



# evatt

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## Abstract

Description of the XMM-Newton event attributes.

## 1 Description

### 1.1 EPIC MOS

`MOS_REJECTION_MASK = OUT_OF_FOV + IN_BAD_FRAME + COSMIC_RAY + ON_BADPIX + REJECTED_BY_GATTI + OUT_OF_CCD_WINDOW + OUTSIDE_THRESHOLDS + ON_BADROW + BAD_E3E4 + UNDERSHOOT + FLICKERING + ON_BADOFFSET`

`MOS_SPECTRAL_MASK = 0xFFFFFFFF - CLOSE_TO_DEADPIX`

#### 1.1.1 Informational attributes

- **DIAGONAL** This event was part of a pair of single events touching one another by a corner, but otherwise isolated. A significant number of those hint at pile-up.
- **CLOSE\_TO\_CCD\_BORDER** This event was immediately next to a border of the CCD, so that part of its charge may have been lost.
- **CLOSE\_TO\_CCD\_WINDOW** This event was immediately next to a border of the current CCD window (when not in full frame mode), so that part of its charge may have been lost. For EPIC/MOS only events next to the left and lower borders are affected and flagged.
- **CLOSE\_TO\_NODE\_BOUNDARY** This event was immediately next to the limit between the read-out nodes (when in 2-node mode), so that its energy may not be precise.
- **CLOSE\_TO\_ONBOARD\_BADPIX** This event was immediately next (to the left, right, above or below but not diagonally) to a bad pixel declared on board. Its energy will be imprecise, but since this may happen only when the bad pixel is inactive it should be a true X-ray.
- **CLOSE\_TO\_BRIGHTPIX** This event was immediately next (to the left, right, above or below but not diagonally) to a bright pixel not declared on board. Its energy will be imprecise, and it could be a false event if the bright pixel next to it was active.
- **CLOSE\_TO\_DEADPIX** This event was immediately next (to the left, right, above or below but not diagonally) to a dead pixel, so that part of its charge may have been lost.



- `CLOSE_TO_BADCOL` This event was immediately next to a column declared bad through its offset, so that part of its charge may have been lost.
- `CLOSE_TO_BADROW` This event was immediately next to a row declared bad through its offset, so that part of its charge may have been lost. It could be a false event if the bad row is bright.
- `IN_SPOILED_FRAME` This event was detected in a frame which was judged imperfect (like frames with extended integration time). As a result the energy or time of the event may be slightly wrong.
- `UNKNOWN_RAWX_PATTERN` to cover the case of COMPRESSED TIMING mode events, whose abscissa and pattern are unknown

This is an approximate ordering, in the order of decreasing energy reliability:

`DIAGONAL > IN_SPOILED_FRAME > CLOSE_TO_NODE_BOUNDARY > CLOSE_TO_DEADPIX > CLOSE_TO_ONBOARD_BADPIX > CLOSE_TO_CCD_WINDOW > CLOSE_TO_CCD_BORDER > CLOSE_TO_BADCOL > CLOSE_TO_BRIGHTPIX > CLOSE_TO_BADROW`

## 1.1.2 Rejection attributes

- `OUT_OF_FOV` This event was detected outside the nominal field of view of XMM. It was most likely a particle event.
- `IN_BAD_FRAME` This event was detected in a frame where something was incoherent, hinting at corrupted data.
- `COSMIC_RAY` This event was detected with one of the large patterns (30 or 31). It was most likely a particle event.
- `ON_BADPIX` This event was detected at the location of a registered bad pixel (not declared on board).
- `REJECTED_BY_GATTI` This event had E1 truncated at the maximum value. It was most likely a particle event.
- `OUT_OF_CCD_WINDOW` This event was detected outside the CCD or the current window. This is usually noise in the under/overscans.
- `OUTSIDE_THRESHOLDS` This event had total energy (E1+E2) lower than the EMDH lower threshold (noise fluctuation) or larger than the EMDH upper threshold (particle event).
- `FLICKERING` This event is due to a flickering pixel.
- `UNDERSHOOT` This event had very negative pixels next to it (electronic rebound).
- `ON_BADROW` This event was part of many events in one row in a single frame.
- `BAD_E3E4` This event had an incoherent local background.
- `ON_BADOFFSET` This event is affected by a bit-flip in the onboard offset table, resulting in wrong energies (and other problems) on that row/column.

Note that `OUTSIDE_THRESHOLDS` could be split between `BELOW_LOWER_THRESHOLD` and `ABOVE_UPPER_THRESHOLD`, as those two cases reflect completely different situations.



## 1.2 EPIC PN

$\text{EPN\_REJECTION\_MASK} = \text{OUT\_OF\_FOV} + \text{IN\_BAD\_FRAME} + \text{COSMIC\_RAY} + \text{ON\_BADPIX} + \text{SECONDARY} + \text{TRAILING} + \text{MIP\_ASSOCIATED} + \text{OUT\_OF\_CCD\_WINDOW}$  Note: `OUT_OF_CCD_WINDOW` is missing in the current implementation. This is, however, not really relevant as events with this flag cannot be handled in tasks later than `epframes`. The flag is set and the events are already rejected within the task. The attribute `IN_BAD_FRAME` is set if `OUT_OF_CCD_WINDOW` is set and `IN_BAD_FRAME` is in `EPN_REJECTION_MASK`.

### 1.2.1 Informational attributes

- `CLOSE_TO_CCD_BORDER` This event was immediately next to a border of the CCD, so that part of its charge may have been lost.
- `CLOSE_TO_CCD_WINDOW` This event was immediately next to a border of the current CCD window (when not in full frame mode), so that part of its charge may have been lost. For EPIC/MOS only events next to the left and lower borders are affected and flagged.
- `CLOSE_TO_ONBOARD_BADPIX` This event was immediately next (to the left, right, above or below but not diagonally) to a bad pixel declared on board. Its energy will be imprecise, but since this may happen only when the bad pixel is inactive it should be a true X-ray.
- `CLOSE_TO_BRIGHTPIX` This event was immediately next (to the left, right, above or below but not diagonally) to a bright pixel not declared on board. Its energy will be imprecise, and it could be a false event if the bright pixel next to it was active.
- `CLOSE_TO_DEADPIX` This event was immediately next (to the left, right, above or below but not diagonally) to a dead pixel, so that part of its charge may have been lost.
- `NEXT_TO_OFFSETCOL` This event was immediately next to a column that has a higher lower threshold than the rest of the CCD. Part of its charge may have been lost.
- `ON_OFFSETCOL` This event was immediately on a column that has a higher lower threshold than the rest of the CCD. Part of its charge may have been lost.
- `IN_SPOILED_FRAME` This event was detected in a frame where other events were detected in wrong readout order or with illegal coordinates. The information related with this events is not reliable.
- `INVALID_PATTERN` This event is part of a pattern that cannot be produced by a single photon. It is either caused by pile-up or is a remnant of charged particle events (MIPs) that were rejected on-board (or in `epframes` if on-board rejection was switched off).
- `OUT_OF_FOV` This event was detected outside the nominal field of view of XMM. It was an out-of-time event recorded during CCD readout or due to internal noise.
- `FLICKERING` This event is due to a flickering pixel.

### 1.2.2 rejection attributes

- `IN_BAD_FRAME` This event was detected in a frame where something was incoherent, hinting at corrupted data.
- `COSMIC_RAY` This event was detected within a large pattern (size > 31). It was most likely a particle event (MIP). Not set yet for PN as the SAS pattern recognition is performed after the SAS MIP rejection.



- **ON\_BADPIX** This event was detected at the location of a registered bad pixel (not declared on board).
- **OUT\_OF\_CCD\_WINDOW** This event was detected outside the CCD or the current window.
- **SECONDARY** This event is a secondary event in a pattern and all the relevant event information is stored with the main event after the pattern recombination.
- **TRAILING** This event is most likely reemission of an event occurring immediately next to it towards the CAMEX and just above the threshold. Its charge is already corrected for in the CTI correction.
- **MIP\_ASSOCIATED** This event is detected in columns that contain high-energy particle events (MIPs) or in adjacent columns. It may be associated to the MIP itself. Even if unrelated its energy cannot be determined with sufficient accuracy because CTI corrections do not apply anymore.

## 1.3 RGS

These flags indicate conditions which cast serious doubt upon the quality of the event as an X-ray detection:

- **ON\_BADPIX**  
At least one pixel included in the event is found in the bad pixel table.
- **NEXT\_TO\_BADPIX**  
The pixel under the event centroid shares an edge with a pixel from the bad pixel table.
- **ON\_WINDOW\_BORDER**  
The pixel under the event centroid lies in the first or last row or column of the telemetered window.
- **BELOW\_ACCEPTANCE**  
The calibrated energy of every pixel included in the event lies below the acceptance threshold.
- **BAD\_SHAPE**  
The event does not lie entirely within a two-by-two pixel region.
- **ON\_NODE\_INTERFACE**  
The pixel under the event centroid shares an edge with the opposing node.

These flags provide information about the composition of the event:

- **ON\_NODE0**  
At least one pixel included in the event lies in node zero.
- **ON\_NODE1**  
At least one pixel included in the event lies in node one.
- **ONBOARD\_SER**  
At least one pixel included in the event represents an on-board reconstruction.
- **FLICKERING** This event is due to a flickering pixel.



## 2 Comments

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## References