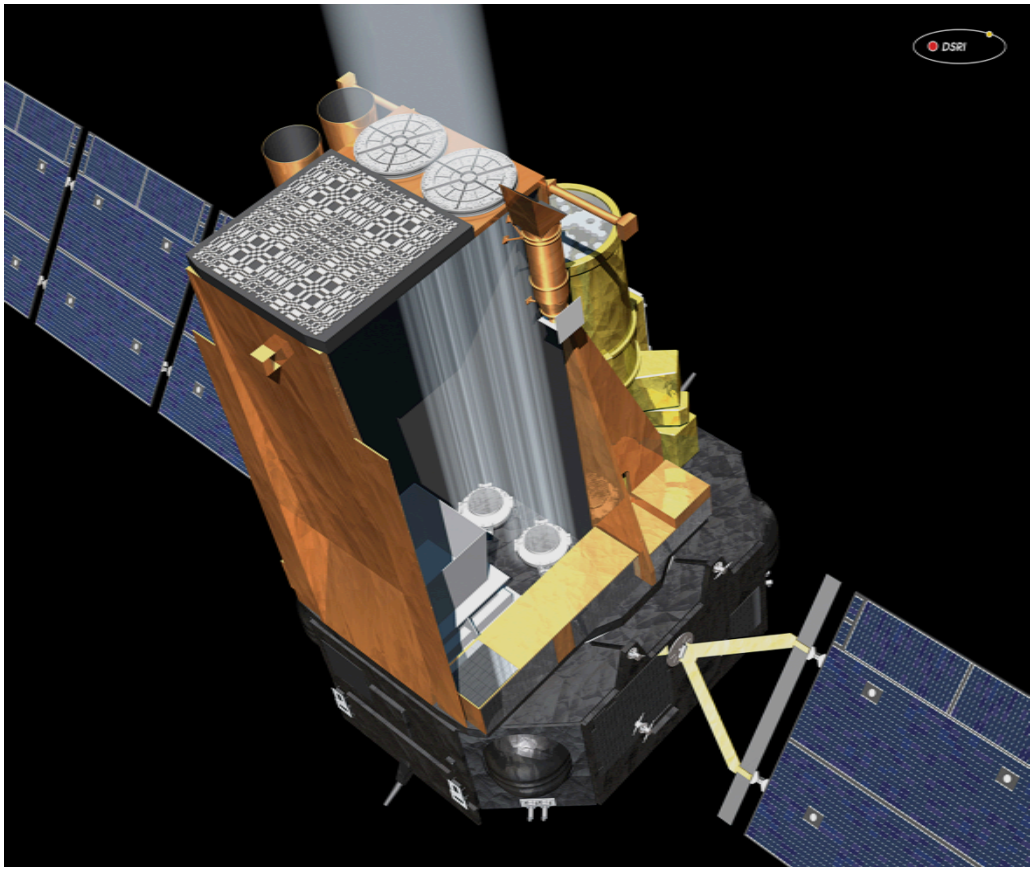
Technical University of Denmark

JEM-X Status, November 2013

Søren Brandt



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Anode status

- ~So far – was on average ~2-3% loss per year (256 anodes in total), but now <1% per year
- However, no loss during ~12 months period in 2007-08
  - Two strips lost in 2008, one in March 2009, three in 2010, one in 2011
- JEM-X1 (~1120 orbits of use)
  - 63 of 256 anodes affected (~25% of area)
    - 35 dead (4 pre-launch, 1 lost during 2010, 2 lost during 2011, 0 lost in 2012)
    - 12 neighbor
    - 16 unstable or low

No anode loss since Dec 2011!

- JEM-X2 (~700 orbits of use)
  - 64 of 256 anodes affected (almost 25% of area)
    - 32 dead (9 pre-launch) (2 lost over past two years, the latest in Aug 2013)
    - 16 neighbor
    - 16 unstable or low

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Gain evolution

- JEM-X1 DV setting was lowered in rev. 978 to DV=70 (~700V), to DV=69 (~690V) in rev. 1010, Jan 20, 2011, and to DV=68 (~680V) in rev. 1089, Sep 13 2011, June 21 2012 DV=67 (~670V) in rev 1183, **Jan 28 2013 DV=66 (660V) in rev 1257**
- 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 ~4-5% per degree
- JEM-X2 DV setting is was lowered to DV=71 in rev. 967 and to DV=70 in rev. 1010, Jan 20, 2011, to DV=69 in rev. 1089, Sep 13 2011, June 21 2012 DV=68 (~680V) in rev 1183, **Jan 28 2013 DV=67 (670V) in rev 1257**
- Gain evolution is caused by ion conducting glass substrate of the micro-strip plate

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JEM-X Gain Calibration in OSA

- Gain calibration requires continued efforts because of the decaying calibration sources
  - Further complicated by increased dependence on temperature = more variation over an orbit
- Calibration data must be collected in increasing time periods
- offline analysis of gain required to ensure correct results
  - However, usually automatic near-real time corrections are not too bad
- Calibration analysis is more difficult in orbits with grey filter
  - More TM has helped avoid grey filter “interruptions” in gain curves
  - But still periods of grey filter, also when background is high.
- Calibration provided by “Instrument Characteristics” tables delivered to ISDC for each revolution
- Eventually the gain calibration will rely only on the Xe fluorescence background line at 29.6 keV and temperature variation modeling

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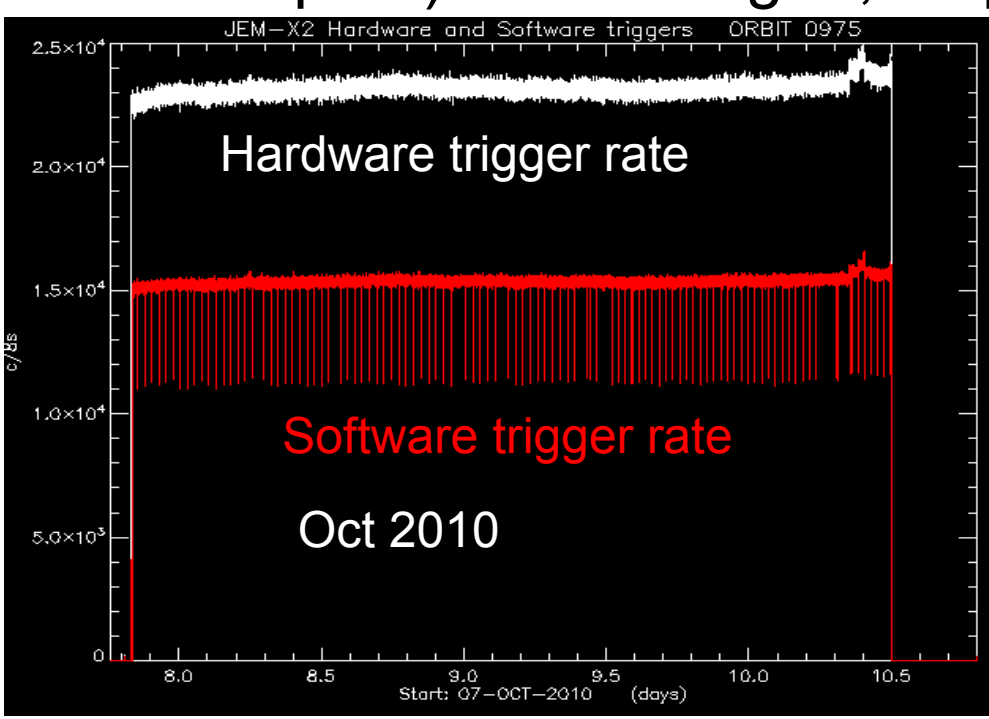
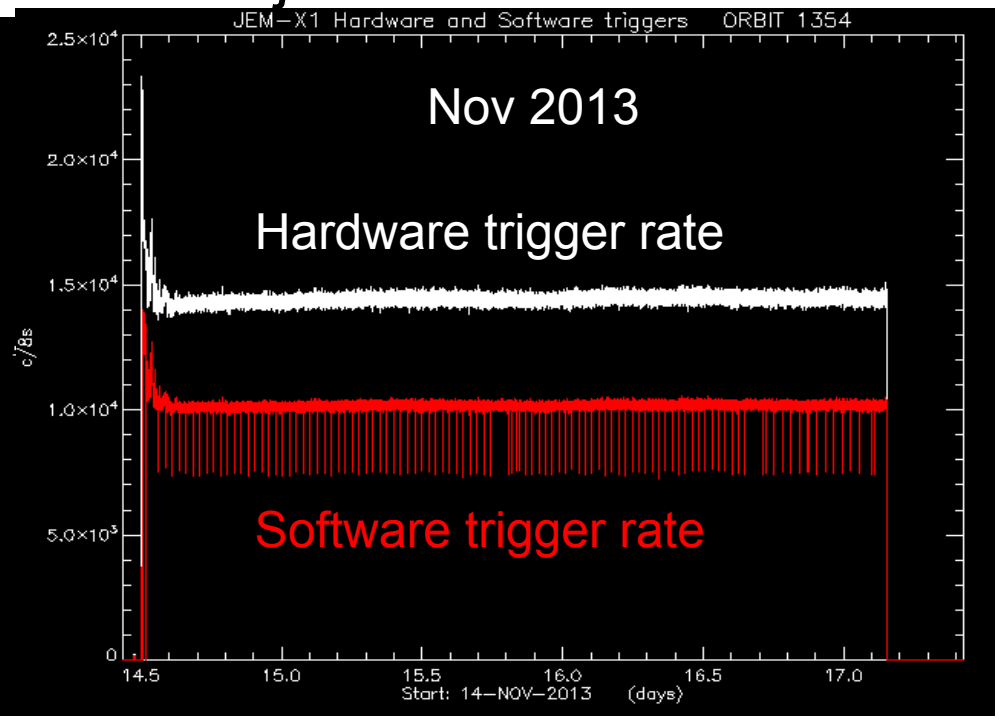
JEM-X particle trigger rate is lowered

- JEM-X HW and SW trigger rate (dominated by particles) is lowered by ~40% since Oct 2010
  - Now ~1800 triggers/sec
- Processing dead time is reduced from ~18% to ~12%
- Background (dominated by CXB, direct + induced Compton) is unchanged, as particle rejection is efficient



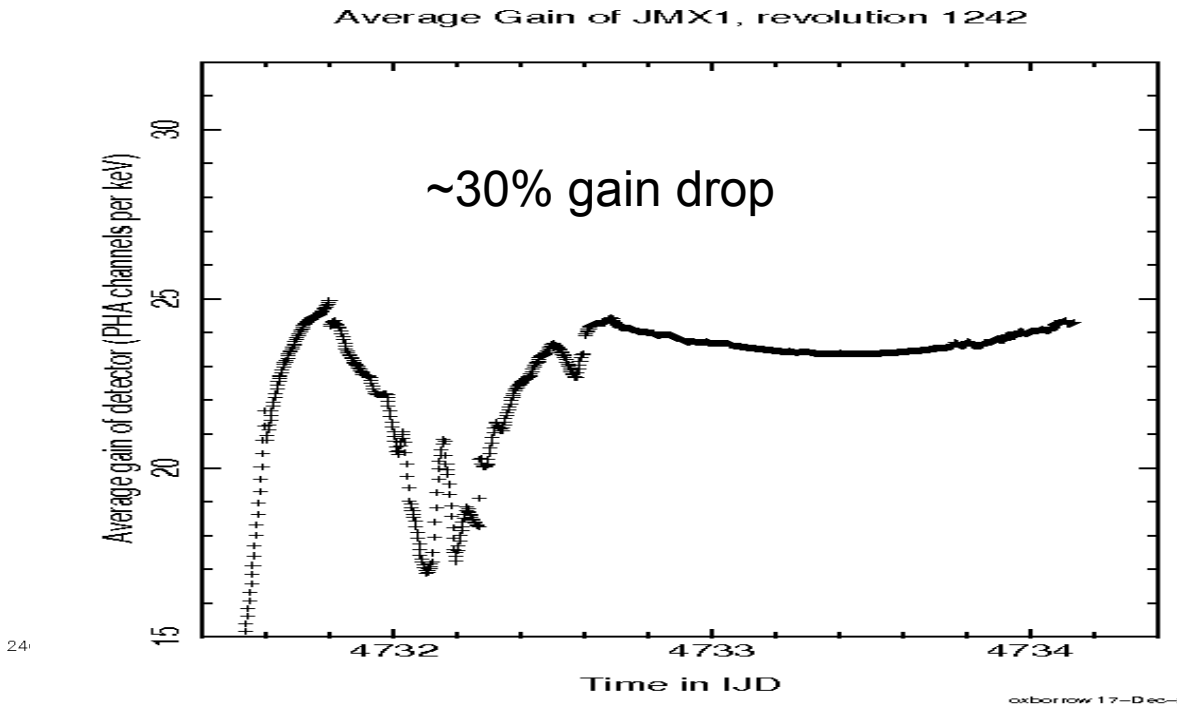


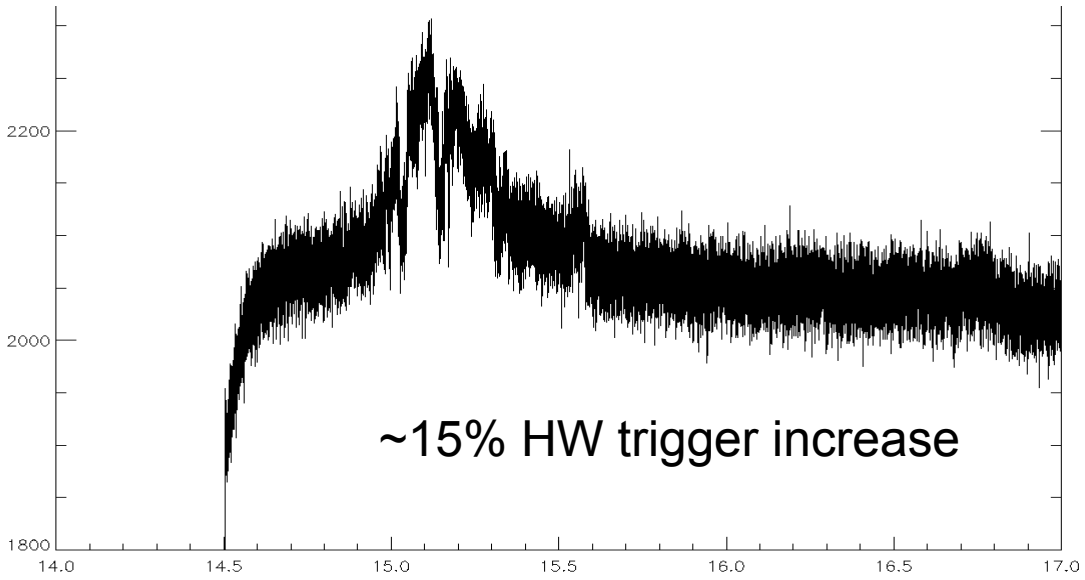
the cosmic ray flux is going down…. slowly.

Some solar events in 2013…

Understanding gain depression events

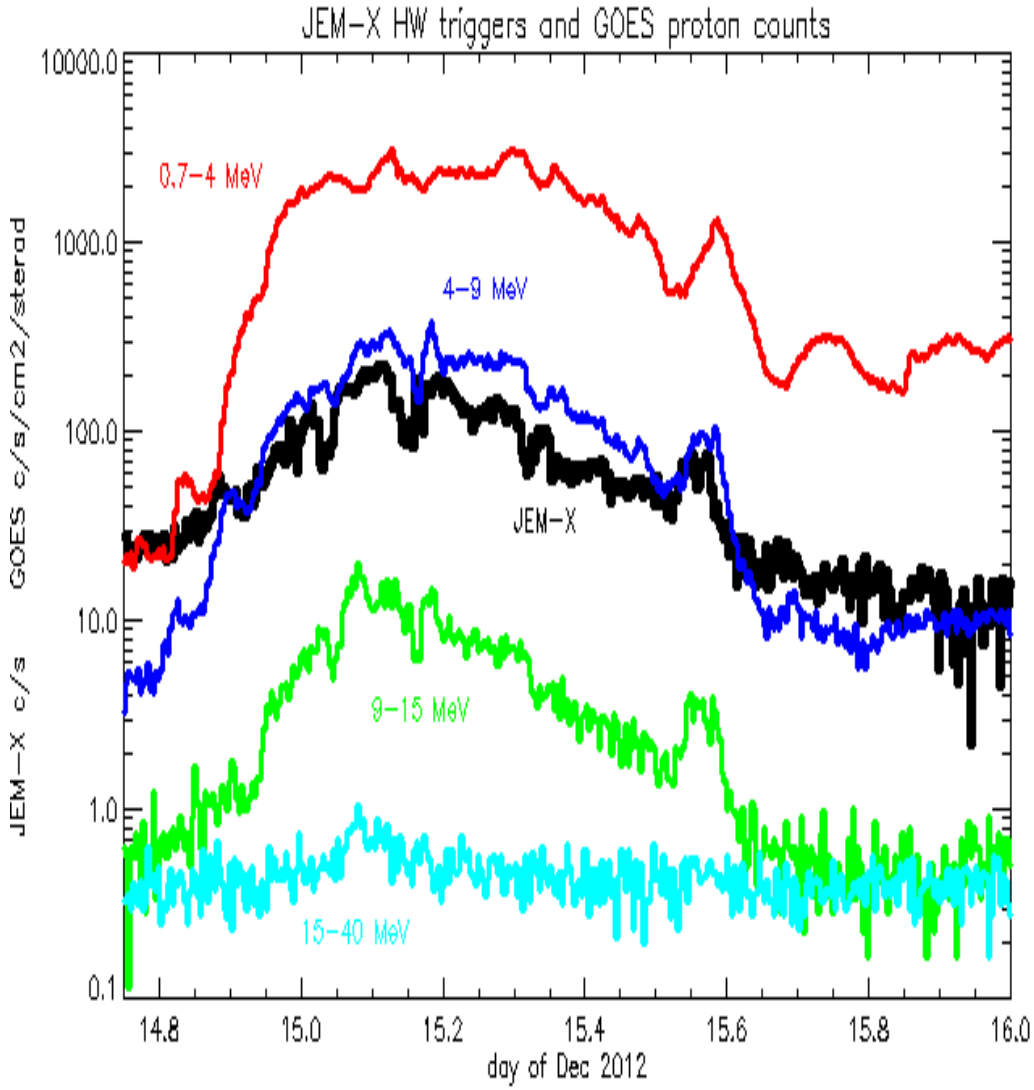
- Example: Solar CME event on Dec 15 2012
- Moderate solar event induced ~30% gain depression in JEM-X
- HW trigger rate increased by ~15%





GOES proton data

- Protons entering through the JEM-X mask
  - FoV 0.01 sterad
  - Area ~100 cm2
  - JEM-X: **~1 cm2 sterad**
- JEM-X excess triggers correlate very well with GOES 4-9 MeV band
- But does it make sense?



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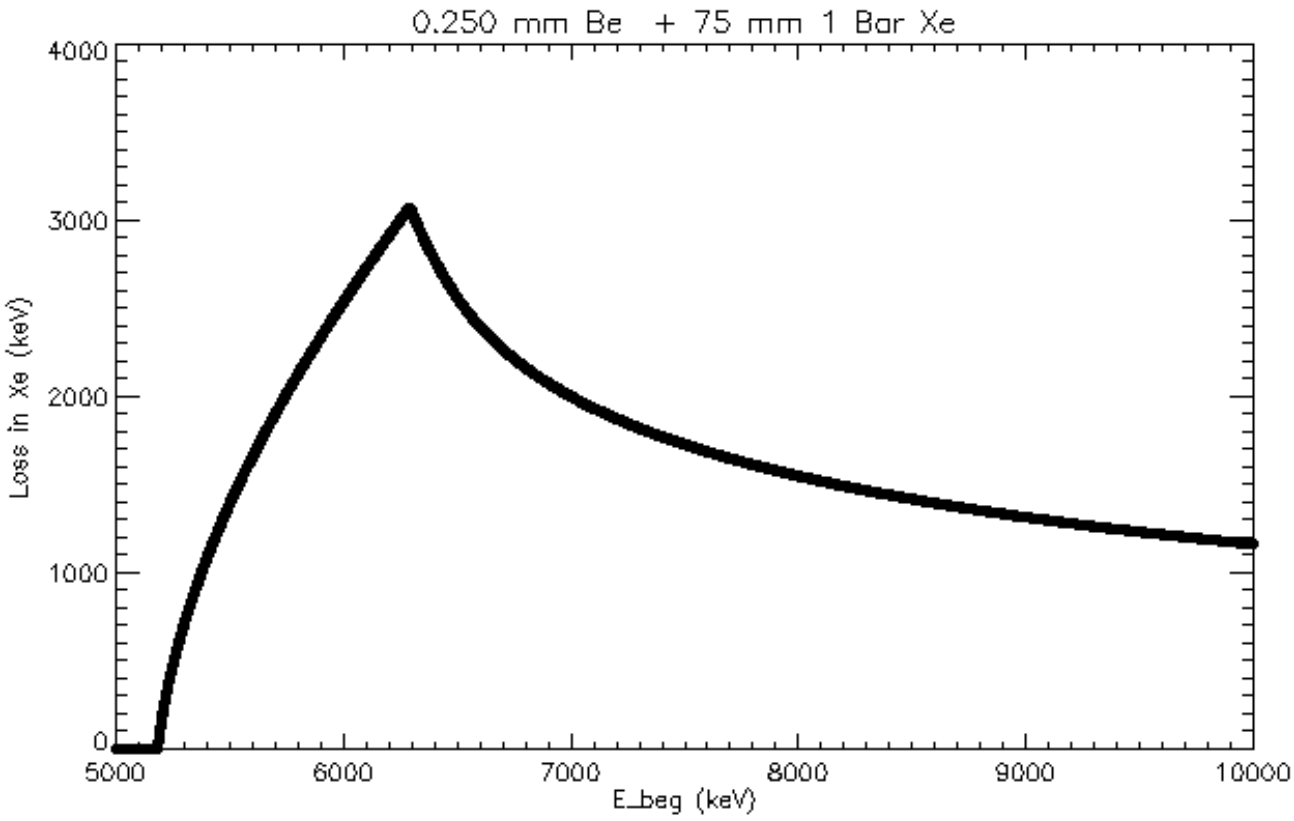
Charge deposition in Xe gas

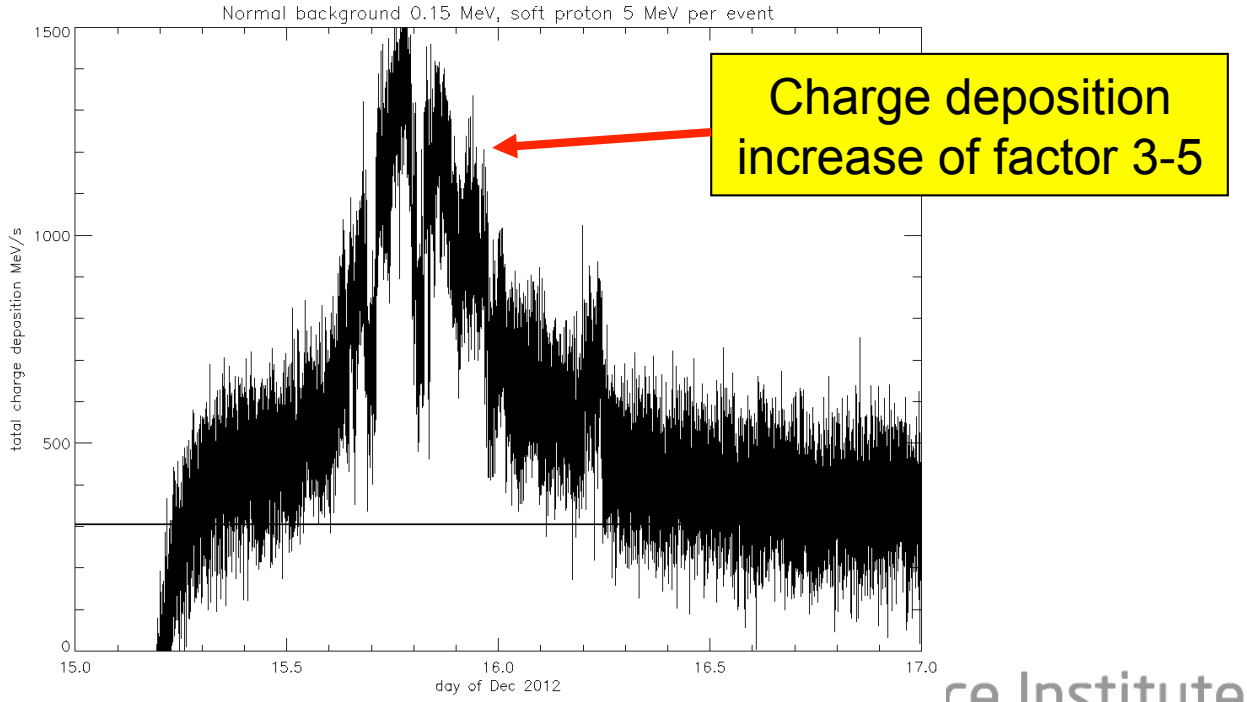
- 250 μm Be window absorbs protons below 5 MeV
- 6 Mev protons can deposit 3 Mev in Xe gas



Charge deposition

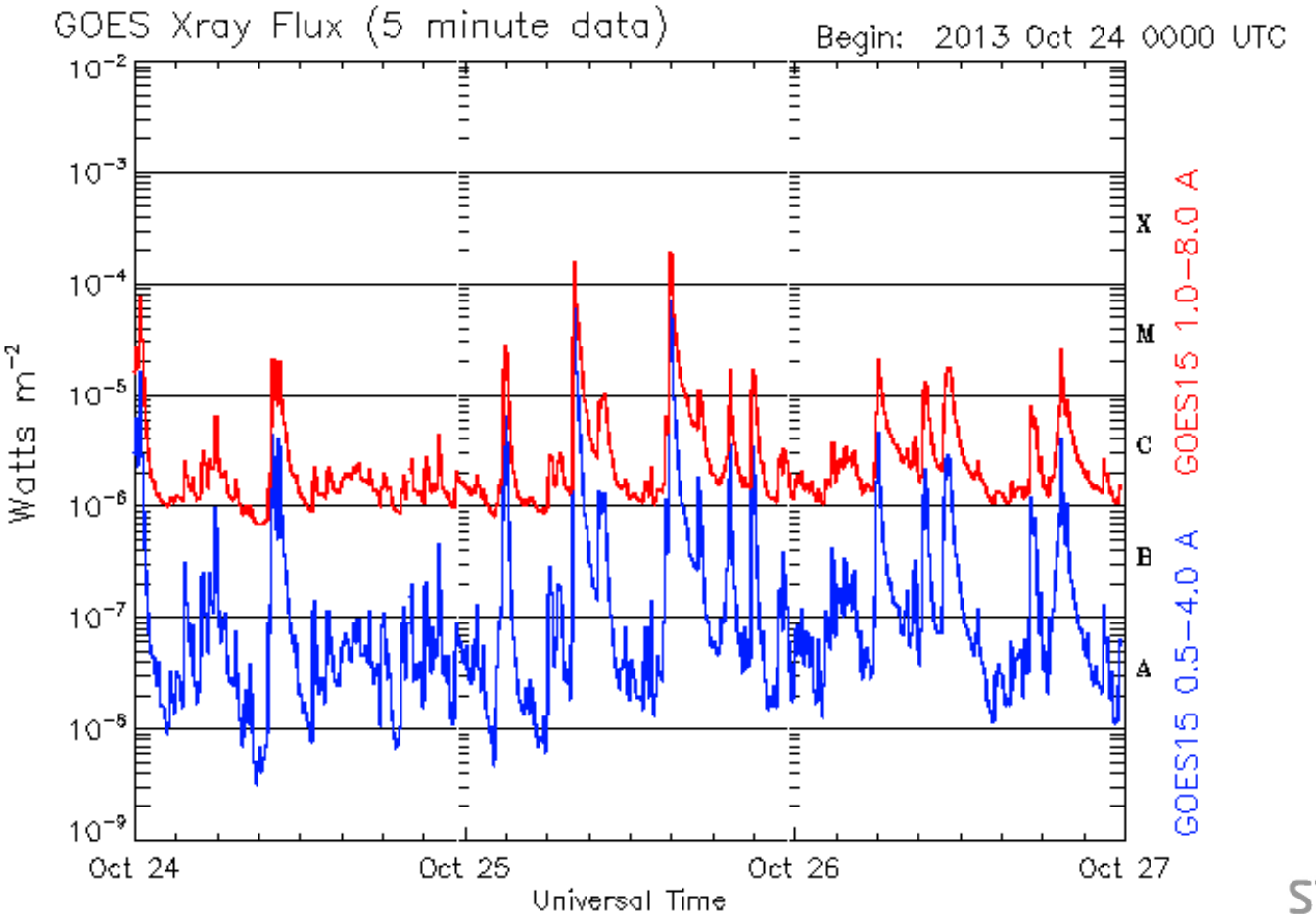
- 5 MeV protons can penetrate the 250 µm Be window
- Each may deposit ~3 MeV in the Xe gas
- Minimum ionizing cosmic ray particles deposits ~150 keV
- Therefore each 4-9 MeV proton results in ~20 times more charge deposition on the glass plate
- Charge load on micro-strip plate is dominated by “soft” protons

Total charge deposition rate MeV/s



Solar X-ray events influencing JEM-X

- 2 very similar X-class X-ray flares on Oct 25 2013 by GOES



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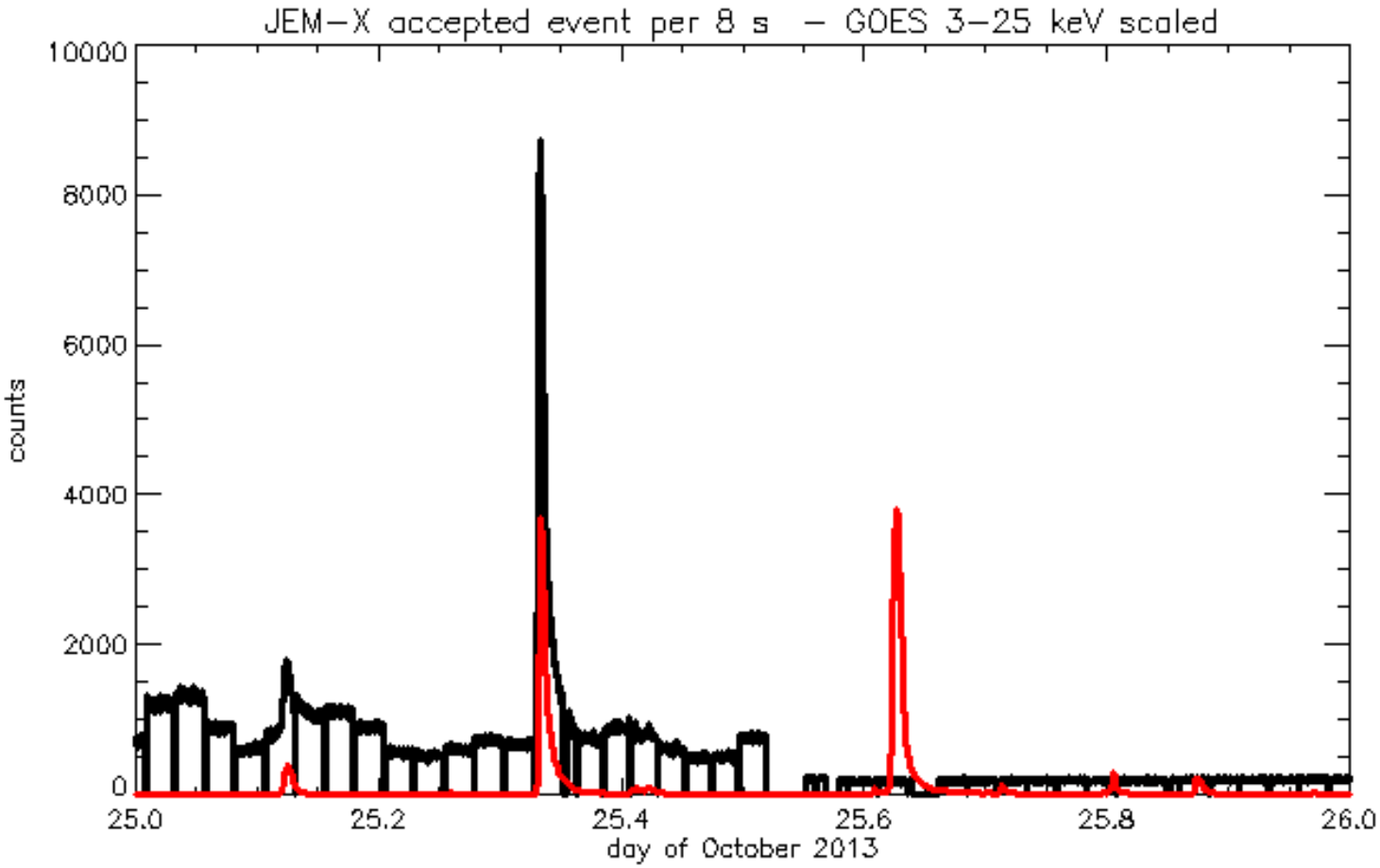
Different response to similar flares

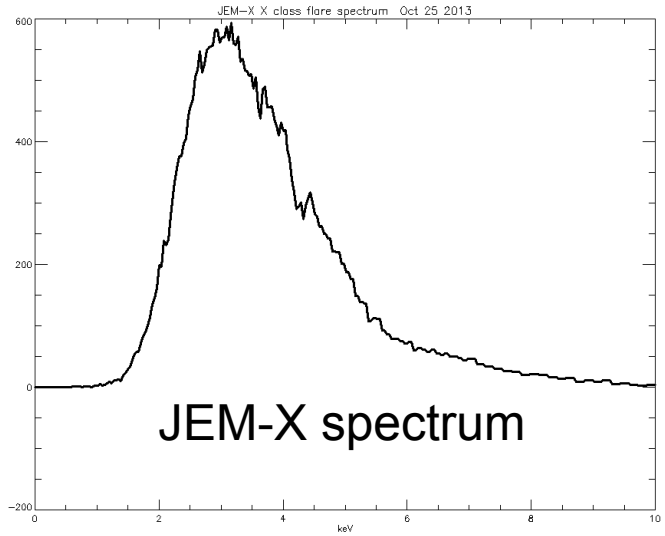
- JEM-X accepted X-ray events (black)
- GOES 3-25 keV Solar X-ray flares (red)



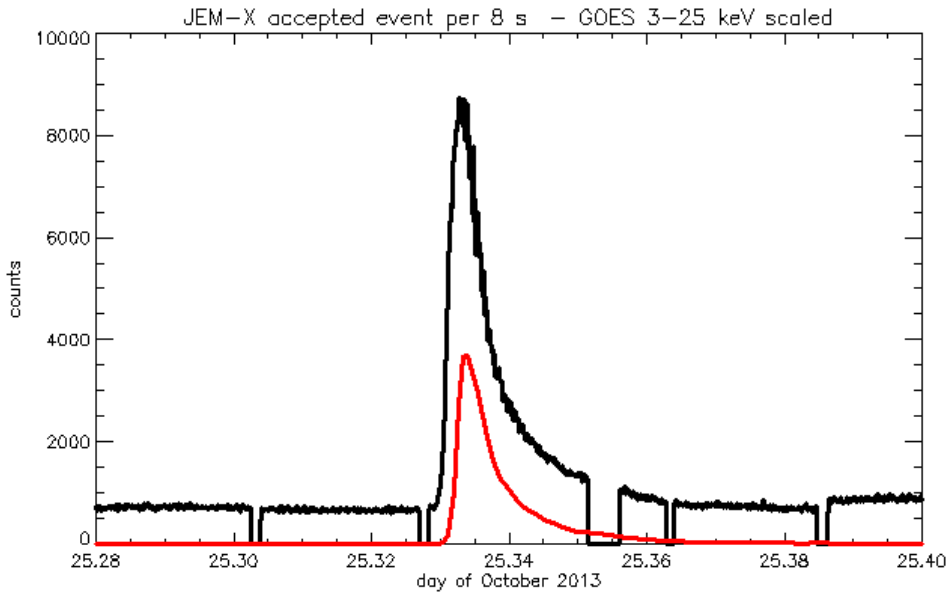
JEM-X,

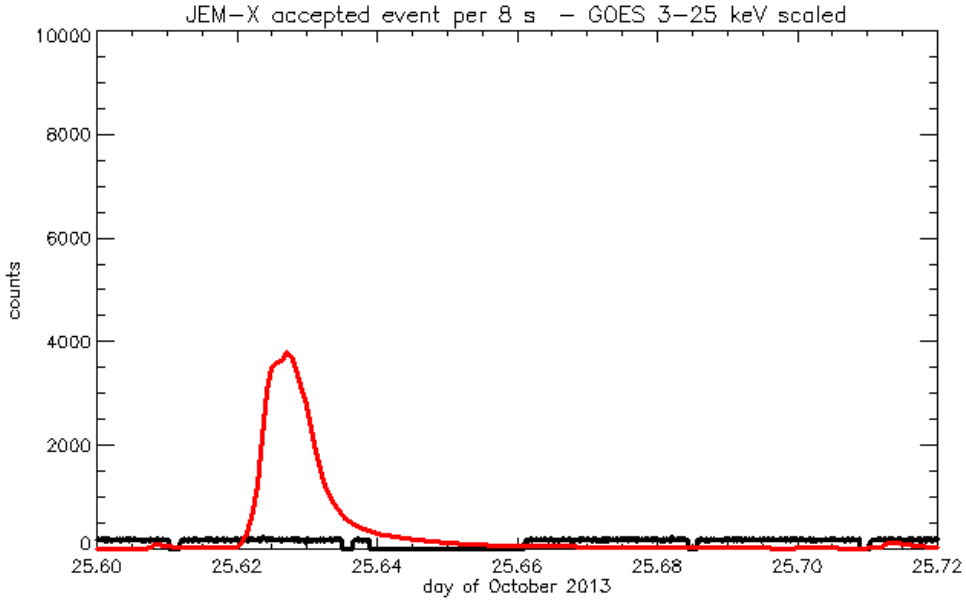
X-ray flare reprocessed photons

- Solar aspect angles 60.3 and 91.4 deg
- First flare illuminates the mask, the second not
- X-ray photons can go through the mask holes and are Compton scattered down into the detector from the C fiber walls(?) or other.



JEM-X spectrum





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
  - Increased TM allocation in 2012 has reduced number of cases with grey filter and thus improved the stability of gain fitting
- Team is still intact – but also busy with other projects
  - Updated LC SW still in the works.
- We expect JEM-X and INTEGRAL to operate in the extension 2015-2016 and beyond
  - Performance is monitored to ensure that running both units will not endanger the future use

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