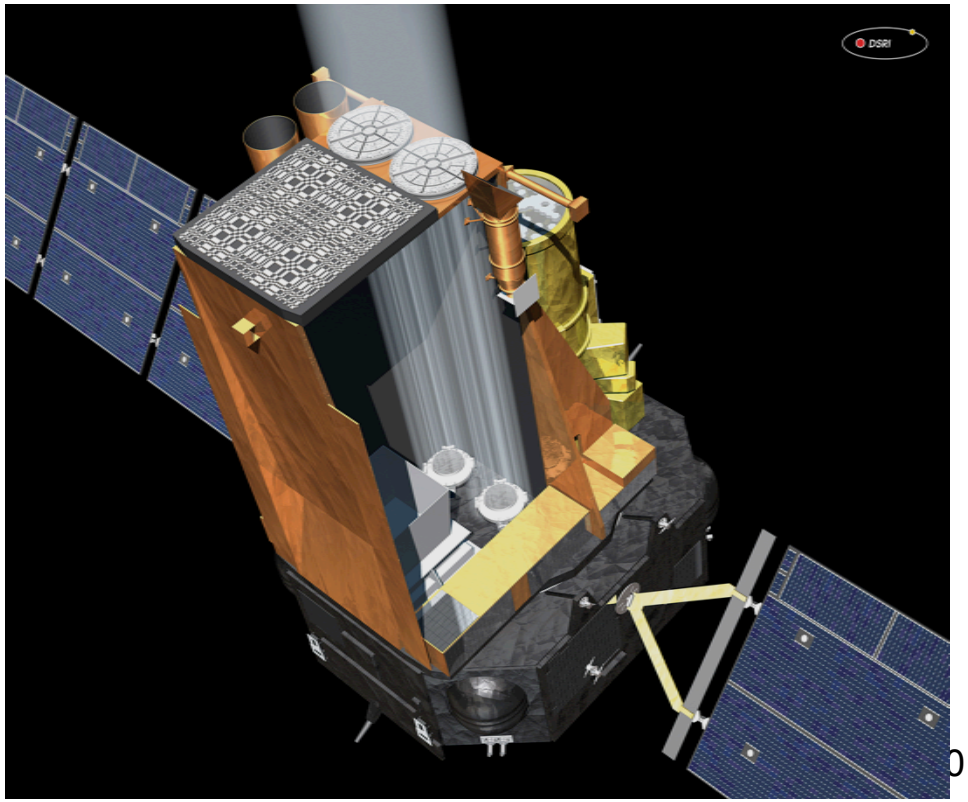
Technical University of Denmark

DTU

# JEM-X Status, February 2010

Søren Brandt



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# Anomaly after eclipse

- The JEM-X DPE sometimes stops in “memory” mode during/after recovery of the DFEE following eclipse
  - (92, 205, 206, 262, 316, 359, 376, 492, 554, 616, 725, 727, 728, 846, 849)
  - CRC of selected DFEE memory areas are stored in the DPE before eclipse, and compared after recovery
- Dump of CRCs was done in 849 after failure – values were as expected
  - In principle this indicates that all is OK → no power cycle needed!

# Background: JEM-X particle trigger rate

- New solar cycle has started, and solar activity has picked up in 2010
  - Sharp(?) decline seen over the past month
  - But no serious decline in particle background yet (about 5% of maximum)
  - “False” maximum seen in the particle rate at the end of 2007
  - (Note that the particle rate is **not** the background rate in JEM-X science data, as 99.9% of particles are rejected by the onboard SW)
- Main effect of high particle rate is the increased (from ~12% to ~22%) dead time, as the onboard processor is very busy rejecting particles (3000+ vs. 30 photons per sec)



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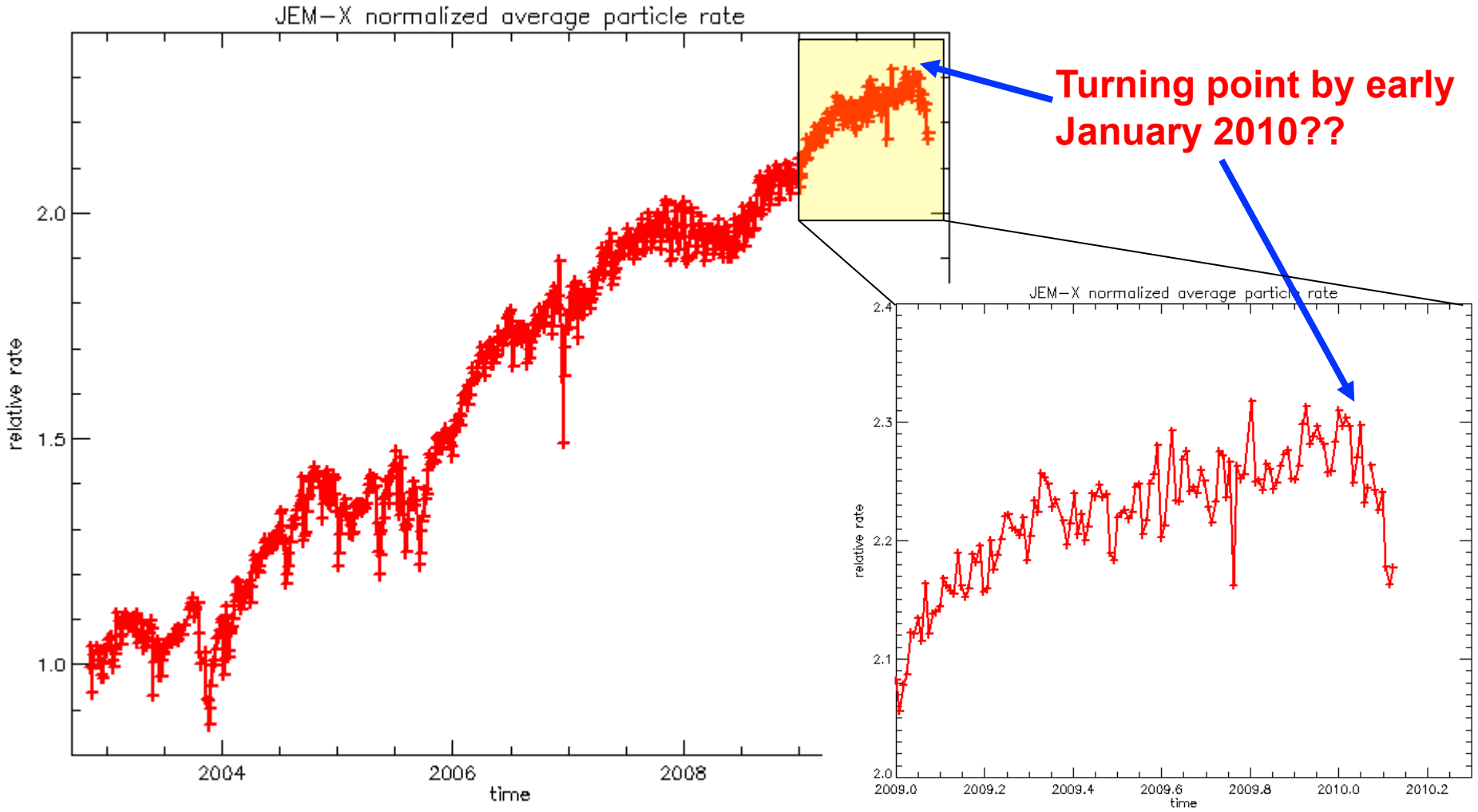
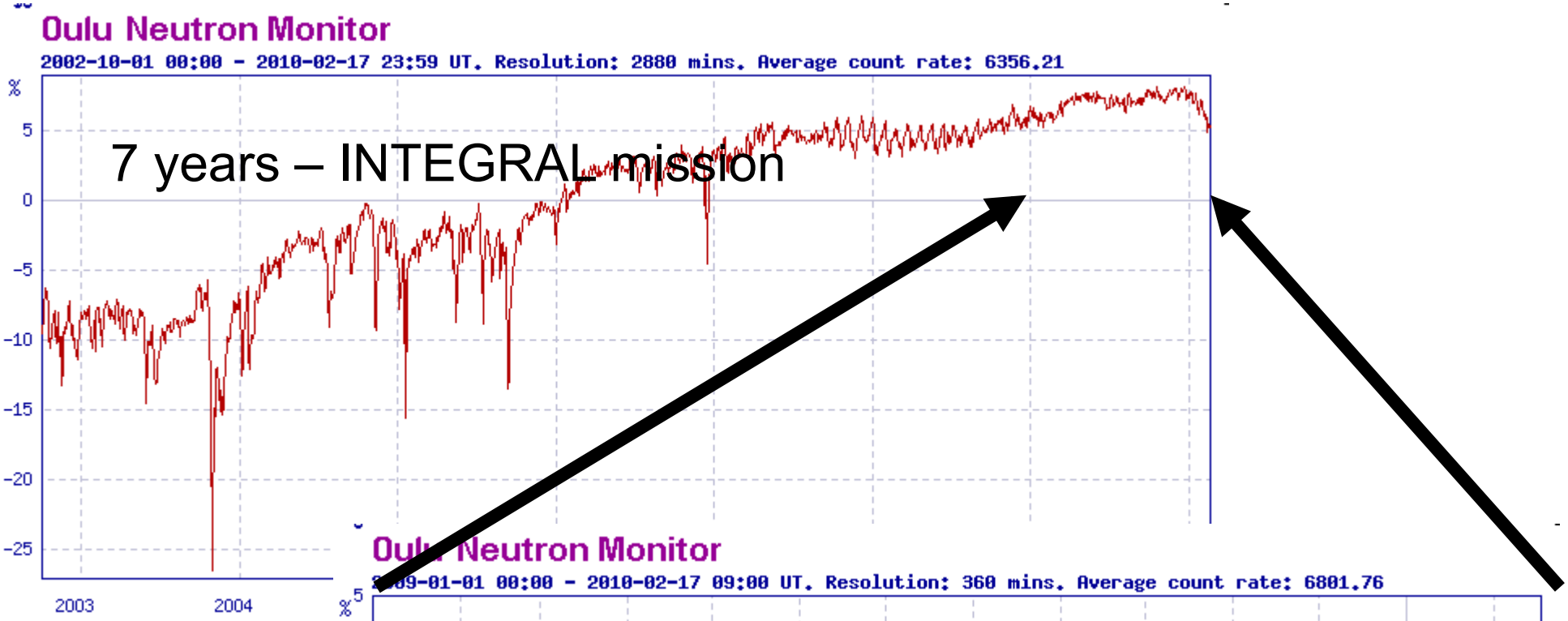
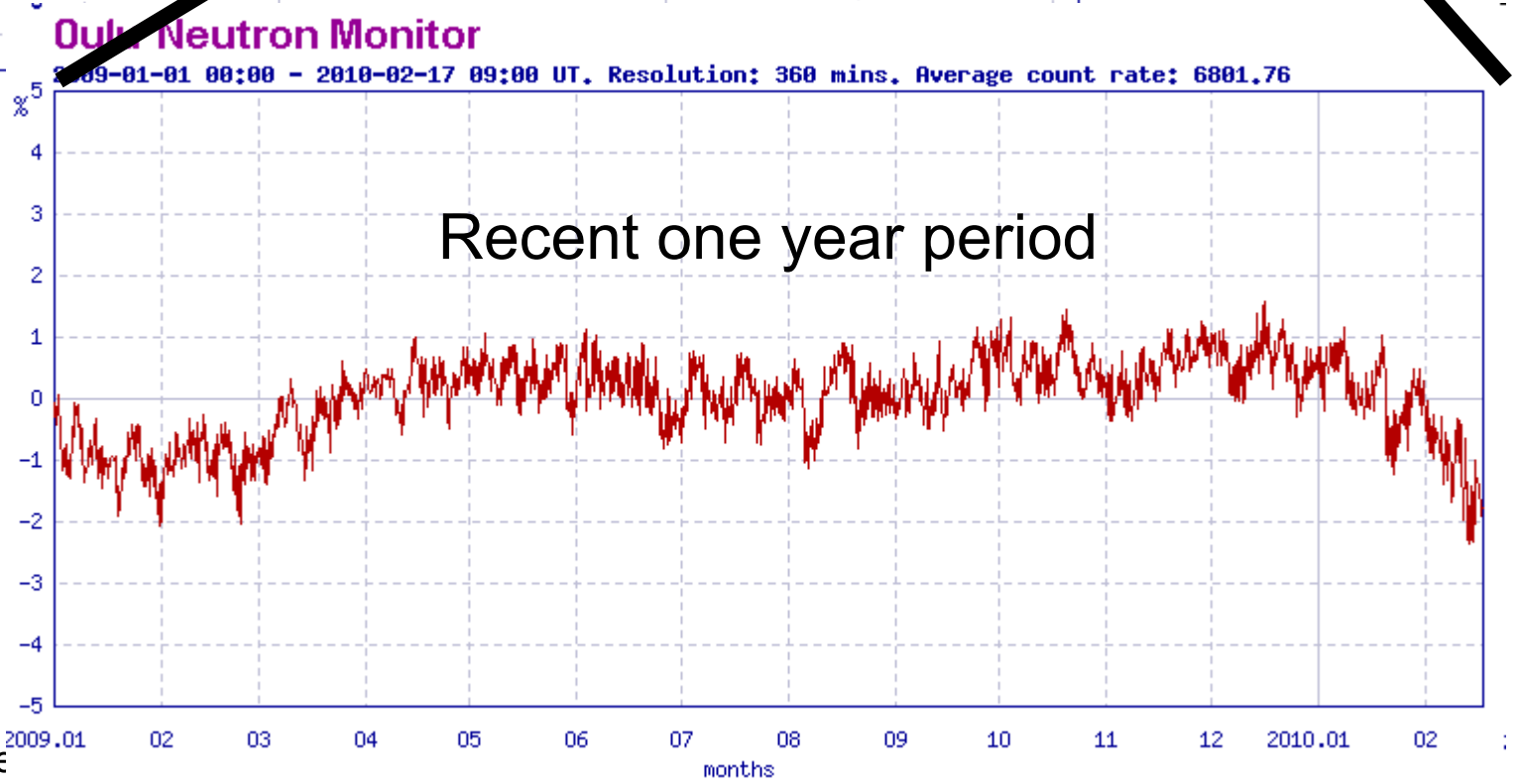
# Particle rate observed by JEM-X

- Rate increased by a factor 2.3 since 2002






the cosmic ray flux is finally going down!

# JEM-X TM usage

- Current allocation: 7 science packets + 1 HK packet
- 1 tm packet allows transmission of 12 c/s
- Background is ~35-40 c/s (3 packets), Crab is ~120 (8-10 packets)
- Running both JEM-X units could make sense with ~6+1 packet per unit, i.e. we need ~6 packets more
- Two units improves statistics by ~1.4 + improves systematics
  - Source detection algorithm depends on detection source in two independent data sets (now different energy bands)

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# JEM-X2 new default unit

- Since revolution 856 (Oct 16, 2009) JEM-X2 is the default JEM-X unit
- JEM-X1 was used from rev. 170-855 and has now been used for 700+ revolutions (almost 6 years of use)
- JEM-X2 had been used for ~250 revolutions (~350 revolutions left till end of 2012)
- Both units have been used for all Crab calibrations
- both units were used during previous SPI annealings, as TM allocation allowed
- When 6-8 TM packets more become available we will consider using both units

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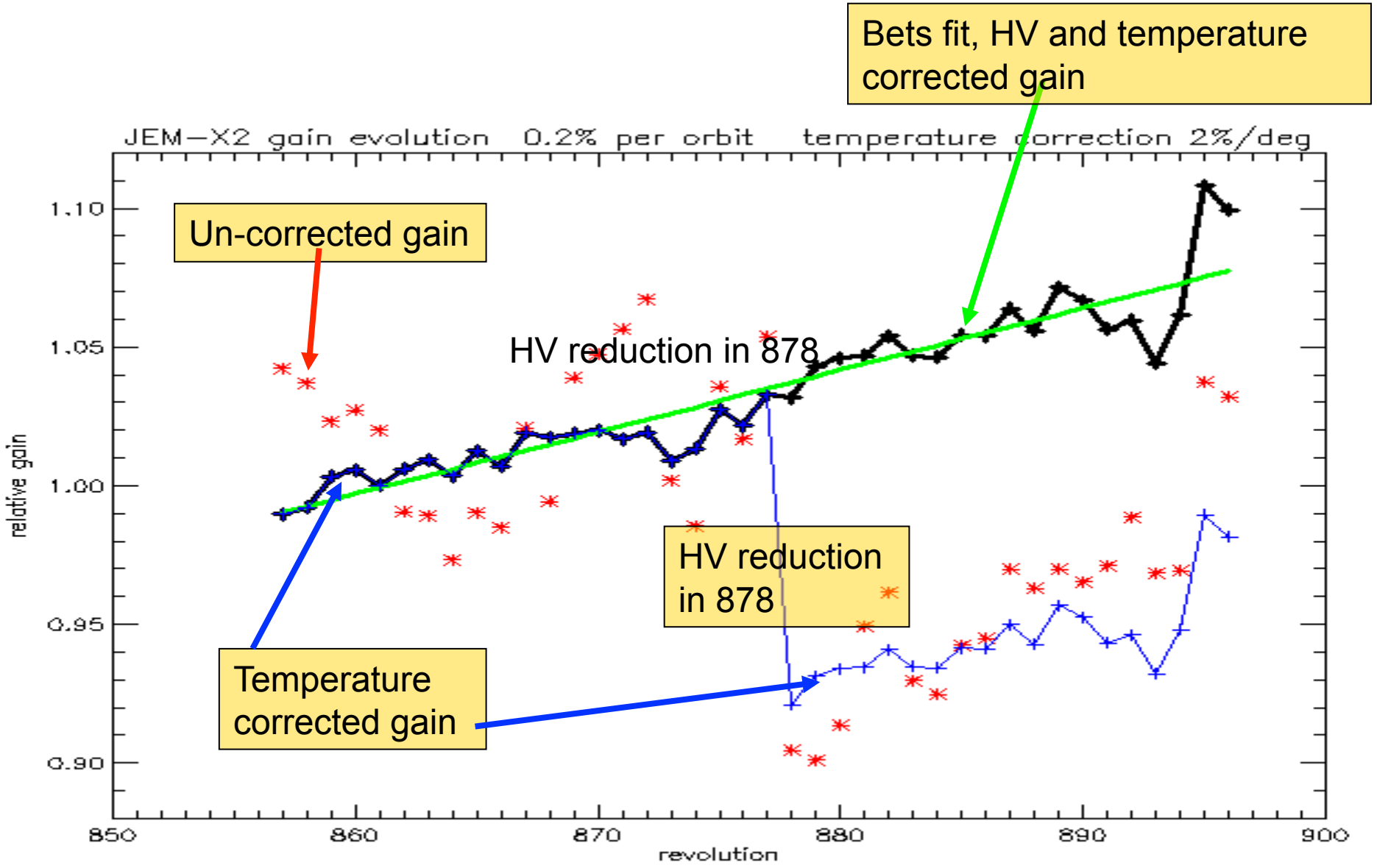
# Gain evolution, JEM-X2

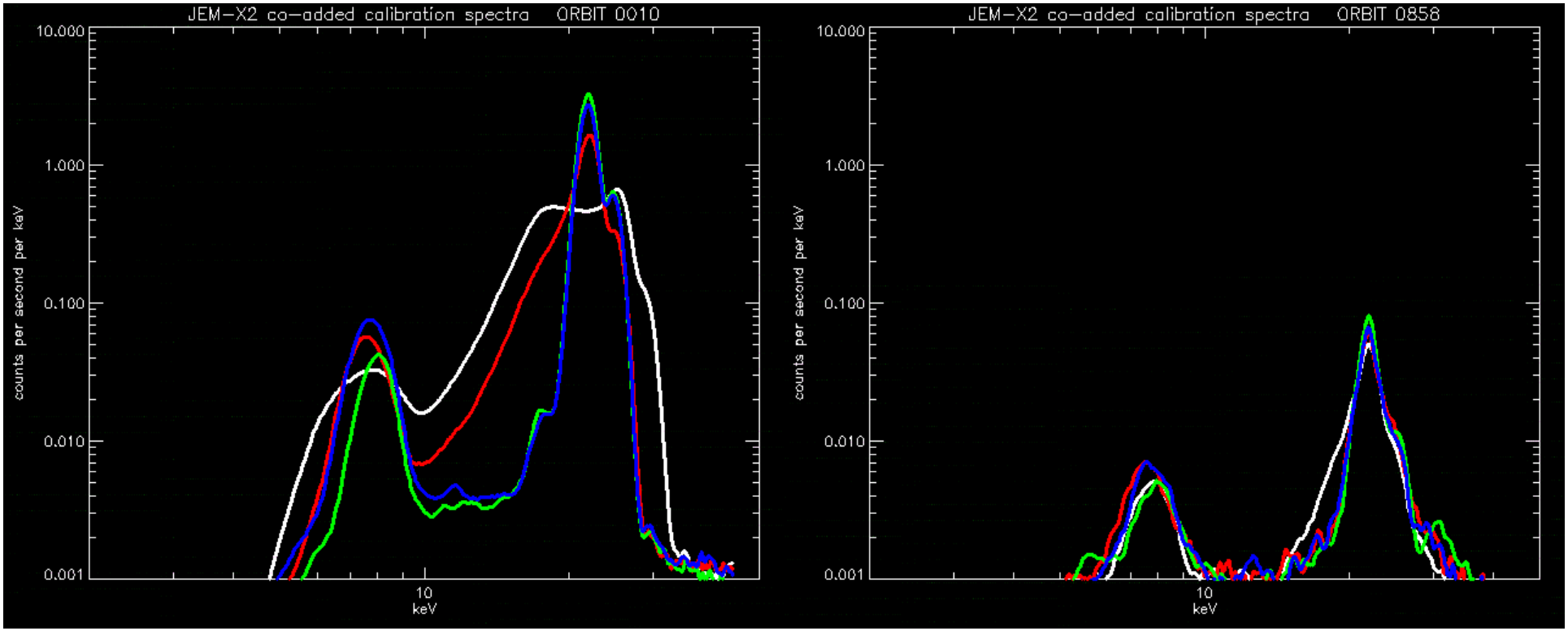
- JEM-X2 DV setting was lowered in rev. 878
- Current gain increase is ~0.2% per orbit (1 DV step corresponds to about 12% gain)
- Expect next high voltage lowering around rev. 930 (6 month interval, interval increasing over time)

# JEM-X2 gain evolution since rev. 856



# JEM-X2 calibration spectra (rev. 10 and 858)

- JEM-X2 has 4 Cd sources, which down by a factor of ~30
- Calibration spectra are integrated over longer time to fit the line
- Xe fluorescent line from detector gas at 29.6 keV also used



# Anode status

- ~So far – on average 2-3% loss per year (256 anodes in total), but now about 1% per year
- JEM-X1 (~700+ orbits of use)
  - 61 of 256 anodes affected (almost 25% of area)
    - 37 dead (4 pre-launch)
    - 13 neighbor
    - 11 unstable or low
- JEM-X2 (~250 orbits of use)
  - 52 of 256 anodes affected
    - 29 dead (9 pre-launch)
    - 16 neighbor
    - 11 unstable or low

One anode lost in JEM-X2 since activation in 856

# Calibration

- Circle of 4 degree off axis completed in 2 most recent Crab calibrations
  - Systematics in light curves on the order of 5% due to the collimator
- Next Crab calibration: 20 ks Crab staring during start of orbit to check the gain correction and electronic efficiency after HV activation



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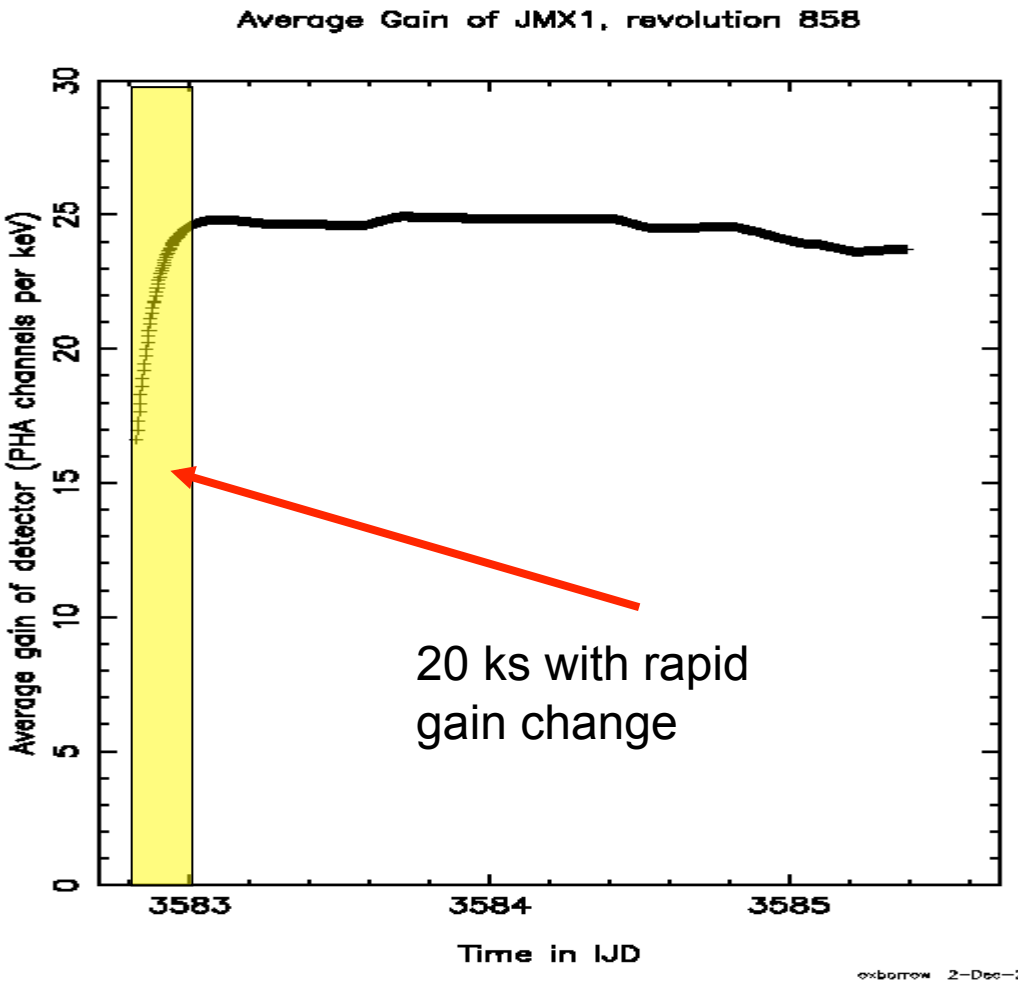
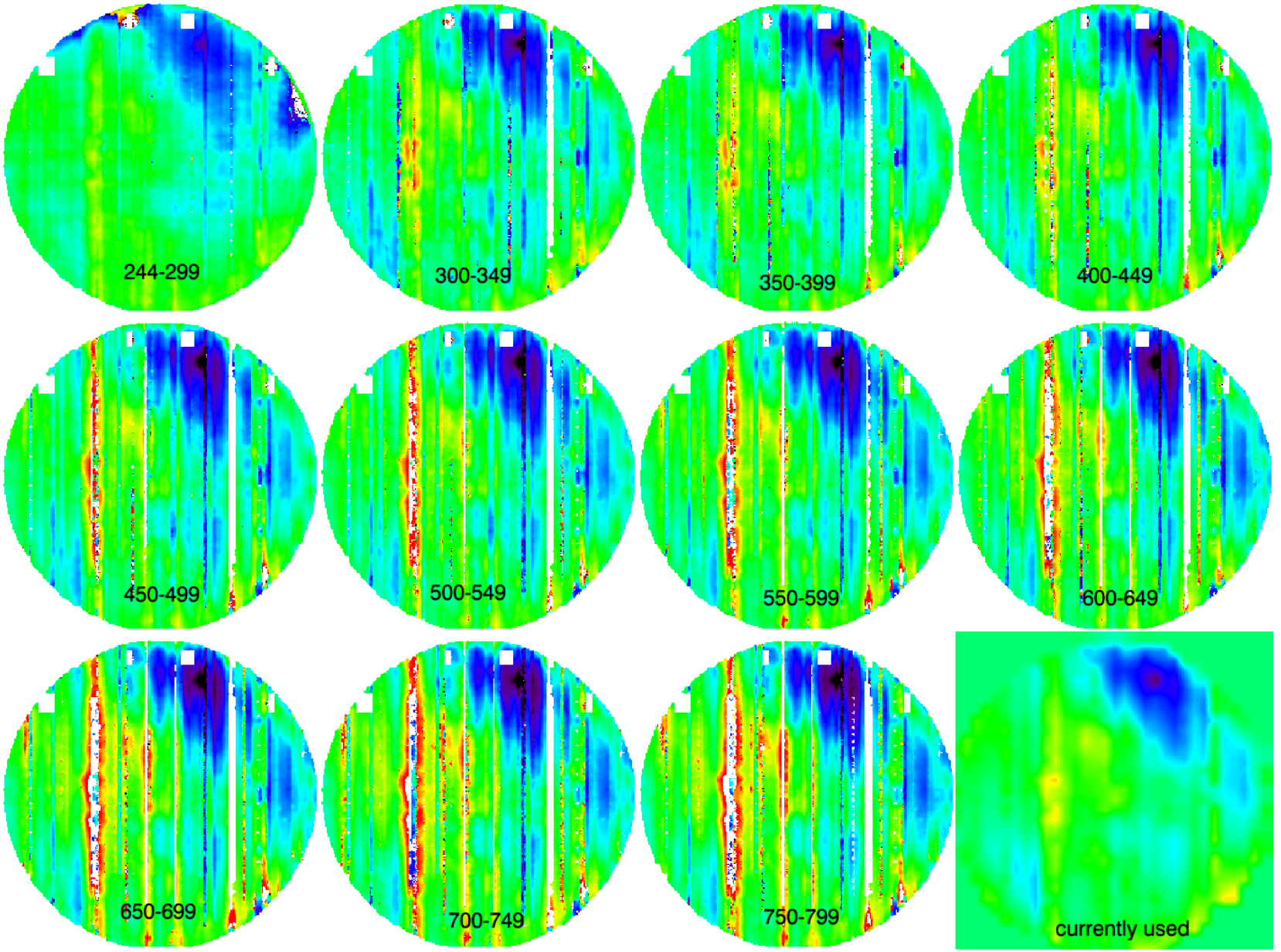
# JEM-X1 gain during typical orbit

- Map response during rapid gain change at HV activation
- Effect in less ”aged” JEM-X2 is less pronounced

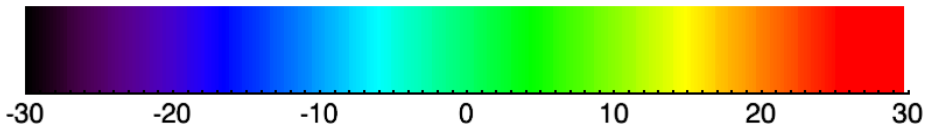


# Spatial gain evolution

- The JEM-X MS plate is born with spatial gain variations
  - Initially mapped during ground calibration
- Gain evolution also involves spatial differences
  - Lost anodes affect the local gain
- Mapped by Xe line at 26.6 kev over 50 orbit intervals to be included in calibration to improve energy resolution (ongoing work)

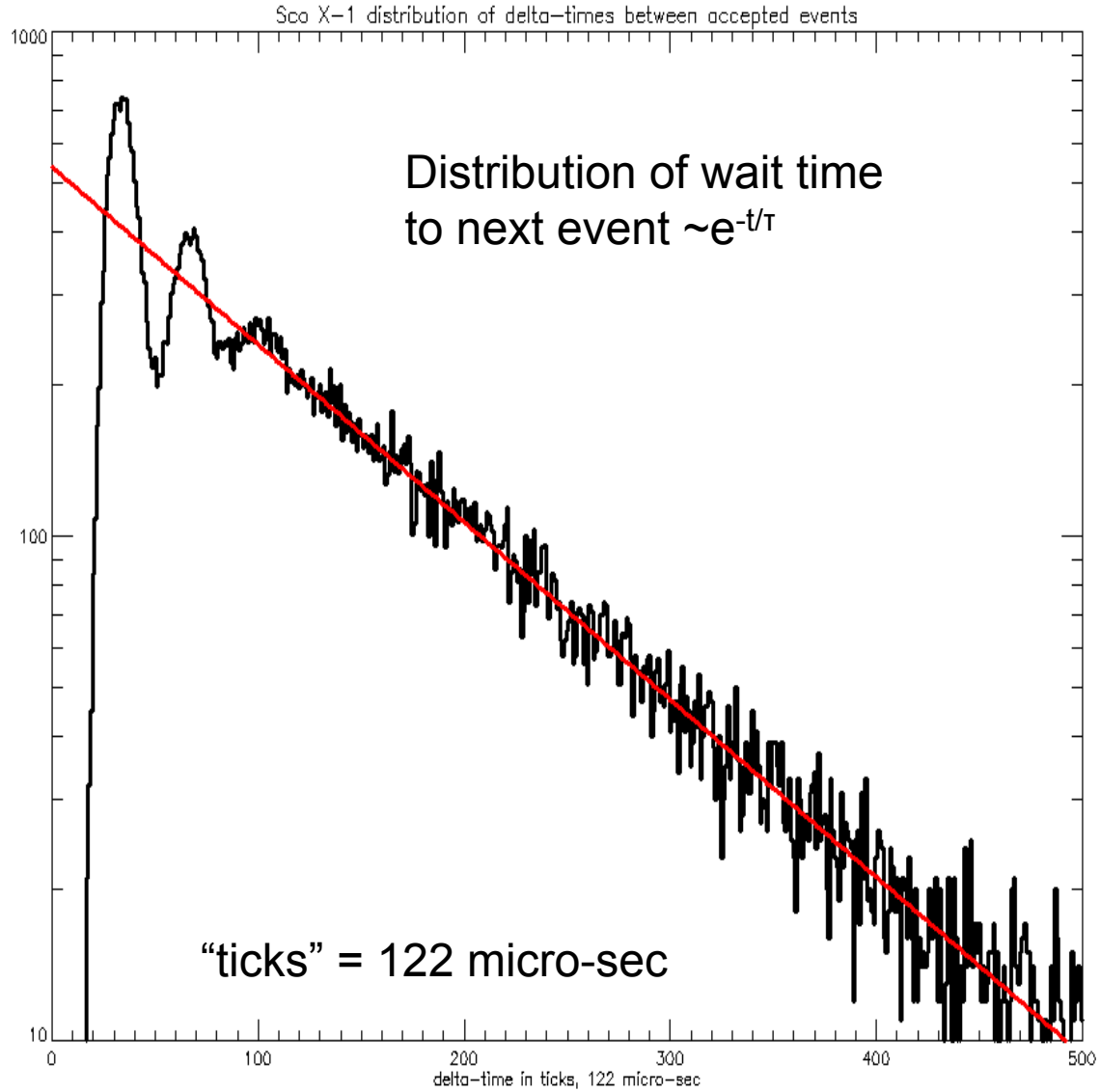



Gain correction to be applied (%)



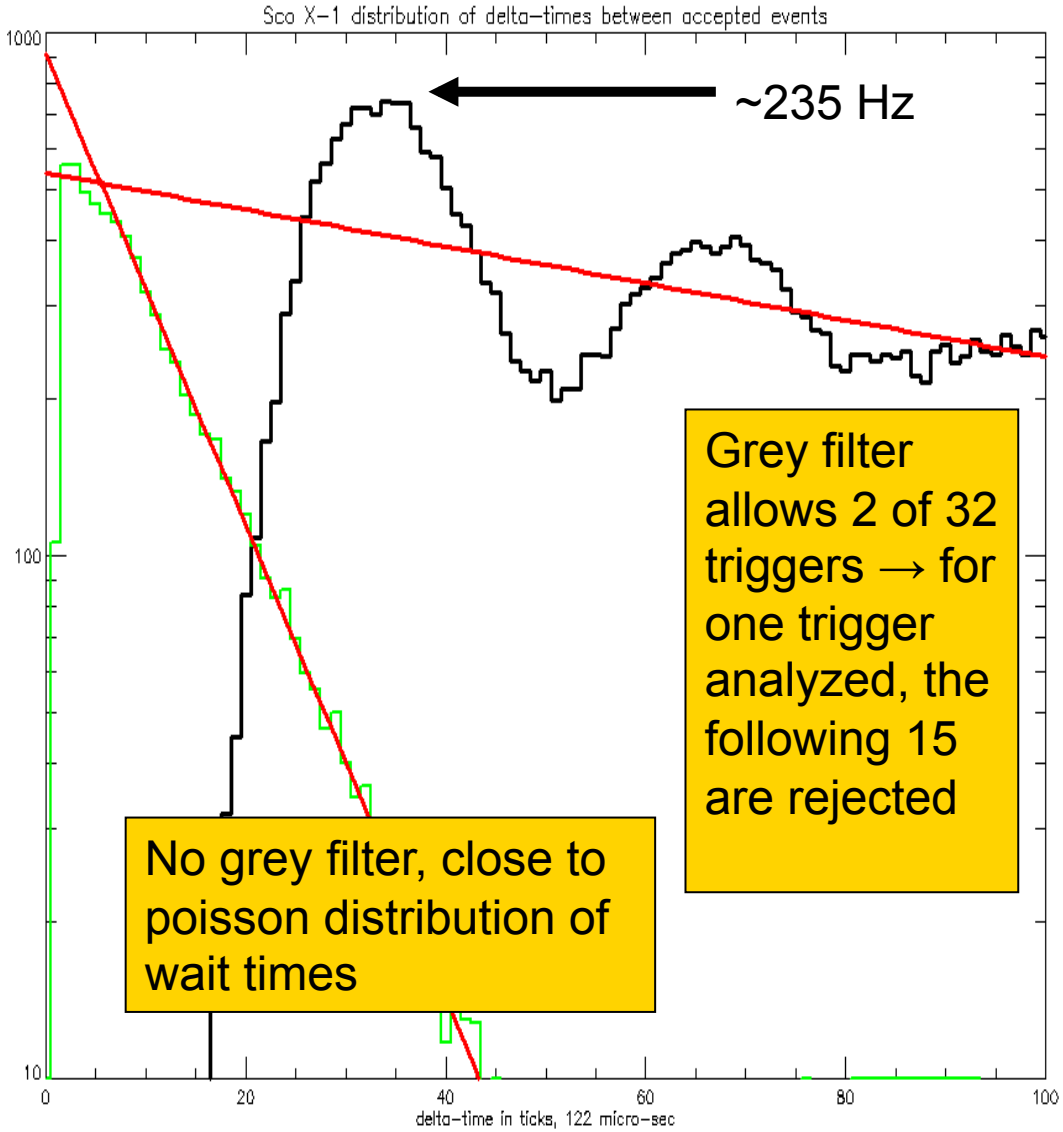
# Very bright sources and timing

- Grey filter rejects triggers according to table with 32 entries
- “random” if X-ray events are much fewer than particle triggers (~3000 c/s)
- Sco X-1 have as many photons as particle triggers



# Sco X-1:more X-ray photons than particle triggers

- The ideal distribution of wait time between is an exponential
- In real life, distribution is cut at the low end due to dead time - ~180 micro-sec
- Non-random grey filter introduces extra dead time and “structure” in distribution
- Beware, when doing timing analysis! (QPOs etc)

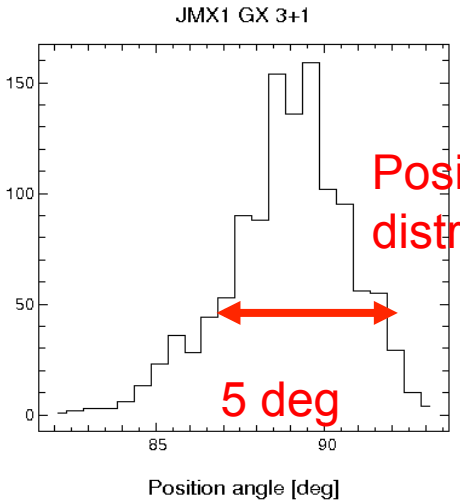


# Imaging artifacts in deep mosaics

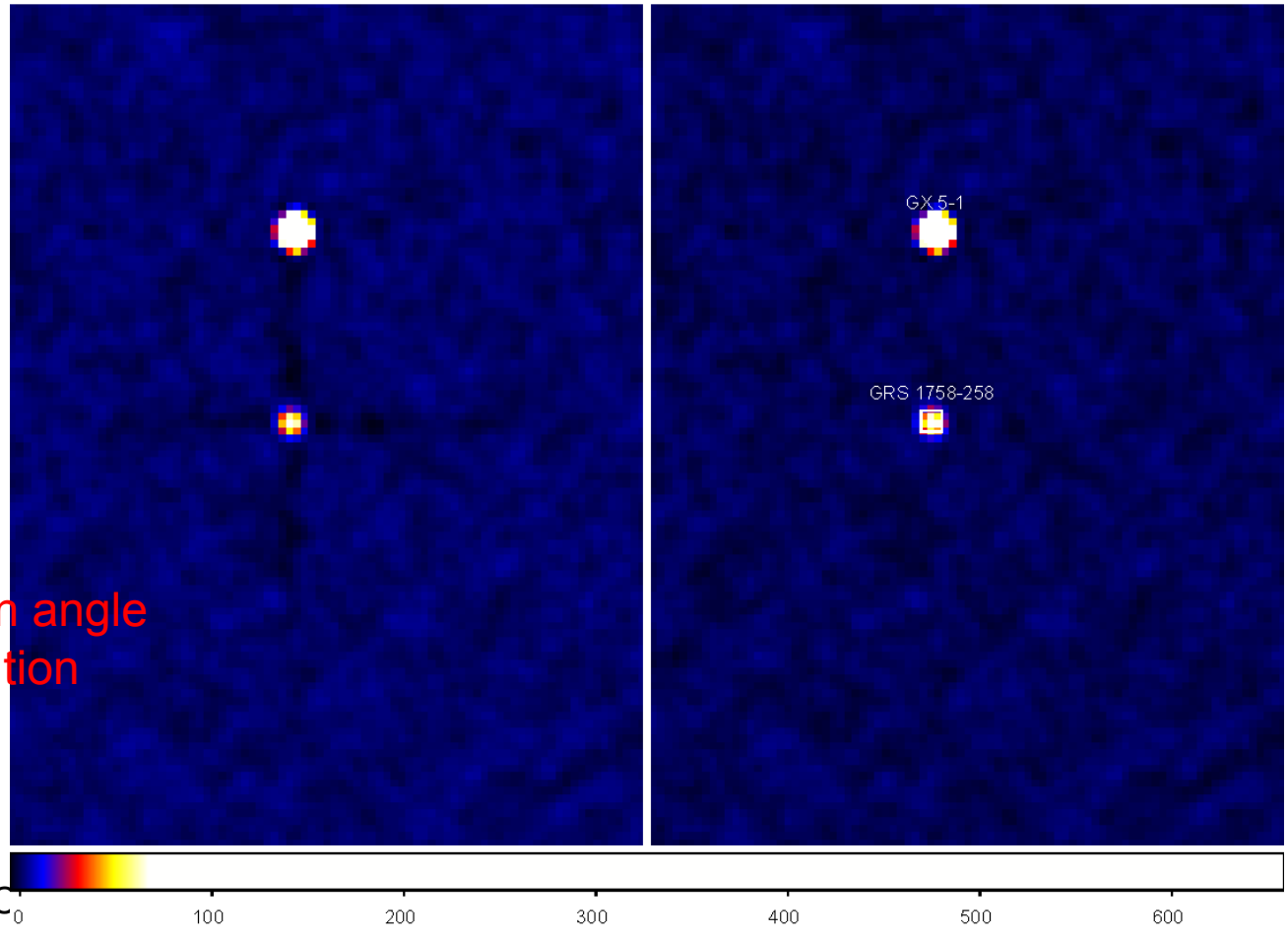
- Weak sources, not detected in individual sci-wins, may be associated with artifacts from the background subtraction algorithm
- Position angles have a rather narrow distribution for a typical sample of “random” pointings, so detector coordinates are almost lined up within a few degrees in the final ra-dec mosaic
- Cure is to force the detection of the source in j_imairos to skip the background cleaning near the source

Example:

GRS1758-258 with 830 sci-wins and 1.4 Ms of exposure, hard source, ~5 mCrab at 3-6 keV, and ~30 mCrab 20-30 keV




Position angle distribution



# Conclusion

- JEM-X is running smoothly
- JEM-X is not expected to be 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
- OSA 8 has improved flux stability
- Running both JEM-X units to improve statistics is desired when “the end” is near and TM allocation allows
- We expect JEM-X and INTEGRAL to operate through 2012 (and longer?)

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