Science Verification

Steve Kent, Oct 8, 2012

- **Requirements I own:**
  - **Point-R1 (absolute pointing)**
  - **Point-R2 (dithered pointing)**
  - **PSF-G1 (psf from stars v. donuts)**
  - **PSF-G2 (whisker patterns)**
- **What I have actually been working on**
  - **Modeling geometry of the focal plane for predicting positions of stars for guider, F/A sensors.**

Ingredients

- des-docdb #5282 (orientation conventions)
- des-docdb #6157 (polar axis misalignment)
- des-docdb #6636 (WCS keyword equations)
- Data:
  - Sets of images taken at a range of HA, Dec
- NOMAD catalog
- Inputs from:
  - Gary Bernstein and others
  - Eric Neilsen

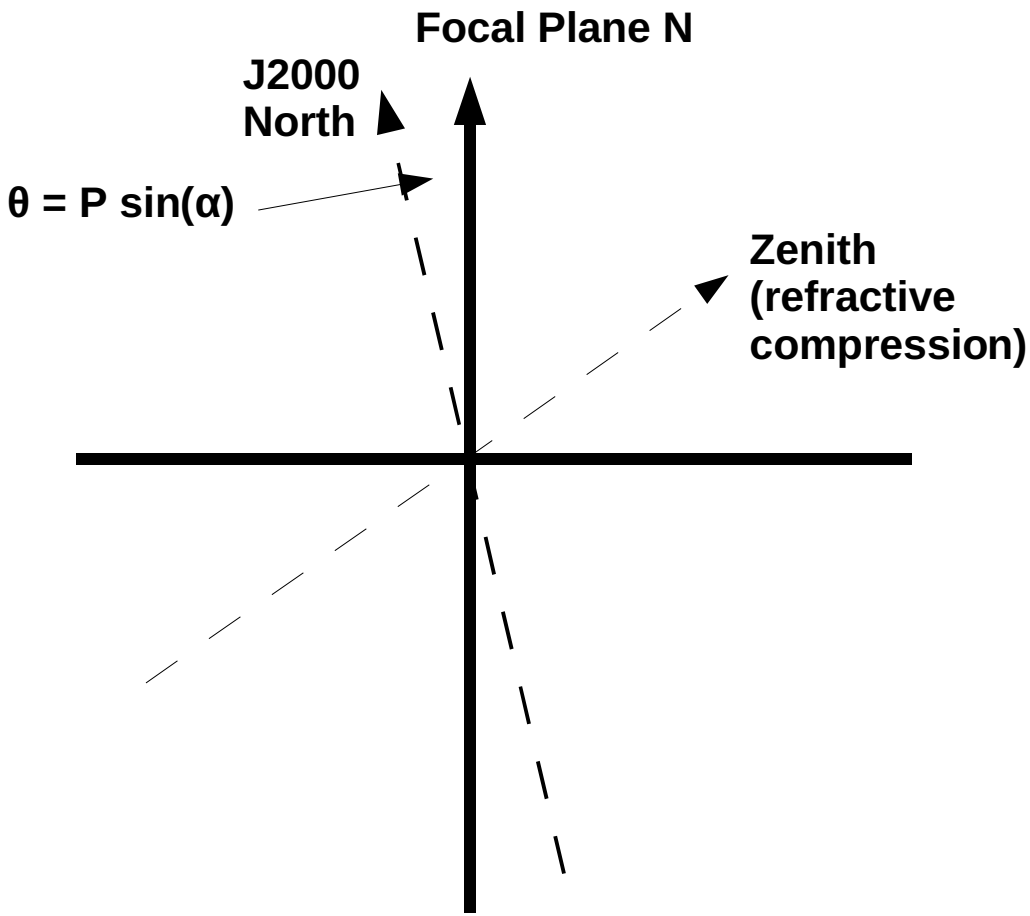
Modeling the Focal Plane

- Geometric layout of CCDs
- Pointing info (RA, Dec, Time)
- Refraction, Aberration
- Precession, Nutation
- Optical model of telescope
  - Including wavelength-dependence
- Note that refraction, aberration, precession, nutation, and optics mean WCS is a function of time, telescope pointing, and filter

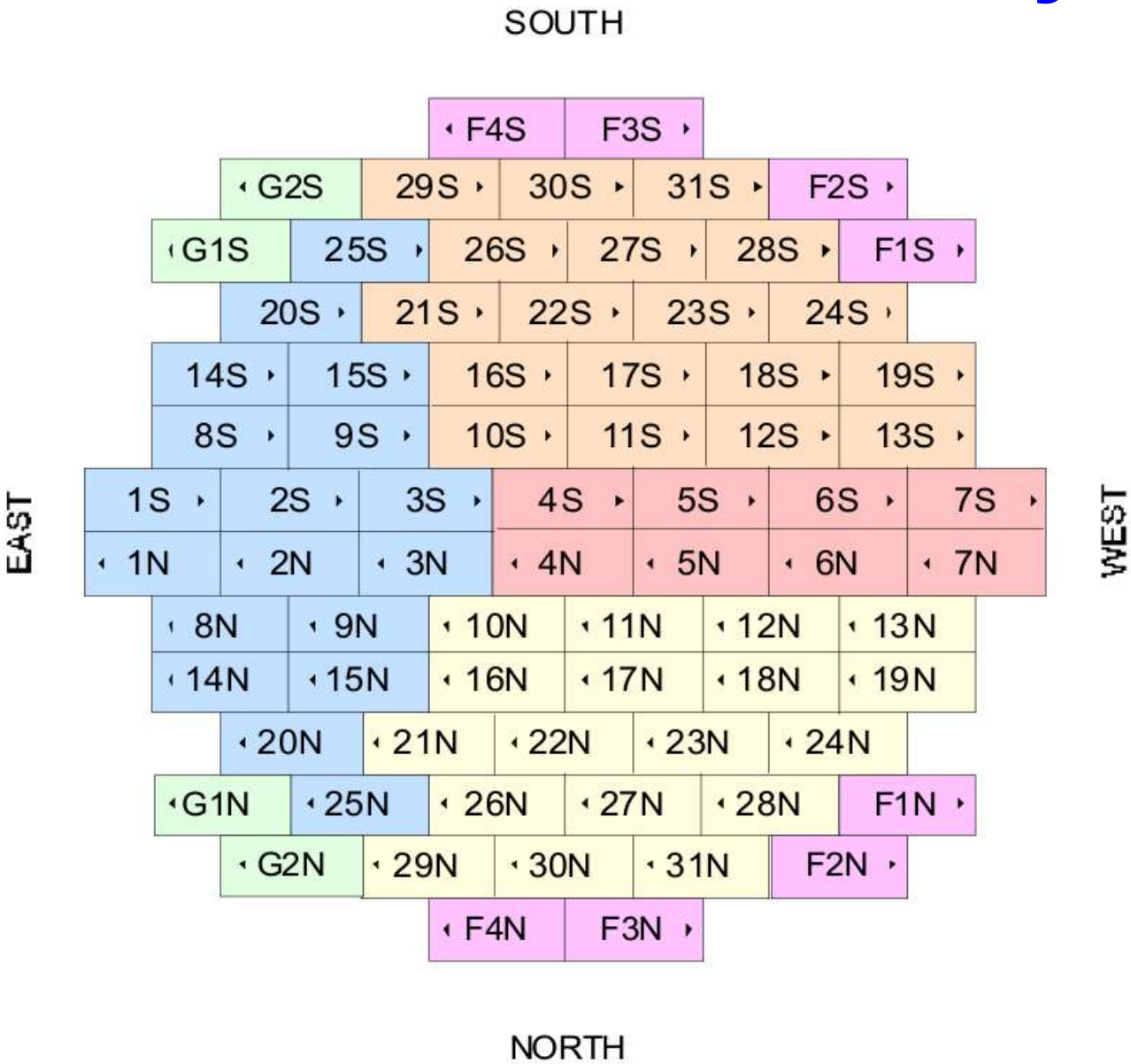
Modeling the Focal Plane

- **Unknowns**
  - **Fine-tune CCD separations in X, Y**
  - **CCD offsets and rotations relative to a uniform layout**
  - **Global rotation offset of focal plane**
  - **Mean scale factor of optics**
  - **Telescope axis misalignment**
    - **Determine from field rotation v. HA, Dec.**
- **Outputs**
  - **Turn everything into WCS parameters**

Rotations and Scale Changes

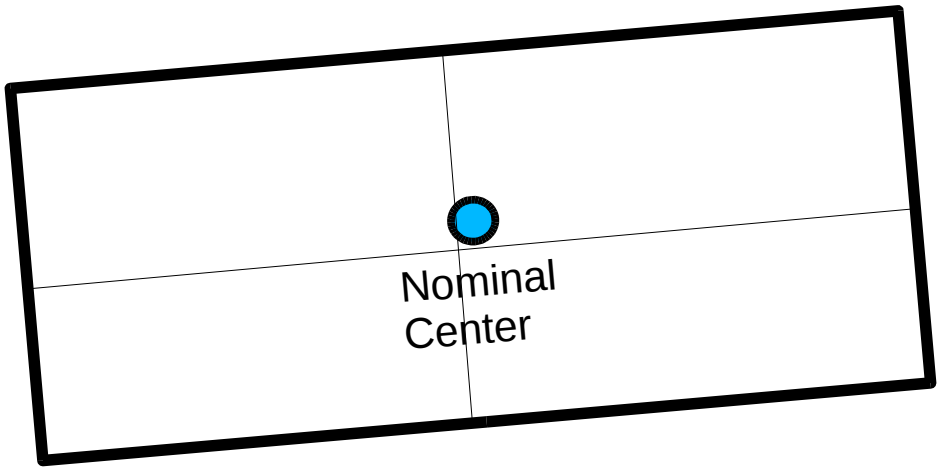


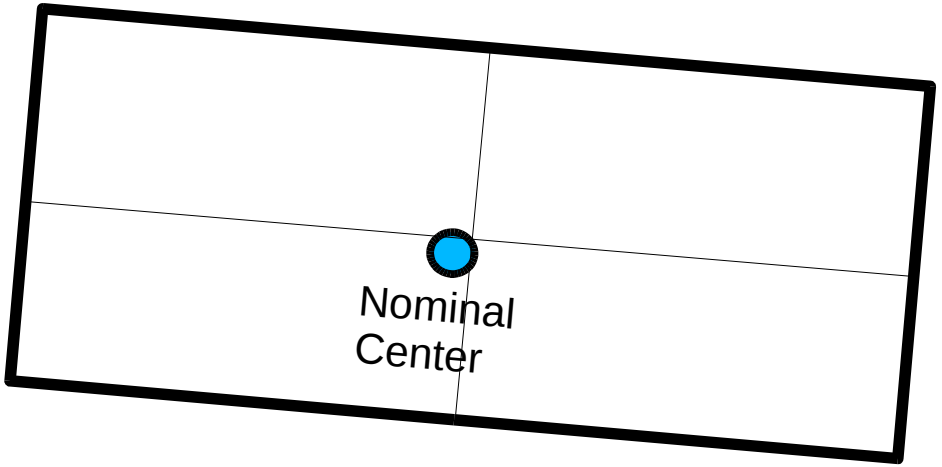
Focal Plane Layout



Derived CCD spacings:
Rows: 4250.3 pixels
Cols: 2249.6 pixels

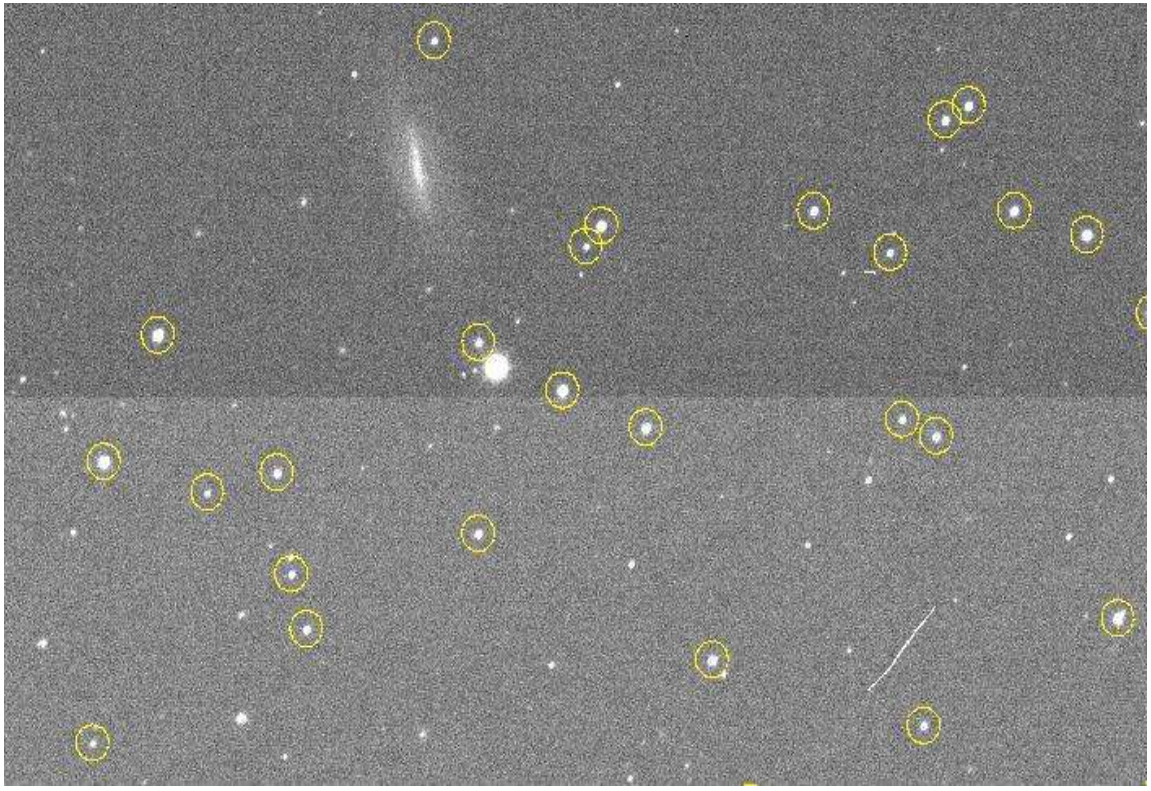
CCD Misalignments



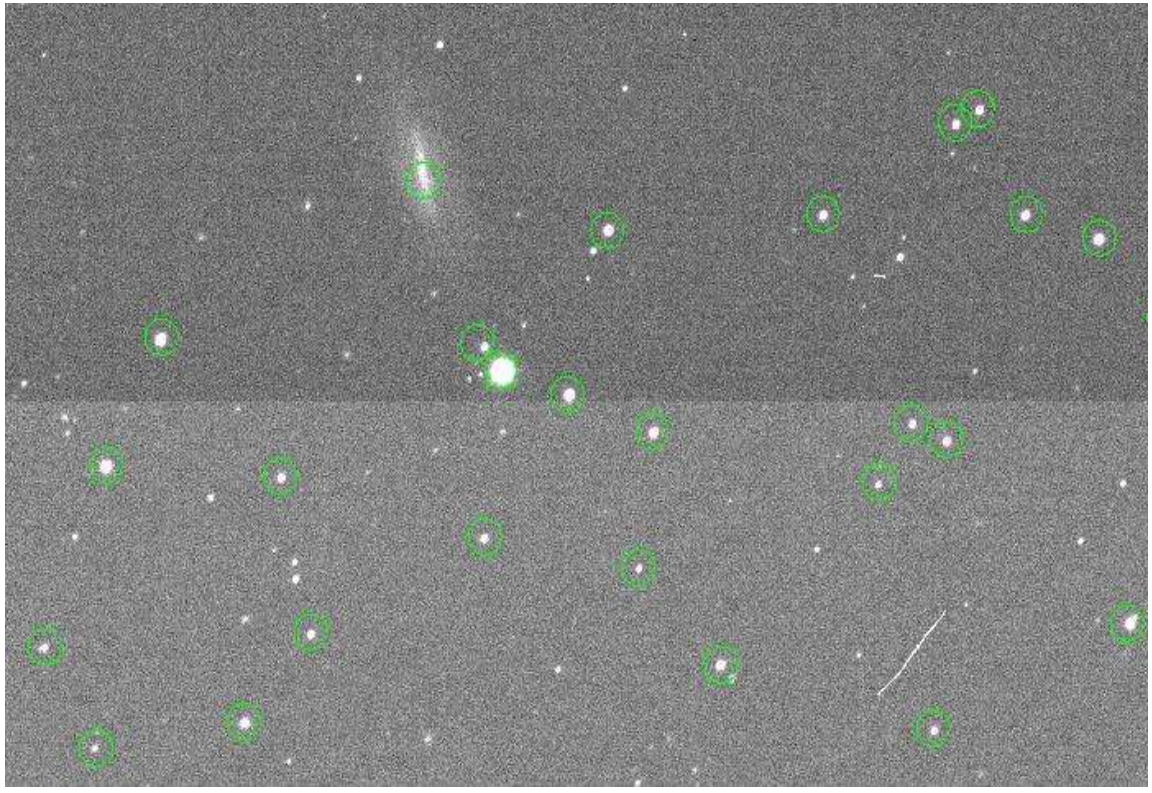


Typical offsets: 30 microns in row, col
Typical rotations: 0.02 degrees

134988
S2



Find Bright Stars



Nomad matchups

More parameters

- **Global focal plane rotation**
  - **-0.05 degrees**
- **Mean telescope scale factor**
  - **17.57509 arcsec/mm (assumes pixels are 15 microns exactly)**
  - **Polar axis misalignment**
    - **+2.2 arcmin azimuth**
- **See #6636 for more detail**

Additional Findings

- **One test of all filters (u,g,r,i,z,Y) - WCS consistent among all; wavelength dependence at u band was seen and correctly compensated.**
- **WCS v. focus - no effect over 100 micron sweep in focus.**
- **Mystery - orientation at large HA (45 deg E or W) and airmass (Dec = -70) still not computed properly (errors of order 120 arcsec) and inconsistent with polar axis misalignment alone.**

To Do

- **Determine offsets for guide, F/A ccds.**
  - **Nominal geometric model works for F/A CCDs to < 15 pixels.**