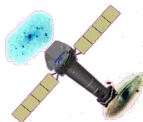# Blank sky data analysis

Jenny Carter, University of Leicester

Andy Read, University of Leicester

XMM
EPIC
MOS

Jenny Carter (jac48@star.le.ac.uk)
3rd EPIC BG WG Meeting
MPE, Germany 02/05/06
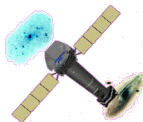
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Leicester

Plan – review

- Aim: Creation of long exposure blank sky EPIC BGevent files

  1 – Writing of the tasks/scripts
  2 – Compiling list(s) of observations
  3 – Creating BG event and other files
  4 – Stacking BG event and other files
     - low BG, long duration observations, no diffuse sources, few central targets

- At last stage aims achieved:

  Using 2XMM pipeline products
  Script 1 – creates event files and exposure maps
  Script 2 – merges created event files
  Script 3 – merges created exposure maps

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General Procedure

Per instrument, filter and mode combination:

List of observations

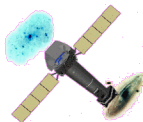no bright sources, long exposure etc

↓

Create event lists and exposure maps

↓

Merge event lists and exposure maps
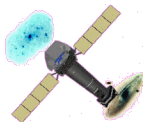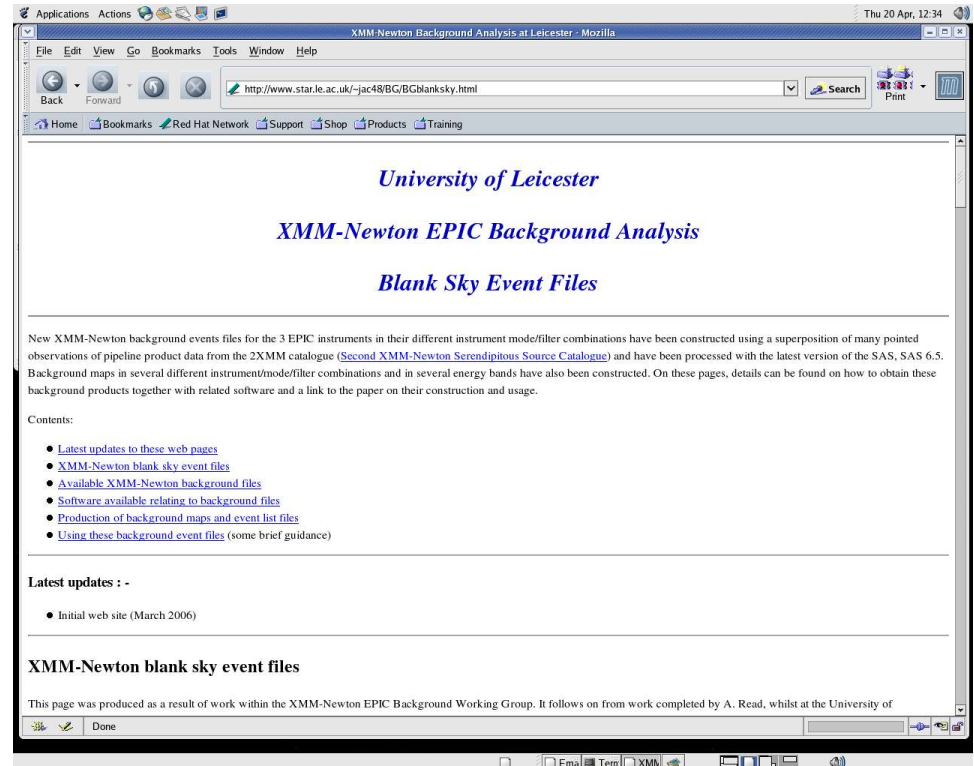
↓

One great big event list with an exposure map

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Current status

- List of obs.
  - Bad obs. removed
- Improved ghosting procedure

- Web page
  - Scripts AMR, JAC

- Files to ESAC
  - Set 1 – unfilled (all)
  - Set 2 – filled (ready to go)

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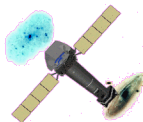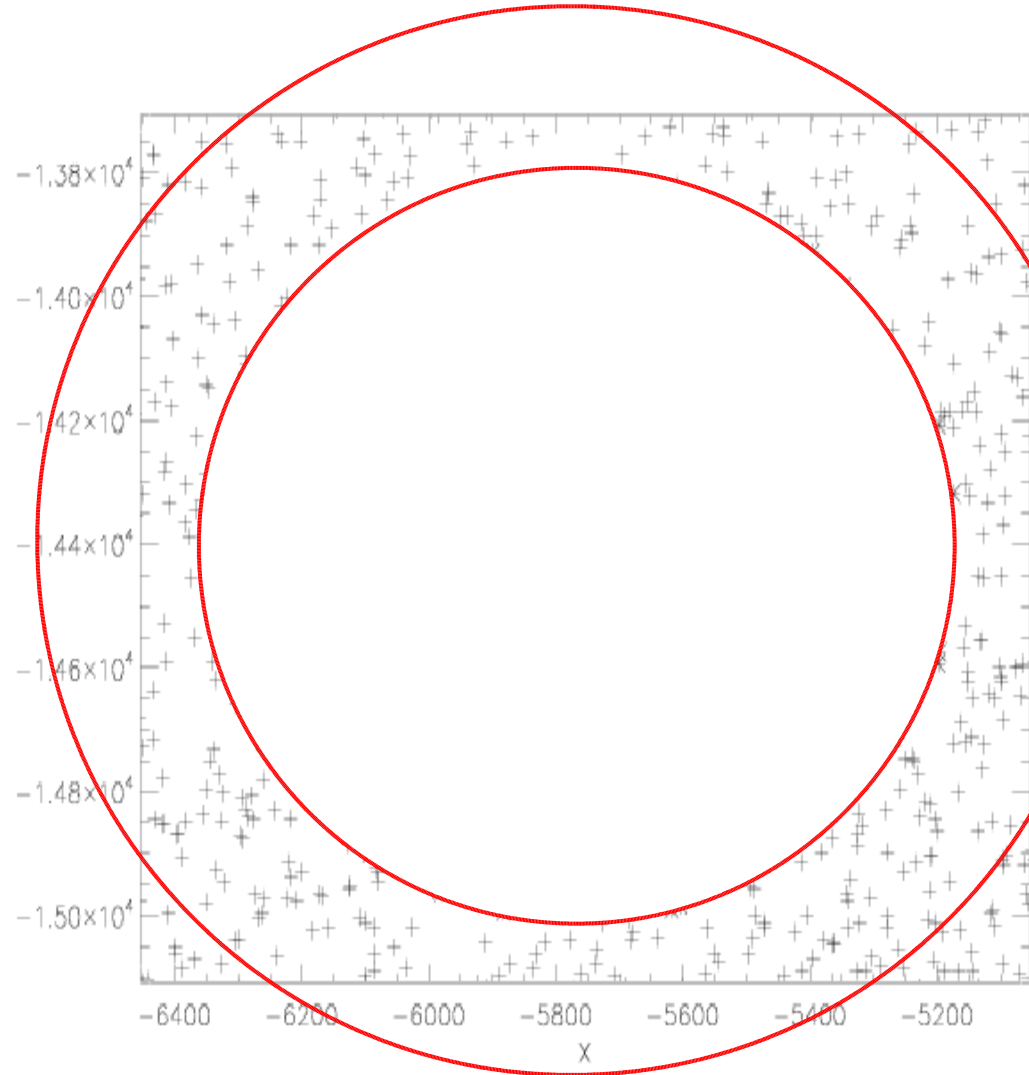3rd EPIC BG WG Meeting
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Filling the source holes in the event files - 'Ghosting'

- 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.)
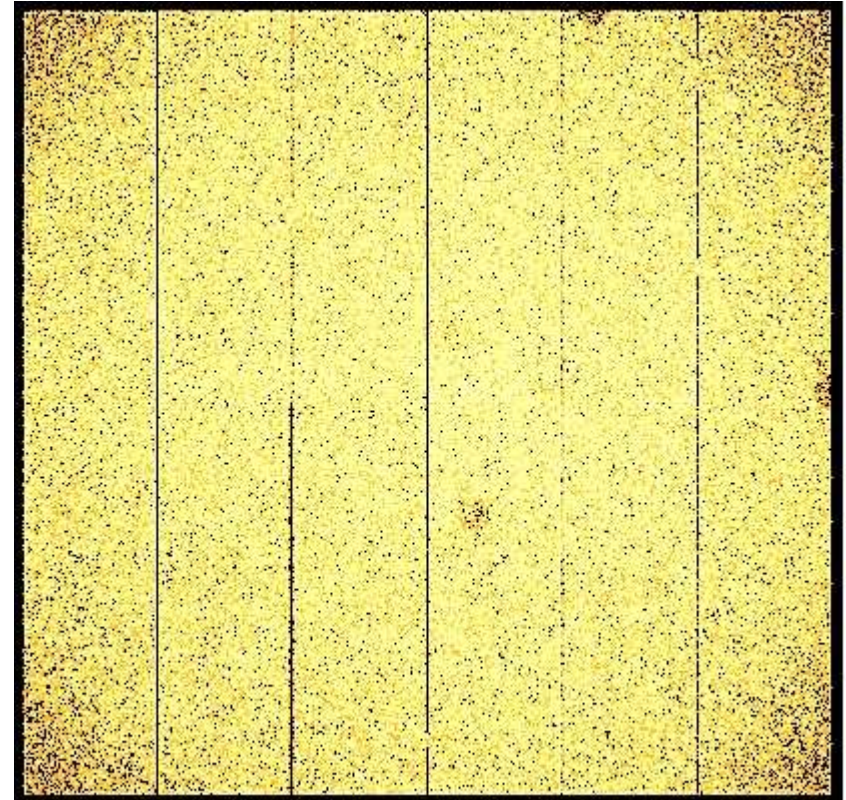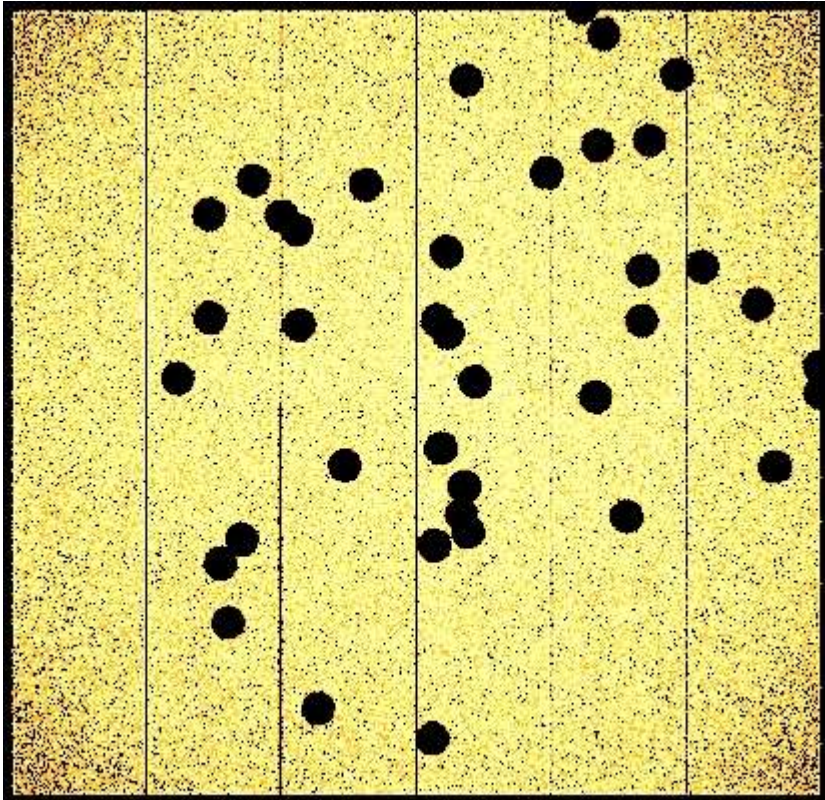
- (attcalc [to 0, 0, 0] to correct X, Y positions)

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Example PN file ghosting procedure
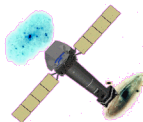
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Details of observations

Instrument	Mode	Filter	N_{OBS}	Exp.time (s)
MOS1	FF	Thick	12	3.01e5
MOS1	FF	Medium	65	1.58e6
MOS1	FF	Thin	113	2.19e6
MOS2	FF	Thick	13	3.44e5
MOS2	FF	Medium	67	1.68e6
MOS2	FF	Thin	111	2.09e6
PN	FF	Thick	10	2.37e5
PN	FF	Medium	33	1.08e6
PN	FF	Thin	42	9.93e5
PN	FFext	Thick	3	58664
PN	FFext	Medium	30	4.62e5
PN	FFext	Thin	62	8.25e5
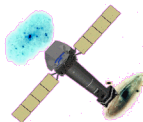
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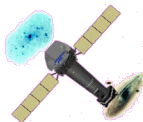
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Location dependence
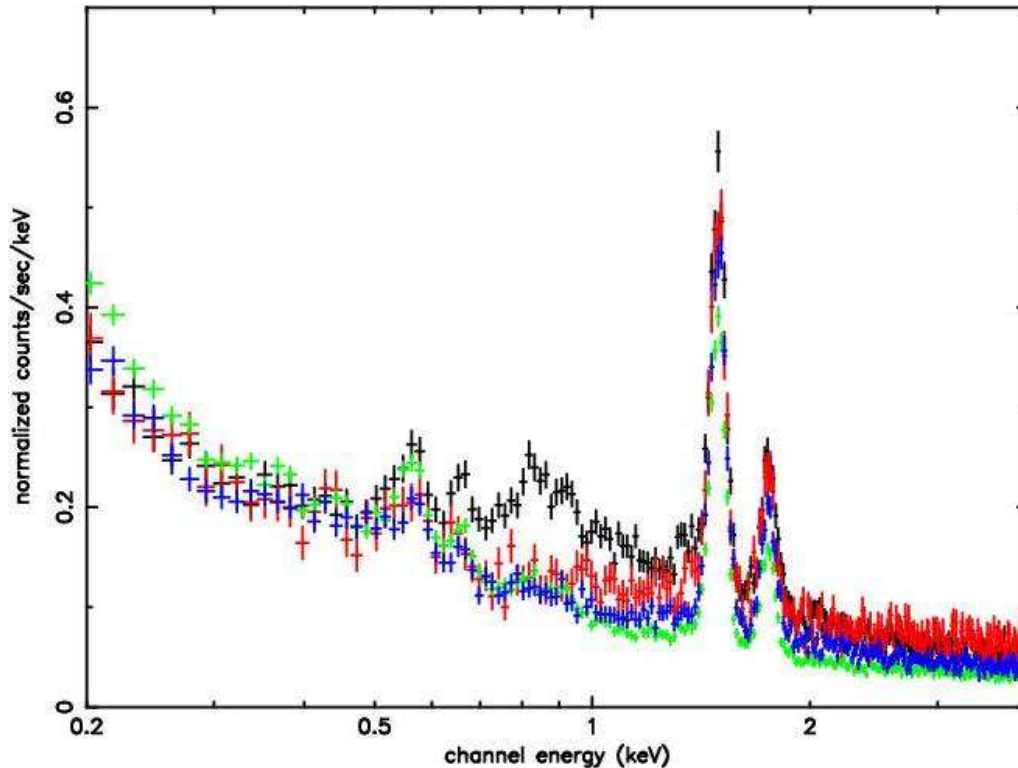
- MOS 1, thin, full-frame event file

- Galactic Centre enhancement features

- Tool produced for selection of events from a certain area of sky

expression = 'circle(0, 0, 10000, DETX, DETY)'

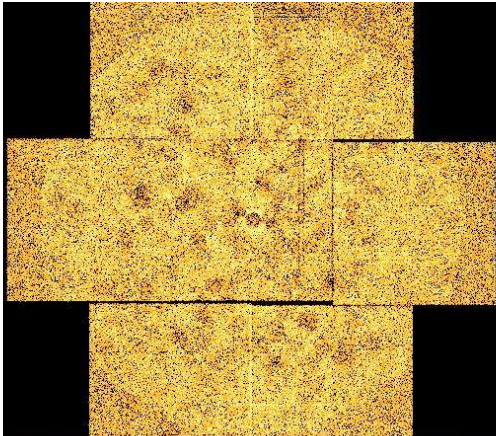**XMM**
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Count rate dependence

data and folded model

spechi.fits specmi.fits speclo.fits
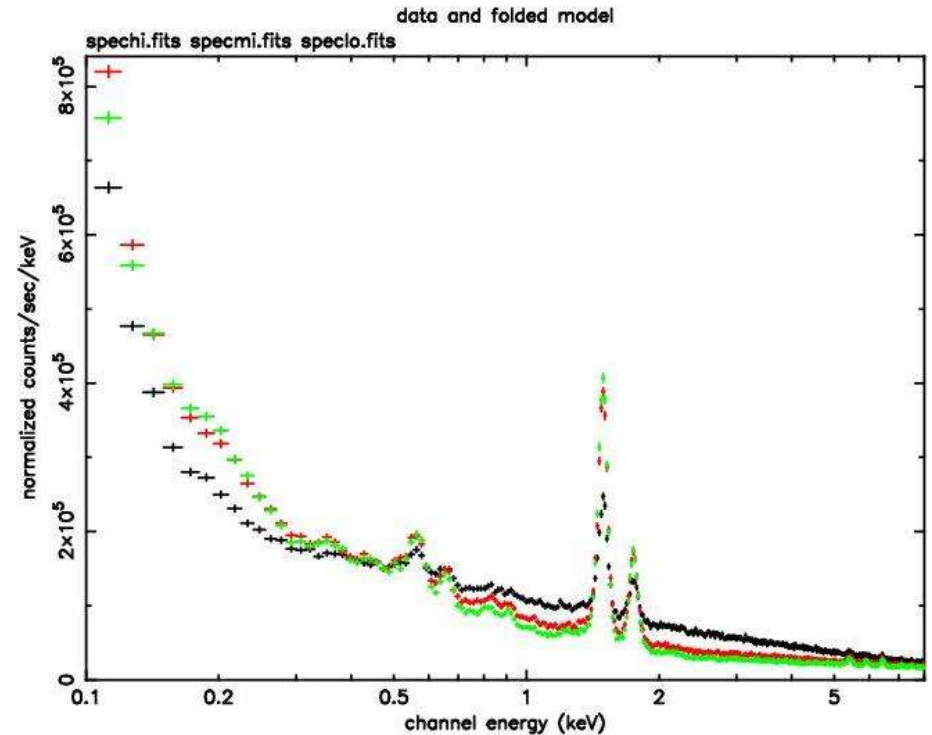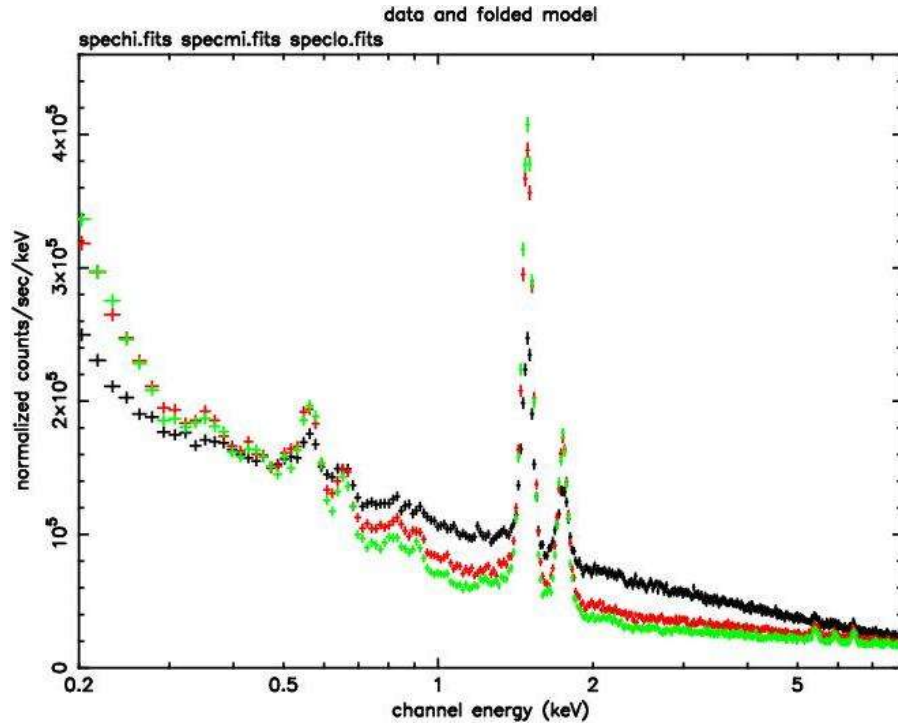
- Users may wish to make a selection based on count rate
- Differences between high, medium and low count rates

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# Out of FOV count rate – instrumental particle BG

- All instruments, patterns = 0 and patterns ≤ 12 (MOS) or ≤ 4 (PN), with (PI >= 2500 && PI <= 6000)

- Differences, Anti-centre – winter, Galactic Centre – summer ??
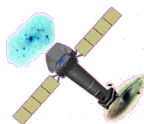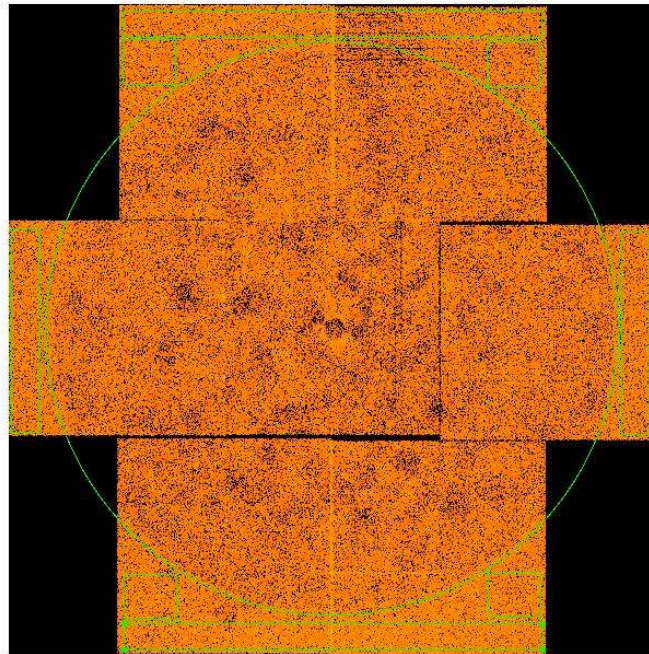
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# Differences between instruments, patterns and locations

Instrument	Mode	Filter	Position	Pattern	CR (cts/s/arcmin² x 10⁻⁴)
MOS 1	FF	T	N/A	0	2.69
MOS 1	FF	T	N/A	12	4.01
MOS 2	FF	T	N/A	0	2.87
MOS 2	FF	T	N/A	12	4.21
PN	FF	T	AC	0	19.2
PN	FF	T	AC	4	29.6
PN	FF	T	GC	0	36.4
PN	FF	T	GC	4	56.1
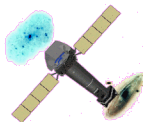
Anticentre exposure times by month: PNTFF — Galactic centre exposure times by month: PNTFF

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MOS
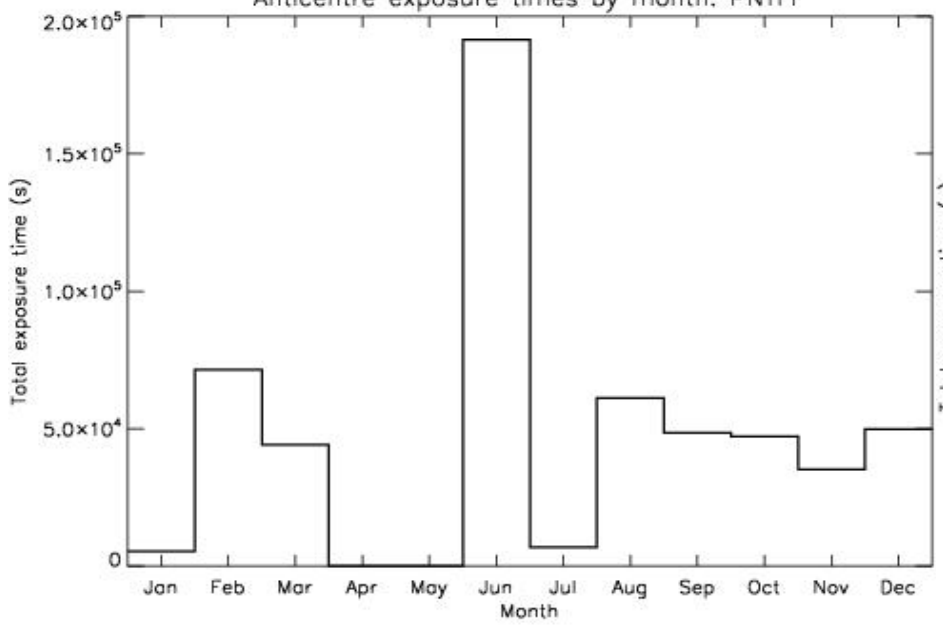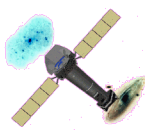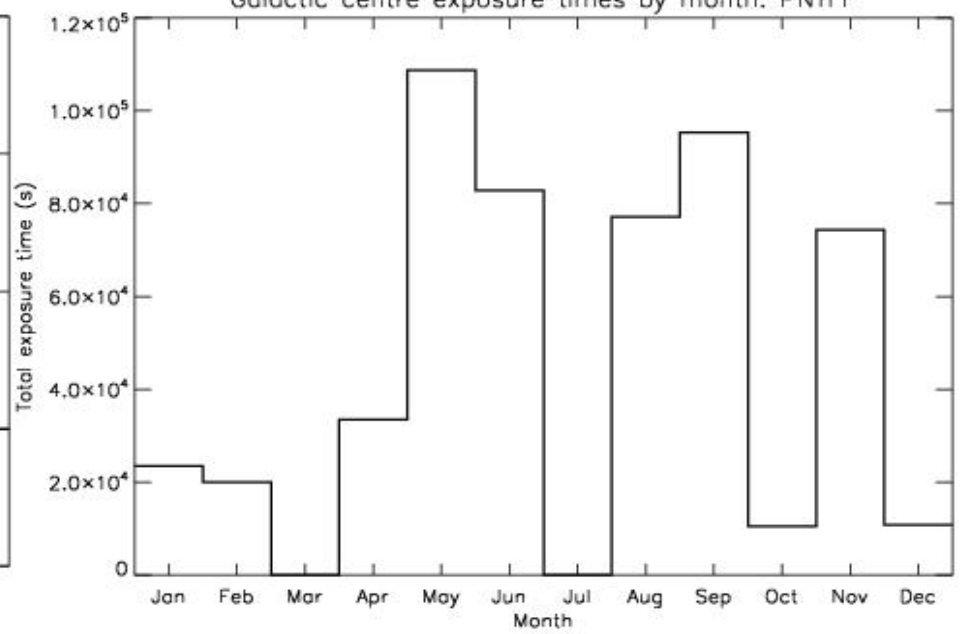
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Final files – pictures MOS 1, unfilled

M1 K FF
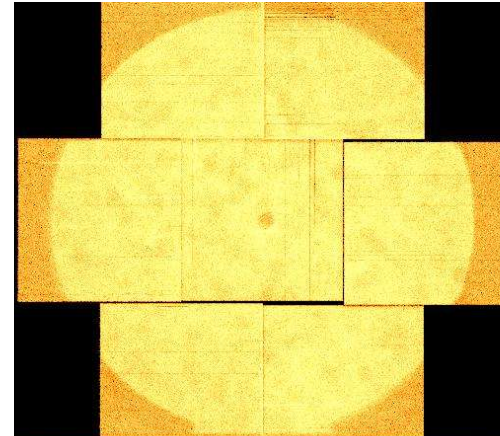
M1 T FF
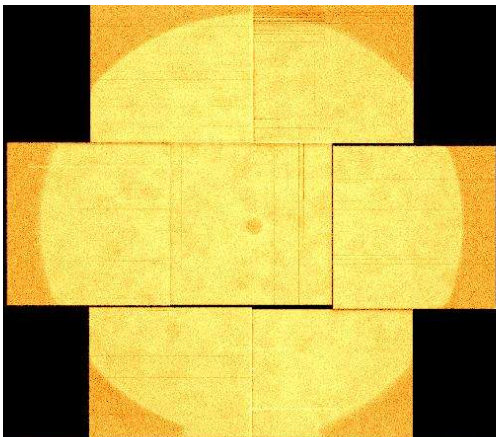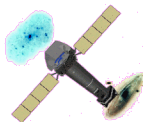
M1 M FF

Images made from
the final event files

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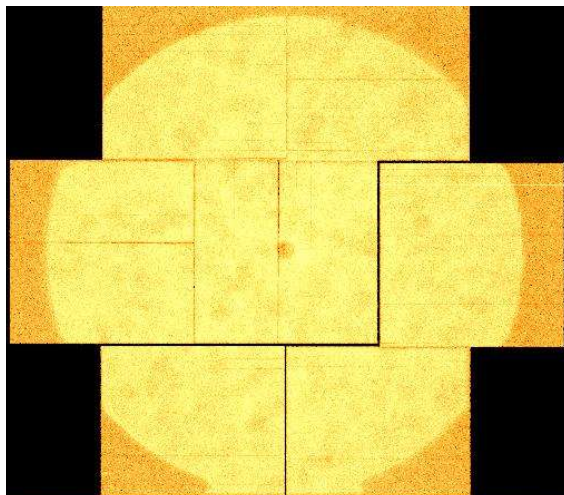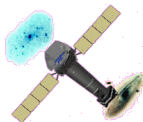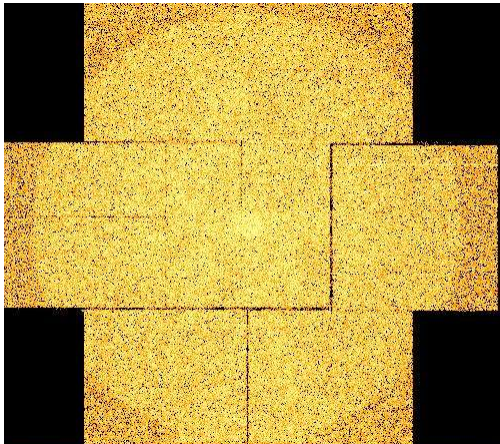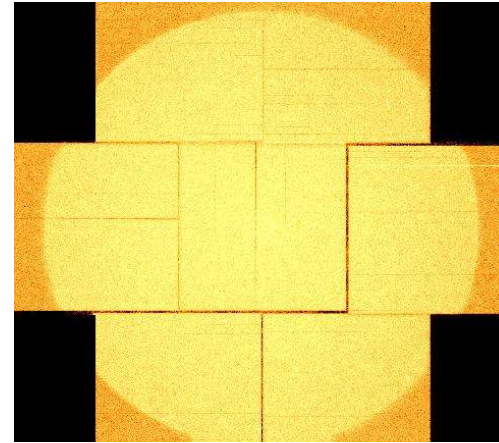MPE, Germany 02/05/06
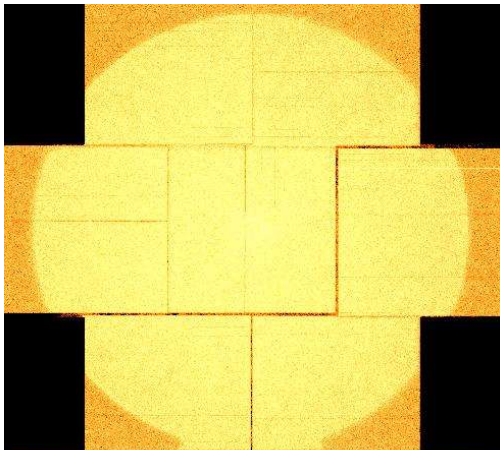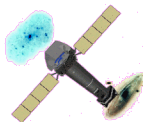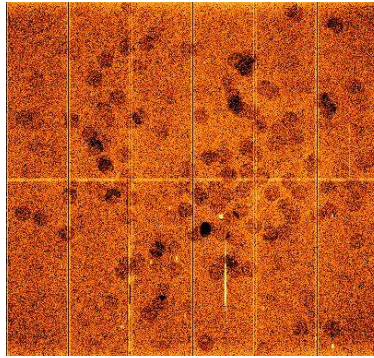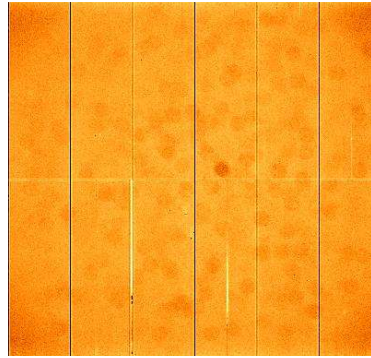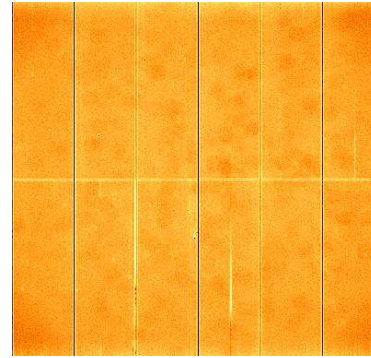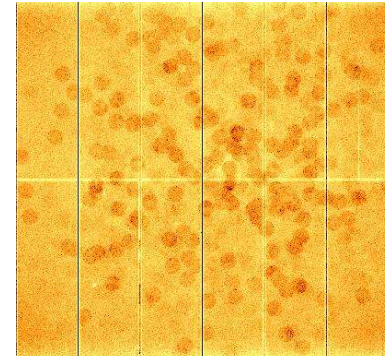
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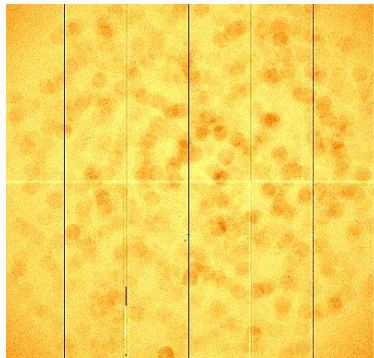Leicester

Final files – pictures MOS 1, refilled
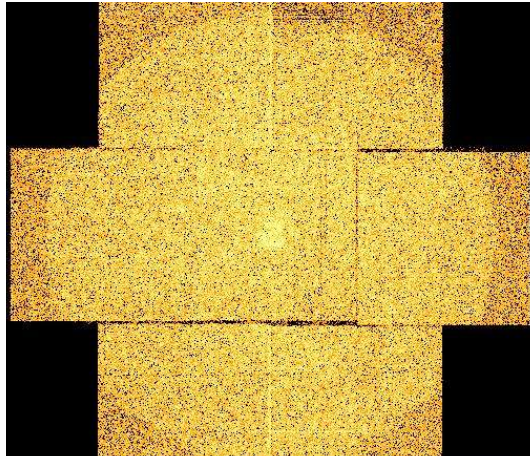
M1 K FF
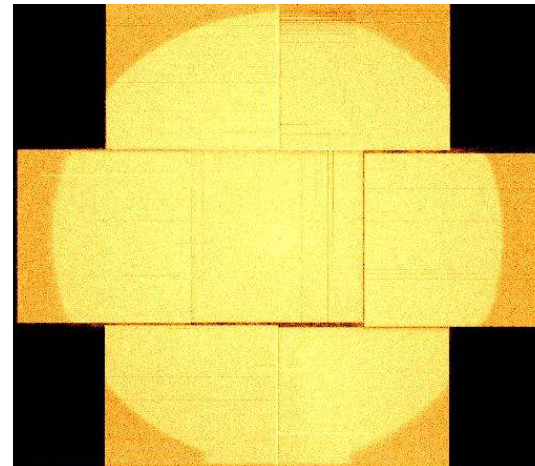
M1 T FF
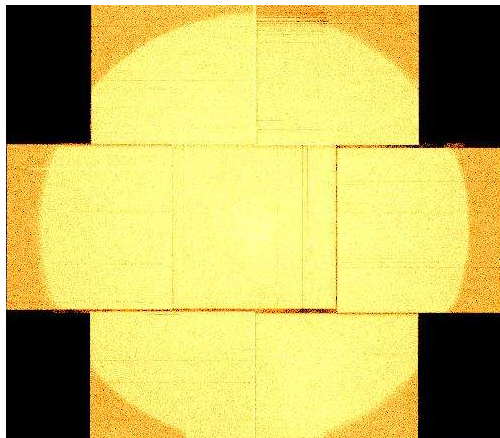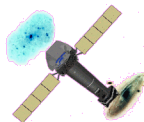
M1 M FF

Images made from
the final event files

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Final files – pictures MOS 2, unfilled
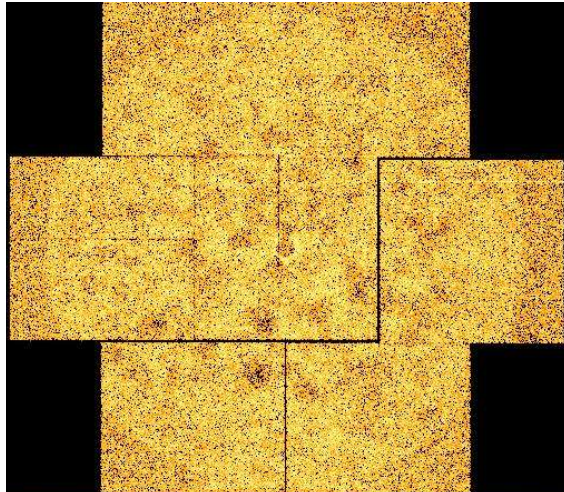
M2 K FF
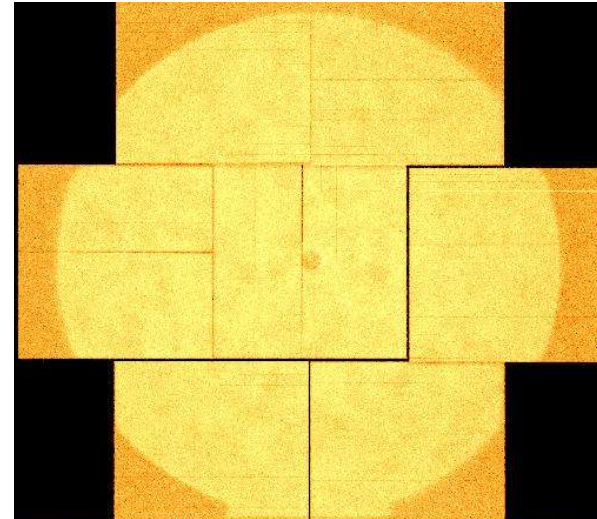
M2 T FF

M2 M FF

Images made from
the final event files

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Final files – pictures MOS 2, refilled

M2 K FF

M2 T FF

M2 M FF

Images made from
the final event files

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Final files – pictures PN, unfilled

PN K EF

PN M EF
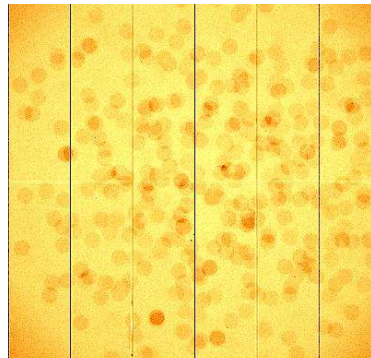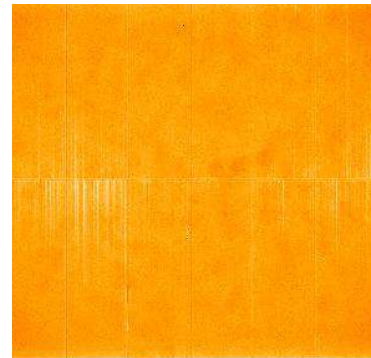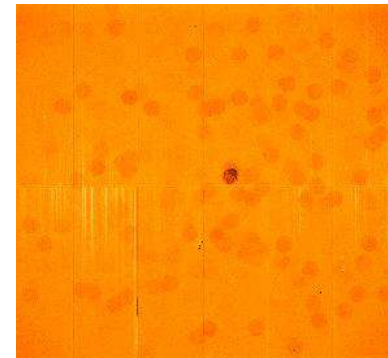
PN T EF

PN K FF

PN M FF
anticentre

PN M FF
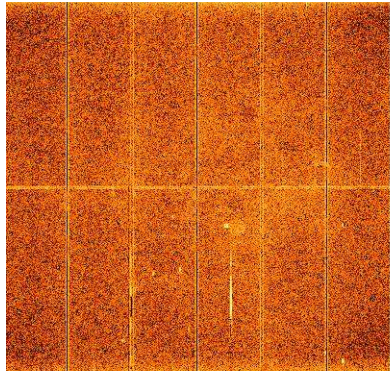Galactic centre

PN T FF
anticentre

PN T FF
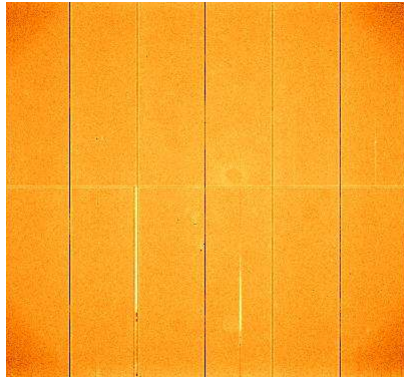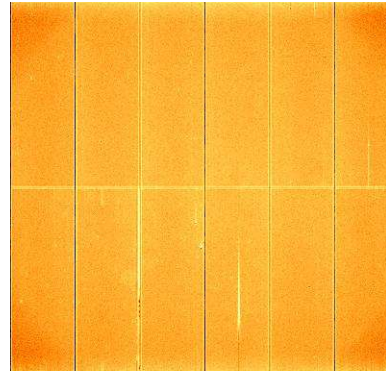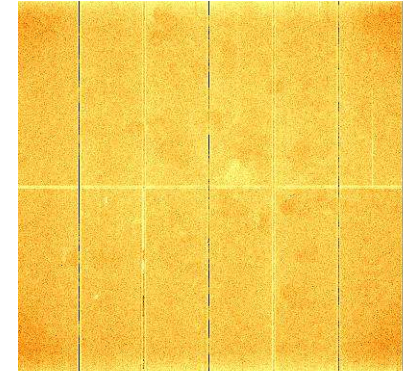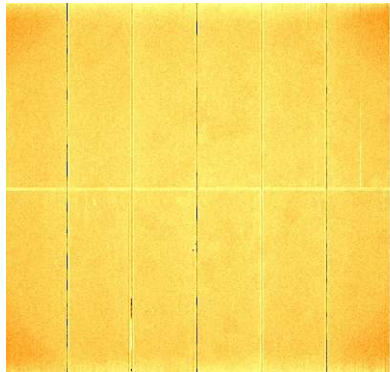Galactic centre

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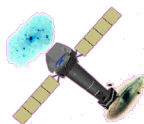
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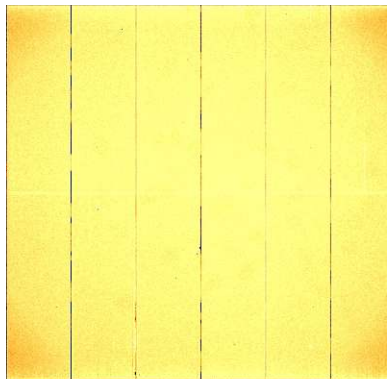# Final files – pictures PN, refilled
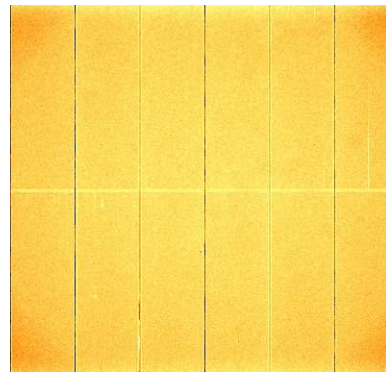

PN K EF

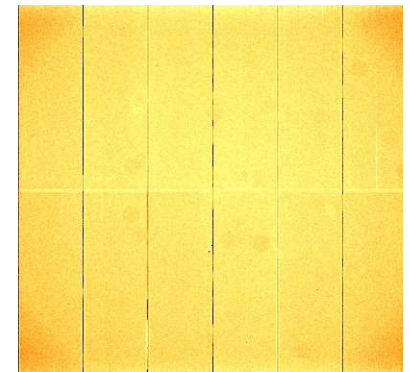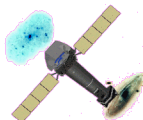PN M EF

PN T EF

PN K FF

PN M FF
anticentre

PN M FF
Galactic centre

PN T FF
anticentre

PN T FF
Galactic centre

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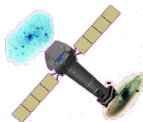3rd EPIC BG WG Meeting
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Tools available on the web page

- SkyCast - attcalc
- BGrebinimage2SKY_2006 – rebinning, positioning
- SelectRADec – select events based on angular separation

Possible additions:

- OOT
- Count rate selection tool

XMM
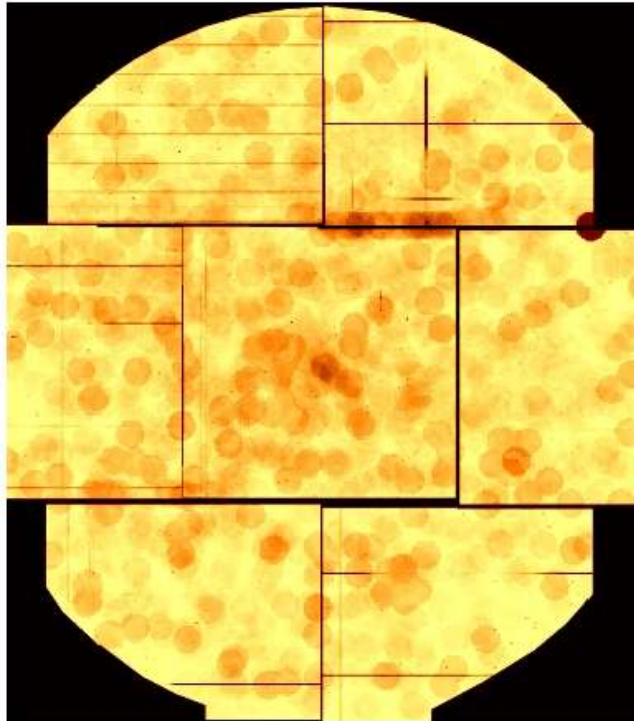**EPIC**
MOS

Jenny Carter (jac48@star.le.ac.uk)
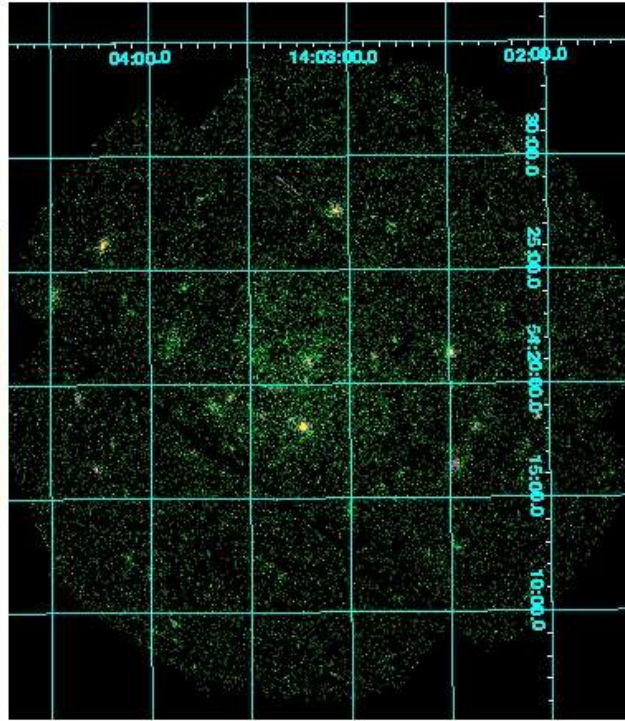3rd EPIC BG WG Meeting
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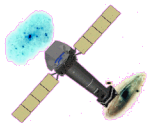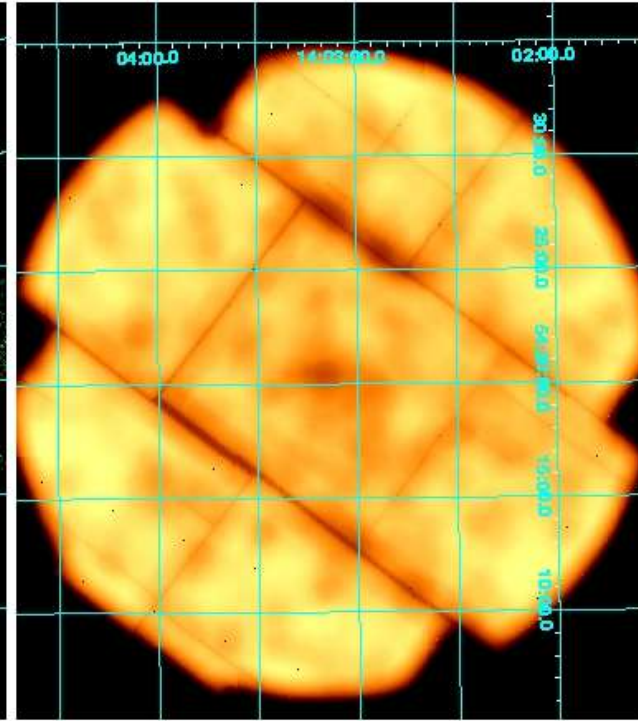# - Use of BGrebinimage2SKY_2006 to transform/rebin from DET to SKY

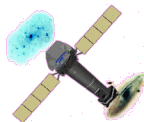| BG Exposure map (4) in detector coordinates | User's image (??) in sky coordinates | BG Exposure map (??) in user's sky coordinates |

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Anticentre exposure times by month: PNMFF
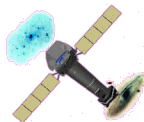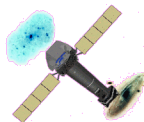
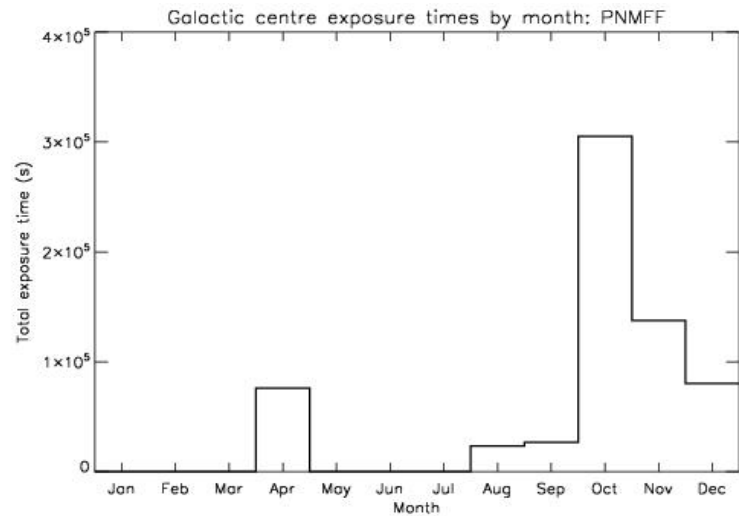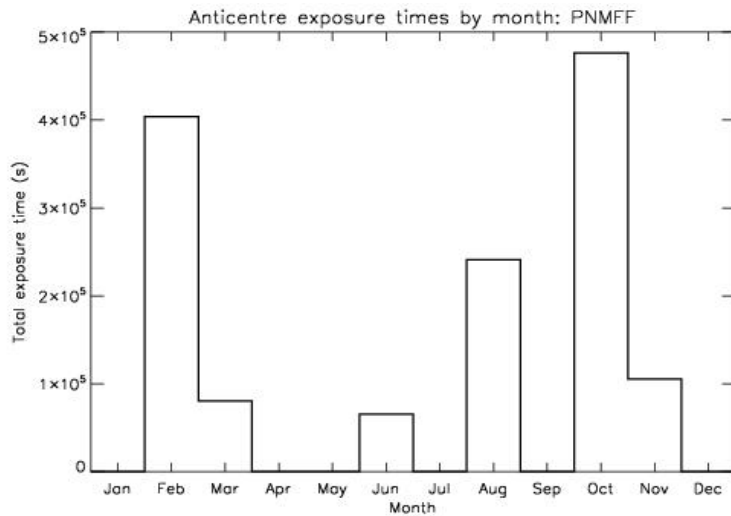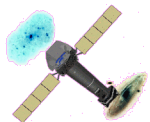Galactic centre exposure times by month: PNMFF

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Anticentre exposure times by month: PNTFF

Galactic centre exposure times by month: PNTFF

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Jenny Carter (jac48@star.le.ac.uk)
3rd EPIC BG WG Meeting
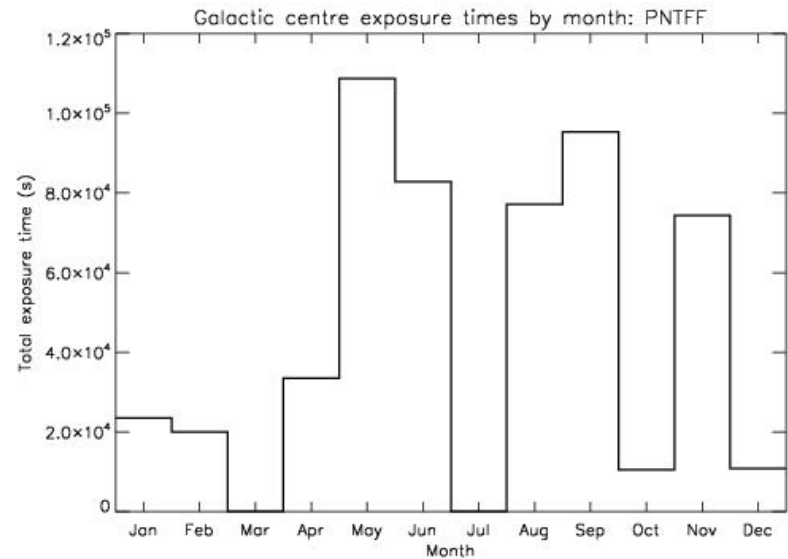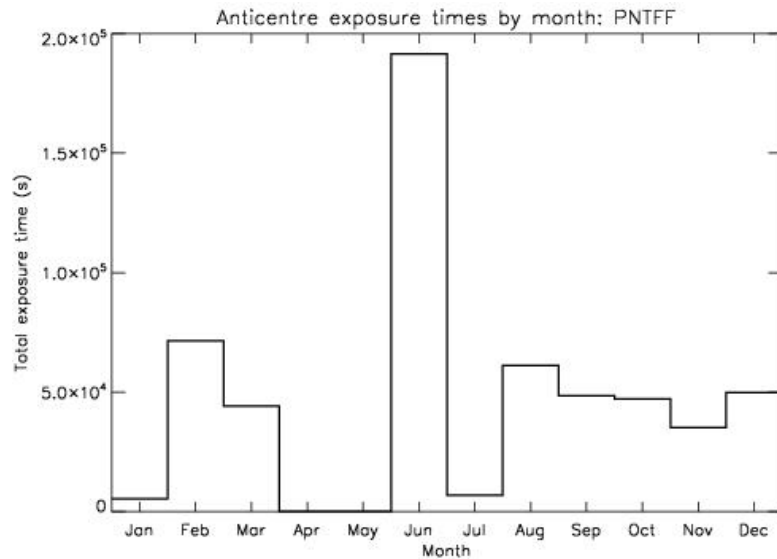MPE, Germany 02/05/06

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