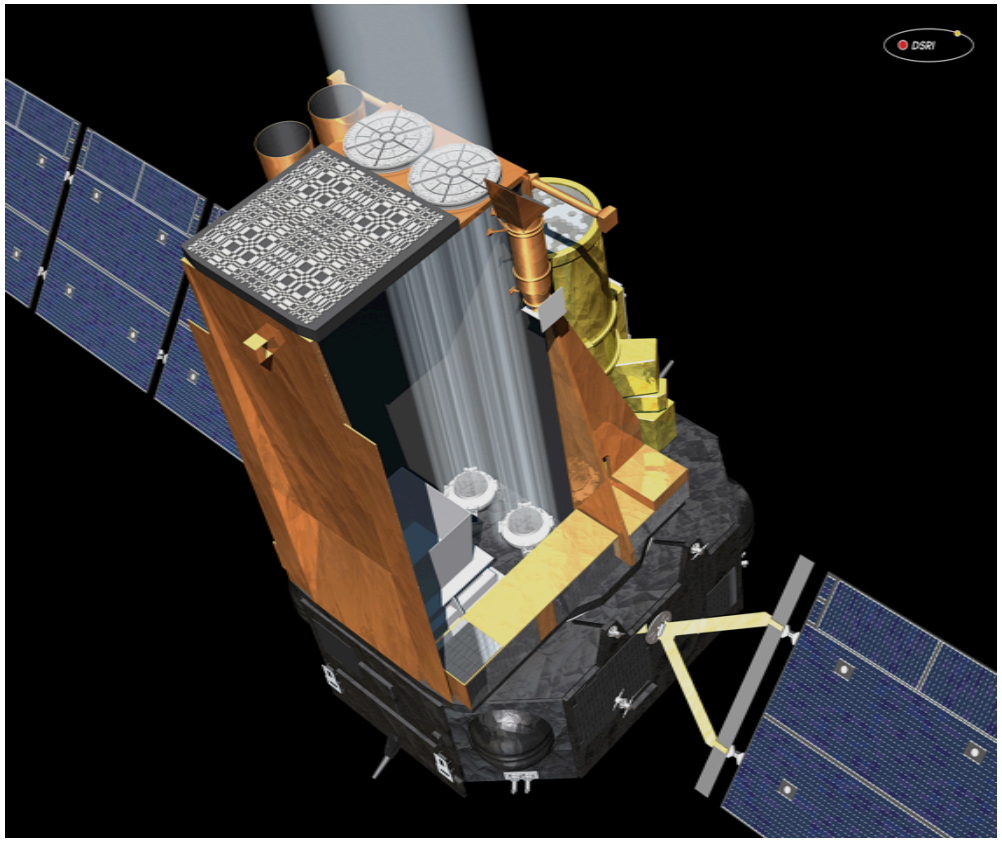
Technical University of Denmark

JEM-X Status, March 2011

Søren Brandt



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Action Items

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AI IOCG/03-01: JEM-X eclipse anomaly

- CRC failure after eclipse power off
  - DPE stores DFEE code segment CRC before eclipse, compares after eclipse recovery
  - DPE stops (sometimes) in memory mode, sends OEM of recovery failure (which may not be seen during perigee)
- It has been found that recovery is indeed correct by requesting and verifying CRC value
  - Why compare fails is still unknown
- However, new procedure implemented: request CRC and proceed with recovery – no power cycle
  - notify PI if the OEM was not seen, to check science data, as recovery could have failed due to a real error
- AI of “less impact procedure” can be closed

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JEM-X Status

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IOCG Meeting, ESOC, March 25 2011

We survived the first 1000 revolutions!

Both JEM-X units new default configuration

- JEM-X1 was used from rev. 170-855 and has now been used for ~750 revolutions (~6 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 ~350 revolutions
- Both units have been used for all Crab calibrations
- Both units were used during SPI annealing, as TM allocation allowed
- S/N ratio improved by ~sqrt(2) with both units

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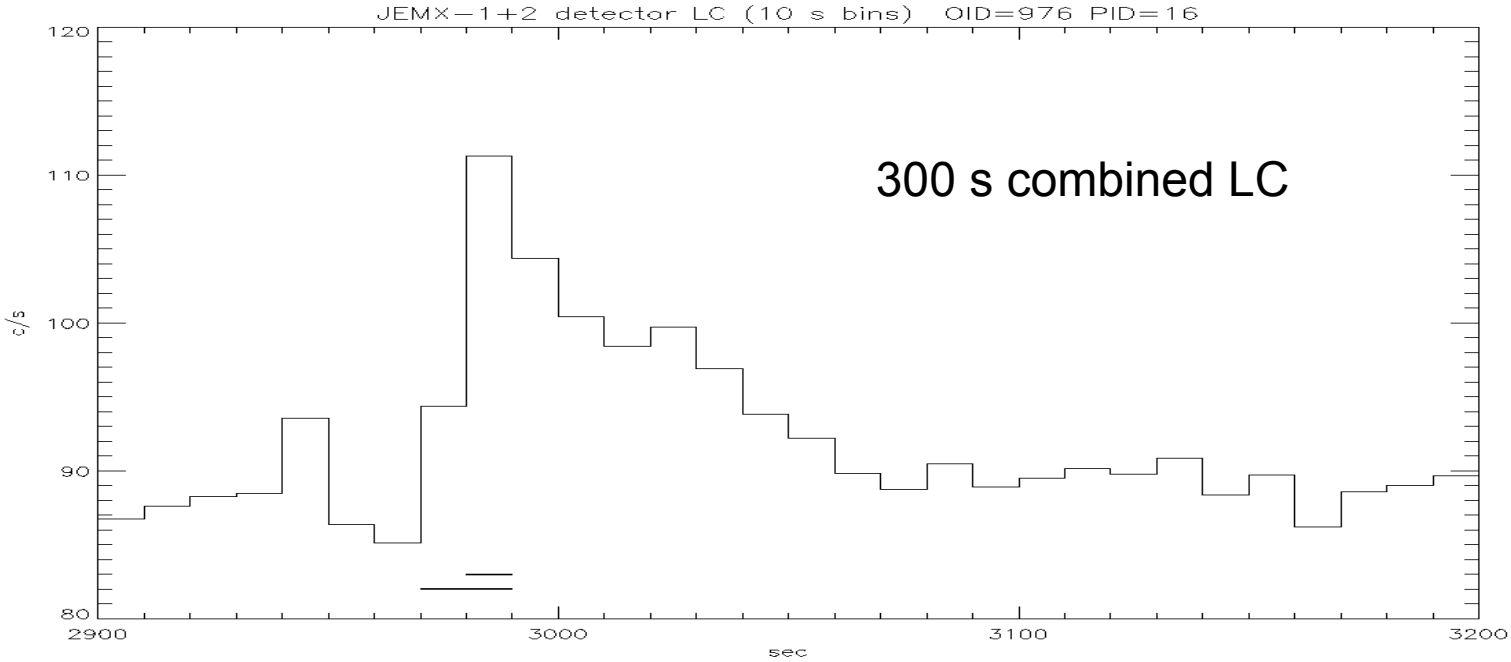
Example, both units:Transient in Terzan 5

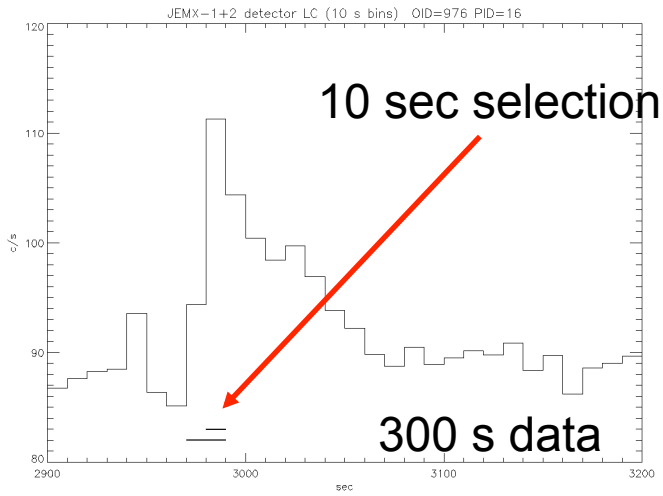
IGR J17480-2446

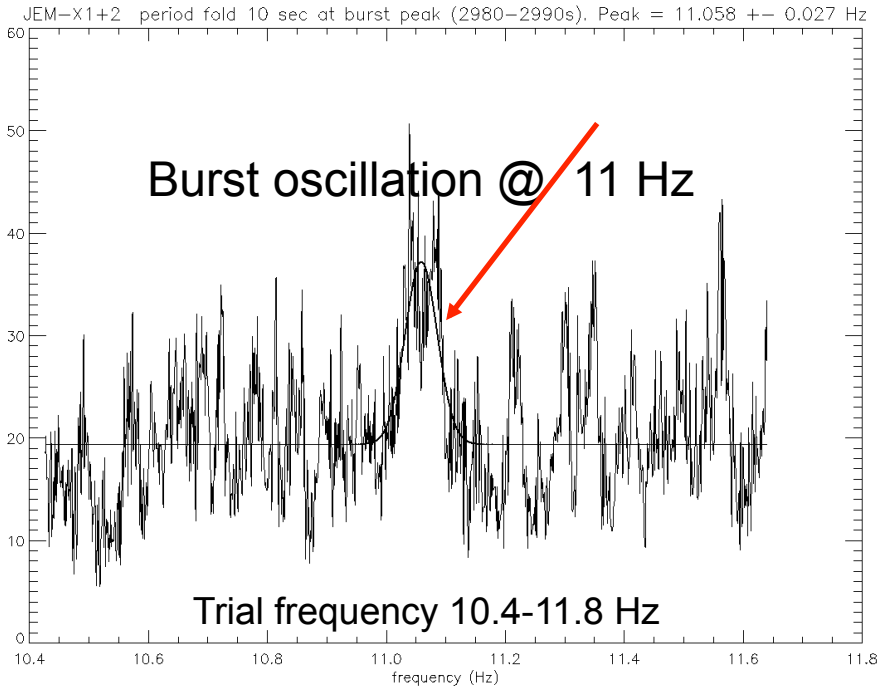
- **"A hard X-ray transient in the direction of Terzan 5 detected by INTEGRAL", ATEL#2919**, Bordas et al. Oct 10, 2010
  - **Rev. 976, first orbit with both JEM-X units on as default**
- Followed up by 15 other ATELs 2920, 2922, 2924, 2929, 2932, 2933, 2935, 2937, 2939, 2940, 2946, 2952, 2958, 2974, 3000, 3044)
- Long discussions on issue if this source is EXO 1745-248, elclipse? Etc.
- Type I X-ray burst discovered by JEM-X on Oct 11 (ATEL 2924)
  - Both JEM-X units were active, adding to statistics



IGR J17480-2446 cont.

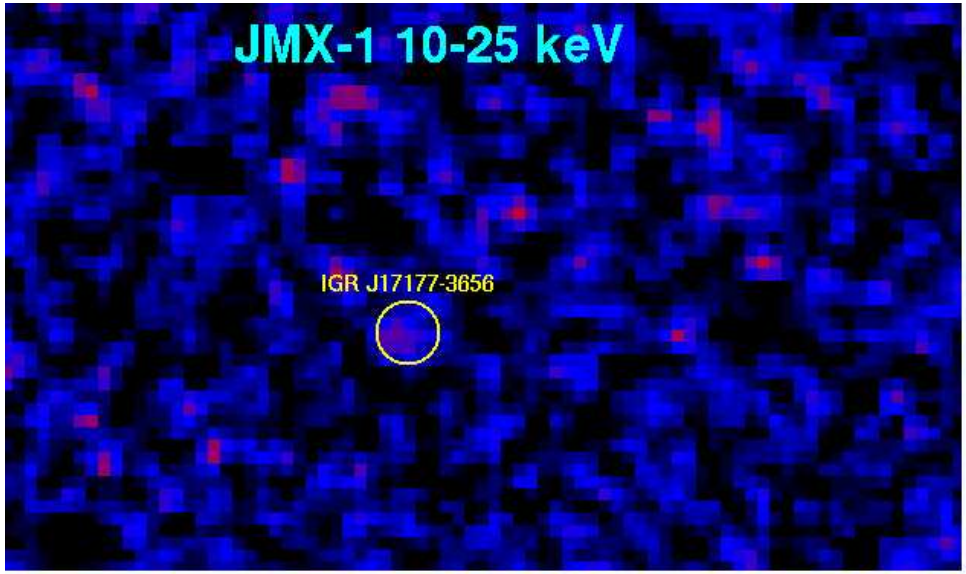
- Shown by XTE to be 11 Hz pulsar
  - Slowest spinning bursting neutron star
- Most X-ray burst neutron star systems do not show pulsations
- Neutron star spin period only revealed very briefly during burs
- Observed by JEM-X

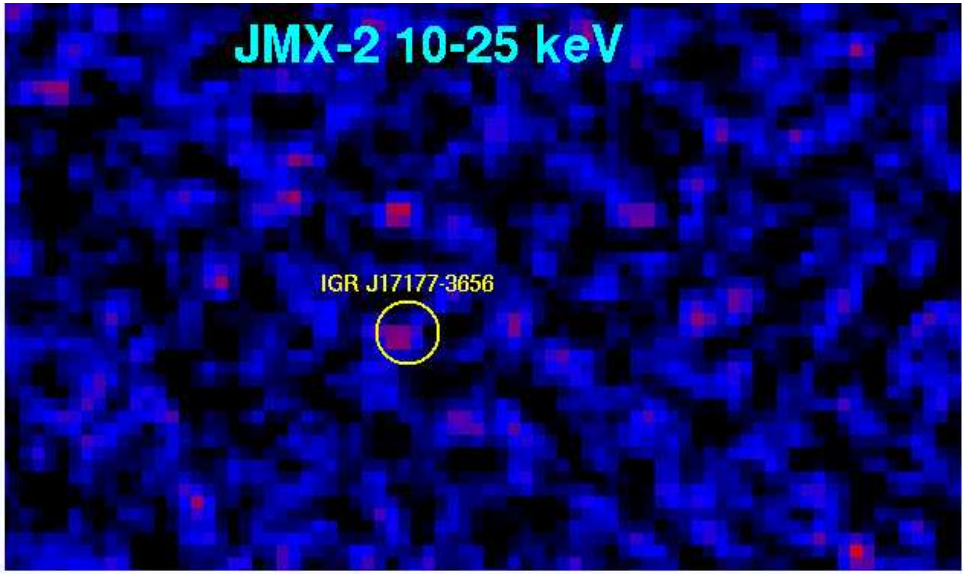


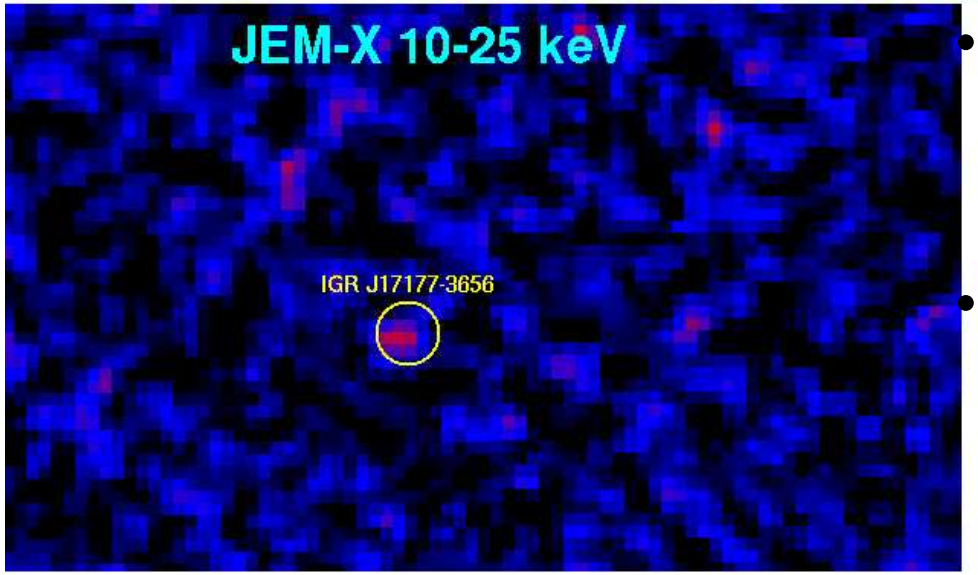


2011

ATEL #3223, March 16, 2011: INTEGRAL discovery of a new hard X-ray transient: IGR J17177-3656







- Source detected at ~3σ in mosaic of both JEM-X units (8+-3 mCrab in 10-25 keV band)
- ISGRI detected the source at higher significance, so the source position was known: i.e. only 1 trial, thefore 3σ is ok

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)
    - Anomaly was seen in JEM-X2 in 1022, but reboot was performed (less experienced operator and other factors)

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 March 2009, one in Aug 2010
- JEM-X1 (~750 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)
    - 13 neighbor
    - 11 unstable or low
- JEM-X2 (~350 orbits of use)
  - 60 of 256 anodes affected (almost 25% of area)
    - 31 dead (9 pre-launch) (+2 since Oct 2009)
    - 18 neighbor
    - 11 unstable or low (+3 since Oct 2009)

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Gain evolution

- JEM-X1 DV setting was lowered in orbit 978 to DV=70 (~700 V) and further i orbit 1010 to DV=69 (690 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% per degree
- JEM-X2 DV setting is was lowered to DV=71 in rev. 967 and to DV=70 in orbit 1010
- Gain evolution is caused by ion conducting glass substrate of the micro-strip plate

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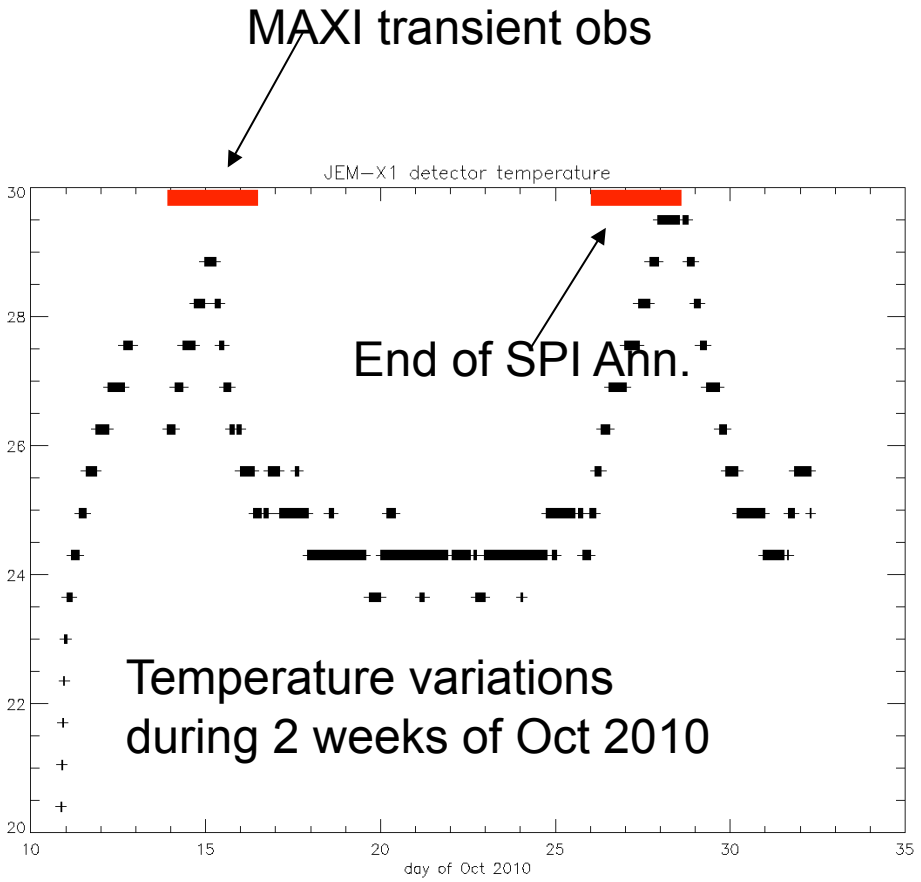
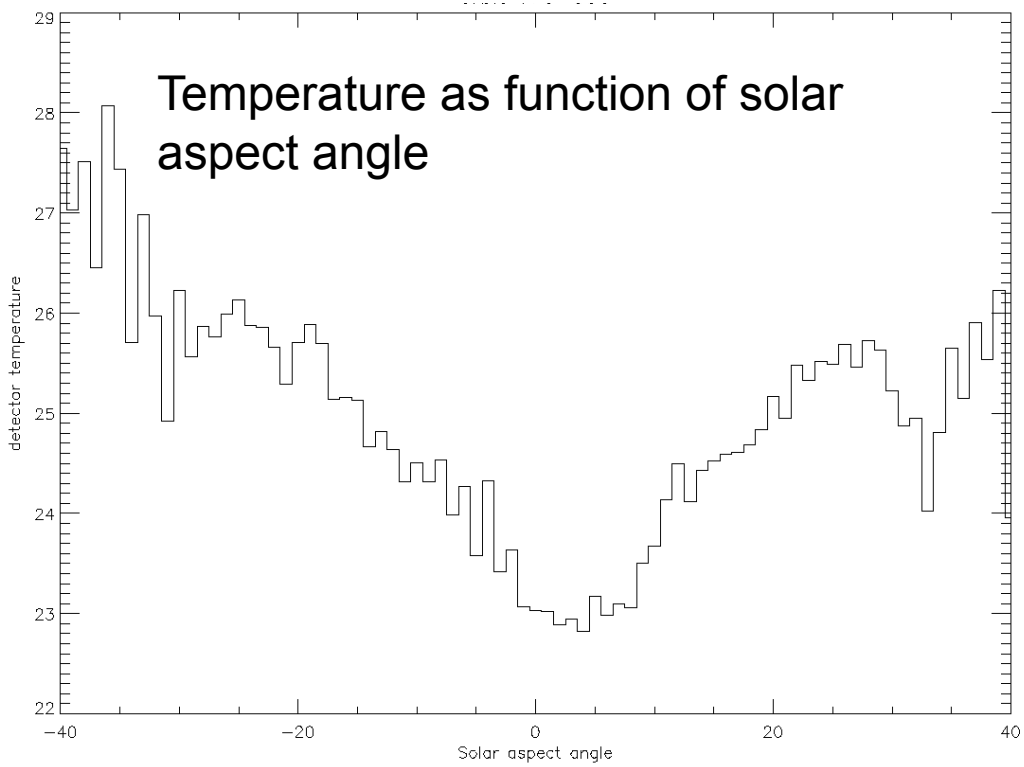
Gain dependence on temperature

- Gain varies as function of temperature
  - ~1%/°C pre-launch
  - JEM-X1 now: ~4%/°C
  - JEM-X2 now: ~2.5%/°C
- ~5°C amplitude
  - 20% gain variation



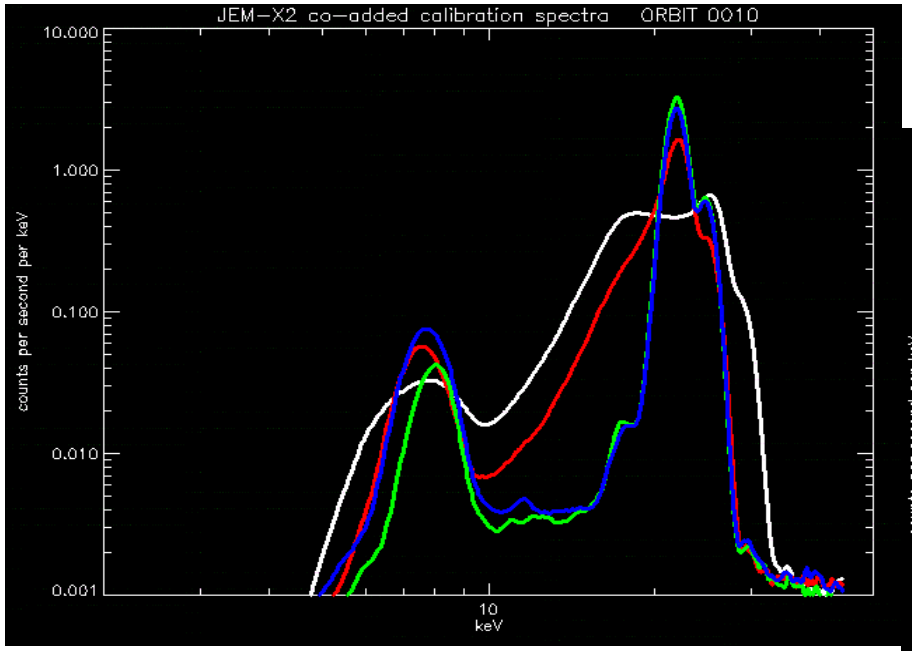
Detector temperature variation

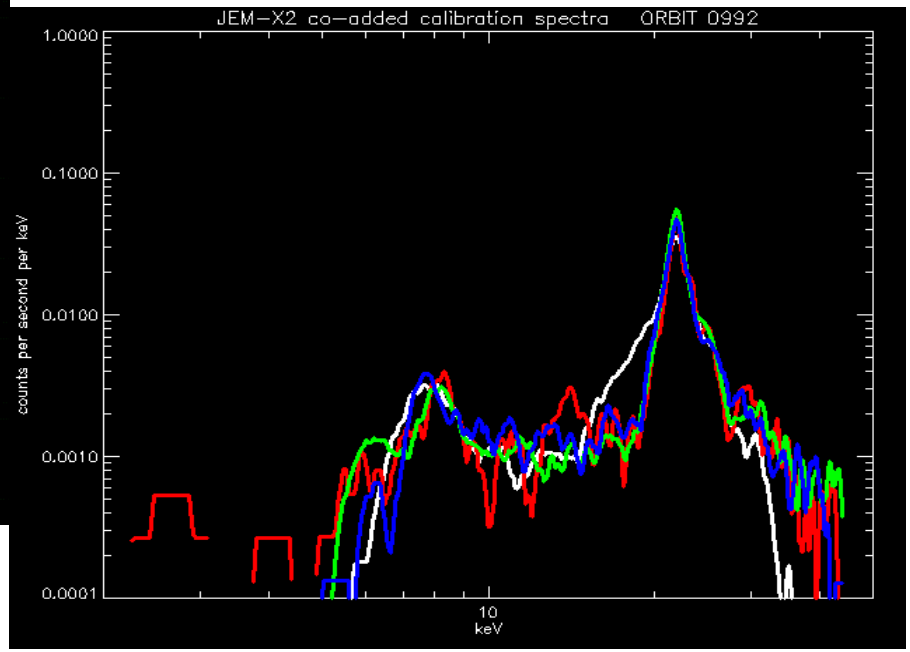
- The JEM-X detector temperature depends on the solar aspect angle
  - +5° to +3° when toward and away from Sun



JEM-X2 calibration spectra (rev. 10 and 992)

- JEM-X2 has 4 Cd sources, which are down by a factor of ~90 since launch
- Calibration spectra integrated over longer time to fit the line
- Xe fluorescent line from detector gas at 29.6 keV also used





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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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 (Silvia Martinez, UA, re-joined!)
- We expect JEM-X and INTEGRAL to operate through 2014 (and longer?)
  - Performance is monitored to ensure that running both units will not endanger the future use

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