

Instrument Pipelines

What are They and how to correctly use them

Faviola Molina





Outline

- What is a pipeline
- Self introduction & Quality Control
- Why do I need to learn how to run a pipeline?
- 4 ways to Run a Pipeline
- Scope of this talk: 1 way (EsoRex)
- Installing EsoRex
- dfitspy
- Running EsoRex for EFOSC2



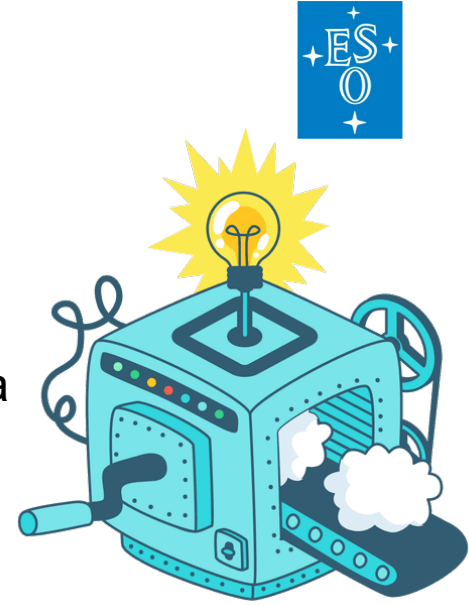
What are pipelines?

Pipelines

Software systems designed to automatically process and reduce raw data. Different modules check for errors and inconsistencies in the data. Others convert the data into a standardized format.

- Pipelines are used to produce master calibrations. They help to remove/reduce artifacts from the data, set references for bands/wavelengths dispersion solutions, etc.
- Pipelines are use to produce the quantitative information necessary to monitor instrument performance.
- Science product creation for supported instrument modes.

[disclaimer: adopted reduction strategies may not be suitable for all scientific goals]

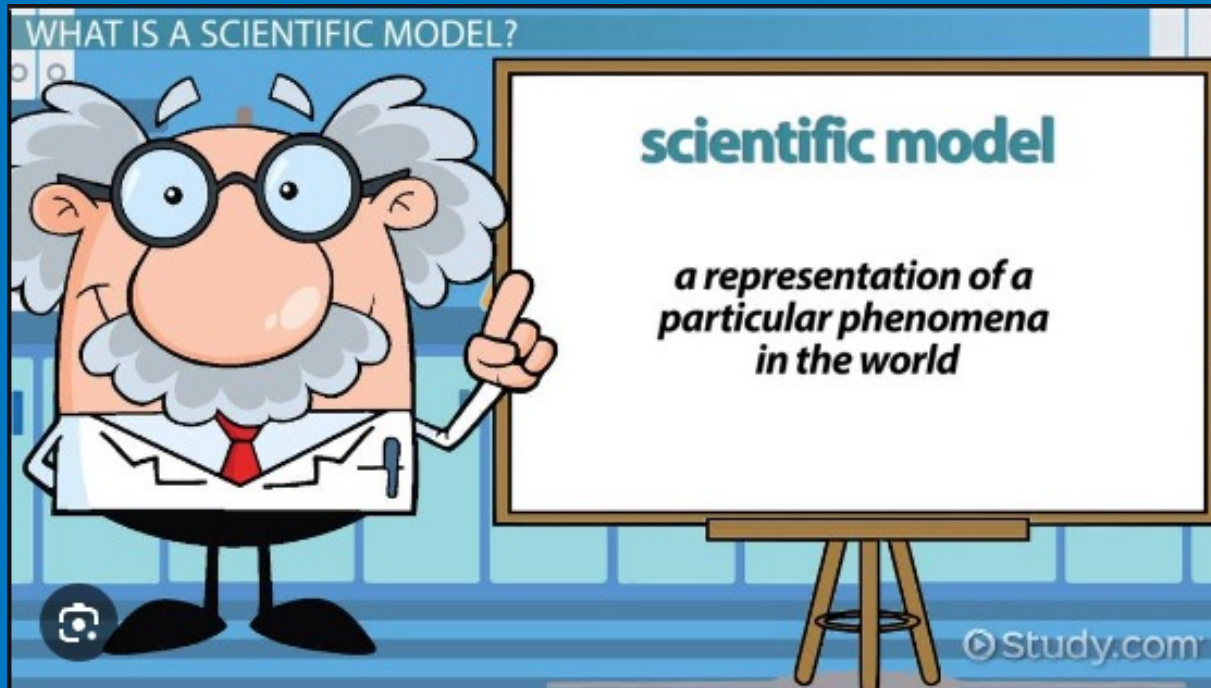




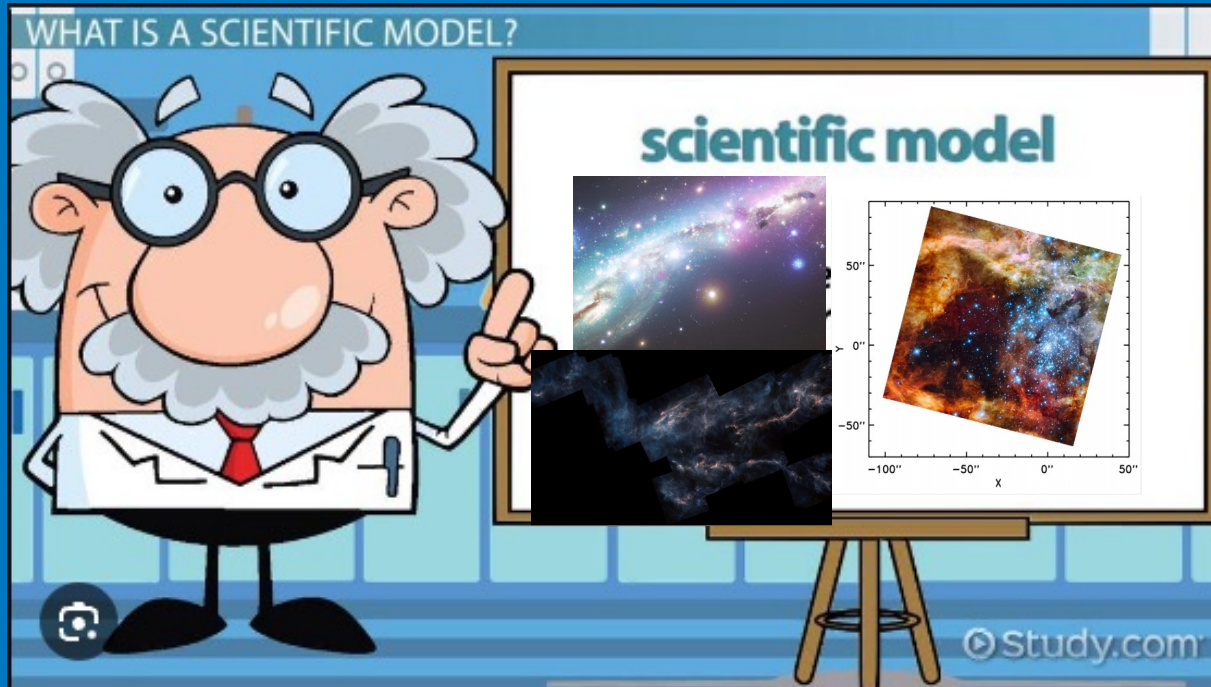
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Me... Faviola Molina, astrophysicist



Me... Faviola Molina, astrophysicist



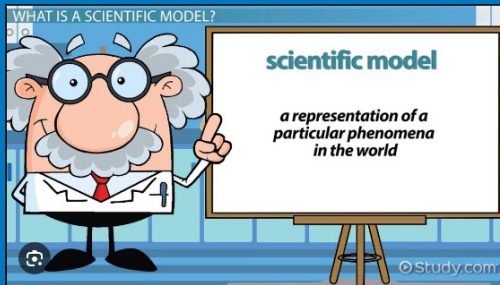
Bachelor

M.Sc.

Ph.D.

Me... Faviola Molina, astrophysicist

Bachelor



M.Sc.



Faviola Molina, Data & Quality Control Specialist



Performance monitoring: verify and certify that all calibration data are processed by the ESO pipeline to produce data products

Quality Control



MUSE product quality monitor (date: 2024-02-11)

This is the product quality monitor, with an overview of the processing status of all processing jobs (ABs) and the quality of the products. These scores which are relevant for instrument health (marked 'HC') are propagated to the QC monitor. The other scores are related to pipeline processing and product quality. Click on the score report to see score details and other information for exploring data quality and trending. For standard DFOS operations, only calibrations are processed, no science data.

Last update: 2024-02-13 15:12:53 (UTC); machine: muse99 browser_refresh: on (every 60 sec) [View](#) | [Log](#) | [Help](#)

Number of ABs (all) | Success | Failed (created): 18 | 18 | 0 | 0 | scored: 14; result: 0/2416

BQS AB NAME	INDEX	COMPL.	AB LOG RECIPE	RAW_TYPE	SETUP	AB STATUS	P LOG T_EXEC
MUSE_2024-02-13_151253_181818	CAL001	complt	muse_scbasic	STD	WFM-NOAO-N_Blue_SCH1.0	OK	3.3+11.1
MUSE_2024-02-13_151253_181818	CAL002	complt	muse_scbasic	STD	WFM-NOAO-E_Clear_SCH1.0	OK	3.0+9.9
MUSE_2024-02-13_151253_181818	CAL003	complt	muse_scbasic	STD	WFM-NOAO-E_Clear_SCH1.0	OK	3.1+11.0
MUSE_2024-02-13_151253_181818	CAL004	complt	muse_scbasic	STD	WFM-NOAO-E_Clear_SCH1.0	OK	3.2+9.8
MUSE_2024-02-13_151253_181818	CAL005	complt	muse_scbasic	STD	WFM-NOAO-E_Clear_SCH1.0	OK	3.4+8.8
MUSE_2024-02-13_151253_181818	CAL006	complt	muse_scbasic	STD	WFM-NOAO-E_Clear_SCH1.0	OK	3.4+7.8
MUSE_2024-02-13_151253_181818	CAL007	complt	muse_bias	STD	WFM-NOAO-N_Blue_SCH1.0	OK	3.5+7.8
MUSE_2024-02-13_151253_181818	CAL008	complt	muse_flat	AMP_FLAT	WFM-NOAO-N_Blue_SCH1.0	OK	3.6+3.7
MUSE_2024-02-13_151253_181818	CAL009	complt	muse_flat	AMP_FLAT	WFM-NOAO-N_Blue_SCH1.0	OK	3.7+2.2
MUSE_2024-02-13_151253_181818	CAL010	complt	muse_flat	AMP_FLAT	WFM-NOAO-N_Blue_SCH1.0	OK	3.8+1.8
MUSE_2024-02-13_151253_181818	CAL011	complt	muse_flat	AMP_FLAT	WFM-NOAO-N_Blue_SCH1.0	OK	3.9+1.4
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MUSE_2024-02-13_151253_181818	CAL015	complt	muse_flat	AMP_FLAT	WFM-NOAO-N_Blue_SCH1.0	OK	4.3+0.2
MUSE_2024-02-13_151253_181818	CAL016	complt	muse_flat	AMP_FLAT	WFM-NOAO-N_Blue_SCH1.0	OK	4.4+0.2
MUSE_2024-02-13_151253_181818	CAL017	complt	muse_flat	AMP_FLAT	WFM-NOAO-N_Blue_SCH1.0	OK	4.5+0.2
MUSE_2024-02-13_151253_181818	CAL018	complt	muse_flat	AMP_FLAT	WFM-NOAO-N_Blue_SCH1.0	OK	4.6+0.2
MUSE_2024-02-13_151253_181818	CAL019	complt	muse_flat	AMP_FLAT	WFM-NOAO-N_Blue_SCH1.0	OK	4.7+0.2
MUSE_2024-02-13_151253_181818	CAL020	complt	muse_flat	AMP_FLAT	WFM-NOAO-N_Blue_SCH1.0	OK	4.8+0.2

QC MONITOR / ESPRESSO | 2024-02-11

Filter jobs: All

Status	Job	Observation Time	Submission Time	Task	Category	Setup	QC Reports	Score	Certification	Comment
CERTIFIED		2024-02-12 09:56:29.406	2024-02-12 10:09:28.351	BIAS	ORDERDEF_A	1, 1, SINGLEHR	6	0/8	Uncertify Reject	
CERTIFIED		2024-02-12 10:04:26.143	2024-02-12 10:09:28.497	FLAT	ORDERDEF_A	1, 1, SINGLEHR	8	0/10	Uncertify Reject	
CERTIFIED		2024-02-12 10:13:25.172	2024-02-12 10:30:38.906	ORDERDEF	ORDERDEF	1, 1, SINGLEHR	8	0/4	Uncertify Reject	
CERTIFIED		2024-02-12 10:22:24.333	2024-02-12 10:30:39.125	BIAS	ORDERDEF	1, 1, SINGLEHR	8	0/8	Uncertify Reject	
CERTIFIED		2024-02-12 10:28:41.101	2024-02-12 10:41:12.669	BIAS	ORDERDEF	1, 1, SINGLEHR	8	0/8	Uncertify Reject	
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CERTIFIED		2024-02-12 11:00:05.797	2024-02-12 11:02:23.517	BIAS	ORDERDEF	1, 1, SINGLEHR	8	0/8	Uncertify Reject	
CERTIFIED		2024-02-12 11:05:02.822	2024-02-12 11:12:57.978	BIAS	ORDERDEF	1, 1, SINGLEHR	8	0/8	Uncertify Reject	
CERTIFIED		2024-02-12 11:09:24.181	2024-02-12 11:12:58.050	ORDERDEF	ORDERDEF	1, 1, SINGLEHR	8	0/8	Uncertify Reject	

HC MONITOR / ESPRESSO

From 2023-11-15 to 2024-02-13 [Reset](#)

FP Counts **0/0** | FP Lines **0/12** | ThAr Lines **0/24**

- > Detector **0/64** [0/2](#)
- Format Check **2/46**
 - Distortion **2/40**
 - Orders **0/6**
 - Alignment **0/0**
- Flat **0/24**
 - Fibre **0/24**
- Wavelength **0/48** [0/3](#)
 - Fibre **0/48** [0/3](#)
- > On Sky **2/45**

#1

#4

Performance monitoring: verify and certify that all calibration pipeline to produce data products

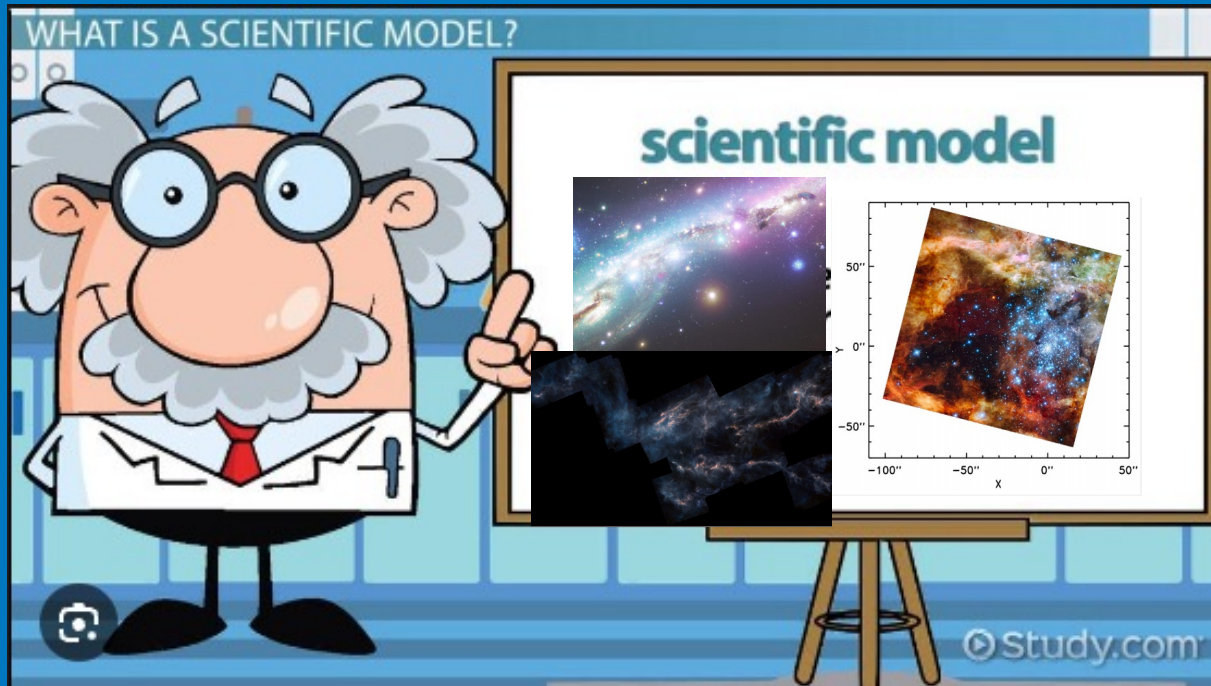
But:



- **Performance monitoring:** verify and certify that all calibration data are processed by the ESO pipeline to produce data products
- **You find something that seems “fishy” in your data**
 - It might be an indication that something in the instrument has changed
 - It might indicate that the pipeline has a bug
 - It might be a new discovery!
- You are willing to learn how a pipeline works!
- **[disclaimer: adopted reduction strategies may not be suitable for all scientific goals]**



Me... Faviola Molina, astrophysicist



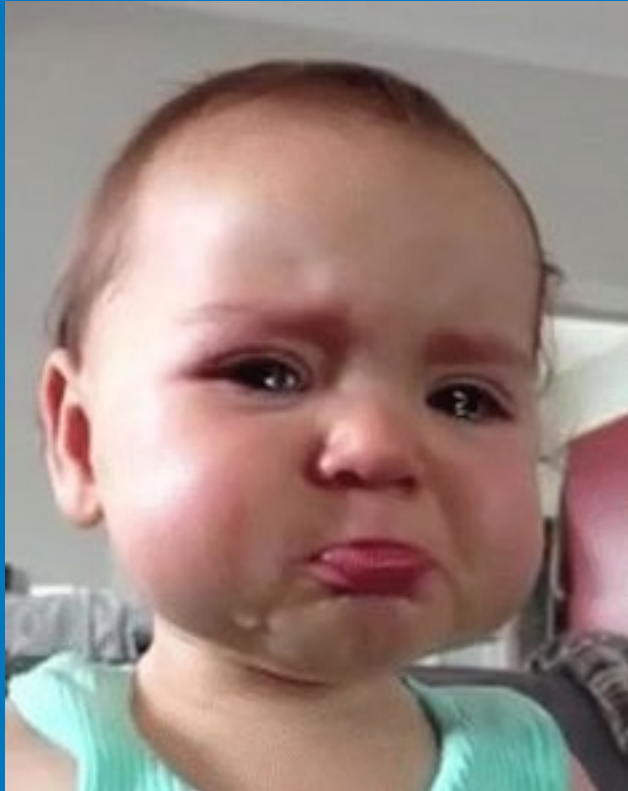
Bachelor

M.Sc.

Ph.D.



Me... Every time I heard the word pipeline



Me...

QC MONITOR / ESPRESSO / < 2024-02-11 > Dr. Molina [Sign out](#)

Filter jobs: [Comment](#) [Autoquery](#) [Comm.](#) [Cascad.](#) [Refresh](#)

Status	Job	Observation Time	Submission Time	Task	Category	Setup	QC Reports	Score	Certification	Comment	Archiving	EDPS
CERTIFIED		2024-02-12 09:56:28.650	2024-02-12 10:09:23.361	BIAS	BIAS	1, 1, SINGLEHR	0	000	Uncertainty Reject		✓	📄
CERTIFIED		2024-02-12 10:04:26.143	2024-02-12 10:09:26.497	ORDERDEF	ORDERDEF_A	1, 1, SINGLEHR	0	000	Uncertainty Reject		✓	📄
CERTIFIED		2024-02-12 10:13:25.172	2024-02-12 10:30:38.906	FLAT	FLAT_A	1, 1, SINGLEHR	0	000	Uncertainty Reject		✓	📄
CERTIFIED		2024-02-12 10:22:24.333	2024-02-12 10:30:39.125	ORDERDEF	ORDERDEF_A	1, 1, SINGLEHR	0	000	Uncertainty Reject		✓	📄
CERTIFIED		2024-02-12 10:28:41.101	2024-02-12 10:41:12.669	BIAS	BIAS	2, 1, SINGLEHR	0	000	Uncertainty Reject		✓	📄
CERTIFIED		2024-02-12 10:28:29.853	2024-02-12 10:41:12.209	ORDERDEF	ORDERDEF_A	2, 1, SINGLEHR	0	000	Uncertainty Reject		✓	📄
CERTIFIED		2024-02-12 10:47:45.867	2024-02-12 11:02:23.289	FLAT	FLAT_A	2, 1, SINGLEHR	0	000	Uncertainty Reject		✓	📄
CERTIFIED		2024-02-12 11:00:05.797	2024-02-12 11:02:23.517	ORDERDEF	ORDERDEF_A	2, 1, SINGLEHR	0	000	Uncertainty Reject		✓	📄
CERTIFIED		2024-02-12 11:05:02.822	2024-02-12 11:12:57.978	BIAS	BIAS	4, 2, SINGLEHR	0	000	Uncertainty Reject		✓	📄
CERTIFIED		2024-02-12 11:09:24.181	2024-02-12 11:12:58.050	ORDERDEF	ORDERDEF_A	4, 2, SINGLEHR	0	000	Uncertainty Reject	fiba_counts_max slightly below limit, best 9 points are remaining. PR-187267	✓	📄



“It would be good if you learn how to run the pipelines by yourself”
(anonymous astronomer)



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- dfitspy
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Me...



PIPELINES
PIPELINES
PIPELINES



There are 4
ways to run
from a
pipeline

Me...



PIPELINES
PIPELINES
PIPELINES



There are 4
ways to run
a pipeline

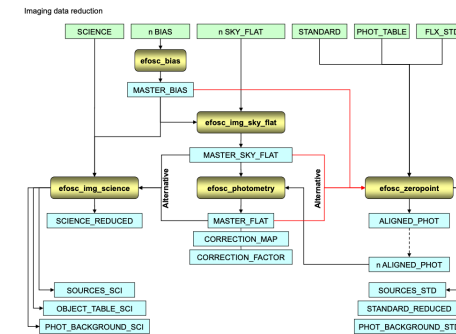


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4 ways to run a pipeline

- **EsoReflex**: a recommended environment. Automatically organizes input files according to their category and runs the entire chain at the push of a button
- **Gasgano**: used to manage and organize in a systematic way the astronomical data observed and produced by the instruments
- **EsoRex**: a command-line utility for running pipeline recipes
- **EDPS**: is the next generation ESO data processing environment, which will eventually replace EsoReflex





1 way: EsoRex

EsoRex: ESO Recipe Execution Tool, a command-line utility for running pipeline recipes. It allows the user to reduce each data type separately. Introducing the parameters specificities required to properly reduce the science case

Getting started:

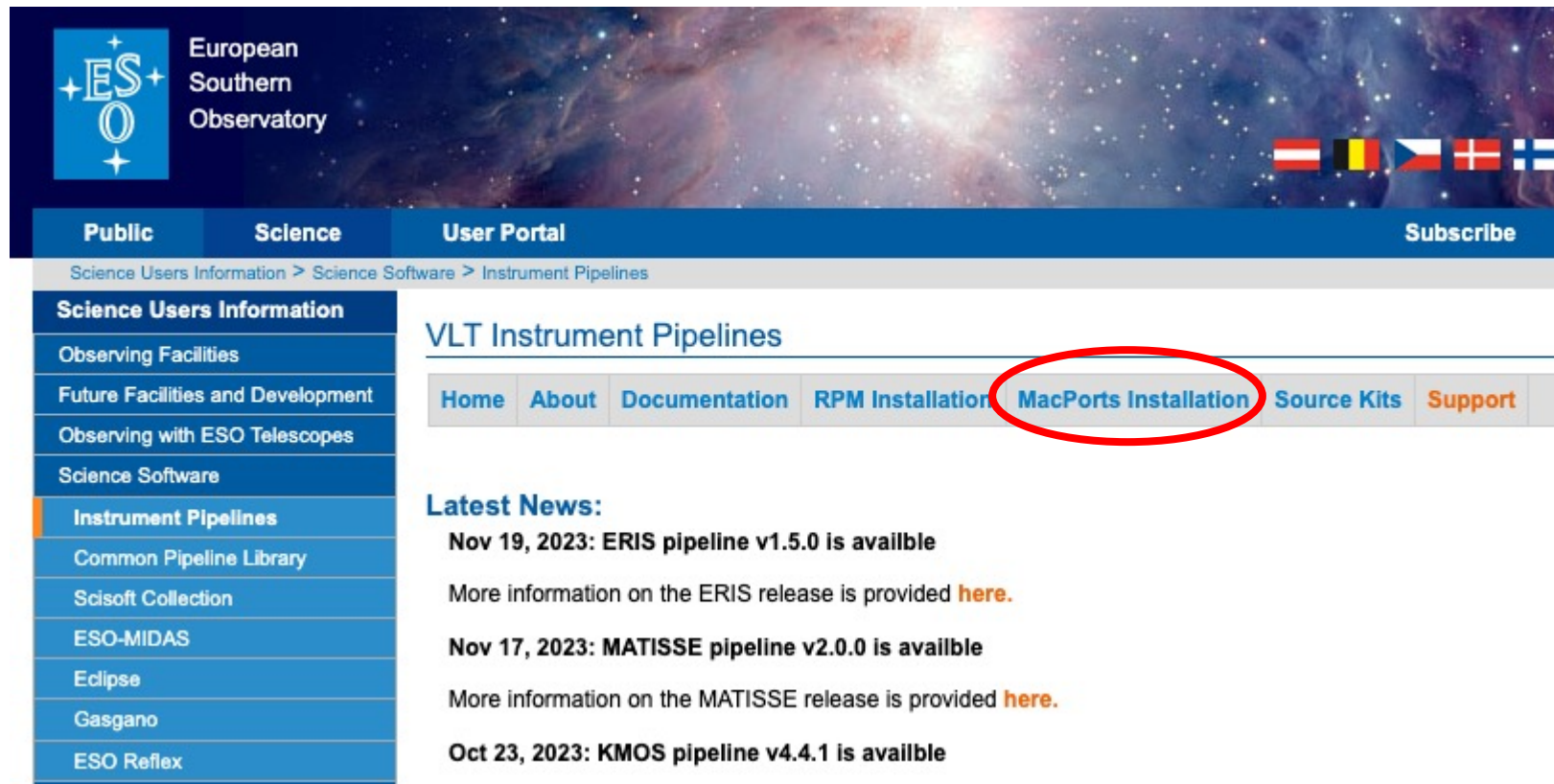
- Install the pipelines using RPM packages, MacPorts packages or Source Kits (I used MacPorts)
- Read pipeline's user manual dedicated to the instrument of your interest.
 - (I know, manuals might be boring to read... but it is the way and they are really helpful)

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Installing EsoRex

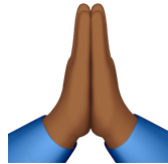
<https://www.eso.org/sci/software/pipelines/> -> RPM | MacPorts | Source Kits (installation)



The screenshot shows the ESO website's 'VLT Instrument Pipelines' page. The top navigation bar includes 'Public', 'Science', 'User Portal', and 'Subscribe'. Below this is a breadcrumb trail: 'Science Users Information > Science Software > Instrument Pipelines'. A left sidebar menu lists various categories, with 'Instrument Pipelines' highlighted. The main content area features a horizontal navigation bar with links: 'Home', 'About', 'Documentation', 'RPM Installation', 'MacPorts Installation' (circled in red), 'Source Kits', and 'Support'. Below this, a 'Latest News' section lists three updates: 'Nov 19, 2023: ERIS pipeline v1.5.0 is available', 'Nov 17, 2023: MATISSE pipeline v2.0.0 is available', and 'Oct 23, 2023: KMOS pipeline v4.4.1 is available'. Each news item includes a link to 'here' for more information.

Installing EsoRex

<https://www.eso.org/sci/software/pipelines/> -> RPM | MacPorts | Source Kits (installation)



Prerequisites that must already be installed:

-  MacPorts
-  XCode command line tools (for MacPorts)

Run the commands from the following steps in a terminal window:

1. **Configure the ESO repository** (This step is only necessary if the ESO repository has not already been previously configured.)

Run:

```
cd /tmp
curl https://ftp.eso.org/pub/dfs/pipelines/repositories/stable/macports/setup/Portfile -o Portfile
sudo port install
sudo port sync
```




Installing EsoRex

<https://www.eso.org/sci/software/pipelines/> -> RPM | MacPorts | Source Kits (installation)

```
fmolina@MC02FC0YAMD6V ~ % cd /tmp
fmolina@MC02FC0YAMD6V /tmp % curl https://ftp.eso.org/pub/dfs/pipelines/repositories/stable/macports/setup/Portfile -o Portfile
```

% Total	% Received	% Xferd	Average Speed	Time	Time	Time	Current
			Dload Upload	Total	Spent	Left	Speed
100	6281	100	6281	0	0	4762	0
				0:00:01	0:00:01	--:--:--	4780

```
fmolina@MC02FC0YAMD6V /tmp % sudo port install
Password:
Warning: port definitions are more than two weeks old, consider updating them by running 'port selfupdate'.
---> Fetching distfiles for esorepo
---> Verifying checksums for esorepo
---> Extracting esorepo
---> Configuring esorepo
---> Building esorepo
---> Staging esorepo into destroot
---> Installing esorepo @1.4_0
---> Activating esorepo @1.4_0
---> Cleaning esorepo
---> Scanning binaries for linking errors
---> No broken files found.
---> No broken ports found.
---> Some of the ports you installed have notes:
    esorepo has the following notes:
        *** Please run 'sudo port sync' to synchronise with the ESO repository. ***
fmolina@MC02FC0YAMD6V /tmp % sudo port sync
Password:
---> Updating the ports tree
```

Installing EsoRex

2. Install the pipelines

The list of available top level packages for different instruments is given by:

```
port list 'esopipe-*-all'
```

To install all pipelines use:

```
sudo port install 'esopipe-*-all'
```

To install an individual pipeline use the following (This example is for X-Shooter. Adjust the port name to the instrument you require.):

```
sudo port install esopipe-xshoo-all
```



Installing EsoRex

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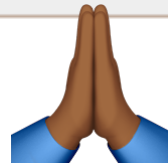
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```
sudo port install esopipe-xshoo-all
```

```

ymolina@MC02FC0YAMD6V /tmp % port list 'esopipe-*-all'
esopipe-amber-all          @4.4.4      science/esopipe-amber-all
esopipe-cr2re-all         @1.4.1      science/esopipe-cr2re-all
esopipe-crire-all         @2.3.17     science/esopipe-crire-all
esopipe-detmon-all        @1.3.13     science/esopipe-detmon-all
esopipe-efosc-all        @2.3.9      science/esopipe-efosc-all
esopipe-eris-all          @1.5.0      science/esopipe-eris-all
esopipe-esotk-all         @0.9.6      science/esopipe-esotk-all
esopipe-espda-all        @1.3.7      science/esopipe-espda-all
esopipe-espdr-all        @3.1.0      science/esopipe-espdr-all
esopipe-fors-all         @5.6.5      science/esopipe-fors-all
esopipe-giraf-all        @2.16.11    science/esopipe-giraf-all
esopipe-gravity-all      @1.6.0      science/esopipe-gravity-all
esopipe-harps-all        @3.0.0      science/esopipe-harps-all
esopipe-hawki-all        @2.4.13     science/esopipe-hawki-all
esopipe-iiinstrument-all  @0.1.14     science/esopipe-iiinstrument-all
esopipe-isaac-all        @6.2.4      science/esopipe-isaac-all
esopipe-kmos-all         @4.4.1      science/esopipe-kmos-all
esopipe-matisse-all      @2.0.0      science/esopipe-matisse-all
esopipe-midi-all         @2.9.5      science/esopipe-midi-all
esopipe-molecfits-all    @4.3.1      science/esopipe-molecfits-all
esopipe-muse-all         @2.8.9      science/esopipe-muse-all
esopipe-naco-all         @4.4.12     science/esopipe-naco-all
esopipe-nirxps-all       @3.0.4      science/esopipe-nirxps-all
esopipe-sinfo-all        @3.3.4      science/esopipe-sinfo-all
esopipe-sofi-all         @1.5.15     science/esopipe-sofi-all
esopipe-spher-all        @0.47.1     science/esopipe-spher-all
esopipe-uves-all         @6.4.1      science/esopipe-uves-all
esopipe-vcam-all         @2.3.12     science/esopipe-vcam-all
esopipe-vimos-all        @4.1.8      science/esopipe-vimos-all
esopipe-visir-all        @4.4.4      science/esopipe-visir-all
esopipe-xshoo-all        @3.6.3      science/esopipe-xshoo-all
  
```





Installing EsoRex

If you have to abort the installation, and run again

> sudo port install esopipe-[instrument]-all

```
fmolina@MC02FC0YAMD6V /tmp % sudo port install
---> Cleaning esorepo
---> Scanning binaries for linking errors
---> Found 4 broken files, matching files to ports
---> Found 2 broken ports, determining rebuild order
You can always run 'port rev-upgrade' again to fix errors.
The following ports will be rebuilt:
  wcslib @8.2.2
  texinfo @7.1
Continue? [Y/n]: Y
---> Installing gperf @3.1_0
Error: Failed to install gperf: no destroot found at: /opt/local/var/macports/build/_opt_local_var_macports_sources_rsync.macpor
ts.org_macports_release_tarballs_ports_devel_gperf/gperf/work/destroot
Error: See /opt/local/var/macports/logs/_opt_local_var_macports_sources_rsync.macports.org_macports_release_tarballs_ports_devel
_gperf/gperf/main.log for details.
Error: Problem while installing gperf
Error: rev-upgrade failed: Error rebuilding wcslib
Error: Follow https://guide.macports.org/#project.tickets if you believe there is a bug.
```

> `sudo port clean gperf`



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dfitspy

<https://astrom-tom.github.io/dfitspy/build/html/index.html>

dfitspy migrates the main **dfits** & **fitsort** capabilities to python

dfits is made to search information inside the header of FITS files

```
> pip install dfitspy --user
```

dfitspy

<https://astrom-tom.github.io/dfitspy/build/html/index.html>

```
fmolina@MC02FC0YAMD6V FLAT_SKY % dfitspy -f EFOSC.2008-05-29T21:54:23.861.fits --list
```

```
[DFITSPY INFO]>keywords in EFOSC.2008-05-29T21:54:23.861.fits
```

```
-----
SIMPLE                | BITPIX                | NAXIS
NAXIS1                | NAXIS2                | EXTEND
PCOUNT                | GCOUNT                | BZERO
BSCALE                | ORIGIN                | DATE
TELESCOP              | INSTRUME              | OBJECT
RA                    | DEC                   | EQUINOX
RADECSYS              | EXPTIME               | MJD-OBS
DATE-OBS              | UTC                   | LST
PI-COI                | OBSERVER              | CTYPE1
CTYPE2                | CRVAL1                | CRVAL2
CRPIX1                | CRPIX2                | CDELTA1
CDELTA2               | ESO ADA ABSROT END   | ESO ADA ABSROT START
ESO ADA GUID STATUS  | ESO ADA POSANG        | ESO DET BITS
ESO DET CHIP1 DATE   | ESO DET CHIP1 ID     | ESO DET CHIP1 INDEX
ESO DET CHIP1 NAME   | ESO DET CHIP1 NX     | ESO DET CHIP1 NY
ESO DET CHIP1 PSZX   | ESO DET CHIP1 PSZY   | ESO DET CHIP1 X
ESO DET CHIP1 XGAP   | ESO DET CHIP1 Y      | ESO DET CHIP1 YGAP
ESO DET CHIPS        | ESO DET DATE         | ESO DET DEC
ESO DET DID          | ESO DET EXP NO       | ESO DET EXP RDTIME
ESO DET EXP TYPE     | ESO DET EXP XFERTIM  | ESO DET FRAM ID
ESO DET FRAM TYPE    | ESO DET ID           | ESO DET NAME
ESO DET OUT1 CHIP    | ESO DET OUT1 CONAD   | ESO DET OUT1 GAIN
```



dfitspy

```
fmoлина@MC02FC0YAMD6V FLAT_SKY % dfitspy -f * -k DET.WIN1.BINX,DET.WIN1.BINY,INS.MODE,DPR.TYPE,INS.FILT1.NAME
```

```
[DFITSPY INFO]> Current directory: /opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY
```

```
[DFITSPY INFO]> 39 fits files will be considered
```

```
[DFITSPY INFO]> We look in HDU 0
```

filename	ESO DET WIN1 BINX	ESO DET WIN1 BINY	ESO DPR TYPE	ESO INS FILT1 NAME	ESO INS MODE
EFOSC.2008-05-29T21:54:23.861.fits	1	1	SKY,FLAT	OIII#687	DEFAULT
EFOSC.2008-05-29T21:55:49.264.fits	1	1	SKY,FLAT	OIII#687	DEFAULT
EFOSC.2008-05-29T21:57:15.847.fits	1	1	SKY,FLAT	OIII#687	DEFAULT
EFOSC.2008-05-29T21:58:42.630.fits	1	1	SKY,FLAT	OIII#687	DEFAULT
EFOSC.2008-05-29T22:00:10.844.fits	1	1	SKY,FLAT	OIII#687	DEFAULT
EFOSC.2008-05-29T22:01:42.050.fits	1	1	SKY,FLAT	OIII#687	DEFAULT
EFOSC.2008-05-29T22:03:45.636.fits	1	1	SKY,FLAT	OIII#687	DEFAULT
EFOSC.2008-05-29T22:05:11.380.fits	1	1	SKY,FLAT	OIII#687	DEFAULT
EFOSC.2008-05-29T22:06:44.826.fits	1	1	SKY,FLAT	OIII#687	DEFAULT
EFOSC.2008-05-29T22:08:22.783.fits	1	1	SKY,FLAT	OIII#687	DEFAULT
EFOSC.2010-03-16T23:10:01.081.fits	1	1	SKY,FLAT	g#782	DEFAULT
EFOSC.2010-03-16T23:12:52.386.fits	1	1	SKY,FLAT	g#782	DEFAULT

Outline

- ~~What is a pipeline~~
- ~~Self introduction & Quality Control~~
- ~~Why do I need to learn how to run a pipeline?~~
- ~~4 ways to Run a Pipeline~~
- ~~Scope of this talk: 1 way (EsoRex)~~
- ~~Installing EsoRex~~
- ~~dfitspy~~
- Running EsoRex for EFOSC2



Running EsoRex for EFOSC2

<https://www.eso.org/sci/software/cpl/esorex.html>

- Go to “Using EsoRex”
- Or in the pipeline user manual of EFOSC2, p. 20, section 4.1.2 (<https://ftp.eso.org/pub/dfs/pipelines/instruments/efosc/efosc-pipeline-manual-1.1.pdf>)

To generate a configuration file `esorex.rc` in the dir `$HOME/.esorex`

```
>esorex --create-config
```

To display EsoRex settings

```
>esorex --config=$HOME/.esorex/esorex.rc --params
```

Listing all available recipes

```
> esorex --config=$HOME/.esorex/esorex.rc --recipes
```

Running EsoRex for EFOSC2

```
fmolina@MC02FC0YAMD6V LaSilla % esorex --config=$HOME/.esorex/esorex.rc --recipes

**** ESO Recipe Execution Tool, version 3.13.8 ****

List of Available Recipes :

  espdr_cal_contam      : Generates a contamination frame and checks contamination level on science fiber
  espdr_wave_LFC       : Wavelength calibration with LFC
  espdr_mbias          : Creates the master bias frame
  espdr_wave_THAR_THAR : S2D extraction of THAR,THAR frames
  espdr_cal_eff_ab     : Computes the relative efficiency between sky and science fibers vs. wavelength
  espdr_single_bias    : Reduceses a single BIAS frame
  espdr_mflat         : Creates the master flat
  espdr_cal_flux       : Measures the absolute efficiency curve
  espdr_wave_THAR     : Wavelength calibration
  espdr_compu_drift    : Measures instrumental drift on wavelength calibration spectra.
  espdr_led_ff        : Computes the mean gain and detect the bad pixels
  espdr_wave_FP       : Wavelength FP calibration
  espdr_mdark         : Creates the master dark & hot pixel mask
  espdr_wave_TH_drift  : Wavelength calibration via drift
  espdr_wave_LFC_LFC  : S2D extraction of LFC,LFC frames
  espdr_sci_red       : Performs science reduction
  espdr_orderdef      : Defines the orders on the CCD
  efosc_img_science  : Reduce scientific exposure
  efosc_calib         : Determination of the extraction mask
  efosc_zeropoint     : Compute zeropoint
  efosc_img_screen_flat : Compute master screen flat frame
  efosc_img_sky_flat  : Compute master img_sky_flat frame
  efosc_extract       : Extraction of scientific spectra
  efosc_bias          : Compute the master bias frame
  efosc_science      : Extraction of scientific spectra
  efosc_photometry    : Compute corrected flatfield
```



Running EsoRex for EFOSC2

To display a recipe parameters

```
>esorex --config=$HOME/.esorex/esorex.rc --params recipe
```

Changing a recipe parameter

```
>esorex --config=$HOME/.esorex/esorex.rc recipe --param=[value]
```

- To use a recipe config file, I prefer EsoRex to generate the file:
\$HOME/.esorex/recipe.rc

```
>esorex --create-config recipe
```

The recipe config file will contain the list of default params + small explanation



Running EsoRex for EFOSC2

```
# File: /Users/fmolina/.esorex/efosc_img_science.rc
#
# Note: This configuration file has been automatically
#       generated by the esorex (v3.13.8) program.
#
# Date: 13-Feb-2024 10:43:40
#
#
# --cr_remove
# Cosmic ray removal.
efosc.efosc_img_science.cr_remove=FALSE
#
# --extract_method
# Source extraction method. <sex | test>
efosc.efosc_img_science.extract_method=sex
#
# --sex_exe
# SExtractor executable.
efosc.efosc_img_science.sex_exe=/opt/local/lib/efosc-2.3.9/bin/sex
#
# --sex_config
# SExtractor configuration file.
efosc.efosc_img_science.sex_config=/opt/local/share/esopipes/efosc-2.3.9/config/efosc.sex
```



Running EsoRex for EFOSC2

```
>esorex --config=$HOME/.esorex/esorex.rc --recipe-config=$HOME/.esorex/recipe.rc recipe data.sof
```

To create a data.sof file

e.g. bias.sof

```
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/BIAS/EFOSC.2010-12-21T20:37:14.168.fits BIAS RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/BIAS/EFOSC.2010-12-21T20:37:44.951.fits BIAS RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/BIAS/EFOSC.2010-12-21T20:38:15.892.fits BIAS RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/BIAS/EFOSC.2010-12-21T20:38:46.925.fits BIAS RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/BIAS/EFOSC.2010-12-21T20:39:17.946.fits BIAS RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/BIAS/EFOSC.2010-12-21T20:39:48.938.fits BIAS RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/BIAS/EFOSC.2010-12-21T20:40:19.900.fits BIAS RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/BIAS/EFOSC.2010-12-21T20:40:50.921.fits BIAS RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/BIAS/EFOSC.2010-12-21T20:41:21.914.fits BIAS RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/BIAS/EFOSC.2010-12-21T20:41:52.176.fits BIAS RAW
```

Running EsoRex for EFOSC2

sky_flat.sof file

```
#/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY/EFOSC.2010-11-04T23:15:16.636.fits SKY_FLAT_IMG RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY/EFOSC.2010-11-04T23:16:16.599.fits SKY_FLAT_IMG RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY/EFOSC.2010-11-04T23:20:25.534.fits SKY_FLAT_IMG RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY/EFOSC.2010-11-04T23:21:05.520.fits SKY_FLAT_IMG RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY/EFOSC.2010-11-04T23:23:06.926.fits SKY_FLAT_IMG RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY/EFOSC.2010-11-04T23:25:09.553.fits SKY_FLAT_IMG RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY/EFOSC.2010-11-04T23:25:45.897.fits SKY_FLAT_IMG RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY/EFOSC.2010-11-04T23:26:23.872.fits SKY_FLAT_IMG RAW
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY/EFOSC.2010-11-04T23:27:02.917.fits SKY_FLAT_IMG RAW
#/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY/EFOSC.2010-11-04T23:27:42.861.fits SKY_FLAT_IMG RAW
#/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/FLAT_SKY/EFOSC.2010-11-04T23:28:22.967.fits SKY_FLAT_IMG RAW

master_bias.fits MASTER_BIAS CALIB
```

science.sof file

```
/opt/local/share/esopipes/datademo/efosc/efosc/efosc-demo-reflex-0.1/SCIENCE_IMG/EFOSC.2010-11-05T00:26:55.510.fits SCIENCE_IMG RAW

master_bias.fits MASTER_BIAS CALIB
master_sky_flat_img.fits MASTER_SKY_FLAT_IMG CALIB
/opt/local/share/esopipes/datastatic/efosc-2.3.9/efosc_phot.fits PHOT_TABLE CALIB
```



Running EsoRex for EFOSC2

9 Pipeline Recipes Interfaces

In this Section a detailed description of the EFOSC pipeline recipes interfaces is given, with a complete specification of the recipes usage, their input, output, and configuration parameters. For a overview of the available pipeline recipes, please see Section 8, page 47.

9.4 `efosc_img_science`

The EFOSC pipeline recipe `efosc_img_science` is used to reduce a direct imaging scientific exposure. The bias master calibration is subtracted. The unbiased signal is then divided by the normalised sky flat field, and the overscan regions, if present, are removed from the result. The calibrated image is finally sent to a source detection and extraction application (SExtractor 2.5.0 [21]).¹⁶

9.4.1 Input files

SCIENCE_IMG: *required* direct imaging scientific exposure.

MASTER_BIAS: *required* bias master calibration frame.

MASTER_SKY_FLAT_IMG: *required* sky flat field master calibration frame (normalised or not).

9.4.2 Output files

SCIENCE_REDUCED_IMG: Reduced science image.

Configuration parameters directly affecting this product are: `--cr_remove`.

9.4 efosc_img_science

The EFOSC pipeline recipe *efosc_img_science* performs master bias calibration, subtracts the overscan regions, if present, and applies detection and extraction applications.

9.4.1 Input files

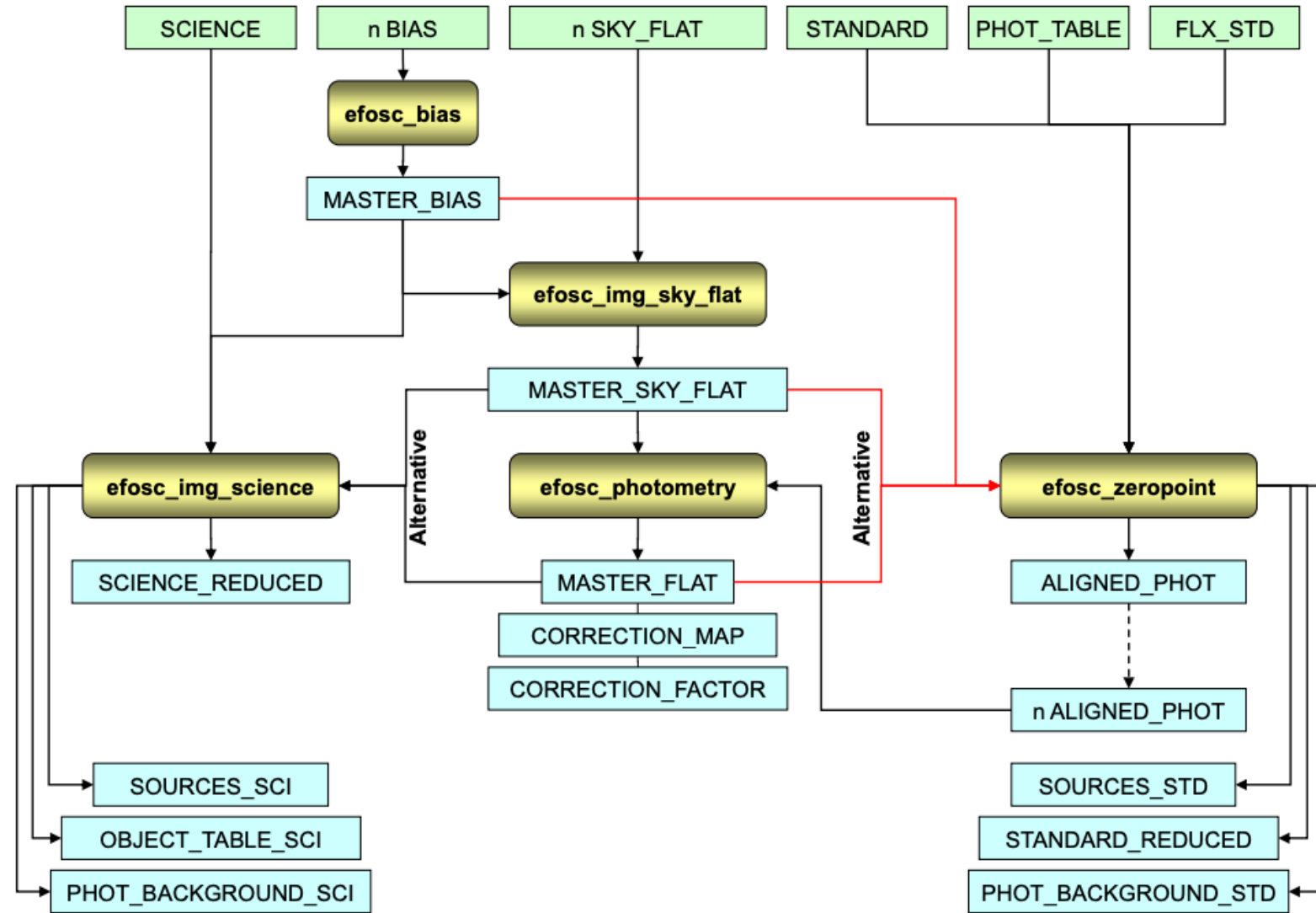
SCIENCE_IMG: *required* directory

MASTER_BIAS: *required* bias master calibration

MASTER_SKY_FLAT_IMG: sky flat master calibration

9.4.2 Output files

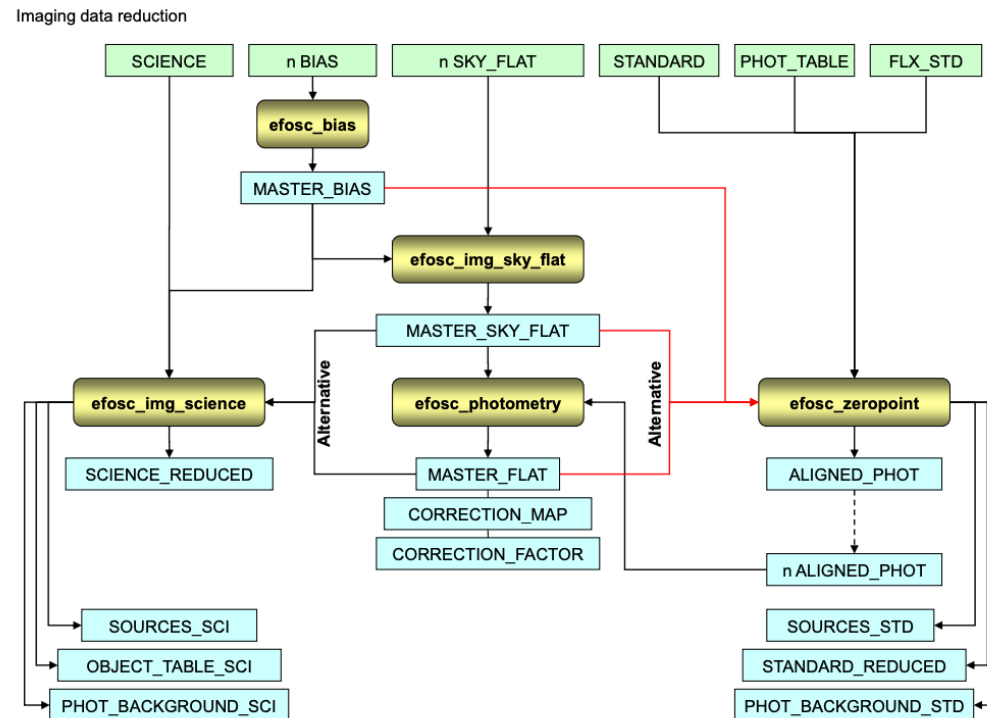
SCIENCE_REDUCED_IMG: science reduced images

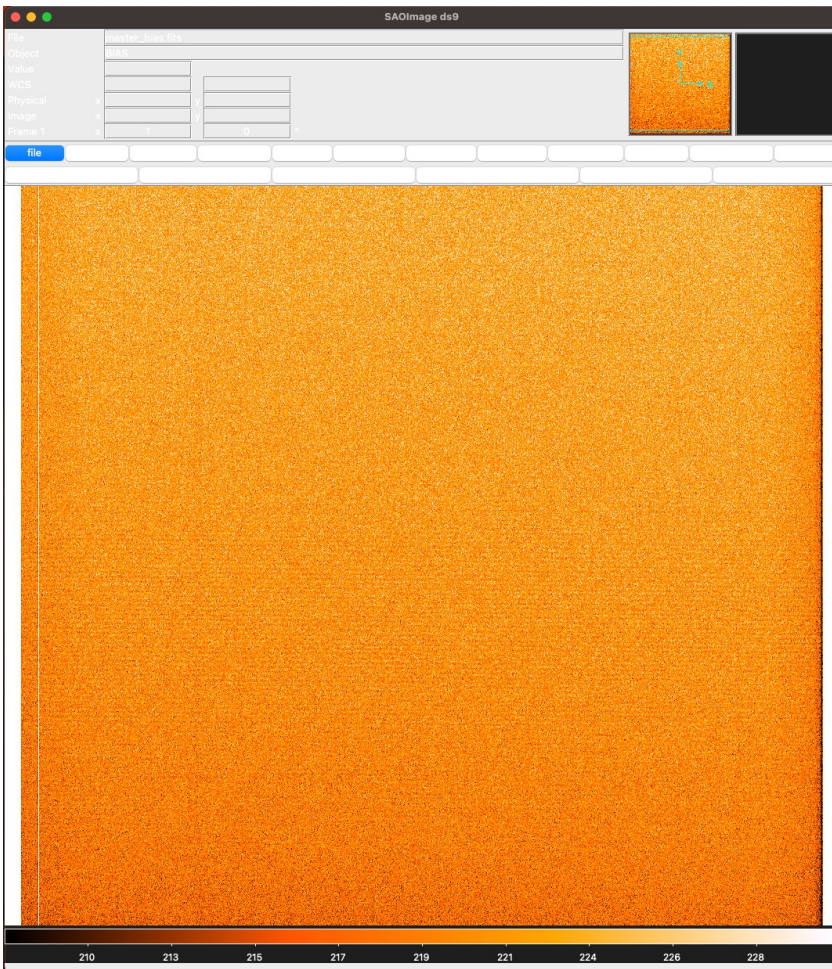


Running EsoRex for EFOSC2

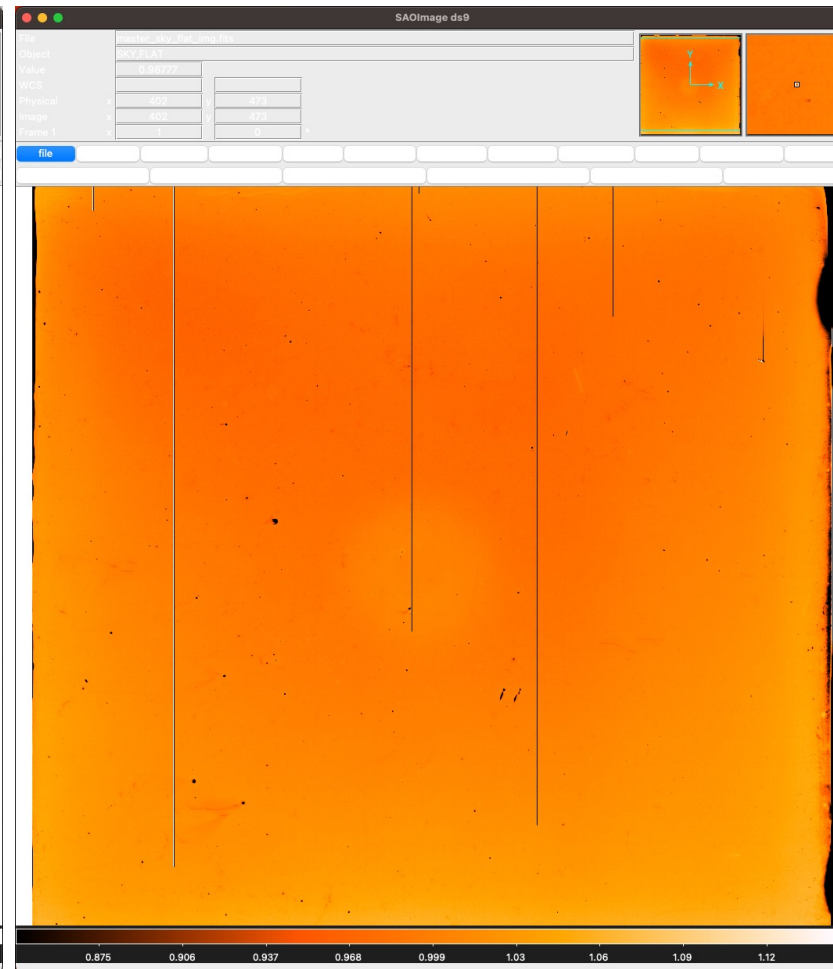
Actually running a recipe:

```
>esorex --config=$HOME/.esorex/esorex.rc --recipe-config=$HOME/.esorex/recipe.rc recipe data.sof
```

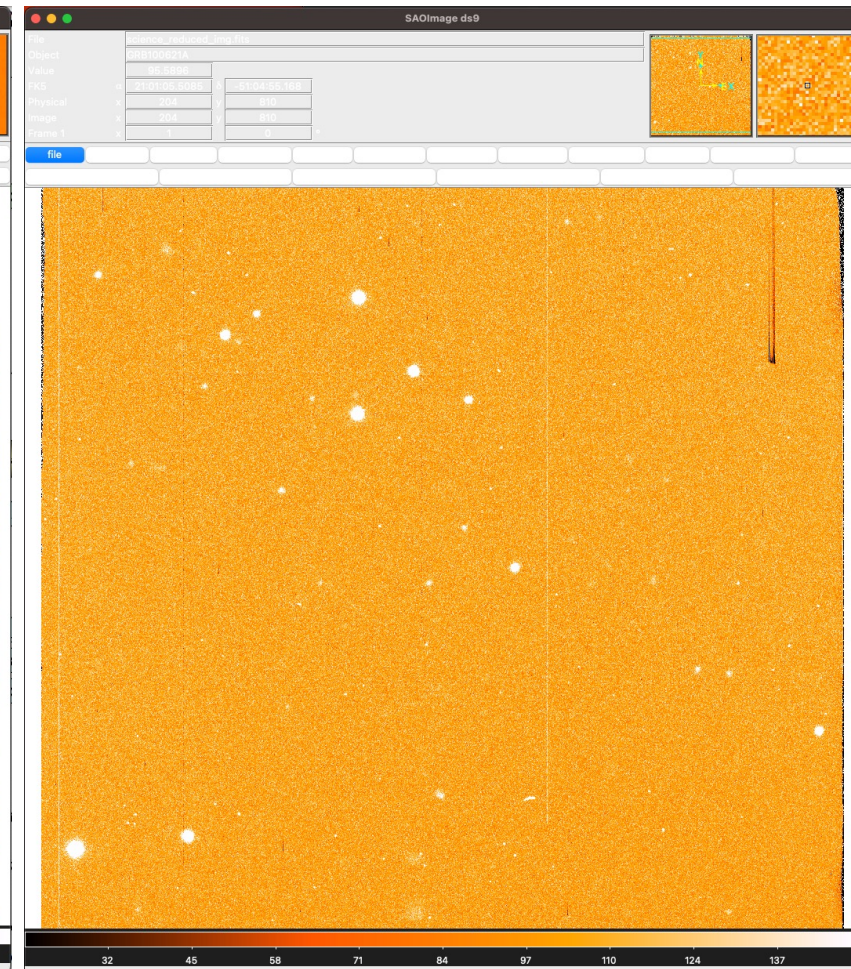




Master_bias.fits



Master_sky_flat_img.fits



science_reduced_img.fits








Why do we need to run a pipeline?

- **It is good to know the steps that provides a correction, standardization, reference, etc.**
- **Sometimes it is not only «nice to know» but necessary**
- **It won't make you bad**



Thank you!

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