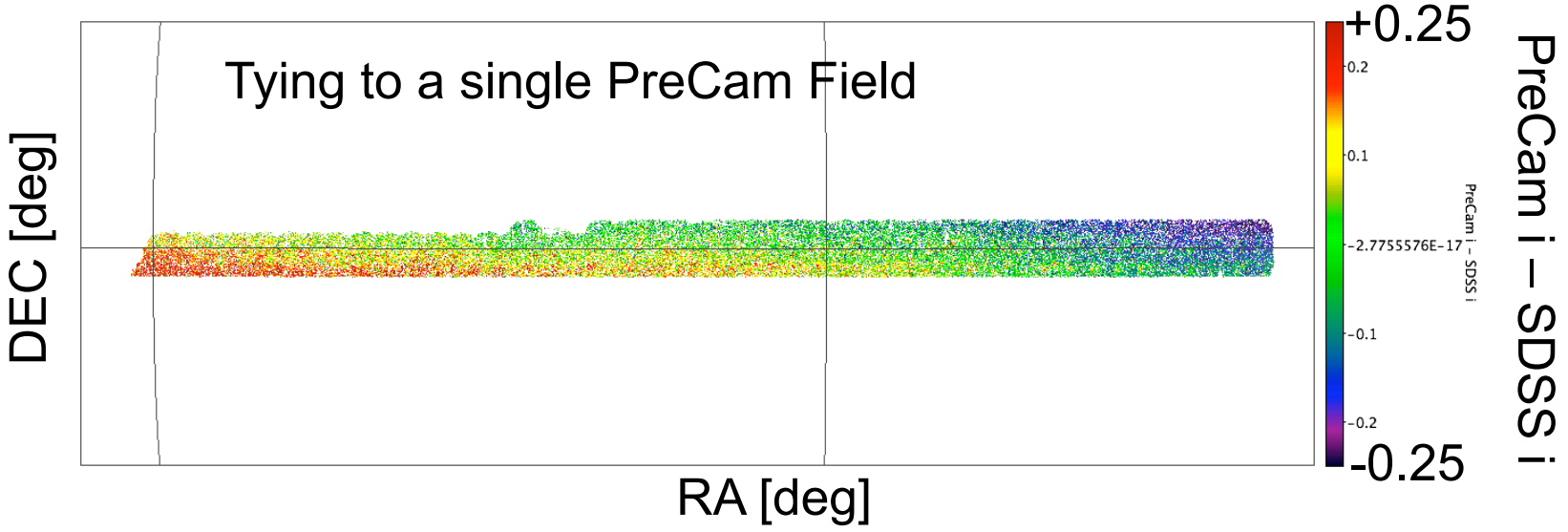

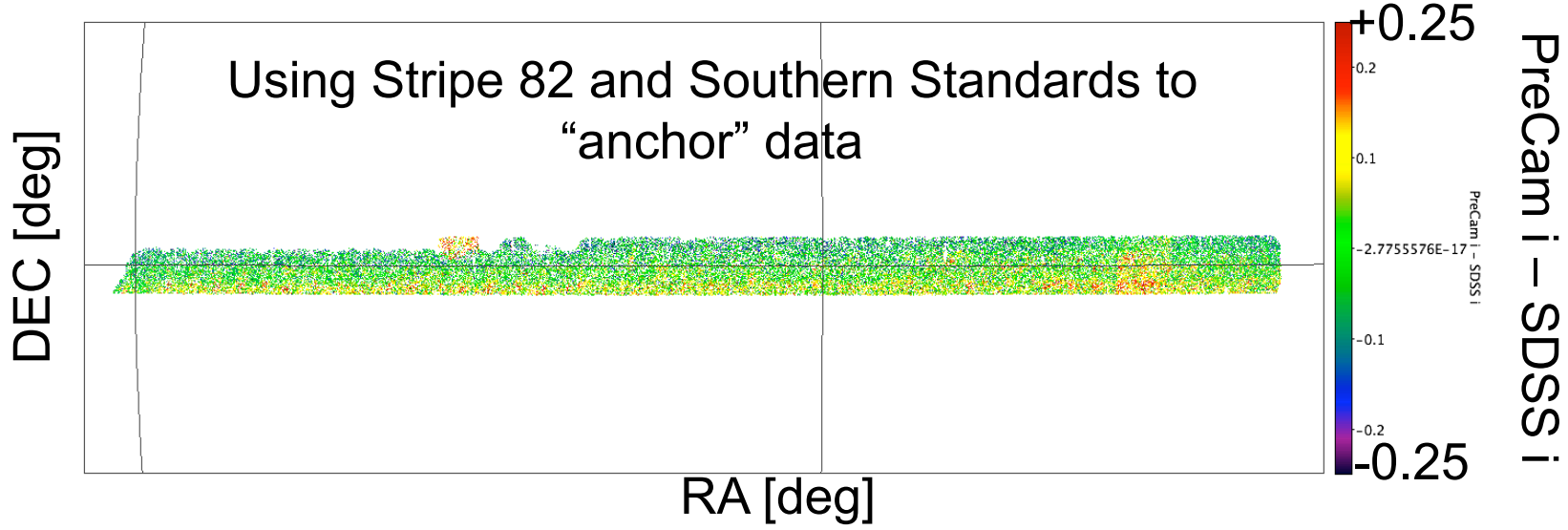

More Results from Second Attempt: Flat Fielding Issues

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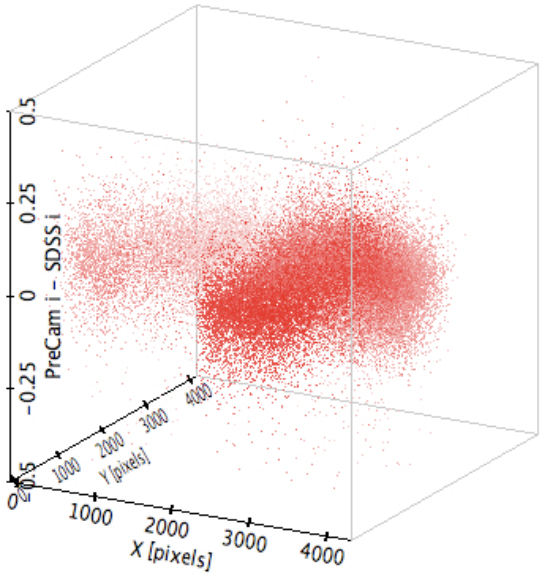

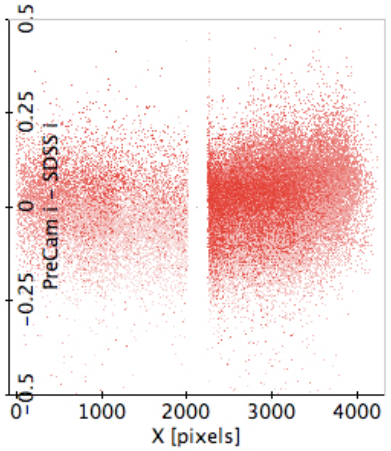

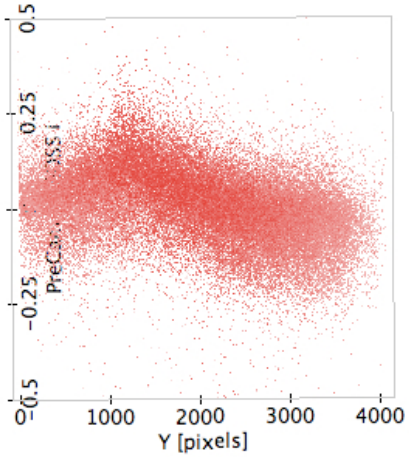

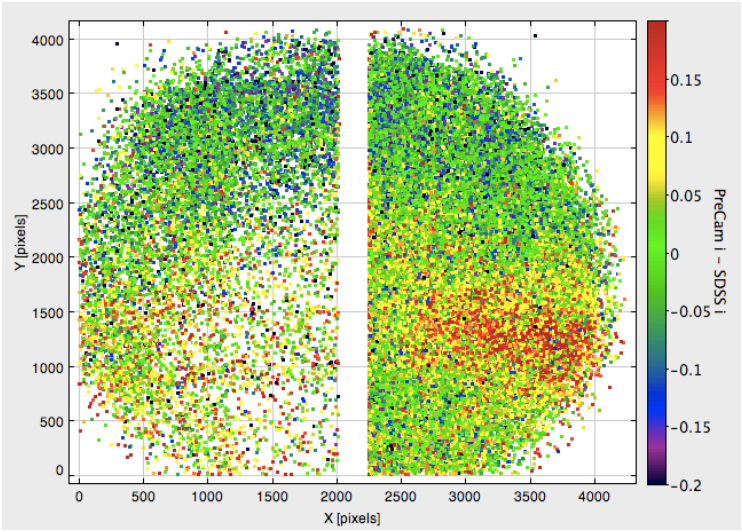

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SURVEY

Extra Slides

Types of Simulations

DARK ENERGY SURVEY

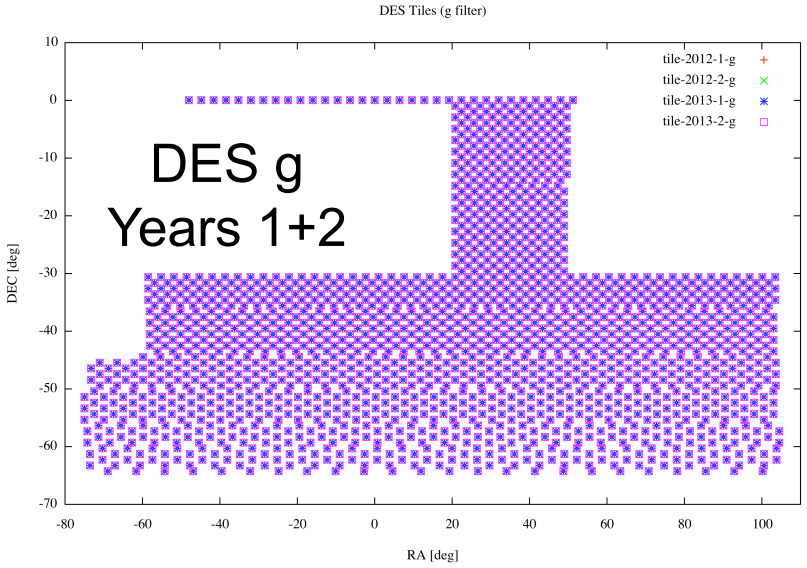
1. “Perfect” Data (DES, PreCam)
   a. No Poisson noise in stellar mags
   b. No flat-fielding errors
   c. Only deviations from perfection are the pointing-to-pointing zeropoint offsets provided by Jim Annis from his Survey Strategy software.

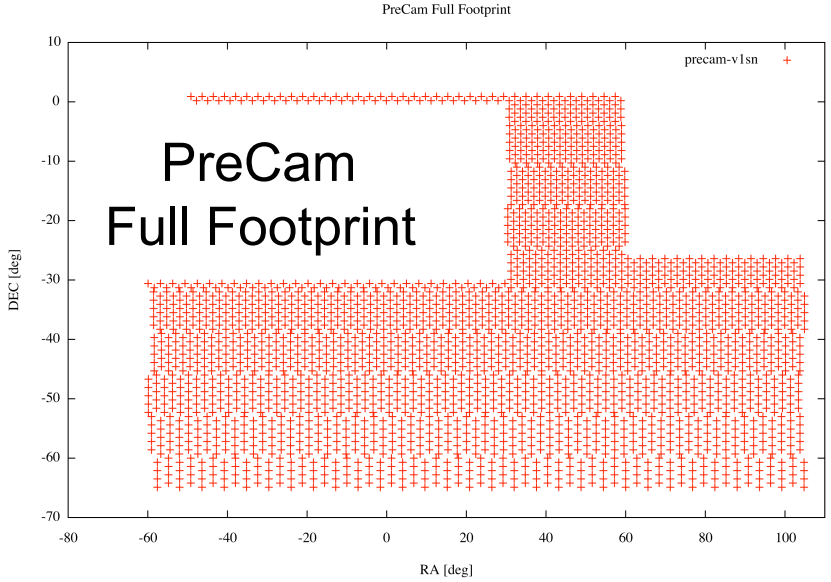
2. “Realistic” Data (PreCam)
   a. All stars used have Gaussian random errors (σ = 0.01mag)
   b. Residual flat-fielding errors of 1% across the focal plane
      1) Linear flat-fielding error across focal plane
      2) Direction of flat-fielding error is random (0°-360°)

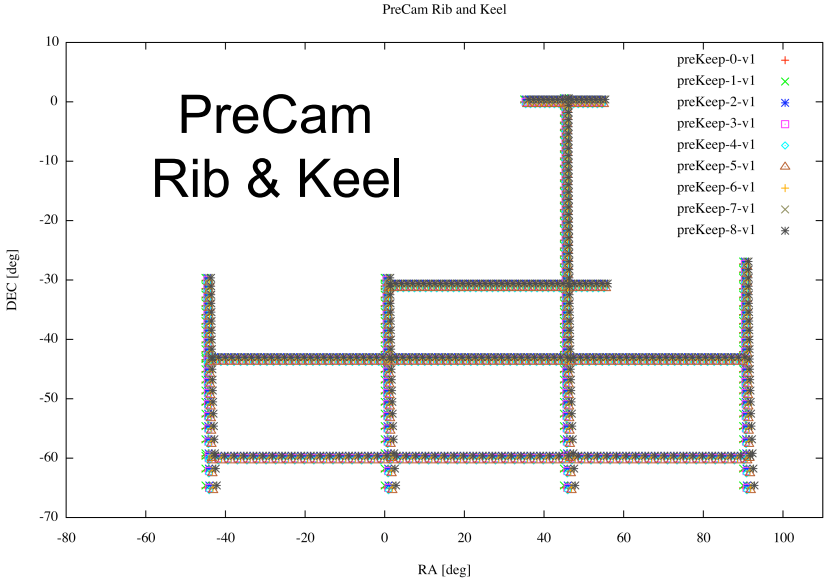
3. “Pessimal” Data (DES)
   a. Same as “2” above, but the 1% flat-fielding error is always in the same direction, from West to East

RA, DEC Plots of 3 Surveys

DARK ENERGY SURVEY







Photometric Zeropoint Offsets from Survey Strategy

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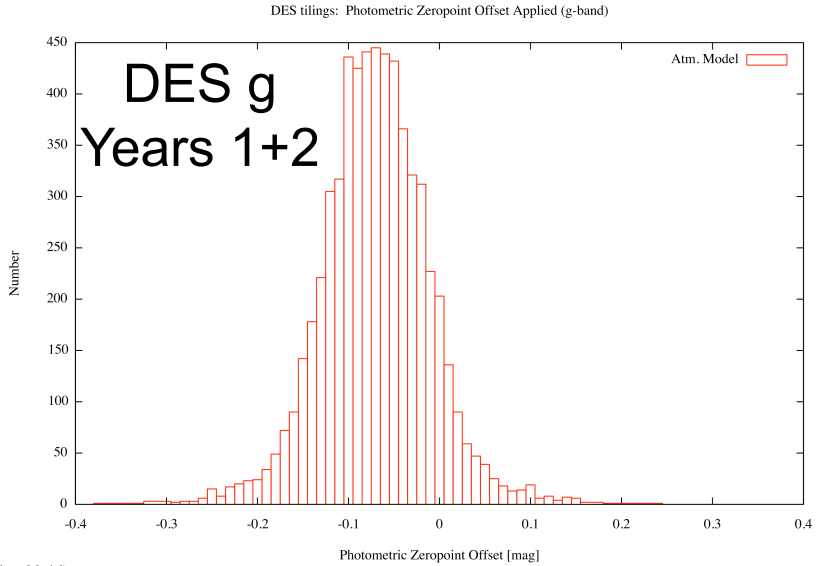

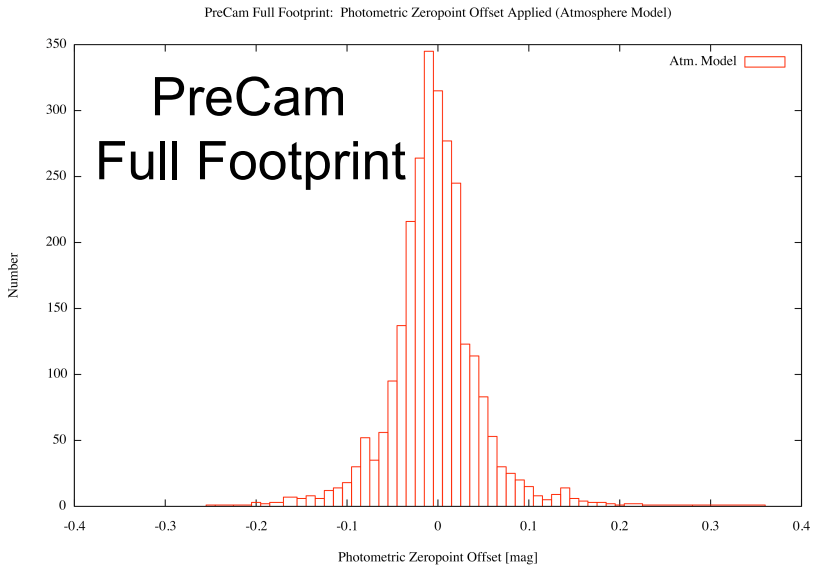

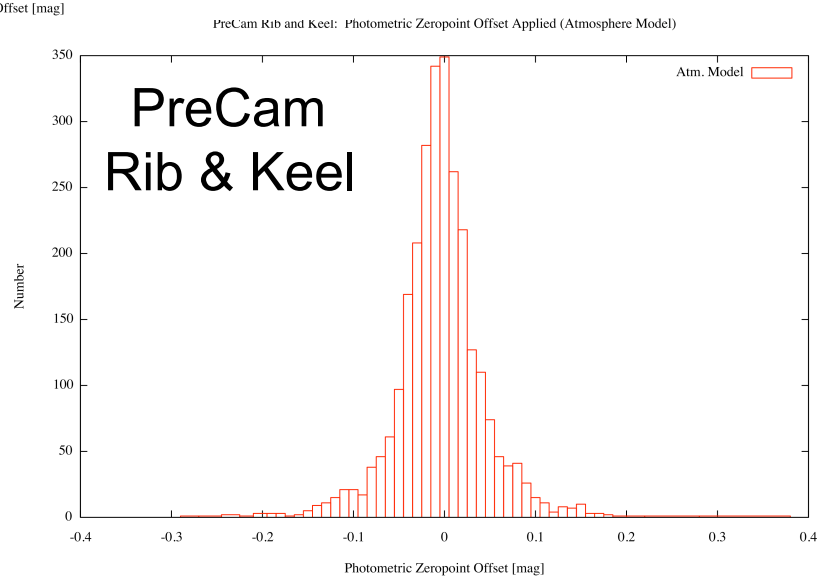

Simulated Stars on the Focal Plane

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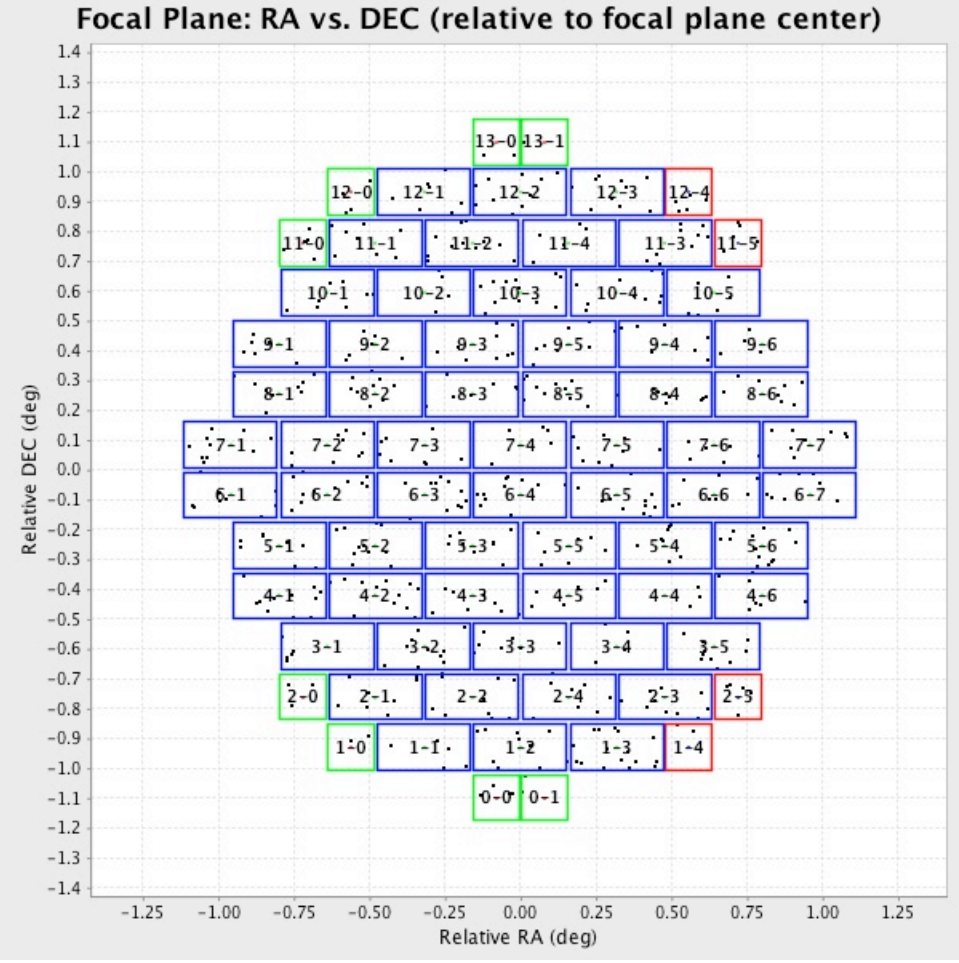
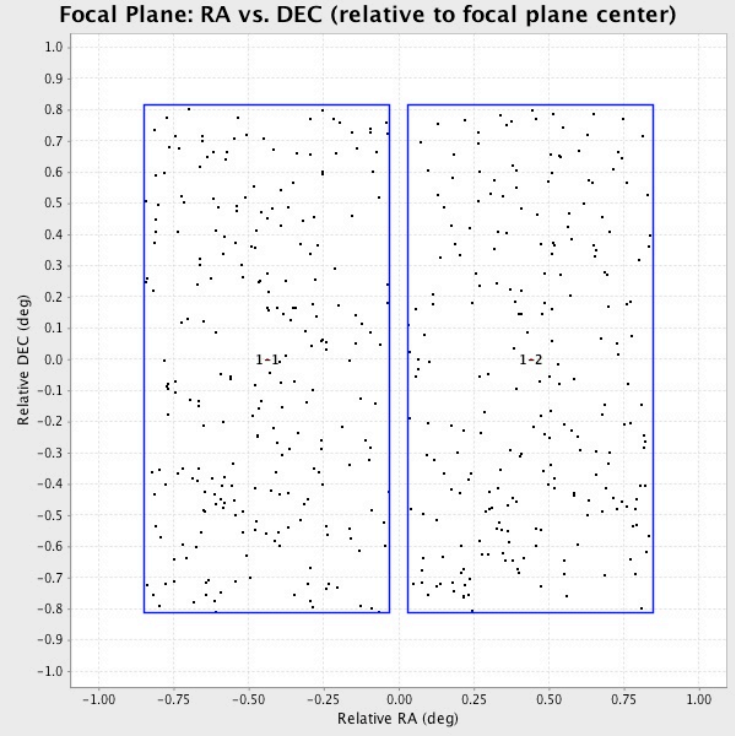
DECam



PreCam



(Not the same fields.)

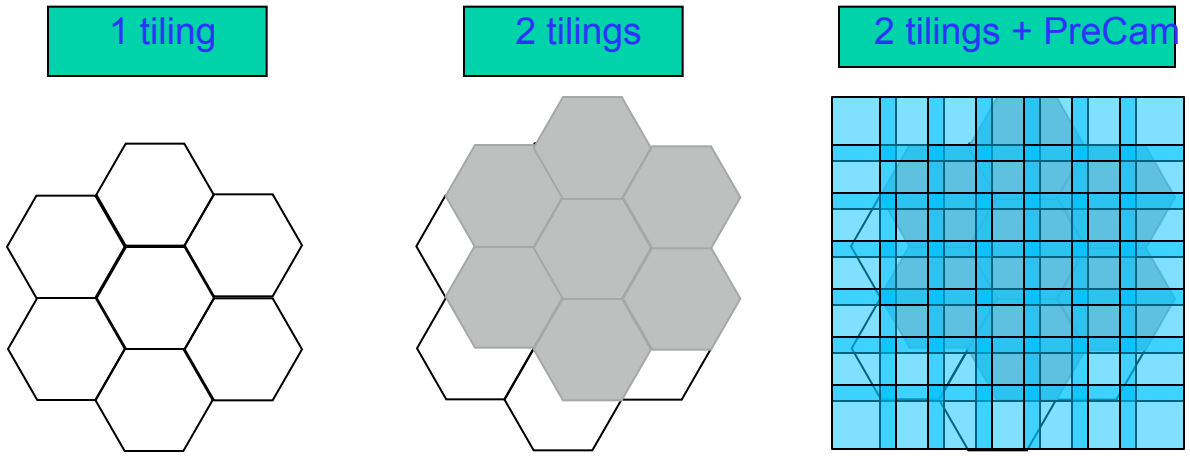
Global (Relative) Calibrations Module (GCM)

DARK ENERGY SURVEY

- Use overlapping images to measure relative photometric offsets.
- Big matrix inversion problem (uses algorithm of Glazebrook et al. 1994).
- For the current simulations, do focal plane-by-focal plane solutions (not CCD-by-CCD solutions), to cover full DES footprint without memory problems.

Example of PreCam Full Footprint Strategy + First Year of DES

From DES-doc #3610



Baseline Test of GCM: Solving ZPs for the "Perfect" Simulations

- "Perfect" simulations tested:
  - DES g Years 1+2
  - PreCam Full Footprint
  - PreCam Rib & Keel

- RMS of the GCM solutions is << 0.00001 mag (below the round-off)
  - This is a measure of the statistical error.

- RMS of (GCM ZP – True ZP) << 0.00001 mag (below the round-off)
  - This is a measure of the systematic error.

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Results

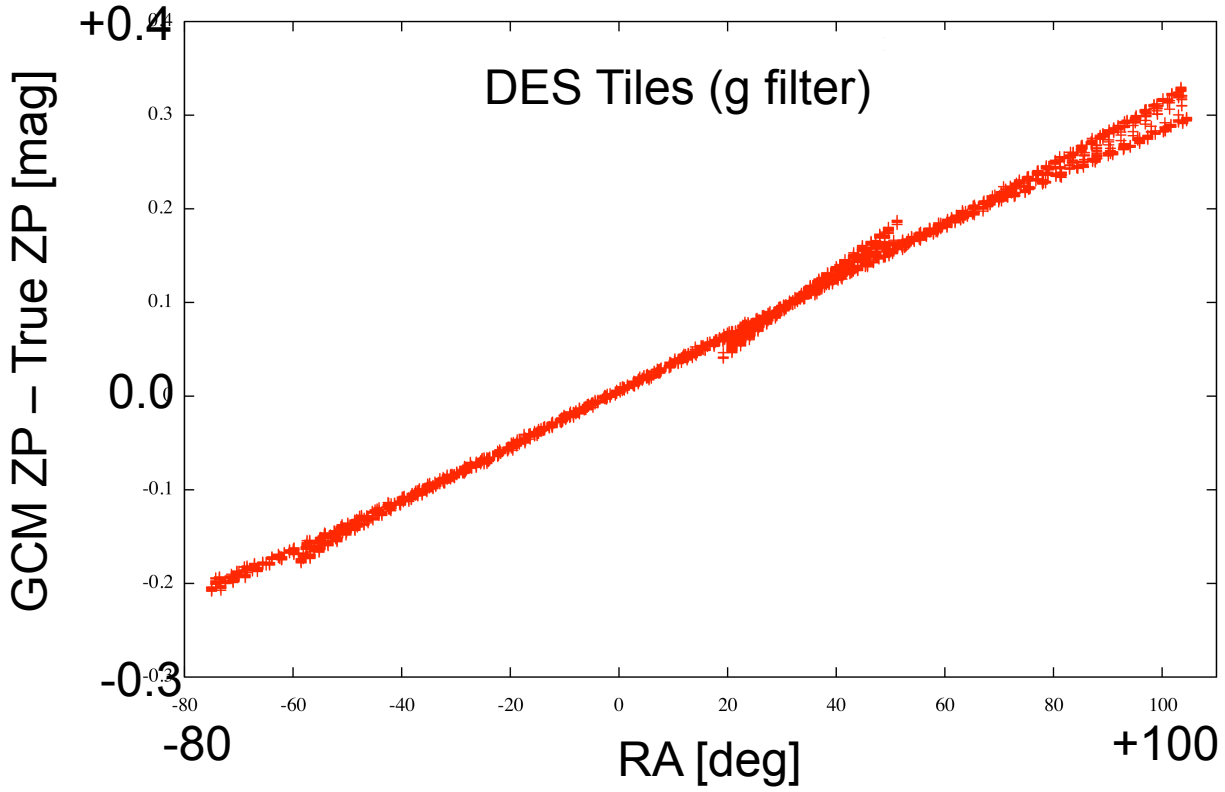
Simulated Data Set	RMS of GCM Solutions (measure of statistical error)	RMS of "GCM ZP-True ZP" (measure of systematic error)
"Realistic" PreCam Full Footprint	0.00431 mag	0.00759 mag ✔
"Realistic" PreCam Rib & Keel	0.00398 mag	0.01183 mag ✔
"Pessimal" DES g-band	0.00358 mag	0.13089 mag ✗
"Pessimal" DES g-band + "Realistic" PreCam Full Footprint	0.00437 mag	0.10304 mag ✗
"Pessimal DES g-band + "Realistic" PreCam Rib & Keel	TBD	TBD
"Pessimal" DES g-band + *Median* "Realistic" PreCam Rib & Keel	0.00568 mag	0.02274 mag ✔

(For "Pessimal" DES g-band, both Years 1 and 2 were used.)

"Pessimal" DES g-band Years 1&2 Alone

DARK ENERGY SURVEY

- RMS of the GCM solutions = 0.00358 mag
- RMS of (GCM ZP – True ZP) = 0.13089 mag ✗



DARK ENERGY SURVEY

"Pessimal" DES g-band Years 1&2 + Median PreCam Rib & Keel

- Here, we created a standard star catalog of all Rib & Keel stars observed at least 5 times, taking the median value for each star as its calibrated magnitude. We then used all these calibrated Rib & Keel stars as members of a single (albeit, strangely shaped) fiducial field, feeding this new fiducial field into the GCM with all the DES g-band stars.

- RMS of the GCM solutions = 0.00568 mag

- RMS of (GCM ZP – True ZP) = 0.02274 mag ✔

PreCam Full Footprint vs. Median PreCam Rib & Keel

DARK ENERGY SURVEY