

XMM-Newton Users Group Presentation

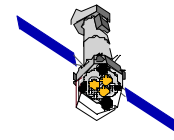
May 6th & 7th 2009

EPIC Background Treatment

(An update on behalf of the EPIC Background Working Group)

Ignacio de la Calle

XMM-Newton SOC, Mission Planning & Community Support Team



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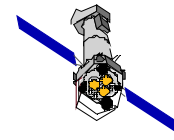
The EPIC Background Working Group

Motivation

The EPIC Background working group was founded in 2005 to provide users with clear information on the EPIC Background and (SAS)-Tools to treat the EPIC Background correctly for various scenarios.

Members

- **LUX**: Andy Read (chair), Jenny Carter
- **GSFC GOF**: Steve Snowden, Kip Kuntz
- **MPE**: Wolfgang Pietsch, Michael Freyberg
- **INAF**: Silvano Molendi, Alberto Leccardi
- **ESA**: Ignacio de la Calle (co-ord.), Matthias Ehle, Carlos Gabriel
- **CEA**: Hubert Chen
- **IAAT**: Christoph Tenzer
- **Guests**: Uli Briel, Steve Sembay, ...



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The EPIC Background Working Group

- **Meetings (linked to EPIC Cal/Ops):**

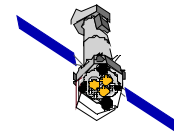
- Jun '05, Nov '05, May '06, Oct '06, Apr '07, Nov '07, Apr '08, Apr '09

All presentations and Minutes of Meetings are available at LUX and can be accessed through:

http://xmm2.esac.esa.int/external/xmm_sw_cal/background/

- **Announcements in XMM-Newton Newsletters:**

- #56 (05 Apr 2006): Extended Source Analysis Software package
- #57 (27-Jun-2006): New EPIC 'blank sky' background events files
- #66 (10-May-2007): EPIC filter wheel closed data
- #67 (13-Jul-2007):
 - The 'images' script: a tool to create attractive EPIC images
 - Revision of the Extended Source Analysis Software (XMM-ESAS)
- #84 (14 Nov 2008):
 - New XMM-Newton Blank Sky Files (*see below*)



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The EPIC Background Analysis Web Page

http://xmm2.esac.esa.int/external/xmm_sw_cal/background/

- **Summarizing table:**
 - BKG components & their temporal, spectral, spatial properties:
 - Particles: high energy penetrating & soft protons
 - Electronic Noise
 - Photons:
 - Cosmic bkg
 - Solar wind charge exchange
 - Reflections from out of FoV sources, OoT events etc.

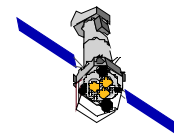
<http://www.star.le.ac.uk/~amr30/BG/BGTable.html>

- **Useful Information:**
 - List of (relevant bkg related) papers & external web pages

"The EPIC-MOS Particle-induced Background Spectra", Kuntz, K. D. & Snowden, S. L., A&A 478, 575 (2008)

"A Catalogue of Galaxy Clusters Observed by XMM-Newton", Snowden S. L., A&A, 478, 615 (2008)

"Radial Temperature Profiles for a Large Sample of Galaxy Clusters Observed with XMM-Newton",
A. Leccardi, S. Molendi, A&A 486, L359 (2008)



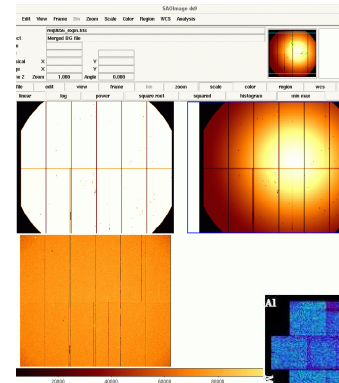
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The EPIC Background Analysis Web Page: Products of the EPIC BGWG

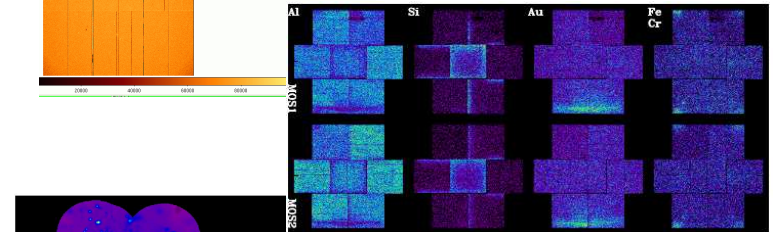
- I. Blank Sky Background Event Files**

Developed and maintain at [LUX](#) by the EPIC Blank Sky team based on the work of J. Carter and A. Read ([A&A 464, p1155, 2007](#))



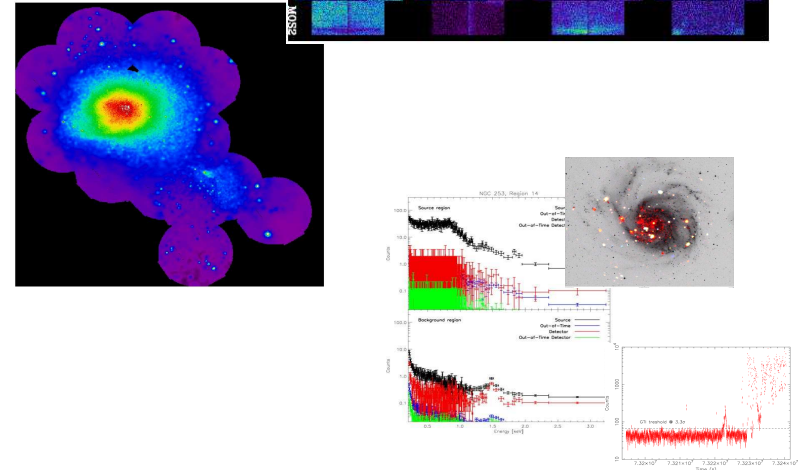
- II. Filter Wheel Close Data (FWC)**

Repository of FWC Data provided by K. Kuntz (EPIC-MOS) and M. Freyberg (EPIC-pn)



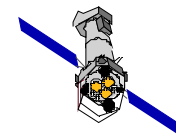
- III. XMM-Newton Extended Source Analysis Software (XMM-ESAS)**

Developed by S.Sembay at the NASA/GSFC [XMM-Newton Guest Observer Facility \(GOF\)](#) in cooperation with the XMM-Newton SOC and the Background Working Group.



- IV. Background treatment Scripts**

Collection of analysis Scripts developed by several teams as part of PhD Theses, Trainee Projects, Research work



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Products of the BGWG: I. Blank Sky Files

- **Motivation: BKG for large or extended sources:**
 - Need to extract BKG far from target source. Source may be so extended that no local background is visible in FoV.
 - Off-axis BKG can be highly inappropriate in analysing (nominally on-axis located) targets:
 - effective area of mirrors changes with off-axis angle
 - instrumental fluorescence
 - spectral response depends on detector position
 - **Blank Sky Files** to be used in case of difficulty extracting a suitable bkg region from a user's observation.

Products of the BGWG: I. Blank Sky Files

Release of tailor-made

Blank Sky Files

- o Release on October 2008
(XMM-Newton Newsletter #84)
- o Web pages redeveloped to accommodate changes
 - Pre-October 2008 Web pages are still available

Revolution : 1717
Refereed Papers : 2082

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????? Confused, lost or need help

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XMM-Newton EPIC 'Blank Sky' Background

This page concerns the XMM-Newton Blank Sky files and related software available for use with XMM-Newton EPIC data.

Blank sky files are constructed using a superposition of pointed observations that have been processed with SAS version 7.1.0.

Please refer to the paper by Carter and Read ([A&A 464, p.1155, 2007](#)) for further information on the creation of these files.

NOTE: One can now receive user defined tailor-made Blank Sky files via the submission of a [XMM-Newton EPIC Background Blank Sky Products Request Form](#).

This page has been greatly remodelled from previous versions of this page to incorporate the new file delivery system. The previous page, including access to the pre October 2008 general Blank Sky files can be found [here](#).

Contents:

- [Latest updates to these web pages](#)
- [XMM-Newton Blank Sky event files](#)
- [Request a Blank Sky file](#)
- [Creation of the Blank Sky files](#)
- [Refilled and unfilled Blank Sky files](#)
- [Watchouts](#)
- [Threads](#)
- [Software](#)
- [Blank Sky file properties](#)
- [Link to pre October 2008 Blank Sky page](#)

Latest Updates

- Oct-2008: Major reworking of website to incorporate new file delivery system

XMM-Newton Blank Sky event files

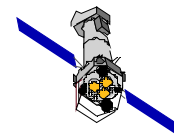
This page was produced as a result of work within the [XMM-Newton EPIC Background Working Group](#). A link to the Blank Sky pages produced prior to October 2008 can be found [here](#).

When performing detailed XMM-Newton EPIC analysis, a good knowledge of the background is required. Sometimes it may be possible to extract the background from a region close to the particular source one is interested in (using a so-called 'local' background). For a large or extended source however, one may have to extract the background far from the target source (the source may in fact be so extended, that no local background is visible within the field of view). Here, a number of effects can cause the extracted local (off-axis) background to be highly inappropriate in analysing the (normally on-axis located) target source, such as the effective area of the mirrors with off-axis angle, instrumental fluorescence and the spectral response which can depend on the position on the detector. These off-axis effects are corrected in the XMM-Newton EPIC calibration.

The files available via these pages are intended to be used in case of difficulty extracting a suitable background region from a user's observation. A guide to these files and their use can be found below.

Request a Blank Sky file

To receive a tailor made Blank Sky event file, ideally suited to a user's own data, plus associated exposure maps, the user is invited to complete the [XMM-Newton EPIC Background Blank Sky Products Request Form](#). The requested Blank Sky file is created in a semi-automatic manner. As soon as the files are available for download, the user receives an email detailing the location of the files and a summary of the request. We endeavour to produce blank sky files as quickly as possible and contact the sender of the request as soon as the files are available. This process takes approximately three working days. Using this form a user may request a specific instrument-mode-filter combination along with other specifications, such as the requesting of blank sky files within a range of XMM-Newton revolutions, within a certain radius from a pointing direction or within a range of count rates. See the [form](#) for more details. A user may wish to receive a refilled event file as opposed to an unfilled event file. Refilled and unfilled event



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Products of the BGWG: I. Blank Sky Files

Users can now receive user defined tailor-made Blank Sky files via the submission of a Web form

REQUIRED

1. User information:

Name
Institute
Email

2. Select instrument specifications:

Instrument Filter Mode Filled status

OPTIONAL

1. Select by various criteria:

Time, e.g. 1.0e8 to 2.5e8 (s) Low: High:
OR
Date, e.g. 2001-10-23 to 2002-04-05 Low: High:
OR
Revolution, e.g. 0301 to 0852 Low: High:
Exposure, e.g. 20.4 to 57.3 (ks) Low: High:
Galactic column nH, e.g. 1.0e19 to 2.0e21 (cm⁻²) Low: High:
Count rate, e.g. 1.0 to 4.2 (cts s⁻¹) Low: High:

UG Recommendation 2008-05-07/07

2. Select by coordinates:

Right Ascension, e.g. 74.523 Declination, e.g. -45.012
OR
Galactic longitude, e.g. 114.025 Galactic latitude, e.g. -52.6
Radius (degrees)

3. Select by number of events:

Max. number of events, e.g. 5e6

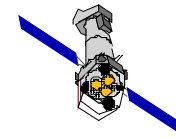
For more information contact: epic-bg@star.le.ac.uk

<http://www.star.le.ac.uk/~jac48/BG/UserRequest/blankskyform.html>

Request Form

Users can as of Oct 2008
make for different instruments,
filters and modes:

- Time based requests
Time, Date, Revolution, Exposure
- Sky region requests
Coordinates, N_H
- Other
Count Rate, Max. Number of Events per file



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Products of the BGWG: I. Blank Sky Files

XMM-Newton EPIC Background Blank Sky Products Delivery

Request id:
0045

Delivered files:

1. Blank sky event file 1: [blanksky_events.fits](#)
2. Blank sky exposure file, non-vignetted 1: [blanksky_expn.fits](#)
3. Blank sky exposure file, vignetted 1: [blanksky_expv.fits](#)

Request sent:
Mon, 16 Jan 2009

Request summary:

Instrument: MOS1
Filter: Medium
Mode: Full-Frame
Type: Ghosted

Advanced selection:

Revolution: No selection
Date: No selection
Time (s): No selection
Exposure (ks): No selection
Galactic column (cm-2): 3.0e20 to 4.0e20
Count rate: No selection

Positional selection:

Equatorial coordinates selected: 193.274, -9.2036
Galactic coordinates selected: No selection
Radius selected (degrees): 100

Number of events:

Maximum number of events: 1.0e6

Diagnostic files:

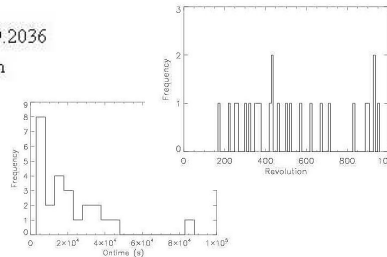
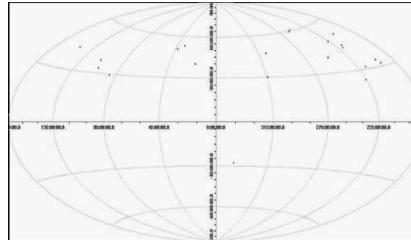
1. Revolution histogram 1: [revnhist.jpg](#)
2. Ontime histogram (post flare cleaning) 1: [ontimehist.jpg](#)
3. Component map (galactic coordinates) 1: [map_selection.jpg](#)

Comment: Files were created for the selection requested. Details of the selection procedure:

1. The instrument, filter, mode and filter status selection was completed successfully, events were found
2. The selection by coordinates was completed successfully, events were found
3. The selection by galactic column density was completed successfully, events were found
4. The selection by maximum number of events was completed successfully, events were found

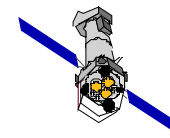
Request from the EPIC Blank Sky team:

We politely request that should the files here contribute to work that leads to publication, that the reference to the Blank Sky work ([Carter and Read \(A&A 464, p1155, 2007\)](#)) be cited.



User Request

- Handled in a semi-automatic way and involve controlled monitoring of the results files.
- The output files are available within 7 working days on a best-effort-basis, and usually much earlier (3 days).
- The user is sent an url with a summary of *Products Delivery* from where the corresponding files can be downloaded.



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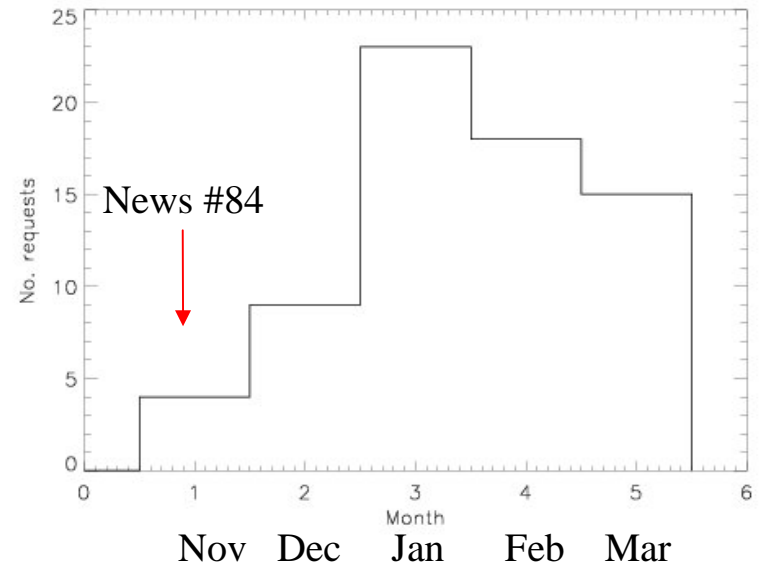
Products of the BGWG: I. Blank Sky Files

Performance

- Total number of requests up to the end of Apr 09: **82 (28 users)**
- If request is too generic, the user is asked to resubmit.
- Responding to user requests on average within a 3 day period.

Future of Blank Sky Files

- Adding more data
- Create Blank Sky Files from SAS v9.0 event files
- **Short-term plan (<2 years):** keep semi-automatic approach unless demand rises above current levels.
- **Long-term plan (>2+ years):** port the system to a fully automatic system.



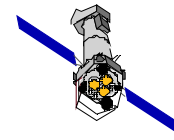
Products of the BGWG: II. FWC

- **Filter wheel closed (FWC) data**

- Data gathered from calibration observations with filter wheel in closed position
- Released in September 2006: stacked collections of FWC data available for MOS and pn
- Dedicated EPIC FWC calibration observation:
 - NRCO#70 in 2007
 - Rout. Cal. 10 ksec /month (*new approach to be implemented*)

- **Recent Updates**

- To solve some user reported issues regarding 'corrupted' X/Y coordinates, the observations have been recast to point at a fixed point in the sky ($RA=DEC=PA=0$). These new files have replaced the older files in the BGWG web pages (**Feb 2009**)



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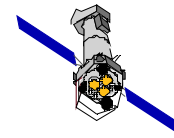
Products of the BGWG: II. FWC

UG Recommendation 2007-06-08/45

- Previous approach (up to 2nd half of 2008): 12 x 10 ksec RCO; CLOSED FF (1/month)

New Operational Implementation:

- New approach: 2 x 10 ksec RCO; CLOSED FF (1/semester)
 - Should there be evidence of response inhomogeneities, this can be increased via NRCOs
- Additionally, during all the slews in every 4th revolution, the MOS cameras can be set to CLOSED FF (pn slews are used for science)
- To be implemented by summer 2009

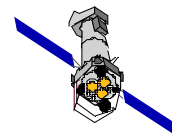


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Products of the BGWG: III. ESAS

- **XMM-Newton Extended Source Analysis Software Package (ESAS)**
 - Released in March 2006 for EPIC MOS detectors.
 - Create model quiescent particle background spectra for user defined regions within the FOV of the detectors.
 - Create bkg subtracted & exposure corrected images.
 - Based on software described in [Snowden, Collier & Kuntz \(2004, ApJ 610, 1182\)](#) and updated & applied to a catalog of cluster observations in [Snowden, Mushotzky, Kuntz, Davis \(2008, A&A 478, 615\)](#).
- **PERL scripts (calling SAS tasks) & stand-alone Fortran 77 programs + FITS Calibration files**
 - Version 2 released, 31 May 2007.
 - *“If problems arise or results look odd, please contact the XMM-Newton Helpdesk”*. Suggestions for improving the software or documentation welcome.
- **Documentation:**
 - Cookbook: incl. example data & recipe of spectral & image data processing
- **Principal Ideas presented in UG meeting in 2007 and 2008**



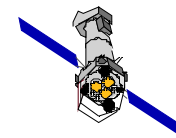
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Products of the BGWG: III. ESAS

UG Recommendation 2008-05-07/05

- **What is new ?**
 - In order to improve the maintenance of ESAS, and to make the life of the users easier, the code has been integrated (A. Ibarra, SOC) in SAS and it is expected to be released with SAS v9.0 in June 2009.
 - The ESAS code will be maintained by S. Snowden (XMM-Newton Guest Observer Facility, NASA/GSFC).
 - There will no longer be a stand-alone version of ESAS.
 - The inclusion of EPIC-pn analysis in ESAS is currently on-going (*testing phase*) and it may be fully implemented for the release of SAS v9.0.
 - The SAS release of the MOS and mosaicing ESAS tasks include upgrades and improvements.



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Products of the BGWG: III.ESAS

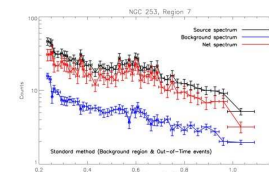
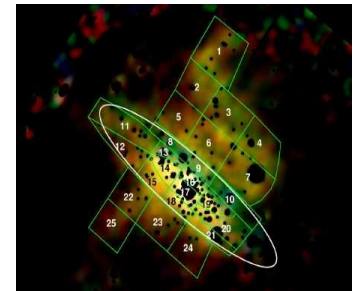
Future plans for ESAS

- Completing the EPIC-pn component of the software, including its evaluation.
- An updated ESAS Handbook to reflect the inclusion of ESAS in SAS.
- Development of analysis scripts to tie ESAS and SAS which simplify tasks such as image creation and mosaicing,
- Development of SAS analysis threads (SOC).

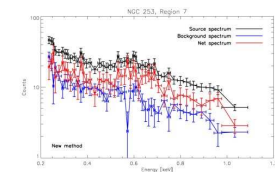
Products of the BGWG: IV. Scripts

The group holds a repository of scripts for background treatment.

- SOC support is given on a best-effort basis
- The aim is to incorporate useful/validated scripts as SAS tasks
- **Estimation of the residual Soft Proton Flare contamination**
(Developed by Silvano Molendi, Andrea De Luca & Alberto Leccardi (2004, A&A 419, 837), and coded by A. Read, for EPIC event files, to estimate the amount of residual Soft Proton flare contamination)
- **The 'images' script: a tool to create attractive XMM-Newton Images**
(Developed at the XMM-Newton SOC as part of a trainee project to create attractive multi-energy band images using and merging data from the three EPIC cameras)
- **NEW: Background correction for faint extended EPIC-pn emission**
(Method developed by [M. Bauer](#) (MPE) to use a local estimate of the sky background to correct for faint extended emission in EPIC-PN data; *Bauer, M. et al 2007, astro-ph/0711.3182*)



Standard Method



New Method

BGWG Summary and Future Plans

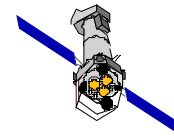
SUMMARY

- Release of tailor-made Blank Sky Files available since October 2008
- Definition of new approach to be taken for FWC observations
- Integration of ESAS code into SAS expected to be release with SAS v9.0 in June 2009

FUTURE

- Standing open invitation to bkg. experts to bring in their ideas, methods, comments
- Maintenance of web pages, add info on EPIC background, if available, add more data (Blank Sky Fields & FWC),
- Validating the implementation of ESAS in SAS

Next BGWG Meeting: April 2010



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