



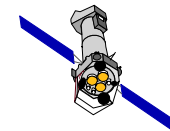
What the PPS products can do for you

Matteo Guainazzi, R. Saxton, N. Loiseau

XMM-Newton Science Operation Centre, RSSD, ESA

Mike Watson

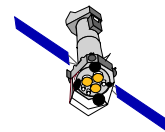
XMM-Newton Science Survey Centre, University of Leicester, UK



XMM-Newton

XMM-Newton data pipeline processing

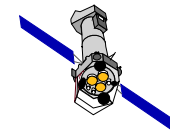
- All the XMM-Newton ODFs are shipped to the Survey Science Centre (University of Leicester, UK), where a standard reduction pipeline (**Pipeline Processing System, PPS**) is run on them.
- PPS products are sent back to the SOC, and made available through the **XMM-Newton Science Archive (XSA)** to authorised users
- 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 in <http://xmmssc-www.star.le.ac.uk/public/pipeline>)
- 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.
- The first bulk reprocessing of all available XMM observations between December 1999 (the mission start) and May 2007 was completed at the end of 2007, the XSA contains then data homogeneously processed with SAS6.9 or newer



XMM-Newton

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 the PI fetches the data, saving time and resources to the users



XMM-Newton

Pipeline processing and ~~SAS~~ XSA

CIF date

PPS version

SAS version

OM reduction pipelines in PPS and public SAS are essentially identical

Observations 45. Showing 1st and each until and including 25th

25 in Page

Each One

Observations

Exposures

Sources

Observation Info

Exposures info

Proposal info

Epic Image

Relo. Light Curve

Exposures	0002940701	UGC4203	08h04m01.53s +05d06'37.6"	-----	Gallery
Sources	0257	2001-05-05 19:22:41.0	2001-05-05 21:45:25.0	8564	Matteo Guainazzi
XID observations	EPN FF(1) MOS1 FF(1) MOS2 FF(1) RGS1 SES(1) RGS2 SES(1) OM Grism2(Opt)(5)				
Details	AGN, QSOs, BL-Lacs and XRB				
Articles	Guest Observer Sep 20 2002				
Query Other Catalogues	Quality Report				
Retrieve	14.1.0/14.1.0	SAS Version 5.1.2	02000037/20010806.101	2001-08-25 13:57:32.0	
Exposures	0002940301	NGC424	01h11m30.74s -38d04'02.4"	-----	Gallery
Sources	0280	2001-06-20 16:18:56.0	2001-06-20 18:32:37.0	8021	Matteo Guainazzi
XID observations	RGS1 SES(1) RGS2 SES(1) OM UVM1(5)				
Details	AGN, QSOs, BL-Lacs and XRB				
Articles	Guest Observer Jan 10 2003				
Query Other Catalogues	Quality Report				
Retrieve	14.1.0/14.1.0	SAS Version 5.1.1	04000005/20010712.13C	2001-07-13 10:49:32.0	
Exposures	0002942301	NGC424	01h11m24.89s -38d05'58.2"	-----	Gallery
Sources	0367	2001-12-10 04:38:35.0	2001-12-10 06:57:54.0	8359	Matteo Guainazzi
XID observations	EPN FF(1) MOS1 FF(1) MOS2 FF(1) RGS1 SES(1) RGS2 SES(1) OM UVM1(5)				
Details	AGN, QSOs, BL-Lacs and XRB				
Articles	Guest Observer				
Query Other Catalogues	Quality Report				
Retrieve	14.1.0/14.1.0	SAS Version 5.2.1	02000038	2001-12-10 06:57:54.0	

Icon N.A.

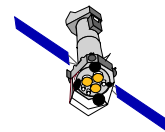
SEQ_ID = '004110' / Pipeline sequence

PROCDATE = '2002-02-11T10:33:10' / Processing date

PROCREV = '1' / Processing revision

PPSVERS = '04000007/20020201.084538' / PPS configuration

SASVERS = 'xmmxsa_20020129_1610' / SAS version



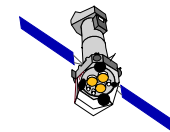
XMM-Newton

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

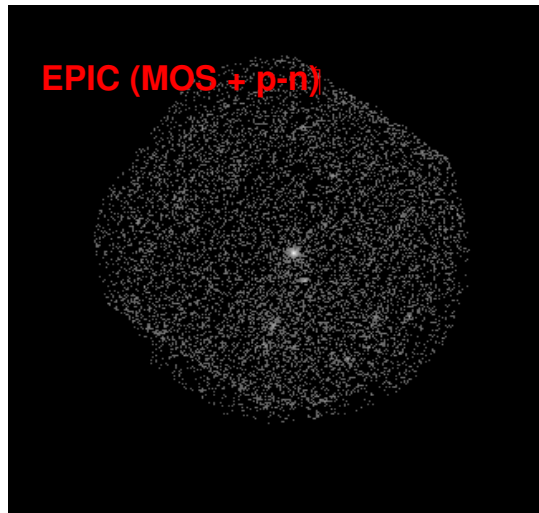
This is the building block of your science!

- 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 (**EXPOSU_{nn}**), a bad pixel map (**BADPIX_{nn}**) 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

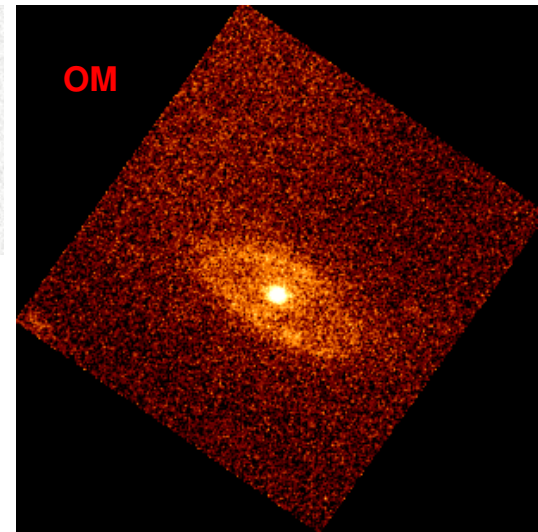
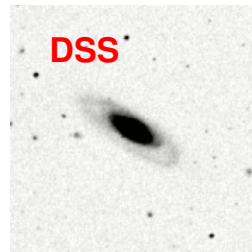


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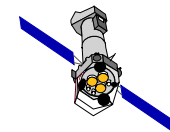
Sky images



- **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 detector coordinates and one in celestial coordinates)



XMM-Newton

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	-3.812282665480E+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	-3.812282665480E+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	-3.812282665480E+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	-3.812282665480E+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	-3.812282665480E+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	-3.812282665480E+01	7.345571E-01	2.833348009528E+02	-7.823582043273E+01

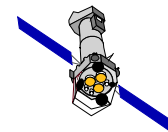
- **3 types of EPIC source lists generated:**

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

- **... plus their combination**

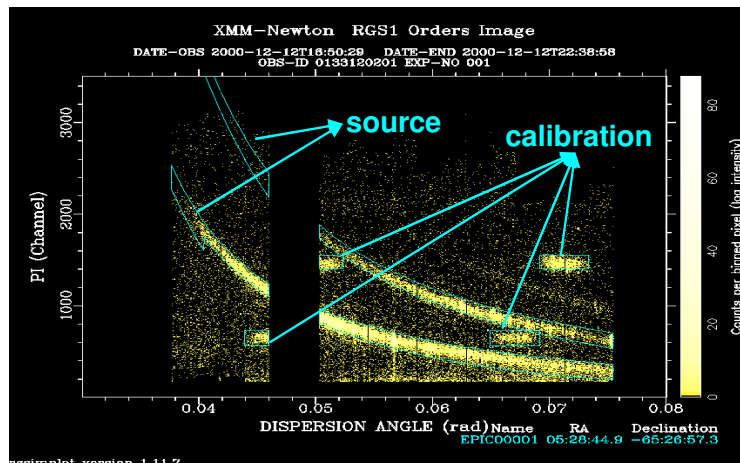
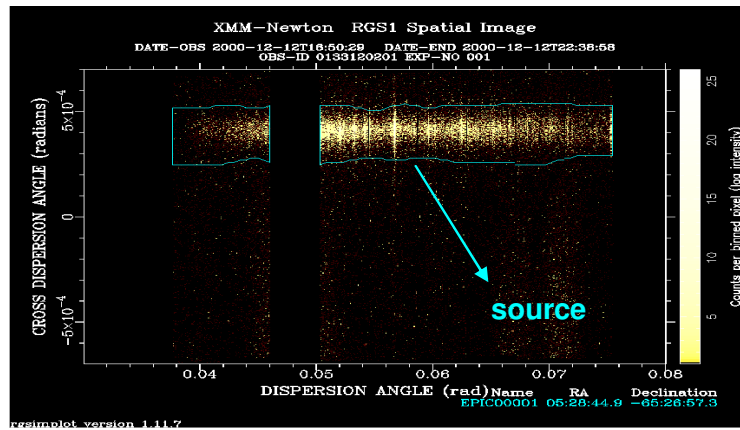
- **For each detected source:**

- 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

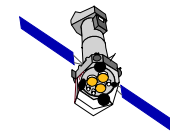


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RGS (diagnostic) images

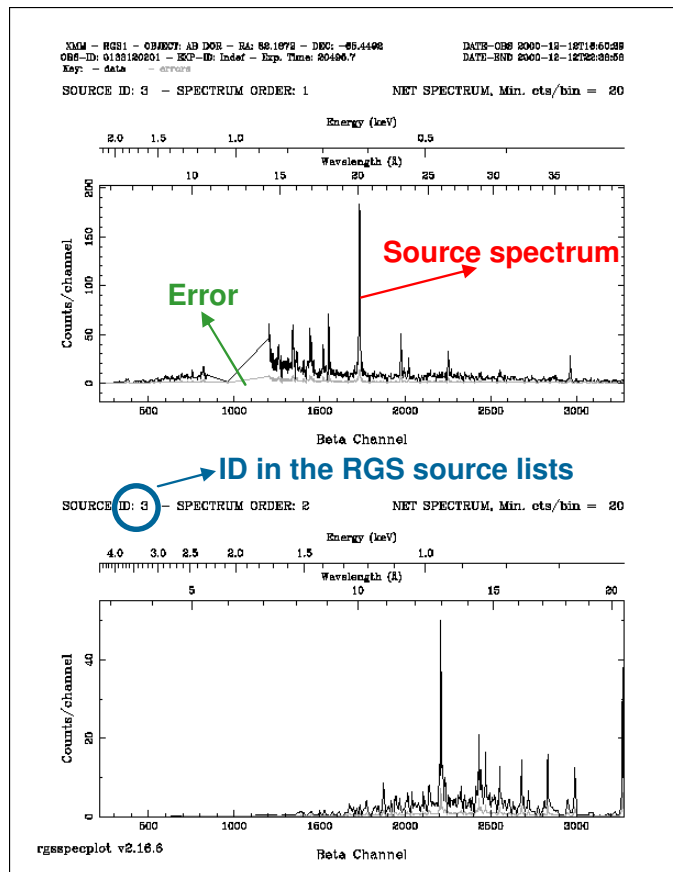


- **Two types of images available**
 - “spatial image”, extracted in cross-dispersion versus dispersion angle
 - “order image”, extracted in PI (energy) versus dispersion angle
 - in FITS and PNG (shown) format
- **The order image clearly separate the different orders**
- **PPS extraction regions are superposed**
- **Allow to evaluate the quality of the RGS spectra extracted by the PPS**

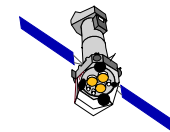


XMM-Newton

RGS spectra

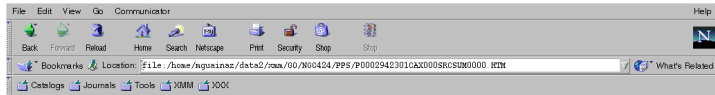


- 1 spectrum for the brightest point source(s) for each RGS camera
- 1st and 2nd order
- Source (FITS and PNG) and background (FITS) spectra available
- Source spectra are background-subtracted, channel-by-channel, after exposure correction
- No spectra for confused or extended sources
- RGS spectral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



XMM-Newton

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 (usually, to the beginning of a section grouping all extractions for this catalogue). For Simbad and Ned entries the "i" 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](#)

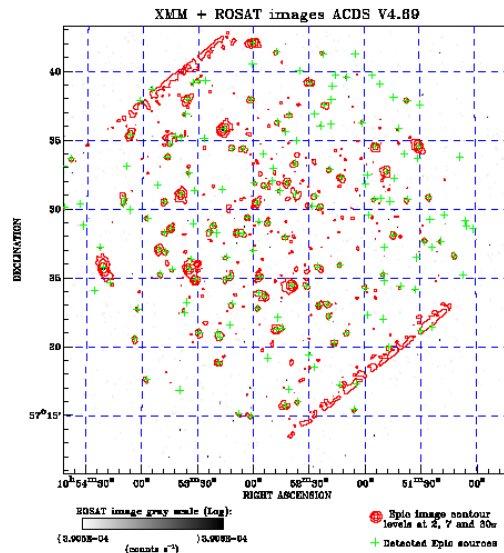
RA	DEC	RADEC_ERR	EP_TOT	EP_EXTEND	EP_EXT_ML	EP_HR1	EP_HR2	EP_HR3	VAR_STAT	P_VAR
01 11 27.549	-38 05 01.34	0.13	5.068e-01							9.481e-

CAT_NAME	CAT_ENTRY	query	RR
Simbad	epm02_236+094-093		01 11 2
Defcal	236+094-093		01 11 2
Ned	N26+0420		01 11 2
Hip	235+094-093		01 11 2
Simbad	166+384		01 11 2
W3	N 424		01 11 2
VY	166-424		01 11 2
J0501_236	236 N 424		01 11 2
J0501	01091-3800		01 11 2
7113a	17_236+1665666667		01 11 2
ES	166+384		01 11 2
Defcal	424 N 424		01 11 2
Defcal	150_236+384+094		01 11 2
J0501	J0501_11127_3-395607		01 11 2
J0501	J0501_11127_3-395607		01 11 2
J0501	J0501_11127_3-395607		01 11 2
7157a	N424-166_0109		01 11 2
W3	166-384		01 11 2
Hip	10111+3804		01 11 2
UBS	0100-384_3001_0		01 11 2
ES	166-384		01 11 2
PN	PNR0111-3807		01 11 4

2

[Finding Chart for this source](#)

RA	DEC	RADEC_ERR	EP
01 11 27.549	-38 05 01.34	0.13	5.068e-01



Principal Investigator:
Dr. Fred Jansen

XMM target name:
lockman Hole

Observation ID:
012370401

Center coordinates:
ra: 10 58 41.71
d: +97 27 5.5

Epic energy band:
0.2-10.0 keV

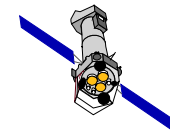
Contour levels (counts):
E: 1.462E+00 To: 3.121E+01
S0: 1.162E+01

Nearest ROSAT image
from Epic image center:
Observation: 000058h
Instrument: ERN
ra: 10 58 56.97
d: +97 28 39.7

Other ROSAT images:
None

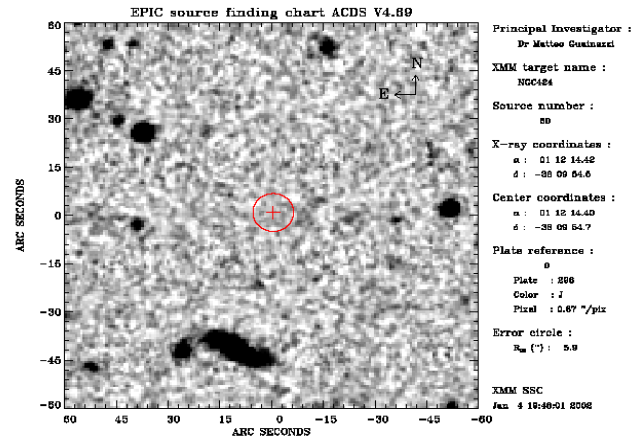
XMM SSC
Sep 24 08:40:08 8001

- 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
 - EPIC image contours and detected sources overlaid on a greyscale ROSAT image
- No cross-correlation for OM sources

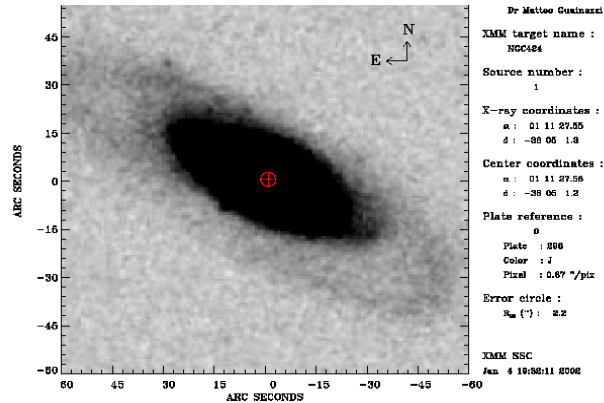


XMM-Newton

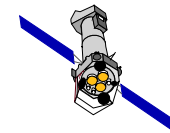
Finding charts



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



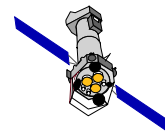
- EPIC flux contours or error circles are overlaid
- start information if you intend to conduct your own follow-up program or you want to investigate the multiwavelength behaviour of your favourite X-ray source



XMM-Newton

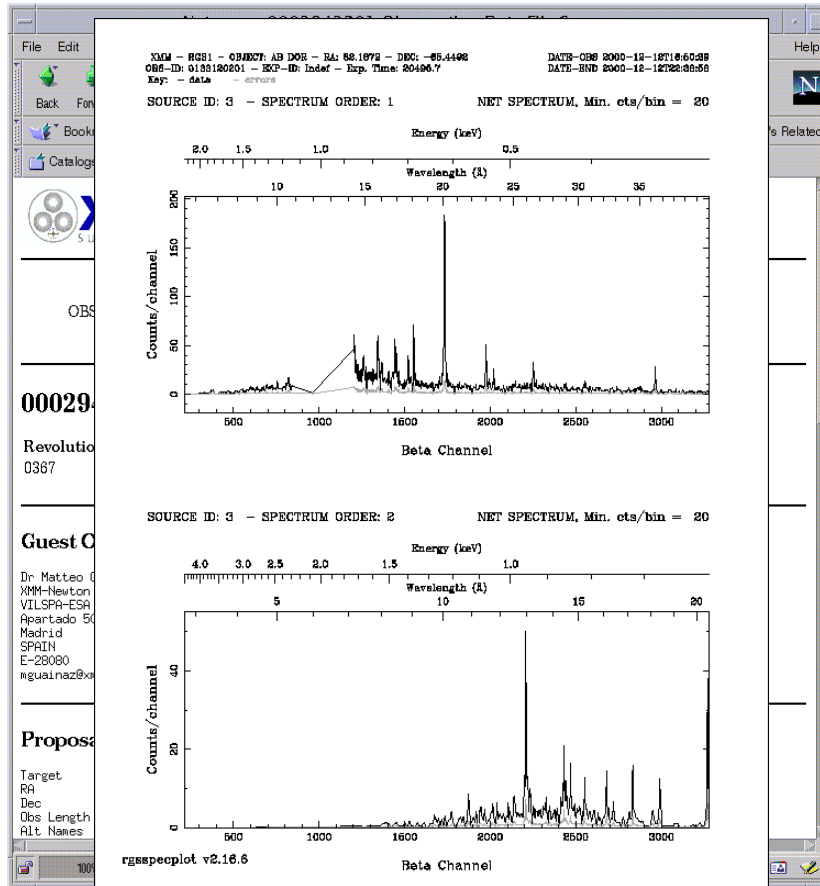
Miscellanea

- **Additional PPS products include:**
 - exposure (EPIC & RGS), and sensitivity maps
 - OM source lists and time series
 - OM tracking frame history
 - housekeeping summaries
 - catalogue lists and description
 - PPS script logs, run messages and summaries
 - PPS product index file
 - various graphical products



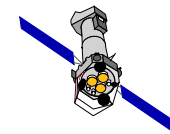
XMM-Newton

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 1 sig measure 2.2 rref 796.0 Diam 10.8 127										
12										
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_V
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 1 sig measure 198.4 Diam 10.8 127										
13										
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_V
01 11 14.828	-38 17 31.87	1.03	2.953e-02 ± 2.175e-02	1.00	1.00	0.36 ± 0.18	-0.85 ± 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 1 sig measure 766.6 Diam 10.8 127										



XMM-Newton