INTEGRAL Science Data Centre (ISDC)
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http://www.isdc.unige.ch/integral

Known issues

Package: OSA
Version: 11.2
Rel. Date: 1 April 2022

General

1. Values of parameters of "real" type with more than 7 digits are handled badly by the Graphical User Interface (GUI). This can lead to errors when the analysis scripts are run. In particular, using the JEM-X GUI, if the user wants to enter timeStart and timeStop values through the GUI, the values will be truncated if, after you edited the fields, you close and reopen the hidden parameter window. Therefore, in case you want to enter accurate time constraints, make sure you reenter the timeStart and timeStop values each time you have to reopen this window.

2. spe_pick when combining spectra of several science windows does not properly write the source position in the header of the resulting file.

3. ii_light
   tfirst is often not correctly computed, resulting sometimes in many thousands of seconds of empty bins

4. spe_pick
   fails with segfault when extracting jemx spectra from pointings with multiple sources with same name. for example multiple "NEW SOURCE". This happens with particularly bright sources. An example is with 193100500010.001. It does not happen for a known source, correctly identified.

5. ibis and jemx science analysis
   due to backward incompatible modifications in rbnrmf, versions of heasoft later than 6.27 are incompatible with energy rebinning of response matrixes. We require to use heasoft 6.27 or less.

IBIS

PICsIT

1. The spectra extraction with the PIF method is not reliable for the moment (executable "ip_spectra_extraction"). The user should extract the spectra from images (count rates from intensity maps and errors from significance maps) and then convolve them with the RMF/ARF.

ISGRI

1. (OSA11) energy boundaries for the response matrix are taken from the table in the file ic/ibis/rsp/isgr ebds mod 0001.fits. They are chosen as close as possible from the boundaries defined int the input parameters. No boudaries from matrices in previous versions of OSA should be used !
2. The PHA2 files produced by spe pick contain a reference to the response matrix used for the particular

science window. These are referenced in the file system used for the analysis. Therefore, the PHA2 files cannot load a matrix when moved on another file system, unless the user takes care of manually copying the single response matrices and update the entry in the PHA2 file with other tools.

3. In general, systematic uncertainties of about 1% should be added to ISGRI counts, fluxes. However, this needs to be checked accurately by scientists performing their analysis (see also below).
4. Since 2016, ISGRI occasionally experiences particularly rapid and unpredictable changes in the detector response, at the scale of up to 5%, which are not corrected in the energy reconstruction and response computation.
5. In the mosaic build with the option spread=1 the source flux is slightly reduced (~10%) compared to the weighted average of the fluxes measured in the Science Window.
6. The maximum number of sources handled by ii spectra extract is 200 but it is strongly recommended to only fit spectra of the sources that are effectively active (visible, detectable) during the Science Window. In some cases, especially in the later part of the mission (as the number of usable pixels has decreased), the maximum number of sources which can be meaningfully reconstructed with ii spectra extract can be as low as 50.
7. The position of low-energy threshold is increasing with time, due to the detector gain variation, which causes the energy scale to be more compressed when expressed as function of the electric signal in the detector. A safe lower limit for the response needs to be carefully verified by the end user. A rule-of-thumb is to ignore until 20 keV at the beginning of the mission and 30 keV at end of the mission. For imaging, lower energy ranges can be used, down to the low threshold of the instrument, which evolves from about 15 to 25 keV along the mission. However, the low threshold and active status of pixels is changed at the beginning of each revolution, according to the instrument status. Using energy ranges at the limit of detector sensitivity might introduce a strong decoding noise in the image, due to the rapid variation of a pixel response with energy. To obtain clean images and optimize detection of weak sources, we recommend to use a low threshold similar to the one recommended for spectral analysis, which, however, slightly reduces the sensitivity to soft sources. We note that a signal from the source is present al lower energies, but with unstable response. Therefore, if one does not need an accurate determination of a source flux, but wants to optimize sensitivity, more inclusive energy cuts can be made. The same considerations apply to light curves.
9. A problem on-board IBIS causes event times to be shifted by 2 seconds under some circumstances (this is rare). The software tries to correct the data. The keyword TIMECORR found in the event files (*-*-ALL or *-*PRP extensions), indicates whether the correction was done. If you are doing an accurate timing analysis and your data contains TIMECORR>0 please take great care: If TIMECORR=1 or 2, the applied correction should be OK. If TIMECORR=3 you should better not use these data. If TIMECORR=4 contact ISDC.
10. The lightcurve extraction (ii lc extract) is performed by building shadowgrams for each time and energy bin. It potentially takes a large amount of CPU time and there is a minimum usable time bin. The time bin must be such that the total number of maps in the file

isgr-corr-shad does not exceed 2 GB
worth of disk space. The product of the number of time bins in a
science window, and the number of
energy bands must be less than about 9942.

11. ii_pif will crash if the input catalog inCat contains more than 500 sources.
12. At large off-axis angles the IBIS response is not well known and strongly energy dependent. Therefore, the user should be careful when analyzing observations performed at large off-axis angles, above ~10 degrees, since systematic flux variations might be introduced. The systematic flux variations are energy dependent, and therefore the user should be careful both with photometric and spectral analysis of sources at large off- axis angles.
13. Due to lack of a consistent calibration information and the lower end of the energy scale, absolute energy scale of ISGRI is poorly defined below ~60 keV. We recommend systematic uncertainty on the absolute energy scale of 1 keV at 30 keV.
14. Specifying energy range with (e.g. 20.1 - 40 keV) crashes the ISGRI pipeline. It is recommended to choose round energy boundaries, e.g. 20 instead of 20.1 keV.
15. ii_shadow_build
    When extracting products for very short intervals (e.g., 0.1 s)
    high-resolution deadtime computation presents misleading log and wrong fits keywords
    DEADC is not written correctly, and the log output says it is wrong.

SPI
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1. SPI is a complex gamma-ray instrument almost always dominated by background contributions. The scientific validation of the SPI data analysis going on at ISDC and at different instrument team sites is as of today far from complete. Users are encouraged to look critically at any result obtained with the ISDC software, and to use external comparisons and simulations when possible. Spurious results can be derived, for example, when using a wrong set of parameters and/or an incorrect background modeling.

2. The SPI instrument is equipped with a Pulse Shape Analysis (PSD) electronic which carries out a parallel processing of the single detector events in order to provide additional information about their pulse shape. The PSD information was intended to help reducing the background. Unfortunately, the in-flight background conditions are such that even the best experts have failed to achieve significant improvements with the PSD. Consequently, all the PSD related processing is currently disabled in the analysis pipeline. PSD events are simply used as standard single events. The basic user choice is then to analyze only single (+PSD) events specifying detector list of 0-18 in the analysis, or to consider double and triple detector interaction with pseudo detectors 19-84.

3. Different instrumental responses are now included in our system, characterizing SPI before, between, and after, the detector 2, 17, 5, and 1 failures. The spi_science_analysis pipeline cannot currently handle a time variable response. The easiest is to analysis the possible cases independently (our software then selects automatically the appropriate response), and to combine the results later on. It is possible however, to analysis different mixtures of different data together using one of the three responses as they are not too different. Great care should be taken in this case anyway to avoid possible biases (see the Tips and Tricks section of our documentation). The spimodfit analysis can instead handle multiple responses which are appropriately used during the data processing.

The final response accounts for the multiple responses accordingly.

4. The "spiros" imaging software is quite a complex tool with many different options and parameters. Not all possible cases have been fully scientifically validated. The best tested modes include "imaging" and "spectral extraction". Other modes such as "timing" and "spectral timing" and other background methods are being further tested and validated. The spimodfit software is an on-going project which has now reached a stable configuration, but not all the features have been scientifically tested.

5. At least in one case, a long (staring) pointing which is split up into several science windows in the ISDC system is not handled correctly in the SPI data analysis. It concerns: ScWs 008200220010.001 008200220020.001 008200220030.001. Only the first pointing is properly included in the analysis, while the subsequent ones are ignored. Please report if you find any other such cases.

6. The "spiros" lightcurve production has shown some crashes when running large data-sets and a time binning of one ore more days is selected. The program handles correctly a resolution of one Science Window, however, so the user is encouraged to use this finer time binning and merge the results afterwards in case he/she finds similar problems during the analysis of a long data-set.

7. "spimodfit" handles time variability through the use of splines. The spline order can be 0 to 5, 0 corresponding to a piecewise constant function (with one scaling parameter per interval) and 3 corresponding to cubic splines. In many cases, when using n-order splines (with n equal or greater than 1), the fitting algorithm fails to find the optimal parameters. This is thought to be due to over-parametrized time variability because of the additional parameters of the splines. In addition, crashes of "spimodfit" have been reported when using a large dataset, with about 1000 pointings or more, their origin is still unclear and is under investigation.

JEM-X

ISSUES can be classified as

1. Detector gain variations.
2. Near-Real-Time data.
3. Cross-talk between sources.
4. Grey-filter artefacts.
5. Flux extraction methods.
6. PIF-option and mosaic_spec.
7. Data from early revolutions.
8. Restricted imaging data.

1. Detector gain variations.
   The JEM-X detector gain varies significantly for a few hours after the instrument has been switched on. These effects are normally taken care of for the CONS(consolidated) data by IC Gain History Tables which are now produced on a revolution by revolution basis by the JEM-X support team. CONS generally has an energy determination within +-2% for spectra integrated over an entire science window and can be used for all energy-sensitive applications. Noisy revolutions with poorer energy determination do occur occasionally and users should check the JEM-X calibration page to get an overview of the goodness-of-energy -determination for the revolutions they are looking here .

   For help fitting data in complicated revolutions contact Dr. Carol Anne Oxborrow at ‘oxborrow@space.dtu.dk’.

1. Near Real Time data.

When analysing Near Real Time data (i.e. within a few hours from the data transmission to ground, and well before the entire revolution is completed) the JEM-X gain calibration is not available. The NRT data from JEM-X are produced prior to the generation of these IC-tables and can therefore only be used for non-spectral applications: e.g. lightcurves covering all energies, source location, mosaicking with a single energy bin etc. For NRT data we suggest to run the analysis with parameter "COR_gainModel=2" to force the use of a simplified fitting model. The default model (COR_gainModel=-1) can be used again at revolution completion.

2. Cross-talk between sources.
It is a fundamental property of coded mask instruments, that every source in the field of view contribute background for all other observed sources. In this sense cross-talk is unavoidable. Specifically, strong bursts from one source will introduce Poisson noise in the light curves for all other sources. The new light-curve extraction method introduced with the OSA 11 release provides very good separation of the sources, but cross talk cannot be fully eliminated. An important new feature is an automatic search for bursts in the count rate records. This allows to identify the bursting source (or provide evidence that the burst is caused by a fluctuation in the instrument background). (See further details in the JEM-X Analysis User Manual). The JEM-X lightcurves are deadtime corrected. The DEADC parameter in the light curve files are therefore set to 1.0 (for XRONOS compatibility).

3. Grey filter artefacts.
A count rate limiting mechanism, the grey filter, is activated when the total count rate exceeds the telemetry capacity. (With the current telemetry allocation this corresponds to about 100 counts/s or about 1.5 Crab). At the beginning og each science window the grey filter is set to zero (no action). If needed, the grey filter will adjust itself automatically, according to the filling level of the onboard telemetry buffers. Ideally, the grey filter should reject events in a completely random way. However, the mechanism implemented is only pseudo-random. Therefore, some care should be taken in interpreting power spectra of arrival times of events from bright sources affected by significant grey filtering, as QPO-like artefacts may show up. As the grey filter varies over a science window and the artefacts are specific to each particular grey filter setting there may be some "averaging" out of the power spectra artefacts. Anyway, if noticing transient features in the power spectra of very strong sources it should be checked if this is limited to a period of a specific grey filter setting. Please check the JEM-X Observers Manual for further explanations.

4. Flux extraction methods.
The flux of a given source can be obtained either with the "standard" extraction or with mosaic_spec. In cases when the fluxes obtained with the two methods differ, it is advised to consider the one obtained from the standard extraction (SPE level).

5. PIF-option and mosaic_spec.
For the time being it is not trustable to extract spectra of strong sources with mosaic_spec from images obtained with the PIF-option.

6. Data from early revolutions.
Due to changes of the on-board configuration at a number of occasions, the detection efficiency has changed significantly several times during the mission history. In particular, for all pointings between revolutions 26 and 45, this means that the measured fluxes of sources - in particular fluxes at low energy - will strongly depend on the specific data taking time.

7. Handling of Restricted Imaging data.
The use of the 'REST' telemetry format has been discouraged since 2004. It has turned out to be difficult to interpret data taken with this format, specifically the energy resolution is very poor. Analysis of REST-format data is only supported in OSA-5 or earlier versions.

8. j_ima_iros
   There is a quirk resulting in empty light curves for some SCWs.
   Negative fluxes and associated small errors appear in some light curves.

OMC
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1. The automatic extraction of fluxes and magnitudes produces reliable results only for point-like sources.

2. For extended sources or high-energy sources with large uncertainties in their position, the OMC planning assigns multiple adjacent sub-windows to cover the whole area. In that case, multiple boxes are found with different ranks but with the same OMC ID.

   From OSA 6.0 onwards these mosaics of sub-windows can be correctly analysed by using IMA_wcsFlag=yes (default in current OSA), once the coordinates are well defined (e.g., from X-ray observations). In this case, o_src_get_fluxes creates a virtual 11x11 pixel sub-window inside the whole area centred at the source position given in the OMC Input Catalogue. After that, OSA works on this new sub-window and ignores the previous windows of the mosaic. This is an internal software trick; these virtual sub-windows do not exist as standard sub-windows (o_ima_build, for example, will not create these virtual sub-windows as images of 11x11 pixels). Note that with IMA_wcsFlag=no, these mosaics of sub-windows will not be analysed correctly as the software treats each box individually. Users should also note that even with IMA_wcsFlag=yes, for those new sources which are not yet included in the OMC Input Catalogue, these virtual sub-windows cannot be created because the software extracts the coordinates from the OMC Input Catalogue. In addition to this method, the observer may extract the optical photometry manually from the corrected images produced by the analysis pipeline.

3. If the source coordinates are inaccurate by more than 2 OMC pixels (~35"), the analysis software will not be able to re-centre the target. As a consequence, fluxes and magnitudes derived using default parameters will not be correct.

4. If another star is within a few pixels from the source of interest, it can introduce systematic errors in the derived fluxes and magnitudes. The strength of this effect can be different for different pointings, since the relative position in the sub-windows will change slightly for different rotation angles.

5. Some of the bright sources slightly saturating one or a few pixels might not be detected as saturated sources. As a consequence, their derived magnitudes might not be correctly computed. The observer should check whether the source could be saturating the CCD for a given integration time, and re-analyze the data rejecting the shots with the longest integration times.

6. Due to thermoelastic deformations, the alignment of the OMC optical axis with the spacecraft attitude reference (after correcting for the known OMC misalignment) may diverge by up to 30" (~2 pixels). This is corrected for in the analysis (OSA 5 upwards) using the photometric reference stars, giving an accuracy better than 2" in most cases.