# 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

EPN_REJECTION_MASK = OUT_OF_FOV + IN_BAD_FRAME + COSMIC_RAY + ON_BADPIX + SECONDARY + TRAILING + MIP_ASSOCIATED + 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 occuring 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 oposing 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