Technical University of Denmark

JEM-X Status, November 2011

Søren Brandt





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INTEGRAL Status

 INTEGRAL is approved by ESA until the end of 2014

– (pending the "usual" review in 2012)
– INTEGRAL user group will prepare extension request for 2015-16

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INTEGRAL continues to provide unique possibilities for studying the high-energy sky, in particular thanks to its imaging, spectral and polarimetric capabilities in the 20 keV to a few MeV range. No mission is planned in the near future to substitute INTEGRAL at energies above a few hundred keV. An extension of the INTEGRAL operations would enable new and interesting science. However, while producing science of high quality, the community making use of INTEGRAL is smaller than for other missions (e.g., XMM-Newton or HST) and the resulting science is of a somewhat less broad nature.

The AWG was impressed by the innovativeness of the INTEGRAL community as shown by recent results. The extension to the end of 2014 will benefit from the low particle background expected around solar maximum and the AWG recommends the extension of the massic DTU Space

INTEGRAL

- Particle background is decreasing
 - Less demand for TM
 - Redistribution of TM is under discussion....
- Perigee is down to a minimum of ~2800 km
 - No adverse effects on JEM-X due to the passage of the proton belts
 - Other systems? Solar panels will age...



Both JEM-X units default configuration

- JEM-X1 was used from rev. 170-855 and has now been used for ~800 revolutions (~7 years of use)
- During revolution 862-975 (Oct 16, 2009) JEM-X2 was the default JEM-X unit
- Since revolution 976 (Oct 10 2010) both JEM-X units have been used (8+8 tm packets allocation)
- JEM-X2 had been used for ~400 revolutions
- · Both units have been used for all Crab calibrations
- Both units were used during SPI annealing, as TM allocation allowed

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S/N ratio improved by ~sqrt(2) with both units
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JEM-X operations

- JEM-X is running smoothly
- Only exception is the "eclipse recovery anomaly"
 - During eclipse the JEM-X DFEE is switched off
 - Sometimes the recovery of the DFEE memory configuration fails/stops with a CRC error reported
 - Troubleshooting has shown that there is no real error
 - A procedure to proceed with instrument activation without reboot has been implemented (to prevent loss of observing time)
 - MOC has proposed a IASW patch to delay patching of DFEE, but unclear if it would have any effect...

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Anode status

- ~So far on average 2-3% loss per year (256 anodes in total), but now about 1% per year
- However, no loss during ~12 months period in 2007-08
 - Two strips lost in 2008, one in 2009, one in 2010, two in 2011
- JEM-X1 (~800 orbits of use)
 - 62 of 256 anodes affected (almost 25% of area)
 - 38 dead (4 pre-launch, 1 lost during 2009, 1 lost during 2010)

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- 13 neighbor
- 11 unstable or low
- JEM-X2 (~400 orbits of use)
 - 61 of 256 anodes affected (almost 25% of area)
 - 31 dead (9 pre-launch) (+2 since Oct 2009)
 - 15 neighbor
 - 15 unstable or low (+3 since Oct 2009)

Recent JEM-X hot spot activity

- Events do not have valid back plane position
 → hot stripe
- PHA/PI very low and easily filtered out
- Relatively small load on telemetry budget JEM-X SDAST Meeting, I



Hot stripe example, Nov 5 2011



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Gain evolution

- JEM-X1 DV setting was lowered in orbit 978 to DV=70 (~700 V), to DV=69 (690 V) in orbit 1010, and further to DV=68 (680 V) in orbit 1089
- When JEM-X1 started as default instrument in orbit 170, we had DV=81 (~810 Volts)
- Gain (at constant HV) has increased by a factor of ~4
- Gain dependence on detector temperature has increased from 1% per degree to ~4% per degree → very high gain during hot operations
- JEM-X2 DV setting is was lowered to DV=71 in rev. 967, to DV=70 in orbit 1010, to DV=69 in orbit 1089

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Gain evolution is caused by ion conducting glass substrate of the micro-strip plate

Gain dependence on temperature

- Gain varies as function of temperature
 - ~1%/°C pre-launch
 - JEM-X1 now: ~4%/°C
 - JEM-X2 now: ~3%/°C
- ~5°C amplitude
 20% gain variation





Detector temperature variation

- The JEM-X detector temperature depends on the solar aspect angle
 - +5° to +3° when toward and away from Sun
 - Note: figure derived with only 1 active unit



JEM-X2 calibration spectra (rev. 10 and 1101)

- JEM-X2 has 4 Cd sources, which are down by a factor of ~135 since launch, Fe-55 source have decayed by 9.8
- Calibration spectra integrated over longer time to fit the line
- Xe fluorescent line from detector gas at 29.6 keV also used



JEM-X1 calibration spectra (rev. 10 and 1101)



JEM-X Gain calibration in OSA

- Gain calibration requires continued efforts because of the decaying calibration sources
- data must be collected in increasing time periods
- offline analysis of gain to ensure correct results
- Calibration provided by "Instrument Characteristics" tables delivered to ISDC for each revolution
- Eventually the gain calibration will rely on the Xe fluorescence background line at 29.6 keV

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JEM-X trigger rate is lowered

JEM-X HW and SW trigger rate is lowered by ~15%



Comapring 2003 and 2011



Calibration

- Circle of 4 degree off axis completed in 774 and 839 Crab calibrations
 - Systematics in light curves on the order of 5% due to the collimator
- In 902 Crab staring during start of orbit to check the gain correction and electronic efficiency after HV activation
- Previous Crab calibration (1019):
 - JEM-X request for checking electronic efficiency by stepping down the DV (3 different levels with each 6 ks Crab on-axis)
 - Diagnostic data request with and without increased drift voltage
 - Purpose: Verification of event selection criteria
 - The 2 5x5 dithers on the Crab were performed with different drift voltage settings
 - Double triggers due to particle tracks is reduced
 - Analysis of data is still.... ongoing
- Big question: do we have "pile-up" problems that introduce a reduced efficiency as function the particle rate??
- Most recent Crab calibration (1089) standard 10 ks staring
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DV-test: observing the same Crab spectrum at different gain



Drift voltage test on 5x5 dither in 1019

 Double trigger rate is reduced from ~20% to <5%



Double triggers

- DV couples to the drift voltage
 - Lowering DV causes slow drift of e-cloud
 - Higher probability of one particle track causing double trigger



Accepted events as function of added, dead time corrected, SW-triggers

 Lost events increase as function of background...



Under-estimated dead time?

- During Sco X-1 observations increase in number of SW triggers and accepted events show a 0.7 correlation
- Does this mean that we loose 30% of good Xrays?
- And why are they lost? - "Pile-up"?
 - Too strict selection
 - criteria?
 - Recent Crab exercises may help find an answer





Delta-time distribution deviations

 Deviation from Poisson distribution at small delta-times



Conclusion

- JEM-X is running smoothly
- JEM-X is not affected by lowered perigee
- Gain evolution is progressing (as expected)
- Switch from JEM-X1 to JEM-X2 was implemented by start AO7 (Oct 2009) to even the "wear" on the detectors
- Running both JEM-X1 and JEM-X2 was implemented in Oct 2010, as sufficient telemetry became available
 Improved statistics and reduction of systematics
- Team is still intact
- We expect JEM-X and INTEGRAL to operate through 2014 (and longer?, next step is end of 2016)

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