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JEM-X SDAST meeting 27, Nov 24–25, 2003 at GACE, University of Valencia, Spain

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December 5, 2003

1 Participants

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2 PK: ISDC news and status

- Operations are running quite smoothly. No dramatic effect of increased solar wind/particles intensity.
- OSA3 release has been converging very slowly but is coming together now. Mostly
- ISGRI is making a step forward e.g. spectral extraction is working better, in a more standardized way.
- Many people are unhappy with AO2 outcome.
- Lots of efforts for coming INTEGRAL workshop.
- Worries about long time future for ISDC, now that Eddington has been cancelled.
- Lots of lower level changes in staff. Laurent Lerusse has moved to Garching. Alain Aubord will reduce ISDC involvement to 20%. Pjotr Lubinski will become assistant system manager. Masha Chernyakova is going t on have 6 months maternity leave. Post-doc position is coming up.

- Roland Walter has obtained permanent position as Maitre d'Enseignement et Recherche at Geneva University. Funding for that position has not been secured yet, so for the time being he remains on project money.
- Planck is not progressing very fast.
- Thierry Courvoisier will take a sabbatical in first half of 2004 .
- Peter Kretschmar is looking for a new position, possibly at Southampton. SDAST should come up with ideas about how to proceed without Peter.

3 NL: Instrument status

- Alot of Solar impact; background was increased by a factor of two. First in a GRS1915 observation so the increased was not noticed i in the beginning. GRS1915 was particularly strong at that time.
- One extra anode behaves badly.
- The energy resolution gives us some worries.
- The calibration resolution seemed not to deteriorate, but this is no longer true, there is a degradation. No news on the position resolution. The 22 keV peak was originally at 9.5% but is now at 11% relative resolution (FWHM).
- The gas composition was checked for FM1 in the laboratory. This detector was exposed to heavy radiation first for an analysis of the increase of gain and loss of anodes. The gain increase is indeed reproduced in laboratory spare, but the more dramatic change is that the detector gain increase in concentrated in the region where the irradiation had been most intense. It is assumed that the impact of counting (mostly at high rate) disturbs the gain and that this disturbance is increasing with time.
- The calibration sources are not representative for the entire detector but they do track the general behaviour of the detectorr: gain changes are are very localised.
- An observation with counts from the FRSS sources included in normal data was analysed. This has revealed that neighboring anodes behave differently with respect to gain i.e. gain varies on a distance scale in the order of 1 mm. It looks as if this localised glitch effect is increasing. There are two types of charging: surface charge and volume charge, not clearly understood yet. Perhaps the glass plate has been damaged by cosmic rays.
- At the next Crab calibration that presumably will take place in Feb, 2004, there will be a switch from JEMX2 to JEMX1 as the operating detector. We expect that JEMX1 will have survived better not being used, but then will degrade similarly to JEMX2.
- AA special issue is out. Now we are preparing for the Munich workshop and developing programs for source search etc.
- The vignetting problem was discussed at the last meeting.
- We also need to be careful with the alignment issue. This is particularly important when looking for sources not directly found in the data.

- Also the X-ray catalogs are not very precise to 10 arcsec or so. In particular GRS1915 had a bad position (Now there is a gnrl_refr_cat_0010 with better positions for many sources. SIMBAD is generally good but there are errors there as well. Conclusion is that when in doubt consult the literature. In some cases JEMX or IBIS might give a better position.

- There is also a slight rotation between the anode strips and the mask. (See NL's figure with position errors plotted). 97% of positions within 1 arcmin radius. The NL alignment numbers should go into the ISDC definition (misalignment matrix).

4 PK: OSA 3.0 status and mini-release

- The software and IC files have been frozen. The formal release is planned for December 10, 2003.

- The scientific performance report is due Dec. 3, 2003.

- The IC tree has grown too large (SPI has 1 Gbyte of old data still in the tree).

- An update of OSA: 3.1 is foreseen for end of January, 2004. Ypdates should be ready by beginning/mid January.

- For OSA4 the expectation is June, 2004.

- Jürgen Knödlseder has made an improvement for SPI, also a new set of SPI-tools.

- What do we actually plan for JEM-X software? We need a real plan with spelled out details and a priority list e.g. planned improvements. We need to avoid working in separate corners because the programs may not work together.

- The Crab spectrum does not look correct with the new spectral extraction. There was also a case with Cyg X-1 where the levelling o out of gain changes was misleading. e.g. in the image flux extraction.

- SL: Taking varying energy resolution into account in the new spectral extraction will improve the spectra,in particular at l low energy.

- We need to be careful about what we say to the users on where (in energy space) the results are reliable.

- Another example is that background correction of images seems to overdo the background subtraction so no improvement is obtained.

- Variance maps should be made for ISSW imaging.

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AI 26.2: On SL: Send NJW data on latest source extraction results and limitations. Due: 3/12/03 AI26.2
AI 26.3: On SM: Send NJW background handling results for SVR. Due: 3/12/03 AI26.3
AI 26.4: On CAO: Send NJW energy resolution results for SVR. Due: 3/12/03 AI26.4
AI 26.5: On JC: Send NJW Xe-energy resolution results for advanced SVR. Due: 15/12/03 AI26.5
AI 26.6: On PK: Send NJW binning data results for SVR. Due: 3/12/03 AI26.6

5 PK, NJW: Proposals for data mode-dependant response functions

- The FULL imaging spectral fitting works OK. Other modes that have been used: SPTI, REST, SPEC.
- We could make one response per type. This requires new branching in the IC tree.
- There are difficulties with combining several data types e.g. FULL and REST data together. The conclusion is that the data types should be analyzed separately and then combined e.g. in XSPEC. The script could be made to discover that several types are present and call spectral extraction several times.

AI26.7 **AI 26.7:** On NJW,JC: Make response matrix for REST and non-imaging modes. Due: 1/04/04

AI26.8 **AI 26.8:** On PK,SMN: Adapt scripts to handle the existence of multi-mode data. Due: 1/03/04

AI26.9 **AI 26.9:** On PK,NJW: Make spectral response templates with data mode tag keyword. Due: 1/03/04

6 NL: Shadowgram simulation

- The mask support structure does play a role in imaging. The two rings appear in the shadowgrams.
- NL has a set of subroutines that defines the open holes for a specific source position.
- This interface needs to be described well.
- The pixel sizes are different and this is corrected for.

7 JC, NL, NJW:Mosaicking tool

- Comparing the ISDC mosaic and weighted mosaic pictures and the weighting does really work. The sources are more apparent and the noise is smaller.
- New mosaic_weight tool has more freedom of parameters such as image size, center and size of input images.
- NL: There is an error in the variance map. Signal and standard deviation

$$Signal_i = N_i - B_i/k$$
$$Sigma_i = \sqrt{(N_i + B_i/k^2)}$$

  k is the number of background pixels. Background is sampled in a diamond shaped region to avoid too strong effect from the collimator.
- Five (or six if you want flux as well) maps are required for the mosaic images to be able to continue building the mosaic:
  - Signal
  - Exposure: Product of vignetting and observation time

- Variance
- Sum of weights so far used
- Sum of square of weights (to handle variance part)
- Flux information

- Getting sensitivity limits and upper flux is also an important issue.
- Taking the image_mosaic code from Roland Walter and change it to include the JEM-X specific is also a possibility.
- The SDAST page contains the longer e-mails with discussion and explanations. Technical notes with more complete discussions should be published on the DSRI/JEM-X page.
- The NL images from midisky_xx need an index table to be used by image_mosaic.
- Nicolas Produit reminded us that the statistical error depends on the number of counts + 1. This may be important for spectral extraction from regions with low number of counts (in particular when divided into energy bins).

AI 26.10: On NL: Update mosaicking discussion to formal document. Due: 5/12/03 AI26.10

AI 26.11: On JC: Include all 6 output images in mosaicking software. Due: 10/12/03 AI26.11

AI 26.12: On NL: Discuss imaging/mosaiking etc. with RW at ISDC. Due: 5/12/03 AI26.12

AI 26.13: On JC: Make a data template for midisky images made by image_mosaic. Due: 20/12/03 AI26.13

8 ALL: ISSW status

- CAO preparation and calibration: j_prp_status_table, j_prp_verify nothing outstanding. j_calib_gain_fitting has one SPR and two SCREWs (not difficult). j_calib_adc nothing outstanding. j_calib_gain, no SPRs/SCREWs but new smoothing model might be required. j_cor_position, no SPRs, a SCREW on hotspots. j_dead_time_calc, no SCREWs, a SPR on obsolete attribute list.
- SM: All components delivered and no important SPRs/SCREWs are outstanding. These models have not been used very much, so it is important to do some fine tuning.
- NJW: imaging: Most important changes in SCREWs and SPRs are using DAL random number generator, introducing variance map, better vignetting correction, changed flux units. PK: We need a better definition of detection significance to translate to number of sigmas.
- SL, source extraction: see below (Source extraction).
- PK, binning tools: Basically they work; no outstanding SPRs and SCREWs. Normalization should be adjusted to units in imaging and source extraction. NL: The dead time correction seems to work fine.

AI 26.14: On PK: Write a SCREW on binning components to use normalised flux. Due: 3/12/03 AI26.14

AI 26.15: On NJW: Write SCREW to change to agreed flux units. Due: 3/12/03 AI26.15

9 SL: Source Extraction

- Pixel Illumination Function: (PIF)compute pixel shapes and area. High resolution event distribution
- Loop over detector pixels (and 4x4 subpixels) Find pixel position. Raytrace through mask and collimator. If open then add 7x7 pixel response map
- Then the illuminated area on the detector is selected as well as the shadowed part is selected for background determination.
- Development in progress: Bug fix (error estimates, detector spatial resolution as function of energy).
- PIF for extended source such as the Crab. IROS: j_src_correlation (pifCut → pifInOpen/Closed)
- The background model inclusion must be for OSA4 right now the background is derived from obscured detector areas.
- Problems seen in a number of tests. New code with precisionLevel = 20 corrects better for vignetting than precisionLevel = 0.
- Error estimates: Done by randomization of event positions and see how the result is changed.
- Reduced Chi2 is around 1 for light curves. The case of looking at a blank field is more tricky since the lower lying points have smaller errors that the high lying points so the mean comes out too low i.e. below zero where it should have been.
- Statistics at low countrates:
  Variance = no. Of bin counts, is a poor estimate. Errors are non-gaussian. They are not symmetric
- For faint source spectra better error estimates are required. Other option is to use the f-tool grppha to obtain better statistics by rebinning.
- XSPEC handles the case if both spectrum and background are supplied and have gaussian statistics (XSPEC uses C-statistic).
- Still not compliant with XRONOS. TIMEDEL column → keyword Solution: Set DEADC, VIGNET keyword and/or add FRACEXP column.
- For OSA3 data a small shell script with f-tools will be provided (already prepared).

AI26.16 **AI 26.16:** On SL: To verify XSPEC C-statistic approach. Due: 15/01/04
AI26.17 **AI 26.17:** On PK: Check GRS1915 position in gnrl_refr_cat_0010. Due: 1/12/03

10 NL: Source detection

- Fixed alignment (misalignment).
- Studied GRS1915 across about 20 SWGs with a dithering pattern. There are conspicuously low countrates when the illuminated area of the detector is very low i.e. $< 1cm^2$. In the case of low energy there is a correlation between the recorded count rate and the illuminated detector area. This correlation can be corrected for.
- Conclusion is that it is possible to make good light curves across SWG boundaries.

- Searching for weak sources. Transient, found in two SWGs IGRJ173912-3020 the new JEM-X source (Revolution 53, PID 65 and 66 (and 68)). To do: look into IBIS data, check if the source is still a active.
- SMN: Spectra of J2032.2+373815 revolution 82. With the new spectrum extraction there seems to be a feature around 8 or 9 keV a dip. It is a faint source, though.

AI 26.18: On SL: Run rev. 53 (PID 65/66, GRS1915) data set to check NL's results. Due: 15/01/04 AI26.18

11 ALL: Contributions to 5th INTEGRAL Workshop

- NL: Invited talk in JEM-X performance. Discussion of obscured sources in the Galaxy.
- JC: On the mosaicking process.
- NJW: The JEM-X survey for weak sources.
- PK: Vela X-1.
- SMN: Results on 2030. 2103 optical + INTEGRAL results. Survey of SMC (so far seen only one source). 3C273 later revolutions.
- CAO: Poster on software mending glitches, hotspots.
- SL: Poster on GRBs, AA paper elaborated. Crosscalibrate the Crab INTEGRAL and XMM.
- SM: With Osmi Vilhu and Diana Hanikainen on Cyg X-3, GRS1915,

12 PK: eXtreme programming

- A seminar at ISDC on software development. Intended for complex software projects. Classical pproach:, waterfall:

$$specs \rightarrow architectural \quad design \rightarrow detailed \quad design \rightarrow code \tag{1}$$

- Important elements of eXtreme programming:
  - Breakdown work in small tasks (max. 1-2 weeks, better days)
  - Rapid turnaround, do waterfall in hours or days
  - Integrate quickly and often, use integrated system for feedback
  - Share code development, ideal 2 developers per screen
  - Change and adapt permanently
- Try to avoid specialists; if there is a single specialist and they get tied up the development is halted.
- Techniques
  - Design test first! Test actual functionality. Test drives software design.
  - No comments in the code. Variable names and function calls should have descriptive names, clear interfaces and well followed standards.

  - Dont guess the future! Implement the current requirements but be ready to change the code completely.
  - Make it work. Make it clean. Make it fast. First implementation is only a draft. Rewrite cleanly once problem is solved.

- On our ISSW:
  - Our code is not clean.
  - Changes are quite slow
  - Single specialists for each step
  - Unit tests are usually simplistic or unrealistic
  - No organized code sharing

- There is a web-site for eXtreme programming.

13 SM, NL, ALL: Background handling

- Presentation of corrected shadowgrams with good events only, predicted background and the difference.

- In revolution 41 there are about 20 cts/s in the background (only blank fields in that revolution). After that there seems to be more background counts. In revolution 102 there are about 30 cts/s in the background. This is due to the change in selection criteria that happened in revolution 45.

- Smoothing of the background map makes background subtraction worse, so the background features are very localized, the ears in particular. A (partial) reason for this could be the different size of the individual pixels so that overpopulated pixels would spill into underpopulated pixels nd cause erroneous subtraction.

- The estimated background shadowgram should be compared with original shadowgram to avoid too many negative values after subtraction.

- There are no ears below 6 keV.

- An attempt to find a correlation between the sun-angle and the orbit phase and the background failed. Orbital phase is the only parameter for which there are different models.

- The revolutions during eclipse periods have not been studied separately but the background could be different for those.

- The IREM is more sensitive now and there are data in the HK that can be used for background model selection. In the period of November 1–20, 2003, there are enhanced background levels.

- A test of the background models should be done before they are delivered to ISDC.

- A tool for tagging the SWG index group with values selected configuration parameters is a possibility (IBIS has this).

- The detector sensitivity degrades in the outermost 5 mm rim due to veto-ring rejection. Usually this region should be excluded from analysis.

AI26.19 **AI 26.19:** On NJW: Provide a list of SWIDs to SM with little source contamination. Due: 1/12/03

AI 26.20: On SM: Write SCREW on dal_verify: check corrupted grouping table numbers. Due: 15/12/03 AI26.20

AI 26.21: On SL: Write SCREW on source extraction: include bkg. subtraction. Due: 15/02/04 AI26.21

AI 26.22: On SL: Include bkg. subtraction in source extraction. Due: 15/04/04 AI26.22

AI 26.23: On NJW: Make images with and without background correction. Due: 15/1/04 AI26.23

AI 26.24: On NL,JC: Check revolution 41, "empty fields" for weak sources. Due: 15/1/03 AI26.24

AI 26.25: On SB: Provide a list of dates of changes of hardware configurations. Due: 15/12/03 AI26.25

AI 26.26: On CAO: Put instrument configuration change list on the SDAST Forum. Due: 4/01/04 AI26.26

AI 26.27: On CAO: To mention the SWG tagging tool in the ADD "dream tools". Due: 15/12/03 AI26.27

AI 26.28: On ALL: Circulate emails with plans for executables to be in OSA3.1. Due: 1/12/03 AI26.28

14 PK: ISDC tools and environments

- There is a document: Introduction to analysis in the OSA release that covers a lot of the extra programs.
- Specifics of working at ISDC: Make two repositories (REP_BASE_PROD), one for NRT data and one for CONS data: usual addresses are /isdc/pvphase/nrt/ops_1, /isdc/arc/rev_1
- IC tree is evolving. Update ic/ and idx/ic/ to keep up. Your repository should contain:Aux; Scw; Obs; Cat; Ic; Idx/ic; Idx/scw and /isdc/testdata/unit_test/ic_tree
- setup software environment with

  ```
  > source /isdc/scripts/login --ACTIVITY=OSA (
  ```

  OSA gives last official OSA; other choices are:

  - –ISDC_ENV= (use specific ISDC environment)
  - –IC_TREE= (set environment variable ISDC_IC_TREE)
  - –REF_CAT= (set ISDC_REF_CAT DOL)

  exact values will evolve.
- Two examples of ISDC_ENV to use: /isdc/integration/jemx_int/sw_rep (file VERSION exists where ingoing versions can be found) /isdc/integration/jemx_int/sw_rep_smn
- Generic ISDC tools: All have the `--h` feature to get a text file with help
- spe_pick. Extract and combine spectra for a specific source across many SWGs.

- lc_pick. Extract and combine lightcurves for a specific source across many SWGs.
- evts_pick. Create combined event table (RAW+PRP+COR) for single ScW. Can be fed back to ISSW.
- evts_extract. Create generic event list with source weights across many ScWs. Cannot be fed back.
- gti_user (prototype being worked on by PK who asks for a dialog about wished for features) Create complex multi-ScW GTIs, e.g. with period repetitions.

15 Any Other Business

- It was agreed that AI26.7 on NL to provide a more detailed vignetting table should be cancelled since this is no longer an important part of the refined imaging reconstruction.
- The data structure with all event characteristics per pointing, evts_pick makes such a table. PK could make a script to run such a program. This is meant for off-line work. Event tables across instruments could be useful, evt_extract.
- ISDC and the Observatory of Geneva have set up a cluster of pcs (about 20 where ISDC has access to 6 of those) with 2.8 GHz and 4 CPUs each. Together with the grid system to distribute the tasks this increases the job speed considerably.

16 Next meeting

- We could use the Munich meeting for discussions.
- Otherwise the next real SDAST meeting will be 26th and 27th of April, 2004, DSRI Copenhagen

17 New Action Items

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