



## **1 Purpose of the XMM EPIC BG working group**

The XMM EPIC BG working group has been founded as a steering and supervising committee to advise and organise the EPIC consortium to provide the user with clear information on the EPIC BG and TBD (SAS)-tools to treat the EPIC BG correctly for various TBD scenarios.

## **2 General overview of EPIC BG components**

### **2.1 General EPIC(AMR)**

BG consists of

- X-ray photons through telescope
- Electronic noise
- Particles (soft protons, high energy induced x-ray)
- Solar wind exchange, measurements proposed to Chandra to provide data base at GOF for that BG component. Possible calibration observation may be needed from XMM for 1 orbit (SS)

#### **SOFT PROTONS (SP)**

- Variable spatially vignetted, no correlation between intensity and shape
- Flaring soft proton (SP) flux is getting worse
- Quiescent SP flux is not evolving in ('02-'04)
- SP vignetting is flatter than X-ray vignetting (@ 10 arcmin: SP: 85%, 55%)
- sig. SP BG component can survive after GTI screening
  - Surface brightness ratio in and out of FOV at 8-12 keV can reveal the presence of this residual BG
  - Spectral shape flat powerlaw, exp cut-off, typical of particle BG
  - Spectral slope highly variable and unpredictable
  - Intensity can be highly variable (up to 300 % and beyond)
  - When intensity of residual BG is low (up to 30 % higher than average) acceptable results can be obtained using a simple renormalization of the quiescent BG spectrum

A BG components synopsis table is available on the web:

<http://www.star.le.ac.uk/~amr30/BGTable.html>(this address may change)

### **2.2 MOS (AMR)**

INTERNAL BG (CR induced)

- Not vignetted
- Al is produced by fluorescence from the camera housing

- Si is much weaker out-FOV
- Au prominent out-FOV
- Cr, Fe, Zn, Mn
- Strong spatial variations in line intensities
- Energies and width stable
- Better to extract internal particle BG from same region of detector as Spectrum (i.e. used CLOSED data as opposed to corners) but may be problems with non-simultaneity
- Below 2 keV large temporal changes are seen
- Possible to use non-simultaneous measures of the internal BG (i.e. closed observations) but only for > 2 keV.

### 2.3 EPIC pn BG description (MJF)

- in addition to MOS also OOT events
- solar wind exchange analysis with HDF north shows additional BG component
- Al, Ni, Cu, Zn, Mo, Ti, Cr, Fe, Au (MO only in doubles)
- internal BG higher by a factor of 2-4 (compared to MOS), depending on energy
- closed observations for high BG seasons differ from those from low bg seasons
- high energy continuum more increased than Cu lines
- pattern distribution is different for camera induced X-rays (more singles)
- low energy BG is dominated by the read out noise of the CAMEX
- strong spatial variation in doubles in 0.2-0.5 keV

### 2.4 UNDERSTAND BG (AMR)

- particle BG for MOS and pn is higher than expected by factor of 2
- are the GAMMA RAY Rates wrong?
- PN BG is greater by a factor of 2 than MOS (agrees with Dave's idea of thickness of detectors)
- cosmic rays should depend on cosmic flux, hence RadMon dependence ?
- can we get rid of quiescent SPs?
- charged particles/MIPs in MOS produce halos around MIP trail (MIP trail is removed, but not halo)

### 2.5 BG reduction (AMR, MJF)

- epreject
- BG improvement regarding noise and offset (already in SAS for FF mode)
- as of SAS 6.next offset tables of individual observations will be used
- emreject could be developed analog
- halo reduction task for mos halos of trails might be in, or should go into SAS em tasks.
- post reduction tasks
- WHAT IS THE BEST WAY OF PROTON SCREENING?
- Should there be a SAS/EPIC task to do that?

Answer: Yes,

- use echain/proc to produce rate curves
- provide tool that:
  - produces GTI files (sigma clipping or countrate screening)
  - applies screening
  - produces screened events file
- GTI for one camera should be able to applied to others SS to provide prototype
- provide already now recipe to do the same with individual steps on web page
  
- Should SAS/EPIC state what they think the optimum strategy is?
 

Answer: yes

  - provide mainstream strategy and caveats for it
  - links to more sophisticated stuff and code
  
- optimum strategy might be different for particular sources or for science attempted.
- general advice for extracting images (no doubles below 0.5 keV)
- > MK to set up web page

## 2.6 BG models

- blank sky files available from AMR, DI, JN, AdeL/SM
- collect all and point from SOC page
- closed blank-sky (particle) event files also exist (PM) Where?
  - collect and pint to via page
- (re)make larger BG blank-sky event files
- (re)make larger closed filter event files
- produce new blank-sky fields routinely after every S/W or calibration update with automated scripts (AMR to provide scripts to be implemented and run at ESAC)
- bg model by SS/KK (see technical note)
  - method to construct a spectrum of the particle-induced BG that can be used for observations of the diffuse BG and other objects that fill the field of view
  - method uses a combination of CLOSED data and a database of the corner- pixel data to construct spectra of the quiescent BG, that can be directly subtracted from the object spectrum
  - in addition a model of the spectrum due to soft flares which can be removed during spectral modeling
  - non SAS tool available and of July
  - SAS version ???

### **3 Detailed descriptions of codes, tasks procedures**

#### AMR

- tool to create BG spectrum for diffuse sources with some local BG in the field of view that can be used. correcting local BG for vignetting taking out particle BG before from outer corners. Effectively that take into account, that local BG is vignetted but particle introduced internal BG is not.
- Tool of SS/KK. Detailed description available at <http://www.src.le.ac.uk/projects/xmm/technical/>

### **4 Other existing procedures**

- Silvano Molendi
- Juka Nevalainen
- Saclay Method Gabriel Pratt
- Alexis Finoguenov

Need for standard candles for the comparison of the different methods

People may be invited (travel will not be paid by ESA) to one of the next meetings to report on their work and to find out if the work may be incorporated in SAS.

### **5 WEB page**

link from main SOC page under calibration to BG analysis

- On BG analysis give top level information
- (non SAS tools) will be available by end of 2005
- Birmingham page should be linked directly
- MK to provide prototype page
- provide CLOSED files
- Could mention minutes, presentations, papers on <http://www.src.le.ac.uk/projects/xmm/technical/> and BG components synopsis table on <http://www.star.le.ac.uk/~amr30/BGTable.html>

### **6 Future Progress**

Next Meetings:

- November 24/11 14:00 - 25/11 18:00 2005, MPE Garching
- April 2006

## **7 Actions items**

- AI\_EPIC\_CAL\_14\_1: Additional time column with other 0 point for ODF (RD, MK, MJF)
- 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
- AI\_EPIC\_BG\_WG\_01\_02: AMR to provide SOC with scripts for blank sky data by end of August
- AI\_EPIC\_BG\_WG\_01\_03: MK to implement AMR scripts for blank sky data at SOC for standard processing after CAL updates
- 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\_06: MK to provide prototype BG web page by End July
- AI\_EPIC\_BG\_WG\_01\_07: AMR to send up to date link to BG pages at Birmingham
- AI\_EPIC\_BG\_WG\_01\_08: AMR to provide table for BG components to SOC
- AI\_EPIC\_BG\_WG\_01\_09: MJF to summarize the work done currently at MPE on pn BG modelling/subtraction at next meeting
- AI\_EPIC\_BG\_WG\_01\_10: MK to put minutes and AMR to put presentations to Leicester page
- AI\_EPIC\_BG\_WG\_01\_11: WNP to provide SOC with script for "good" image to be turned to a SAS thread
- AI\_EPIC\_BG\_WG\_01\_12: TBD: 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.

## **8 AOB**

- Links to S/W that produce nice images (SS, WNP, AMR) may be included in the BG pages
- BG subtracted images
- Explain BG methods for source finding
- How to produce good images without gaps