The XMM GOF at Goddard Space Flight Center

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ABSTRACT

In order to support the use of XMM by the US astronomical community, NASA has established an XMM Guest Observer Facility at the Goddard Space Flight Center. The GSFC GOF will provide a clearing house for ESA project-generated technical information and analysis software, as well as provide direct user support (including GO proposal support) on the US side of the Atlantic. The GOF will also provide an on-line archive of US PI observations after they become public. The XMM GOF is incorporated within the Office of Guest Investigator Programs (OGIP) at GSFC. The GOF will act in conjunction with the High Energy Astrophysics Science Archive Research Center (HEASARC) and the GOFs of other high-energy astrophysics missions (e.g., ROSAT, ASCA, RXTE, AXAF, and ASTRO-E) to coordinate with a multi-mission archive and data analysis environment.

1. Introduction

The primary purpose of the GOF at GSFC is to support the analysis of XMM data by US astronomers. This will include facilitating the submission of GO proposals to ESA and the supplying of help, analysis software, documentation, and data to both successful GOs and to the general astronomical community in the exploitation the XMM data archive.

2. The GOF in the Age of the Internet

In the current era of Guest Observer support, nearly all interactions between users and the GOF will occur over the internet. Accordingly, considerable emphasis will be placed on creating complete and easily accessible document and data archives, data analysis packages, and on-line help. The OGIP structures of multi-mission data analysis packages and data archives will be used as a basis for GOF operations. This leads to two clear advantages. First, there is no reason to "reinvent the wheel" given the many aspects of other GOFs that can easily be adapted for the use of XMM. Second, most users will have familiar structures with which to interact.

WWW pages for the GSFC XMM GOF can be found at:
http://heasarc.gsfc.nasa.gov/docs/xmm/xmmgof.html

3. Support Activities

3.1. On-Line Help

The XMM GOF will operate an e-mail help desk for the user community, xmmhelp@athena.gsfc.nasa.gov. This method has proven to be an expedient way to provide timely help to, and to receive feedback from, the user community. Through launch there will be two XMM GOF scientists responsible for answering questions. After launch, depending on the level of activity, a third scientist position may need to be added. The US GOF will provide an interface between the US XMM user community and both the US instrument teams and the XMM SOC at ESTEC. *The GOF will provide a single point of contact for the US user community with the entire XMM project.*

3.2. Proposal Support

ESA and ESTEC are responsible for the preparation and release of XMM GO calls for proposals. NASA will release US XMM NRAs (NASA Research Announcements) in support of ESA to announce the availability of funding for successful US XMM proposals. Proposals will be submitted directly to ESTEC via the electronic proposal submission application XMM Remote Proposal Submission Software (XRPS) (similar to the OGIP RPS system). The GOF will provide timely responses to XMM-related questions. This will be necessary both because of the time-zone difference between Europe and the US and because there will be a limited number of user support scientists at the SOC. The XMM GOF will provide expert advice to the community for the planning of GO proposals. This will include the best instrument modes to use to derive the best science from an observation and the various instrumental constraints on XMM observations.

The GOF will support project data simulation software and observation planning tools, and add functionality where needed. SciSim (Science Simulator) is the basic tool for modelling XMM data. It performs a complete ray-tracing of the mirror response and folds in the detector effective areas and artifacts. However, SciSim is supported by the SOC only on the Solaris and Linux operating systems requiring alternative options. Consistent with OGIP's user support ideals, the XMM GOF will adapt SciSim to other platforms if possible. We are also currently developing a SciSim alternative (Quicksim, see §6) to model EPIC observations which will be platform independent.

3.3. Tools

OGIP and HEASARC have a number of multi-mission tools which are extensively used by the astronomical community which are, and will be, updated to include XMM data and mission information.

PIMMS – PIMMS, and its WWW counterpart W3PIMMS, are probably the premier tool for the preparation of GO proposals. Astronomers have come to rely upon it for its ease of use and the ability to predict source count rates from spectra and fluxes and to convert between count rates of essentially all X-ray astronomy missions of interest. In preparation for the first solicitation of GO proposals, PIMMS is being modified to support the different XMM X-ray detectors and the numerous scientific modes of their operation.

BROWSE – BROWSE, and its WWW counterpart W3BROWSE, provide an environment to present a wide variety of mission operation and status information concerning XMM observations. Various aspects which will be included in "browsable" tables are:
– The abstracts of successful proposals.
– The status of targets of accepted proposals.
– The availability of observation data sets in the public archive.

Ftools – Ftools will likely be the package of choice in the US for the analysis of XMM observation X-ray data sets. The GOF is currently supporting the development of XMM-specific tasks through two programmers resident at the XMM SSC at Leicester University. However, the Ftools currently under development (SAS and its subset PPS) provide only the basic level of analysis procedures and are for the most part limited to those needed for the standard processing of observation data sets by the SOC. A more flexible and extensive set of Ftools will be needed by users in order to extract the maximum amount of scientific information from the data. To further this aim the GOF will hire additional programmers after launch to support XMM Ftool development. In this area as well there is no intention to reinvent the wheel. For instance, while considerable additional software beyond the SAS will be required for the analysis of RGS spectral data, similar software has already been created for the AXAF transmission-grating data (e.g., modifications to Xspec). It will be considerably more cost- and time-effective to modify existing software to operate on XMM data than to produce the software from scratch.

Electronic Newsletters and Status Reports – Regular communication with their user community is an important duty of any GOF. Keeping users informed of observatory status, calibration issues, and project activities will aid in producing the greatest scientific return from the XMM mission.

3.4. Anonymous FTP Account

Anonymous FTP (File Transfer Protocol) accounts, including their access through WWW browsers, provide an ideal mechanism for the distribution of documentation, software packages, and archive data to the user community. A well-used structure for GOFs already exists in the HEASARC which will be expanded to include an XMM area.

4. XMM Data

As XMM is an ESA mission, all of the primary processing of XMM data, both flight science data and ground and flight calibration data, is a European responsibility. Therefore, the US data management responsibilities are limited, more-or-less, to that of a middleman, and will lie in three general areas: 1) the distribution of observation data sets to US observers, 2) the creation and maintenance of a documentation, analysis software, and calibration database at GSFC to support the analysis of XMM observations by US observers, and 3) the creation and maintenance of an XMM data archive (see §5).

Distribution of US XMM Observation Data Sets – The distribution of XMM data sets to US observers will follow the ISO "template." After the creation of calibrated observation data sets in Europe, ESA will ship the data (in CD format) to the XMM GOF at GSFC. Upon receipt of the data at GSFC, the XMM GOF will archive a copy which will be made public after the proprietary period is complete. After the copy is made, the data will be shipped to the observer.

It is solely the responsibility of the XMM Science Operations Center (SOC) to provide the science data properly calibrated and in a format usable by the observer. The responsibility of the GSFC XMM GOF is to ship the data on to the GO and to store a copy of the data for the public archive after the proprietary period has expired.

Documentation, Analysis Software, and Calibration Data – A primary task of the XMM GOF at GSFC is to support the analysis of XMM data by US astronomers. Implicit in this task is the creation and maintenance of a data base containing project documentation, data analysis software, and calibration data. The SOC at ESTEC is responsible for producing most of the required documentation and calibration files while much of the data reduction software will be produced by the SSC. The role of the GSFC GOF in this area will be to duplicate the data bases on the US side of the Atlantic to speed internet response times for US astronomers. In general this will require only the downloading of the files from the SOC calibration area and documentation archives and installing them in a format consistent with existing OGIP structures. Any documentation and calibration data will be kept current with those available through the SOC.

5. Data Archive

XMM GO observation data sets will be publicly released after a one-year proprietary period. An agreement with ESA/ESTEC has been reached which will allow for the creation of an XMM observation data set archive for US GO observations. It is the goal of the GSFC GOF to expand the agreement to include the complete XMM archive, including GO observations, Guaranteed Time Observations (GTOs), and Calibration and Performance Verification (Cal/PV) observations.

The High Energy Astrophysics Science Archive Research Center (HEASARC) within the Office of Guest Investigator Programs (OGIP) supports multi-mission X-ray and gamma-ray

archival research. The XMM GOF in collaboration with the Astrophysics Data Facility (ADF), HEASARC, and other OGIP groups is responsible for creating the XMM archive and supporting archival research starting during the operational lifetime of the mission. The access and organization of the XMM archive will be consistent with those of other high-energy astrophysics archives within the HEASARC. Upon closure of the XMM GOF, the responsibility for the XMM archive will be transferred to the HEASARC.

Consistent with other OGIP/HEASARC archives, the XMM archive will be accessed through an anonymous ftp directory: **ftp://legacy.gsfc.nasa.gov/data**. There will be no restriction on the data access so that all users, independent of country of origin, will be able to use the facility.

6. QuickSim

QuickSim is designed to provide a platform-independent method for modeling XMM EPIC observations. It is not meant to replace SciSim which is the project simulator and includes all instrumental effects with a complete ray-trace modeling of the mirrors and the quantum efficiencies of the gratings, filters, and detectors. However, QuickSim does provide reasonable modeling for EPIC spatial and spectral distributions for a variety of input spectra and angular distributions, including user supplied spectra and images. As the name implies, it also runs significantly faster than SciSim.

The QuickSim distribution consists of three fortran 90 files and seven data files. The package also requires cfitsio (available from HEASARC) which includes the fortran 90 interface software. Currently the beta-level test files can be downloaded from: **ftp://legacy.gsfc.nasa.gov/xmm/software/quicksim**

The images below demonstrate QuickSim EPIC MOS simulations. The four simulations of astrophysical objects below are based on *ROSAT* HRI observations.

Table 1: Quicksim Simulations

Object	Exposure	Counts
M31	30 ks	320000
Trapezium	30 ks	470000
N132D	10 ks	609000
Cas A	10 ks	4280000

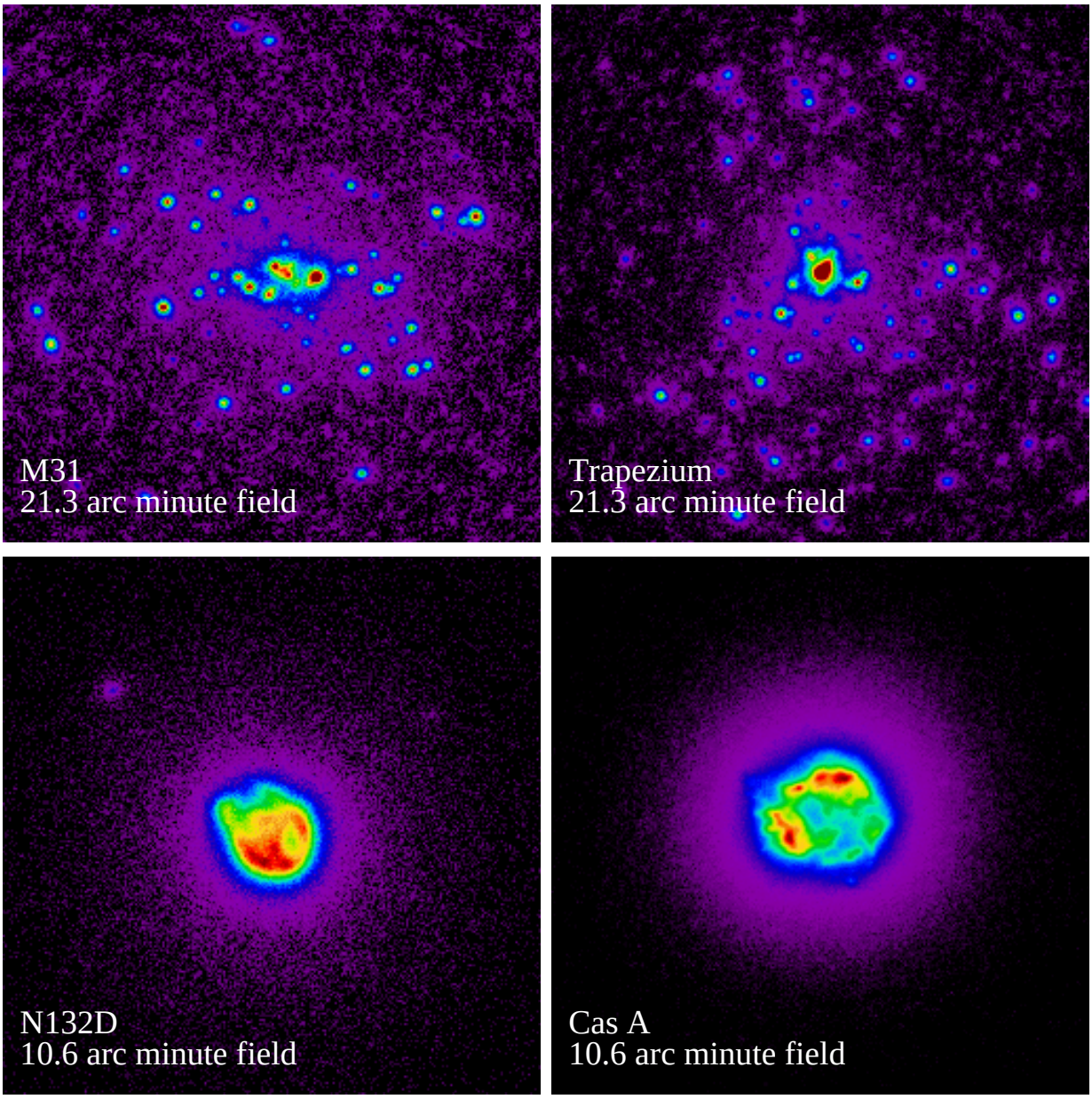

Fig. 1.— Quicksim EPIC MOS simulations of M31, the Trapezium, N132D, and Cas A. The "thin" filter and spectra appropriate for the different objects were used. The size of the fields are noted in the images.