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EPIC BG working group:          3rd meeting 02/05/06 - MPE
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        Agenda
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Small new seminar room @ MPE: Basement No. 1.1.18a. (There will be a
beamer, an overhead projector and WLAN/LAN connections for laptops.)

Tuesday 02/05/06 09:00->19:00 (Lunch 12:30-13:30?)
(With coffee/tea breaks at appropriate times)
Marcus & I shall try to take the minutes, edit them and distribute them.

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1) - Action Items from last meeting  (AMR/MK)

2) Progress Reports (Including Actions):

   - XMM-ESAS (SS/KK)

   - Soft proton screening tool (SS,[BP])

   - Blank Sky event lists and related files (JAC/AMR)

   - Status of closed event files and out-of-FOV straylight (MJF)

   - Web Pages, BG Components Synopsis Table, mirroring (MK/ME/AMR...all)

3) New Items

   - Background treatment in spectral analysis of low surface brightness
     sources (SM + Student)

   - Double-subtraction (AMR) ?

4) Final session: - Summing-up

   - AOB

   - Plans for the next period

   - Next meeting (and/or next progress [teleconf?] meeting).
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Actions from last meeting (taken from minutes) 1/2

5 Action items

AI_EPIC_BG_WG_02_01: MK to ask RGS if RGS BG light curve could help EPIC screening

AI_EPIC_BG_WG_02_02: MK to change "mission BG history" information link (different name) and introduce new link for Background analysis linking to page with EPIC, RGS, OM BG information

AI_EPIC_BG_WG_02_03: ME to test and transfer WNPs script of 01_11 to SOC thread

AI_EPIC_BG_WG_02_04: MK to organize providing of merged closed data files for all cameras at the SOC, these files will be mirrored at Goddard. (20 Gig) , pn files to be provided by MJF, MOS files by SS

AI_EPIC_BG_WG_02_05: MK to send SS information how to get CALCLOSED and CLOSED data and to include SS in the CALCLOSED and CLOSED mailing list

AI_EPIC_BG_WG_02_06: MK to change wording for "Files that you do need for your data analysis" to Files that you may need for your data analysis", and separate link of Response from BG files

AI_EPIC_BG_WG_02_07: AMR to ask GP to provide double background subtraction tool to BGWG with the final idea to provide it as an extra tool on the Background page if possible.

AI_EPIC_BG_WG_02_08: MJF to get numbers for out-of-FOV contribution (i.e. single reflections)

AI_EPIC_BG_WG_02_09: all to provide presentations to AMR

AI_EPIC_BG_WG_02_10: all to provide proposal to AMR to link relevant papers to the BG component table

AI_EPIC_BG_WG_02_11: ME to check with mission planning if criterion can be added for SWCX avoidance.

AI_EPIC_BG_WG_02_12: JAC, MJF, WNP to check if OOE can be flagged on an event basis

AI_EPIC_BG_WG_02_13: SS to provide task description of the Goddard BG tasks for BG page

Actions from last meeting (taken from minutes) 2/2

6 Open old action items

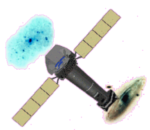
AI_EPIC_BG_WG_01_01: SS to provide by October 2005 to SOC
- Proton screening tool
- Use of multiple light curves for screening
- BG tool
- Provide list of st. candles for BG analysis comparison with different tools

- Proton screening tool and multiple light curve prototype available, by end of December a SAS task version will be available for DT., aiming release for SAS 7.0
- BG tool prototype is available for testing within BGWG, will not make it into SAS 7.0 but a non SAS version will be made available by end of March 2006
- list of BG candles is ongoing task

AI_EPIC_BG_WG_01_04: AMR to invite other BG experts to next meetings and to provide possibly scripts/tasks

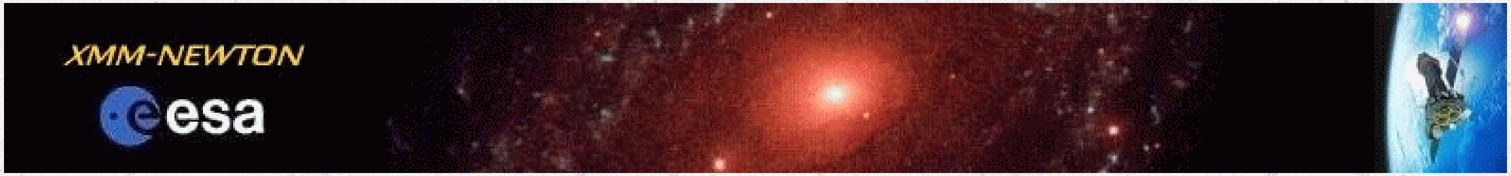
AI_EPIC_BG_WG_01_05: MJF to provide link to processed pn closed event files for all modes to MK

AI_EPIC_BG_WG_01_12: MJF: Once any BG or Closed fits files had been obtained, the user can change their CCF_PATH etc. setup so that a new cifbuild would incorporate these extra files. This enables the BG/Closed events files (e.g. the ones used in SS's task) to be used in the SAS, without them having to be included in the CCF files.



Meetings

- Report on BGWG activities at SAS Working Group (Leicester, 31/01/06)
- Poster on BGWG activities at NAM06 (Leicester, 3-7/04/06)
- Several telecons



Welcome to the XMM-Newton Science Operations Centre Home Page

XMM-Newton Revolution	1120
XMM-Newton Refereed Papers	0996

- Home
- News
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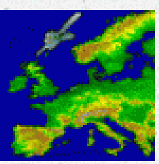
- (About) Scheduling
- User Support
- Software & Calib.
- Data Access
- Science
- Links

Where is XMM-Newton Now ?



XMM-Newton Obs (Rev 1120)

- PKS 0237-23
- MZ 10451
- RXCJ1236-3354
- NGC 7618/UGC 12491

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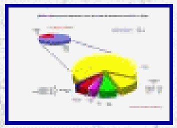
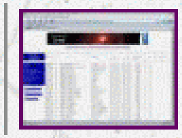


11-Jan-2006:
XMM-Newton 2005/Q4 Status Report
The status & performance report for 4th Quarter 2005 has now been released.
Check our Quarterly Status Pages



10-Jan-2006:
XMM-Newton AO-5 OTAC Results
Proposals accepted by the AO-5 OTAC are now available. Check the details on our AO-5 Results Pages.

News (more)

- XMM-Newton Latest News
- XMM-Newton Newsletter
- XMM-Newton Quarterly Status Reports **Updated**
- XMM-Newton AO-5 OTAC Results **New**
- EPIC MOS1 Event of Rev. 961

Software & Calibration (more)

- SAS Science Analysis Software
- SAS Scientific Validation
- Calibration
- Background Analysis **New**
- Science Simulator (SciSim)
- SAS Workshops

Observer's Info (more)

- Observation & Data Processing Status
- Planned and Performed Observations
- Observation Log Browser
- Live Radiation Monitor Data

Data Access (more)

- XMM-Newton Science Archive (XSA)
- Reading Data Products CD's

(About) Scheduling (more)

- Target of Opportunity Alert
- Target of Opportunity Details
- Target Visibility Tool
- Observation Lokator
- Observation Enhancement
- Scheduling Guided Tour
- Long Term Observations Plan
- Scheduled Observations Search

Science with XMM-Newton (more)

- XMM-Newton Image Gallery
- XMM-Newton AO-5 Submission
- Publications (from NASA XMM-GOF)
- Source Naming Convention
- Publication Guidelines
- XMM-Newton SOC Research Fellowship
- X-ray Universe 2005 Symposium

User Support (more)

- Proposer's Info and Manuals **User Guides Updated**
- XMM-Newton Users Group **Updated**
- Search this Site
- Helpdesk
- How to contact us
- How to get to ESAC

Links (more)

- XMM-Newton SOC Trainee Projects **Updated**
- XMM-Newton SSC
- Project Related Links
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- Other X-ray Missions
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Background Analysis

This page gives information on the background analysis of all XMM-Newton instruments (EPIC, RGS, OM) in order that a proper data reduction may be undertaken.

EPIC Background	RGS Background	OM Background

EPIC

The XMM-Newton observatory provides unrivalled capabilities for detecting low surface brightness emission features from extended and diffuse galactic and extragalactic sources, by virtue of the large field of view of the X-ray telescopes and the high throughput yielded by the heavily nested telescope mirrors. In order to exploit the excellent EPIC data from extended objects, the EPIC background, now known to be higher than estimated pre-launch, needs to be understood thoroughly.

There are several different components to the EPIC background:

1. Photons:

   - The astrophysical background, dominated by thermal emission at lower energies (E<1 keV) and a power law at higher energies (primarily from unresolved cosmological sources). This background varies over the sky at lower energies.
   - Solar wind charge exchange.
   - Single reflections from outside the field of view, out-of-time events etc.
2. Particles:

   - Soft proton flares with spectral variations from flare to flare. For weak sources the only option is to select quiet time periods from the data stream for analysis.
   - Internal (cosmic-ray induced) background, created directly by particles penetrating the CCDs and indirectly by the fluorescence of satellite material to which the detectors are exposed.
3. Electronic Noise:

   - Bright pixels, columns etc., readout noise etc.

A table summarizing the temporal, spectral and spatial properties of these EPIC background components is available here.

There have been various attempts to describe/model the EPIC Background in the past. This page will provide an overview on all sources of background analysis and modelling pointing out the recommended mainstream for background treatment by the EPIC consortium.

In 2005 the XMM-Newton EPIC Background working group was founded as a steering and supervising committee to provide the user with clear information on the EPIC Background and (SAS)-Tools (TBD) to treat the EPIC Background correctly for various TBD scenarios.

Current progress of the XMM-Newton EPIC Background working group can be monitored here.

In March 2006, the EPIC Background Working Group released the XMM-Newton Extended Source Analysis Software package, XMM-ESAS, allowing the user to model the quiescent particle background both spectrally and spatially for the EPIC MOS detectors.

Also available soon will be new long-duration EPIC blank-sky background event lists for each of the various instrument/mode/filter combinations, constructed using data from the new (>SAS-v6.5) SSC reprocessing pipeline.

The following sources of information (including collections of background blank sky fields) are also available:

1. Paper: "The XMM-Newton EPIC background: Production of background maps and event files", A.M. Read & T.J. Ponman, A&A 409, 395 (2003)
   Web site: Related EPIC background event files, maps, software, analysis techniques etc.
2. Paper: "XMM-Newton EPIC background modelling for extended sources", J. Nevalainen, M. Markevitch & D. Lumb, ApJ 629, 172 (2005)
   Web site: Supporting data, background event files etc.
3. Paper: "X-ray background measurements with XMM-Newton EPIC", D. Lumb, R.S. Warwick, M. Page & A. De Luca, A&A 389, 93 (2002)
   Web site: Related background files and explanatory notes.
   [An older version of the background files is still available: Web site: Old background files and old explanatory notes].
4. Paper: "The EPIC/MOS view of the 2-8 keV Cosmic X-ray Background Spectrum", A. De Luca & S. Molendi, A&A 419, 837 (2004)
5. Paper: "XMM-Newton Data Processing for Faint Diffuse Emission: Proton Flares, Exposure Maps and Report on EPIC MOS1 Bright CCDs Contamination", J. Pradas & J. Kerp, A&A 443, 721 (2005)

XMM-Newton EPIC Background Components

Table summarizing the components within the XMM-Newton EPIC Background; temporal, spectral and spatial properties.

	PARTICLES			PHOTONS	
	SOFT PROTONS	INTERNAL (cosmic-ray induced)	ELECTRONIC NOISE	HARD X-RAYS	SOFT X-RAYS
Source	Few 100 keV solar protons, accelerated by magnetospheric reconnection events. Dominate times of high-BG.	Interaction of High Energy particles (cosmic rays) with detector - associated instrumental fluorescence.	(1) Bright pixels & (parts of) columns. (2) CAMEX readout noise (pn). (3) Artificial Low-E enhancements in MOS1 CCDs 2 & 5 (Also dark current - thought negligible).	X-ray background (AGN etc), single reflections from outside FOV. OOT events (pn)	Local Bubble, Galactic Disk, Galactic Halo, Solar Wind Charge Exchange, single reflections from outside FOV. OOT events (pn)
Variable? (per Observation)	Flares (>1000%). Unpredictable, significant quiescent component (long flares) - survives GTI screening. (Also additional possible 'irreducable' component).	+/-10%. MOS: >2keV continuum unchanged, small changes in fluorescence lines. <1.5keV continuum varies - may be be due to Al redistribution. pn: Difference between continuum and lines (some correlation).	(1) +/-10%. (2) Very constant. (3) Believed constant.	Constant.	Constant. Long obs. may see effect of SWCE.
Variable? (Obs. to Obs.)	Unpredictable. Affect 30%-40% of time. Flaring SP getting worse? Quiescent SP not evolving. More far from apogee. Low-E flares turn on before high-E.	Majority @ +/-15%. Can be x10 higher in high radiation periods. No increase after solar flares. Plus above 'per Observation' variations.	(1) >1000% (pixels come and go, also (micro-)meteorite damage). (2) Mode-dependent (lowest eFF, then FF, LW, highest SW) (3) CCD2: effects 50% of obs. (factor increases with high-BG rate); CCD5: effects 15-20% of obs. (by factor~2).	Constant. OOT events (pn) mode-dependent (LW:0.16%, FF:2.3%, eFF:6.7%)	Variation with RA/Dec (+/-35%). SWCE may affect observations differently. OOT events (pn) mode-dependent (LW:0.16%, FF:2.3%, eFF:6.7%)
Spectral	Variable. Unpredictable. Continuum spectrum (no lines), fitted by unfolded xspec PL model for E>0.5keV (E<0.5keV, less flux is seen). Variable in intensity + shape (the higher the intensity, the flatter the slope).	Flat (MOS index~0.2) + fluorescence + detector noise. MOS: 1.5keV Al-K, 1.7keV Si-K. Det.noise <0.5keV. High-E lines (Cr, Mn, Fe-K, Au). PN: 1.5keV Al-K. No Si (self-absorbed). Cu-Ni-Zn-K (~8keV). MIP noise <0.3keV.	(1) low-E (<300eV), tail may reach higher-E. (2) low-E (<300eV). (3) low-E (<500eV).	1.4 power law. Below 5keV, dominates over internal component.	Thermal with ~<1keV emission lines. Exgal.>0.8keV spatially uniform, index=1.4. Galactic - emission/absorption varies. SWCE very soft, with unusual OVII/OVIII line ratios (plus others).
Spatial - Vignetted?	Yes (scattered) - vignetting is flatter than for photons.	No.	(1,2) No. (3) Yes - evident in vignetting maps. (similar, smaller-magintude vignetting asymmetries seen in pn).	Yes.	Yes.
Spatial - Structure?	Perhaps, in MOS due to the RGA. No structure seen in pn. SPs observed only inside FOV.	Yes. Detector + construction. MOS: outer CCDs more Al, less Si. CCD edges more Si. Less Si out-FOV. Continuum diff. between out-FOV and in-FOV below Al line (redistribution?). More Au out-FOV. Changes in high-E lines. CCD-to-CCD: line intensity variations, energies/widths stable. PN: Line intensities show large spatial variations from electronic board. Central 'hole' in high-E lines (~8keV). Residual MIP contribution near CAMEX readout (low-E, non-singles, parallel to readout).	Yes. (1) Individual pixels & columns. (Also [pn] sections of columns away from CAMEX, near to FOV centre) (2) Near pn readout (CAMEX), perpendicular to readout. (3) Confined to MOS1 CCDs 2 & 5.	No. Single reflections diffuse flux from 0.4-1.4 deg (out-FOV) is ~7% of in-FOV signal. OOT events (pn) smeared along readout from bright sources of X-rays. (extra BG in pn LW mode due to frame store area).	No, apart from real astronomical objects. Single reflections diffuse flux from 0.4-1.4 deg (out-FOV) is ~7% of in-FOV signal. OOT events (pn) smeared along readout from bright sources of X-rays. (extra BG in pn LW mode due to frame store area).
Patterns	Distribution similar to genuine X-rays.	Distribution different from genuine X-rays.		Genuine X-ray distribution.	Genuine X-ray distribution.

	PARTICLES			PHOTONS	
	SOFT PROTONS	INTERNAL (cosmic-ray induced)	ELECTRONIC NOISE	HARD X-RAYS	SOFT X-RAYS
Source	Few 100 keV solar protons, accelerated by magnetospheric reconnection events. Dominate times of high-BG.	Interaction of High Energy particles (cosmic rays) with detector - associated instrumental fluorescence.	(1) Bright pixels & (parts of) columns. (2) CAMEX readout noise (pn). (3) Artificial Low-E enhancements in MOS1 CCDs 2 & 5 (Also dark current - thought negligible).	X-ray background (AGN etc), single reflections from outside FOV, OOT events (pn)	Local Bubble, Galactic Disk, Galactic Halo, Solar Wind Charge Exchange (SWCX), single reflections from outside FOV, OOT events (pn)
Variable? (per Observation)	Flares (>1000%). Unpredictable, significant quiescent component (long flares) - survives GTI screening. (Also additional possible 'irreducable' component).	+/-10%. MOS: >2keV continuum unchanged, small changes in fluorescence lines. <1.5keV continuum varies - may be be due to Al redistribution. pn: Difference between continuum and lines (some correlation).	(1) +/-10%. (2) Very constant. (3) Believed constant.	Constant.	Constant. Long obs. may see effect of SWCX (e.g. varies at 0.5-1.2 keV [OVIII/MgXI], but not at 2-4 keV).
Variable? (Obs. to Obs.)	Unpredictable. Affect 30%-40% of time. Flaring SP getting worse? Quiescent SP not evolving. More far from apogee. Low-E flares turn on before high-E.	Majority @ +/-15%. Can be x10 higher in high radiation periods. No increase after solar flares. Plus above 'per Observation' variations.	(1) >1000% (pixels come and go, also (micro-)meteorite damage). (2) Mode-dependent (lowest eFF, then FF, LW, highest SW) (3) CCD2: effects 50% of obs. (factor increases with high-BG rate); CCD5: effects 15-20% of obs. (by factor~2).	Constant. OOT events (pn) mode-dependent (LW:0.16%, FF:2.3%, eFF:6.7%)	Variation with RA/Dec (+/-35%). SWCX may affect observations differently. OOT events (pn) mode-dependent (LW:0.16%, FF:2.3%, eFF:6.7%)
Spectral	Variable. Unpredictable. Continuum spectrum (no lines), fitted by unfolded xspec PL model for E>0.5keV (E<0.5keV, less flux is seen). Variable in intensity + shape (the higher the intensity, the flatter the slope).	Flat (MOS index~0.2) + fluorescence + detector noise. MOS: 1.5keV Al-K, 1.7keV Si-K. Det.noise <0.5keV. High-E lines (Cr, Mn, Fe-K, Au). PN: 1.5keV Al-K. No Si (self-absorbed). Cu-Ni-Zn-K (~8keV). MIP noise <0.3keV.	(1) low-E (<300eV), tail may reach higher-E. (2) low-E (<300eV). (3) low-E (<500eV).	1.4 power law. Below 5keV, dominates over internal component.	Thermal with ~<1keV emission lines. Exgal.>0.8keV, index=1.4. Galactic - emission/absorption varies. SWCX very soft, with unusual OVIII/OVII line ratios (plus others) - Strong OVIII & MgXI
Spatial - Vignetted?	Yes (scattered) - vignetting is flatter than for photons.	No.	(1,2) No. (3) Yes - evident in vignetting maps. (similar, smaller-magintude vignetting asymmetries seen in pn).	Yes.	Yes.
Spatial - Structure?	Perhaps, in MOS due to the RGA. No structure seen in pn. SPs observed only inside FOV.	Yes. Detector + construction. MOS: outer CCDs more Al, less Si. CCD edges more Si. Less Si out-FOV. Continuum diff. between out-FOV and in-FOV below Al line (redistribution?). More Au out-FOV. Changes in high-E lines. CCD-to-CCD: line intensity variations, energies/widths stable. PN: Line intensities show large spatial variations from electronic board. Central 'hole' in high-E lines (~8keV). Residual MIP contribution near CAMEX readout (low-E, non-singles, parallel to readout).	Yes. (1) Individual pixels & columns. (Also [pn] sections of columns away from CAMEX, near to FOV centre) (2) Near pn readout (CAMEX), perpendicular to readout. (3) Confined to MOS1 CCDs 2 & 5.	No. Single reflections diffuse flux from 0.4-1.4 deg (out-FOV) is ~7% of in-FOV signal. OOT events (pn) smeared along readout from bright sources of X-rays. (extra BG in pn LW mode due to frame store area).	No, apart from real astronomical objects. Exgal.>0.8keV spatially uniform. SWCX over whole FOV. Single reflections diffuse flux from 0.4-1.4 deg (out-FOV) is ~7% of in-FOV signal. OOT events (pn) smeared along readout from bright sources of X-rays. (extra BG in pn LW mode due to frame store area).
Patterns	Distribution similar to genuine X-rays.	Distribution different from genuine X-rays.		Genuine X-ray distribution.	Genuine X-ray distribution.

XMM-Newton EPIC
at the University of Leicester

XMM-Newton is currently on its 1121 orbit of the Earth

- Home
- EPIC outreach
- EPIC instrument
- EPIC calibration
- EPIC consortium
- Photo gallery
- Links

Space Research Centre
University of Leicester

User Resources

This page contains details on the XMM-Newton EPIC cameras, including health monitoring, and presentations from calibration meetings and background meetings.

Attendees' presentations from past meetings are available in the following formats: postscript (ps), powerpoint (ppt), or acroread (pdf). Presentations that comprise of several files are tape-archieved (tarred), and often compressed (using gzip). All the health monitoring plots are in PostScript format, unless otherwise stated.

Calibration Meeting Presentations

- ESAC, October 2005
- Mallorca, February 2005
- Vilspa, March 2004
- Saclay, September 2003
- Tuebingen, February 2003
- Vilspa, July 2002
- Ringberg, April 2002
- Milan, November 2001
- Leicester, June 2001
- Paris, February 2001
- Leicester, July 2000
- Paris, June 2000

Background WG Meeting Presentations

- MPE, November 2005
- ESAC, June 2005

Background talks are also included in the Calibration Meetings above.

OOT events – removal on an event-by-event basis?

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============
AMR - 020206
============
To remove OOT events on a statistical basis from pn event files.
=================================================================

- shell-script? SAS-task?

- Takes (clean) pn event file as input, obtains mode, hence knows
  fraction of events that are OOT events (e.g. 6.3% for FF mode [2.3%
  for eFF]).

- Per CCD

  - Per RAWX (if stats allow - can be checked first - if not [low
    stats] can go to groups of columns e.g. 2/4/8/16 RAWX...)

    - Analyse events in particular RAWX column - Select 6.3(FF)% of
    the events such that:
    1) They are uniformly distributed (flat) in RAWY
    2) Anything else? e.g. spectral considerations...

    - Remove these events to a separate (OOT) file

  - Next RAWX

- Next CCD

- Updates header values - e.g. such that one is unable to do the same
  procedure again (only want to do this once to a file).

===================================================================
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Andy Read (amr30@star.le.ac.uk)

Double-Subtraction

(Arnaud et al 2002, A&A, 390, 27)

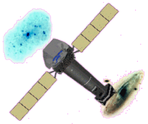
- Step 1: Prepare observation event lists (all cameras)
    - Flare cleaning
    - Add ‘weight’ column in event list (SAS-evigweight)
    - Estimate count rate in hard band (factor A - new keyword)

tcsh script – calls IDL (for flare cleaning)

Double-Subtraction

- Step 2: Prepare BG event lists for particular observation
  - Blank Sky fields
  - Additional flare cleaning
  - Add ‘weight’ column in event list (SAS-evigweight)
  - Complex exposure dependence (position-related)
  - Estimate count rate in hard band (factor B - new keyword)
  - Blank Sky fields ‘Skycast’ed to observation
  - Renormalise weight column by A/B ratio

tcsh script



Double-Subtraction

- Step3: Extraction of scientific products – Done for both observation and blank sky event lists and for all cameras
  - Spectra
    - In principal, can be done with SAS – 2 IDL routines are used (spectral extraction, BACKSCALE calculation)

  - Surface brightness profile

  - IDL tool (nothing in SAS)

Double-Subtraction

- Step4: Computation of background-subtracted products
  - 4a: Surface brightness profiles
    - Have SX_obs, SX_bkg, SX_oot (pn)
    - IDL tools to subtract SX_bkg from SX_obs (1^{st} BG subtraction), then plot, and identify (by eye) region without cluster emission
    - Fortran tool to estimate count rate in this external region, subtract it (2^{nd} BG subtraction) and rebin profile (various options)

Double-Subtraction

- Step4: Computation of background-subtracted products
  - 4b: Spectra
    - SX (4a) must be performed first to identify off-cluster region
    - Scripts (using mathpha) for spectral background subtraction
    - IDL tool (equivalent to grppha) to regroup spectra to a N detection in each bin
    - Plus modified version of double-subtraction to avoid addition of unecessary noise

Double-Subtraction

- Difficulties/comments as regards a common, general, user-friendly tool:
  - Various programming languages are used; tcsh script, fortran, ftools, plus IDL (not everywhere)
  - Some steps require manual input (e.g. identification of the region for the residual [off-cluster] background)
  - Developed tools are very much cluster-science oriented
  - No well-integrated set of tools, i.e. a full pipeline for extended source analysis ('very useful, but very very difficult…')

Solar Wind Charge Exchange (SWCX)

Charge exchange emission between highly ionized solar wind and either interstellar neutrals in the heliosphere or material from Earth's exosphere

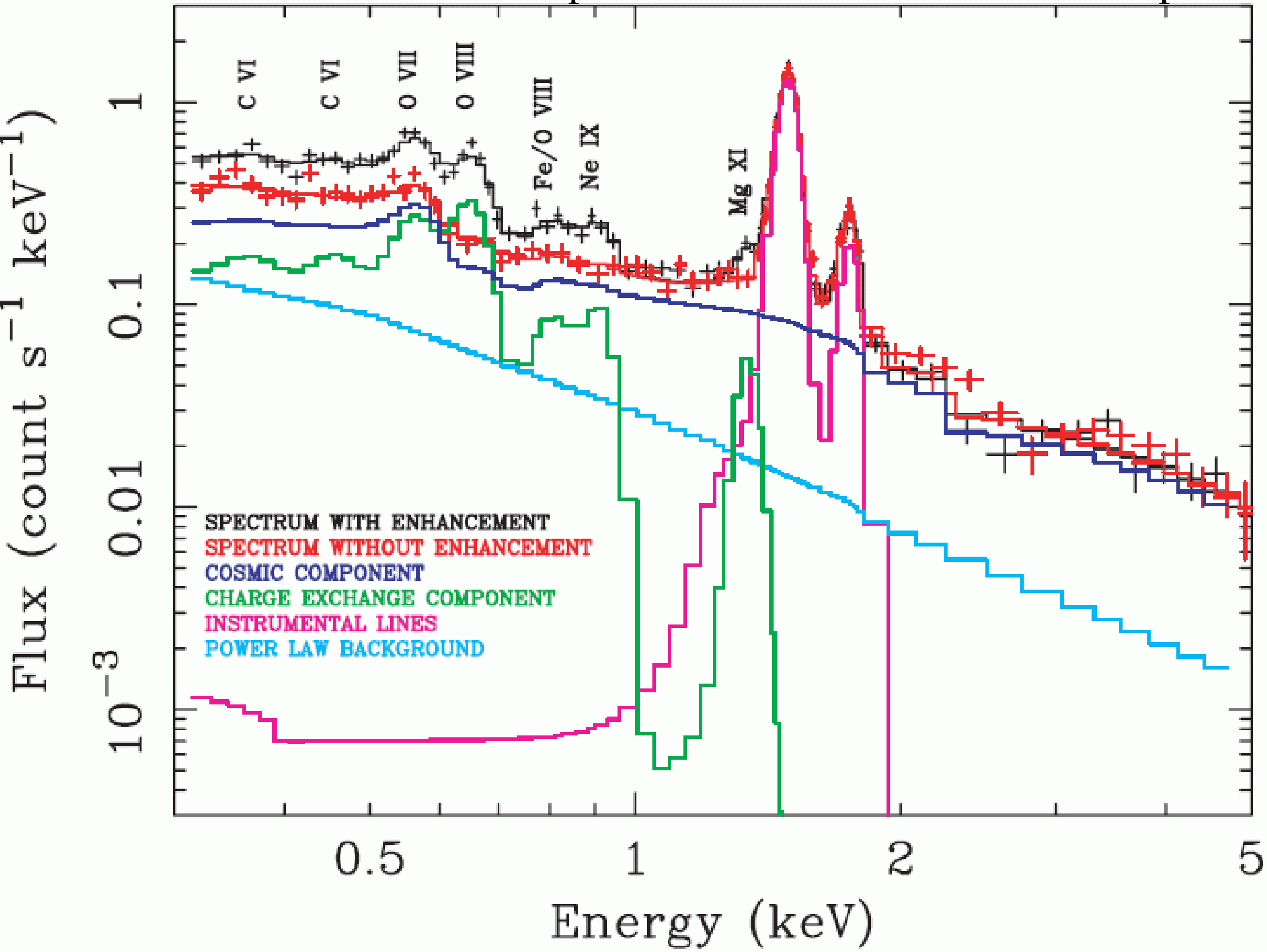


Fig. 3.—Model components of the best spectral fit folded through the instrumental response. The MOS1 spectra from HDF-N #1 (*red*) and from the SWCX emission period of HDF-N #4 (*black*) are shown along with the SWCX, cosmic background, instrumental lines, and power law (likely soft proton) background components.

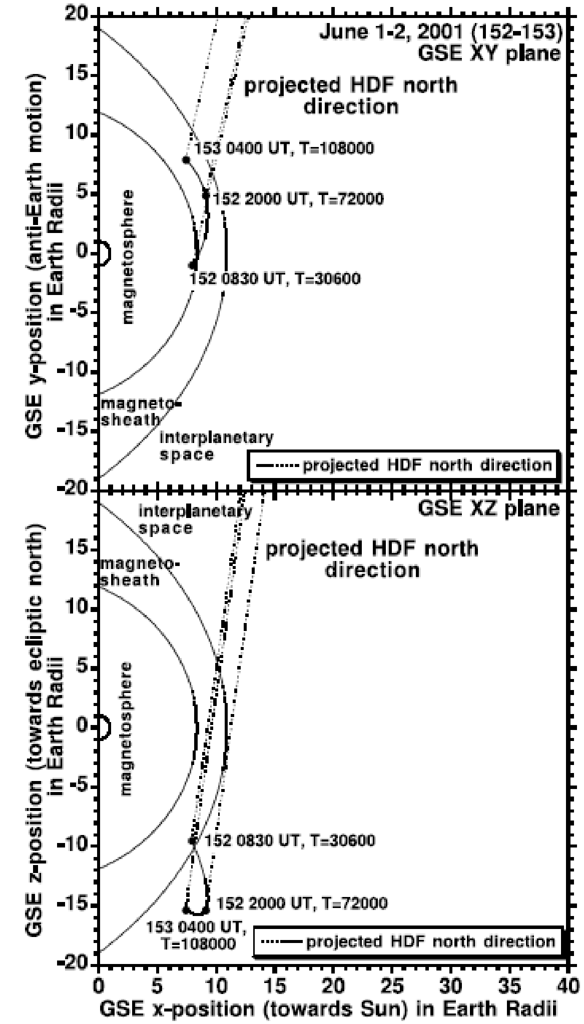


Fig. 5.—Geometry of the 2001 June 1 (fourth HDF-N) observation. The upper panel shows the observation line of sight projected onto the plane of the ecliptic, where the positive *x*-axis points toward the Sun and the positive *y*-axis is opposite to Earth's velocity vector. The bottom panel shows the observation line of sight projected onto the vertical plane, where the positive *z*-axis is toward the north ecliptic pole. Note that the line of sight is slightly sunward and lies in all cases outside of the magnetosphere. However, also note that there is some uncertainty in the exact location in the magnetosheath and magnetosphere boundaries.

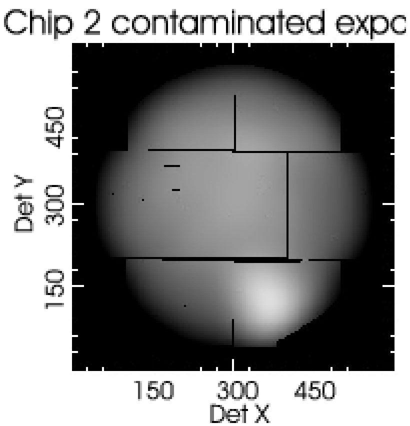
XMM
EPIC
MOS

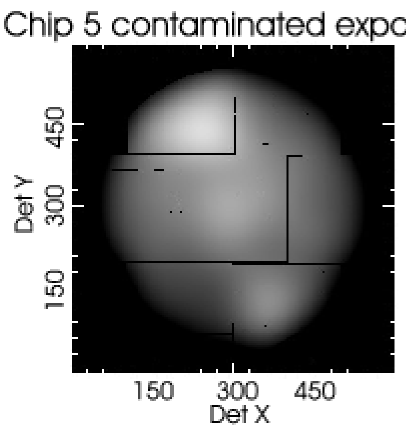
Andy Read (amr30@star.le.ac.uk)

3rd EPIC BG WG Meeting
MPE, Germany 02/05/06

University of Leicester

Low-E enhancements in MOS1 CCDs 2 & 5





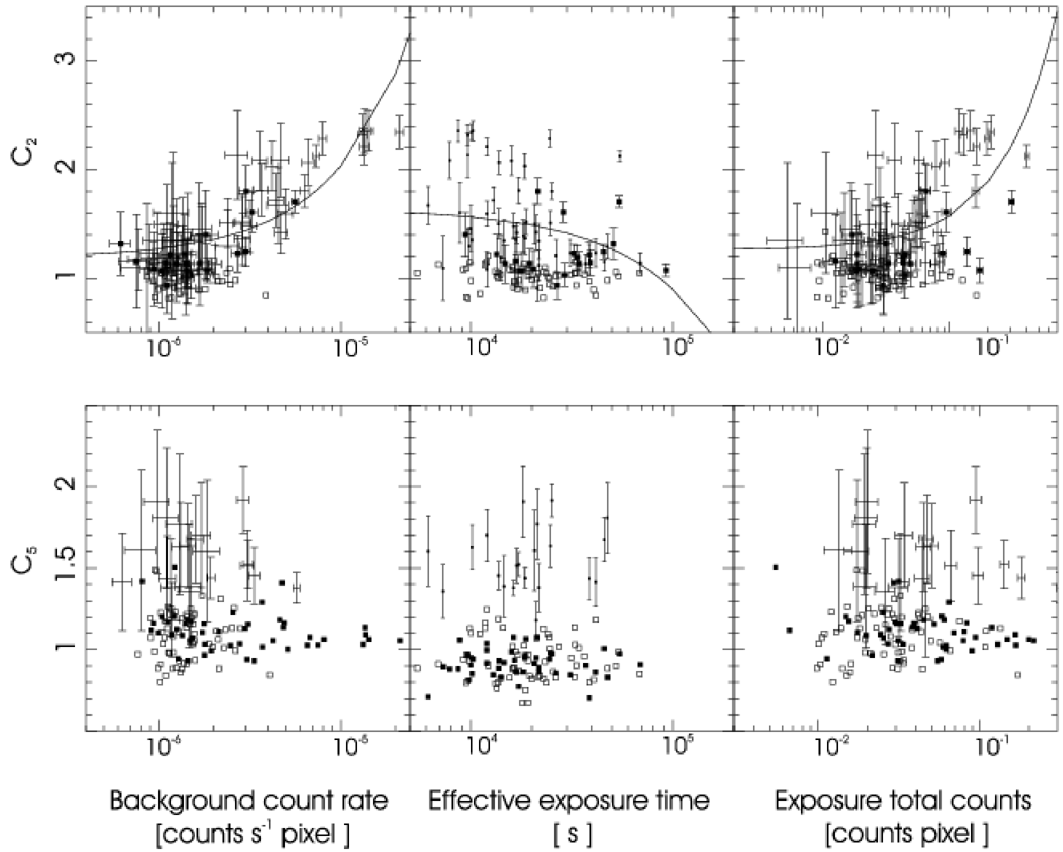


Fig. 10. *Upper panels*: scatter plots of the CCD2 contamination as defined in Eq. (2) vs. the quantities indicated in the horizontal axes in logarithmic scale. The points with error bars represent contaminated observations (Eq. (1)), where solid squares correspond to observations which also present CCD5 contamination. Empty squares represent uncontaminated observations. The curves correspond to the regression lines of the data. The statistical significance of the regression lines is shown in Table 2. The mean background intensities of the left panel are calculated using the data gained with CCDs 3, 4, 5 and 7. *Lower panels*: equivalent to the upper panels for the CCD5 contamination. Points with error bars are CCD5 contaminated, solid squares show CCD2 contaminated observations and empty squares represent uncontaminated observations. No regression lines are shown because the statistical tests do not reject the zero correlation hypothesis in any of the three cases shown here (see Table 2 and Sect. 5.1). Visually, the CCD5 contaminated set is well separated from the remaining observations which are located close to the $C_5 = 1$ line as expected for pointings free of contamination.

BG Blank Sky data analysis

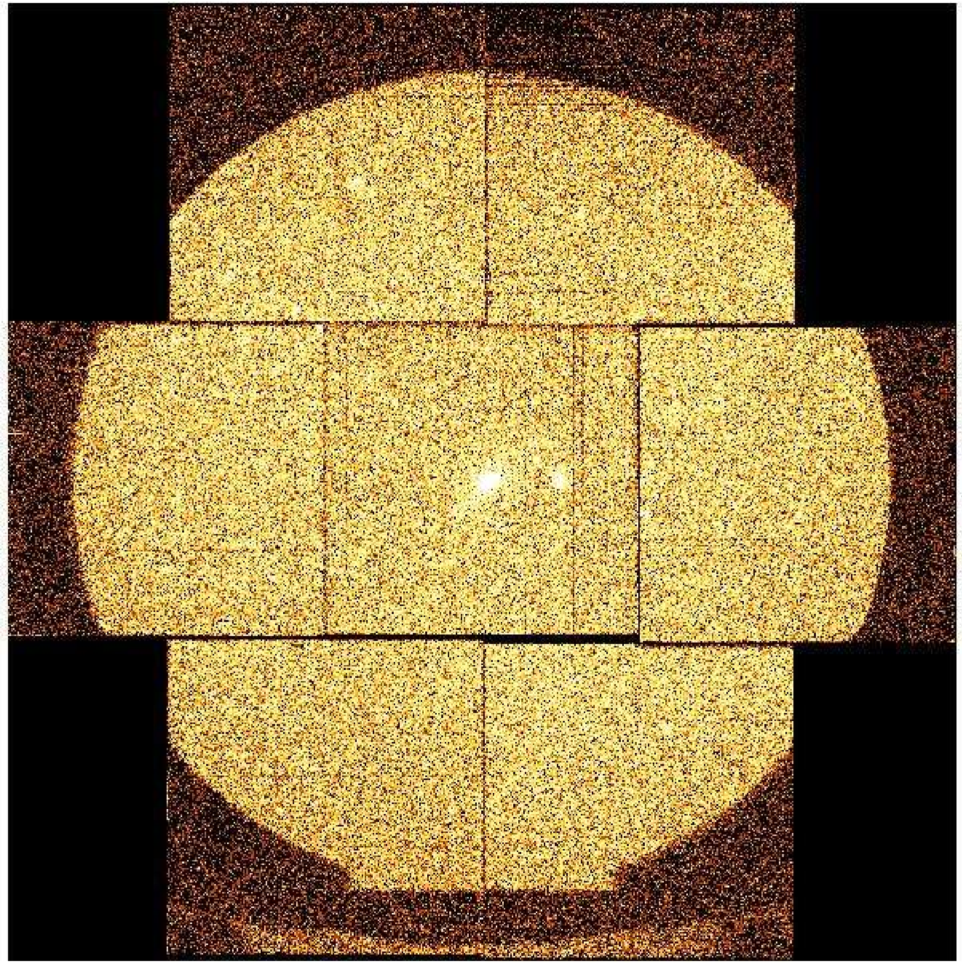
XMM-Newton - the greatest X-ray-collecting observatory ever - only instrument able to study the very faintest, and diffuse and extended astronomical objects - clusters and groups of galaxies, individual galaxies, supernova remnants etc., but require an excellent model of the background.

`03- Background event files created for the three EPIC detectors, and for each instrument/ mode/filter combination, using large amounts of pointed XMM-Newton data (Read & Ponman `03).

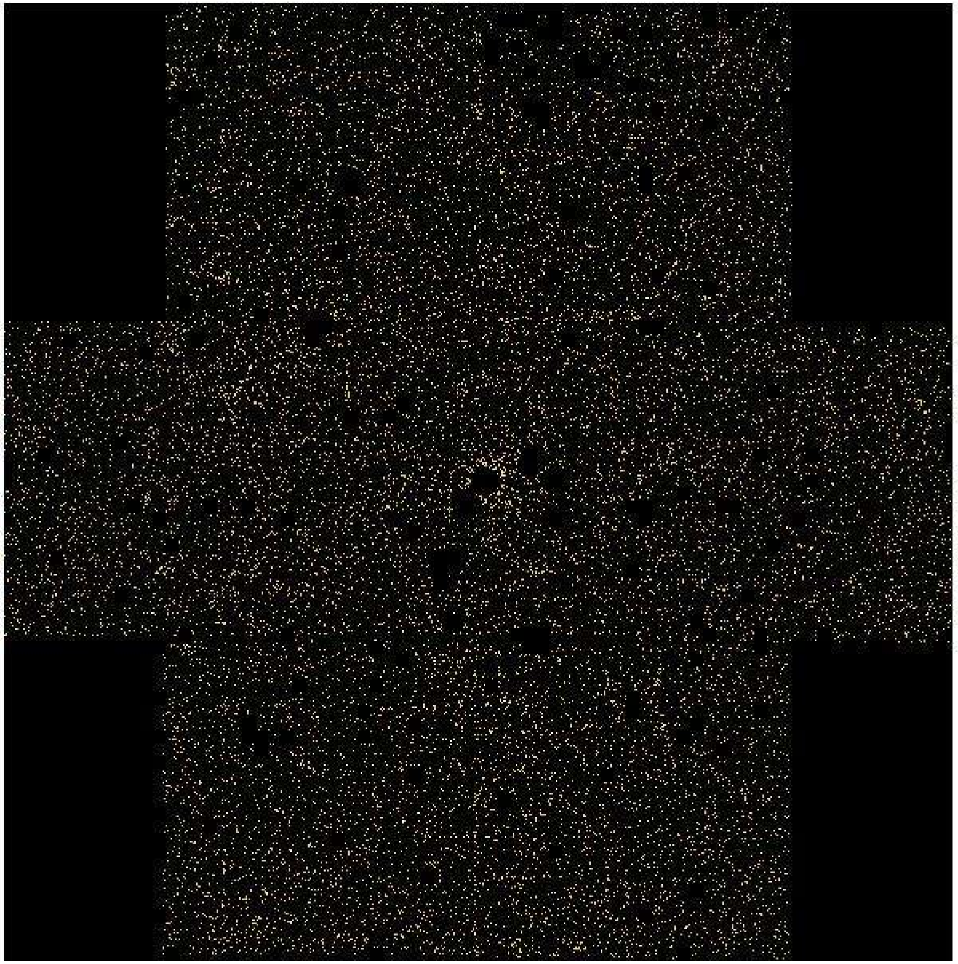
Have been used very extensively by the community, especially e.g. when target source fills the FOV – files regarded as the best and easiest to work with.

Plan to create at Leicester (Carter & Read) very much improved and larger BG event files using new SAS-6.5 reprocessed pipeline products.

New BG Blank Sky data analysis

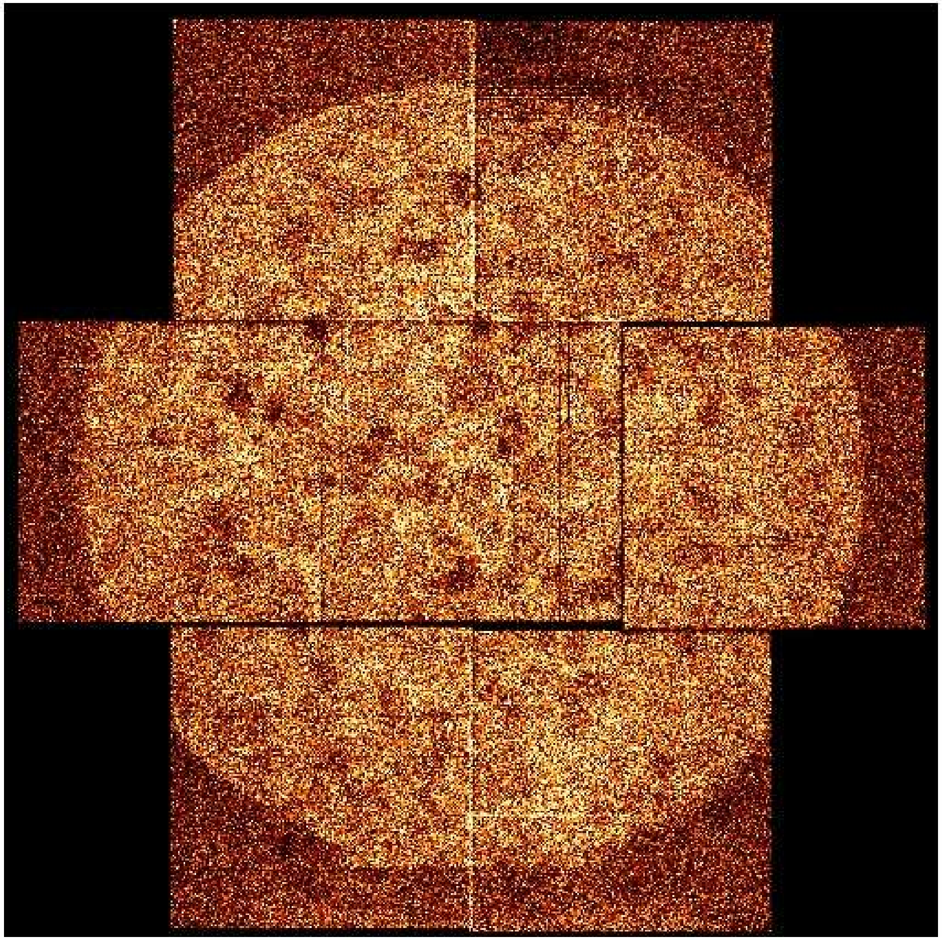


Original pps product event file

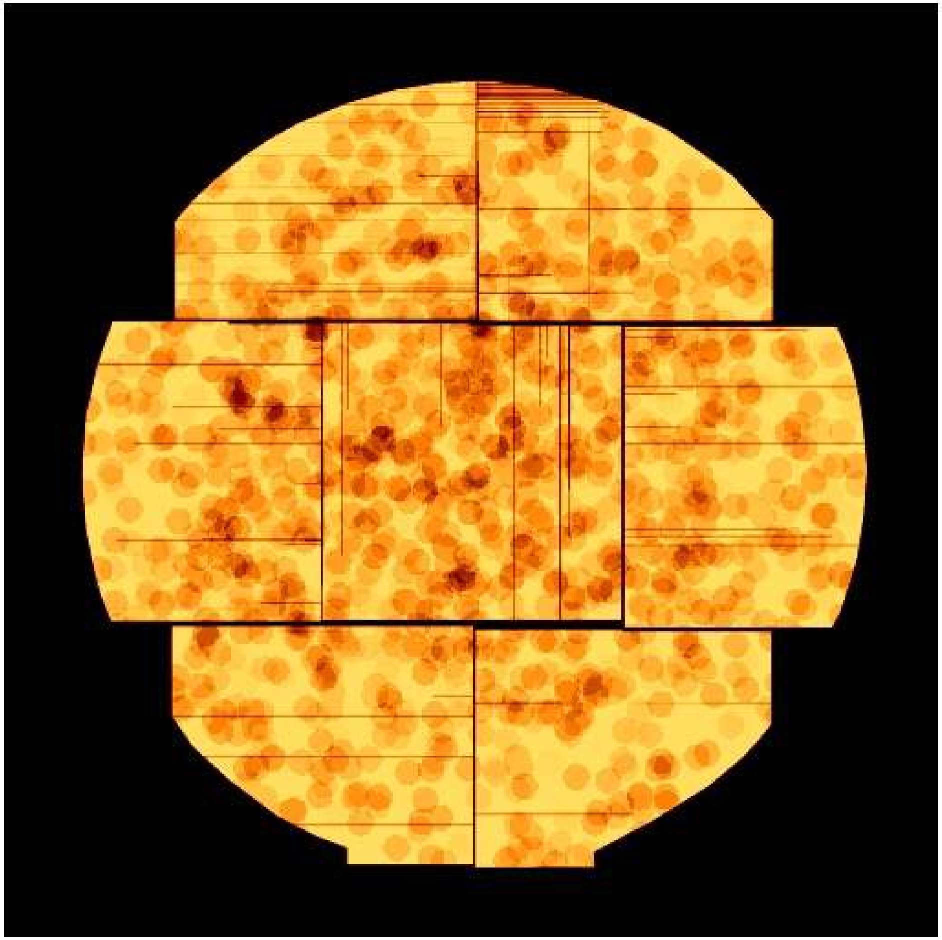


Source-removed, BG-flare-filtered, plus energy, pattern, flag & FOV filtering

Perform for several clean, long-exposure, non-bright-source observations and stack…

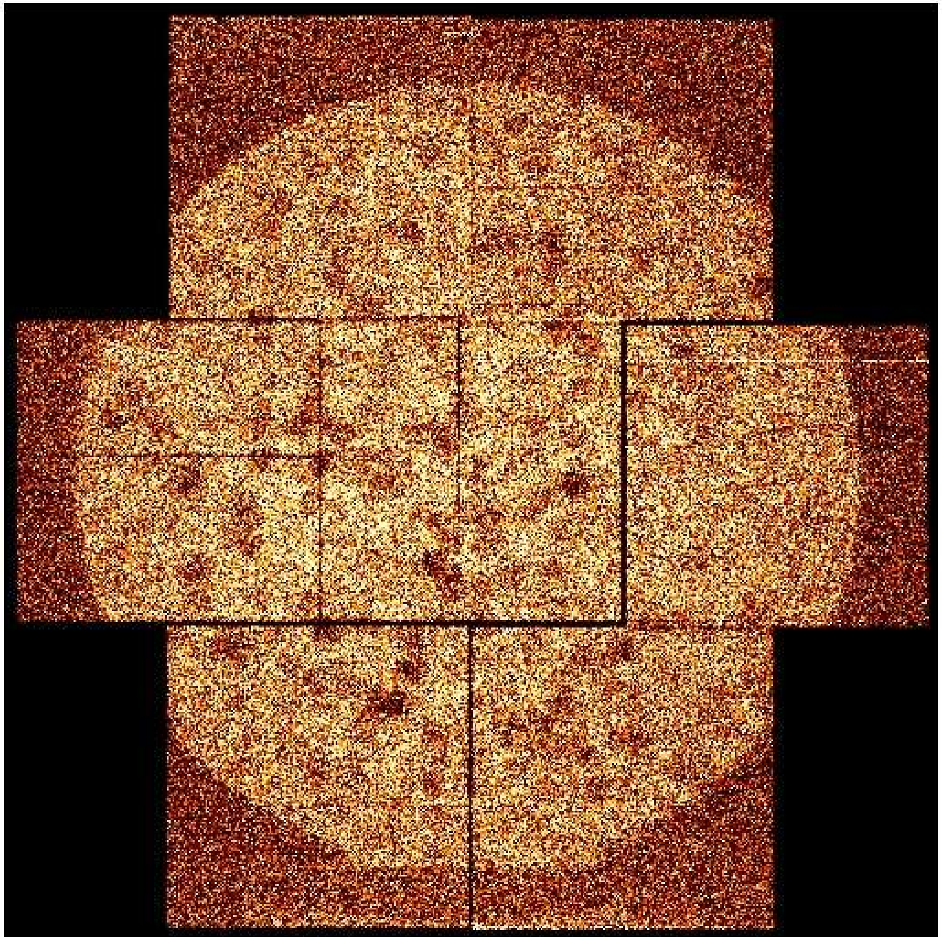


Event file (DETX-DETY co-ordinates)

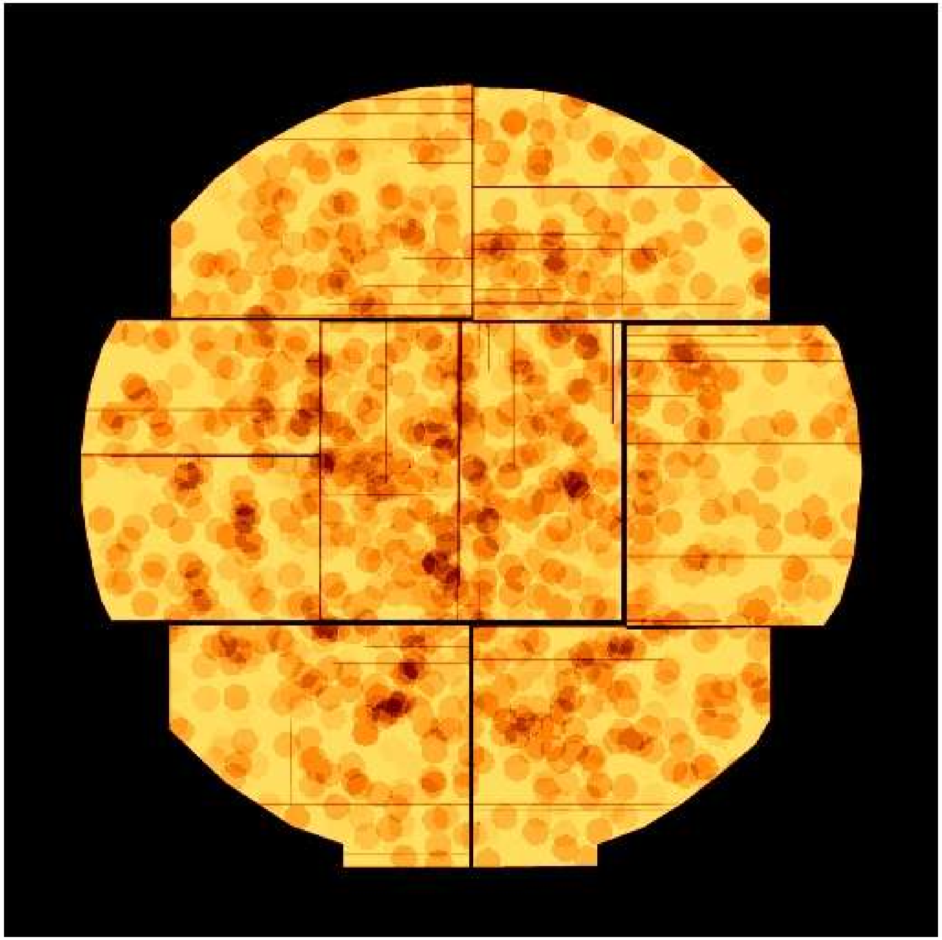


Exposure map

Example: MOS1 Thin Filter, Full Frame mode – 18 exposures – 415 ksec

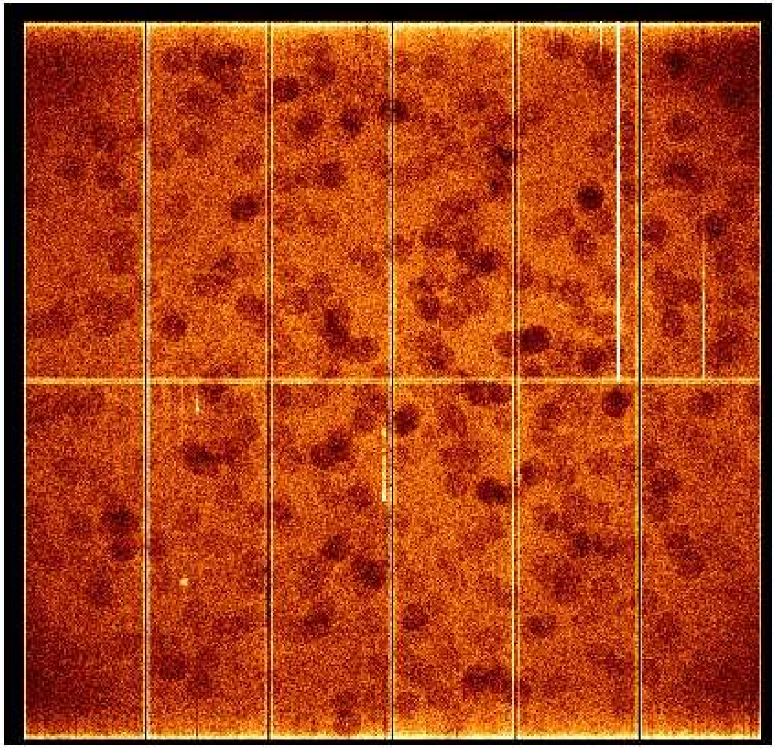


Event file (DETX-DETY co-ordinates)

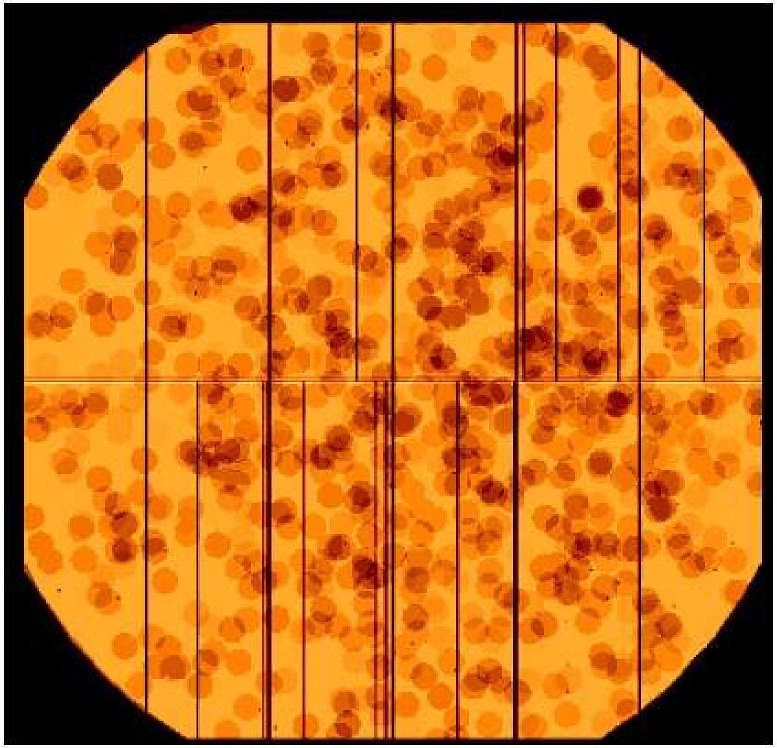


Exposure map

Example: MOS2 Thin Filter, Full Frame mode – 17 exposures – 380 ksec



Event file (DETX-DETY co-ordinates)



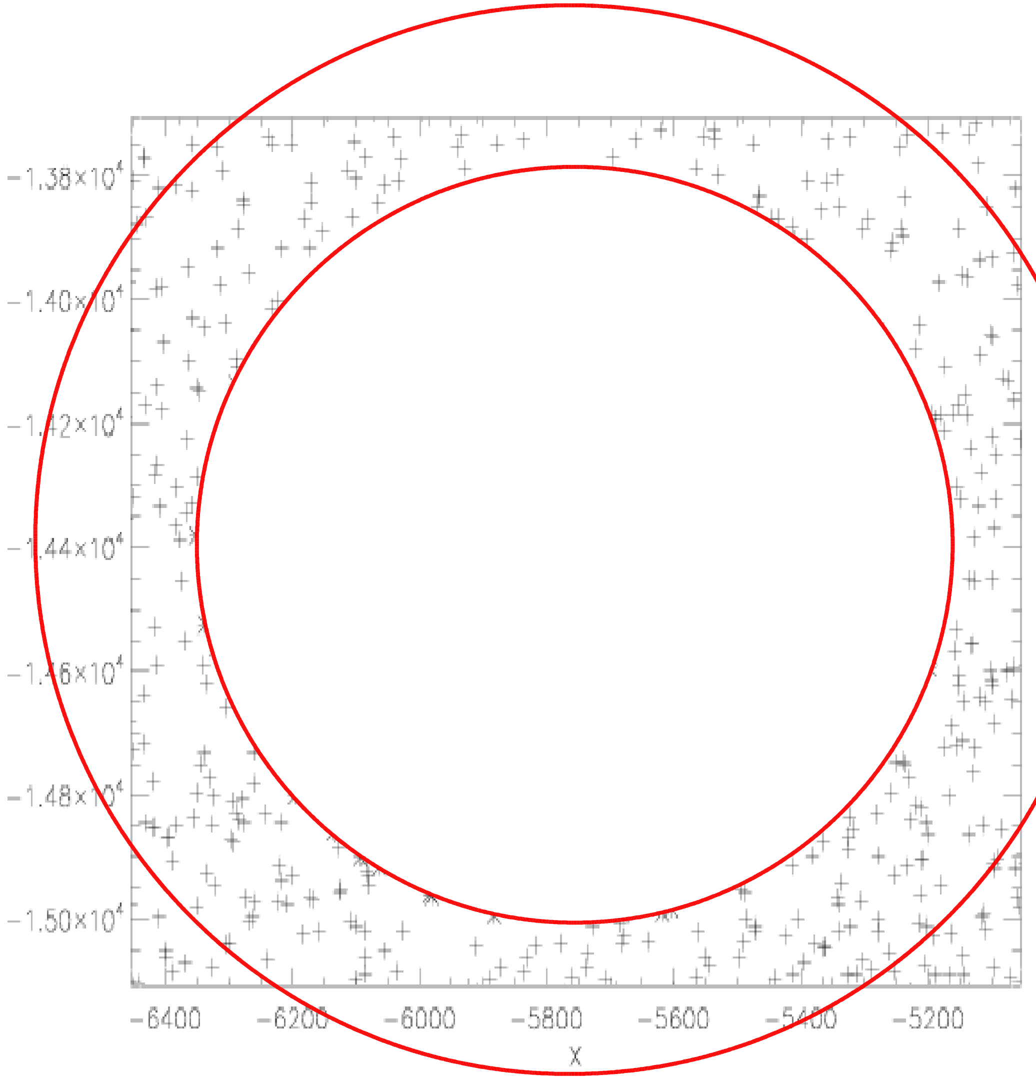
Exposure map
(Complicated analysis?)

Example: pn Thin Filter, Full Frame mode – 11 exposures – 280ksec

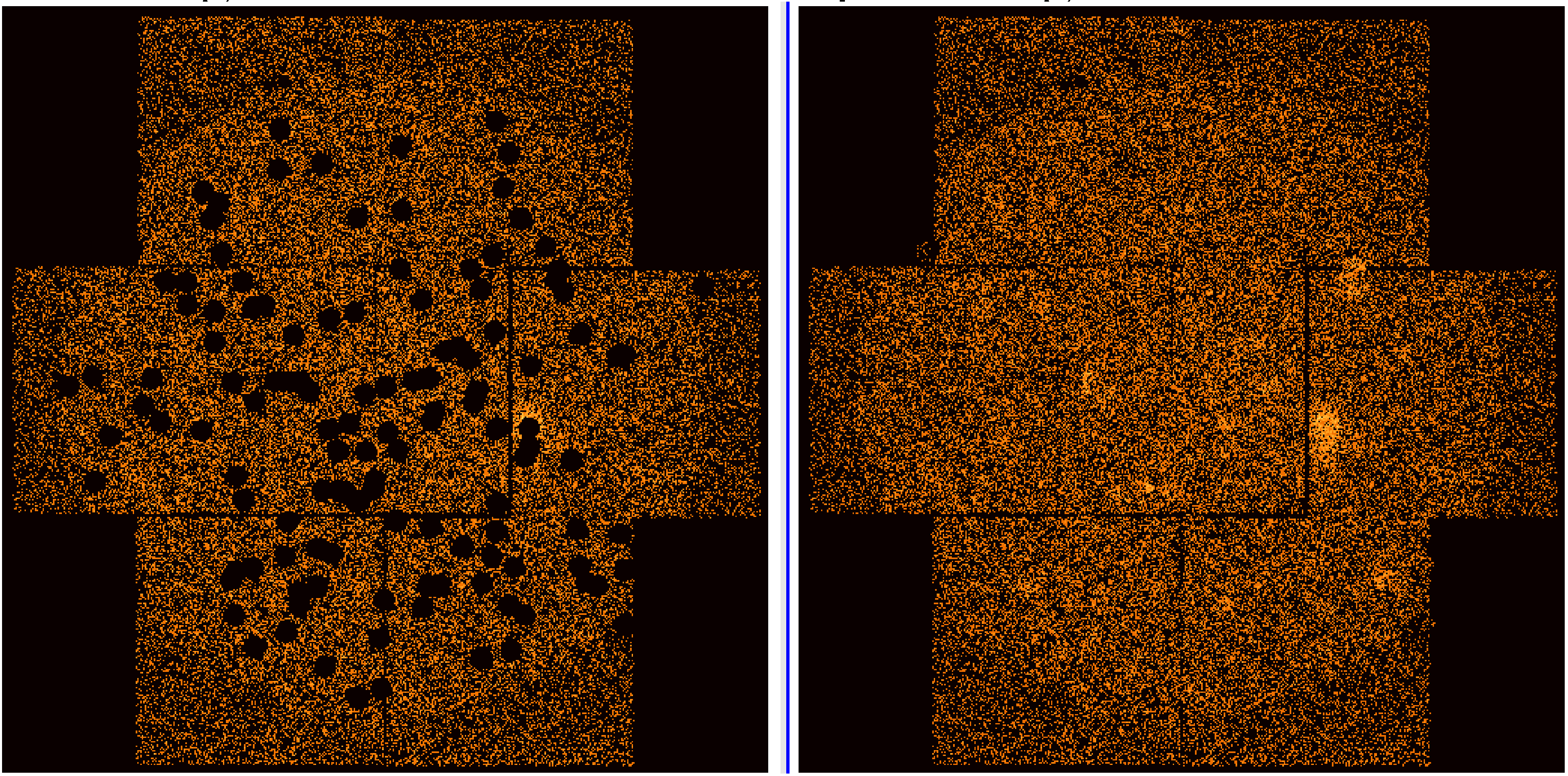
Filling the source holes in the event files - ‘Ghosting’

- Match the area of the source hole to the area of an annulus surrounding the hole
- Copy the events in the ring
- Randomise the DETX, DETY positions of these copied events inside the annulus
- Add these events to the event file

- Consider complicated situations (multi-holes, edges etc.)
- (attcalc [to 0, 0, 0] to correct X, Y positions)



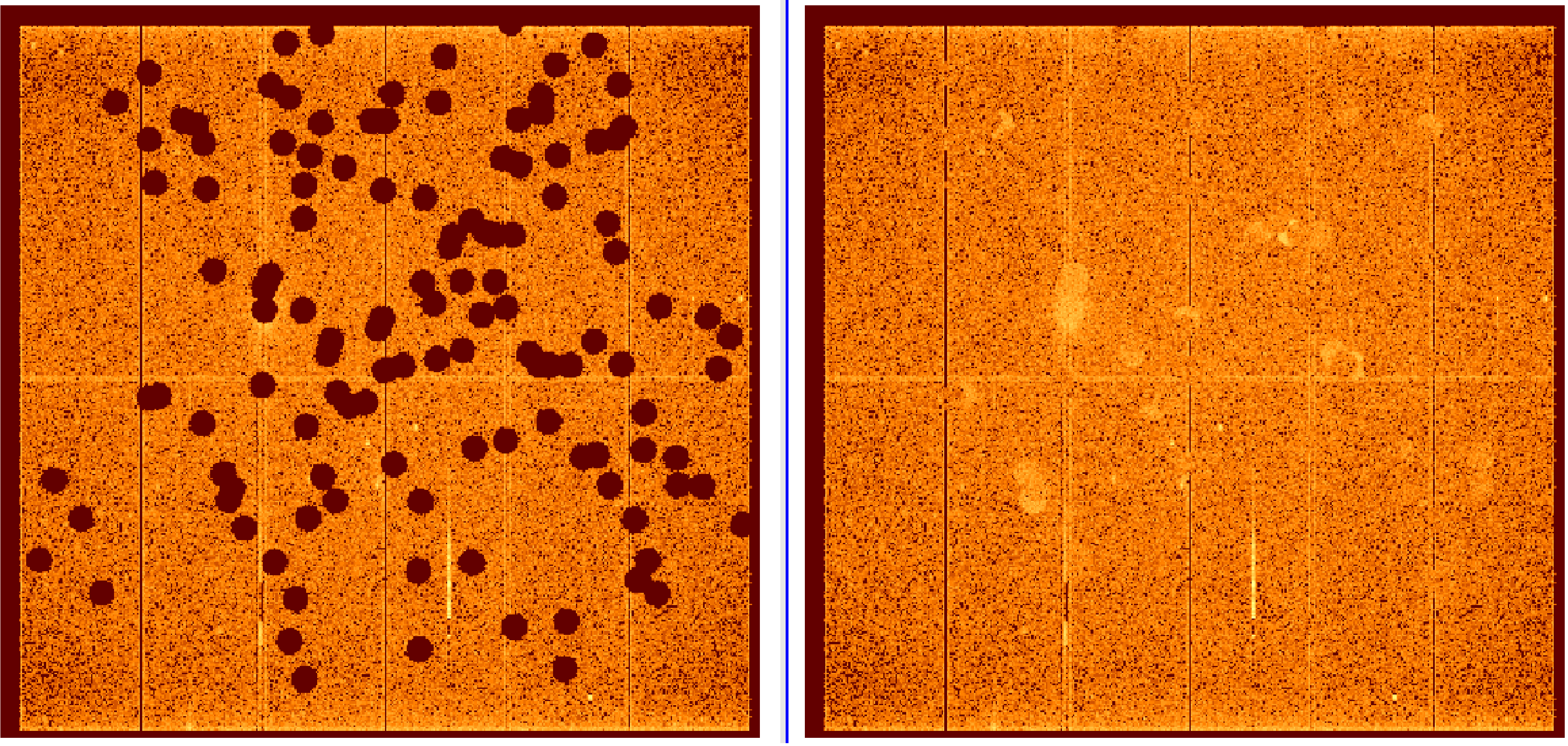
Filling the source holes – example – single MOS2 event file



- Most holes filled perfectly – few complicated scenarios remain (multi-holes) plus some bright source and CCD-edge effects
- Stacking of event files will smooth these small effects

Andy Read (amr30@star.le.ac.uk)

Filling the source holes – example – single pn event file



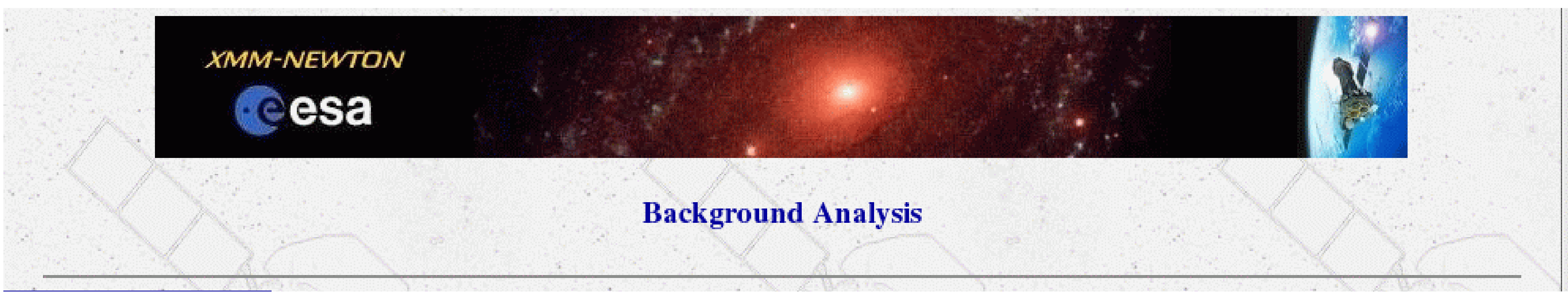
- Allows usage of simple, flat exposure maps – no complicated exposure calculations necessary

EPIC Background Working Group:

For updates on:

knowledge, understanding, software, files (blank sky, closed) etc. …

http://xmm.vilspa.esa.es/external/xmm_sw_cal/background/index.shtml



EPIC BGWG

- XMM-Newton EPIC **B**ack**G**round **W**orking **G**roup founded
  Steering and supervising committee to provide the user with clear information on the EPIC Background and (SAS)-Tools to treat the EPIC Background correctly for various TBD scenarios (ESAC, Goddard, Leicester, MPE)

- Regular meetings and telecons

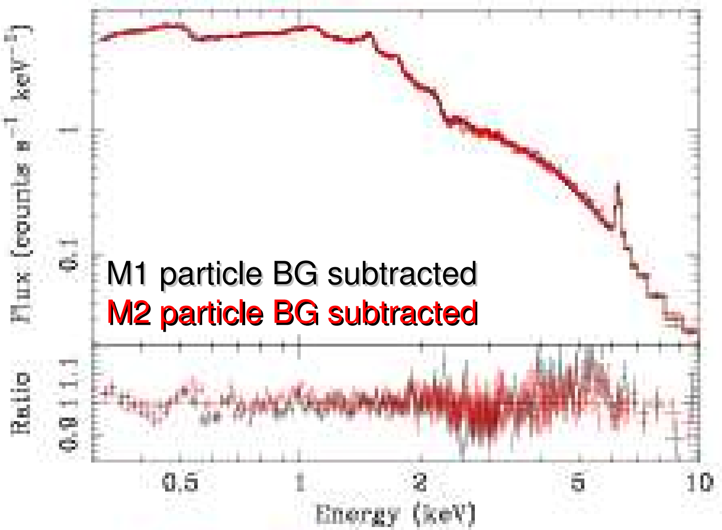
- Released:
  - **BG analysis web page** with recommended information, papers, summary tables etc.: **http://xmm.esac.esa.int/external/xmm_sw_cal/background/index.shtml**
  - **XMM-ESAS** XMM-Newton Extended Source Analysis Software package → model the quiescent particle background both spectrally and spatially for the EPIC MOS detectors
  - XMM-Newton blank sky event files → to be used when the user has difficulty in extracting a suitable background region from their observation

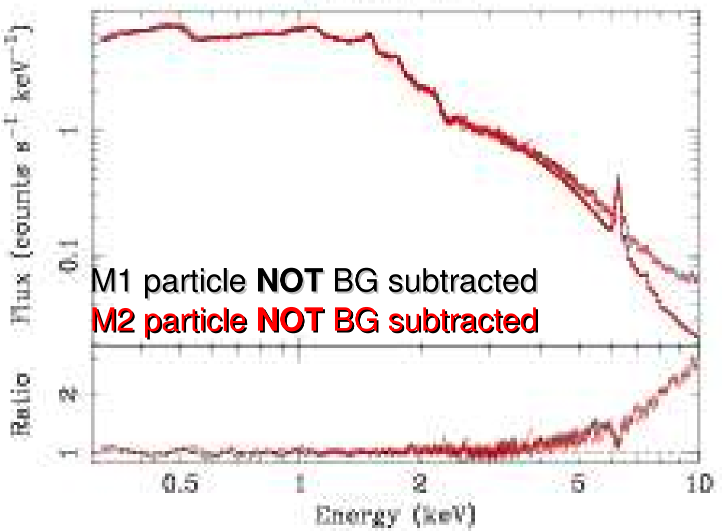
- Under development:
  - FILX: SAS tool to perform professional screening for flares for EPIC-MOS and EPIC-pn
  - XMM-ESAS for pn
  - Double background subtraction (Clusters of Galaxies)

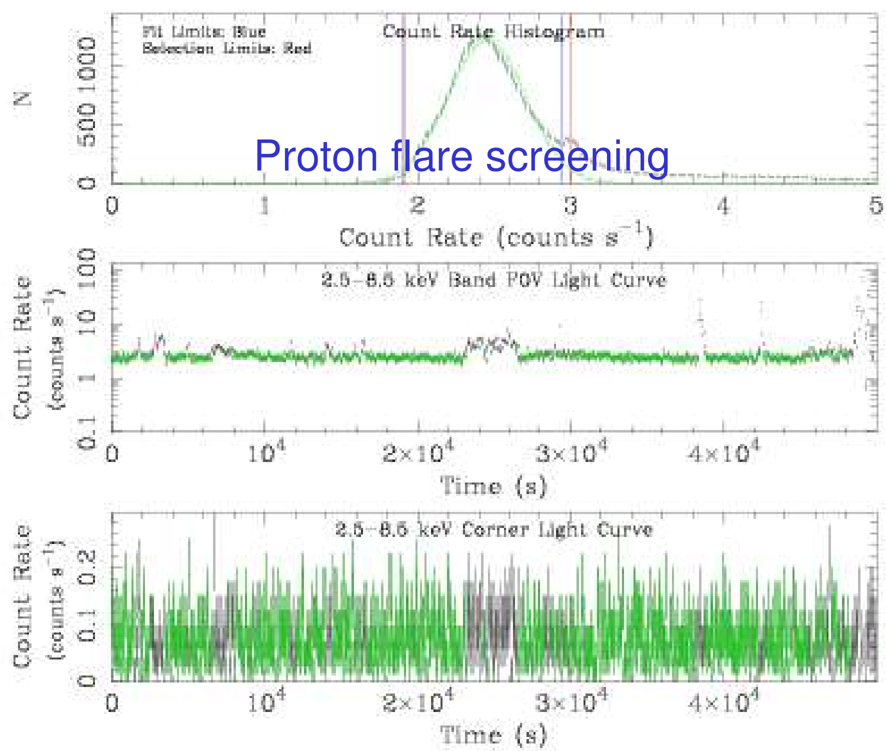
XMM-ESAS

- soft proton flare screening
- modeling the quiescent particle background both spectrally and spatially for the EPIC MOS detectors
- producing background spectra for user-defined regions of the detectors and background images (FITS standard)

- XMM-ESAS is based on the software used for the background modeling described in Snowden, Collier & Kuntz (2004, ApJ, 610, 1182).







blank sky images

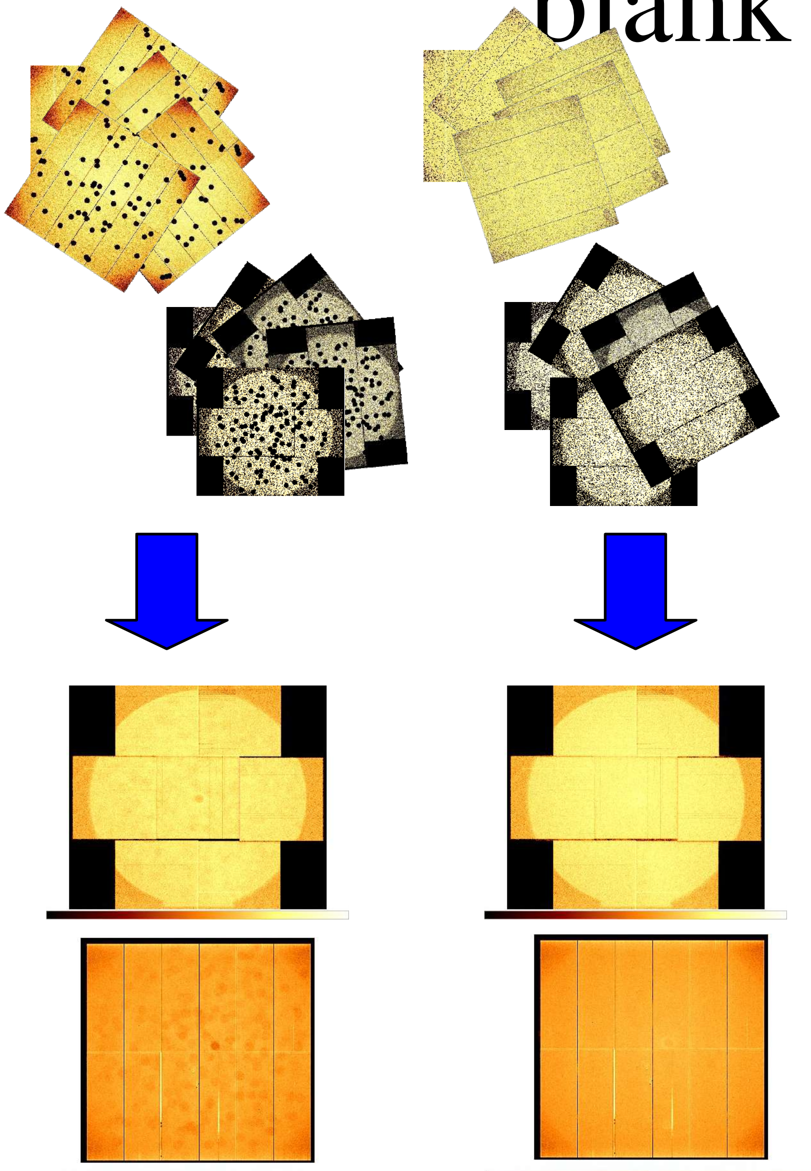


image from pn events files with sources removed

image from pn events files after event filling procedure

- superposition of many pointed observations of pipeline product data from 2XMM
- background events files and exposure maps
  - Mode (eFF, FF)
  - Filter (all)
  - Type (filled, unfilled)
  - Vignetting (with, without)
- S/W
  - select events from a certain area of the sky
  - Cast event files on sky