



xmm-newton



# Practicing during the Workshop

Eduardo Ojero Pascual, XMM-Newton SAS Team

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- SAS 13.5.0: xmmsas\_20131209\_1901
- Released December 11<sup>th</sup> 2013 (<http://xmm.esac.esa.int/sas/>)
- Release notes:  
[http://xmm.esac.esa.int/sas/current/documentation/releasenotes/xmmsas\\_13.5.0.shtml](http://xmm.esac.esa.int/sas/current/documentation/releasenotes/xmmsas_13.5.0.shtml)

# Required Software Tools



- Any installation of perl (e.g. OpenSuSE 12.3 includes perl 5.16.2 that works fine).
  - <http://www.cpan.org/src/>
  
- SAO ds9 7.2 + xpa 2.1.14.
  - <http://hea-www.harvard.edu/RD/ds9/>
  
- Grace 5.1.23 (xmgrace)
  - <http://plasma-gate.weizmann.ac.il/Grace/>
  
- Heasoft 6.15.1
  - <http://heasarc.nasa.gov/lheasoft/>
  
- wcstools 3.8.7
  - <http://tdc-www.harvard.edu/wcstools/>

- A set of example observations (ODF) for selected objects.  
These are the same that are used for the Scientific Validation of the public releases of SAS (~4 GB).
  
- Where to find these example ODFs ?
  - Linux Desktops: /SAS\_Workshop/<objectname>/ODF
  - ftp: [ftp://xmm.esac.esa.int/pub/sasdev/SAS\\_Workshop\\_Example\\_ODF](ftp://xmm.esac.esa.int/pub/sasdev/SAS_Workshop_Example_ODF)
  - USB
  
- You may use any data of your interest by downloading it directly from the XMM-Newton Scientific Archive (XSA) (as already explained by Nora Loiseau).

# Example Observations



- AB-Dor: K-type Zero-Age-Main-Sequence star, RGS calibration target with lot of emission lines, **ObsId = 0133120201**.
- BPM 16274: White Dwarf, OM calibration target (many OM exposures in different modes and filters), **ObsId=0125320701**.
- G21.5-09: Crab-like SNR, all EPICs in Full Frame, suited for spectral fitting (both individual and combined), **ObsId=0122700101**.
- Lockman Hole: the popular observation field in all wavelengths. EPIC source searching, population, hardness ratios, **ObsId=0123700101**.
- Mkn 421: BL Lac, RGS effective area calibration target, very bright continuum with almost no lines, suited for RGS spectral fitting, **ObsId=0099280201**.
- PKS0558-304: bright quasar, different EPIC window modes, specially suited for EPIC spectral fitting, **ObsId=0129360201**.
- HD 13499: F-Type star, OM Calibration target (wavelength calibration of grism), **ObsId=0125911301**.
- Hz2: OM Calibration target (grism and UV flux), **ObsId=0125910901**.
- Timing: Data for timing analysis (PSRB1509), **ObsId=0128120401**.

# SAS Packages and Tasks (1)



- SAS uses tasks to process data.
- Tasks are grouped into packages.
- A Package might include one or several tasks related to each other.
- A task is a single executable:
  - A real binary, Linux ELF 32 or 64 bit LSB or Mac OS X Mach-O 64-bit
  - An executable perl script (e.g. one that has in the first line `#!/usr/bin/perl` )

## Packages and Tasks (2)



- To identify the version and package for a given task:

```
# epproc --version  
epproc (epicproc-2.14.4) [xmmsas_20131209_1901-13.5.0]
```

Task name

Package name and version

SAS Manifest identification

SAS Release identifier or AKA



# Task's common options and parameters



- Task command line format:

`<task> [options] --<param>=<value>`

- Besides their specific parameters, all SAS tasks have a common set of options:

|  |   |
|--|---|
| <code>-a &lt;dir1&gt;[:&lt;dir2&gt;...]</code> | <code>--ccfpath &lt;dir1&gt;[:&lt;dir2&gt;...]</code> |
| <code>-c</code>                                | <code>--noclobber</code>                              |
| <code>-d</code>                                | <code>--dialog</code>                                 |
| <code>-f &lt;f1&gt; [&lt;f2&gt; ...]</code>    | <code>--ccffiles &lt;f1&gt; [&lt;f2&gt; ...]</code>   |
| <code>-h</code>                                | <code>--help</code>                                   |
| <code>-i &lt;cifname&gt;</code>                | <code>--ccf &lt;cifname&gt;</code>                    |
| <code>-m</code>                                | <code>--manpage</code>                                |
| <code>-o &lt;odfname&gt;</code>                | <code>--odf &lt;odfname&gt;</code>                    |
| <code>-p</code>                                | <code>--param</code>                                  |
| <code>-t</code>                                | <code>--trace</code>                                  |
| <code>-V &lt;level&gt;</code>                  | <code>--verbosity &lt;level&gt;</code>                |
| <code>-v</code>                                | <code>--version</code>                                |
| <code>-w [code n]</code>                       | <code>--warning [code n]</code>                       |

- Option `-h` provides a listing of all available task parameters.

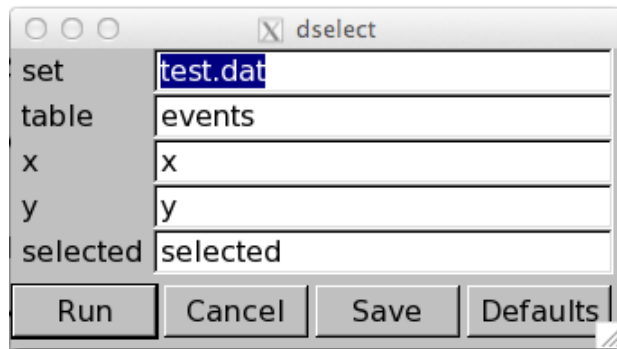
- <http://xmm.esac.esa.int/sas/current/doc/taskmain/node2.html>

# GUI versus command line

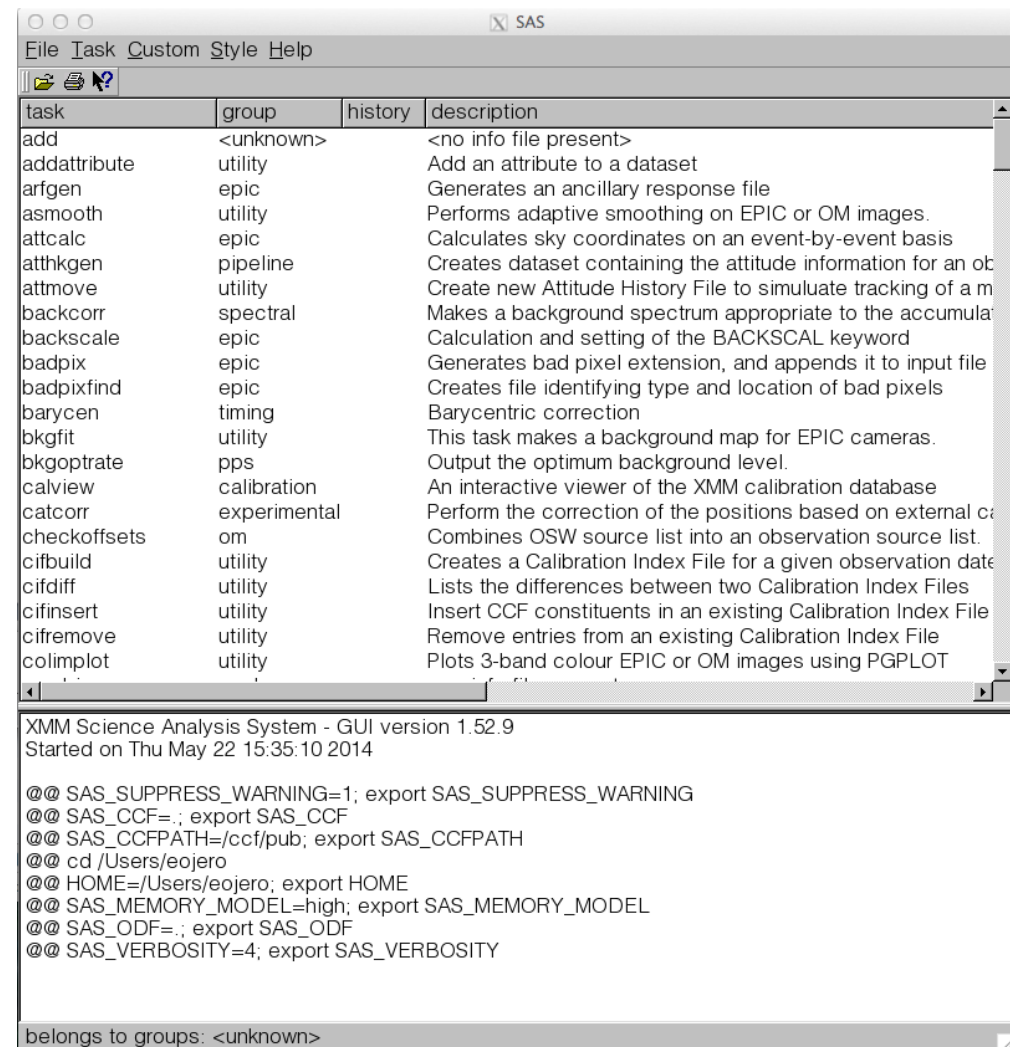


## ➤ The SAS GUI (sas)

- You may run any task
- Launches the specific individual task GUI (e.g. dselect -d)



- Have access to all parameters (filled with defaults)



# Identifying the origin of the SAS installed



## ➤ sasversion

```
sasversion:- Executing (routine): sasversion -w 1 -V 4
sasversion:- sasversion (sasversion-1.2) [xmmsas_20131209_1901-13.5.0] started:
2014-05-22T15:14:33.000
```

```
sasversion:- XMM-Newton SAS release and build information:
```

```
SAS release: xmmsas_20131209_1901-13.5.0
Compiled on: Mon Dec 9 19:32:59 GMT 2013
Compiled by: sasbuild@xmac01.net4.lan
Platform : Darwin-11.4.2 64
```

```
SAS-related environment variables that are set:
```

```
SAS_DIR = /sas/Darwin/11.4.2/64/sas13_5_0_x86_64
SAS_PATH = /sas/Darwin/11.4.2/64/sas13_5_0_x86_64
SAS_CCFPATH = /ccf/pub
```

```
sasversion:- sasversion (sasversion-1.2) [xmmsas_20131209_1901-13.5.0] ended:
2014-05-22T15:14:33.000
```

# Getting Help and Documentation



- The sashelp command launches a local browser to navigate the HTML documentation.
- SAS\_BROWSER variable allows to change the browser (default in Linux is firefox).
- Help on a specific task:
  - sashelp --doc=<task>
  - <task> --manpage (do not use -help; instead it will list all available parameters)
- SAS 13.5.0 On-line help at the XMM-Newton SOC: <http://xmm.esac.esa.int/sas/current/doc/>
- SAS 13.5.0 User's Guide (html/pdf) available at the XMM-Newton SOC: [http://xmm.esac.esa.int/external/xmm\\_user\\_support/documentation/sas\\_usg/USG/](http://xmm.esac.esa.int/external/xmm_user_support/documentation/sas_usg/USG/)
- HelpDesk: [http://xmm.esac.esa.int/external/xmm\\_user\\_support/helpdesk.shtml](http://xmm.esac.esa.int/external/xmm_user_support/helpdesk.shtml)

# SAS by example: Threads



- A Thread is an example of a procedure where several SAS tasks are applied in sequence to process our data in a specific manner.
- All threads are available in <http://xmm.esac.esa.int/sas/current/documentation/threads/>

**SAS Threads**

| Common Threads   |                            |                    |
|--|----------------------------|--------------------|
| <b>Starting the SAS</b>  |                            |                    |
| - SAS start-up   | command line               |                    |
| <b>All in one go: from raw data (ODF) to science products</b>                        |                            |                    |
| - Analysis chain for point-like sources: <i>xmextractor</i>                          | command line               |                    |
| <b>Guidelines for scientific analysis</b>  |                            |                    |
| - Spectral analysis with XSPEC   | command line               |                    |
| - Timing analysis with XRONOS  | command line               |                    |
| <b>EPIC related Threads</b>  |                            |                    |
| <b>All in one go: from raw data (ODF) to science products</b>                        |                            |                    |
| - Analysis chain for point-like sources: <i>xmextractor</i>                          | command line               |                    |
| <b>Step-by-Step</b>  |                            |                    |
| <b>Event list generation:</b>  |                            |                    |
| - How to reprocess ODFs to generate calibrated and concatenated EPIC event lists     | command line               |                    |
| <b>Filtering against high background:</b>  |                            |                    |
| - How to filter EPIC event lists for flaring particle background                     | command line & GUI version |                    |
| <b>Light curve generation:</b>   |                            |                    |
| - Extraction of a light curve for a point-like source (EPIC and RGS)                 | command line               | GUI version        |
| <b>Spectrum extraction:</b>  |                            |                    |
| - Extraction of MOS spectra from point-like sources                                  | command line               | GUI version        |
| - Extraction of MOS spectra from point-like sources taken in timing mode             | command line               | GUI version        |
| - Extraction of pn spectra from point-like sources                                   | command line               | GUI version        |
| - Extraction of pn spectra from point-like sources taken in timing mode              | command line               | GUI version        |
| - Extraction of spectra in a few clicks: <i>aspects</i>                              | command line               | GUI version        |
| - Combining the spectra of the 3 EPIC cameras  | command line               |                    |
| - Overlapping EPIC data treatment: <i>multiimagelect</i>                             | command line               | GUI version        |
| <b>Point Spread Function (PSF) generation:</b>                                       |                            |                    |
| - 2-D PSF à la carte   | command line               |                    |
| <b>More complex analysis for bright or extended sources</b>                          |                            |                    |
| - Dealing with EPIC Out-of-Time (OoT) events   | command line               |                    |
| - How to evaluate the pile-up fraction in an EPIC source                             | command line               |                    |
| <b>ESAS:</b>   |                            |                    |
| - Creation of EPIC background subtracted, exposure corrected images                  | command line               |                    |
| - Creation of EPIC merged background subtracted and exposure corrected images        | command line               |                    |
| - Creation of EPIC spectra analysis files for a cluster radial profile               | command line               |                    |
| <b>The "images" Script:</b>  |                            |                    |
| - A shell script to create attractive EPIC-pn & MOS combined images                  |                            | dedicated Web page |
| <b>Source detection</b>  |                            |                    |
| - EPIC source finding thread in one go: <i>edetect_chain</i>                         | command line               |                    |
| - EPIC source finding thread: step-by-step   | command line               |                    |
| - EPIC source finding in overlapping exposures                                       | command line               |                    |
| <b>Slew data processing</b>  |                            |                    |
| - How to process EPIC slew data  | command line               |                    |
| <b>RGS related Threads</b>   |                            |                    |
| <b>All in one go: from raw data (ODF) to science products</b>                        |                            |                    |
| - Analysis chain for point-like sources: <i>xmextractor</i>                          | command line               |                    |
| <b>Step-by-Step</b>  |                            |                    |
| - How to reduce RGS data and extract spectra of point-like sources                   | command line               |                    |
| - <i>raspecs</i> , coordinates and masks   | command line               |                    |
| <b>Light curve generation:</b>   |                            |                    |
| - Extraction of a light curve for a point-like source (EPIC and RGS)                 | command line               | GUI version        |
| <b>More complex analysis for the very bright sources</b>                             |                            |                    |
| - Pile-up in the RGS: how to prevent it, evaluate its existence and make corrections | command line               |                    |
| <b>OM related Threads</b>  |                            |                    |
| <b>All in one go: from raw data (ODF) to science products</b>                        |                            |                    |
| - Analysis chain for point-like sources: <i>xmextractor</i>                          | command line               |                    |
| <b>Step-by-Step</b>  |                            |                    |
| - OM image mode data processing chain  | processing chain           | command line       |
| - OM fast mode data processing chain   | processing chain           | command line       |
| - OM grism processing chain  | processing chain           | command line       |
| - Interactive OM photometry  | command line               |                    |



# Computers to practice and Calibration Files (CCF)



- Personal Laptops must have already installed
  - SAS 13.5.0 (requires perl be available during installation process).
  - Heasoft, either a binary install or a built from source code.
  - Graphics tools: ds9 and xmgrace.
  
- Desktops: Linux (RHEL 5.8 64-bit).
  
- Calibration Files: Updated CCF set (~ 4 GB).
  - Available from ESAC
    - `rsync -a xmm.esac.esa.int::XMM_RED_CCF .`
    - [ftp://xmm.esac.esa.int/pub/ccf/red\\_constituents](ftp://xmm.esac.esa.int/pub/ccf/red_constituents)
  - USB (together with Workshop example data).