JEM-X SDAST Meeting: Friday 4th March 2011

Participants: Niels-Joergen Westergaard; Stephane Paltani; Erik Kuulkers; Niels Lund, Jerome Chenevez; Soeren Brandt; Lucia Pavan; Carol Anne Oxborrow; Silvia Nunez Martinez; Carl Budtz-Joergensen.

Welcome (NJW)

Special welcome to Lucia who is joining the team as ISDC JEM-X liaison and Silvia who is rejoining the SDAST after several years away. Lucia is a post-doc at ISDC and works as the operations scientist and testing of software. She did her PhD at Padua on galactic objects and is continuing this research at ISDC.

SB: JEM-X Status (see his presentation)

- 1000 orbits in December 2011: Cake and software upgrades to handle 4 revolution digits.
- Original mission lifetime was 2 years with and extended mission lifetime of only 5 years. Current extension is until 2014. Our original AWG review grade was not good, but at a higher level we came out well.
- We can expect improved data in the near future as solar activity increases and CR background drops. Especially SPI and IBIS sensitivity should improve.
- Orbit evolution is bringing down perigee altitude so that satellite dips into the proton belts that we'd prefer to avoid: 2800 km over south pole, with proton belt at the equator. In the summer we were affected by reflected heat from the pole.
- Nominal mission configuration for JEM-X was to run with single units at a time to conserve microstrip strips. This was also needed to fit in with the mission's telemetry budget.
- Neutron star bursters aren't generally pulsars, so the rotational period is not usually seen, but with the Terzan 5 observation in rev.976, the 11 Hz rotation was actually confirmed.
- Reloading the entire collection of memory patches for JEM-X re-activation after eclipse passage takes a couple of hours, which operators don't want to do. The eclipse recovery anomaly however, only occurs every 10th time or so, and it's not clear what causes it in these cases.
- Without lowering the HV, the total gain increase since launch would have been a factor of 4, which is totally unacceptable. Running both units together increases their temperature because of heat from the two DFEEs. The ion-conducting glass used for the microstrip plate is not optimal because the better-suited glass couldn't be produced in time to build the instruments. Quantum efficiency is also affected by gain of the instrument.
- Cooling down SPI at the end of annealing seems to dump heat into the other instruments and we experience high temperatures at the end of annealing. The Maxi transient required a very small Solar Aspect Angle which also produced high temperatures. When satellite is pointing away from the Sun, the bottom gets heated and produces temperatures almost as high as when pointing towards the Sun. The mask temperature due to solar warming can produce offsets from the Star

Tracker of 10''-15'' which also has to be corrected. A very detailed thermal model would be needed to predict these effects.

- Calibration of the instrument has become pressing since there are things about our Crab fluxes that we just don't understand. Efficiency, particle rejection criteria, dead time and double triggers are all important influences that need to be understood. SCO X-1 used to determine how deadtime changes with event rate and it's clear that there's a steady loss of accepted events. SP suggests that there's something wrong with the grey filtering, but this seems unlikely since the 0.7 slope between accepted events versus s/w trigger rate is already clear at low trigger rates where there is no grey filtering.
- Deviation of dt distribution from expected Poissonian statistics indicates that there is something fishy going on that could be affecting our fluxes. This will arise from the signal shapes from the amplifiers where the pulses appear with a decaying sinusoidal tail that will affect the detection of quick-following events after the first pulse and cause 'pile up'.
- In conclusion, the instruments functioning well, though there are some details we still need to understand better.

SP: ISDC News

- Thierry back from his yachting trip. He is the head of ISDC, but is not officially involved in any particular mission. ISDC: `Institute Scientifique de Courvoisier' or just the `ISDC Data Centre for Astrophysics'.
- This is SP's last day working on JEM-X/INTEGRAL
- Now working on ASTRO-H, Japanese hard-x-ray mission, for launch in Feb. 2014. ISDC will be the European ASTRO-H science data centre, working on calibration and verification of the data with a help-desk type support fo r the users.
- SP will also be working on Euclid as head of the Swiss science data centre for this mission. Currently in definition phase.
- CTA is waiting to be realized at ISDC with a group ready to work on this. Swiss collaboration is working on a APD detector in Zurich.
- GAIA is also going very strong at ISDC. So there's lots of missions and future missions being worked on to provide a future for ISDC, so not much work or manpower left for INTEGRAL. S/W development is decreasing though operations and archive have to keep running at their original level. However, manpower is generally being shifted over to other missions.
- There is supposed to be a new OSA release in 2011, including JEM-X software.
- ISGRI calibration: in Paris they think they can complete the work for a new release. In theory there is not a hard connection between OSA release and calibration, but in practice ISDC needs particular IC files to proceed with a release.
- IC files can be updated by users using an ISDC tool, but most people seem to be ignorant of the existence of the tool, and this should be advertised in the Cookbook and other s/w documentation.
- People still working on INTEGRAL: 5.5 FTEs. PhD students 10% of their time as SCODIs.

EK: News from ESAC/ISOC (See his presentation)

- SPI still manages to return to their launch energy resolution, or something like it with each annealing.

- Deadline for AO9 is 14th April 2011
- Data rights cover sources in the FOV of accepted observations for other objects
- Russians have to write proposals that are reviewed on same footing as all other proposals, except that 25% of time has to be for Russian proposals. In practice there is a preliminary review panel in Russia.
- PGT : Proposal Generation Tool. Updated for multi-year proposals.
- Lots of constraints to be taken into account for Earth occultation observations. And how much of this time will be Russian time?
- AI42_1: On Erik, to look into the PIMMS for JEM-X and compare it with the Crab. Is this representative of JEM-X1 now, and is the SQRT(2) factor correct for the running of two instruments: compared to their pristine launch values, or what?

NJW: j_ima_iros_lc

- Up till now we've been using the s/w written by Stefan Larsson many years ago, but it doesn't take into account the presence of other sources in the FOV, which are treated as background and cause a good deal of contamination, especially when studying a weak source near stronger ones.
- Since NL has such a good understanding and experience of PIF methods, we should take advantage the source detectiion/separation already built into j_ima_iros. So we propose that the j_ima_iros s/w be extended to make lightcurves. The output would be both in the form of lightcurves based on time-binned imaging of the FOV, and also as an event list extended with PIF values indicating which source each event belongs to, so that other tools can be used to build light curves.
- J_ima_iros has the advantage that it takes into account electronic efficiency and similar affects.
- Also, multi-science-window lightcurves can be built
- Silvia will be able to spend about 20% of her time on this.
- We hope that the software will be ready by autumn 2011.
- Lucia will be handling the scripts at ISDC
- Though the results will not give absolute fluxes, you can compare with the Crab lightcurves made in the same conditions to normalize the lightcurves.

NL: Crab Fluxes (see his presentation)

- Summary of `When a Standard Candle Flickers'
- Basically, the result you get depends on the s/w you use. Important to have the electronic efficiency taken into account. Flux determination cannot be done quick'n'dirty.
- RTE shows a fabulous series of fluctuations in intensity confirmed, especially for the last months, by Swift and INTEGRAL.
- SP thinks the results would be much more convincing with SPI results – the omission makes people suspicious. Results should come from spiros since this is the standard s/w – people shouldn't all use their own s/w.
- Now we have to cope with the fact that Crab does indeed fluctuate.
- NL spent a lot of time smoothing out these variations found from fluxes in j_ima_iros, so standard j_ima_iros is not suitable for making crab fluxes that vary, since two linear slope corrections are

already included in the s/w. Changes in selection criteria make it difficult to compare fluxes throughout the mission. However, it was very hard for NL to see where these changes in flux slope were coming from. Since there were differences between JEM-X1 and JEM-X2, he could see that there was some aging problem that could explain the problem, and that the units have aged differently due to their different usage. In practice, some of the flux difference we see must come from the instruments because our flux variation is bigger than for the other instruments that have seen changes in Crab flux. Since JEM-X1 sees the greatest change in Crab flux, it would seem that an aging effect is involved too.

- There's still a lot that is not explained about the figures that have been presented in the original article, like why ISGRI fluxes are so much higher than RXTE ones prior to MJD=53800.
- CB thinks that now that the Crab flux shape has been determined well by other more stable instruments, then we should use their results to learn about our own instruments, for which flux determination is very complicated with lots of scatter, depending on electronic efficiency, dead anodes, ARFs, deadtime, grey-filtering, rejection criteria etc. etc.
- EK: If there's flux differences between the two units then we should see differences in spectra with the two units, and this is in fact true. JEM-X1 and JEM-X2 do diverge above 10keV, by maybe as much as 10%.

CBJ: Crab Flux Analysis (see his presentation)

- CBJ found crab fluxes, but only using a very tightly constrained part of the JEM-X detectors where there have never been any dead anodes
- He finds, unlike NL, that there's no difference in the fluxes between the two units and that our later results agree very well with the other instruments' results presented in `When a Standard Candle Flickers'. However, earlier in the mission the Crab fluxes appear to be too strong. He thinks this is due to deadtime problems, or rejection criteria fuzziness.
- For poissonian distribution, log N vs. log dt, should be a straight line pointing down, but what we saw during on-ground testing, was that there are sizeable wiggles on this line, suggesting some very interesting non-linear affects causing ringing, probably involving hardware deadtime, rejection criteria, drift rate, double triggers and electronic response etc.
- Conclusion is that both detectors are affected by a similar effect that we don't really know what it is. Effect is on order of 15 to 20% across the mission, going from a low background (solar max) to a high background regime.
- Ongoing work: NL, CBJ, SB – to discover what the background-dependent effect is that affects the Crab fluxes.

JC: j_ima_mosaic

- A bug has been found during an observation of Cas A a month ago. With a typical 5X5 dither pattern, start by calculating the largest dimension that is needed to cover all 25 FOVs. However expressed in Ra and Dec, .the pointings come in different order than previously tested, which led to too small mosaics. This has been corrected now.

NL: Improved Imaging for JEM-X (see his presentation)

- Cleaning process takes about 1 hour per SCW, rather than 1 minute but it has very big advantages.
- Using WCS all SCWs are imaged in identical co-ordinate systems which makes mosaicking a simple weighted addition, however you need to choose the co-ordinate system that best fits your area of the sky. This is instead of using the local, detector, projection. These maps can then be saved in HEALPIX format.
- Systematic rings appear around strong images, even after cleaning for detector stripes. Ring cleaning is very difficult to do in images of FOVs with many strong sources, e.g. galactic centre, though it works well for isolated strong sources like GRS 1915.
- In un-cleaned images you can get noise artifacts that are very source-like, but these disappear with the cleaned and PIF-selected images, as well as weak sources becoming visible in the cleaned images. So we can conclude that this imaging is superior to j_ima_iros.
- Takes about 6 weeks to do 16000 SCWs in the galactic centre observations – but evidently worth the effort.
- `The number' is about 7, for `promising candidates'
- For source-search S/N below 6 an unmanageable number of unidentified sources suddenly appears because you're well down into the noise, so 6 has been found to be a reasonable limit.
- The selected PIF method could be implemented in j_ima_iros to make better images where the user could decide how the PIF values are weighted.
- As wells as finding new sources, you do get a better S/N ratio for the found sources and should provide better flux estimates for known sources. Implementing flux determination is still to be done.

SB:Crab Calibration recent results (see his presentation)

- Using accepted events vs. S/W triggers we can see that we only got about 85% of the expected events at the beginning of the mission, and this has dropped to 70% now, 8 years later.
- 1000 accepted events per second is the practical limit to the onboard processing chain which is why the curve flattens out for both phases of the mission (early and late)
- Generally the curve demonstrates that it's the high background now that screws up our fluxes for some reason, probably having to do with the onboard processing constraints.
- All the instruments cited in the `Flickers' paper are subject to the same change in background, so it could be this rather than any intrinsic change in the Crab that causes the change in flux, though admittedly our flux changes are more dramatic than other instruments'.
- Doing an ad hoc correction using the Oulu neutron monitor CR rate brings our Crab fluxes more closely into line with the other instruments, which would indicate a dead-time/rejection problem connected to the background.
- Again, it's only circumstantial evidence that there is something unusual with our deadtime effects which is not covered in the straight-forward deadtime correction

All: Focus of Future Software Development

- Lightcurve production is more important than incorporating improved imaging in j_ima_iros: everyone seems to agree with this prioritization. Ideally both will be done for the next OSA release

by the end of the year. So j_ima_iros_lc takes precedence, followed by image cleaning in j_ima_iros.

- The adding image cleaning and PIF selection in j_ima_iros would make further improvement to j_ima_mosaic unnecessary
- Are there other s/w wishes? Apparently not, unless something can make calibration sources stronger.
- How to quantify the importance of our candidate sources when clearly the source-finding procedure does not behave like Gaussian statistics?

CAO: Xe line analysis and IC tables (see my presentation)

Documentation, User Manual and Cookbook

- JC thinks all information that is common to all instruments must be put in an introductory section of interest to all instrument uses. He has a number of very specific improvements to the text as well. Lucia will implement these changes.
- The way the scripts handle single SCWs is very cumbersome because of the observation group mechanism, and this could be made simpler. The old j_scw_analysis should be re-instated. It should also be written in the manual that this is no longer possible as it once was.
- Spectral extraction from images: SMN having segmentation trying to use XSPEC on those spectra, though it works with mosaic image spectra. Getting this to work is very cumbersome and should be improved.
- The SPR (4839) on the GUI should not be closed, but rather be taken into account, for the problem still persists about limited resolution on IJD for observation start and stop values, since many more digits now allowed.
- Using a user catalogue to force source positions for detection doesn't get implemented, and standard source positions get used instead.
- The TFIRST and TLAST values specified by the user get lost in the output and only the beginning and ending times of the SCW is quoted in the header, which is wrong
- AI42_2: JC to send an email with all his corrections
- AI42_3: JC to find which SPRs need to be written or re-activated to solve these problems
- JC feeling bad about neglecting the ADD, but he has lots of material to integrate into the next document
- EK: the mission history archive. EK hasn't done more on this recently. Just to have all the documents in one place is a huge project with both archiving and making document trees.
- AI42_4: CAO to send EK SDAST meeting minutes
- AI42_5: NJW to send EK Monday meeting summaries

AOB

- Does the ARF need updating since JEM-X1 and 2 show clear differences
- AI42_6: NJW to update ARFs for both units
- SMN planning to visit us again at the end of summer

Next Meeting

- In September/October. Maybe in Alicante, via Norwegian Airways
- AI42_7: NJW to send out a Doodle email to organize next meeting
- We can have intermediate meetings using Skype which is free. This would help us to be in contact with SMN and LP more frequently.