SAS Recent Developments and Near Future

Anthony Marston & Richard Saxton

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Outline

- Some recent highlights and 19 April 2023 SAS v21 release

- Some release details

- Operating systems

- Items being considered for SAS future (next 2 years).

- Summary

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Some Recent Highlights

Some recent major initiatives leading to SAS v21 released 19 April 2023.

1. Introduction of Python. Python version supplied in the build which is stable.

   a. Run SAS routines through 'pysas'.

   b. Runs in notebooks

   c. Docker version. Initial version running in ESAC's datalabs. (prototype) Code comes to the data.

2. Integration of ESAS (extended X-ray emission analysis) into SAS in April 2023 release. Run with standard calibration file setup (use of usual XMM CCFs).

   a. Complete upgrade of the package and rationalised into SAS

   b. Cookbook and documentation updates.

Some detailed changes in SAS v21 – released 19 April

- Spatial CTI correction, based on Sanders et al. 2020, A&A, 633, A42. See new task *epspatialcti.* This is implemented for EPIC-pn FF and eFF observing modes and is especially useful for the spectral analysis of extended sources.

- New task, *evenergyshift,* has been added. This allows an ad-hoc shift to be applied to event energies from EPIC-pn FAST mode (Timing / Burst mode) using offsets measured at line or edge energies, such as Silicon or Gold.

- Several tasks which produce plots using the PGPLOT package have been converted so that the plotting is performed by in Python.

- Quiescent particle background (QPB) files can now be produced for EPIC-pn extended full frame mode (EFF) data using *evqpb* and *qpbselect.*

- OM magnitude plots have the Y axis corrected so that lower-magnitude / higher-flux measurements sit above higher-magnitude / lower-flux points.

- Multiple improvements to source detection tasks.

- Infrastructure has been added to SAS 21 to aid the construction of Python scripts and notebooks.

Multiple operating systems – plus VM and Docker

This version of SAS is released in two 64-bit binary versions for Linux
(**Red Hat Enterprise Linux 8.6 and Ubuntu 22.04LTS and 20.04LTS**), and one for **MacOS 12.6 (Monterey).**

These versions have been tested and found to run correctly on
several other platforms including **MacOS Bigsur (11.6) and Ventura-M1 (13.2).**

Ubuntu 22 version also available in a VM and Docker
    XMM Docker available in ESA Datalabs collaborative learning (**https://datalabs.esa.int**)
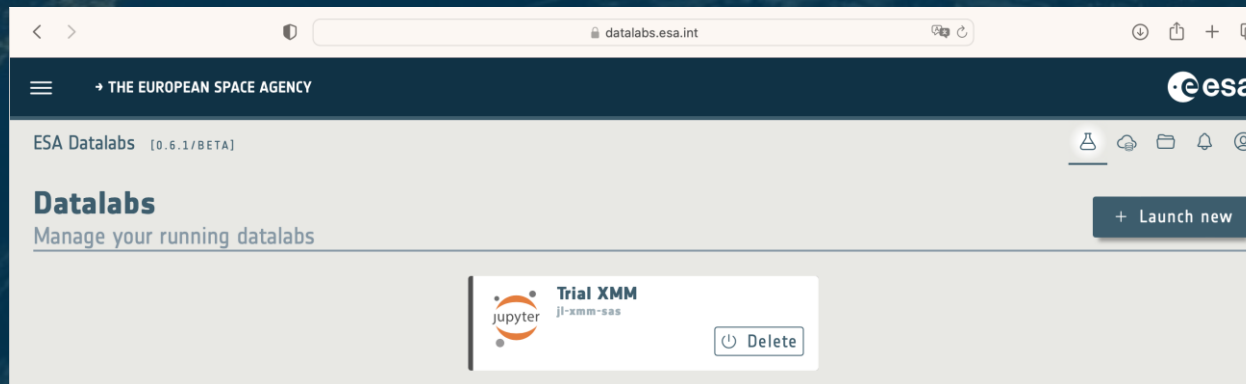
Upcoming items for SAS (~2 years)

1. **Probable patch release for public code version of SAS.**

   1. Removal of <u>Numerical Recipes</u> code – make SAS available for public release, expected in late 2023.

2. **Update documentation and training including availability of Python for running SAS.**

   - **Extend the use and knowledge of SAS Python.**

   - **Consider user data analysis training in SAS /ESAS**

   - **SAS Threads – examples and development of Notebooks.**

XMM-Newton Science Analysis System

pysas (pysas-1.4.1) [xmmsas_20211130_0941-20.0.0]
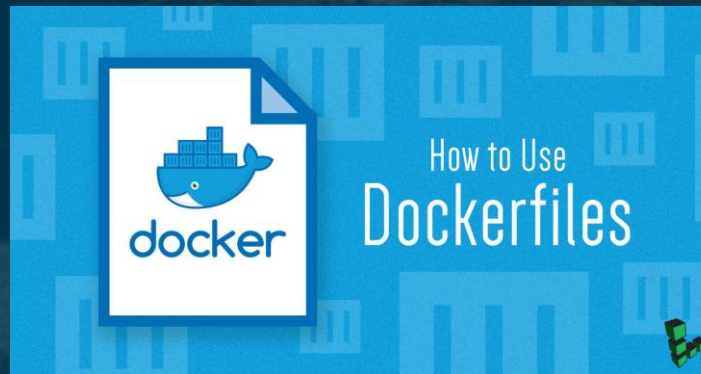
pysas
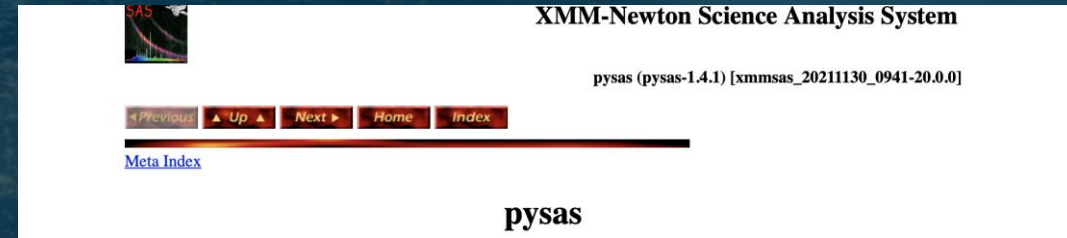
3. **Introduce modern software build and development system.**

   Docker-based.

   Different Docker per OS build.

   Continuous integration

   Nightly builds w/test scripts

SAS Technology Stack

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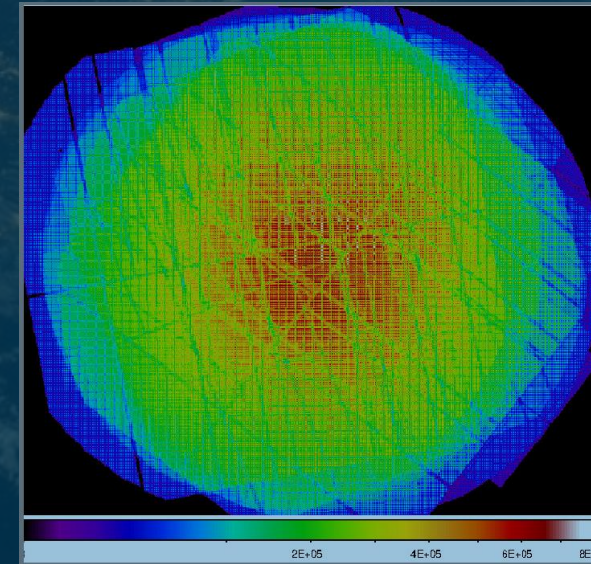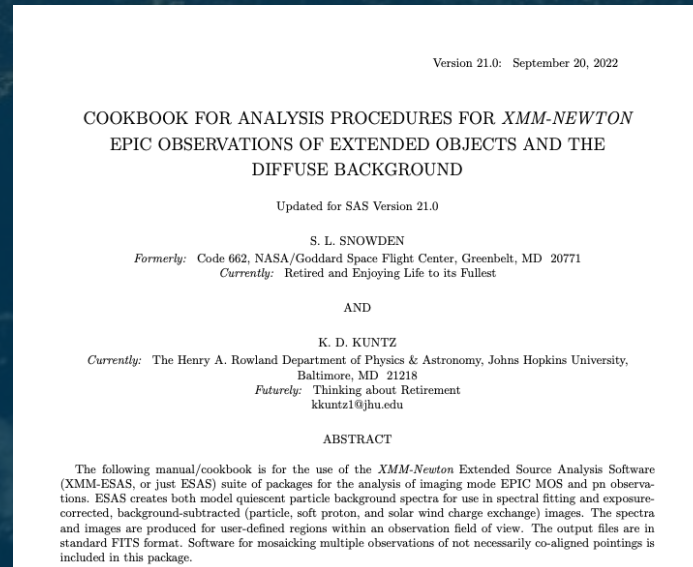
3. ESAS – further updates (TBD).

    a. Community input algorithms and software requests for including in the ESAS module. There are several private codes developed in the community which might usefully be included in ESAS.

    b. Further work to make ESAS work with external software more efficiently such as DS9

    c. Development of ESAS tasks working within a Python environment

    d. Parallelisation of some code.

Version 21.0: September 20, 2022

COOKBOOK FOR ANALYSIS PROCEDURES FOR *XMM-NEWTON* EPIC OBSERVATIONS OF EXTENDED OBJECTS AND THE DIFFUSE BACKGROUND

Updated for SAS Version 21.0

S. L. SNOWDEN
Formerly: Code 662, NASA/Goddard Space Flight Center, Greenbelt, MD 20771
Currently: Retired and Enjoying Life to its Fullest

AND

K. D. KUNTZ
Currently: The Henry A. Rowland Department of Physics & Astronomy, Johns Hopkins University, Baltimore, MD 21218
Futurely: Thinking about Retirement
kkuntz1@jhu.edu

ABSTRACT

The following manual/cookbook is for the use of the *XMM-Newton* Extended Source Analysis Software (XMM-ESAS, or just ESAS) suite of packages for the analysis of imaging mode EPIC MOS and pn observations. ESAS creates both model quiescent particle background spectra for use in spectral fitting and exposure-corrected, background-subtracted (particle, soft proton, and solar wind charge exchange) images. The spectra and images are produced for user-defined regions within an observation field of view. The output files are in standard FITS format. Software for mosaicking multiple observations of not necessarily co-aligned pointings is included in this package.

5. **Development of Dockers + SAS available within ESAC Datalabs.**

   a. Initial Datalabs capabilities Docker in place and tested.

   b. Running notebooks is a standard means of using Datalabs

   c. Collaborative environment for users. See https://datalabs.esa.int. Currently public Beta

   d. Environment set up for you, once SOC defines full Docker – include SAS, XSPEC etc.

   e. Run RISA in Datalabs?

   f. Use of TM assessment via ARES.
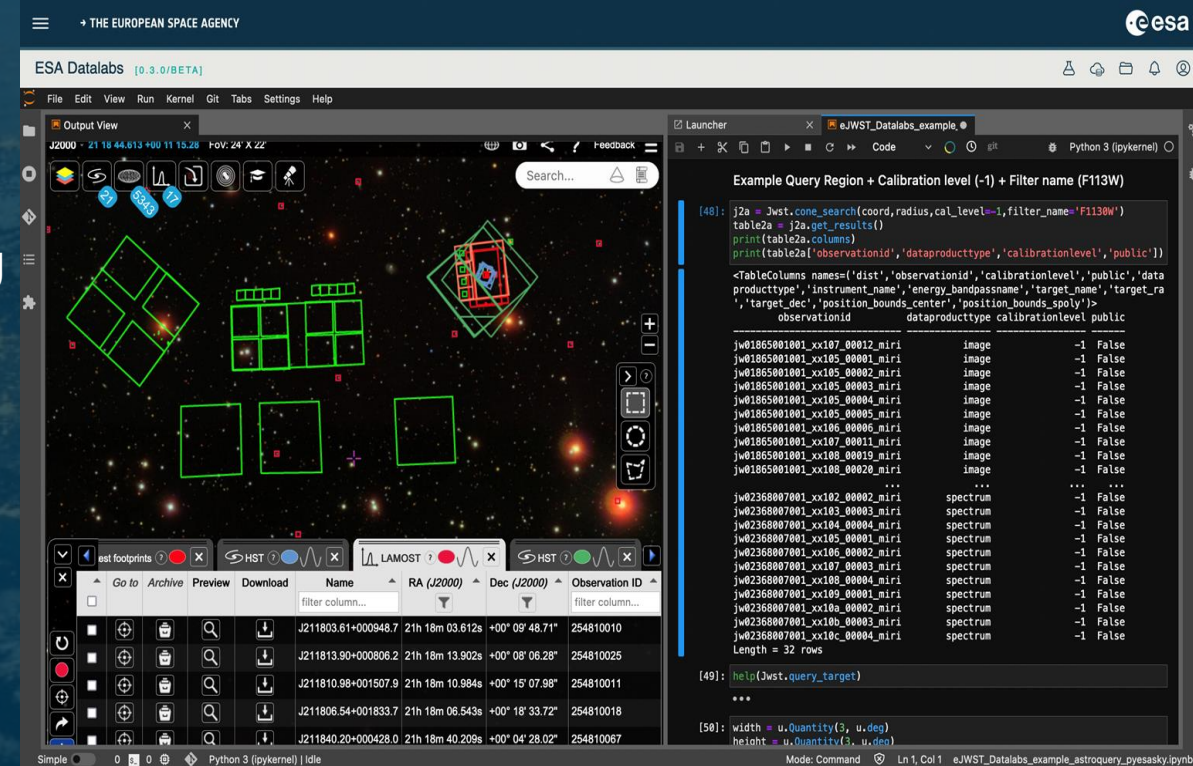
Example: Notebook, ESASky and links to archives (Astroquery)

Items being considered for SAS (~2 years)

6. **Code improvements (as time permits)**

   a. Complete PGPlot removal

   b. GCC updates – now moved to compiler 11

   c. OM items. The software is not in an easy state to handle. Likely to continue to be slow improvements.

7. Preparations for pipeline updates needed for next reprocessing and catalogue production.

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Summary

- More emphasis on making system more manageable and useable.

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