Correcting For The Unexpected:Dead Anodes, Glitches, HotspotsAnd Gain Drift in JEM-X Data Processing

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ABSTRACT: Since launch the JEM-X units have developed a number of unexpected effects which have been observed in the science data. This is especially true for JEM-X2 which has been in constant use since the switch on of the high voltage supply in October 2002. These anomalies have to be detected and corrected automatically in the ISDC processing using the Instrument Specific Software (ISSW). The design of the ISSW made allowance for such corrections, which are implemented through correction tables, instrument characteristics, event flagging and selection, and performance monitoring. We discuss the various strategies for dealing with dead anodes, gain glitches hot spots and gain drift. It would appear that all these problems stem from unexpectedly damaging cosmic ray interactions with the microstrip plates and detector gas. While these effects are beyond our control, the JEM-X experience should benefit future space-based missions using microstrip technology.

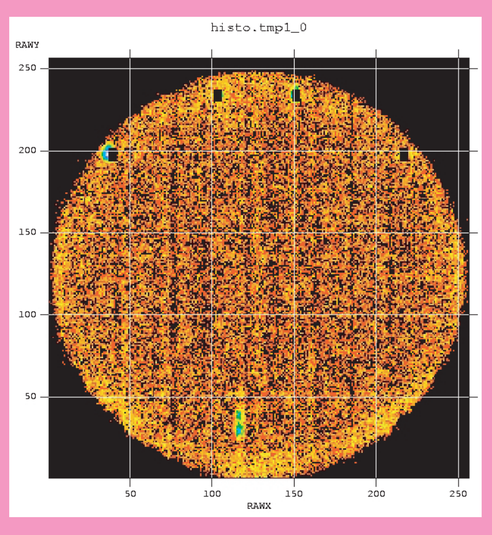

Figure 1: JEM-X1 hotspot, rev. 20

HOTPOTS

Transient hotspots can occur on the microstrip detectors, though usually in one particular place. A good example was seen on JEM-X1 at the beginning of Revolution 20 (fig.1), apparently caused by some event during passage through the radiation belts. Its strength fluctuated on a time scale of minutes (fig.2) in indivdual Science windows and from SCW to SCW for several hours. Events originating in the hotspot region are flagged to be ignored during processing, as indicated on the detector characteristics map (fig 6). These 'events' are easily detected due to the very low energy signal they produce (fig 3)

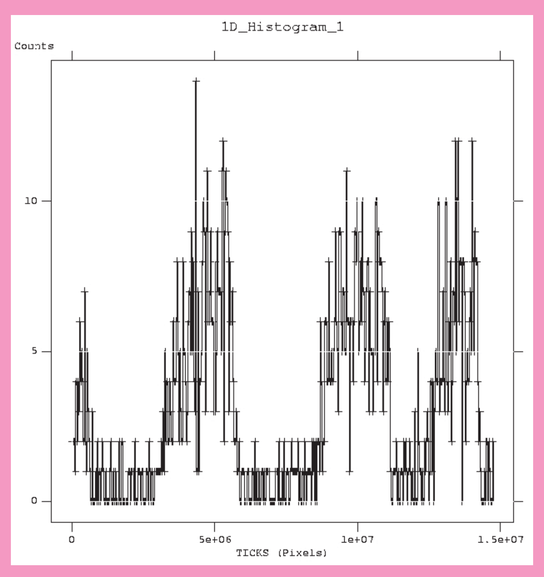

Figure 2: Hotspot stregth during first rev. 20 Science Window

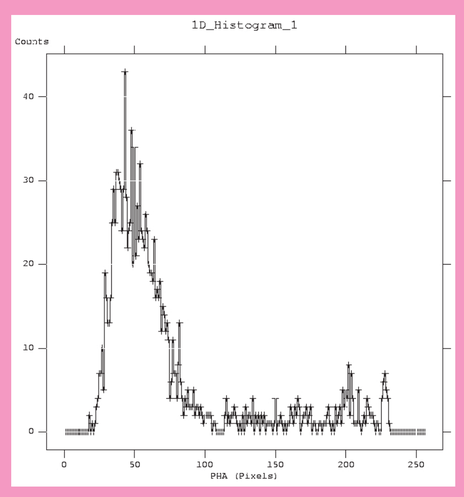

Figure 3: Spectrum of hotspot 'events'

GAIN GLITCHES

The gain of each unit is determined by the position of the Cd-109 line in calibration spectra. Small, sudden localised drops in gain are common. This is probably due to charging of the microstrip plates by cosmic rays. The biggest 'glitch' so far was on anode 3 of JEM-X2 towards the end of rev. 60 (fig. 4) The gain (black)drops by about 36%. Interestingly, the neighbouring anodes show little or no effect of this dramatic event.

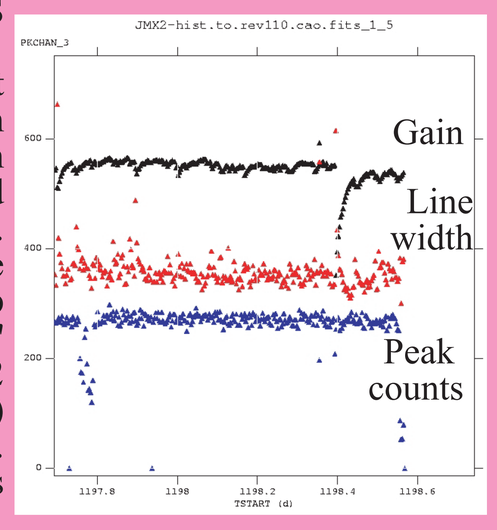

Figure 4: JEM-X 2 gain glitch, rev. 60

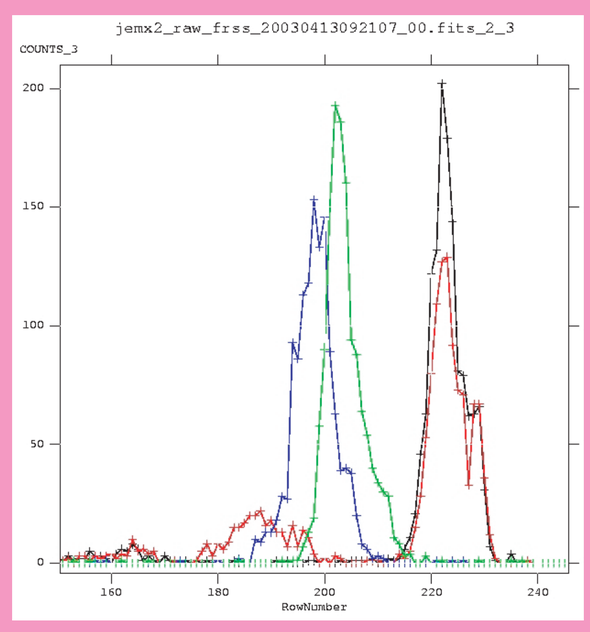

Figure 5: Calibration spectra during the rev. 60 gain glitch

Figure 5 shows the calibration spectra during the glitch. Initially (black) there is high gain and a clear sharp peak showing the Cd-109 doublet. During integration of the next spectrum (red) gain drops, producing a small lower peak. Later spectra (blue, green) show the gain recovering, but are broadened by integrating while gain is varying. Local gain glitches are removed from the calibration data by fitting smooth gain model for each orbit before calculating event energies from the entire detector.

DEAD ANODES

It has been discovered that individual anode strips on the microstrip plates can be damaged, presumably by cosmic rays hitting the fine gold filaments. These dead anodes detect fewer events than normal and these are flagged using the detector characteristics map (fig. 6). A smilar map of gain corrections is also used for each anode.

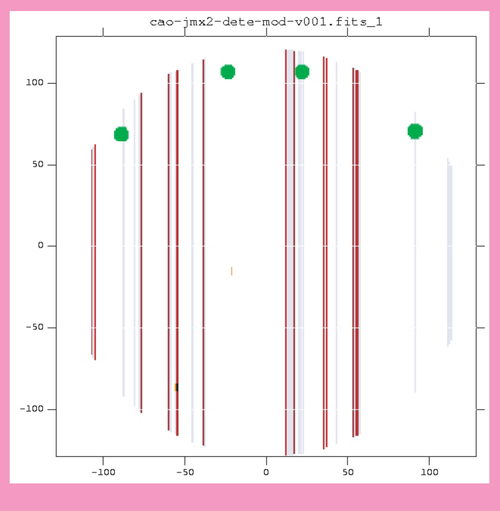

Figure 6: Detector correction map for JEM-X2

GAIN DRIFT

Generally we have corrected data for post launch anomalies. However, the steady gain increase in JEM-X2 can only be solved by decreasing the high voltage on the microstrip plate (figure 7). This has been done so that the Xe lines from thedetector gas can be used to monitor detector performance over the plate and to maintain the energy range of the instrument. The cause of this drift is unknown. The quench gas in the detector may be cracked by cosmic ray activity. Damage to the microstrip plate itself could also be the cause of the problem.

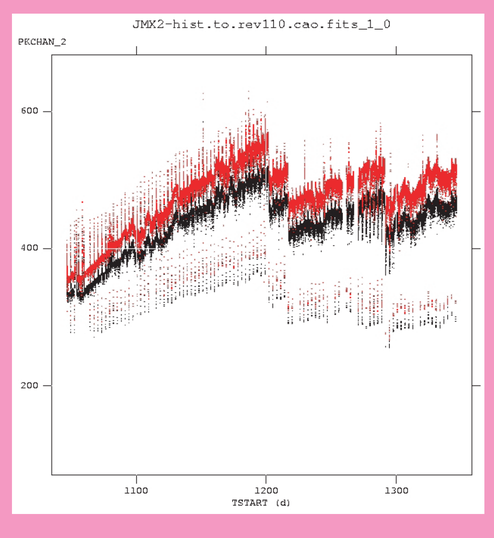

Figure 7: JEM-X2 gain on anodes 2 and 3, upto rev. 110