

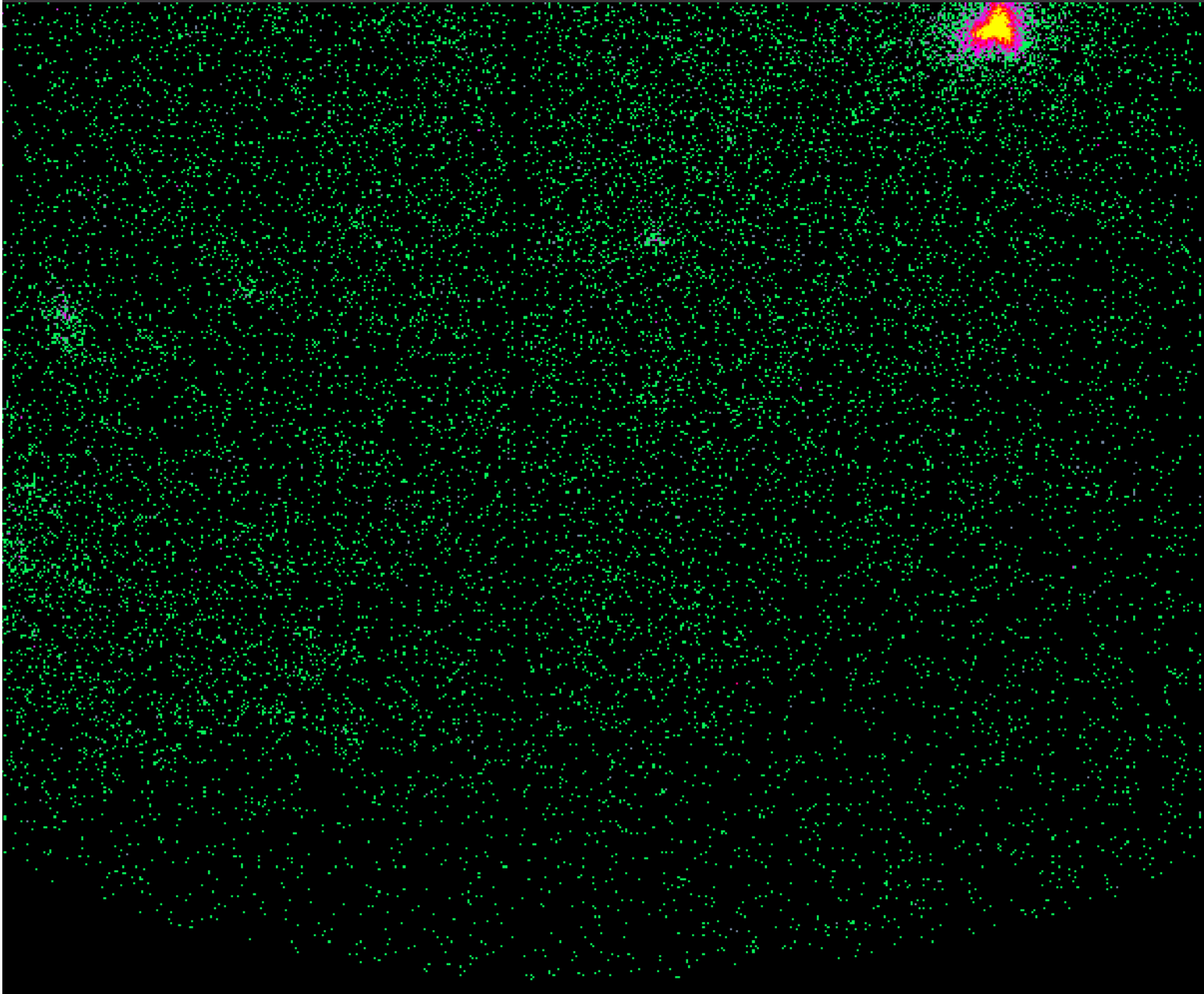
Bit flips in the MOS offset tables

- First detected in 0640_0160160101 MOS 1, CCD 6 by M. Ceballos in routine screening. RAWY=303 had its offset increased by 256.
- All low energy events on that row did not pass the EDU.
- All events on that row and rows just next had ENERGYE3 decreased by 512 or 768, so that they were flagged as UNDERSHOOT and rejected by *emevents*.
- All events 2 rows off (301 and 305) had ENERGYE4 decreased by 1280, so that many were flagged as BAD_E3E4 and rejected by *emenergy*.
- Lasted for two revolutions, disappeared by itself (?)
- Other occurrence: 0576-0577 (MOS 2, CCD 4, RAWY=384, +2048).

Detection algorithm

- At the last Cal/Ops meeting (09/03), I was asked to think of an algorithm to detect that feature automatically.
- The idea is to use E3 (sum of charges in pixels surrounding the maximum) for that purpose. For each row/column, compute median E3, keeping only single events > 500 eV (mostly real).
- Detect rows/columns where that value is unusually large (negative).
- Invert (locally) the linear equation relating median E3 and additional offset.
$$E3_i = 3 \Delta\text{off}_{i-1} + 2 \Delta\text{off}_i + 3 \Delta\text{off}_{i+1}$$
- Weight each equation (each row) by number of events in that row. Assume that Δoff is 0 where the median is compatible with 0.
- Allows to recover flips for bits ≥ 64 .
- Bit 32 is set in normal conditions (offsets ~ 50) so a flip would result in a too small offset. Events would be lost (entire row/column $>$ threshold) over three rows/columns. Not seen yet ? Lower bits are more difficult.

MOS offset flips



- Charged particle induces bit flip in a single onboard offset value (here +256 at RAWY=303)
- Results in very negative ENERGYE3/4 values over two rows on each side, rejected by *emevents*
- Unknown to *eexpmap*
- Can last a few orbits
- Detected automatically in SAS 6. Only one row is lost, known to *eexpmap*

Implementation in SAS 6

- *emevents* 8.2.1
 - Detects the wrong offsets
 - Writes them to an OFFSETS extension
 - Flags the events on that row/column (ON_BADOFFSET)
- *emchain* 11.4.3
 - ON_BADOFFSET bit (13) in XMMEA_EM
 - Merges OFFSETS extensions (for exposure calculation)