Instrumental Calibration

Frank Masci

IPAC/Caltech

Frame Processing Flow

INPUTS:
* raw "level-0" FITS frame
* ground/orbit calibrations

↓

Mask initialization and checks
Flag known "bad" pixels in a processing mask ← **CAL**

↓

Initialize uncertainty image using error model

↓

Bias/offset correction using Reference pixels

↓

Droop/electronic corrections ← **CAL**

↓

Dark subtraction ← **CAL**

Non-linearity correction ← **CAL**

⇢ **Input for Dynamic Flat PL**

↓

Responsivity (flat) correction ← **CAL**

⇢ **Input for Dynamic SkyOffset + transient bad-pix PL**

↓

Sky-offset correction ← **CAL**

↓

Frame QA metrics/statistics

↓

OUTPUTS:
* instrumentally calibrated FITS frame
* bit-mask storing processing status
* uncertainty image frame
* QA diagnostics

Detector-cal Summary

Excludes optical source-artifact characterization (e.g., glints, ghosts, latents..), *PSF*, distortion

| product	ground	IOC	survey mode
Darks	yes	yes - only W1, W2 with cover on	no
Flats	yes	yes - cover off (tune)	yes (dynamic)
Low-frequency flats	no	yes - cover off	no
Non-linearity	yes	yes - cover on and off (check)	no
Saturation limits	yes	yes - cover off (check)	yes (and monitor)
Gain and read-noise maps	yes	yes (?)	monitor
Droop	yes	yes - cover off (check)	monitor
Bad-pixel masks	yes	yes - cover on (update)	yes: transients (dynamic)
Sky-offsets	no	yes - cover off (tune)	yes (dynamic)

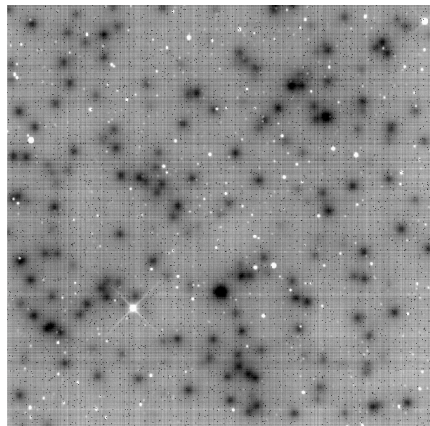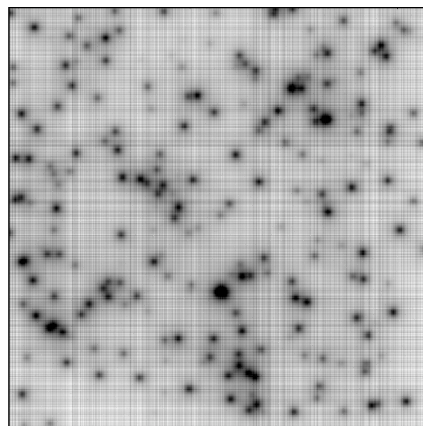# E.G. from vsn1.5 Pipeline

Band 3 frame:
Ned's Nov '08
single-oribit sim
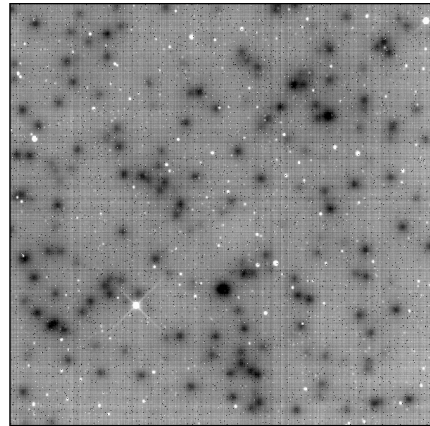
Raw

−
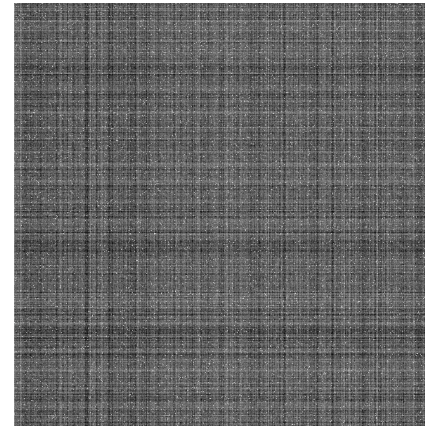
Dark Calibration

Dark-subtracted

÷

Responsivity Map

=

Final Frame

Some things that worry me..

- Detectors will perform completely differently from that seen on the ground (new signatures?)

- Stability of flats, darks, bias structure over arrays. Cannot capture short term transient behavior using sky-offset cal. Will manifest as systematics and impact photometric accuracy/repeatability

- Bands 3 and 4 darks - can <u>only</u> be derived on the ground. They better be stable!

- Bands 1 and 2 on-orbit flats - how many frames needed to fill up the wells?

- Bands 3 and 4 on-orbit flats also need to be super accurate since backgrounds are $> 100 \times$ point source flux near 5σ sensitivity limits. A bad flat $=>$ bad local background estimation $=>$ bad photometry

- Science data losses, e.g., from anneals, bright sources, SAA passages,… and recovery thereafter?

- Impacts from accumulated image persistence (latents) on responsivity, depth-of-coverage, completeness, reliability, photometric accuracy…