

SAS in ESA Datalabs

Demo

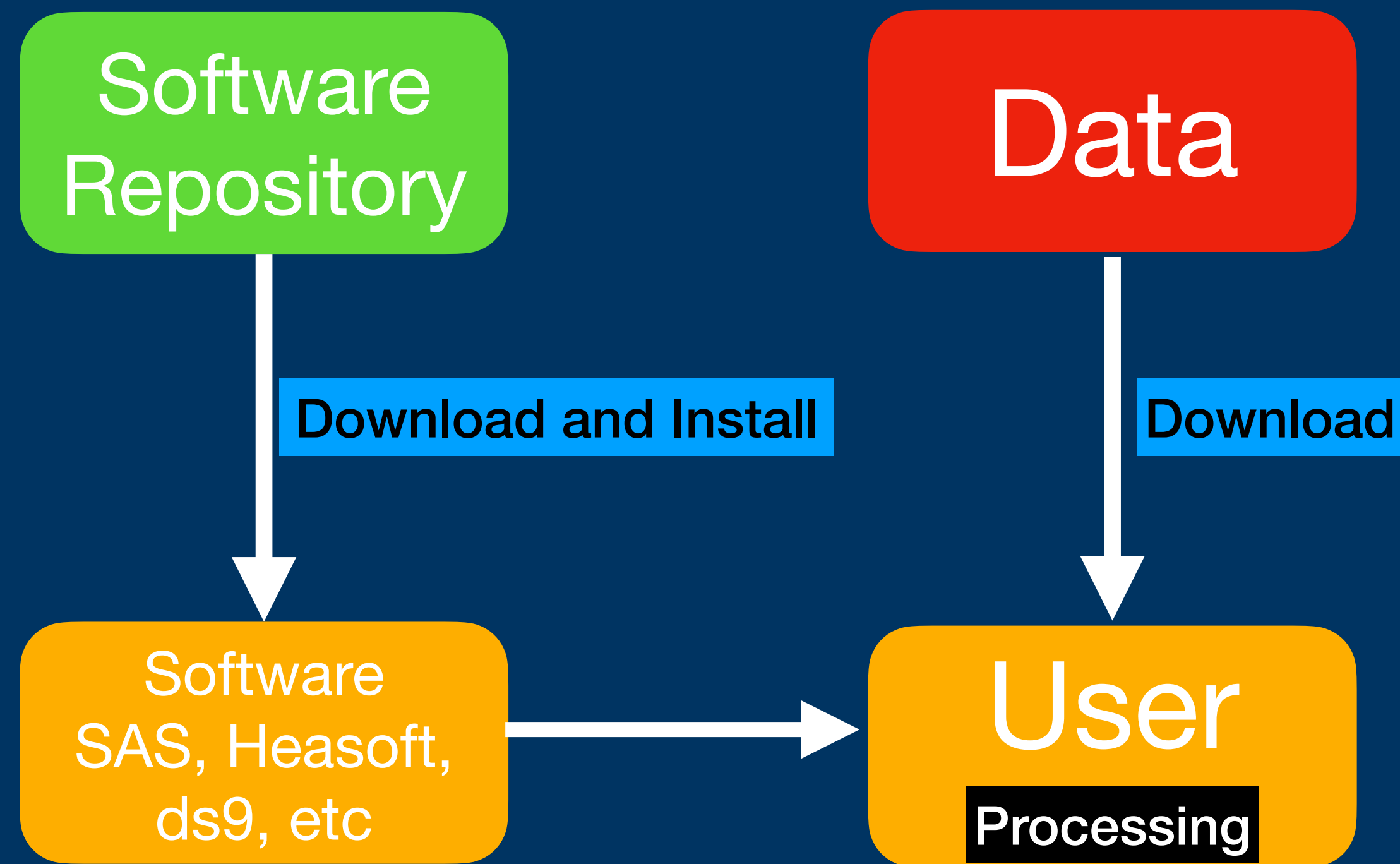
Eduardo Ojero, UG Meeting #23, 16-17 May 2022

SAS in ESA Datalabs - Demo

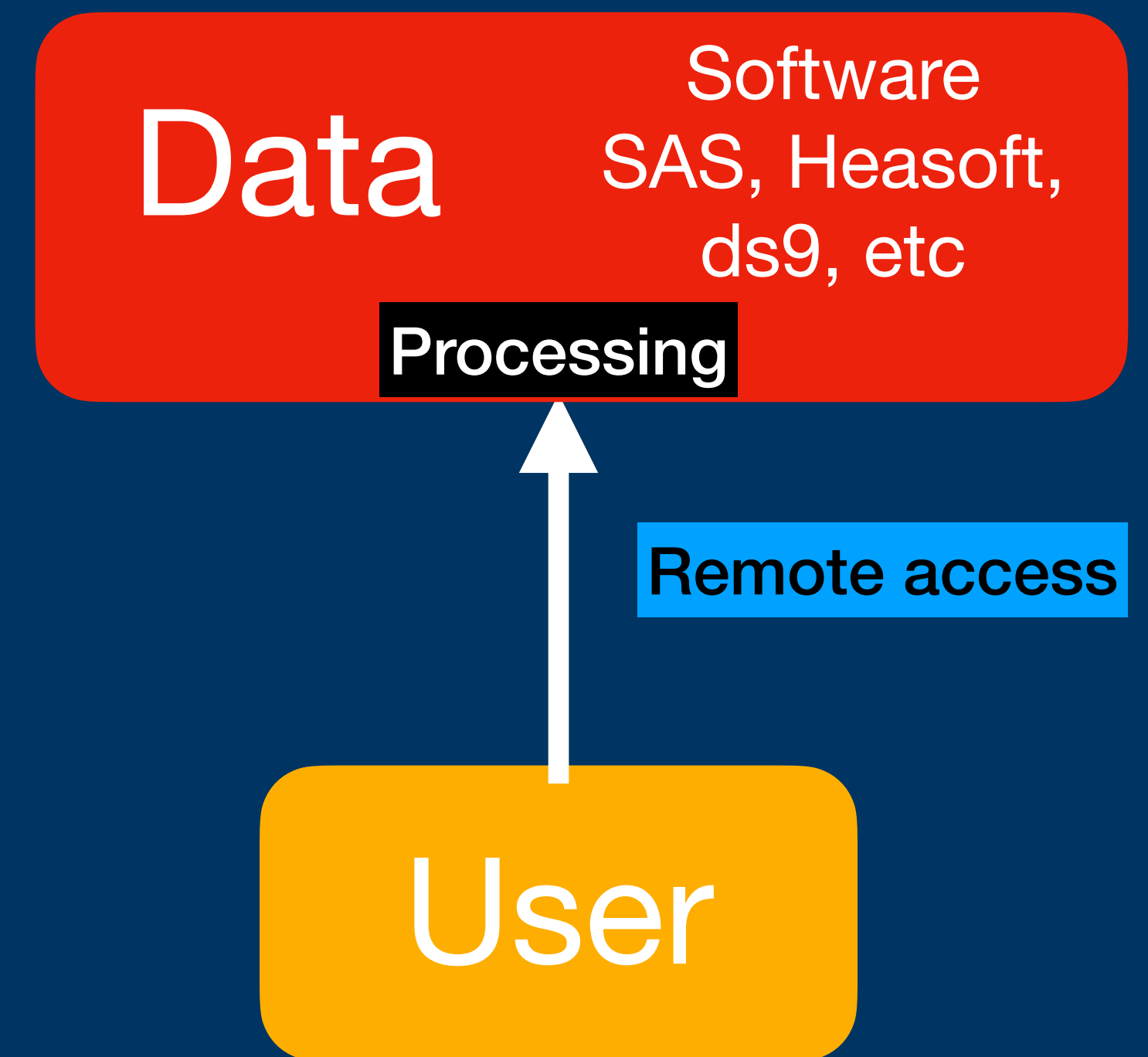
What is the Demo about?

- 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)**.

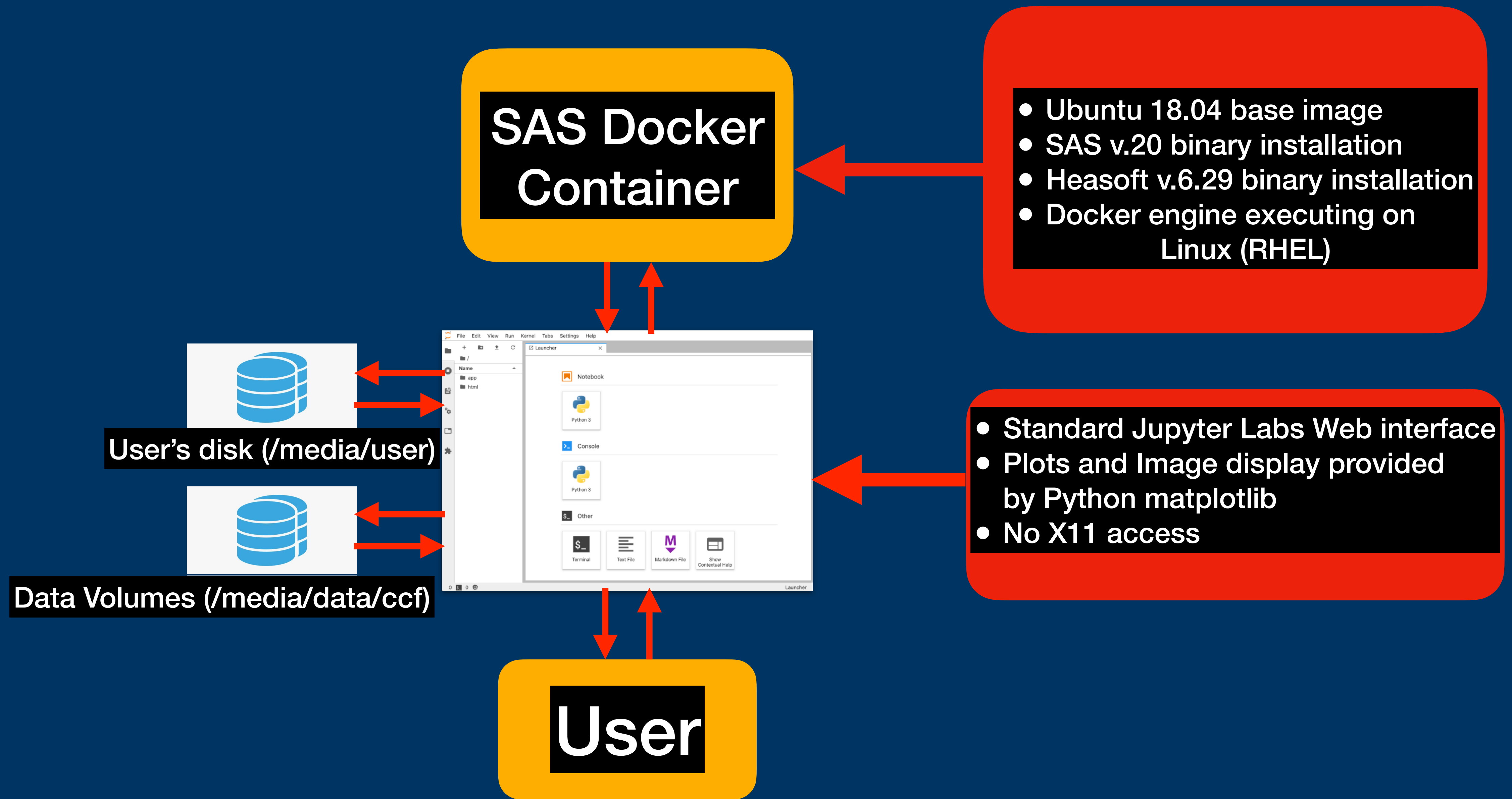
Standard Client-Server Model

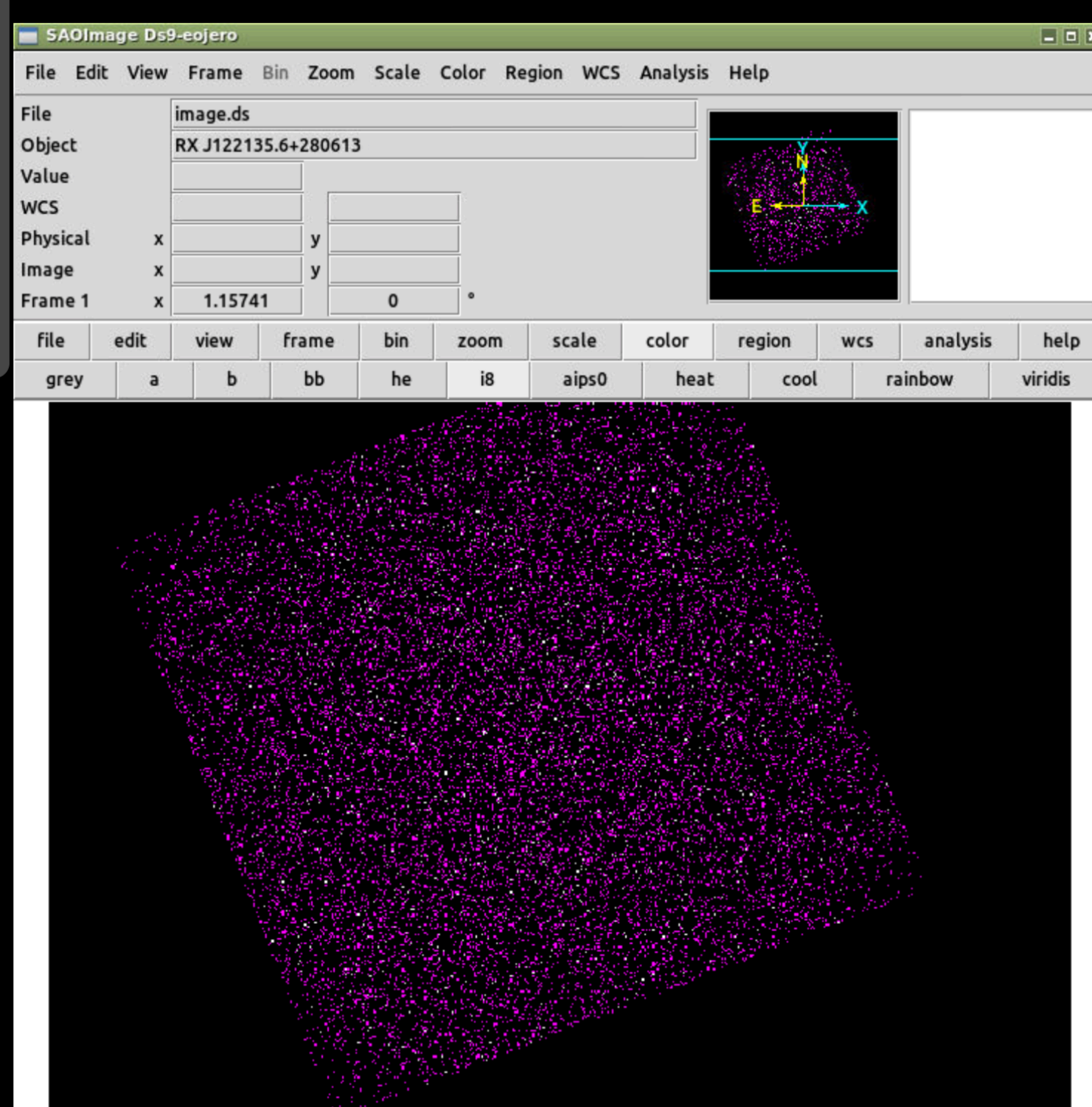
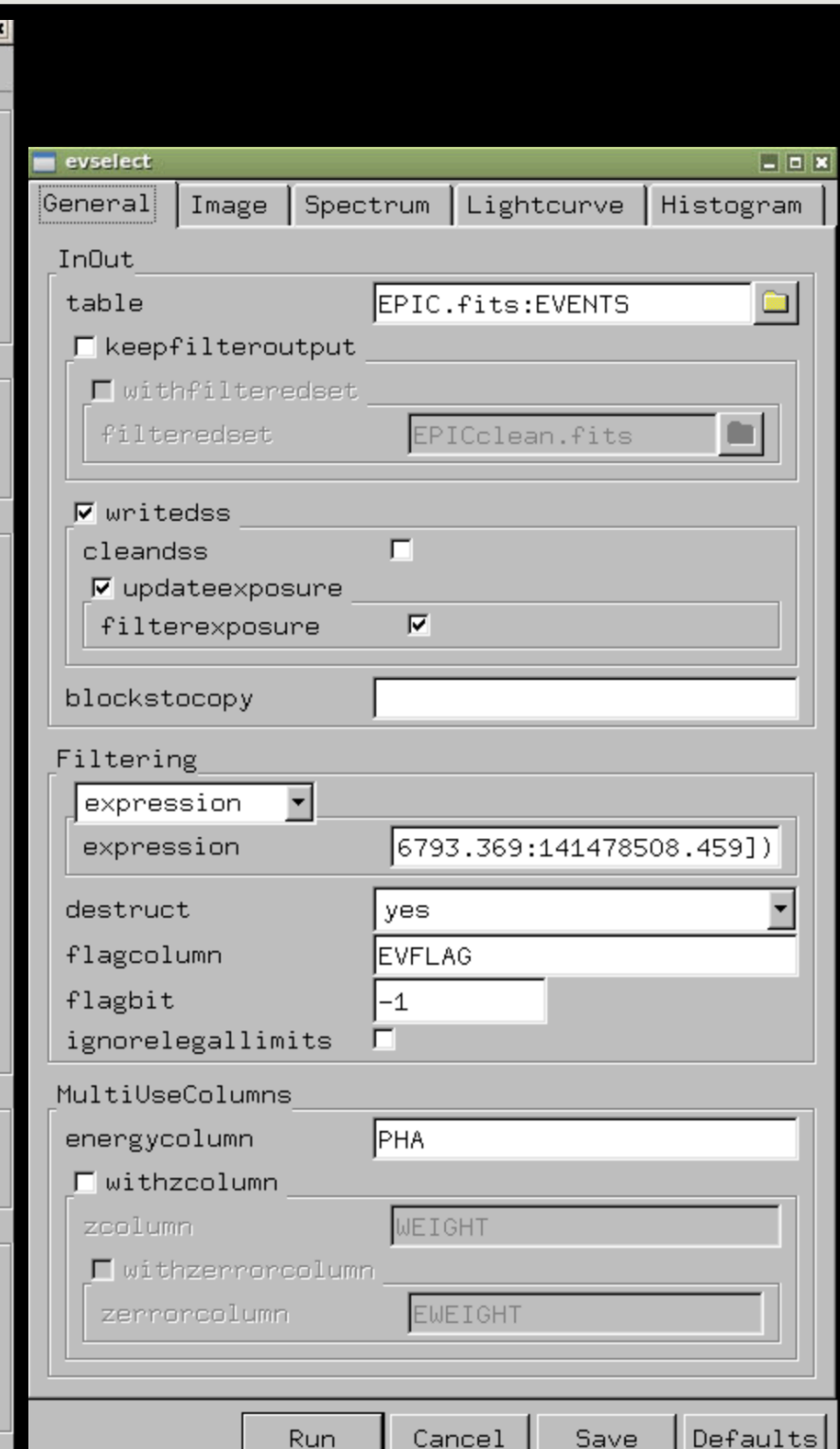
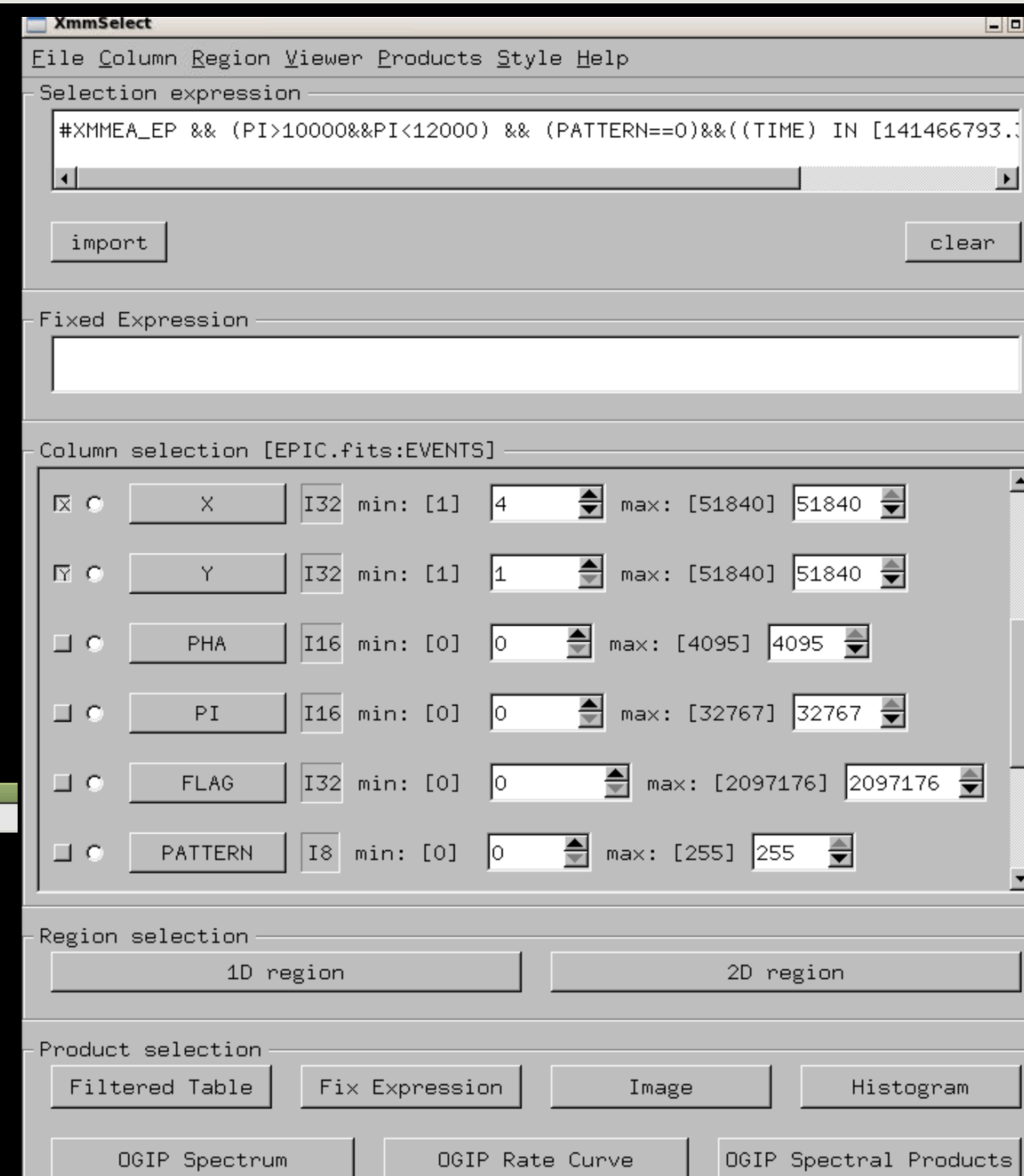
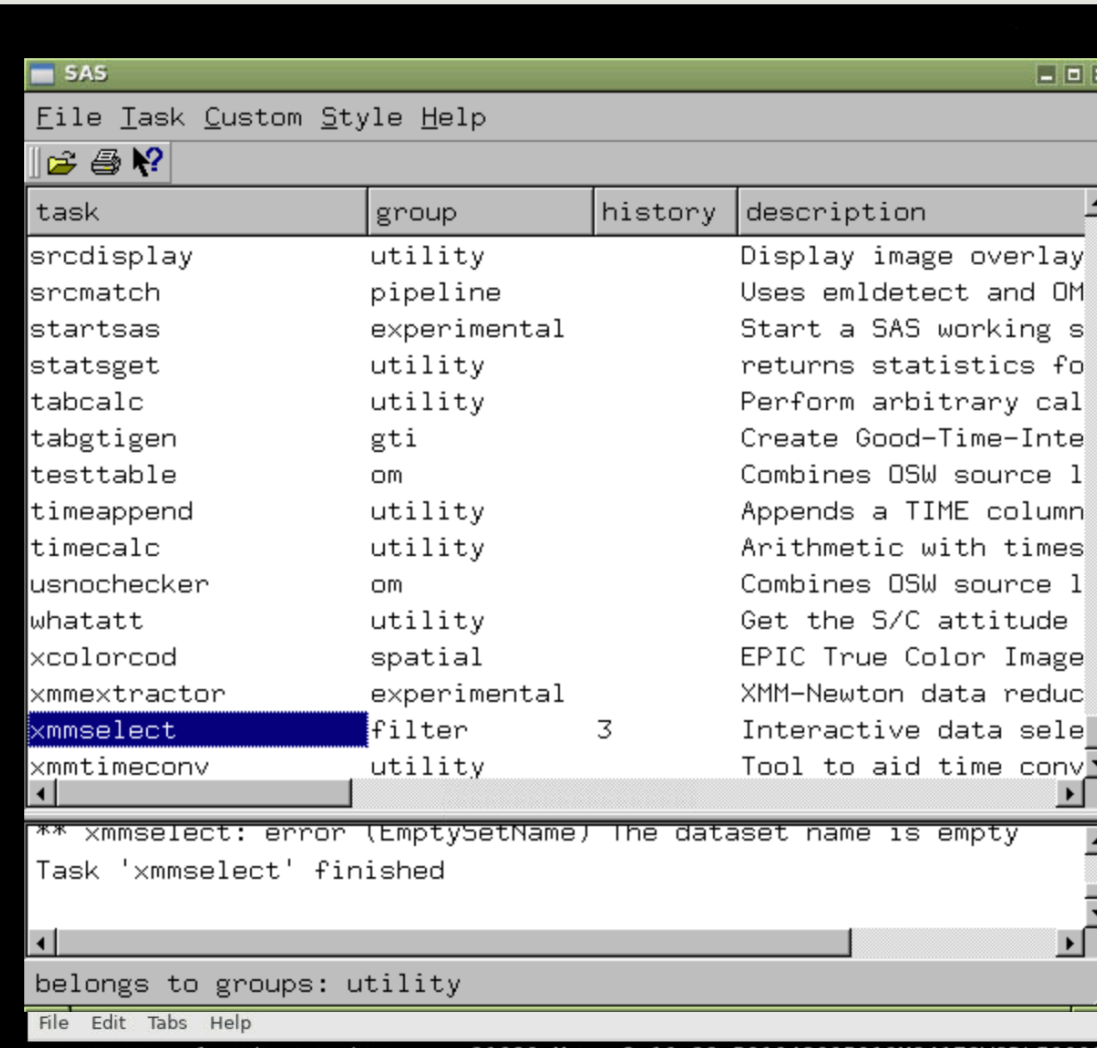
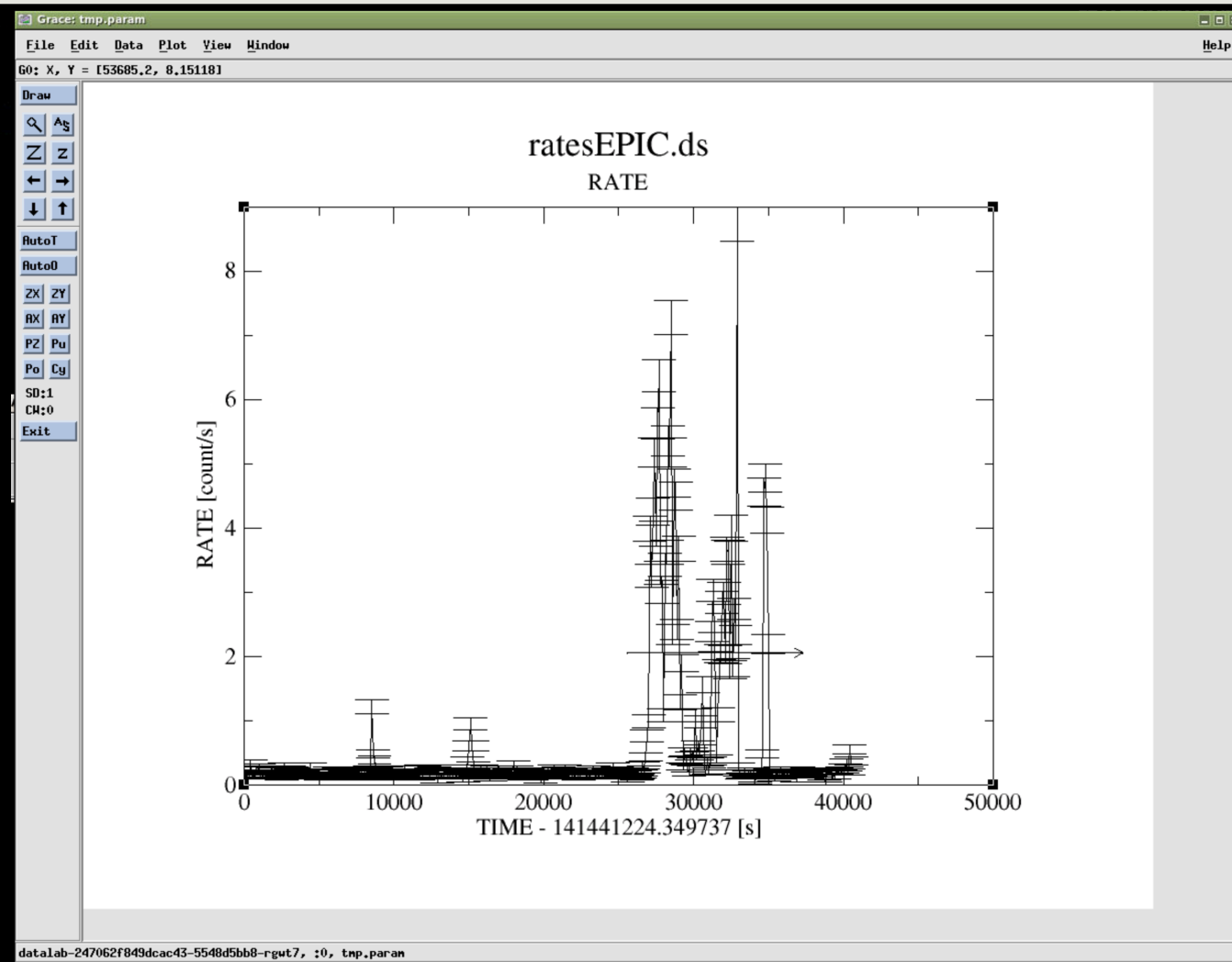


ESA Datalabs Model



Jupyter Labs Interactive Access (main)





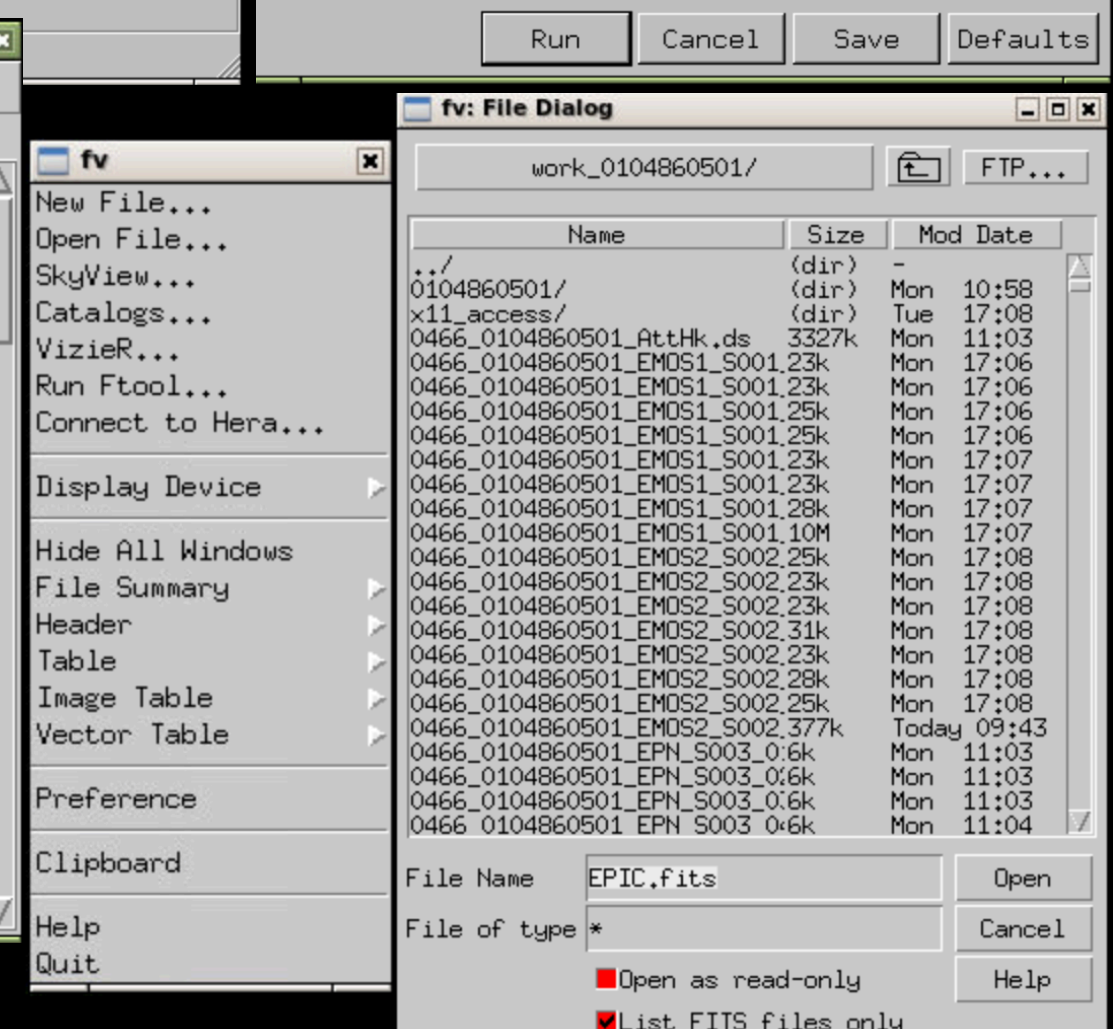
```

1 ejoero ejoero 37440 May 2 16:38 P01048605010MS417WSRLI10000.FIT
-rw-rw-r-- 1 ejoero ejoero 31680 May 2 16:38 P01048605010MS418WSRLI0000.FIT
-rw-rw-r-- 1 ejoero ejoero 34560 May 2 16:38 P01048605010MS418WSRLI10000.FIT
-rw-rw-r-- 1 ejoero ejoero 31680 May 2 16:38 P01048605010MS419WSRLI0000.FIT
-rw-rw-r-- 1 ejoero ejoero 37440 May 2 16:38 P01048605010MS419WSRLI10000.FIT
-rw-rw-r-- 1 ejoero ejoero 31680 May 2 16:38 P01048605010MS420WSRLI0000.FIT
-rw-rw-r-- 1 ejoero ejoero 37440 May 2 16:38 P01048605010MS420WSRLI10000.FIT
-rw-rw-r-- 1 ejoero ejoero 31680 May 2 16:38 P01048605010MS421WSRLI0000.FIT
-rw-rw-r-- 1 ejoero ejoero 34560 May 2 16:38 P01048605010MS421WSRLI10000.FIT
-rw-rw-r-- 1 ejoero ejoero 31680 May 2 16:38 P01048605010MS422WSRLI0000.FIT
-rw-rw-r-- 1 ejoero ejoero 34560 May 2 16:38 P01048605010MS422WSRLI10000.FIT
-rw-rw-r-- 1 ejoero ejoero 31680 May 2 16:38 P01048605010MS423WSRLI0000.FIT
-rw-rw-r-- 1 ejoero ejoero 37440 May 2 16:38 P01048605010MS423WSRLI10000.FIT
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-rw-rw-r-- 1 ejoero ejoero 37440 May 2 16:38 P01048605010MS424WSRLI10000.FIT
-rw-rw-r-- 1 ejoero ejoero 41611 May 2 16:38 P01048605010MCOMB08BSML10000.reg
-rw-rw-r-- 1 ejoero ejoero 155520 May 2 16:38 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 1078811 May 2 16:38 P01048605010MCOMB08BSML10000.FIT
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-rw-rw-r-- 1 ejoero ejoero 17553600 May 2 16:40 P01048605010MCOMB08BSML10000.FIT
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-rw-rw-r-- 1 ejoero ejoero 17553600 May 2 16:43 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 63360 May 2 16:43 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 48960 May 2 16:43 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 72000 May 2 16:43 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 216000 May 2 16:43 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 233280 May 2 16:43 P01048605010MCOMB08BSML10000.FIT
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-rw-rw-r-- 1 ejoero ejoero 23040 May 2 17:06 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 23040 May 2 17:06 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 25920 May 2 17:06 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 25920 May 2 17:06 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 23040 May 2 17:07 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 23040 May 2 17:07 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 28800 May 2 17:07 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 9987840 May 2 17:07 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 25920 May 2 17:08 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 23040 May 2 17:08 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 23040 May 2 17:08 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 31680 May 2 17:08 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 23040 May 2 17:08 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 28800 May 2 17:08 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 25920 May 2 17:08 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 4096 May 3 17:08 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 385920 May 5 09:43 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 135714240 May 5 09:52 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 6078 May 5 09:53 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 305280 May 5 10:12 P01048605010MCOMB08BSML10000.FIT
-rw-rw-r-- 1 ejoero ejoero 29617920 May 5 10:20 P01048605010MCOMB08BSML10000.FIT
(base) ejoero@datalab-247062f849dcac43-5548d5bb8-rgwt7:/media/user/work_01048605015 fvs
[4] 261
(base) ejoero@datalab-247062f849dcac43-5548d5bb8-rgwt7:/media/user/work_01048605015 fvs

```


fv: Summary of EPIC.fits in /media/user/work_0104860501/

Index	Extension	Type	Dimension	View				
0	Primary	Image	0	Header	Image		Table	
1	EVENTS	Binary	15 cols X 1122303 rows	Header	Hist	Plot	All	Select
2	OFFSETS	Binary	3 cols X 14 rows	Header	Hist	Plot	All	Select
3	EXPOSU01	Binary	2 cols X 551635 rows	Header	Hist	Plot	All	Select
4	BADPIX01	Binary	5 cols X 72 rows	Header	Hist	Plot	All	Select
5	DLIMAP01	Binary	3 cols X 200 rows	Header	Hist	Plot	All	Select
6	HKAUX01	Binary	2 cols X 27546 rows	Header	Hist	Plot	All	Select
7	EXPOSU02	Binary	2 cols X 551635 rows	Header	Hist	Plot	All	Select
8	BADPIX02	Binary	5 cols X 68 rows	Header	Hist	Plot	All	Select
9	DLIMAP02	Binary	3 cols X 200 rows	Header	Hist	Plot	All	Select
10	HKAUX02	Binary	2 cols X 27546 rows	Header	Hist	Plot	All	Select
11	EXPOSU03	Binary	2 cols X 551630 rows	Header	Hist	Plot	All	Select
12	BADPIX03	Binary	5 cols X 64 rows	Header	Hist	Plot	All	Select
13	DLIMAP03	Binary	3 cols X 200 rows	Header	Hist	Plot	All	Select




Datalabs


+ LAUNCH NEW DATALAB



SAS20-JL


jl-xmm-sas

 DELETE



SAS20-X11























x-xmm-sas

 DELETE

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 <i>Simbad database</i> , the <i>VizieR</i> service and other archives for all known astronomical objects in the field.	 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			

Data Volumes

+ ADD CUSTOM


nfs

CCF

/media/data/ccf

nfs://netapp6.evsp.lan/xmm_sas_ccf

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

←→↺🏠

Most VisitedGetting StartedAppleYahoo!Google MapsYouTubeWikipediaNewsPopularExact Synergy Enter...

FileEditViewRunKernelGitTabsSettingsHelp

+📁⬆️↺🔍

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 1sas-startup.ipynbepic-reprocessing.ipynbepic-bkgfiltering_singleevt

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

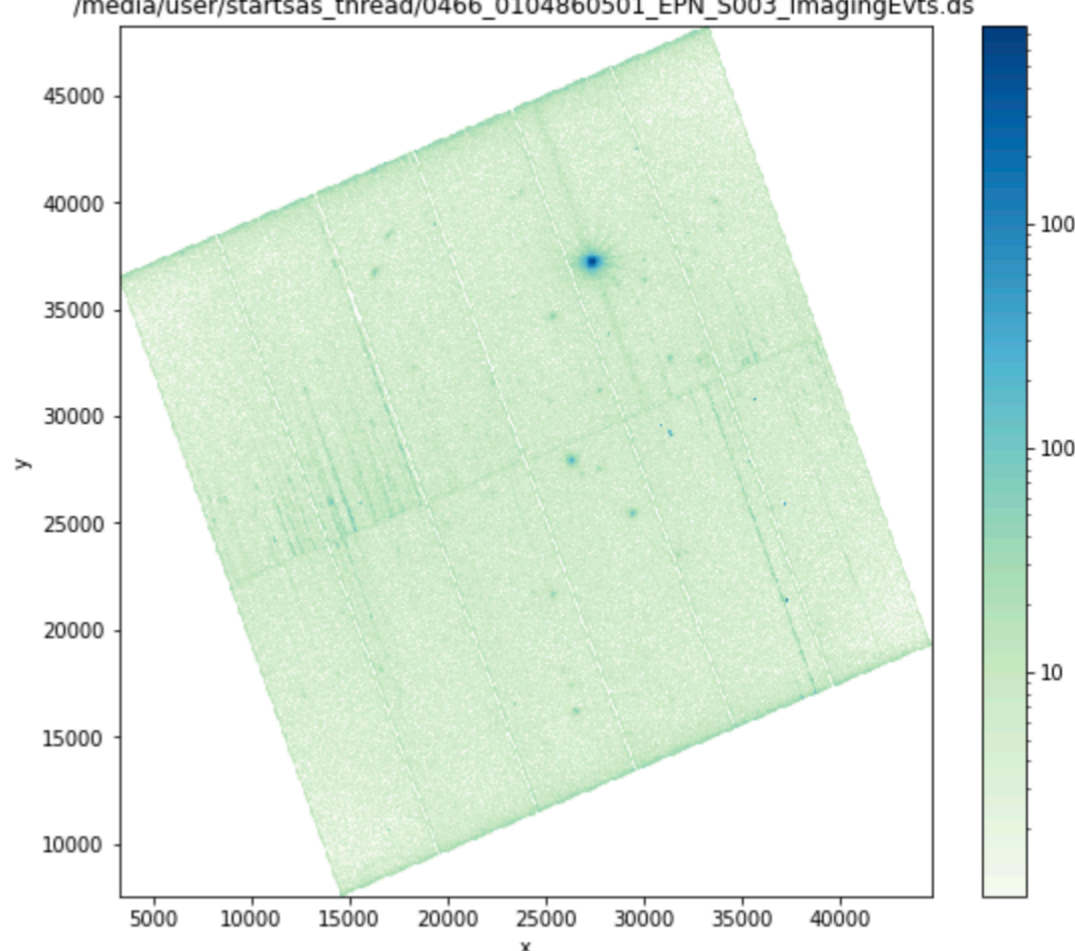
hdu_list.close()
```

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

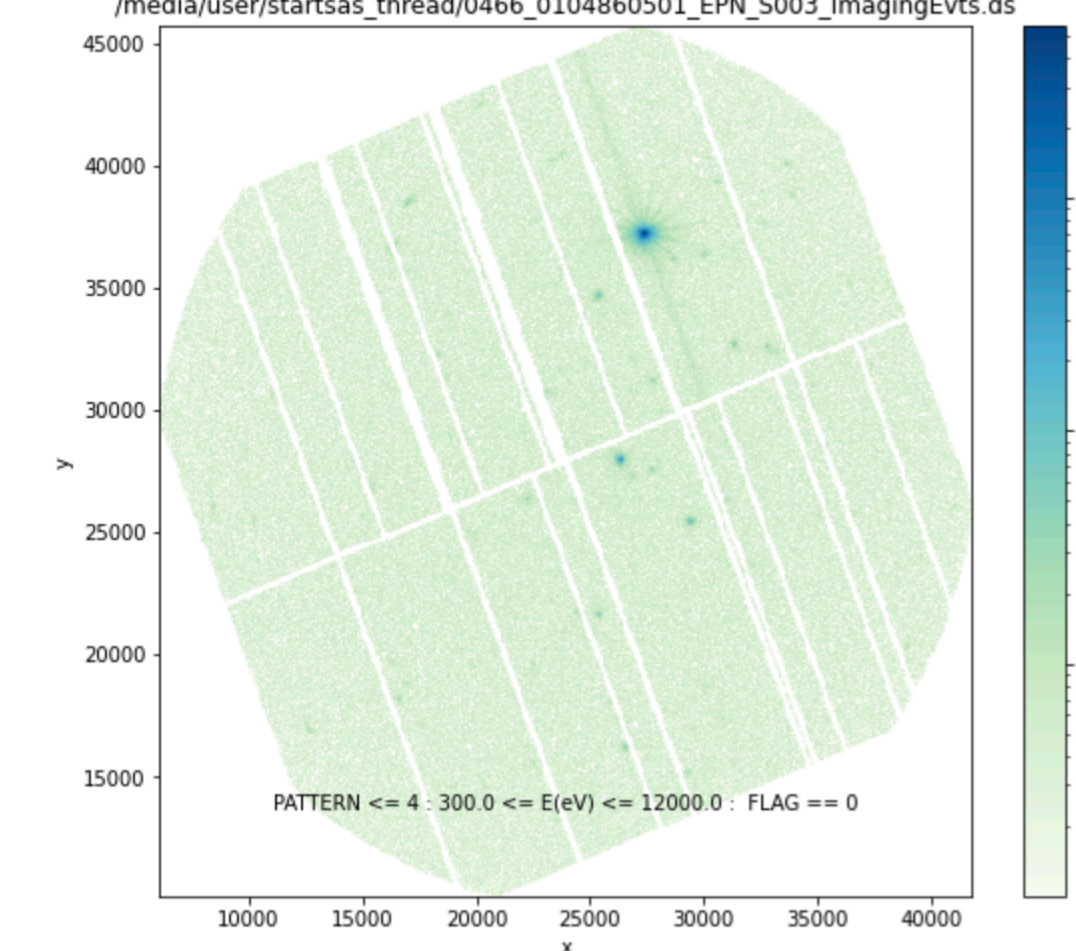
Events in filtered event file /media/user/startsas_thread/0466_0104860501_EPN_S003_ImagingEvts.ds: 580415

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

/media/user/startsas_thread/0466_0104860501_EPN_S003_ImagingEvts.ds



/media/user/startsas_thread/0466_0104860501_EPN_S003_ImagingEvts.ds



- 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']

    cols = fitsFile[1].columns
```

Simple13Python 3 (ipykernel) | IdleMode: CommandLn 1, Col 1epic-bkgfiltering_singleevt.ipynb

DEMO

SAS in ESA Datalabs - Demo

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.

SAS in ESA Datalabs - Demo

Some ideas

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