A Completely Different View Of RGS Observations: A Trial To Estimate The Intrinsic Discovery Space

High resolution X-ray spectroscopy: towards IXO

March 19 and 20, 2009, MSSL, Holmbury St Mary, UK

Norbert Schartel,

Maria Santos-Lleo, Matthias Ehle and Rosario Gonzalez





XMM-Newton launch on 10 December 1999



Publications



Status of the Reflection Grating Spectrometers





- 2 CCDs were lost early in the mission (full wavelength coverage due to redundancy between RGS1 and RGS2)
- RGS 2 single readout mode since August 2007 to avoid ADC errors (no impacts for large majority of sources)
- Reduction in EPIC MOS and RGS operating T in 2002 resulted in far fewer hot pixels



Status of the Reflection Grating Spectrometers





RGS Offset Evolution



Only change in last period due to R1-CCD 2 new operational voltages from rev 1400 on





XMM-Newton

Expectations and Questions

- XMM-Newton can observe up to the 2018/2020 years
- After 2018/2020 consumables (fuel) run out
- → 10 years more to go
- → What to do with RGS? Where to go?





Large and Very Large Programs?

- Abstract for Proposal 060139 (PI: J. Kaastra)
- Anatomy of an outflow: mapping the Markarian 509 warm absorber AGN outflows impact the evolution of supermassive black holes, host galaxies, surrounding IGM, and cooling flows. However, the physical properties of these winds are poorly known. We propose to obtain the deepest RGS spectrum of any AGN, allowing us to determine the physical conditions of the gas. Through monitoring of the warm absorber using the combined EPIC and RGS spectra we will unambiguously constrain the location and geometry of this outflow. These unprecedented constraints allow us to estimate the parameters that determine the effect of AGN outflows on their environment: mass flux and kinetic luminosity. For this ambitious program, we propose to observe Mrk 509 for 600 ks using 10 observations of 60 ks each, spaced by 4 days.



Compact, Conical, Accretion-Disk Warm Absorber Of The Seyfert 1 Galaxy NGC4051







Absorber consists of two different ionization components, with a difference of ~100 in ionization parameter and ~5 in column density

Distances 0.5-1.0 lt-days (2200RS-4400RS) and <3.5 lt-days (<15,800 RS) from the continuum source Suggests strongly accretion-disk origin for the warm absorber wind

Mass outflow rate from wind is 2%-5% of the mass accretion rate Krongold et al., 2007, ApJ 659, 1022

But

- XMM-Newton is an observatory!
- Large community, Large oversubscription, one paper per 50ks
- In total 15 Ms per AO
- → 30 LPs?
- → Minimum of 150 targets?



The XMM-Newton Archive is full!





The XMM-Newton Archive is full!





XMM-Newton: The Next Decade



large an







Specific Problems

- Typically 10

 objects per class
 have well exposed
 spectra either with
 XMM-Newton or
 Chandra
- Most new objects need (much) long(er) exposure time

- One additional Source:
 - Oversubscription does in general not allow to allocate observing time for objects specific questions!
 - Do we really learn something new which does change our understanding of the class?

XMM-Newton



Specific Problems

- Typically 10

 objects per class
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 spectra either with
 XMM-Newton or
 Chandra
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- Source 11 to 20:
 - Lot of observing time!
 - Does improved sample statistics (e.g. mean value) makes scientifically sense?
 - Do we really find new spectral features which are relevant for the physical understanding of class?





Discovery Space?

Is there a specific unexplored discovery space for RGS in the next 10 years?

What can we reasonably observe with RGS?





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RGS Spectra with 5000 to 10000 counts





RGS Spectra with 5000 to 10000 counts



Fluxes

Model	Γ or $T[keV]$	Ratio
pow	1	0.78
pow	1.5	0.87
pow	2.0	0.99
ЪЪ	0.5	0.67
ъъ	1.0	0.65
ЪЪ	1.5	0.65
ЪЪ	2.0	0.64
ЪЪ	2.5	0.63
tЪ	0.5	1.27
tЪ	1.0	0.94
tЪ	1.5	0.90
tЪ	2.0	0.90
tЪ	2.5	0.90
RS	0.5	0.90
RS	1.0	0.69
RS	1.5	0.76
RS	2.0	0.79
RS	2.5	0.80

Table 1: Conversion factors between ROSAT PSPC hard band and RGS (both instruments and orders) for different models (power law, blackbody, thermal Bremsstrahlung and Raymond-Smith) and different parameters.

Bright Sources

The ROSAT All-Sky Survey Bright Source Catalogue (1RXS)

W. Voges, B. Aschenbach, Th. Boller, H. Bräuninger, U. Briel, W. Burkert, K. Dennerl, J. Englhauser, R. Gruber, F. Haberl, G. Hartner, G. Hasinger, M. Kürster, E. Pfeffermann, W. Pietsch, P. Predehl, C. Rosso, J.H.M.M. Schmitt, J. Trümper, and H.-U. Zimmermann

Max-Planck-Institut für extraterrestrische Physik, 85740 Garching, Germany

Astronomy and Astrophysics 349, 389-405 (1999). The catalogue can be used for scientific purposes as long as the above publication is referenced.

rosat@mpe ... up

Abstract

We present the ROSAT All-Sky Survey Bright Source Catalogue (RASS-BSC, revision 1RXS) derived from the all-sky survey performed during the first half year of the ROSAT mission in 1990/91. 18,811 sources are catalogued, with a limiting ROSAT PSPC countrate of 0.05 cts/s in the 0.1-2.4 keV energy band. The sources have a detection likelihood of at least 15 and contain at least 15 source photons. At a brightness limit of 0.1 cts/s (8,547 sources) the catalogue represents a sky coverage of 92%. The typical positional accuracy is 30 arcsec.

For each source the ROSAT name, the position in equatorial co-ordinates, the positional error, the source countrate and error, the background countrate, exposure time, hardness-ratios HR1 and HR2 and errors, extent and likelihood of extent, and likelihood of detection are provided. For 94% of the sources visual inspection confirmed the results of the standard processing with respect to existence and position. The remaining 6% have been analyzed using interactive methods; these sources have been flagged. Broad band images are available for a subset of the flagged sources.

A list containing correlations with other catalogues and identifications will follow soon.

Questions or comments may be directed to xray-info (at) mpe . mpg . de In particular we would be grateful if any errors or inconsistencies found in the data would be reported to this e-mail address.

xray-info (at) mpe . mpg . de © MPE / <u>Max-Planck-Institut für extraterrestrische Physik</u> / <u>Impressum</u> Page author: <u>Jakob Englhauser</u> / 1996-Jun-14

350 Brightest Sources

Required	Sources	in XSA	Proposed
Exposure Time [s]			
<5000	113	93	20
5000 10000	112	77	35
10000 - 15000	128	37	91

146

Sources

Simbad Classification	a	Ъ	С
Variable Star	1	3	11
Rot. variable Star			1
High proper-motion Star			1
Flare Star		1	
T Tau-type Star			2
SuperNova Remnant			1
Variable of BY Dra type		4	6
Variable of RS CVn type	3	9	14
Nova-like Star		1	
Eclipsing binary	1		
Eclipsing binary (W UMa)	1		
Eclipsing binary (beta Lyr)		1	2
Low Mass X-ray Binary	11		2
Seyfert 1 Galaxy / Quasar		2	11
BL Lac - type object	1	4	16
Cluster of Galaxies		2	7
X-ray source	2	5	10
UV-emission source			1

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Possible Scenario

- RGS spectra for the 350 brightest RASS sources (d<5amin)
- Each RGS spectra has between 5000 and 10000 counts
- Unique sample to explore high-resolution X-ray spectroscopy in preparation for future missions
- Sufficient room for follow-ups, i.e. 45ks, 130 ks
- Costs:
 - 150 observations with exposure time between 5k and 15 ks
 - 1.8 Ms in total, i.e. 10% of an AO,
 - One (medium size) very large program
 - Supporters?, competing proposals?

Question

• What do you want to have in the XSA?

Next Call of Proposals: A09

- **Planned key milestones:**
 - Announcement:
 - Due date for proposals:
 - Final approved program:

 - Start of observations:

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25 August 2009
9 October 2009 (12:00 UT)
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- late December 2008
- Second phase submission: 11 January 5 February 2010
 - May 2010

2009 Scientific Workshop

Local Organising Comm M. Diaz-Trigo M. Amizou M. Ehle C. Gabriel C. Homandez N. Loiseau J.-U. Ness R. Saxton M. Stuhlinger ISING Committee: MPE Garching, Garmany Harvard-Smithsonian C/A, Cambridge, US ESA XMM-Newton SOC, Madrid, Spain MPE Garching, Germany ICE/CSIC & IEEC, Barcelona, Spain Keio University Yokohama, Japan Institut d'Astrophysique de Paris, France NASA/CSFC, Greenbelt, USA INAF - Padova, Italy University of Leicester, UK ESA XMM-Newton SOC, Madrid, Spain

Supersoft X-ray Sources: New Developments

18th to 20th May 2009

European Space Astronomy Centre (ESAC) Villafranca del Castillo Madrid, Spain

http://xmm.esac.esa.int/external/xmm_sc ience/workshops/2009_science/

Proceedings will be published as regular issue of the Astronomical Notes