ASTROSAT CALIBRATION MEETING

UVIT GROUND CALIBRATION

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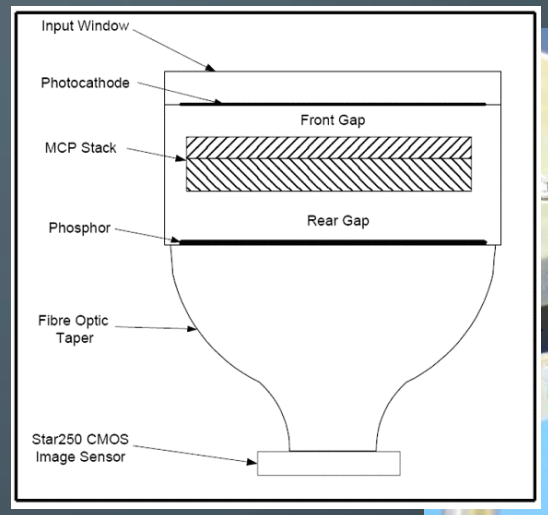
CALIBRATION TASKS

- Flat field
- Fixed pattern noise – centroid bias correction
  - from flat field data
- Pulse Height Distributions
  - from flat field data
- Cosmic Rays
- Distortion – line scans on micrometer stage
- Pipeline - Drift correction & PSF Optimization

CPU – CAMERA PROXIMITY UNIT (DETECTOR)

- Intensified imager 39mm
- High gain photon counting
- Low gain integration mode
- Full field @ 29 Hz imaging
- Partial field up to 600 Hz



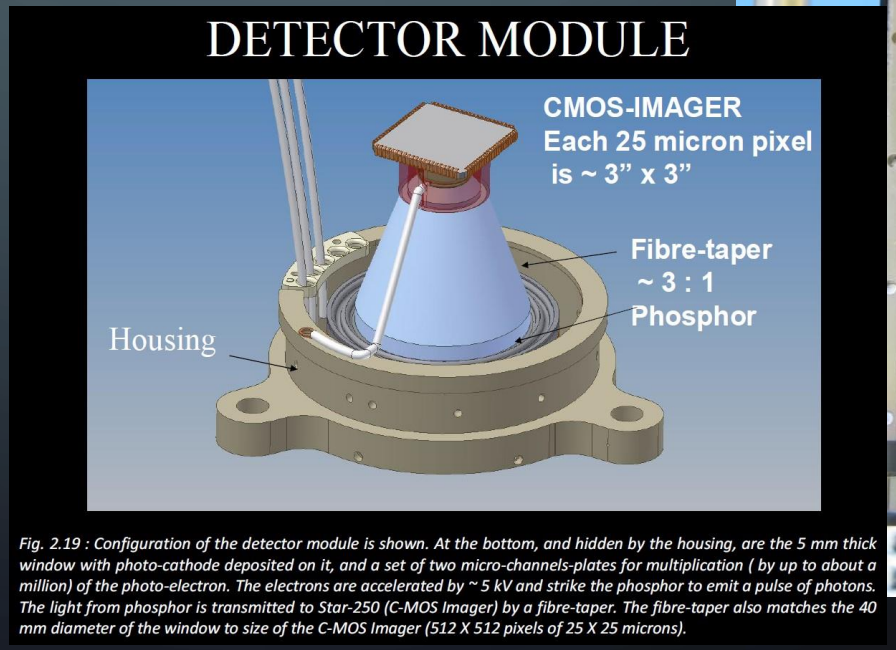
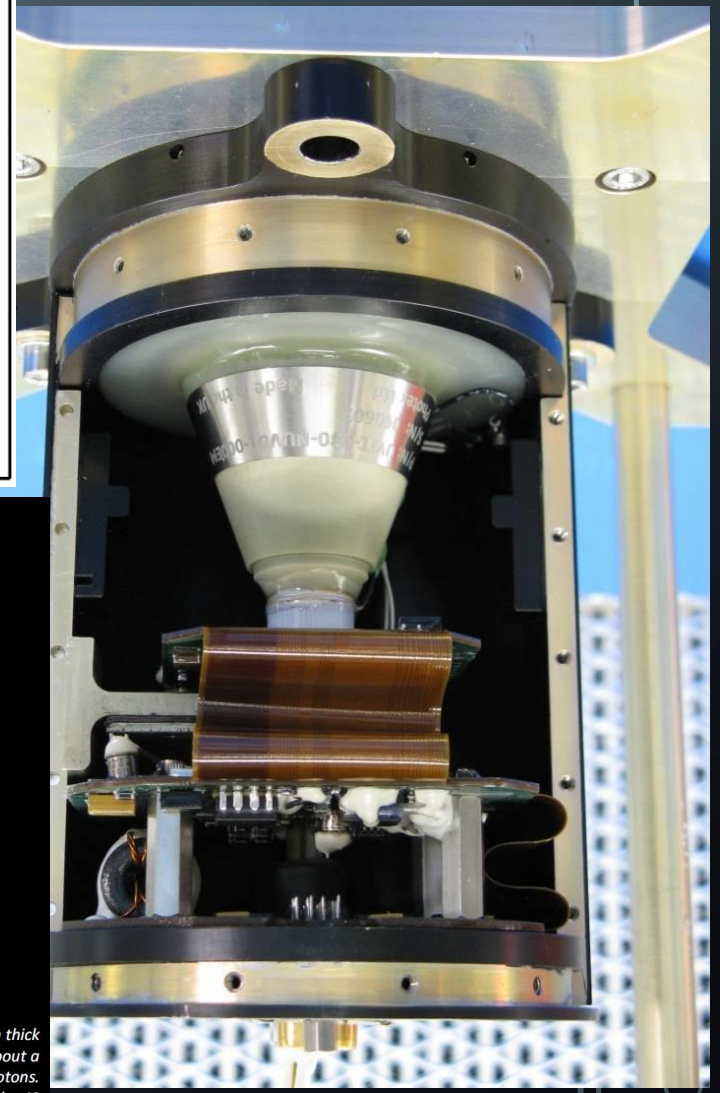


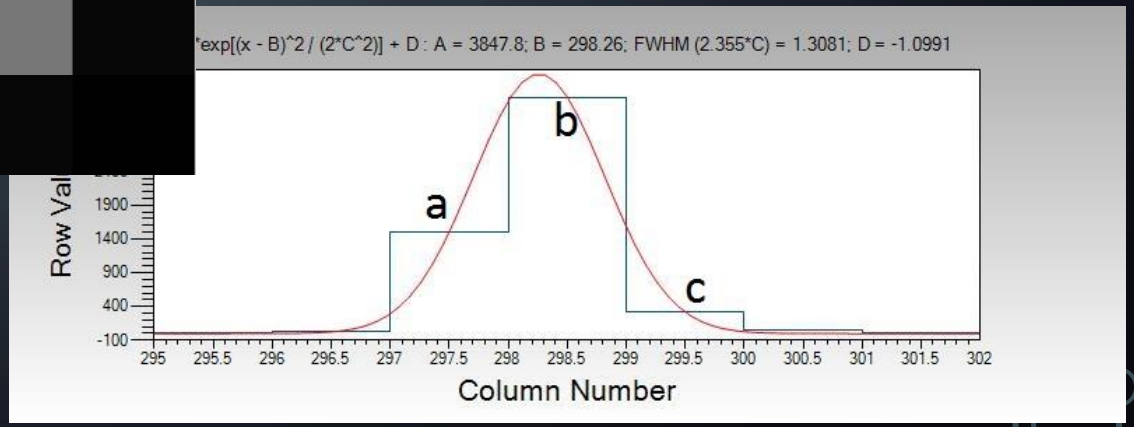
Fig. 2.19 : Configuration of the detector module is shown. At the bottom, and hidden by the housing, are the 5 mm thick window with photo-cathode deposited on it, and a set of two micro-channels-plates for multiplication (by up to about a million) of the photo-electron. The electrons are accelerated by ~ 5 kV and strike the phosphor to emit a pulse of photons. The light from phosphor is transmitted to Star-250 (C-MOS Imager) by a fibre-taper. The fibre-taper also matches the 40 mm diameter of the window to size of the C-MOS Imager (512 X 512 pixels of 25 X 25 microns).



DETECTOR SYSTEM

- 2-D photon counting @ 30Hz to 600 Hz
- On-board photon event centroiding in photon-counting mode
- Integration mode also available (used mainly on VIS channel, for tracking)
- Centroiding allows sub-pixel resolution for improved astrometry

- Centroid = (c-a)/(a+b+c)
- Coarse sampling and linear operation on Gaussian signal results in fixed-pattern-noise
- Background estimation required (Leahy)



FLAT FIELD

- Performed with UV integrating sphere
  - 3 in. window placed directly at 2.5 in. CPU
- FUV, NUV, VIS Channels
- Integrated for ~12-24hrs @~300 cpf

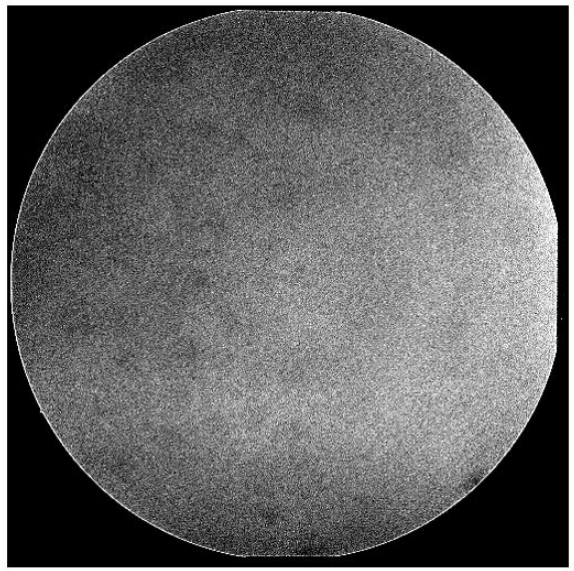


Figure 31: FUV 3x3 Square High Voltage Flat Field

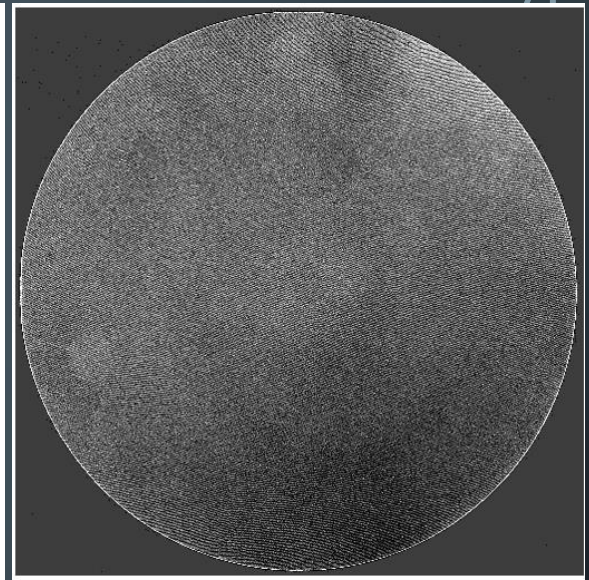


Figure 35: NUV 3x3 Square High Voltage Flat Field

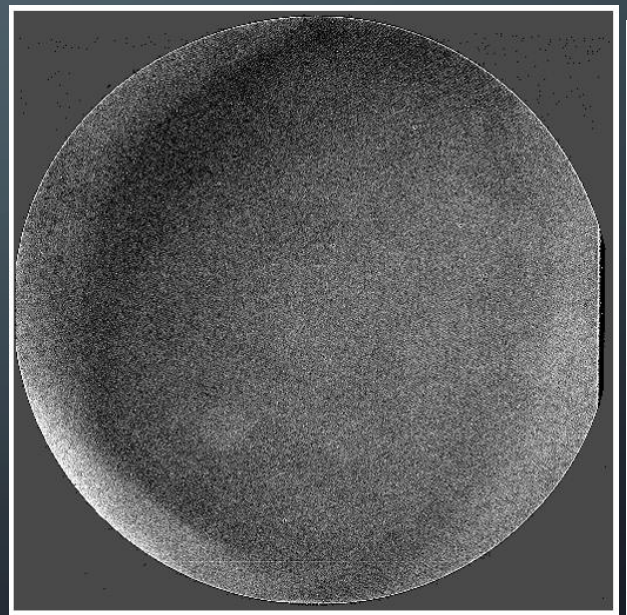


Figure 39: VIS 3x3 Square High Voltage Flat Field

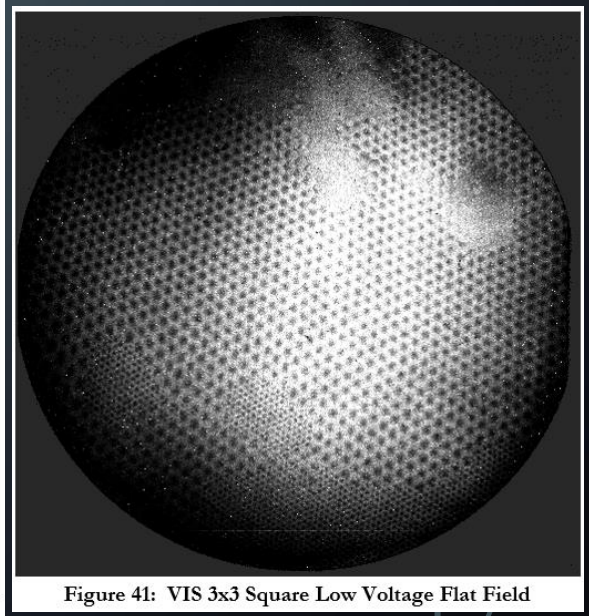


Figure 41: VIS 3x3 Square Low Voltage Flat Field

CENTROID BIAS CORRECTION

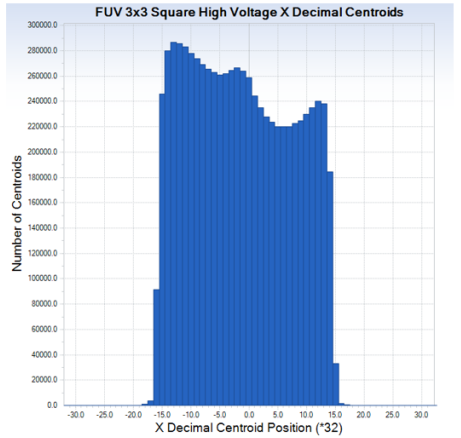


Figure 43: FUV 3x3 Square High Voltage X-Decimal Centroids

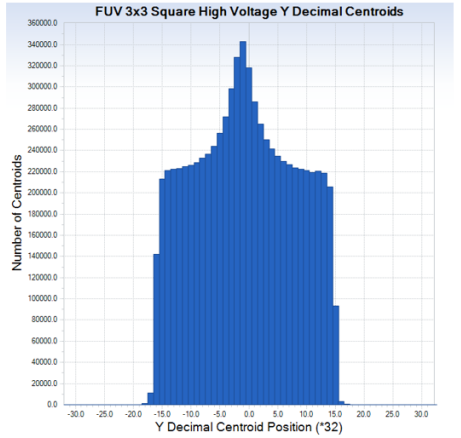


Figure 44: FUV 3x3 Square High Voltage Y-Decimal Centroids

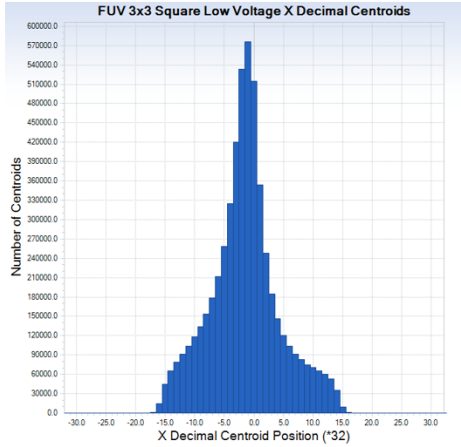


Figure 45: FUV 3x3 Square Low Voltage X-Decimal Centroids

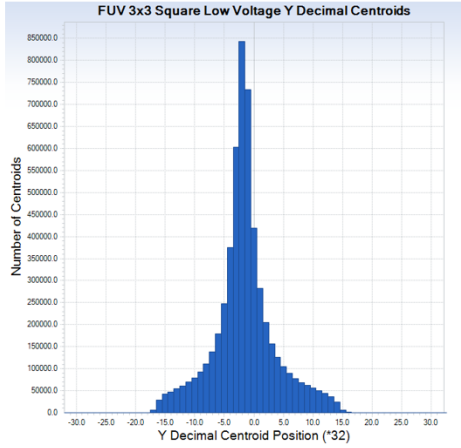
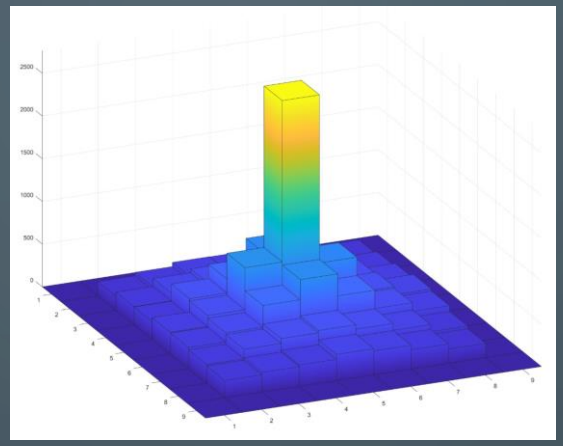
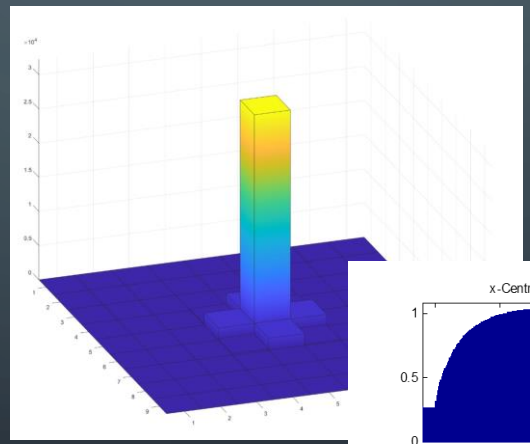


Figure 46: FUV 3x3 Square Low Voltage Y-Decimal Centroids





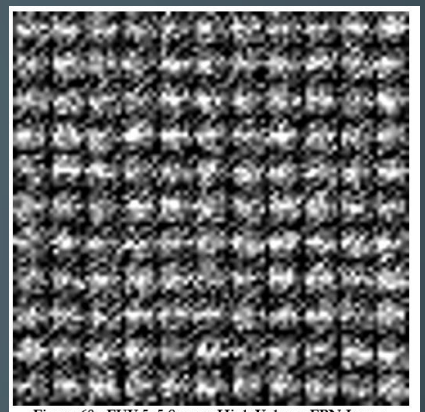


Figure 68: FUV 5x5 Square High Voltage FPN Image

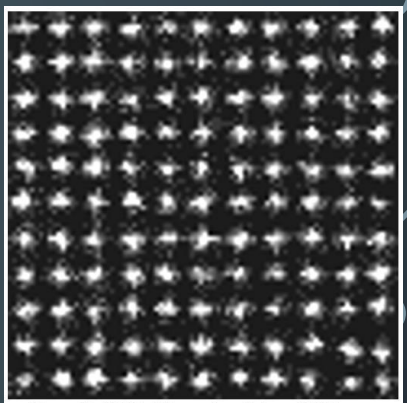


Figure 70: FUV 5x5 Square Low Voltage FPN Image

- The more a PSF tends toward a delta function at the pixel scale, the poorer the resolution of its centroid at sub-pixel scale
- The effect is systematic as a function of displacement from 0, thus is correctable with calibration

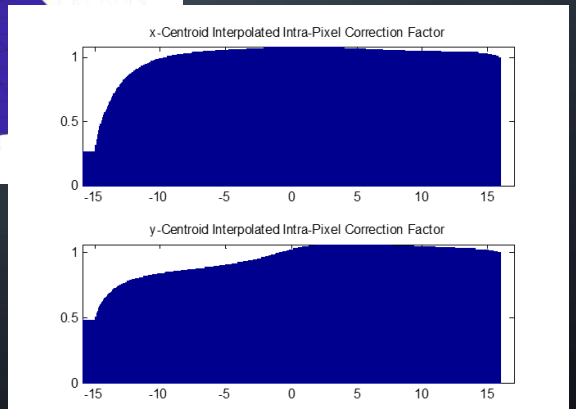


Figure 82: FUV 3x3 Cross High Voltage Interpolated FPN Correction Factor

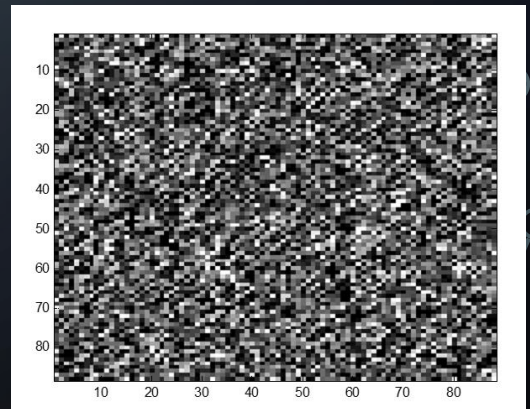


Figure 85: FUV 3x3 Cross High Voltage Image after correction

PULSE HEIGHT DISTRIBUTION – CENTROID THRESHOLDS

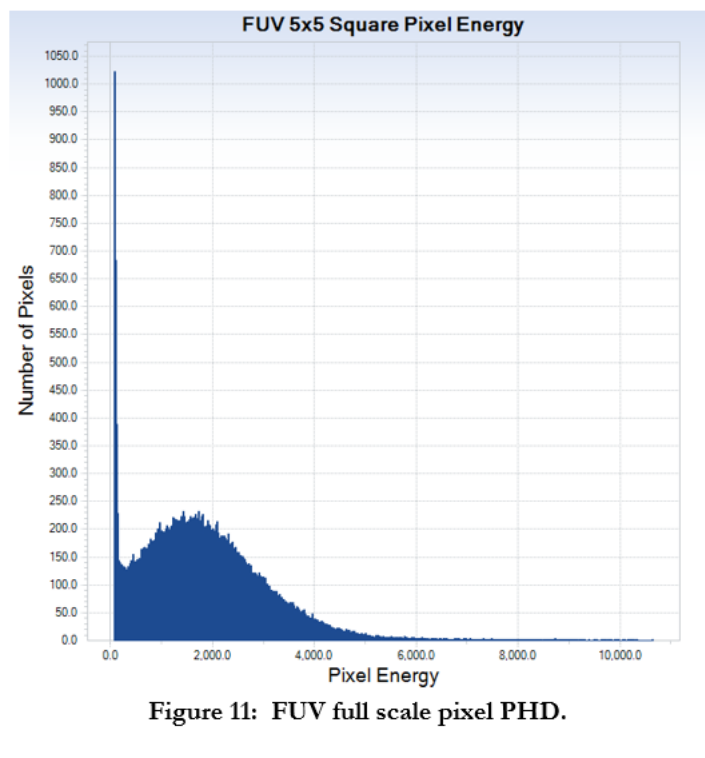


Figure 11: FUV full scale pixel PHD.

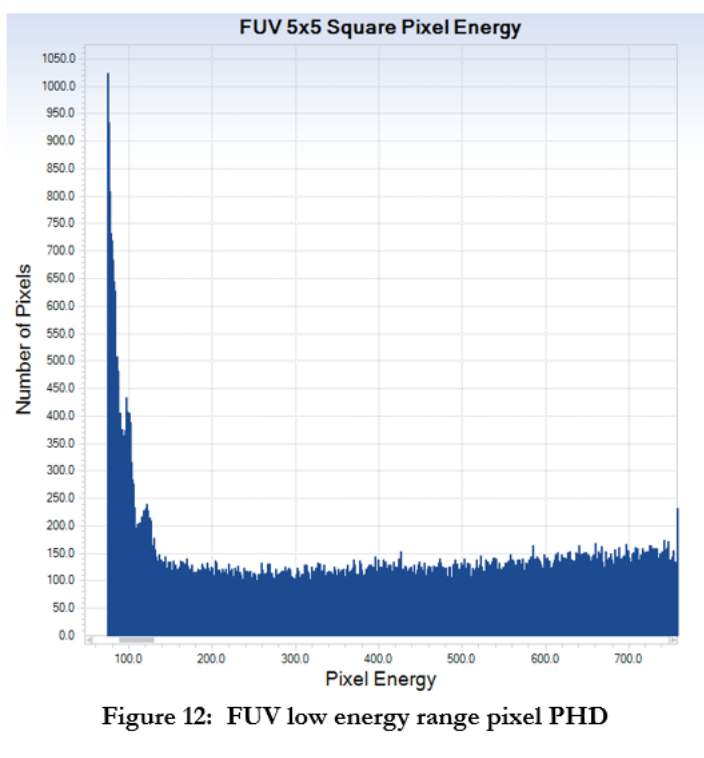


Figure 12: FUV low energy range pixel PHD

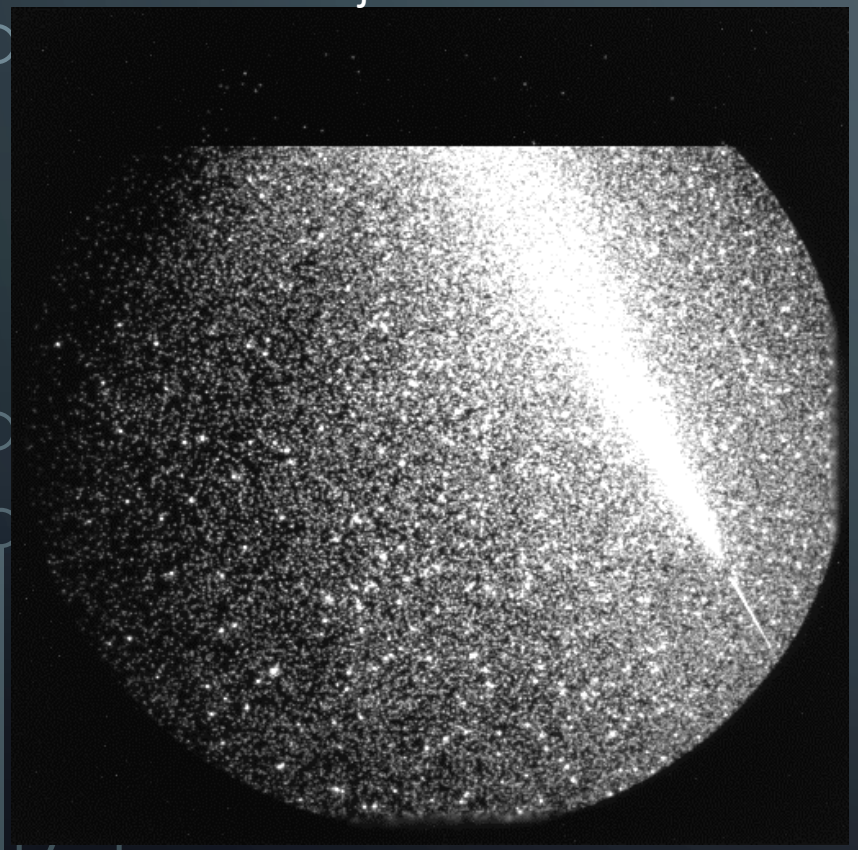
FUV Thresholds:
Pixel = 300; Energy = 384
High Voltages:
Cathode = -270; MCP = 2300; Anode = 5000

NUV Thresholds:
Pixel = 500; Energy = 800
High Voltages:
Cathode = -200; MCP = 2060; Anode = 5000

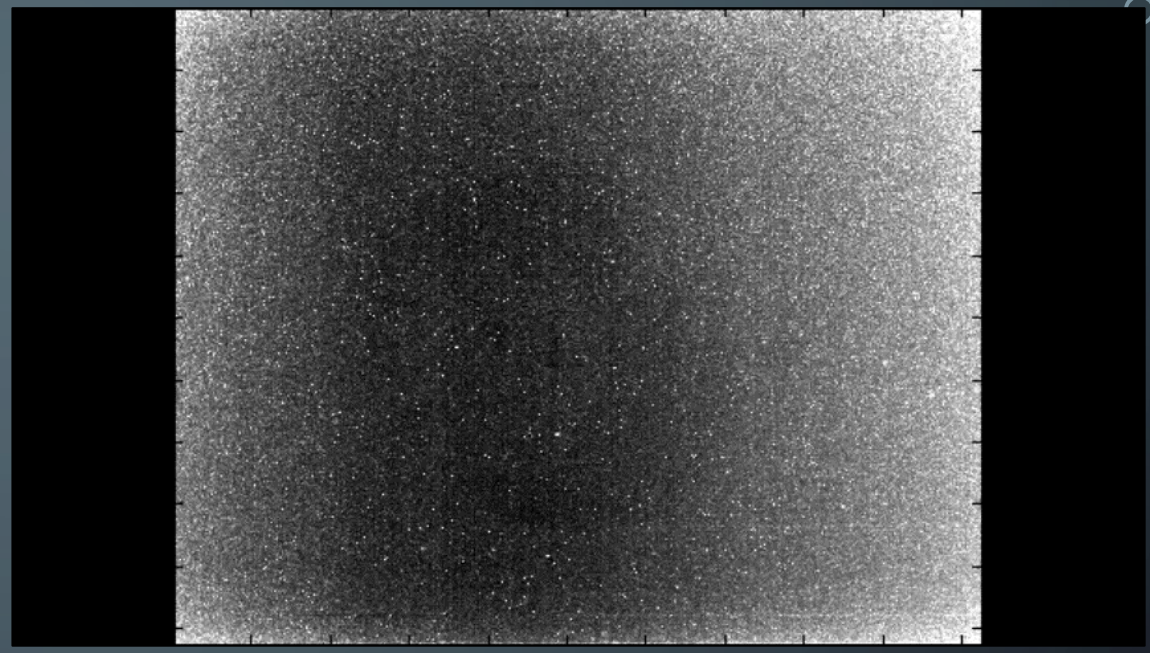
VIS Thresholds:
Pixel = 400; Energy = 512
High Voltages:
Cathode = -400; MCP = 2025; Anode = 5000

COSMIC RAYS

Major event



Nominal High Voltage – VIS Channel



Splashes

Reduced Voltage – VIS Channel

DISTORTION

Raw distortion scale ~9”
Stdv of WCS with GaiaDR3 now ~0.25”

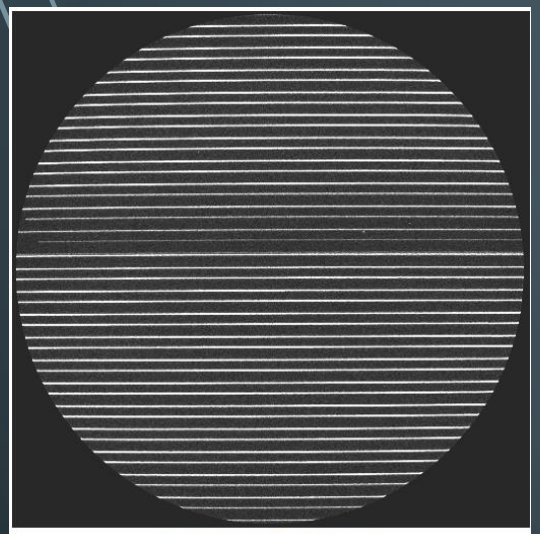


Figure 112: NUV x-axis scan

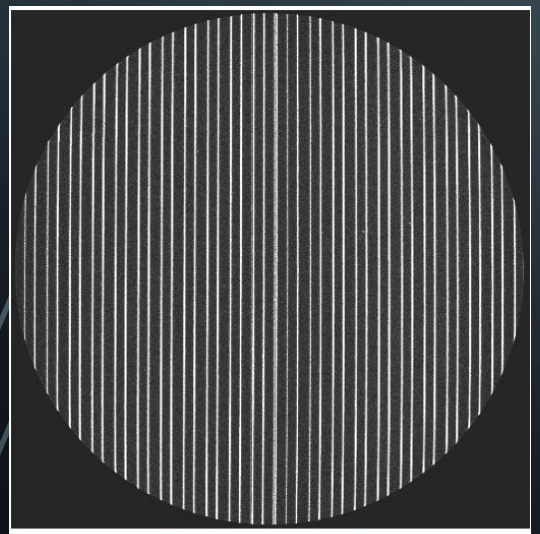


Figure 113: NUV y-axis scan

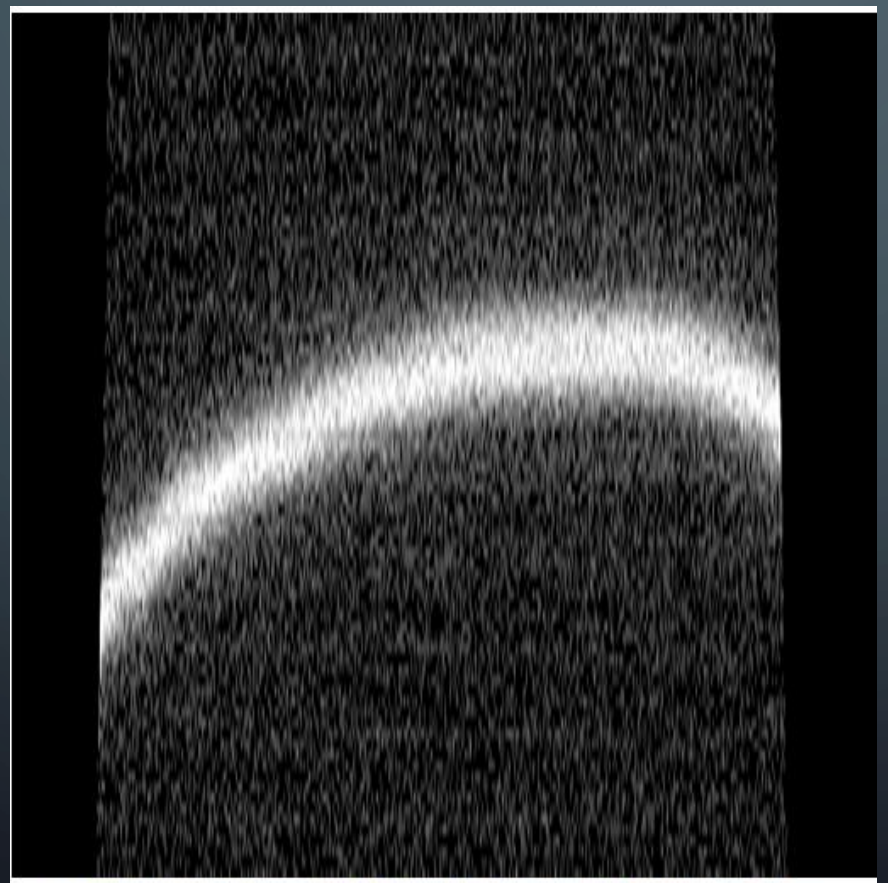


Figure 115: Example of a single horizontal NUV Scan-Line

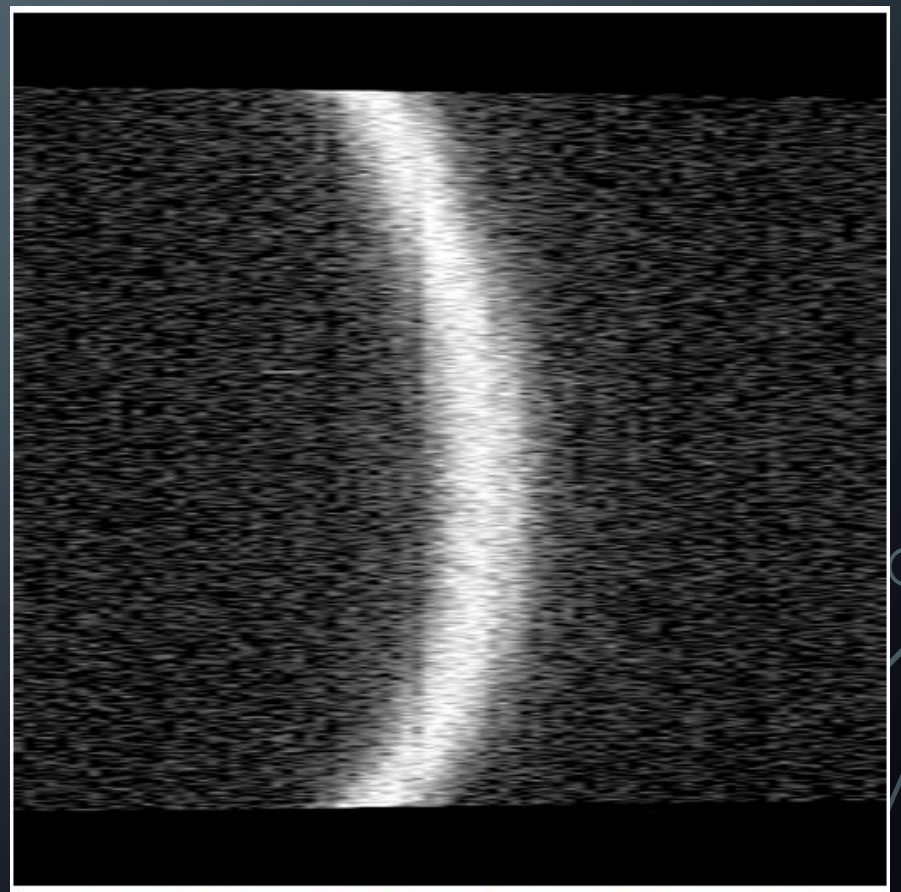
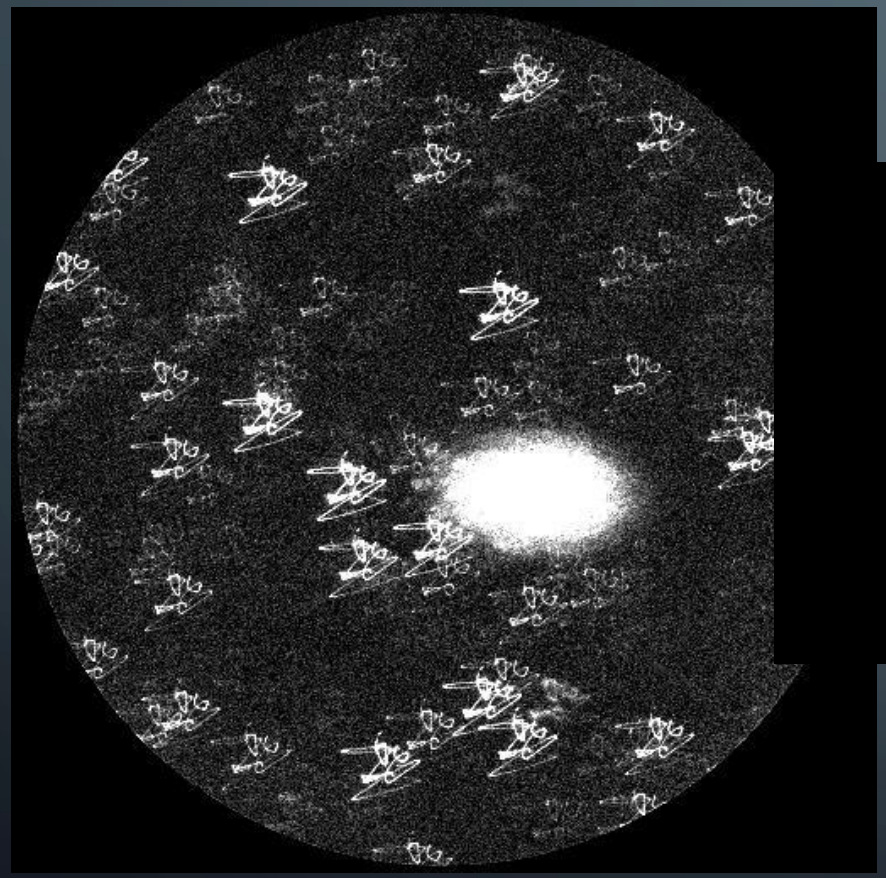
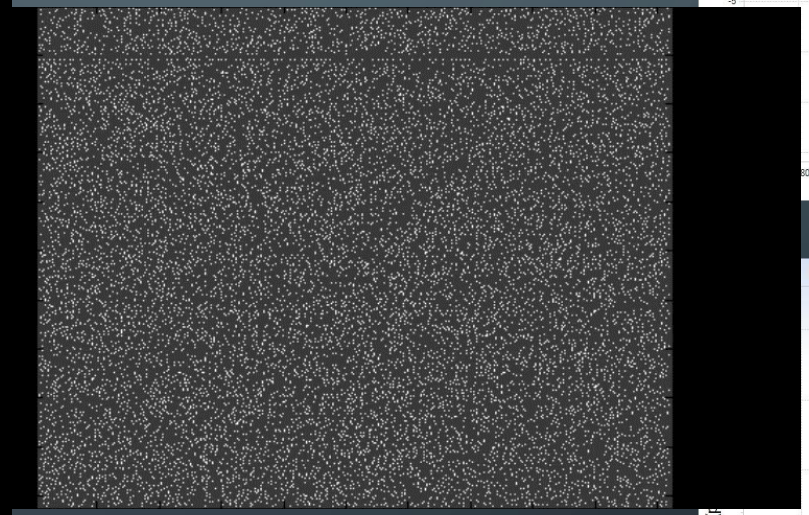
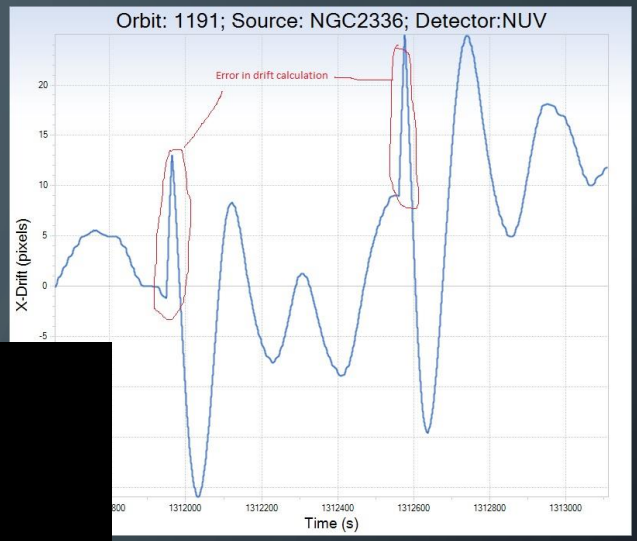


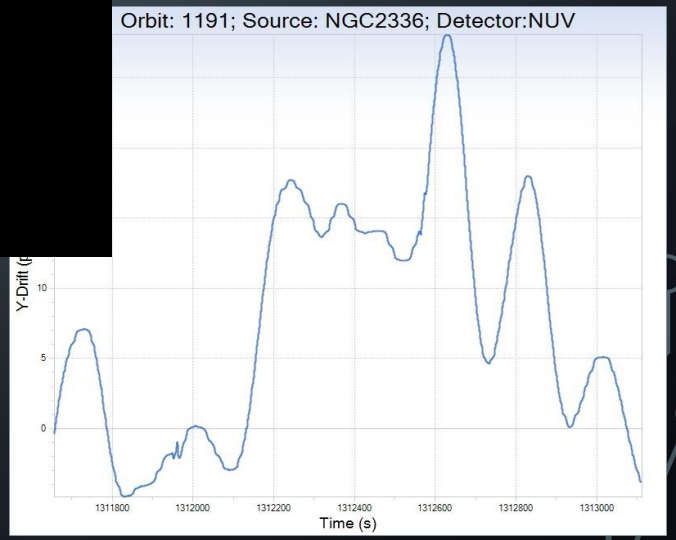
Figure 116: Example of a single vertical NUV Scan-Line

DRIFT CORRECTION

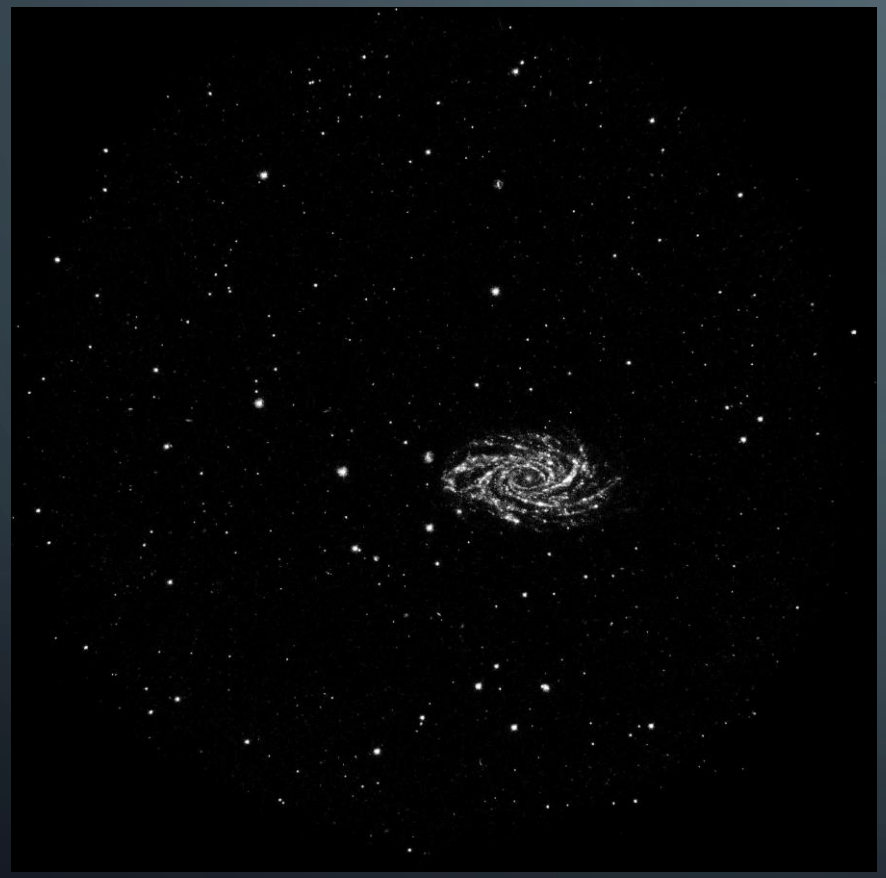




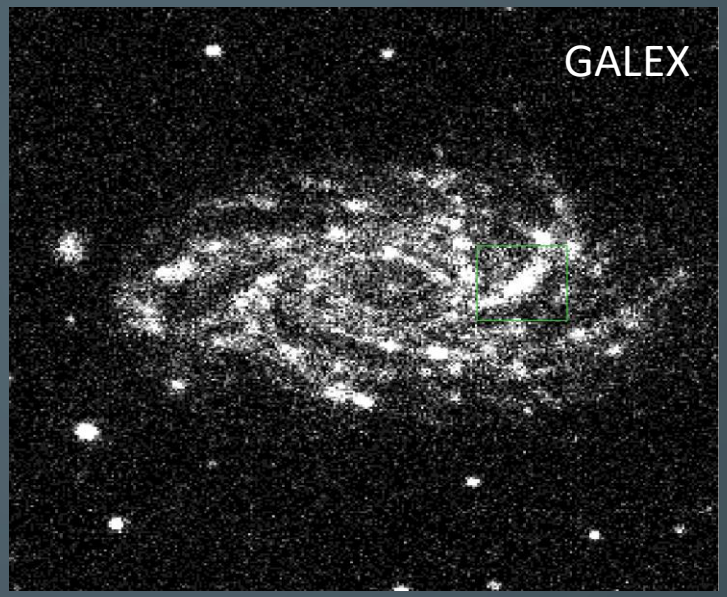




PERFORMANCE



NGC 2336



~ 5 arcmin

Successful data pipeline software test! (CCDLAB)