Semi-realistic tests of chip-to-chip offsets

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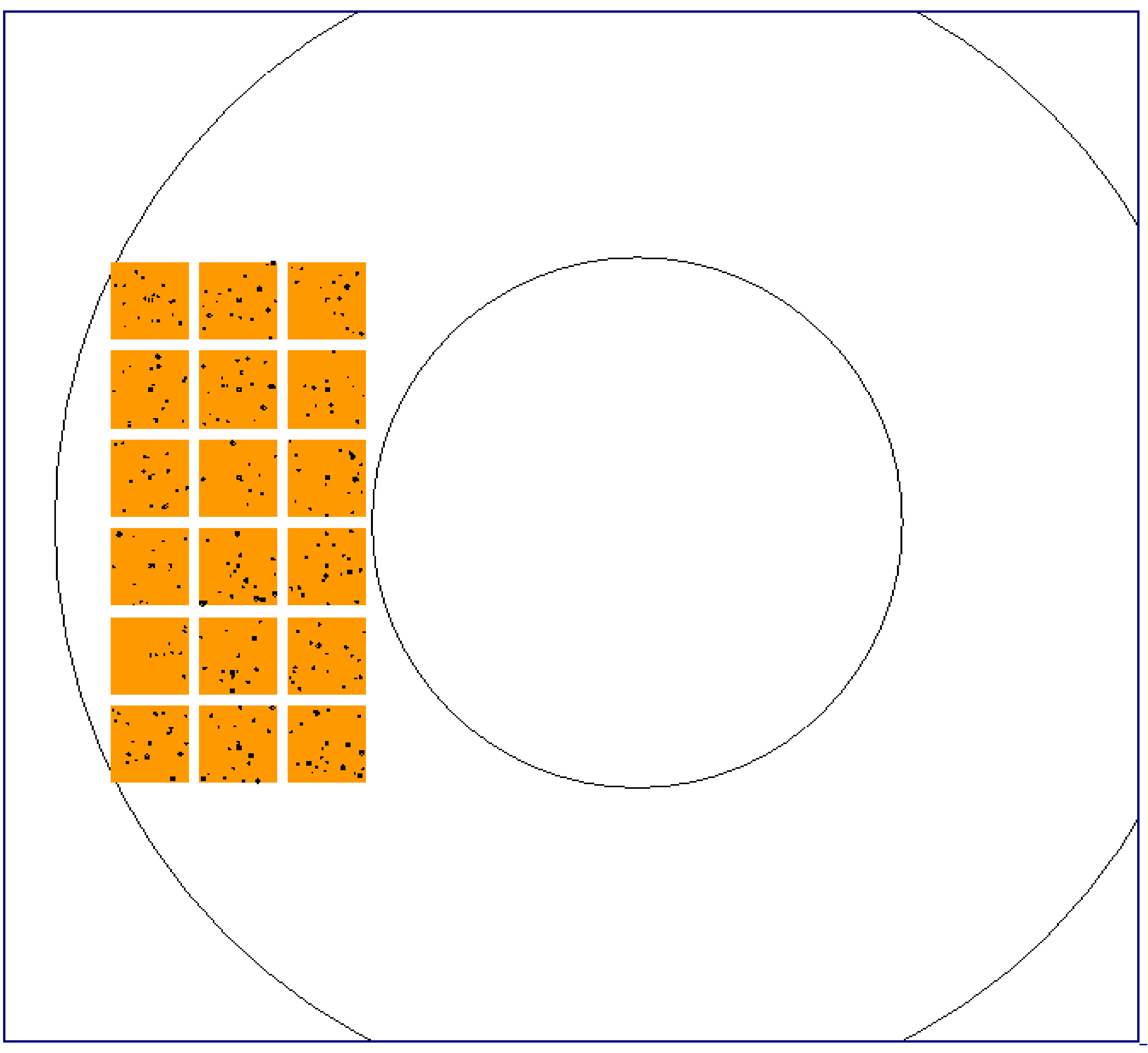
I am gradually increasing the realism of tests using [my photometric simulator.] This week, I wanted to look at

- chip-to-chip offsets
- using both simplified and real focal plane layouts
- with a catalog of real stars

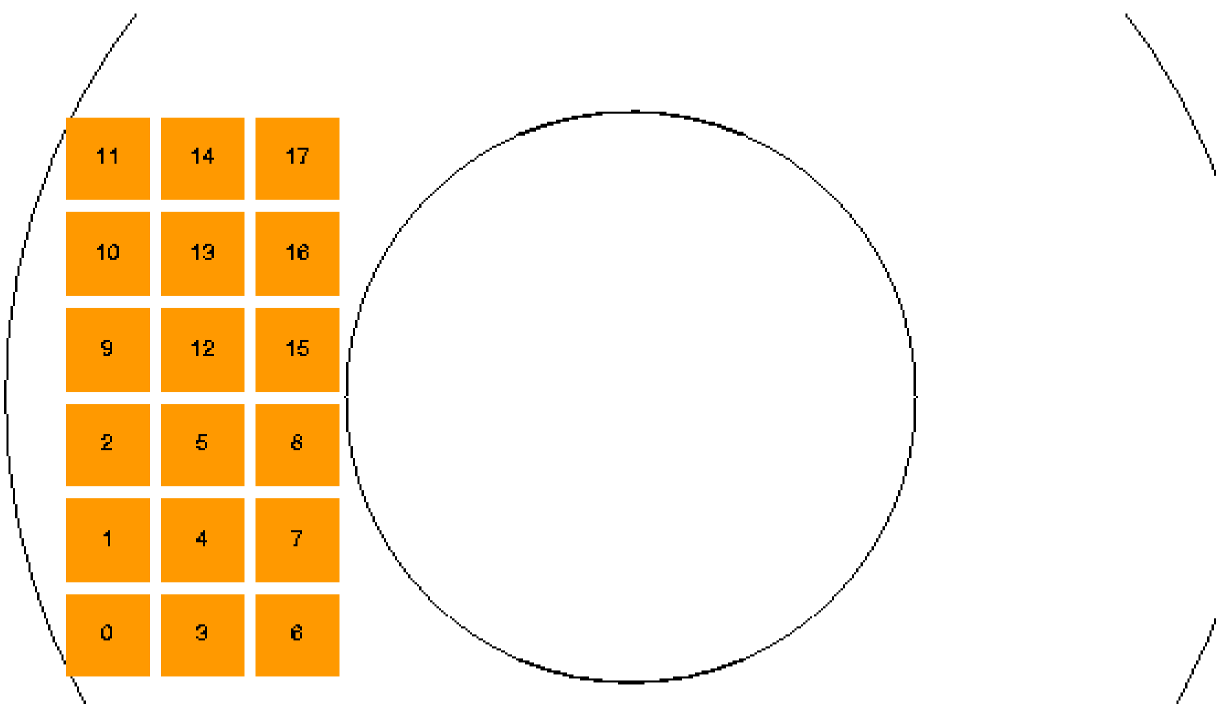
The chip-to-chip offsets are only one factor in the overall flatfielding problem. I described [in an earlier document] some very simple tests, but I wanted to make the process more realistic.

Input Catalog

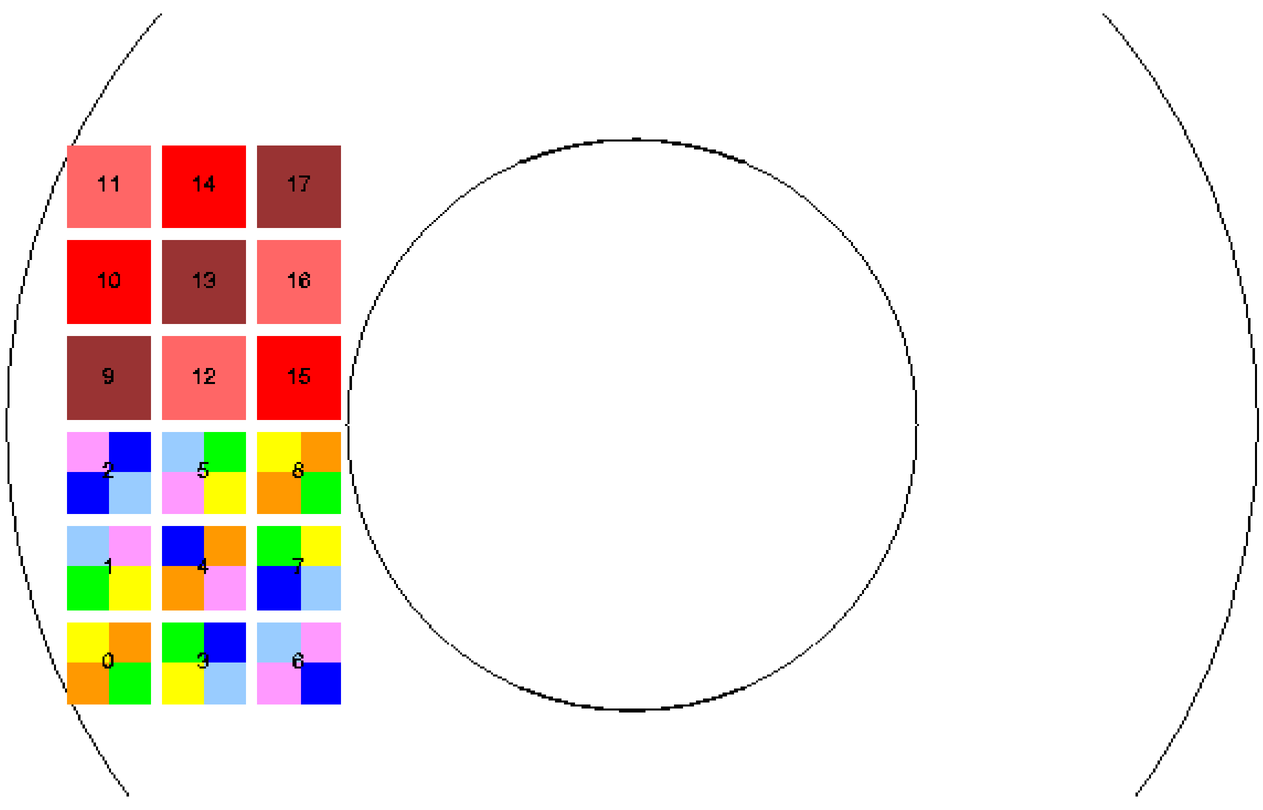
The input stars in this simulation are based on the USNO-A2.0 catalog of the Northern SNAP field. I point the telescope at RA=270 degrees, Dec=+67 degrees, and then consider only the eastern quadrant of the detector. I include all stars with B and R magnitudes brighter than 18.0, in a one-degree box around the center of the eastern quadrant (RA=271.28, Dec=67.0). That yields about 1840 stars. I assign a spectral type to each star based on its (B-R) color from the USNO-A2.0 catalog. Click on the image below for a larger version.



I used both a simplified, "monochromatic" version of the focal plane, in which all detectors were optical CCDs with fiducial filter 5,

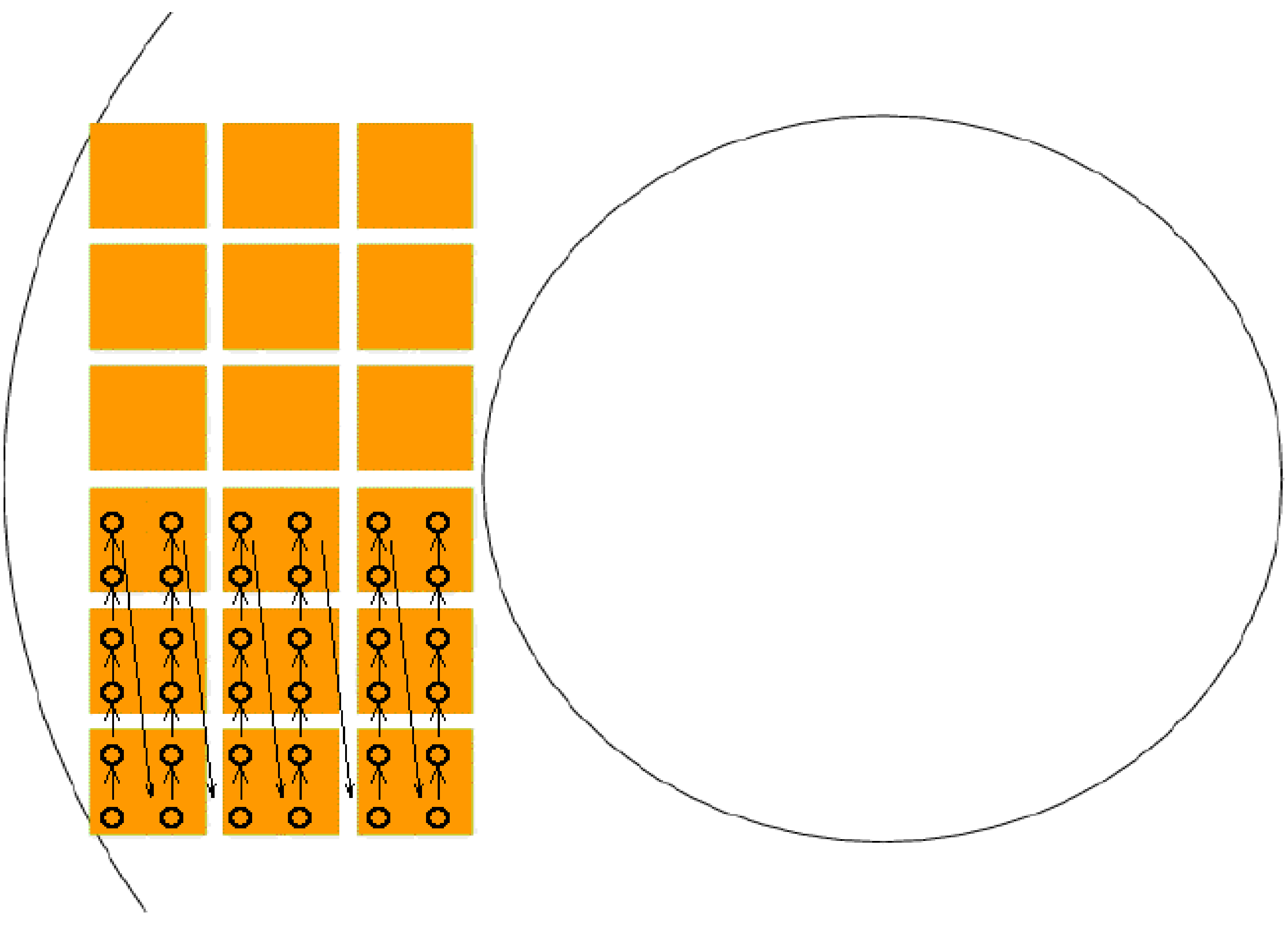


and a realistic focal plane, with a block of optical CCDs and a block of near-IR detectors:



Observations

I moved the telescope in a 6x6 grid-like pattern, so that some stars would move across one entire block, appearing at least once on each visible CCD, or at least once on each near-IR detector.



All exposures were 10 seconds long. I used two modes of observing:

- take one image (snapshot) per position; total 6x6x1 = 36 images
- take 4 images per position; total 6x6x4 = 144 images

Of course, in any particular snapshot, some stars will fall between detectors. My analysis uses [Honeycutt's inhomogeneous ensemble photometry technique] to make use all any stars which are detected on at least 10 images.

It turns out that some fraction of the stars in this input catalog will be saturated; I'm still working on the exact numbers, but something like 15 to 30 percent of may have to be discarded from the calculations. I will include this factor in future work.

I did NOT include any of these complicating effects:

- intra-chip sensitivity variations
- shift in bandpass due to angle of incidence
- color terms between supposedly identical filters
- shutter effects

The simulator can add all these effects to the "observations", but my analysis code does not yet take them into account. I will be improving the analysis code to include them.

Results

The question is: **how well can one determine the chip-to-chip offsets** from a set of exposures which move across a field of stars? The results of this simulation are

- with a monochromatic focal plane, a 6x6 grid determines chip-to-chip offsets to less than 1 mmag
- with a realistic focal plane, a 6x6 grid of 1 snapshot at each position determines offsets to a precision of 3-7 mmag (depending on the filter)
- with a realistic focal plane, a 6x6 grid of 4 snapshots at each position determines offsets to a precision of 1-2 mmag, (depending on the filter)