SAS in ESA Datalabs

Demo

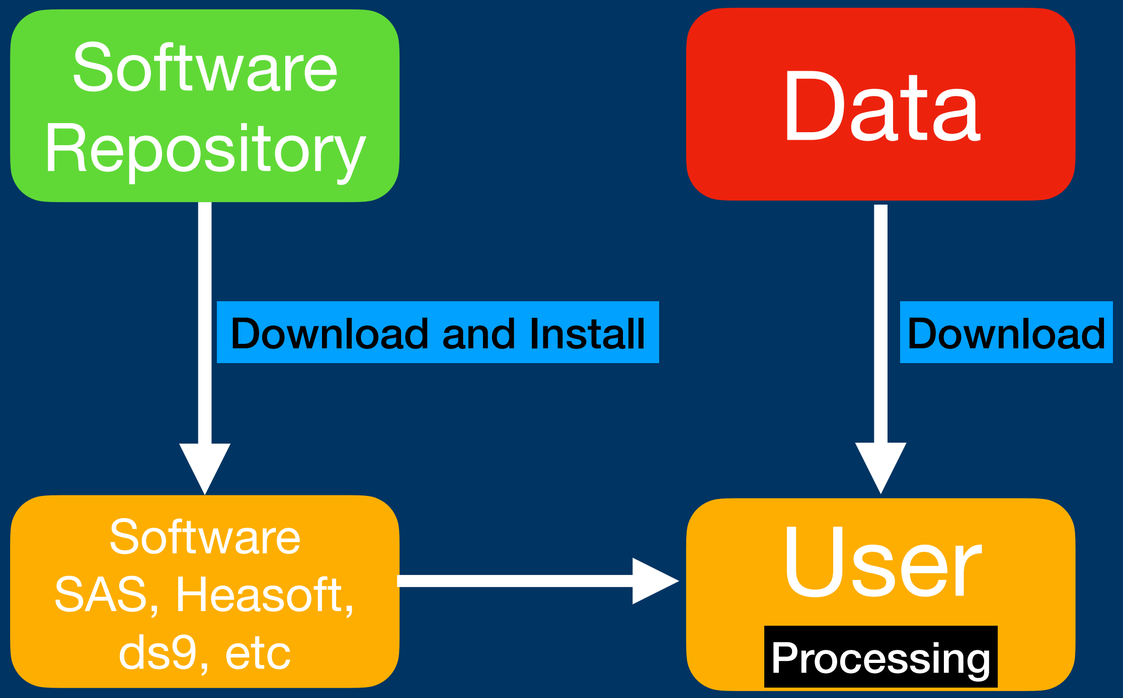
Eduardo Ojero, UG Meeting #23, 16-17 May 2022

SAS in ESA Datalabs - Demo

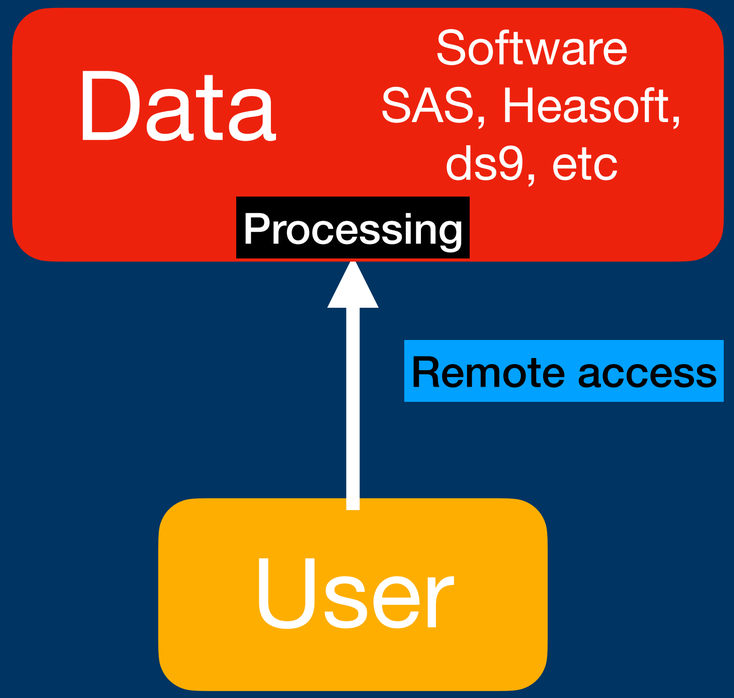
What is the Demo about?

- Shows how to access **SAS** remotely and use it interactively in **ESA Datalabs**.
- Explains basic concepts of the **ESA Datalabs** system.
- It is an advanced prototype based on **Datalabs 0.3.0/BETA**.
- Not yet open neither for testing at the XMM-Newton SOC nor for public access.
- Uses the publicly released **SAS v20.0 Docker image.**
- Shows two interactive access methods to **SAS**:
    - **Jupyter Labs**.
    - **X11 GUIs through a web interface (noVNC)**.

Standard Client-Server Model



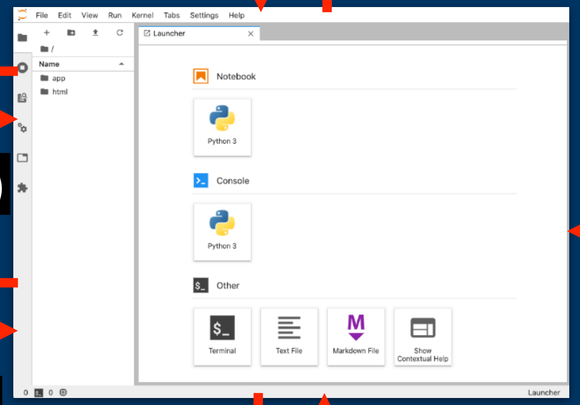
ESA Datalabs Model



Jupyter Labs Interactive Access (main)

SAS Docker Container

- Ubuntu 18.04 base image
- SAS v.20 binary installation
- Heasoft v.6.29 binary installation
- Docker engine executing on Linux (RHEL)

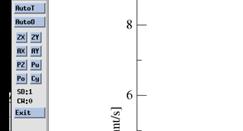


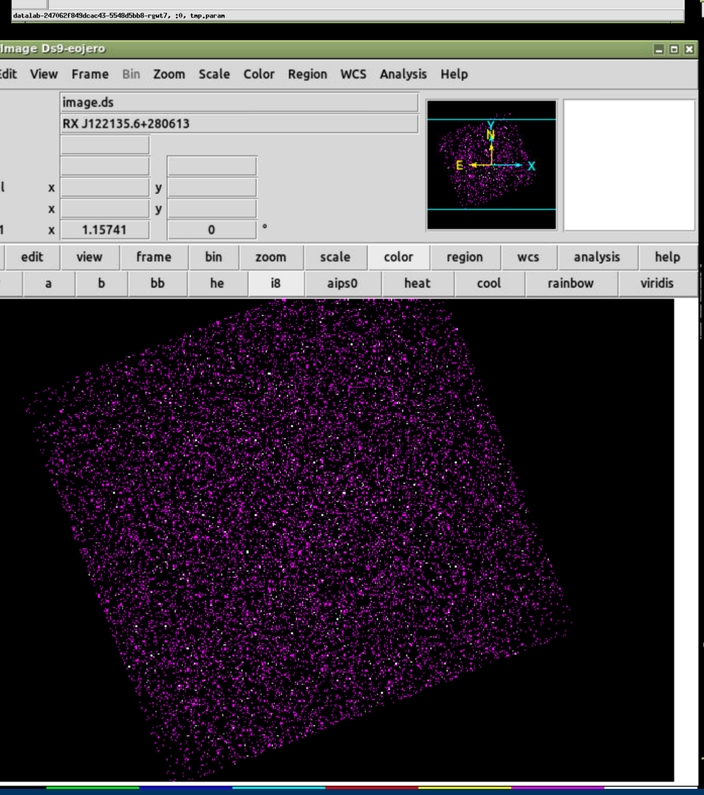
User's disk (/media/user)

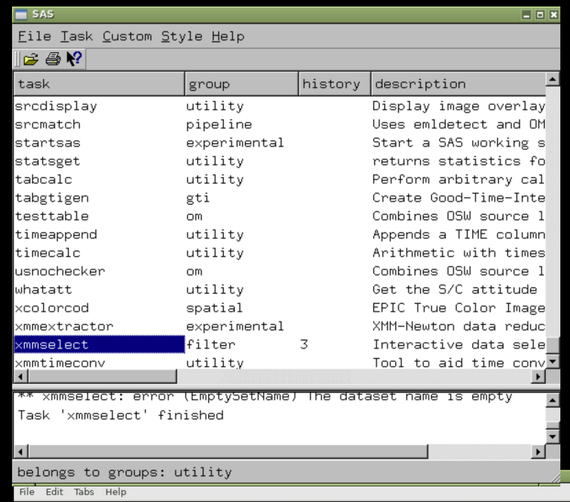
Data Volumes (/media/data/ccf)

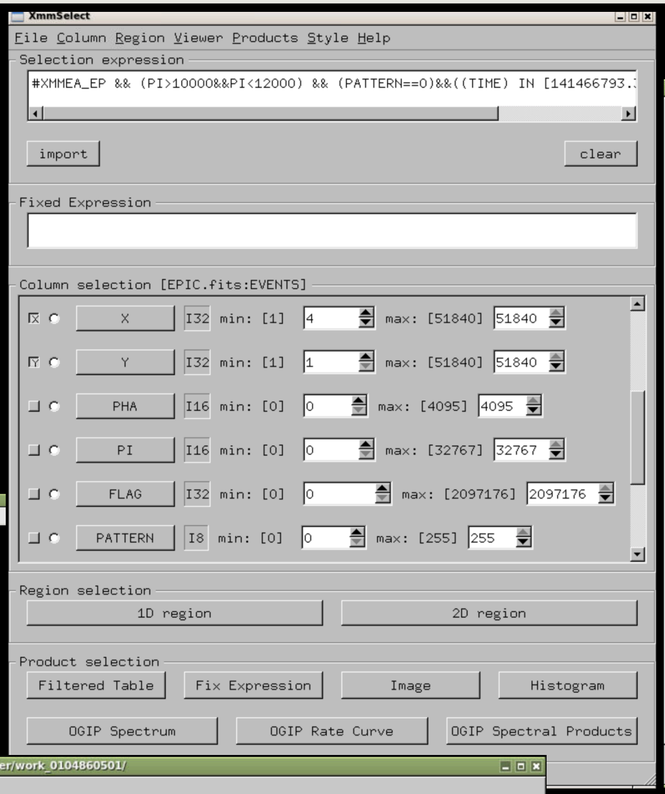
- Standard Jupyter Labs Web interface
- Plots and Image display provided by Python matplotlib
- No X11 access

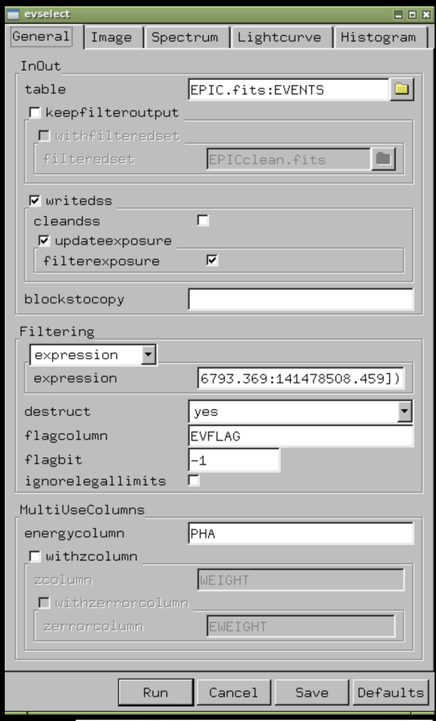
User

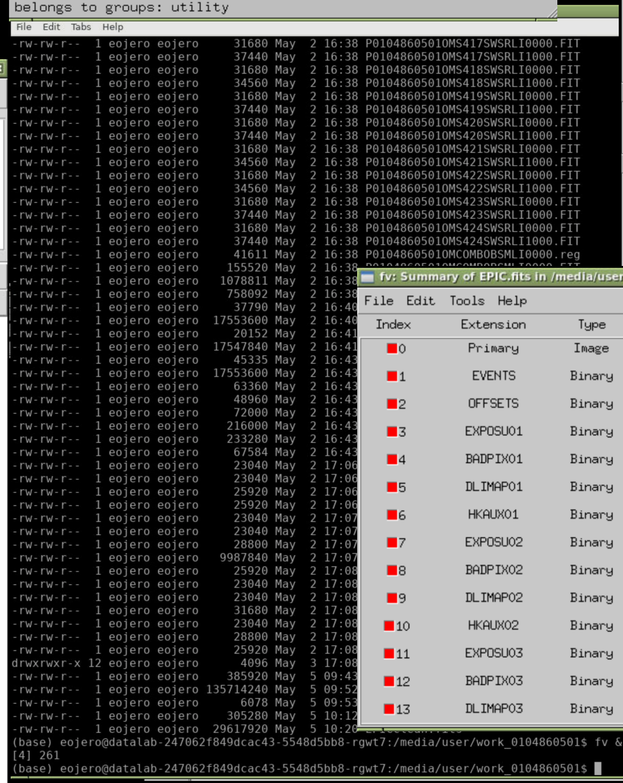


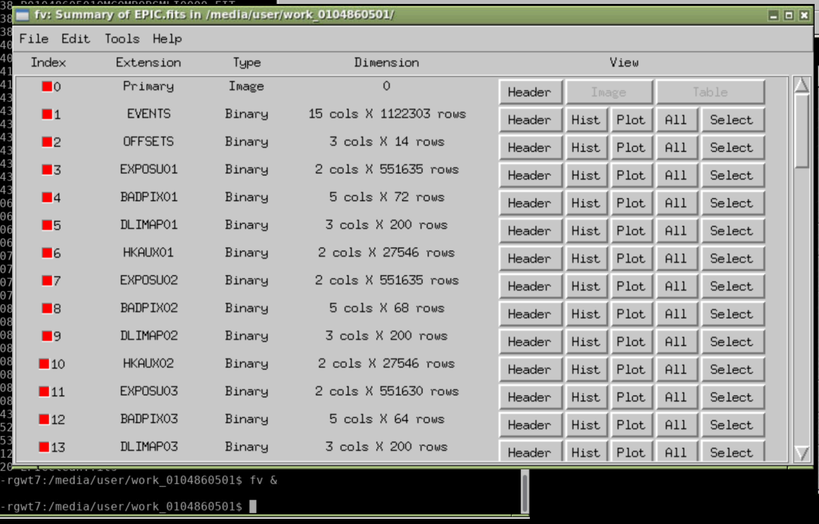


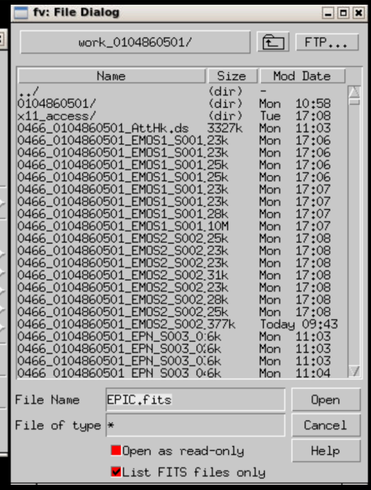












X11 GUIs Interactive Access (auxiliary)

ESA Datalabs [0.3.0/BETA]

Datalabs

+ LAUNCH NEW DATALAB

https://datalabs-dev.situk8spro.ebe.lan/datalab-chooser

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Create Datalab

Find a datalab in ESA datalabs catalog

Filter results

aladin
Aladin is an interactive sky atlas allowing the user to visualize digitized astronomical images or full surveys, superimpose entries from astronomical catalogues or databases, and interactively access related data and information from the *Simbad database*, the *VizieR* service and

filezilla
FileZilla

fv
FV - An image display and visualization tool for astronomical data

jl-esdc
Jupyterlab ESDC

jl-euclid-dps
Euclid DPS JupyterLab

jl-herschel
Herschel JupyterLab

jl-juice
JupyterLab with JUICE moon coverage tool (0.8.0). (with kernels)

jl-pangaia
PanGaia JupyterLab

jl-xmm-sas
Jupyterlab XMM SAS

jupyterlab
Plain JupyterLab for demonstration of basic functionality.

jupyterlab-cuda
JupyterLab for demonstration of GPU functionality (CUDA 10.0).

jwst
Jupyterlab JWST

jwst-miricle
Jupyterlab JWST Miricle

jwst-nips
Jupyterlab JWST NIPS

jwst-nsrt
Jupyterlab JWST NSRT

qfitsview
QFitsView - An image display and visualization tool for astronomical data

theia-python
Theia Python Editor

x-ds9
SAOImageDS9 - An image display and visualization tool for astronomical data

x-glab
GNSS-Lab Tool (gLAB)

x-octave
Scientific Programming Language.

x-topcat
Tool for OPerations on Catalogues And Tables

x-xmm-sas
XMM SAS for X11 - Interactive

https://datalabs-dev.situk8spro.ebe.lan/datavol-manager

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Data Volumes

+ ADD CUSTOM

https://datalabs-dev.situk8spro.ebe.lan/datavol-settings/25d83be1091107b5

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Data Volume Settings

Name: CCF

Path in datalab: /media/data/ ccf

Data source URL: Please fill at least the "Connection type" and "Server" fields below

Connection type: nfs

Server: netapp6.evsp.lan

Port:

Path: /xmm_sas_ccf

UPDATE | CANCEL

Filter files by name

/ my_workspace /

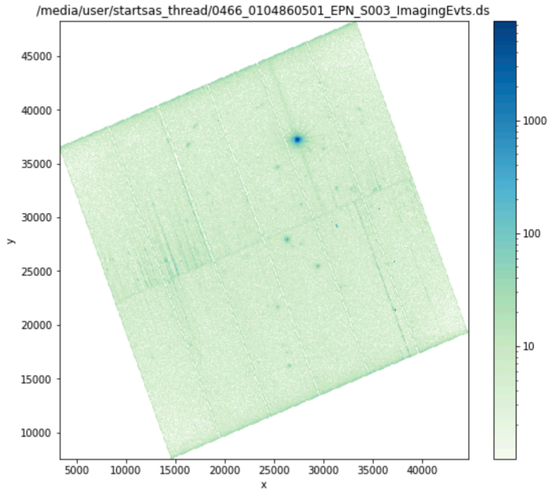
Name	Last Modified
data	9 days ago
work_0104860501	29 minutes ago
epic-bkgfiltering_singleevt.ipynb	a day ago
epic-reprocessing.ipynb	a day ago
notebooks	9 days ago
sas-startup.ipynb	a day ago
sas20_test_27_04_2022.ipynb	8 days ago
startsas.log	3 days ago

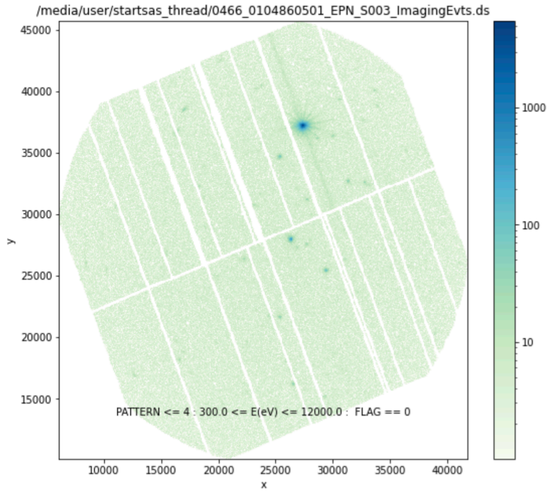
Terminal 1 | sas-startup.ipynb | epic-reprocessing.ipynb | epic-bkgfiltering_singleevt

Markdown | git | Python 3 (ipykernel)

```
plt.title(eventfile)
plt.xlabel('x')
plt.ylabel('y')

txt=("PATTERN <= " + str(pn_pattern) +
     " : " + str(pn_pi_min) + " <= E(eV) <= " + str(pn_pi_max) +
     " : " + " FLAG == " + str(pn_flag))
plt.text(xmid, ymin+0.1*(ymax-ymin), txt, ha='center')

pl=pl+1

hdu_list.close()
```

```
Events in event file /media/user/startsas_thread/0466_0104860501_EPN_S003_ImagingEvts.ds: 1122116

Events in filtered event file /media/user/startsas_thread/0466_0104860501_EPN_S003_ImagingEvts.ds: 580415

   Filter: PATTERN <= 4 : 300.0 <= E(eV) <= 12000.0 :  FLAG == 0
```





- Extract a single event (i.e. pattern zero only), high energy light curve, to identify intervals of flaring particle background.
  - Notice how the EPIC-pn energy range selected for producing the background light curve includes events only up to 12 keV. The reason for this is to avoid *hot pixels* being miss-identified as very high energy events (for EPIC-MOS the cut can include events with energies up to 20 keV).
  - The value for the threshold in rate will be different for each data set (for EPIC-MOS a value of 0.35 cts/sec). The value given here represents a good reference value for a standard observation.
- One can look at the produced background light curve by running the next blocks. The next blocks also show how to use more complex filtering expressions by using the SAS task `evselect`.

[16]:
```
# Function to plot Lightcurve from event file
def plotLC(plt,threshold,fileName):
        if fileName != "NOT FOUND":
            fitsFile = fits.open(fileName)
            prihdu   = fitsFile[1].header
            if ('CUTVAL' in prihdu):
                threshold = prihdu['CUTVAL']
```

DEMO

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Conclusions

- SAS can be used interactively through Jupyter Labs.
  Plot/image display done through `matplotlib`.
- X11 GUI interface is useful when interaction between GUIs is required (e.g. `ds9` & `xmmselect`).
- All processing is performed on the SAS Docker container.
- XSA data (ODF & PPS) download through Python `astroquery`.
- User can upload and use any Python or shell script.

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Some ideas

- Foster training on SAS by making available Python Threads.
- Foster remote collaboration.
- Foster collaboration among SAS developers.
- Help SAS Validation before release.