SDAST Meeting 40: Copenhagen, 20th November 2008

Present: SB, CBJ, NL, NJW, JC, CAO, SP, EK

JEM-X Status (SB)
Gain Evolution: DV setting for JEM-X1 lowered in rev 533 to DV=73 and and in rev. 623 to DV=72. Next lowering will be in rev 747 (to DV=71).
The temperature dependence of gain has increased by a factor of 4 since launch. By lowering HV regularly we can keep temperature-corrected gain within about 10% of ideal. For the temperature uncorrected gain, we're still stable to about 20%. But another 5 years of use would make the instrument very difficult to use.
Anode death is still a concern. Though for one year we didn't see any anode losses (2007-2008). Other years we see 2-3% of anodes dying in a random way. It has not been demonstrated that there is a connection between the loss rate and the gain (except in the very beginning of the mission).
The particle trigger rate has increased by a factor of two since the beginning of the mission. The new solar cycle has not yet led to diminished trigger rate.
No official confirmation of mission extension to 2012 yet, but PK has talked as though it was finally approved. SPC has to meet and to the final approval.
JEM-X1 has run now for 5 years of operation and JEM-X2 hasn't run for a whole year yet.
Next SPI annealing is in April, where both units can be used. The instrument switch could happen at the beginning of the next AO. Baseline to switch to JEM-X2 would be October of next year. AOs will eventually be aligned with calendar year.
Calibration source decay: Cd sources down by a factor of 28, and Fe sources down by factor of 5. We still believe the rate is sufficient to continue with another 4 years if necessary.
Other issues:

- DFEE has to be reconfigured after eclipse season perigee passage, and this still isn't quite automatic. The explanation could be a memory discrepancy between DFEE and DPE. It is not a problem, but operators have to do reconfiguration manually.
- Trying to avoid instrument cooldown by keeping DFEE on during eclipse

At the end of the mission it could be an advantage to run both instruments simultaneously for maybe one or two years. One constraint is that background counts are lower so that we have enough telemetry.
Currently it is too early to decide when to start parallel running of both units. SB wants to see a year or so of stable JEM-X2 operations before a decision is made. It must be remembered that JEM-X2 had more dramatic gain aging and more dead anodes, which is why we switched it off in the first place.

** Action Item: JC and others, to assess the relative quality of JEM-X1 and JEM-X2 images for analysis of their relative merits, and how they work together.

News from ISDC and Future OSA releases (SP)
Two free positions have been filled. Meharga will no longer be doing database work but general s/w development. Simona is leaving and her position will be filled as a postdoc, and a new PhD

student will also be hired. One of these will work with Stephane on JEM -X. On OSA, JEM-X will be the driver for the next release. There may be also a new release of the ISDC tree for OMC and IBIS. No new software for OMC and very little for IBIS and SPI. A new tool as a competitor to ima_spiros may be developed for OSA use, though it's not an important addition to the software.

News from ESAC (EK)
Operations are running smoothly, no problems. The antenna switch problem that XMM-Newton experienced cannot happen to INTEGRAL.
ISOC staff has not changed but new longterm planning tool called AIMS - the APSI INTEGRAL Mission Scheduler. Nice frontend and backend and testing still to be done, by YGT Delphine Anger (Young Graduate Trainee). A new RF Simone Migliari (research fellow) started Nov.1. Will work on radio/IR and multiwavelength observation of Xray binaries.
AO6 extended by 2 months and AO7 will be extended by 2.5 months and thereafter
AOs will be annual and will be synchronized with mission extensions.
AO7 documentation finalized. AO7 will start on 16th Oct. 2009 (See EK's presentation for full list of timeline for this AO).
No Core Program anymore, 80% of mission is Key Programs (more than 1 Megasecond each). Rest are standard obs (less than 1Msec) and TOOs. Associated proposals can be submitted for targets in KP FOV but not for TOO observations, since latter would be great deal of work for TAC and others at ESAC.

Achievements of j_ima_iros and OSA 7+ (NL)
The goal for the development is to get uniform fluxes throughout the mission. Work was done on the Crab. There are 9 crab calibrations between orbits 39 and 605.
All the problems of interest are strongly energy dependent, so work was done with 16 energy bands. Users, however, can use their own energy bands.
There are two competing methods of flux determination: j_ima_iros (shadowgram data) with results in srcl_res files, and backprojected images from j_ima_iros.
A correction for the gain dependent electronic efficiency is an important feature introduced since OSA-7 (version 2.2.2).
Energy-dependent corrections of the effective area as a function of off-axis angle have also been added, on top of and energy-independent collimator tilt and misalignment corrections.
There was also a slow degradation in instrument sensitivity (JEM-X1) after revolution 170.
Apart from electronic efficiency, all the new corrections are empirical, based only on observations of the instrument behaviour.
There are additionally, some extra flux bumps around 6keV. Dramatic increases with time of Crab flux in the very lowest energy bands were mostly ironed out by electronic efficiency correction. What is left is a steady decline in flux of the high channels and a steady (but small) increase in flux in lowest bands. SP wants to be sure that this is not just a temperature effect that will be smoothed out by CAO's software.
It was enerally agreed that NL's results should be repeated with the new j_cor_gain 8.0 with temperature variation corrections. Orbit 451 has its own particular problems.
By empirically removing the time drifts for each energy bands, you get a smooth flux, though rev 451 still shows some bumps.
Off axis corrections are big effects of many percent but are constant for the entire mission, and collimator tilt is also constant and subtracted before calculation of the off-axis corrections, which

reflect geometrical systematics. Using these corrections gives flat flux curves for all x-axis angles. NL goes up to 5 degrees only.
Systematic rms is about 3 to 6 percent over all 16 energy bands. Biggest systematics are in the two most extreme bands, but NL chose his bands to best cover the difficult energies most tightly. 3-25keV is the realistic JEM-X energy range. NL would go up to 35keV, but below 3keV the electronic efficiency is so steep that it can't really be corrected for.
CBJ's electronic efficiency doesn't work below 3keV because it's so steep. ARF is the same for JEMX-1 and JEM-X2, which is quite an achievement. We have to work from the assumption that users understand the limits of energy resolution etc. when they use our data.
Current status is that j_ima_iros is that it crashes.

*** AI on CAO: reprocess all Crab calibration data with j_cor_gain 8.0

NJW: New tool at ISDC for conversion of spectra. SP: j_reform_spectra, removes SL's software from the script. The way to extract spectra in OSA8 will be to use the fluxes in srcl-res, and then j_reform_spectra takes these fluxes and reformats them. Fluxes from images are no longer the way to find spectra. Standard processing provides images in 3 bands as default, and uses spectral resolution, not imaging resolution. Input parameter for energy bins is now a log 2 value and the script finds the band widths and boundaries, so that the user doesn't need to input all the channel boundaries manually. So input 0 gives one big bin (3 to 25 keV); input -3 produces 8 bins.
The negative number indicates that the user is supplying a logarithmic bin number. For users with special needs the usual, positive, bin specification can be used. Still needs to be decided what amount of flexibility will be available in this tool for the ARF choices: default and user-specified? NL warns against making a single energy bin that includes the extreme bands in his 16 band scale since these are each more unstable than all the other bins and interpolation of empirical correction values between them will not give good results.

Flux extraction from Images (NL)
Images are important because this is where we get the best sensitivity to faint sources that can't be found in single SCWs. Roland Walter has written the mosaic_spec tool with 7 input parameters, which each have an optimum value of JEM-X: ra, dec, Posmode, Widthmode psf, size, Back. The position parameters ra and dec are just starting values for the source position fit. In Posmode=-1 freezes the source position at the input values; use value 0 to allow position to be free for all energy bands. A posmode value of 1 freezes the source position as that found in the first energy band (which would be JEM-X's worst band, 2.5-3keV).
Preferred value is 0. Widthmode takes values -1 (radial width frozen at input value); 0 (radial width left free in all bands); 1 (x and y widths free in all bands); 2 (x and y widths as found in first energy band). -1 is recommended. psf is 1.2 for JEM-X and size is 7 with no background intensity.
Evaluation: NL used same input parameters as JC's galactic bulge work initially. Flux values had a larger scatter than for j_ima_iros fluxes. What was needed was to find the optimal psf value. Unfortunately, our actual psf changes with energy. But differences between using psf=1.2 and 1.8 shows very little difference in size of systematic noise, but the results with mosaic_spec are consistently noisier in flux than j_ima_iros fluxes. This is the case for both units. Out PSF varies very strongly with energy. Large at both ends of the scale, extra large at low end, but turns out not to be so important. But mosaic_spec is actually asking for PSF in image domain, not in

shadowgram domain, so the PSF is dominated by mask hole size. The aim is to make stable flux values, but CBJ thinks we should use PSF that gives the largest flux. Unfortunately mosaic_spec fluxes increase continually with increasing PSF. For JEM-X mosaic_fit fluxes are found by integrating the image peak, but for ISGRI it takes the peak value. But is the dependence of PSF of the tool a non-physical effect? Is it a problem with the program? Appears that you also need to let the Background be fitted for each value of PSF too. SP suggests this non-physical PSF evaluation is something we should check.

~~~ AI on NL to send all his plots to SP who can forward them personally to RW for further discussion.

Done!
SB suggests a very simple test on a small selection of data to see if there really is a problem.
SP suggests that for a non-gaussian in the data, a big PSF will force the program to fit more and more in the wings rather than the peak, and therefore one could see these same effects. So it could be a model mismatch.

*** AI: on NL, NJW and CBJ: to find the true imaging PSF for both units that can be used with mosaic_spec.

For weak sources these results are okay, since otherwise we can't see them at all.
Back projection efficiency vs. energy: ratio of flux values found by mosaic_spec and j_ima_iros depends on energy. These seems to be because position resolution is energy dependent which couples to the backprojection procedure. Also gas penetration is also energy dependent, and photons with unknown interaction point cannot be correctly back projected, which leaks events from the source peak. This problem must be corrected with a new ARF or by adding an empirical efficiency factor for image fluxes.

New parameters for j_ima_iros (NJW):
Only really needs a vote of the assembled SDASTers. Proposed two new input parameters are: no. of output user-defined images (userImagesOut or specImagesOut) and no. of output detection imagaes (detImagesOut). NJW is opposed to userImagesOut. We need to choose between these two output possibilities. The last is already available though not specifically and only needs to be made visible. SP prefers that j_ima_image determines how many images are saved to disk to save on disk. what we're really voting on is the names, not the functionality.

j_ima_src_locator and source list fluxes (NJW)
Fluxes from j_ima_src_locator and from the srcl-res are consistently different. Images consistently give fluxes that are lower than j_ima_src especially at low evergy, just like NL showed us. RMS variation in the fluxes is significanly different too, even though fluxes were first normalized the same size before calculating the RMS variation. Moving up to higher energy bands brings the rms values together.

*** AI on NJW: To find out how the flux extraction from j_ima_iros and j_src_locator compare in both units and absolute size.
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Full discussion of the absolute meaning of the fluxes that are derived by the two programs. Fitted PSF widths from j_ima_src_locator drops significantly when going to higher energies but levels off at just above one pixel. This agrees with CBJ's results, though doesn't rise as dramatically at the lowest end. This result seems to be sensible, but mosaic_spec doesn't give semsible results, giving too low a PSF. NL feels this tool needs to be improved to give better, more realistic PSFs. CBJ: PSFs for the JEM-X instrument is well fitted by a gaussian, and 1.5 on his plot corresponds to 1.0 on NJW's, so his minimum value (in mm) is slightly lower than NJW's. At highest energies, 30 to 40keV CBJ's PSF begins to rise again but this couldn't be seen on NJW's plot that ended at 30 keV. This suggests that CBJ's images have sharper peaks, but he restricted himself to on-axis sources, which could easily explain the difference. NJW could remake his figure with only on-axis sources to see how CBJ's and NL's images compare.

PCA-JEM-X fluxes (EK)
Found fluxes with mosaic_spec in two bands 3-10 and 10-25keV to find JEM-X fluxes from GRB monitoring program in rev 736, using fixed source positions. He then normalized found fluxes to the Crab for both JEM-X and RXTE/PCA bulge monitoring. Though significantly more scattering for JEM-X, the general levels for the two instruments compare very nicely. This was done with OSA7.0. Same procedure done 2 years ago show considerable differences, which indicates that the JEM-X software is slowly converging on how it should be. RXTE/ASM results however lie lower than either JEM-X or PCA, so that would appear to be a problem for the RXTE team.
Appears that PCA error bars are strongly unestimated. For lower countrate sources JEM-X also seem to agree but more analysis and comparison is needed. ASM shows a lot of scatter for the weaker source (more than for either J or P). Same general results with second weak source, so conclusion is that JEM-X results from mosaic_spec agree very well indeed with PCA, and ASM has some problems. Rebinning in finer bins could help illuminate the small discrepancies in the bright source.

Next OSA (general discussion): NL and NJW must tackle the bug which makes j_ima_iros crash and handling errors and error messages. Then it can be delivered for OSA integration. NL's various empirical flux factors for images are not tabulated, but are found from an algorithm that finds the factors for a user's own energy bands. Why is a new ARF not a solution for this problem? Because NL's flux factors depend on PHA not energy. Should we deliver an energy efficiency table for OSA8.

*** AI on NL and NJW to explore how the image corrections should be implemented and when.

SP: What should we do with SL's software? SP would like to keep it as standalone tool with description on how to use it for quick extraction of results in short time bins (i.e. won't be able to compare fluxes over long intervals, and j_ima_iros should be used instead). Also SL's tools should remain in the scripts for those who still want to use them.

*** AI on NJW, NL and SB: what to do with Stefan's software for OSA8 and the long run.

Where do we go after OSA8? Should we get rid of Stefan's software entirely? We have dream to produce j_source_properties with flux determination like that in j_ima_iros, which will have good

lightcurve extraction in many bins (64?), so that would be a future goal for OSA9. Corrections must be made on the fluxes, not on the raw counts because this messes up your statistics. Contents of spectra and lightcurves should be identical, the only difference being that the first has few (1) time bin and many energy bins and the latter has many time bins and few energy bins. Further discussion must be offline. EK focus of software developement, seen from the user point of view: nothing he can think of.

Crab Calibrations (all):
NJW: We could do with Crab calibrations quite far off axis. Do we need long starings off-axis? IBIS and SPI want this for pinning down their systematics, but we should be able to do this from the data we have. If it developes with time, we'll need additional data. A five by five dither should be enough for us to test our off-axis and partially code FOV.
SB time developement of systematics: would also be revealed by on-axis observations.
EK's plots show that we don't have nay 5deg off-axis crab calibrations and perhaps we could order an observation here. It would also be nice to complete our 4deg circle of crab observations. CBJ thinks we should understand the systematics involved in the data we already have before ordering up new ones.

*** AI NJW, NL, SB: consider what we really want in the Crab calibration observations.

CAO: Xe analysis, gain aging and temperature variation corrections (see my presentation)
CAO to email Pavel Binko whenever she needs access to private science data.

** CAO to update calibration reference channels for both JEMX1 and JEMX2

IMOD updates (NJW): 5 new IMOD tables: CFTM, CFEX, CFEY, CIEX and CIEY which are respectively time correction of slopes; flux correction as function of energy and x or y; and image correction as function of energy and x or y. DETN-MOD table will be added to IMOD group to describe the problems with each pixel on the detector for which the ordering of the pixel description values has changed compared to DETE-MOD and one new one has been added: 4, hyperactive anode.

Next Meeting: When, what timeframe? End of January would be possible OSA8 release. March or April are likely for the next meeting.

** AI everyone to send their presentations to CAO
** AI on SP: to discuss mosaic_spec with RW, or just get him to answer NL's email.