SAS status and development - medium and long term strategy

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XMM-Newton Science Operations Centre – ESAC / ESA

On behalf of SOC SAS & SAS WG teams

21st XMM-Newton Users Group Meeting

Overview

- SAS v19.0 – status and contents
- SAS short and medium term plans
- Long-term strategy

SAS 19 : schedule

- **Freeze SAS development around now**
- **Science validation over summer**
- **Expected release after AO 20, October/November**

SAS 19 : contents

Increase flexibility for product extraction

- Extraction region centre defined in celestial coords - CIRCLE(RA,DEC,radius)
- Extraction region defined by an image

Support combined spectra from different cameras and from different observations

- multiespecget, multixmmselect: already in SAS 18, improve documentation, threads

Produce quiescent particle background products from FWC scaled by the discarded line rate

RGS background smooth – new algorithm

OM degradation, new algorithm

PN energy scale - new algorithm for Burst mode, rate-dependent correction

Small enhancements/fixes (epevents, emtaglenoise, emosaic,emsaplib, emask…)

Extended Source Analysis System (esas) updates

Build and infrastructure

Python changes

Region definition by image

evselect table=myobs.FTZ expression="IMAGE(image.ds)"

Use any image with WCS coordinates

Make a mask:

Used to INCLUDE area

cf: "MASK(image.ds)"
(used to exclude area)

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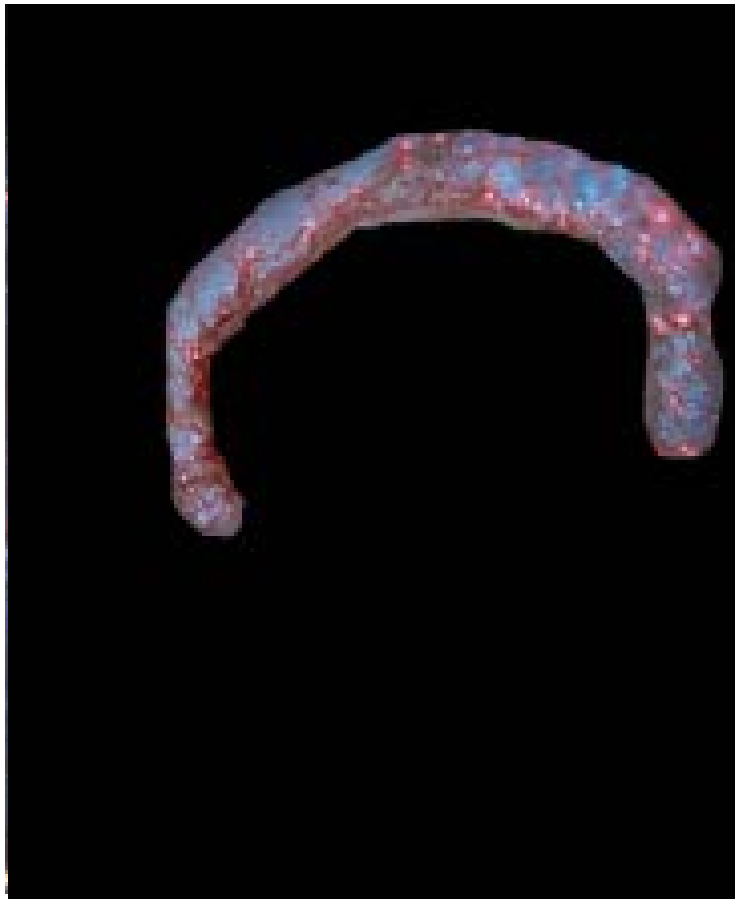
evselect table=myobs.FTZ expression="IMAGE(image.ds)"



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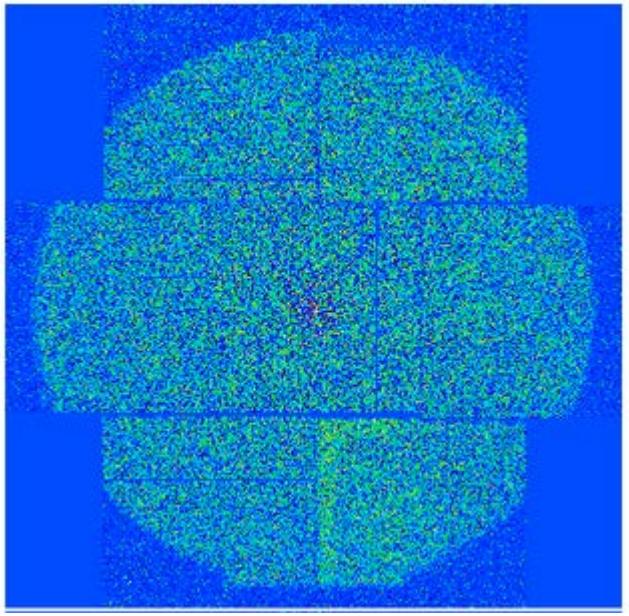
esas – extended source analysis (NASA)

SAS 19 changes

- **Make tasks modular and independent**
- **Redesign of the extended emission calibration method**
- **Convert internal calibration files into SAS CCFs**
- **Use the SAS Filter Wheel Closed CCF**
- **Update documentation and cookbook**

Future changes

- **New technique, avoiding use of corner (out-of-FOV) data**
- **Enhance compatibility with e.g. ds9**



A model soft-proton background produced
By the task *proton*

SAS 19 contents – Build and Infrastructure

GCC v9.2 – affects C++/F90 interface – fixed for infrastructure code and OM code

Release platforms: Linux (Ubuntu18.04LTS, RHEL6.8), Mac-OS (Catalina), VM for windows

Source code release: on-hold. Numerical Recipes code to be replaced because of copyright issues. Then code to be used for building SAS to aid long-term preservation.

Use of PERL, PGPLOT/Grace, HEASOFT complicates installations.

SAS 19 contents – Python

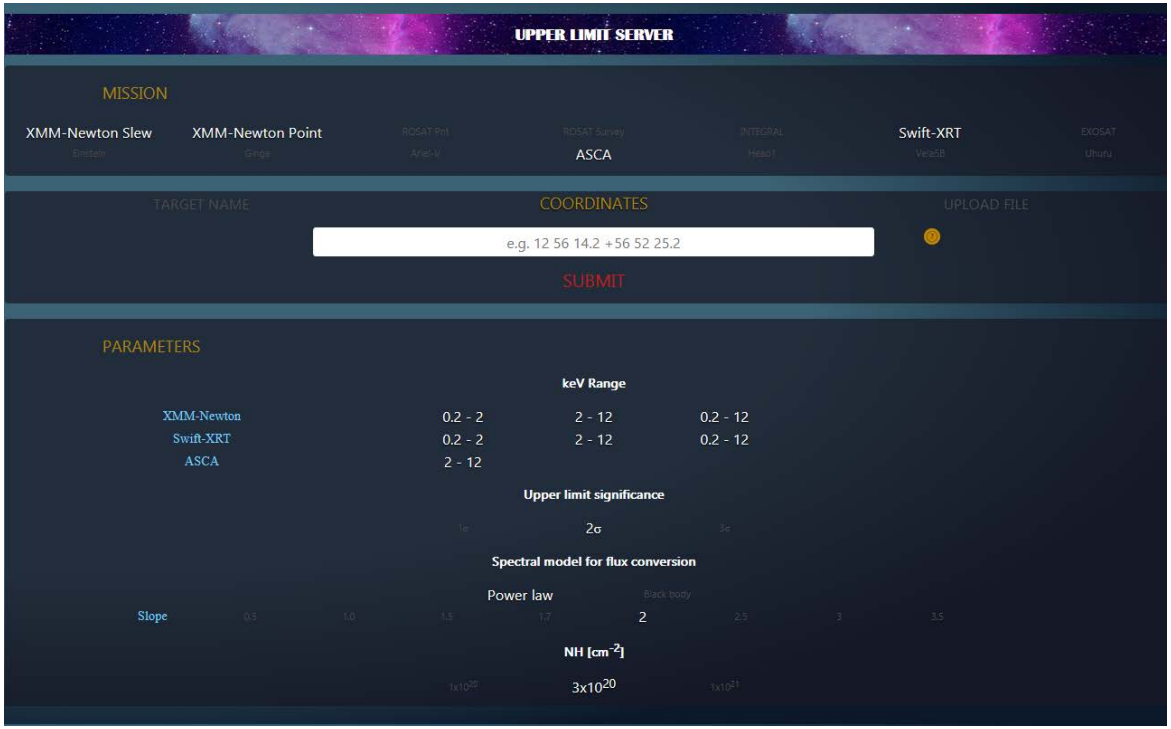
- **Prepare the Python infrastructure – saspython package (error, param, utils) .**
- **SAS threads as Jupyter notebooks**
- **Make released SAS compatible with other pre-existing python installations.**
- **Replacement of PERL, in collaboration with task maintainers (post-SAS19)**
- **Replacement of PGPLOT / GRACE with Python plotting (post-SAS19).**

Future Plans – **short**/medium term

- Fix EPIC-pn filter recognition when temperature is low
- Solve EPIC-pn exposure time problem with huge count rates
- Concatenate OM fast mode light curves per filter
- Rapid-XMM : Upper limits
- Build SAS from source, release source code

- Implement EPIC-pn phenomenological response matrices
- Use of Cu line to aid energy scale calibration (no SAS change)
- Introduction of spatially-dependent CTI correction.
- Add multi-threading to improve performance (C++)
- *cifbuild* – introduce index metafile to avoid opening EVERY file
- Introduction of community-supplied extended emission algorithms into sas / esas.

Upper Limits



HILIGT, released in 2019.
Good for small numbers
Of position.

Contract started to pre-calculate upper limits from XMM pointed and slew data
Can return ~20 positions per second. Ready by end of year.

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Future Plans – long term

Goals and Desires

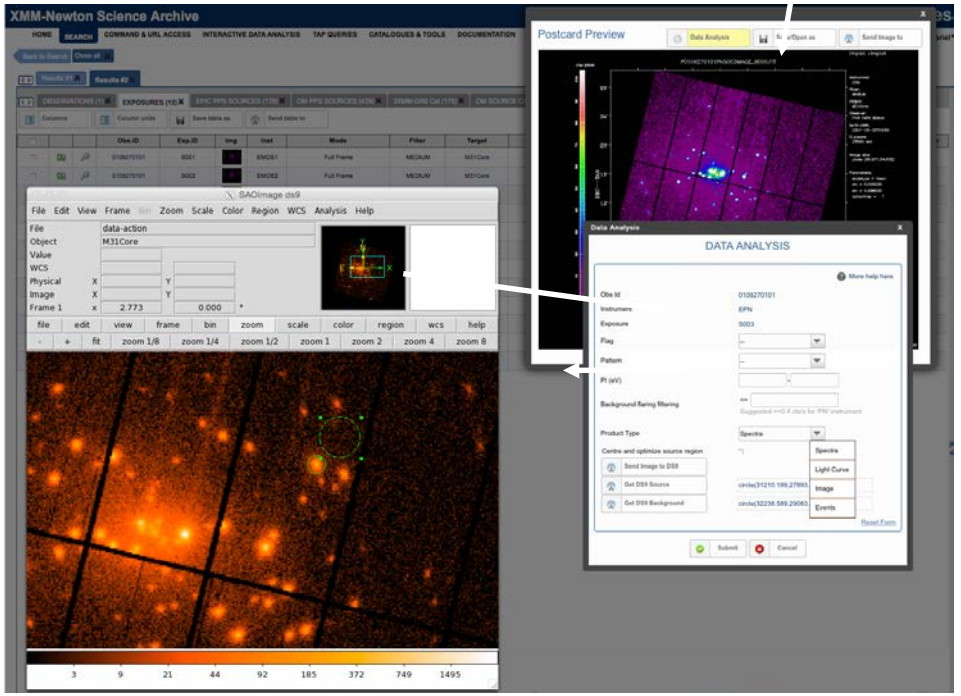
- S/W as far as possible maintenance free for 20 years
- XMM-Newton data can be used by non X-ray astronomers
- Community can support and expand the s/w functionality
- Processing is fast – code close to data
- Data can be used within multi-wavelength analysis

Solution

- On-the-fly, GUI-based processing
- Integrated into ESAC archives
- Compatible with Jupyter labs/hub/notebooks
- Wrap SAS in Virtual Machine or Docker

RISA – running within XSA

- Datalabs – ESAC processing platform – ready end 2020
- XMM section, based on Jupyter -> long-term support from Archive team
- Aim to have SAS running fully autonomously in Datalabs within 2-3 years.
- Will report on progress next year



Summary

- SAS v19.0 – release towards end of year
- esas further integration into SAS
- Support for Python scripting
- GCC v9.2
- Upper limit servers released, much faster by end of year
- Future enhanced integration of GUI-based SAS with XSA