

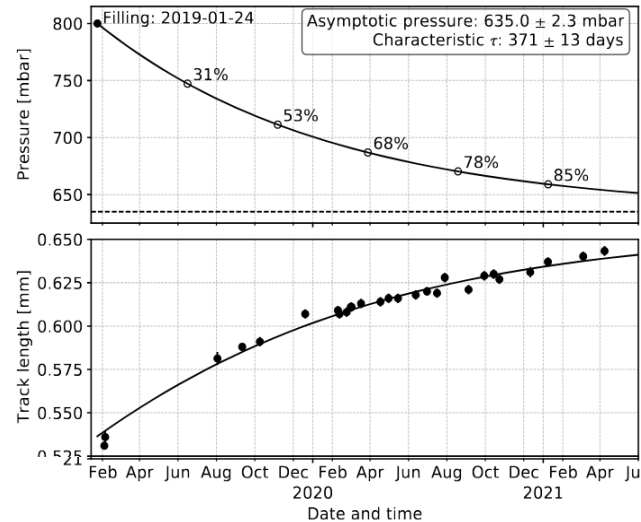
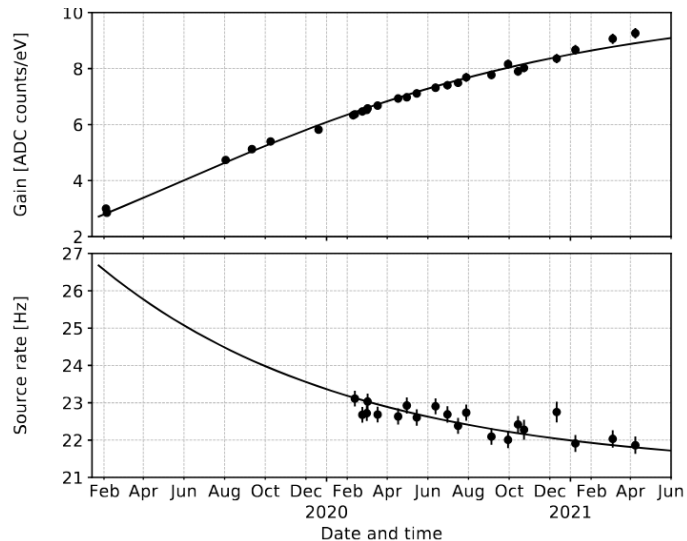


# IXPE mission and data processing status updates



Chien-Ting Chen  
IXPE SOC, MSFC/USRA

- ❑ **CALDB to be updated for DU2-related calibration files, and for GPD pressure related response matrices and quantum efficiency updates.**



Baldini+2021

## ❑ Data processing:

- We typically process data as soon as we received them.
- Internal data verification and validation before releasing to HEASARC.
- For segmented observations, the data delivery happens when all segments are completed. We try to schedule all segments to be completed within six months of the first segment.

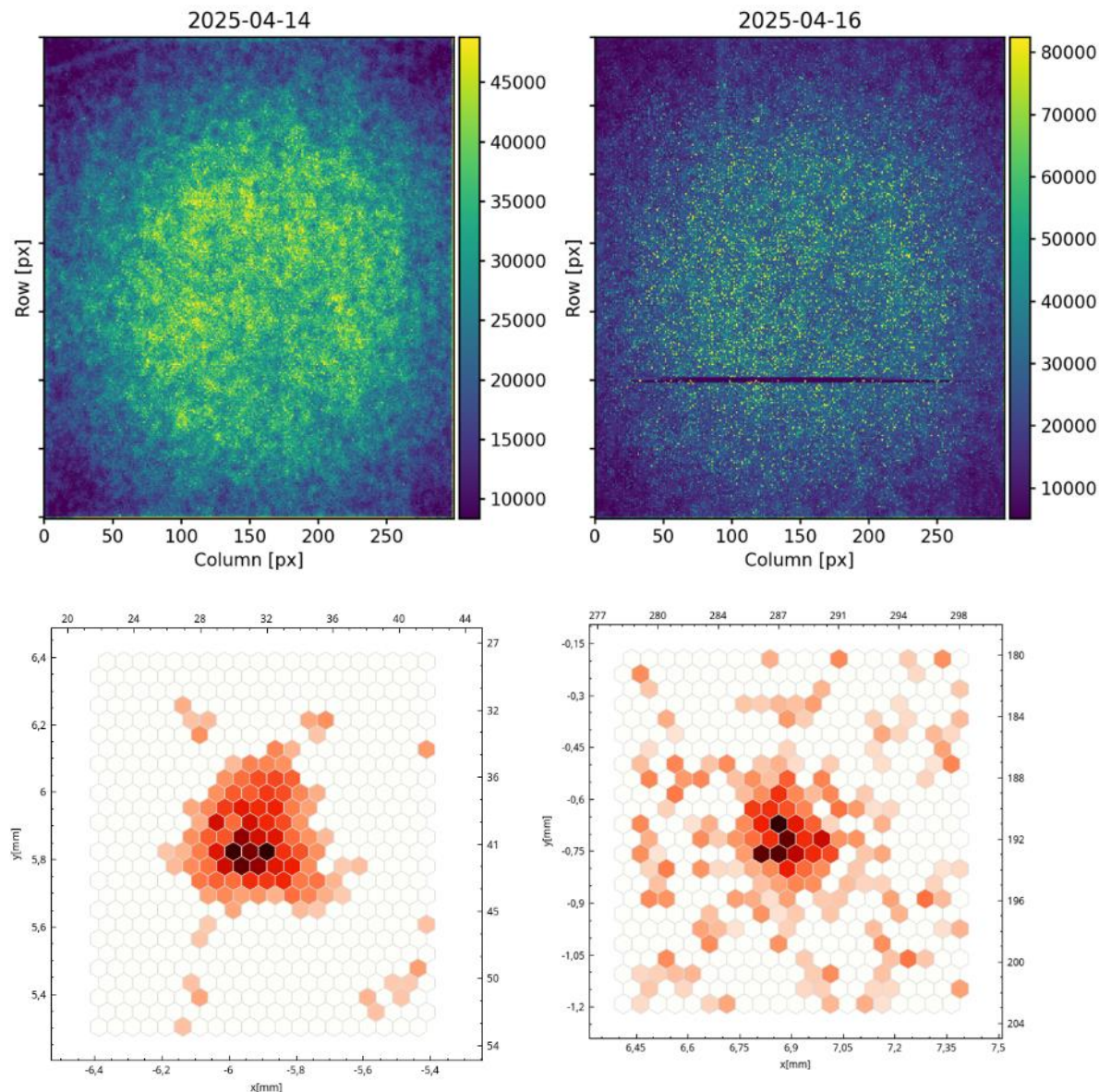
# Detector Unit #2 Anomaly

Detector Unit #2 suffered an anomaly on 15 April 2025.

- Drop in  $V_{ref}$ , increase in pixel gain ( $1.5\times$ )
- Changes in gain and pedestal of individual pixels
- Two rows of nearly dead pixels (figure, top – detector response before (left) and after (right) anomaly)
- Increased noise in the detector response (figure, bottom – photoelectron tracks before/after anomaly).

Effects:

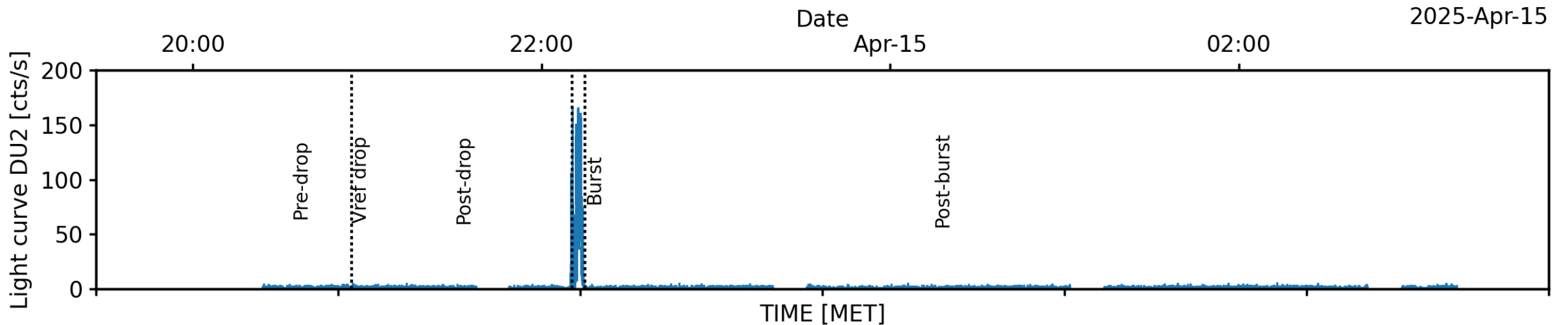
- Change in input charge versus measured PHA response ('pixel equalization' and 'pedestal')
- Change in 'Trigger Minicluster Offset', signal due to pixel cluster being triggered
- Change in polarization response at low energies
- Changes to parameters used in background filtering.



# Detector Unit #2 Anomaly

Date-time (UTC)	Event
2025-04-14T20:54:31.0	Drop of Vref on DU2
2025-04-14T22:09:57.0	Start of burst phase
2025-04-14T22:14:49.0	End of burst phase

- Event at Vref drop shown on next slide.
- A bursts of events for about 5 min, 75 min later

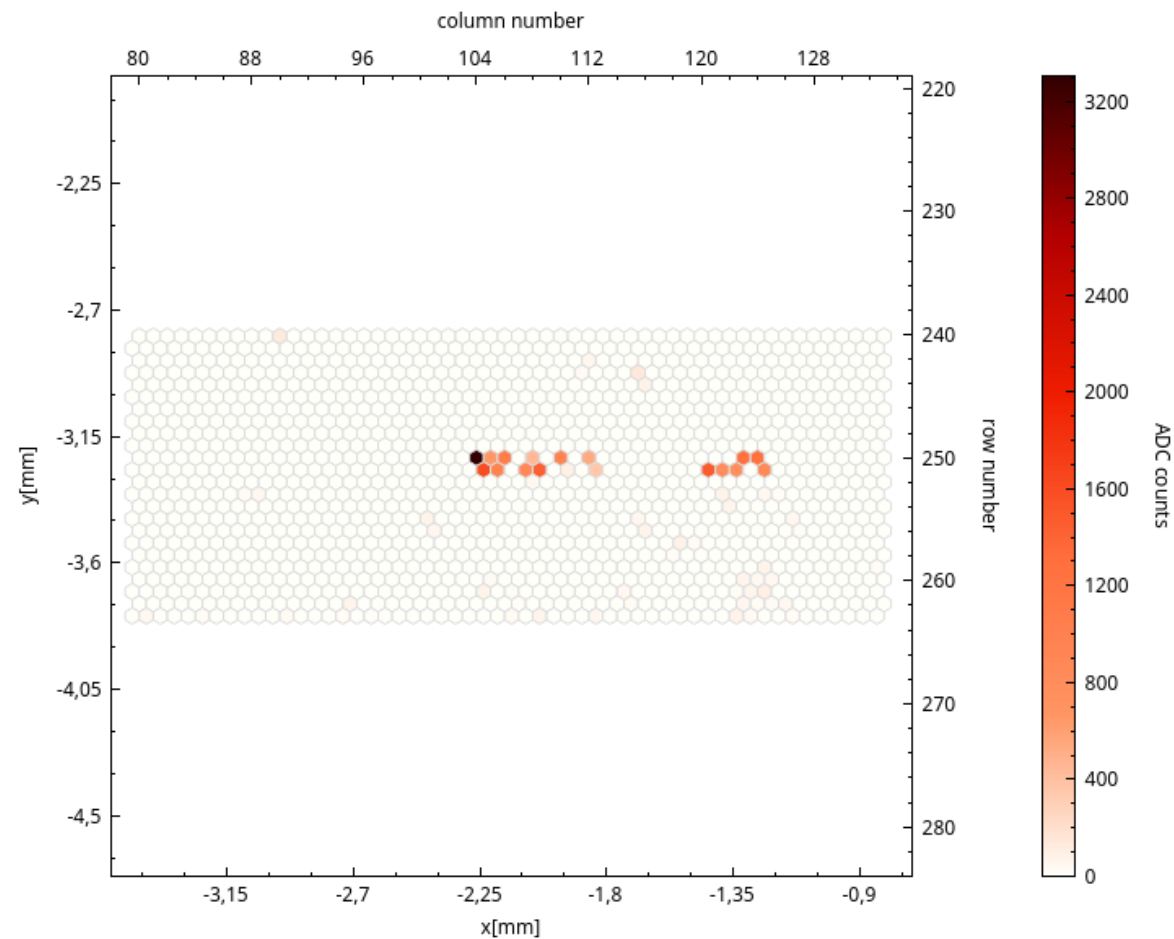
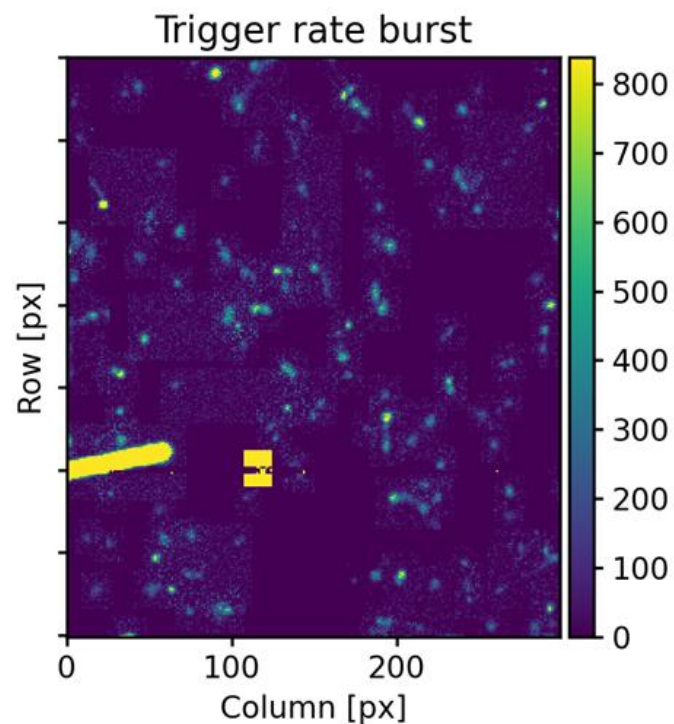


# Event at time of Vref drop

Right - Event that occurred at Vref drop

- Charge deposited along bad rows
- Consistent with energetic highly charged particle

Below – burst of events (alpha particle on left)

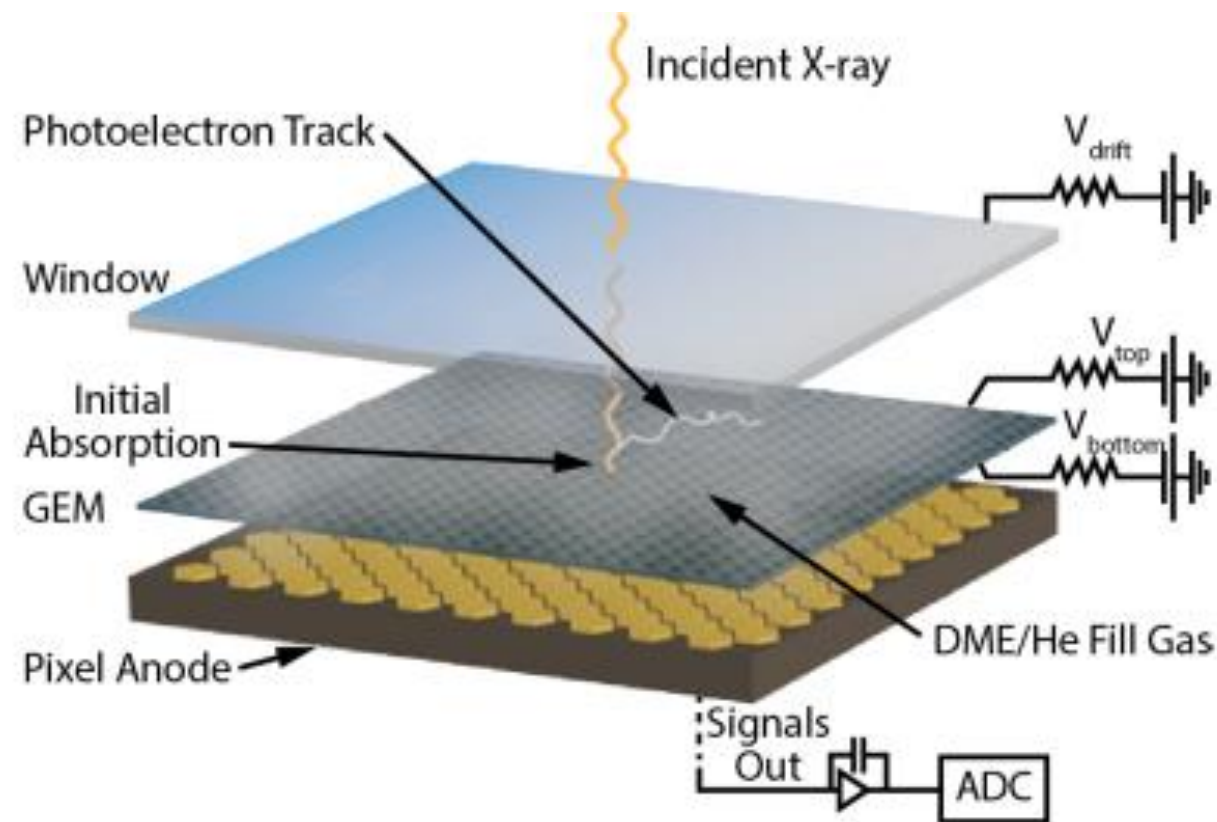


# DU2 anomaly root cause?

The limited information available prevents certainty in reaching a microscopic understanding of the DU anomaly and the underlying root cause.

A large deposition of charge into the ASIC either directly from a highly charged particle at the end of range or after amplification by the GEM is a potential root cause. Unusual event at time of  $V_{ref}$  drop is consistent with the former.

Electron multiplication is essential for operation of the GPDs and there is no way to effectively shield against energetic particles with high charge. Therefore, it is not possible to modify the operating parameters of the GPDs to exclude similar, rare events occurring in the future.



IXPE Gas Pixel Detector

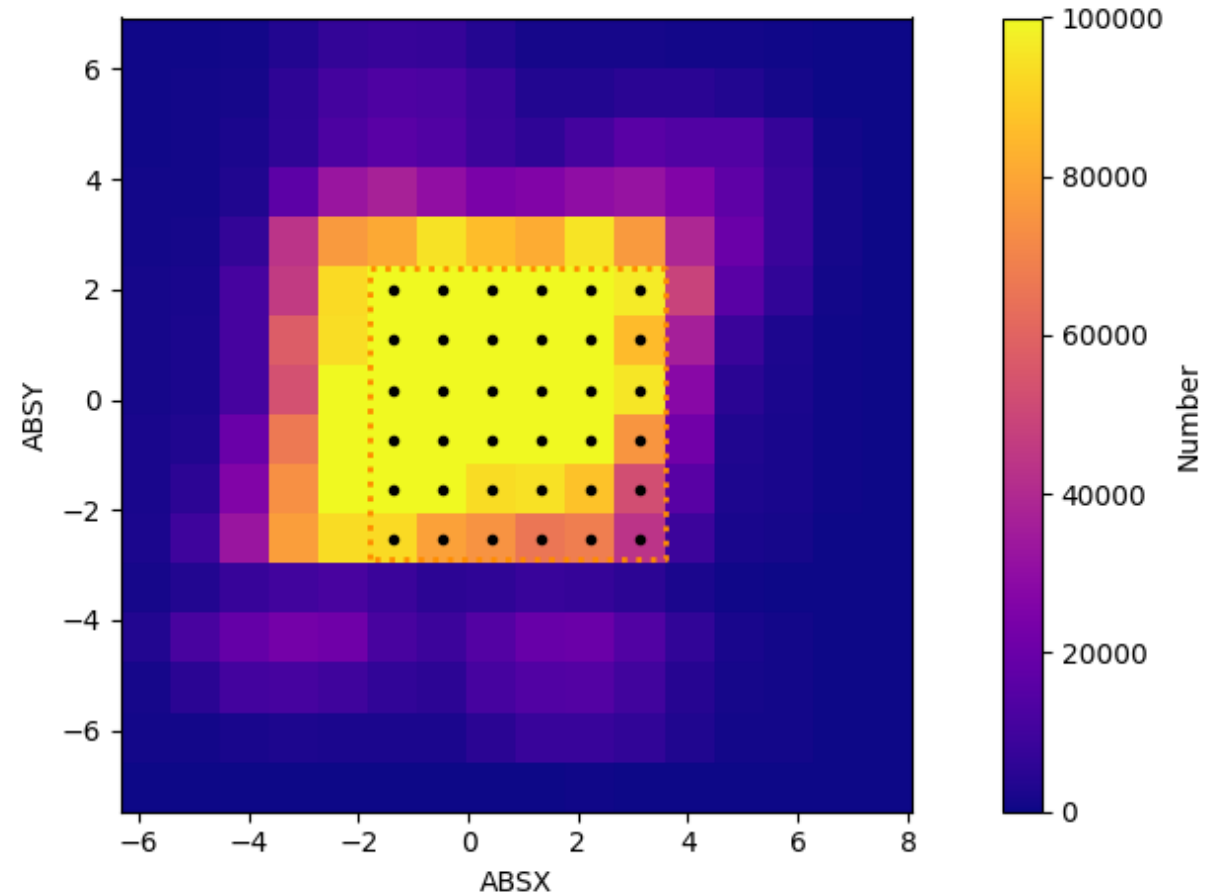
# Mitigation of Detector Unit #2 Anomaly

## Mitigations:

- ✓ Modified pipeline to rescale the overall gain in DU2.
- ✓ Created 'bad pixel map' to mask out events nearby affected rows.
- ✓ Found new Trigger Minicluster Offset (TMO), new value = 10, old =5
- ✓ Produced new charge versus PHA and pedestal calibrations for all pixels (pixeq, pedestal files).
- ✓ Tested that new pixeq/pedestal corrects spectral response.
- ✓ Recalibrated polarization response:
  - ✓ Extensive campaign on Cyg X-2 in 12/2025 to 1/2026 to create new spurious polarization map.
  - ✓ Multiple iterations of new spmod maps created and tested during 9/2025 – 3/2026.
  - ✓ Final spmod maps tested with eight bright targets observed from 8/2025 to 3/2026.
- ✓ Derived new background filtering cuts.
- ✓ Modified pipeline to allow time-dependent background filtering cuts.
- ✓ Built new software components ('Ftools') and deploy new pipeline
- ✓ Began reprocessing.

# DU2 polarization calibration observations

- Intensive campaign 2025-12-03 to 2026-01-31 including 19 observations of Cyg X-2
- Total exposure of 2.7 Ms
- Major effort by science and mission operations teams, pushed (and exceeded!) the limits of data storage and telemetry

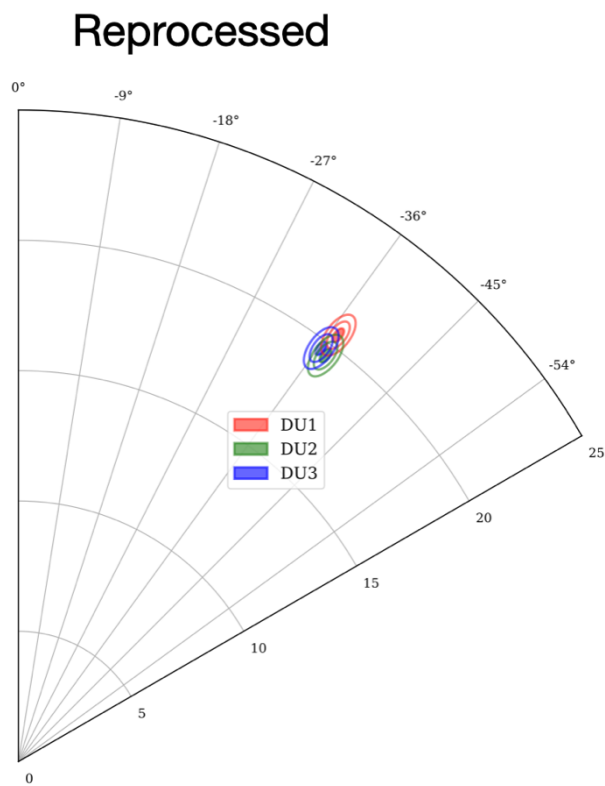
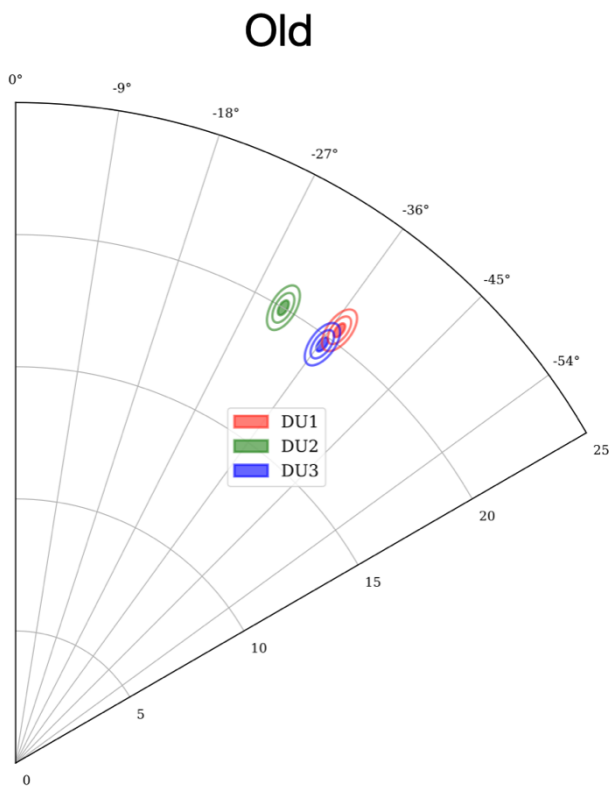


Counts per 0.9 mm pixels.

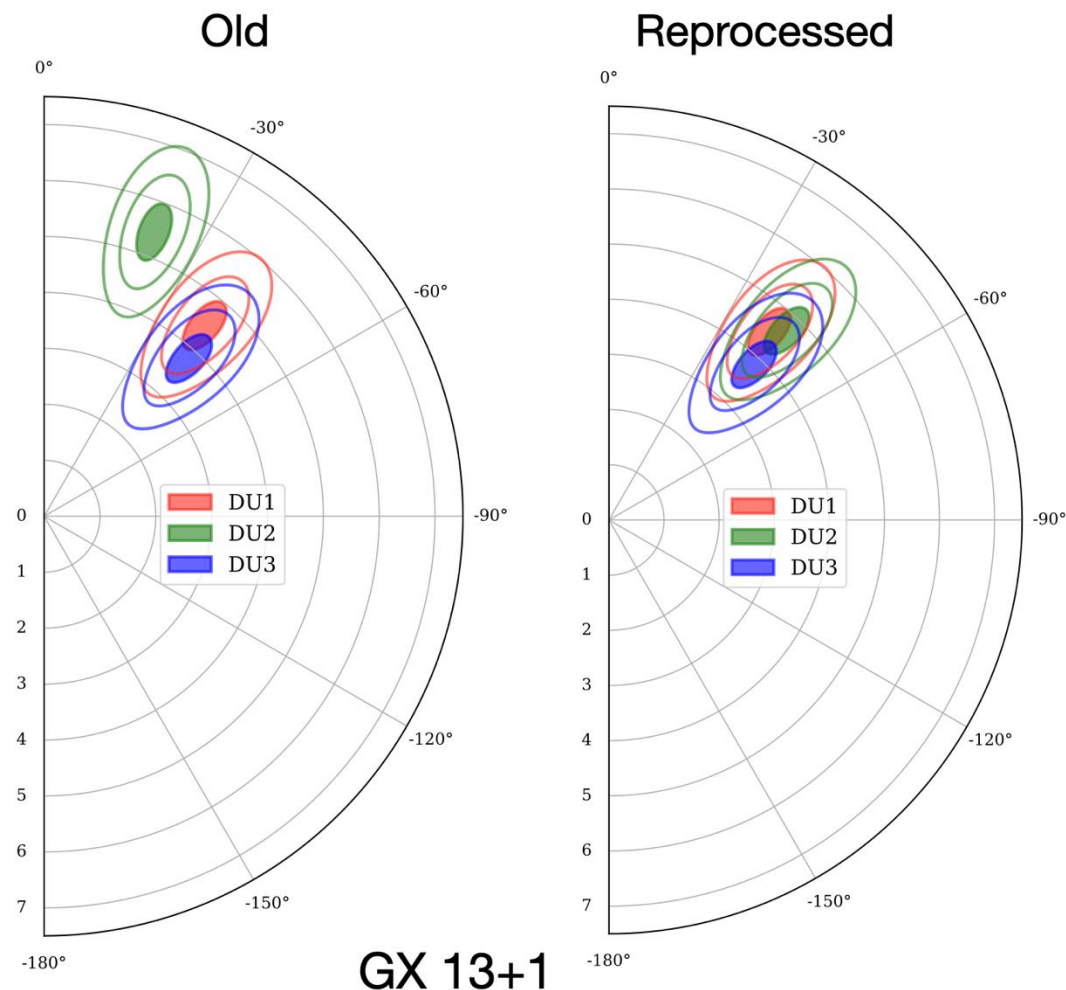
Orange = point source calibration region.

Low counts in lower, right due to offset on DU1+3.

# Reprocessed observations showing good agreements between all three DUs



**Crab Nebula**



# Delivery of DU2 data

- DU2 behavior has been stable since 15 June 2025, reprocessing of observations after this date is ongoing.
- SOC will restart delivery of new observations once reprocessing reaches current observations. Observations up to December 2025 have been reprocessed and delivered to HEARAC.
- We are still testing reprocessing for 15 April to 16 June 2025, will deliver these data after testing is complete.