SDAST Meeting #35

Copenhagen 2006-04-06 and 2006-04-07

Participants: NL, CAO, SB, JC, CBJ, and NJW from DNSC
Stéphane Paltani, ISDC
Silvia Martínez-Nuñez, University of Valencia
Tim Oosterbroek, ESTEC

Welcome address by NL.

Old action items (CAO): http://www.spacecenter.dk/~oxborrow/sdast/AIlist.html

JEM-X status (SB): Increase of particle background since the launch of INTEGRAL by 60-70%. The dead time has increased from 12% to about 17% because the processor has to work more but the rate of accepted events is almost unchanged. A correlation of the hardware trigger rate and the Oulu neutron monitor has been found. JEM-X can contribute to the saving of TM by switching off the DPE of the dormant instrument (that is currently sending 1 packett per polling cycle).
Crab calibration with a period of lowered HV: one with 4 steps down and one with 2 steps down.
Fine tuning of source position determinations by the mask temperature – solar angle correlation.
The gain increase with time continues (interrupted by regular stepping down of HV settings).
Future:

- 1% increase of gain per revolution relative to original gain
- Gain is reduced 12-14% per step of HV
- After 250 revolutions gain has increased by a factor 2.5 (when corrected for HV)
- At end of year 2010 this factor will be around 10
- We must foresee ~11 steps of HV reduction
- We expect further changes of the spatial gain map

The energy resolution has not degraded in JEM-X1.
Gain recovery after switching off

- For radiation belt passage: 2 hours
- For extended period (months): 5 hours.

The latter value is expected to increase slowly in the course of time.
The spatial gain correction map might be different in this relaxation period compared to the stable operation so watch out for energy resolution!

Future problems of gain correction: Cd has halflife 1.24 yr, Fe55 2.7 yrs.
End of 2010 Cd rate will be 1.1% and Fe 13% of launch activity. The gain calibration/correction software is to be updated soon (also because of grey filter activity at periods).
A note on imaging: Sources separated by 2.8 arcmin (of about equal intensity) can be detected clearly as two sources.
Conclusions:

- JEM-X is stable
- Hot spot activity is low
- Particle background is high (Solar minimum)

Earth observation has provided internal background spectrum

Anode situation (JC): Recently 1 anode lost in JEM-X, 3 adjacent ones in JEM-X2.
Total number of anodes with problems: 44 and 49 for JEM-X 1 and 2 resp.
List found at `/r6/jemx/jemx_history/Anodes_list.txt`

Action: on JC/CAO: Make list of anode status available on web (SDAST forum)
Action: on NJW: Initiate procedure for update IMOD files with detector map.

Earth observation (NL): In one case (out of four) some kind of emission from the North Polar region was visible below 5 keV.
The angular extent of the Earth is large enough to completely block the JEM-X FOV. Therefore the Earth occultation observation gave us a unique chance to observe the part of detector BKG which does not enter through the mask (the 'internal' BKG).
The level of the DXB as measured by JEM-X seems to be higher that the HEAO value and with a softer spectrum; we do not know why. Perhaps the presence of the Earth in the FOV may change the X-ray background (2/3 of the photons are stopped on the mask and collimator and they may contribute to the background).

Science KS 1741-293 paper (SMN): The derived flux seems to be correlated with the dither pattern but this could be a result of the way that data are presented. This will be investigated. This case can be used as a test case for the new j_src_properties executable.

Source property extraction – wish list (NJW):
This new tool will use j_Ima_iros methods to make both spectra and lightcurves. It should be delivered in May 2006. OSA6.0 is relying on this tool as an important component. The lack of IROS functionality in the current tool(s) gives problems in crowded fields (a single strong source was enough to disturb the spectral extraction from the weaker sources). Background subtraction is also simplified.
The PIF routines used in j_ima_iros have been moved out into a separate software package "jmx_lib_pif", with its own header files and initilization routines. A new version of j_ima_iros (1.5) has been written using this new tool.
The following points must be considered for the new tool:

- Output of event list with PIF information per source
- Graceful if source outside FOV is requested
- X-ray source information from various source
- Default binnning a factor of three oversampling (in contrast to what we have now
  - where we have an oversampling of perhaps 10
- Spectral binning depending on the number of counts from the source
  - User defined binning table
  - User control to finetune proposed binning
- All functionalities of the old programs.

Some functionality of j_src_properties (NL): Produce spectra, light curves, and event lists with illumination fraction from each source.
Work when source is outside FOV.
Associated with each source ‘signal’ counts and ‘background’ counts (for sources in partially coded FOV only relevant part of detector should be used as backgrund).

Reduce effect of strong source in FOV (when analyzing for weak sources) by eliminating the part of the detector illuminated by the strong source.
More complex multi-source selections should be done off-line based on the event lists.

One should take into account that combining spectra from a number of science windows so the binning should be the same in all cases. (ISGRI has one fine binning and one coarse binning table). The spepick tool can be used to combine spectra using the (inverse) variance as weighting factor.

Shortcoming of j_ima_iros: the source positions derived by the shadowgram fitting are not as accurate as the ones found in the image (by gauss peak fitting). JEM-X1 and JEM-X2 give the same position between themselves but noisy with respect to catalog positions.

Should the ARF be calculated per source per observation (for N observations) and then fitted in XSPEC12 with N datasets consisting of (spectrum, error, ARF)? But most users might want to combine the spectra into a single one (with proper weighting) by applying suitable correction factors to the events. In that way the fitting procedure becomes more transparent for the user.

One should also keep in mind that spectra can be derived from mosaic images.

For light curve production as much of the ARF correction should be put into the flux otherwise the light curve could look strange.

Script requirement: Try to keep the names (and significance) of parameters the same as for j_src_spectra/j_src_lc. Also the output formats should be kept. Give list of parameters as early as possible for the scripting generation process.

Action (SP): Verify (and urge programmers) that output of j_src_properties that light curves are expressed in flux and for spectra the ARF is correct taking into account the current gain.

ISDC news (SP): Released new IC file two weeks ago. ISGRI also has different ARFs for different observation times but the effect is not large. ISGRI response has not quite yet settled and will not be so for OSA6. OSA6 is mostly driven by JEM-X i.e. j_src_properties. New update of ISR (INTEGRAL Source Results) processed by OSA5.1 software. This has a webpage that can be reached from the ISDC home page. SP pushes for update of j_ima_iros so that fluxes can be extracted from the images and therefore from mosaic images.
ISDC will be engaged in GAIA hopefully with some funding also.

IT representative at ISDC (JC): April JC, May NJW, June SB
What should we do when we are there?

- Before going: Inform Stéphane that you are coming and supply a few items to discuss
- Discuss ISSW issues with users and IT people (Bruce, Mark Gaber)
- Recent ISWT observation analysis (GPS, GCDE) compare results with other instrument team members
- Check the instrument station
- Talk with shift team in operations room (log book check)
- Check with Andrii and Stéphane the status of documentation
- Discuss with Simona Soldi on JEM-X work

Mosaicking, source finding and source fluxes (JC):
Improvements:

Output list of used science windows in mosaic header
SPR 4377 on energy selection has been fixed
Coordinate transformation now works for large angles with WCS
(parameter selection)
Significance map in sigma units is in place, except perhaps off by a constant factor.

Discussion on exactly how to define the flux conservation and how to get the significance in sigmas. Is the result already in that unit? The distribution of values in the significance map seems to be a factor close to two too wide. There is some intrinsic features in the j_ima_iros that still persist and those may affect the j_ima_mosaic results.

The source finding tool: jwfindsrc (NJW): A tool to search for sources in j_ima_iros, j_ima_mosaic and other FITS format images has been made.

- Uses mexican hat kernel to smooth and flatfield in one operation
- Or fits the PSF around each pixel and use derived amplitude and chi-square
- Modify these two possible methods with local RMS values
- Produces JEMX-SRCL-RES ready for use with q_identify_srcs and cat2ds9

It seems reasonably capable of finding the sources. The most important input information is the width (sigma) of the PSF expressed in pixels. For map projections where the PSF is constant in angular space but not in pixel space this constitutes a limitation – though not a serious one. jwfindsrc should be delivered as part of OSA6 and it could be part of level IMA2. It could also just be a separate tool.
The option of inputting a (user) catalog should be added with the advantage that known sources may be accepted with lower significance.

Action (NJW): Provide Simona with list of analyses to do for the science validation.

JEM-X Electronic Efficiency (CBJ): Bootstrapping method for getting the electronic efficiency by on-axis Crab observations with two different HV settings (and hence two different gains). Forgetting about the finite energy resolution of the detector the Crab spectrum is derived to have a photon index of 1.99. An estimate of the influence of the energy resolution gives a photon index of 2.06. Testing the result on other Crab data (revol. 365) gives the same result with good accuracy. Applying the same method to revol. 422 data gives the same result.

Action (NJW+?): Prove that the electronic efficiency will produce high quality ARF for Crab observation interpretations.

Friday 2006-04-07

Science Search for X-ray bursts (SB):

Public data
Galactic bulge
2 new bursters discovered

XTE J1739-285 was thought to be a BHC but type 1 bursts (24 seen) showed that it is a NS system. New burster IGR J17254-3257 and 1A 1742-294 verified.

[Remark by SP: Are images made with j_ima_iros? There has been a problem with a rather short duration getting a division by zero – an SPR has been written].

Science Focussing Gamma Radiation (NL): What to do in Gamma Ray Astronomy after INTEGRAL? GRI consortium. Studying formation flying with Laue lens.

JEM-X gain/revolution web page etc. (CAO):
http://www.spacecenter.dk/~oxborrow/sdast/JEM-Xforum.html
is an entry point to much information about JEM-X gain behaviour and documents etc.
The gain – averaged over the detector surface – expressed as number of (linear) PHA channels per keV should also be added on this page.

Action (CAO): Update the gain web page with average gain (PHA/keV).
Action (CAO): Make a clear statement: Read the note if the color differs from the standard color.

Access to science data (to verify the Xe and other line positions) must be done with the help and password of NL (just a single team member can have this permission).

Gain history tables as IC files (CAO, SP): A template has been made for the gain history table made manually to correct for errors in the automatically generated one. Note that this table is not an index table as is the case for the ISDC version. The future versions of the gain history tables should contain the averaged gain factor as well.
It is foreseen to have a single IC file consisting of an index table and an number of children, one per revolution where special values should be used. Datastructure name JMXi-GAIN-HIS-IDX and filename jmxi_gain_his_idx_0000.fits.
The check for existence of special gain history values should be done in the script where the functionality has already been built in.

Action (SMN): Implement the selection of the gain history table in the script.

It is required that the assessment of the gain correction step before the processing of the consolidated data begins, so there is one or two weeks (normally) to react, either give a ‘go-ahead’ or send updated gain history table. Can this validation be done at ISDC as a task of the operators? The procedure of CAO implies the use of IDL which is a difficulty at ISDC.
The gain factor as a function of time is required for deriving the electronic efficiency to be used by e.g. j_src_properties.

SVR updates (NJW): (Include notes by CAO and Silvia here).

Action (SB): To check whether there has been changes in the spatial gain that require update of the SPAG table.

No required update of SPAG section of SVR.

Internal background information from Earth Observations should be added to the background section.

Action (CBJ+SB): Provide new figure of gain increase

Action (JC): Provide new figure on detector energy resolution

Add a piece to deadtime description how the increased particle background has increased deadtime by about 5%.

Add a bit on absolute timing problems for INTEGRAL due to groundstation delays

Action (CAO): Check that STATUS values are in correct order as shown in table.

Action (NL): Edit (mostly shorten) description of IROS procedure.

Remove section 3.4 and other imaging sections that don't tell the user what s/w is capable of.

Update fig. 3.1 to have white background around image (and perhaps find a better field).

Improve figs. 4.1-4.7 and table 4.1 to show results of current s/w. In fig. 4.7 add limit curve.

Add a bit about different procedures that can produce fluxes.

Page 29: Should we add a bit more related to promises made on the last line of the current text?

Somewhere a section on flux derivation (how to extract from j_ima_iros images) based on comparisons with CBJ images should be added. Also experiments with attenuating and mixing Crab observations to produce faked observation with known flux values could give some input here.

Should we ban the non-imaging modes or a subset of them? Currently it is strongly recommended NOT to use them. For AO4 TAC should try to convince observers only to use FULL imaging mode. NL: We should keep the data modes of JEM-X as they are in the case where something goes wrong and they may be required again. In that case we will have to update the SW to handle them well.

Person power (all): CAO needs more time for Planck work. JC, SB, NJW are full time on JEM-X. CBJ wil on the average have about 50% available for JEM-X. NL can also spend 50% on JEM-X, in particular for the j_src_properties making. SMN has full time on INTEGRAL analysis in 1.25 yr from now including script updates and scienctific analysis. TO will have a small fraction of time for JEM-X analysis etc. after July 2006. SP can spend 15-20% on JEM-X including everything e.g. questions on instrument behavior. PK is willing to help but he has less time for it. Clear input and guidance is requested. Simona Soldi can use 15-20% on JEM-X evaluation and testing. Andrii Neronov will also be available for a small fraction of time.

The task of updating the limit file should be taken off PK's shoulders and given to JC.

The question on deriving source fluxes and improved source positions (involved: SB, SBJ, NL, SP, and SS) must be looked at. Similarly the method to extract flux from the mosaic images should also be established. Recommandation: Use simple test cases to verify that intensities and variances are transferred correctly.

Checks of the significance calculations should be done both in images and in light curves. One possibility is to use Crab data where we know the number of sources photons or attenuated versions.

Plans for OSA6 (all):

j_src_properties – new executable (NL, NJW, end of May 2006)
j_ima_mosaic (various updates) (JC, end of April 2006)
jwfindsrc – new executable (NJW, mid of May 2006, IMA or IMA2?)
j_cor_position – updates (CAO, end of July 2006)
j_cor_gain – updates (CAO, end of June 2006)
j_calib_gain_fitting (CAO, end of May 2006)
IC files (jmxi_gain_his_idx_????.fits) mid June 2006
j_ima_iros (update and SPRs) (NL, NJW end of May 2006)
jmx_lib_pif (new component) (NL, NJW, end of May 2006)
Scripts: jemx_science_analysis, j_imaging etc. (updates for new components and SPRs) (SMN, begin of June 2006)

Internal OSA6alpha in June 2006 for serious testing before releasing OSA6 that then could happen in September 2006. This means that j_src_properties should be handed over to SMN for script update well before June 2006. Also IC files (updates) must be available at that time.

Next meeting: August 2006, to be confirmed.

AOB: It is suggested that for the next meeting the time is shifted so that the meeting starts in the morning and ends around noon the next day. This fits better with flight schedules.

/NJW (with inputs from CAO and SMN).