

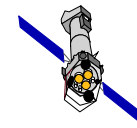
What the PPS products can do for you

Matteo Guainazzi, R.Saxton

XMM-Newton Science Operation Centre, RSSD, ESA

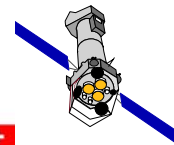
Mike Watson

XMM-Newton Science Survey Centre, University of Leicester, UK



XMM-Newton data pipeline processing

- All the XMM-Newton ODFs are shipped to the Survey Science Centre (University of Leicester, UK), where a standard reduction pipeline (**Pipeline Processing System, PPS**) is run on them
- The PPS consists of a set of SAS tasks grouped together in modules which run in a sophisticated processing control system (the pipeline configuration is described http://xmmssc-www.star.le.ac.uk/newpages/pipe_top_ext.html#config)
- Top-level scientific products are generated, together with cross-correlation products (with lots of catalogues, and the ROSAT field)
- Data are screened and their quality assessed in **PPS release notes**
- Only public versions of SAS are used, to ensure homogeneity and reproducibility
- PPS products are shipped back to the SOC, and made available through the **XMM-Newton Science Archive (XSA)** to authorised users

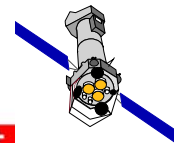


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Why?

- **To provide the XMM-Newton users with validated top-level, quick-look scientific products of homogeneous scientific quality, intended to be the first “building blocks” of their scientific analysis**
- **To facilitate the scientific exploitation of the XMM-Newton data, through the compilation of multi-wavelength information**
- **Pathfinder for the SSC X-ray identification program (XID)**
- **To ensure a basic level quality control on XMM-Newton data**
 - if SAS does not run on an XMM-Newton dataset, investigation can be started before shipping the data to the PI, saving time and resources to the users



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Pipeline processing and ~~SAS~~ XSA

CIF date

PPS version

SAS version

Observations 7. Shown: 1st and each until and including 7th

25 in Page
Each One

Observations Exposures Sources

Exposures info
Proposal info
Icon
Configuration Info

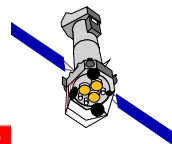
0002940181	NGC4968	13h07m07.37s -23d40'22.9"	-----
0197	2001-01-05 05:57:30.0	2001-01-05 08:19:30.0	8520 Matteo Guainazzi
EPN FF(1) MOS1 FF(1) MOS2 FF(1) RGS1(1) RGS2(1)			
AGNs, QSOs and BL-Lacs			
Multiple		02000028/20010122.10	Feb 5 2001 10:24:46:0

0002940701	UGC4203	08h04m04.91s +05d06'38.6"	-----
0257	2001-05-05 19:22:41.0	2001-05-05 21:45:25.0	8564 Matteo Guainazzi
EPN FF(1) MOS1 FF(1) MOS2 FF(1) RGS1(1) RGS2(1)			
AGNs, QSOs and BL-Lacs			
11.0.0		SAS Version 5.1.2	02000037/20010806.10 Aug 25 2001 1:57:32:0

0002940301	NGC424	01h11m27.77s -38d04'38.5"	-----
0280	2001-06-20 16:18:56.0	2001-06-20 18:32:37.0	8021 Matteo Guainazzi
RGS1(1) RGS2(1) OM UVW1(5)			
AGNs, QSOs and BL-Lacs			
SAS Version 5.1.1		04000005/20010712.13	Jul 13 2001 10:49:32:0

Proprietary

Proprietary



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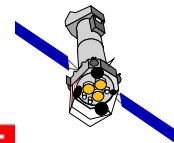
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Event lists (EPIC & RGS)

	TIME	X	Y	PI	PATTERN
	s	0,05 arcsec	0,05 arcsec	eV	
1	7,563809845289648E+07	26098	28269	620	0
2	7,563809845289648E+07	25542	27996	4145	0
3	7,563809846991545E+07	26176	27881	1205	0
4	7,563809846991545E+07	26062	28207	-670	78
5	7,563809846991545E+07	26131	28368	1125	0
6	7,563809848126143E+07	26054	28353	785	0
7	7,563809848126143E+07	25954	28221	980	0
8	7,563809848693442E+07	27406	27219	1450	3
9	7,563809849260741E+07	25564	28443	6485	0
10	7,563809849828041E+07	26326	28093	1040	2
11	7,563809849828041E+07	26272	28268	1775	0
12	7,563809849828041E+07	26090	28275	610	0
13	7,563809850395340E+07	25495	27248	565	0
14	7,563809850395340E+07	26033	28206	535	0
15	7,563809851529938E+07	26208	28164	590	0
16	7,563809851529938E+07	25990	28130	1340	0
17	7,563809852097237E+07	25970	27975	1740	1
18	7,563809852097237E+07	26235	28224	2515	0
19	7,563809852664536E+07	26219	28196	2065	3
20	7,563809852664536E+07	26669	28743	565	0

**This is the building
block of your science!**

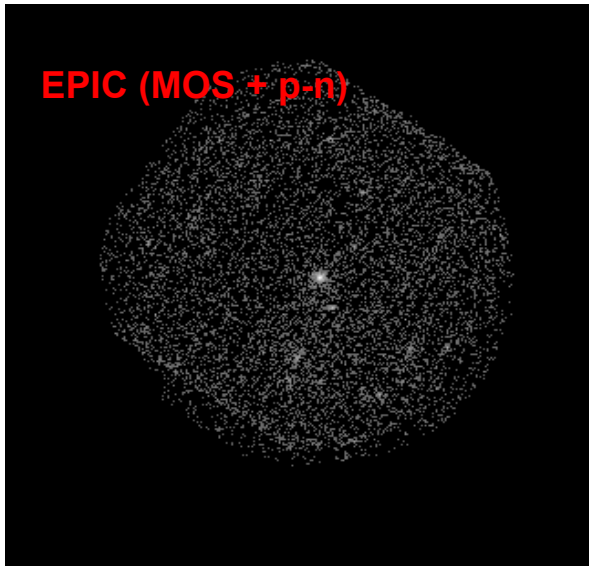
- Binary tables, containing information on the time, energy, position, event shape (whenever pertinent) of each photon
- Starting point for extraction (`evselect`) of top-level scientific products (spectra, images, light curves, source lists)
- Together with the **EVENTS** extension, contain an exposure map (**EXPOSUnn**), a bad pixel map (**BADPIXnn**) and a **GTI** (**STDGTI**) for each chip
- The Calibration Index File used for the event list generation is included in extension **CALINDEX**
- Not-destructively filtered against high background intervals



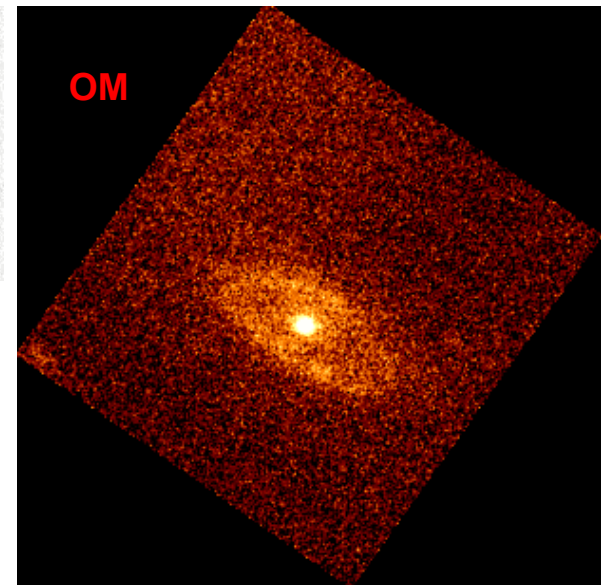
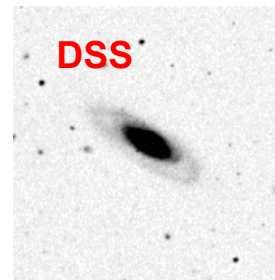
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Sky images



- **EPIC**
 - 1 for each exposure (not exposure-corrected) in 5 different energy bands
 - 1 for the whole observation (combined and exposure corrected in the 0.2-12 keV band)
 - available as FITS and PNG format



- **OM; for each exposure:**
 - 1 for each OM science window
 - 1 in celestial coordinates

Source lists

	<input type="checkbox"/> FLUX E cgs	<input type="checkbox"/> FLUX_ERR E cgs	<input type="checkbox"/> RATE E counts/s	<input type="checkbox"/> RATE_ERR E counts/s	<input type="checkbox"/> RA D deg	<input type="checkbox"/> DEC D deg	<input type="checkbox"/> RADEC_ERR E arcsec	<input type="checkbox"/> LII D deg	<input type="checkbox"/> BII D deg
1	2.779508E-12	2.533461E-13	1.145921E-01	3.994429E-03	1.786449560318E+01	-3.808367442798E+01	2.725261E-01	2.831964137996E+02	-7.826656099024E+01
2	1.385727E-13	1.068070E-14	2.224092E-02	1.714252E-03	1.786449560318E+01	-3.808367442798E+01	2.725261E-01	2.831964137996E+02	-7.826656099024E+01
3	2.609514E-13	1.370665E-14	5.075765E-02	2.666081E-03	1.786449560318E+01	-3.808367442798E+01	2.725261E-01	2.831964137996E+02	-7.826656099024E+01
4	2.003038E-13	1.882831E-14	1.511392E-02	1.420690E-03	1.786449560318E+01	-3.808367442798E+01	2.725261E-01	2.831964137996E+02	-7.826656099024E+01
5	8.456383E-13	6.892671E-14	2.260137E-02	1.842204E-03	1.786449560318E+01	-3.808367442798E+01	2.725261E-01	2.831964137996E+02	-7.826656099024E+01
6	1.334041E-12	2.424395E-13	3.878192E-03	7.047959E-04	1.786449560318E+01	-3.808367442798E+01	2.725261E-01	2.831964137996E+02	-7.826656099024E+01
7	4.728389E-13	2.749225E-14	6.605086E-02	3.840393E-03	1.786449560318E+01	-3.808367442798E+01	2.725261E-01	2.831964137996E+02	-7.826656099024E+01
8	7.688315E-14	8.348612E-13	9.581931E-03	2.668466E-03	1.784625093090E+01	-3.8122822665480E+01	7.345571E-01	2.833348009528E+02	-7.823582043273E+01
9	1.156738E-14	2.434788E-15	1.856565E-03	3.907835E-04	1.784625093090E+01	-3.8122822665480E+01	7.345571E-01	2.833348009528E+02	-7.823582043273E+01
10	3.091736E-14	4.652040E-15	6.013735E-03	9.048683E-04	1.784625093090E+01	-3.8122822665480E+01	7.345571E-01	2.833348009528E+02	-7.823582043273E+01
11	1.625892E-14	5.188405E-15	1.226817E-03	3.914911E-04	1.784625093090E+01	-3.8122822665480E+01	7.345571E-01	2.833348009528E+02	-7.823582043273E+01
12	1.813949E-14	1.225191E-14	4.848141E-04	3.274568E-04	1.784625093090E+01	-3.8122822665480E+01	7.345571E-01	2.833348009528E+02	-7.823582043273E+01
13	0.000000E+00	8.347386E-13	0.000000E+00	2.426669E-03	1.784625093090E+01	-3.8122822665480E+01	7.345571E-01	2.833348009528E+02	-7.823582043273E+01

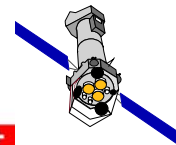
- **3 types of EPIC source lists generated:**

- local box background estimation (eboxdetect)
- background map interpolation (eboxdetect)
- maximum likelihood (ML; emldetect)

- **For each detected source:**

- position (in sky, ecliptic and Galactic coordinates)
- count rate, fluxes and hardness ratios
- background and exposure map values at the source position
- vignetting and EEf corrections
- extension parameter ML fit

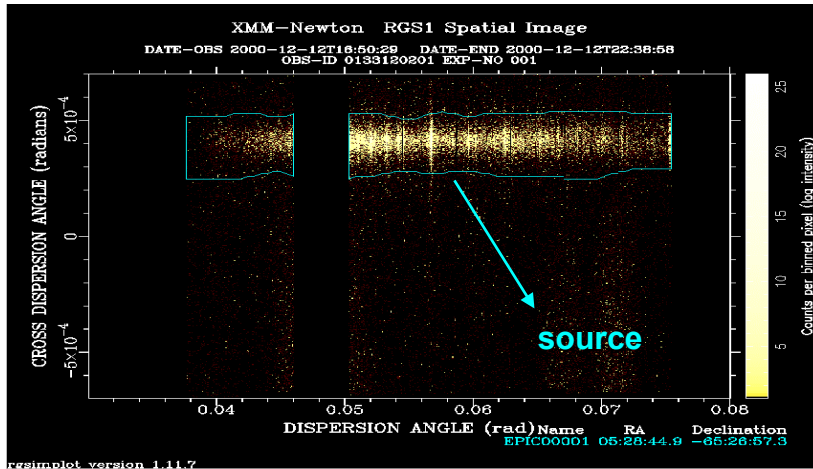
- **... plus their combination**



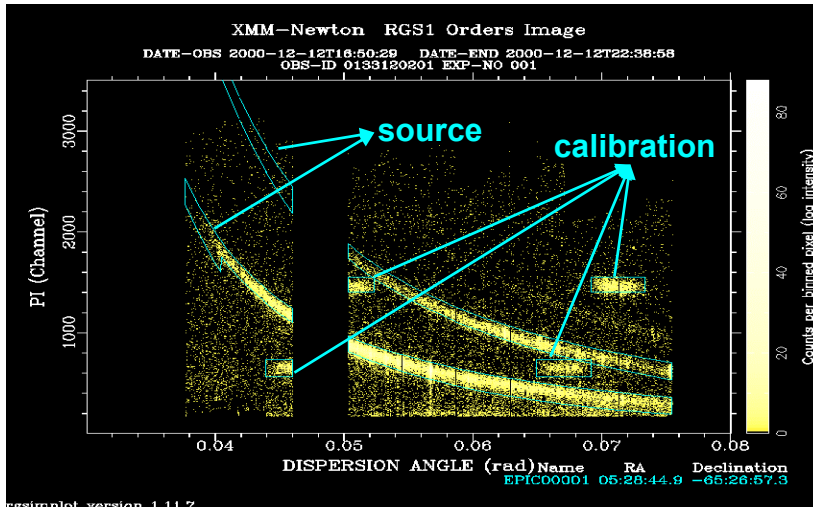
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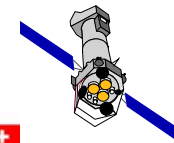
RGS (diagnostic) images



- **Two types of images available**
 - “spatial image”, extracted in cross-dispersion versus dispersion angle
 - “order image”, extracted in PI (energy) versus dispersion angle
 - in FITS and PNG (shown) format



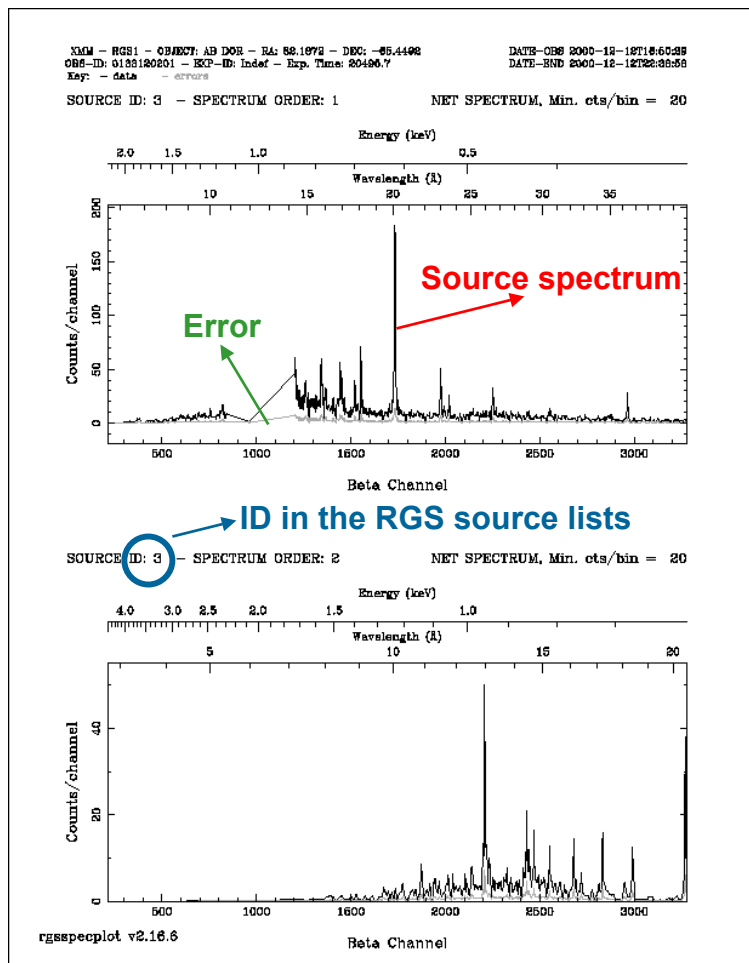
- **The order image clearly separate the different orders**
- **PPS extraction regions are superposed**
- **Allow to evaluate the quality of the RGS spectra extracted by the PPS**



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RGS spectra



- 1 spectrum for the brightest point source(s) for each RGS camera
- 1st and 2nd order
- Source (FITS and PNG) and background (FITS) spectra available
- Source spectra are background-subtracted, channel-by-channel, after exposure correction
- No spectra for confused or extended sources
- RGS spectral matrices are *not* PPS products

Cross-correlation products



This page lists all archival catalogue entries correlating with EPIC sources, sorted by increasing distance between centres of error ellipses. An archival and an EPIC source are possibly the same object if the distance between them corresponds to the 99.99 % confidence level (3 Gaussian sigma) given their respective positional uncertainties. Links in CAT_NAME column point to catalogue descriptions. Links in CAT_ENTRY column point to the full catalogue extraction (actually, to the beginning of a section grouping all extractions for this catalogue). For Simbad and Ned entries the "?" in query column allows to query in real time these databases for this source.

For each catalogue a representative measurement (CAT_MEAS) has been selected. Its value is printed in CAT_VAL column. CAT_NUM is an absolute archival entry number which can be used to locate archival entries on the catalogue plot product for instance.

1 Cross-correlation summary

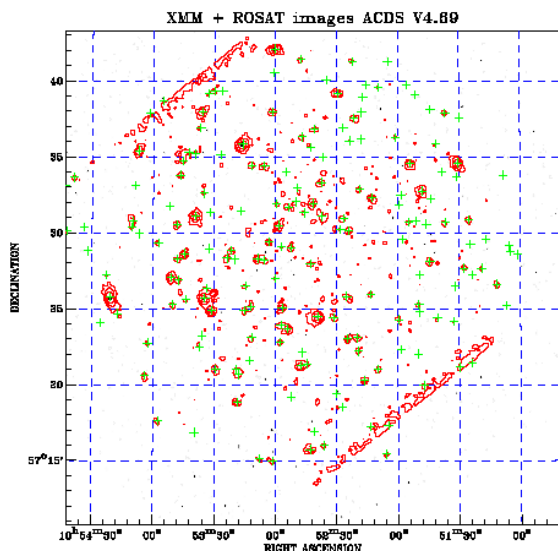
[Finding Chart for this source](#)

RA	DEC	RADEC_ERR	EP_TOT	EP_EXTEND	EP_EXT_ML	EP_HR1	EP_HR2	EP_HR3	VAR_STAT	P_VAR
01 11 27.548	-38 05 01.34	0.13	5.098e-01							
			9.481e-01							

CAT_NAME	CAT_ENTRY	query	RA	DEC
SIMBAD	4PM052_296+094-093	2	01 11 2	01 11 2
sdss	296+094-093	2	01 11 2	01 11 2
NEJ	194_1924	2	01 11 2	01 11 2
SPH-NGC	296+094-093	2	01 11 2	01 11 2
SIMBAD	NGC_424	2	01 11 2	01 11 2
NGC	NGC_424	2	01 11 2	01 11 2
VV	NGC_424	2	01 11 2	01 11 2
IC501_2.0h	391_11_424	2	01 11 2	01 11 2
IC501	1091_390	2	01 11 2	01 11 2
T1138	17_200116666666667	2	01 11 2	01 11 2
USJ	296+94_4	2	01 11 2	01 11 2
sdss	296+94 NGC_424	2	01 11 2	01 11 2
sdss	091_296+94 NGC_424	2	01 11 2	01 11 2
1905	1905_3011127_3_300607	2	01 11 2	01 11 2
1905	1905_3011127_3_300607	2	01 11 2	01 11 2
1905	010101-2003	2	01 11 2	01 11 2
T1074	HS2101010109	2	01 11 2	01 11 2
sp	0109-391	2	01 11 2	01 11 2
WAT	301114-2904	2	01 11 2	01 11 2
LCDS	0100-08_3001_0	2	01 11 2	01 11 2
IC	312_363	2	01 11 2	01 11 2
PH	PH0011433007	2	01 11 2	01 11 2

[Finding Chart for this source](#)

RA	DEC	RADEC_ERR	EP



Principal Investigator:
Dr. Fred Jansen

XMM target name:
lockman Hole

Observation ID:
0123700401

Center coordinates:
α: 10 58 41.71
δ: +97 27 5.5

Epic energy band:
0.2–12.0 keV

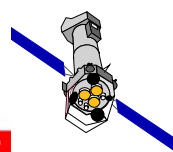
Contour levels (counts):
2σ: 1.402E+00 7σ: 3.121E+01
30σ: 1.102E+01

Nearest ROSAT image
from Epic image center:
Observation: 000052h
Instrument: ERI
α: 10 58 56.97
δ: +97 29 59.7

Other ROSAT images:
None

XMM SSC
Sep 24 05:40:06 8001

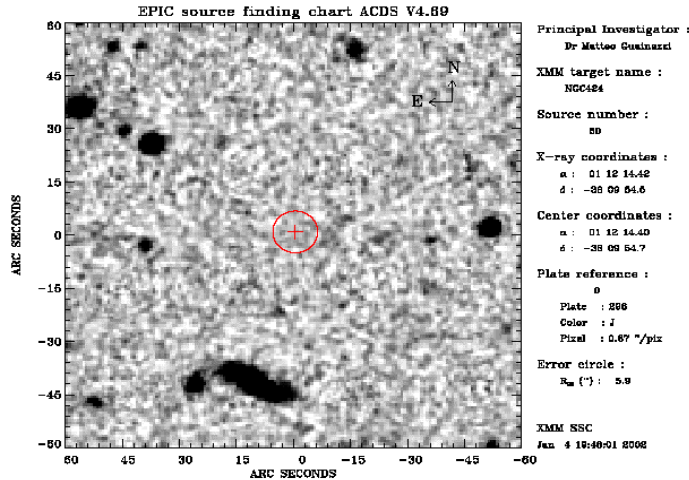
- Two-step process (EPIC coordinates are first refined through correlation with USNOA2)
- PPS products available:
 - correlation of EPIC sources with ~100 catalogues (positional coincidence at 99.93% c.l.)
 - archive content of the EPIC field-of-view (independently on EPIC detection) in X-ray catalogues and SIMBAD
 - field-of-view entries overlaid on an EPIC image
 - EPIC image contours and detected sources overlaid on a greyscale ROSAT image
- No cross-correlation for OM sources



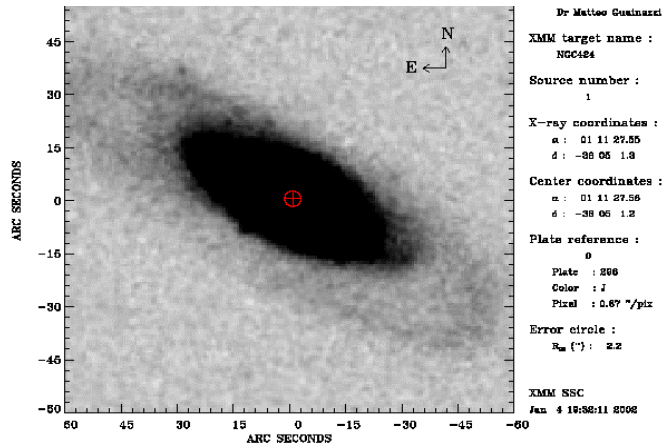
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Finding charts

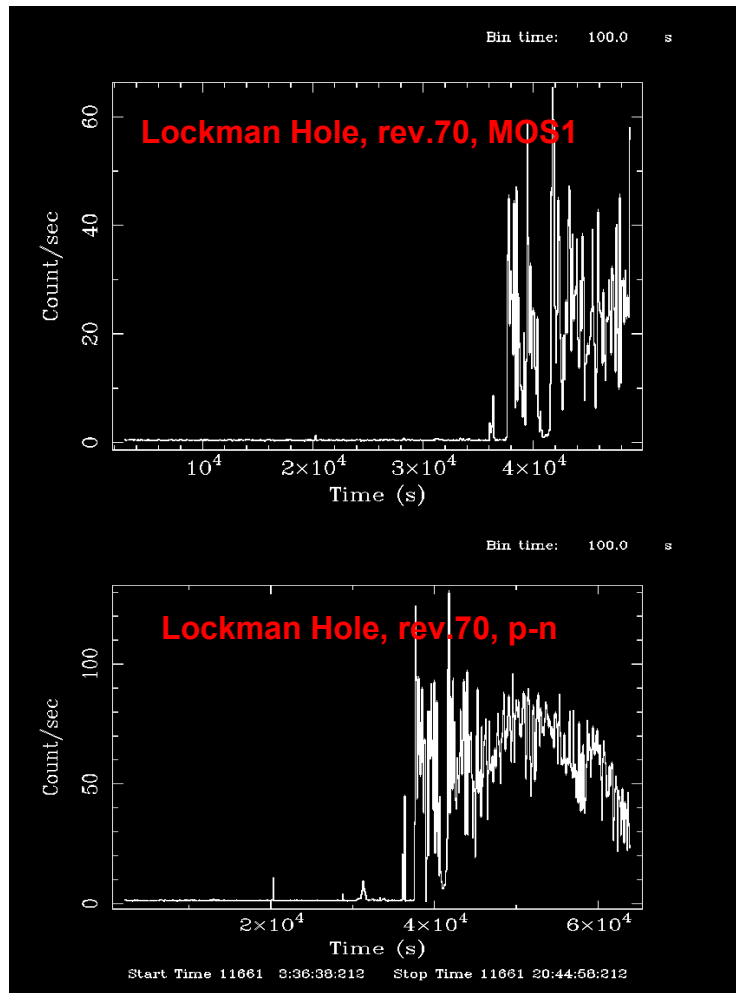


- 1 finding chart, 2×2 arcminutes with 1 arcsecond pixel is available for each detected EPIC source, centred on its best position



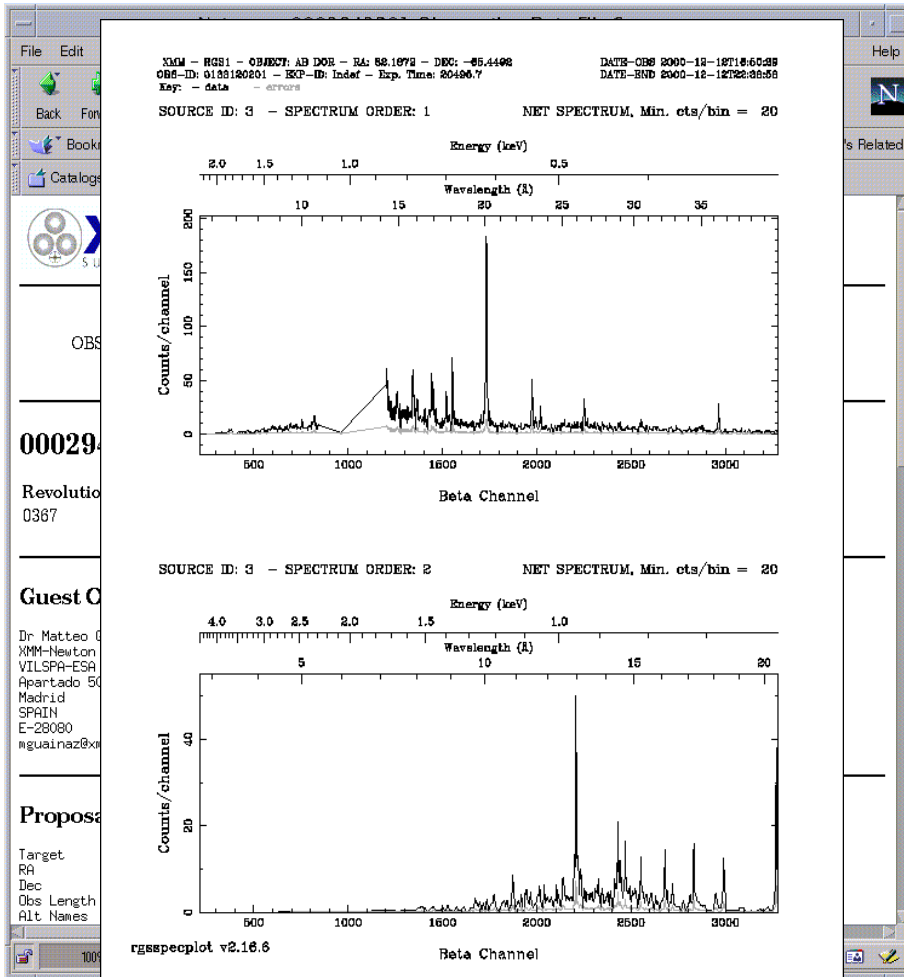
- EPIC flux contours or error circles are overlaid
- start information if you intend to conduct your own follow-up program or you want to investigate the multiwavelength behaviour of your favourite X-ray source

Flaring background light curves



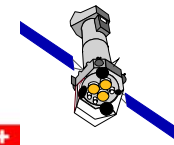
- “Background flaring light curves” are extracted for each observation
- MOS curve is calculated on the “GATTI events” ($E > 12$ keV)
- p-n curve is calculated on the source-masked $E > 7$ keV image
- Available in FITS format, hence directly usable for the generation of GTI (via, e.g., `tabgtigen`)
- They may cover different time span due to different instrumental overheads or contingencies

Summary pages



Netscape: ACDS V4.69 - EPIC sources cross-correlation summary

RA	DEC	RADEC_ERR	EP_TOT	EP_EXTEND	EP_EXT_ML	EP_HR1	EP_HR2	EP_HR3	VAR_STAT	P_V
01 10 34.980	-37 56 30.81	1.03	2.588e-02 ± 3.590e-02	1.00	1.00	0.25 ± 0.37	-0.63 ± 0.16	-0.84 ± 6.49	1	1
CAT_NAME CAT_ENTRY query RA DEC ERR D_EPIC_CAT CAT_MEAS CAT_VAL CAT_NUM H:M:S (J2000) D:M:S (") selected measure										
NED 6PMUKS(BJ) B010817.02-381228.0 2 01 10 35.163 -37 56 31.15 0.61 2.2 nref 0 8 RM 0109-382 01 11 26.871 -38 04 58.29 282.56 796.0 Diam 10.8 127										
12 Finding Chart for this source										
01 11 14.787	-38 02 40.41	1.55	5.561e-03 ± 6.523e-03	1.00	1.00	0.00 ± 0.00	-0.28 ± 0.21	-1.00 ± 4.14	1	1
CAT_NAME CAT_ENTRY query RA DEC ERR D_EPIC_CAT CAT_MEAS CAT_VAL CAT_NUM H:M:S (J2000) D:M:S (") selected measure										
RM 0109-382 01 11 26.871 -38 04 58.29 282.56 198.4 Diam 10.8 127										
13 Finding Chart for this source										
01 11 14.828	-38 17 31.67	1.03	2.953e-02 ± 2.175e-02	1.00	1.00	0.36 ± 0.18	-0.65 ± 0.18	0.60 ± 0.37	1	1
CAT_NAME CAT_ENTRY query RA DEC ERR D_EPIC_CAT CAT_MEAS CAT_VAL CAT_NUM H:M:S (J2000) D:M:S (") selected measure										
RM 0109-382 01 11 26.871 -38 04 58.29 282.56 766.6 Diam 10.8 127										

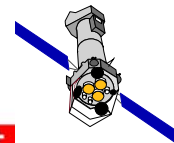


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Miscellanea & future

- **Additional PPS products include:**
 - exposure (EPIC & RGS), and sensitivity maps
 - OM source lists
 - OM tracking frame history
 - housekeeping summaries
 - catalogue lists and description
 - PPS script logs, run messages and summaries
 - PPS product index file
 - various graphical products
- **Future development will include:**
 - variability and 3-colors images, and wavelet maps (EPIC)
 - spectra and light curves for each EPIC source
 - XID products



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