Technical University of Denmark

JEM-X Status, March 2017

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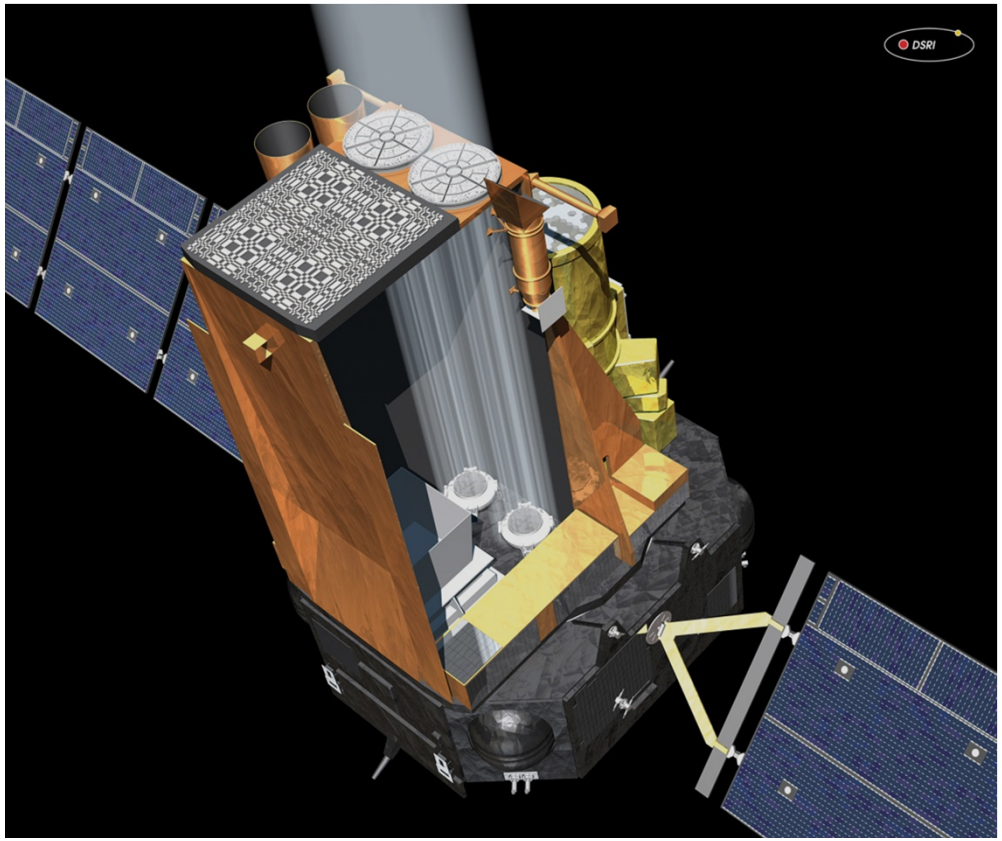

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Anode status

- Was on average ~2-3% loss per year (256 anodes in total), but now << 1% per year

- JEM-X1 (~1350 orbits of use)
  - 63 of 256 anodes affected (~25% of area)
    - 35 dead (4 pre-launch, latest loss in 2011)
    - 12 neighbor
    - 16 unstable or low

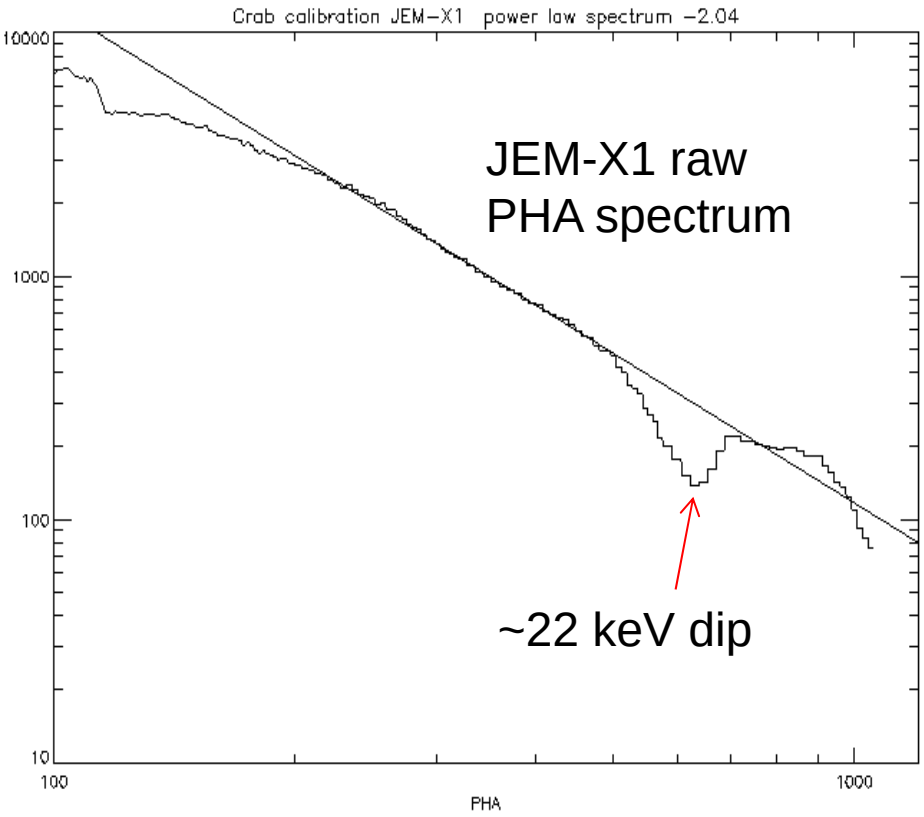
No anode loss in more than 5 years!

- JEM-X2 (~950 orbits of use)
  - 64 of 256 anodes affected (almost 25% of area)
    - 32 dead (9 pre-launch) (latest loss in Aug 2013)
    - 16 neighbor
    - 16 unstable or low

No anode loss in ~4 years!

Update of particle rejection

- During Feb 2014 Crab calibration a spectral dip was observed at PHA ~ 600, ~22 keV in JEM-X1
- Gain was very high
- Change in “fast” amplifier response used in “ratio” criteria for particle rejection was identified as the cause
  - Some X-rays were rejected as particles
- Particle rejection parameter update was prepared (OCRs 354-355)
- Implemented in Crab calibration Oct 2014 (rev 1461)
  - Data with old and new parameters were acquired to allow forward and backward valid response files



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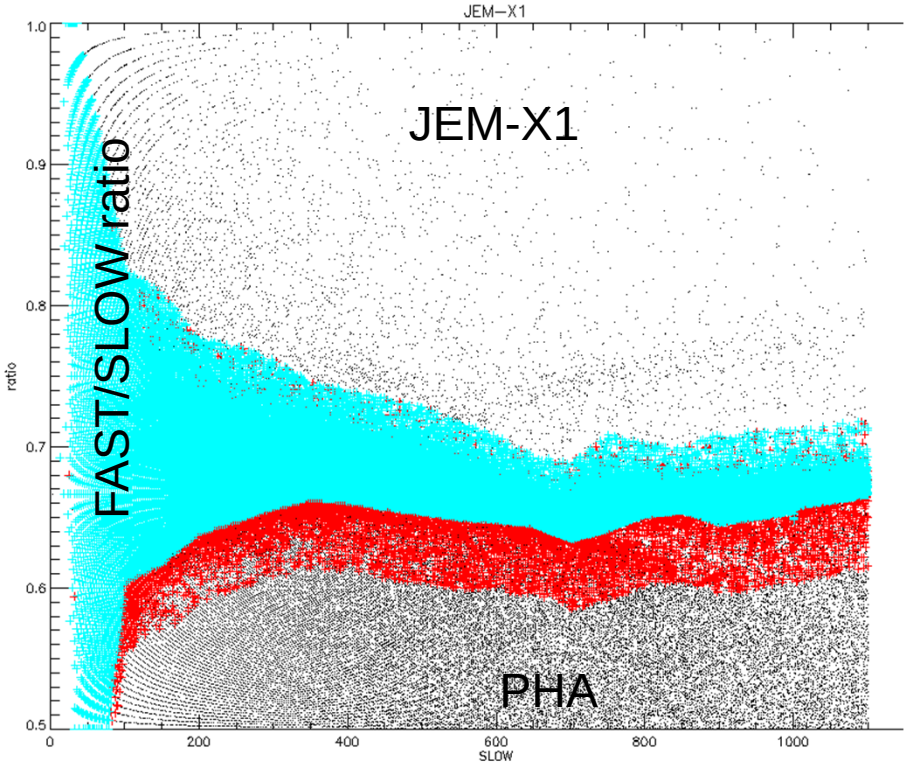
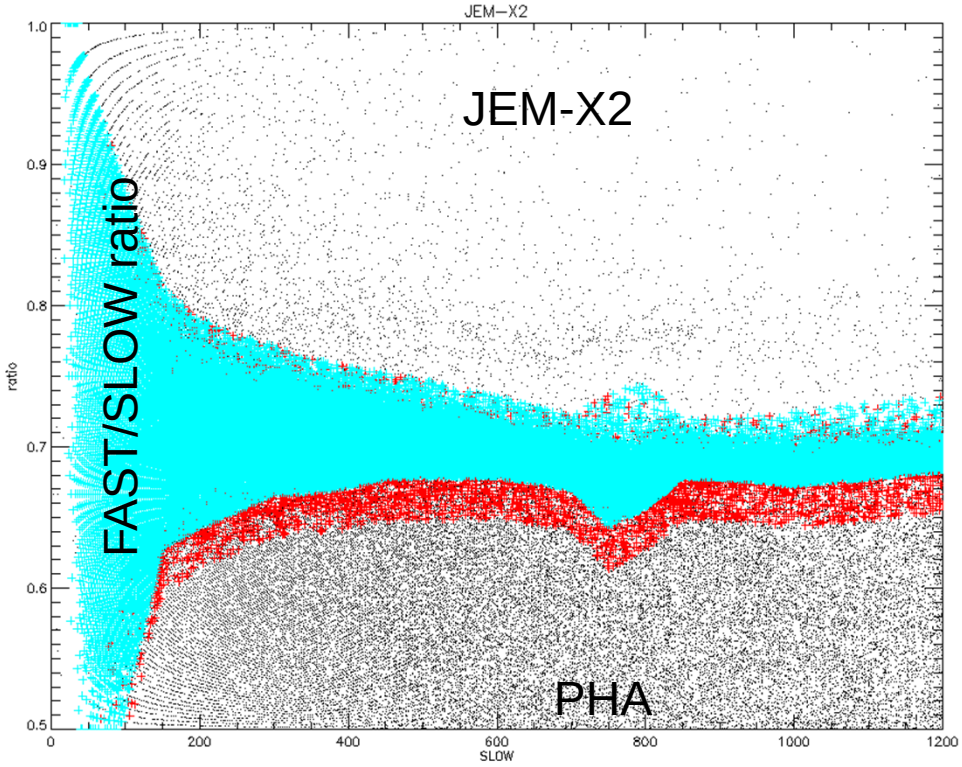
“Opening” of JEM-X ratio rejection

- The band accepted events has been widened to avoid throwing out good events
- The price: slightly increased background
- The prize: better and more even response





Gain evolution

- JEM-X1 DV setting was lowered 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, DV=66 (660V) in rev 1257**, in rev 1397, Mar 24 2014 DV=65 (660 V)**

- 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=70 in rev. 1010, to DV=69 in rev. 1089, DV=68 (~680V) in rev 1183, DV=67 (670V) in rev 1257**, in rev 1397, Mar 24 2014 DV=66 (660 V)**

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

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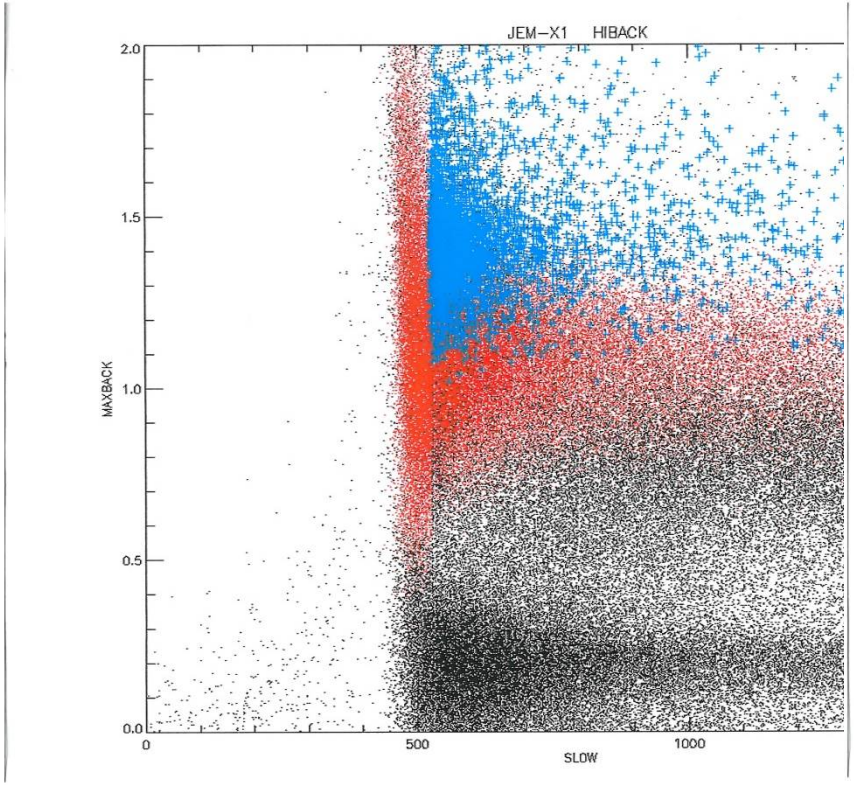
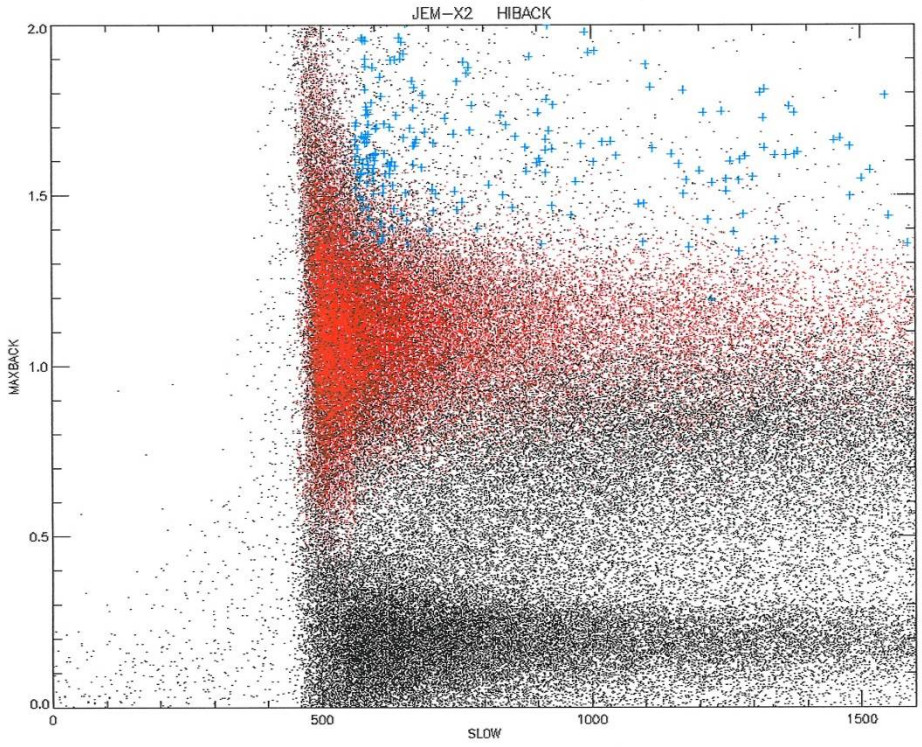
JEM-X Gain Calibration in OSA

- 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

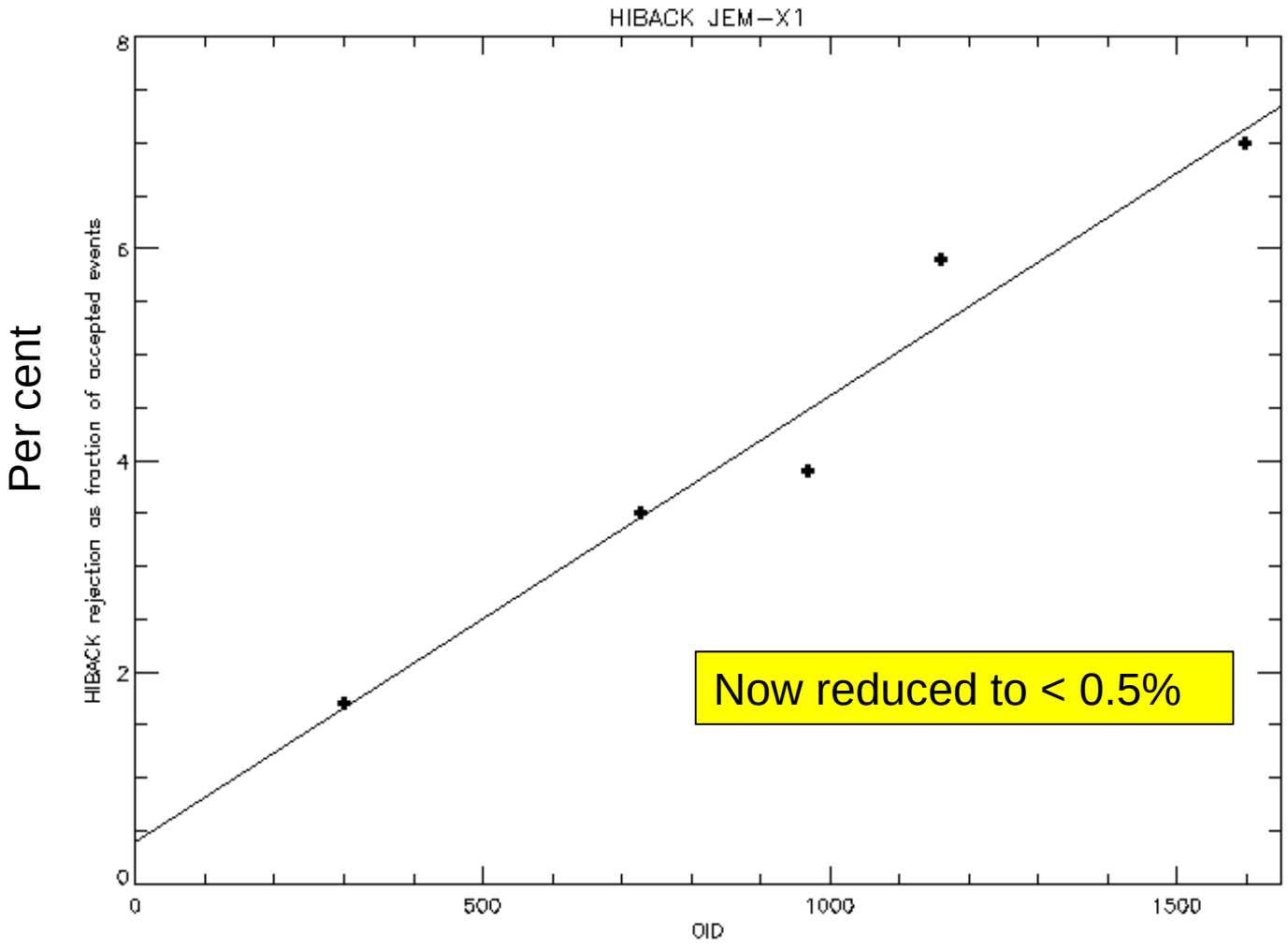
High Back Plane signal rejection

- JEM-X1 has shown an increasing trend
- Analysis of increased count rates during Crab observations indicates loss of 6-8% of events
- No problem in JEM-X2 (criteria more “open”)



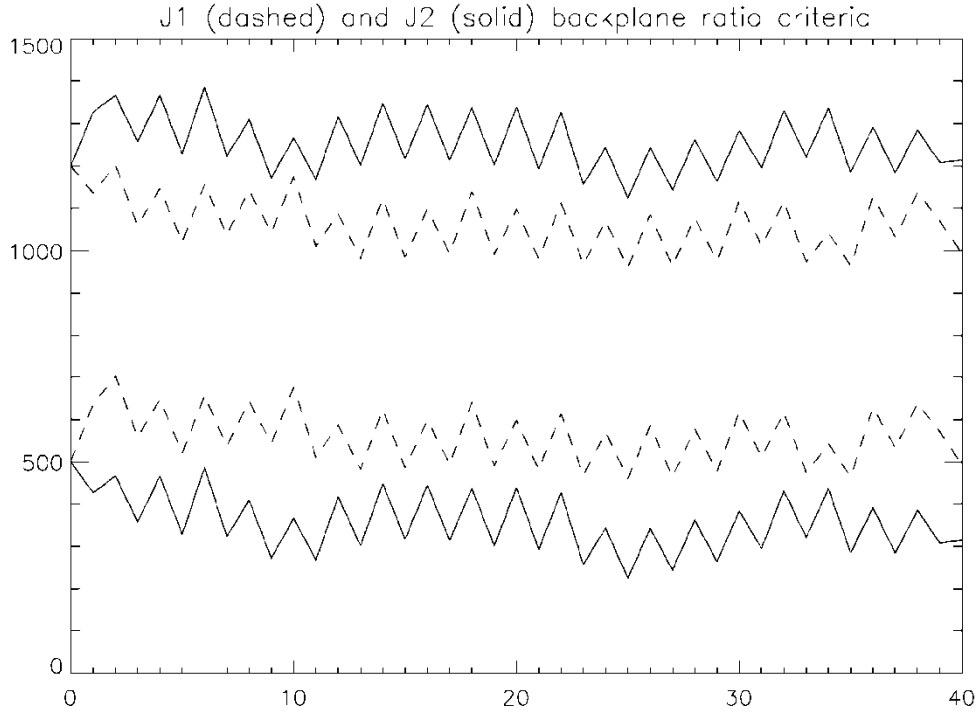


JEM-X1 Upper Back rejection trend



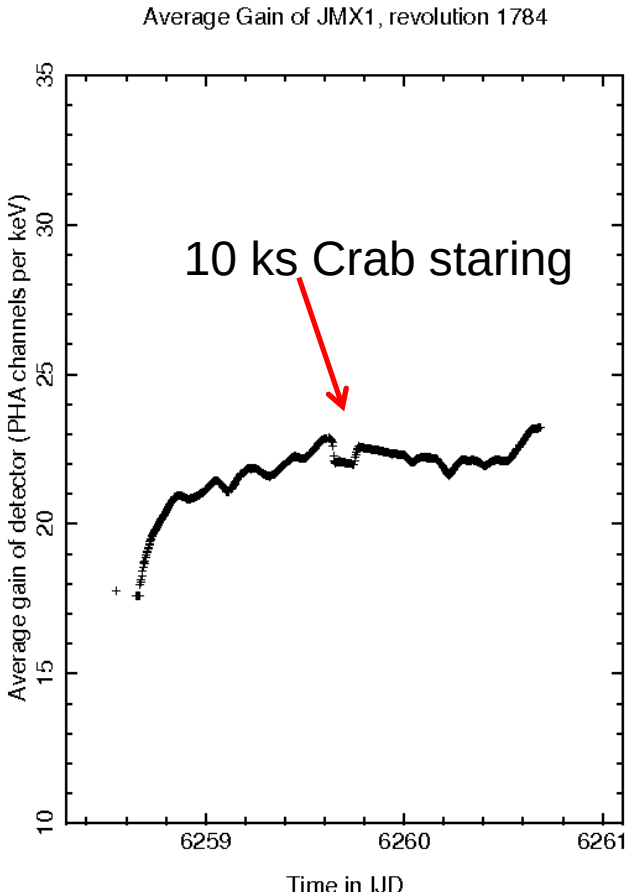
Back plane rejection criteria

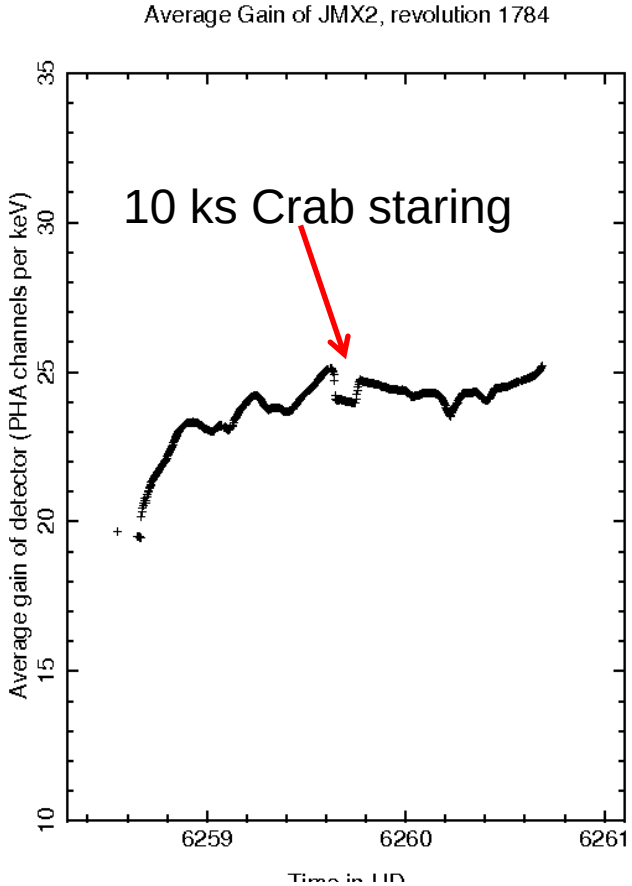
- OCR 375 adjusted the JEM-X1 parameters in April 2016, 1667 (setting the upper limit to 1500)
- Different settings in JEM-X1 and JEM-X2 (for “unknown” reasons)
- Ratio between back plane and anode signal may change over time due to the change of the electrical properties of the glass substrate
- About 6% increase in the count rate from the Crab



JEM-X gain suppression

- At higher count rates we see a lower gain
- Caused by lower conductivity of glass plate





Conclusion

- JEM-X is running smoothly (with various signs of age)
- No anode loss for several years
- Gain evolution is slowing down (no HV reduction since March 2014)
- Gain fitting is becoming more challenging, as calibration sources decay and temperature dependence increases
- Amplifier response evolution is monitored
- Back plane rejection criteria was updated in JEM-X1, April 2016
- Running both JEM-X1 and JEM-X2 was implemented in Oct 2010, as sufficient telemetry became available
  - Improved statistics and reduction of imaging systematics
  - Increased TM allocation in 2012 has reduced number of cases with grey filter and thus improved the stability of gain fitting
- Instrument Team is still intact – but also busy with other projects
  - Niels Lund, Carl Budtz-Jørgensen, Niels Jørgen Westergaard, Ib Lundgaard Rasmussen have emeritus status
- We expect JEM-X and to operate smoothly in the extensions 2017-2018 (and beyond… maybe not all the way to 2029 ☺)
  - Performance is monitored to ensure that running both units will not endanger the future use