



The ESO Archive and Reflex Pipeline Workflows

(or, how do I get data and process it too?)

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Outline

Part 1: In Theory

Getting Data from ESO:

- the contents of the ESO Science Archive Facility (SAF)
- how to access the archive for high-level science data or for raw data

Using Data from ESO:

- Reflex workflows and ESO pipelines
- Reflex workflow basics
- installing Reflex
- a summary of the main features of Reflex

Part 2: In Practise

A Practical Demonstration

- retrieving raw data from the ESO archive
- retrieving science products from the ESO archive
- of the HAWK-I Reflex workflow



The ESO Archive

The ESO Science Archive Facility (SAF):

==> the operational and technical data archive for the La Silla Paranal Observatory
(serving 3 + 4 + 2 telescopes and 6 + 12 + 2 instruments)

Data Content (both raw and data products):

~ 500 TB of data consisting of 25 million files (~23 billion database rows of searchable header keywords)

Data Inflow:

~12 TB/month

Data Outflow:

~15 TB/month



Archive Contents

RAW data from the La Silla Paranal Observatory:

==> science, calibration, and technical data

Pipeline products:

mainly science products + ancillary data (standards, catalogues, error maps, etc.)

Two primary sources:

1. products generated at ESO by running the instrument data reduction pipelines with the standard calibration plan
 - these are products that are not tailored to a specific science case, and can be processed further
2. products returned by the community through Phase 3
 - tailored to the science cases of the programmes they originated from (Public surveys, Large Programmes, etc.)
 - include highly processed data (tiles, stacks, catalogues)
 - includes valuable historical data sets (e.g. GOODS, zCOSMOS, . . .)
 - well-documented to summarize the characteristics and limitations of the data

Both are homogeneously accessible through the same archive interface to allow queries on the science and not the data origin



Archive Contents

1. Pipeline products:

many products available since the beginning of science operations

Currently available:

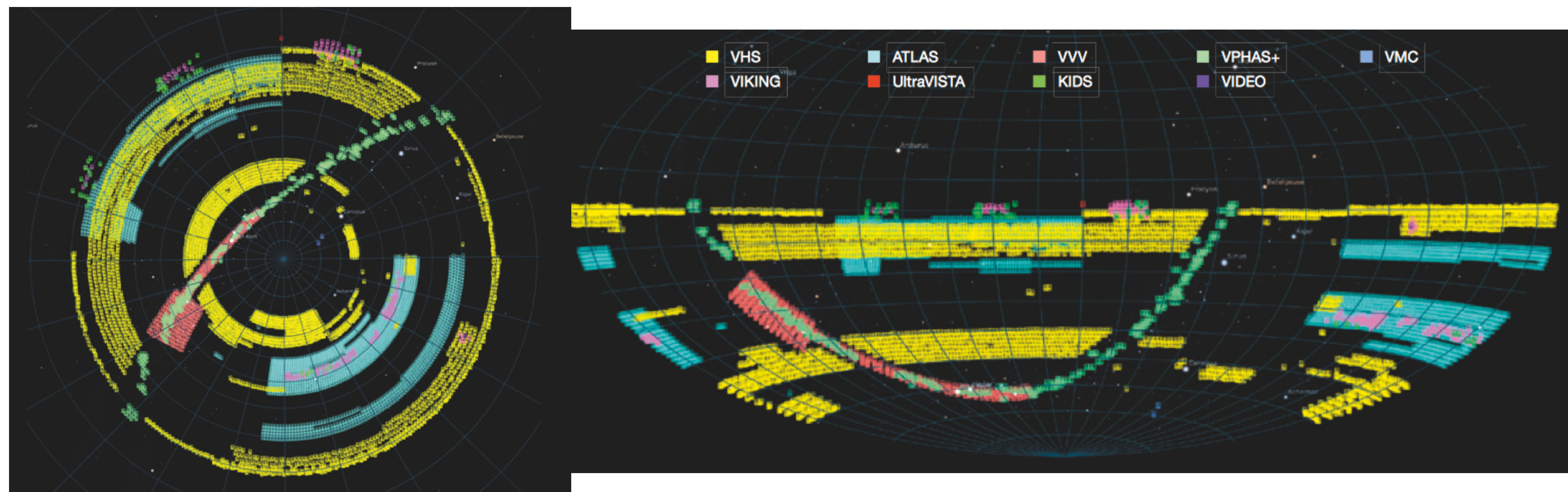
UVES, X-Shooter, HARPS, FLAMES-GIRAFFE

Soon to be available:

HAWK-I, VIMOS (imaging), MUSE, KMOS, and PIONEER

2. Public Survey products:

- Third public data release of the 6 VISTA public surveys: VIDEO, VHS, VVV, VIKING, UltraVISTA, and VMC
- Second public data release of the 3 VST public surveys: KiDS, VPHAS+, and ATLAS
- Second data release from the 2 public spectroscopic surveys: Gaia-ESO and PESSTO
- 2 surveys with VIMOS just beginning: VANDELs and LEGA-C

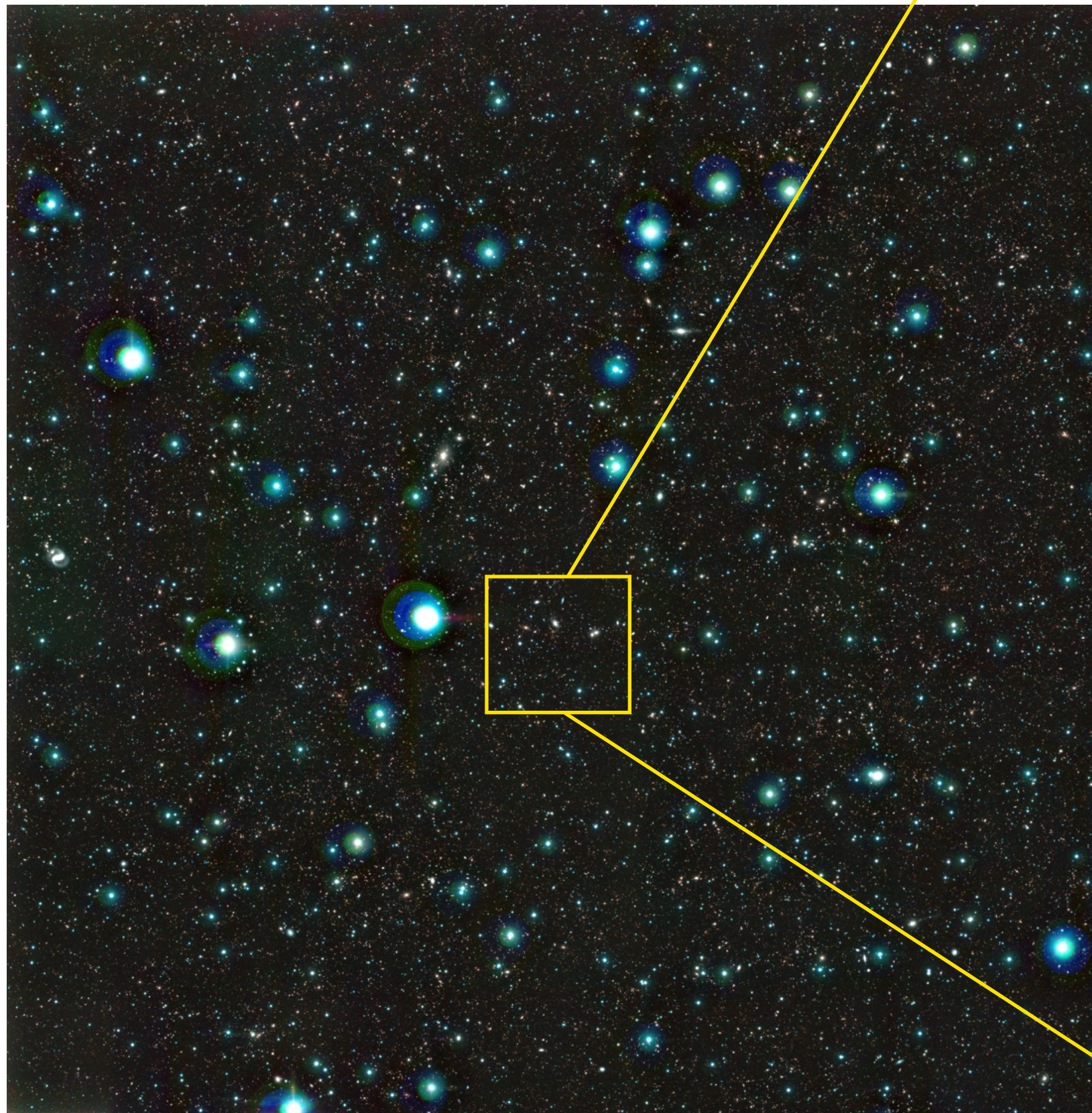




Archive Contents

2. Public Survey products:

e.g. second public data release of the UltraVISTA





Archive Starting Point

archive.eso.org

1. create your account on the ESO User Portal
(not needed for browsing, but for downloads)
2. access RAW data
3. or, access phase 3 data products
(images and spectra)
4. or, specific phase 3 catalogues

Welcome to the ESO Science Archive Facility

The ESO Science Archive Facility contains data from ESO telescopes at La Silla Paranal Observatory, including the APEX submillimeter telescope on Llano de Chajnantor. In addition, the raw UKIDSS/WFCAM data obtained at the UK Infrared Telescope facility in Hawaii are available.

The Principal Investigators of successful proposals for time on ESO telescopes have exclusive access to their scientific data for the duration of a proprietary period, normally of one year, after which the data becomes available to the community at large. Please read the [ESO Data Access Policy statement](#) for more information, along with the [relevant FAQs](#).

Browsing the archive does not require authentication, but to request and download data you have to log in to the [ESO User Portal](#). Please [acknowledge the use of archive data](#) in any publication.

Latest News and Updates

- New Release of PESSTO public survey data (06 Aug 2015)
- First release of the band merged catalogue for the VST Photometric H-alpha Survey of the Southern Galactic Plane (VPHAS+) (30 Jul 2015)
- New Release of Gaia-ESO Spectroscopic Public Survey Data (22 Jul 2015)

[More news ...](#)

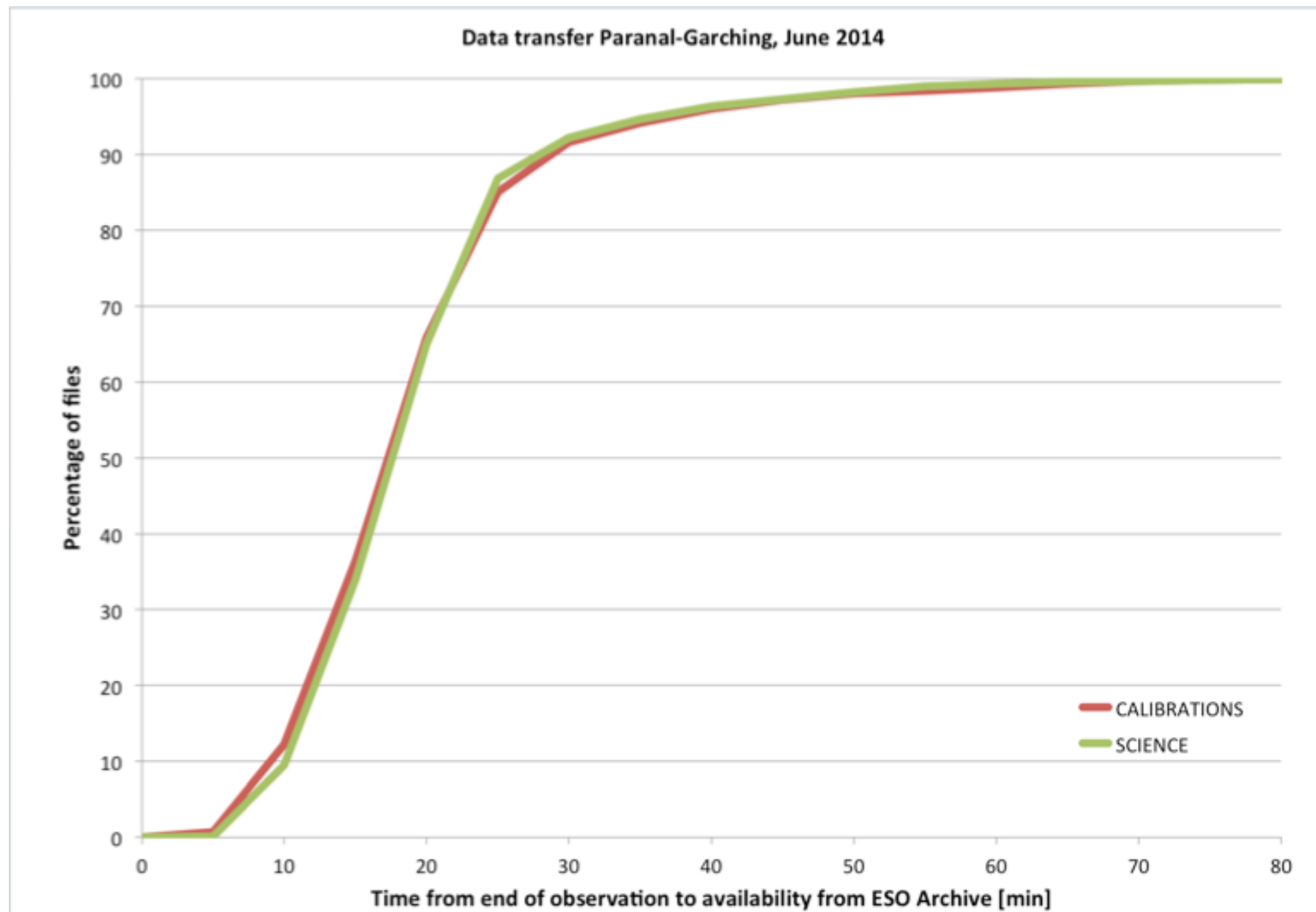
To browse the archive

Currently, **raw data** and various types of **data products** can be reached via different interfaces:

Category	Access Point	Data collection	Data Type	Instruments
LPO Raw Data	Raw data query form (all instruments) Instrument specific query forms Direct retrieval of raw data by file name	All ESO raw data	Various	Many La Silla Paranal instruments
LPO Data Products [Description of reduced data products types]	Phase 3 main query form Phase 3 imaging query form Phase 3 spectral query form Phase 3 VIRCAM-specific query form	Phase 3 Data Products (ESO public surveys; ESO pipeline-reduced products; Large programs: GOODS, zCOSMOS; etc.)	Currently, Imaging and Spectroscopy	Various Pipeline products for UVES, XSHOOTER, HARPS, and more to come.
	Catalogue Facility query interface	Phase 3 Catalogues [ESO User Portal authentication required also when browsing]	Catalogues	Various
	FEROS and HARPS-Polarimetry pipeline processed data query form	FEROS and HARPS-Polarimetry pipeline processed data	Spectroscopy	FEROS, HARPS-Polarimetry, HARPS reduced calibrations (other HARPS see Phase3 above)
	Other Advanced Data Products (available only as downloadable packages, no query form)	Various (30 Doradus, Corot, GaBoDs, etc.)	Spectroscopy Imaging Flux maps	FEROS WFI APEX
	Science Verification, Commissioning, EIS, etc. (no query form)	Full list of available data packages	Various	Many
APEX Quick Look Products	APEX query form	APEX	Heterodyne, Bolometer	APEX-2A, LABOCA, SABOCA, SHeFI
LPO Schedule	Scheduling query form	ESO Observing Programme Information and Scheduling		All La Silla Paranal instruments, including APEX
ALMA Data	ALMA Science Archive	All ALMA data	Cube	ALMA

Access to RAW data

Availability of raw data (Paranal → Garching transfer):



50% within 20^{min}

90% within 30^{min}

98% within 1^{hour}



Archive Content (RAW data)

http://archive.eso.org/eso/eso_archive_main.html



ESO Archive Query Form

[ESO Archive Overview](#) [Help Page](#) [FAQ](#) [Archive Facility HOME](#) [ESO HOME](#)

To search through the raw frames **querying for instrument-specific parameters**, please use the [instrument-dedicated query forms](#). To search for **reduced Data Products**, including public surveys and pipeline-reduced and quality-controlled science-ready data, please have a look at the [generic data products](#) query form. A list of other non-searchable [advanced data products is available](#).

The checkboxes on the right of the parameters define whether or not they will be displayed on the query result page.

Search

Reset

Output preferences:

html table

Return max

200

 rows.

All Fields

Syntax Help

Target, Program and Scheduling Information

Target Name

☒

NGC4039

Resolved by SIMBAD

RA

DEC

J2000

Search Box

Input

Output

☒

Sexagesimal (h, deg)

List of Targets

Choose File

no file selected

Night

☐

(YYYY MM(M) DD)

Otherwise give a query range using the following start/end dates:

Start

12 hrs [UT]

End

12 hrs [UT]

Program ID

☒

Program Type

☐

Any

PI CoI

☐

SV

☐

Any

Title

☐

Observing Information

Imaging

ALL

NONE

☐ EFOSC2/LaSilla

☐ EMMI/LaSilla

☐ FORS1/VLT

☒ FORS2/VLT

☐ HAWKI/VLT

☐ GROND/LaSilla

☐ ISAAC/VLT

☐ NACO/VLT

☐ OMEGACAM/VST

☐ SOFI/LaSilla

☐ SPHERE/VLT

☐ SUSI2/LaSilla

☐ TIMMI2/LaSilla

☐ VIMOS/VLT

☐ VIRCAM/VISTA

☐ VISIR/VLT

☐ WFI/LaSilla

Spectroscopy

ALL

NONE

☐ CES/LaSilla

☐ CRIRES/VLT

☐ EFOSC2/LaSilla

☐ EMMI/LaSilla

☐ FEROS/LaSilla

☐ FORS1/VLT

☐ FORS2/VLT

☐ GIRAFFE/VLT

☐ HARPS/LaSilla

☐ ISAAC/VLT

☐ KMOS/VLT

☐ MUSE/VLT

☐ NACO/VLT

☐ SINFONI/VLT

☐ SOFI/LaSilla

☐ SPHERE/VLT

☐ TIMMI2/LaSilla

☐ UVES/VLT

☐ VIMOS/VLT

☐ VISIR/VLT

☐ XSHOOTER/VLT

Interferometry

ALL

NONE

☐ AMBER/VLT

☐ MIDI/VLT

☐ PIONIER/VLT

☐ VINCI/VLT

Polarimetry

ALL

NONE

☐ EFOSC2/LaSilla

☐ FORS1/VLT

☐ FORS2/VLT

☐ ISAAC/VLT

☐ NACO/VLT

☐ SOFI/LaSilla

☐ SPHERE/VLT

Coronagraphy

ALL

NONE

☐ EFOSC2/LaSilla

☐ NACO/VLT

☐ SPHERE/VLT

Other

ALL

NONE

☐ BOL/APEX

☐ HET/APEX

☐ LGSF/VLT

☐ MAD/VLT

☐ MASCOT/Paranal

☐ WFCAM/UKIRT

Category

☒

☒ SCIENCE

☐ CALIB

☐ ACQUISITION

Data Product Info

Type

☒

OBJECT

User defined input:

Mode

☒

Any

User defined input:

Dataset ID

☒

Orig Name

☐

Release Date

☒

OB Name

☐

OB ID

☐

Instrumental Setup

Exptime

☒

Filter

☒

Grism

☐

Grating

☐

Slit

☐

Instrument & Mode

☒

((ins_id like 'FORS2%' AND dp_tech like 'IMA%'))

output preferences

search criteria: target name
RA, DEC
single night
range of nights
programme ID
PI name

instrument specific criteria

ESO/IAU-Opticon Summer School 2015



Archive Content (RAW data)



ESO Archive Query Results

[ESO Archive Overview](#) [Help Page](#) [FAQ](#) [Archive Facility HOME](#) [ESO HOME](#)

To request data please select the datasets in the results table by marking the checkbox in the left-most column, then press the the **Request marked datasets** button.
(You will be prompted for your ESO User Portal username and password. If you do not yet have an ESO User Portal account, please fill out the [registration form](#).)
Datasets for which the proprietary period is over are highlighted in **green** and are publicly available.
Datasets that are still under the proprietary period are highlighted in **red** and can only be downloaded by the corresponding PI.
Datasets that are not yet available in the Archive are marked with a "N/A".

SIMBAD coordinates for NGC4039 : 12 01 53.7, -18 53 08.0.

Request marked datasets

Reset

MarkAll

MarkPublic

MarkProprietary

New query

Programmatic

Your Requests

	More	HDR	OBJECT	Target Ra, Dec	Program_ID	Instrument	Category	Type	Mode	Dataset ID	Release_Date	Exptime	Filter	MJD-OBS	Airmass	Ambient
<input type="checkbox"/>		Header	H-04GT_BVRI	12:01:50.37 -18:53:32.7	075.D-0662(B)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2005-05-24T03:22:03.370	May 24 2006	1.998	B_BESS	53514.140317	1.281	DIMM Seeing?
<input type="checkbox"/>		Header	H-04GT_BVRI	12:01:50.37 -18:53:32.7	075.D-0662(B)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2005-05-24T03:22:03.371	May 24 2006	1.998	B_BESS	53514.140317	1.281	DIMM Seeing?
<input type="checkbox"/>		Header	H-04GT_BVRI	12:01:50.37 -18:53:32.7	075.D-0662(B)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2005-05-24T03:22:44.603	May 24 2006	0.998	V_BESS	53514.140794	1.284	DIMM Seeing?
<input type="checkbox"/>		Header	H-04GT_BVRI	12:01:50.37 -18:53:32.7	075.D-0662(B)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2005-05-24T03:22:44.604	May 24 2006	0.998	V_BESS	53514.140794	1.284	DIMM Seeing?
<input type="checkbox"/>		Header	H-04GT_BVRI	12:01:50.37 -18:53:32.7	075.D-0662(B)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2005-05-24T03:23:24.365	May 24 2006	0.999	R_SPECIAL	53514.141254	1.287	DIMM Seeing?
<input type="checkbox"/>		Header	H-04GT_BVRI	12:01:50.37 -18:53:32.7	075.D-0662(B)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2005-05-24T03:23:24.366	May 24 2006	0.999	R_SPECIAL	53514.141254	1.287	DIMM Seeing?
<input type="checkbox"/>		Header	H-04GT_BVRI	12:01:50.37 -18:53:32.7	075.D-0662(B)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2005-05-24T03:24:03.548	May 24 2006	2.001	I_BESS	53514.141708	1.289	DIMM Seeing?
<input type="checkbox"/>		Header	H-04GT_BVRI	12:01:50.37 -18:53:32.7	075.D-0662(B)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2005-05-24T03:24:03.549	May 24 2006	2.001	I_BESS	53514.141708	1.289	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T01:33:59.998	Mar 11 2012	179.992	G_HIGH	55631.065278	1.732	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T01:33:59.999	Mar 11 2012	179.992	G_HIGH	55631.065278	1.732	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T01:38:14.910	Mar 11 2012	699.969	HEII	55631.068228	1.692	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T01:38:14.911	Mar 11 2012	699.969	HEII	55631.068228	1.692	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T01:50:19.122	Mar 11 2012	699.977	HEII	55631.076610	1.590	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T01:50:19.123	Mar 11 2012	699.977	HEII	55631.076610	1.590	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T02:02:43.484	Mar 11 2012	599.971	OIII	55631.085226	1.501	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T02:02:43.485	Mar 11 2012	599.971	OIII	55631.085226	1.501	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T02:13:07.199	Mar 11 2012	599.977	OIII	55631.092444	1.436	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T02:13:07.200	Mar 11 2012	599.977	OIII	55631.092444	1.436	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T02:23:31.143	Mar 11 2012	599.982	OIII	55631.099666	1.379	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T02:23:31.144	Mar 11 2012	599.982	OIII	55631.099666	1.379	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T02:34:24.469	Mar 11 2012	299.995	R_SPECIAL	55631.107228	1.326	DIMM Seeing?
<input checked="" type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T02:34:24.470	Mar 11 2012	299.995	R_SPECIAL	55631.107228	1.326	DIMM Seeing?
<input type="checkbox"/>		Header	NGC4038	12:01:51.59 -18:52:31.8	086.D-0309(A)	FORS2	SCIENCE	OBJECT	IMAGE	FORS2.2011-03-11T02:40:14.848	Mar 11 2012	299.985	U_HIGH	55631.111283	1.300	DIMM Seeing?

search results for:
NGC4038 / FORS2

green indicates publicly
available data
red is proprietary



Archive Content (RAW data)


download searched files:

A new archive feature will match your RAW science frames with:


- associated raw calibrations
- associated master calibrations

For this FORS2 data this means:

- bias




European
Southern
Observatory



ESO Archive Requests

ESO — Reaching New Heights in Astronomy.



ESO HomeUser PortalContactSite MapSearch: Go!

Science User Information > ESO User Portal > ESO Archive Requests

ESO User Portal

Data Access Control

ESO Query

Science Archive

Archive Requests

All Requests

Recent Requests

FAQ

Submit Request

Request Description

Media delivery Type

Options

Requested Datasets

How do you want your files to be delivered?
☒ Instant Download
☐ Mailed USB Disk (only for very large requests)

Which files do you want to be delivered?
☐ Only selected files
☒ Selected files + associated raw calibrations (if available)
☐ Selected files + associated processed calibrations (if available)

Submit

- FORS2.2011-03-11T01:33:59.998
- FORS2.2011-03-11T01:33:59.999
- FORS2.2011-03-11T01:38:14.910
- FORS2.2011-03-11T01:38:14.911
- FORS2.2011-03-11T01:50:19.122
- FORS2.2011-03-11T01:50:19.123
- FORS2.2011-03-11T02:02:43.484
- FORS2.2011-03-11T02:02:43.485
- FORS2.2011-03-11T02:13:07.199
- FORS2.2011-03-11T02:13:07.200
- FORS2.2011-03-11T02:23:31.143
- FORS2.2011-03-11T02:23:31.144
- FORS2.2011-03-11T02:34:24.469
- FORS2.2011-03-11T02:34:24.470

NGRH-1_7_2© ESO Data Flow Infrastructure



Welcome to the ESO Science Archive Facility

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Latest News and Updates

- [First release of PESSTO spectral data products \(20 Jan 2014\)](#)
- [DSS and Skycat catalogues services migrated \(17 Jan 2014\)](#)
- [New data of the VISTA Deep Extragalactic Observations Survey in the VIDEO-XMM field released \(17 Jan 2014\)](#)

[More news ...](#)

To browse the archive

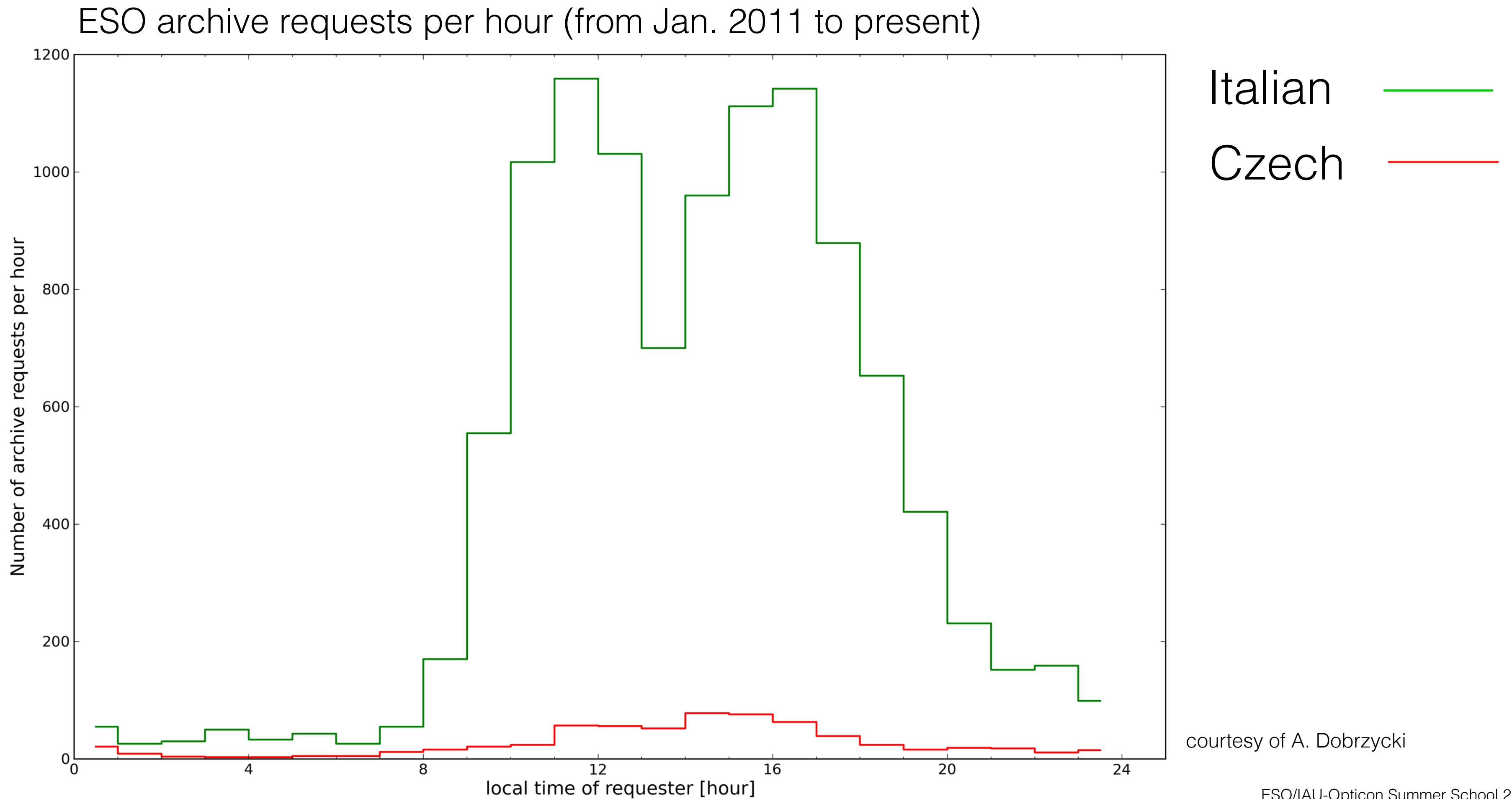
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	Catalogue Facility query interface	Phase 3 Catalogues [ESO User Portal authentication required also when browsing]	Catalogues	Currently, VISTA/VIRCAM, FEROS
	Advanced Data Products query form	GOODS (C.Cesarsky)	Imaging, Spectroscopy	FORS2/ISAAC/VIMOS
		zCOSMOS (S.Lilly)	Spectroscopy	VIMOS
		Observation of Corot astroseismologically-selected HD stars (E.Poretti)	Spectroscopy (time series)	FEROS
		Time-domain survey of NGC 2547 (S.Aigrain)	Imaging	WFI
	FEROS/HARPS pipeline processed data query form	FEROS/HARPS pipeline processed data	Spectroscopy	FEROS, HARPS
	Science Verification, Commissioning, EIS, etc.	Full list of available data packages	Various	Many
APEX Quick Look Products	APEX query form	APEX	Heterodyne, Bolometer	APEX-2A, LABOCA, SABOCA, SHeFI
LPO Schedule	Scheduling query form	ESO Observing Programme Information and Scheduling		All La Silla Paranal instruments, including APEX
ALMA Data	ALMA Science Archive	All ALMA data	Cube	ALMA

The ESO Science Archive Facility was developed in partnership with the [Space Telescope – European Coordinating Facility \(ST-ECF\)](#). It was operated jointly until the [closure of the ST-ECF](#) in December 2010.



Archive Usage (an aside)





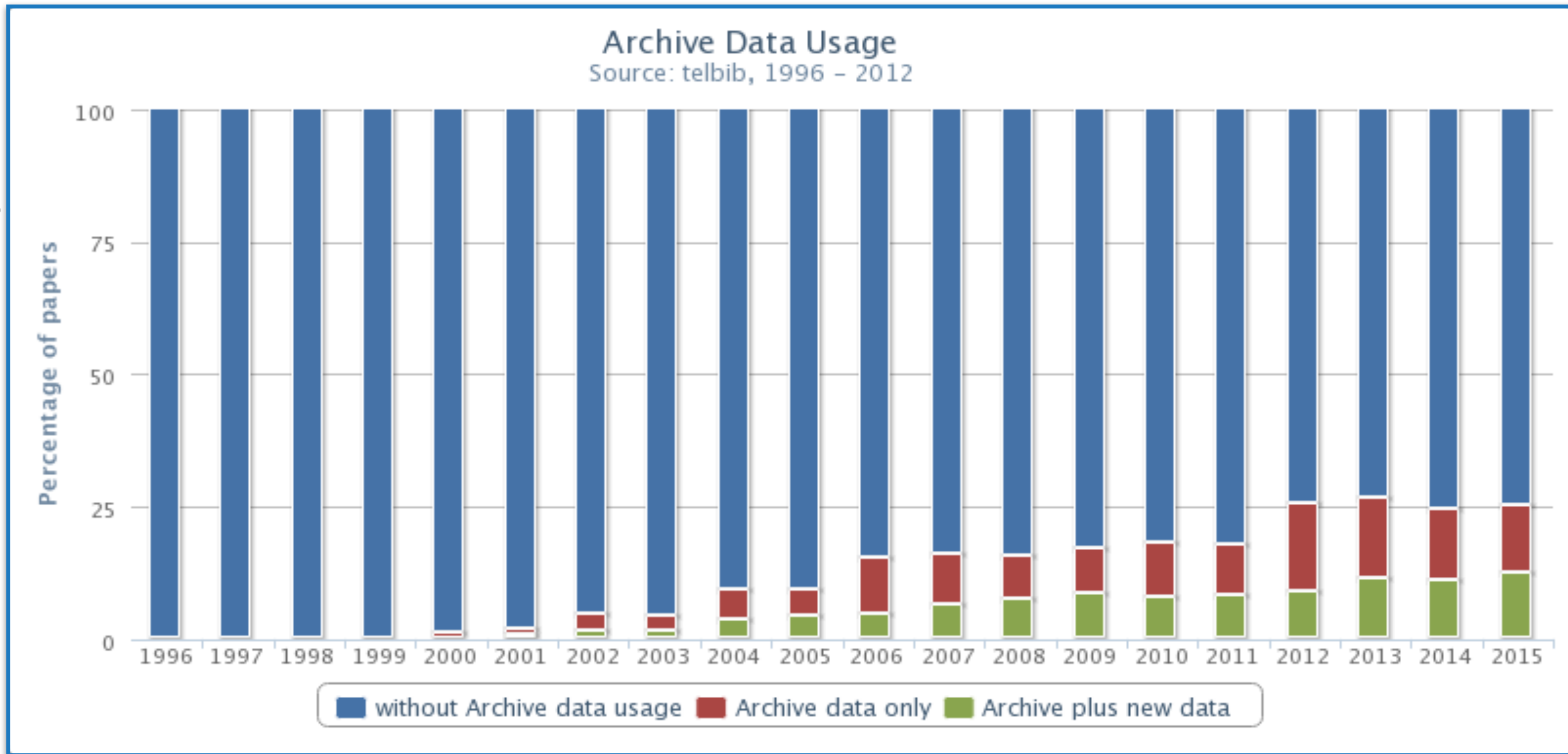
Conclusions: Archive Value

Archival (re)use of data is/will be a major mode for modern astronomy:

- gives anyone the ability to scrutinize any claimed result ==> the foundation of the scientific method
- data recycling increases its initial value
- allows genuinely new science (e.g. statistically meaningful samples from scattered, multiple programmes, or time-domain studies).
- allows for fast-track science (submitting observing proposals and getting data takes a long time)
- lowers the access threshold to data (==> a new community of users)
- allows a PI to assess the feasibility of new observations (preparation for phase 1 and phase2).

Conclusions: Archive Value

source: <http://telbib.eso.org>

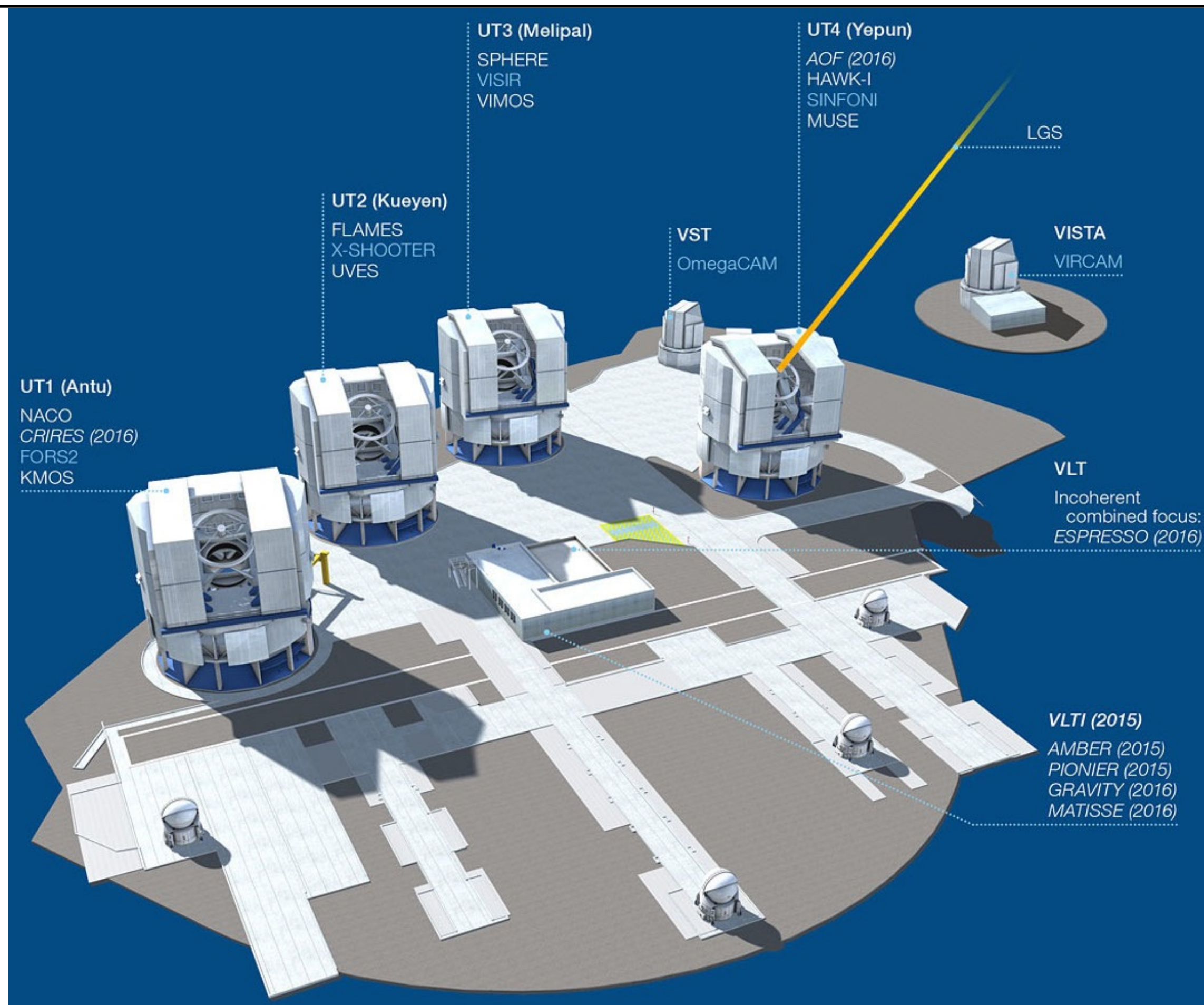


An archive publication is defined as a paper in which none of the authors was part of the original proposal
 ==> a steady 25% of ESO refereed publications since 2012
 ==> equivalent to one VLT 8.2 m telescope!

Processing Your Data

By 2016 ESO/Paranal will be offering ~20 instruments to the community

<http://www.eso.org/public/teles-instr/vlt/vlt-instr/>





Processing Your Data

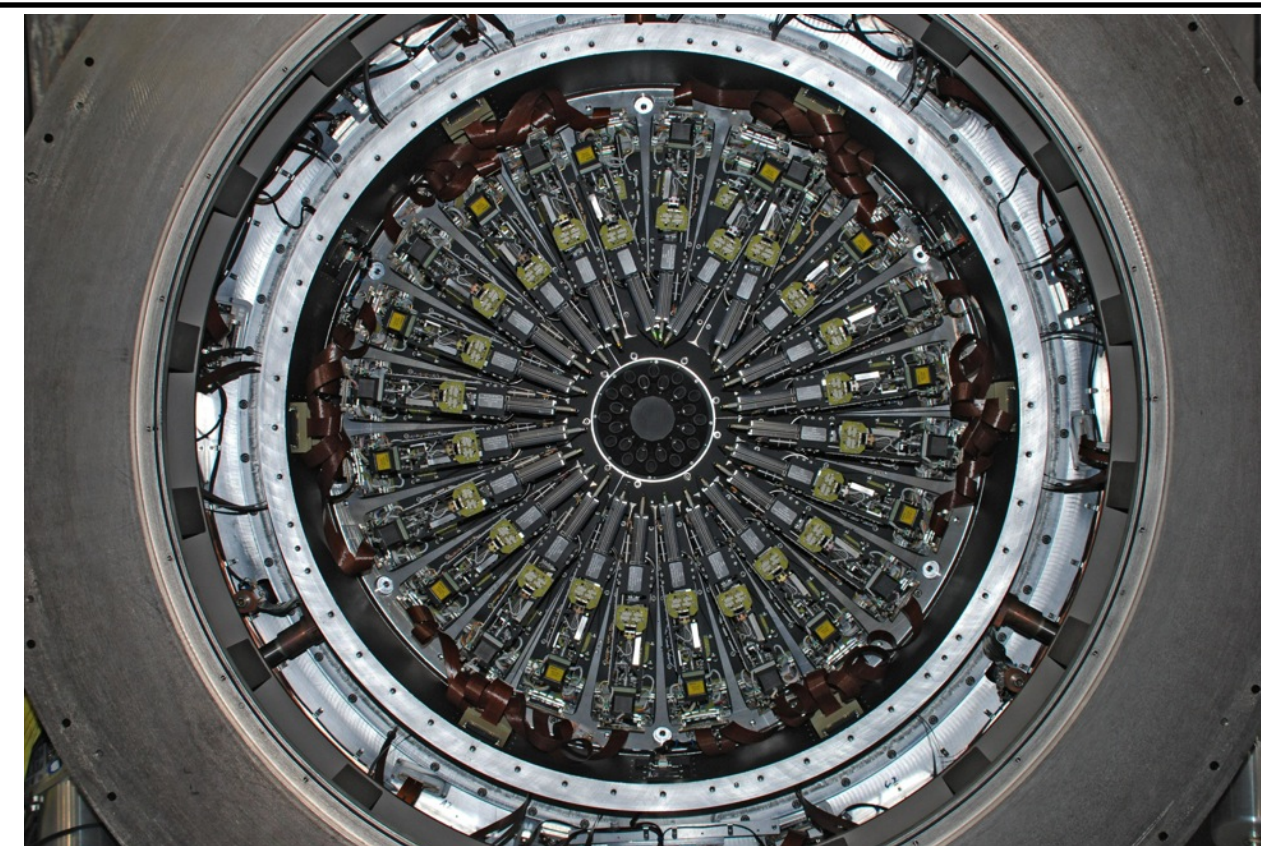
These instruments are becoming very complex

- ==> complex data formats (e.g. multi-layered MEF files)
- ==> complex data dependencies (science \longleftrightarrow calibrations)
- ==> complex pipelines

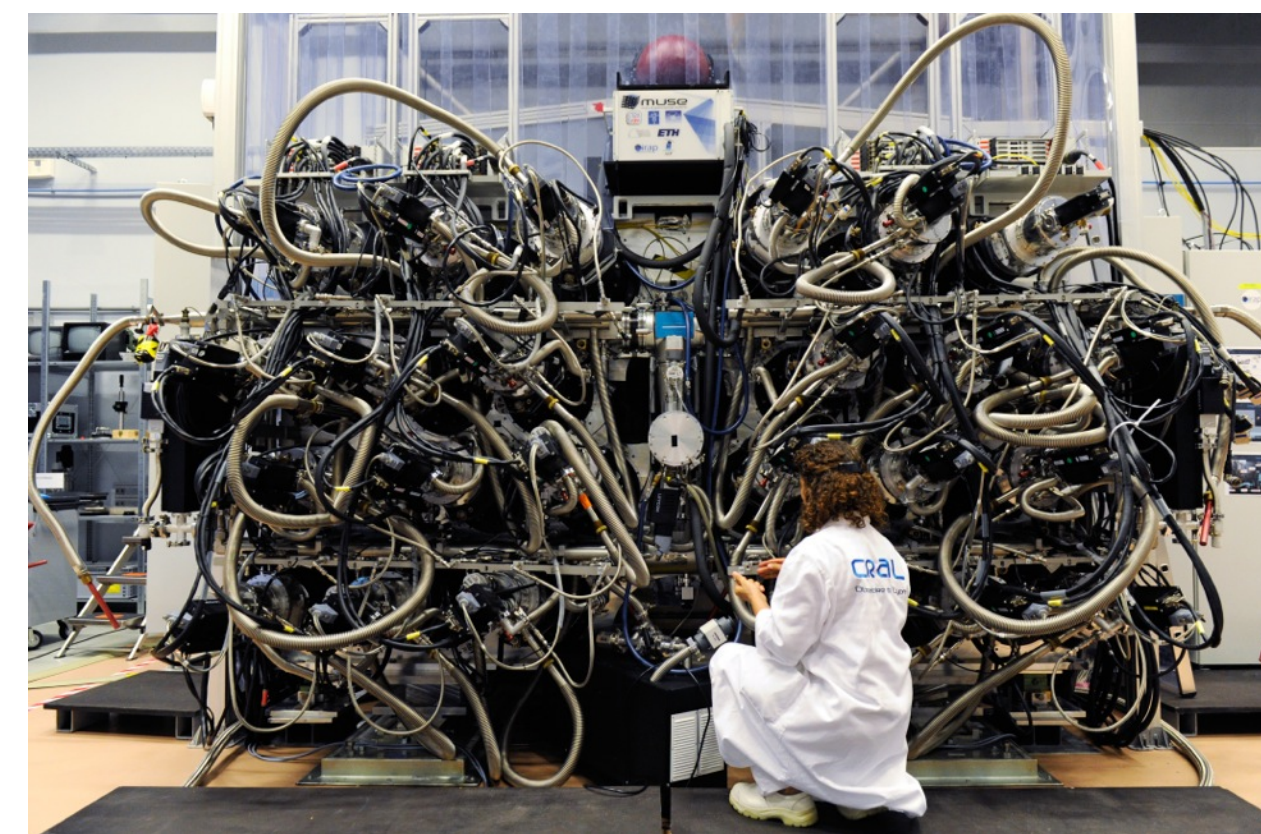
Traditionally, the way to process your raw data involves:

- a steep learning curve to become an expert in the instrument (read a lot of users'/instrument/pipeline manuals).
- write your own scripts to sort, select, and process the data (IDL, IRAF, python, C++, etc.).
- ~trial-and-error your way to some reasonable results.

There is now a better way . . .



e.g. KMOS: 24 fibre arms feeding 3 spectrographs



e.g. MUSE: an integral field spectrograph with 24 IFU's each of which is sliced into 48 mini slits



Processing Your Data Using ESO Reflex

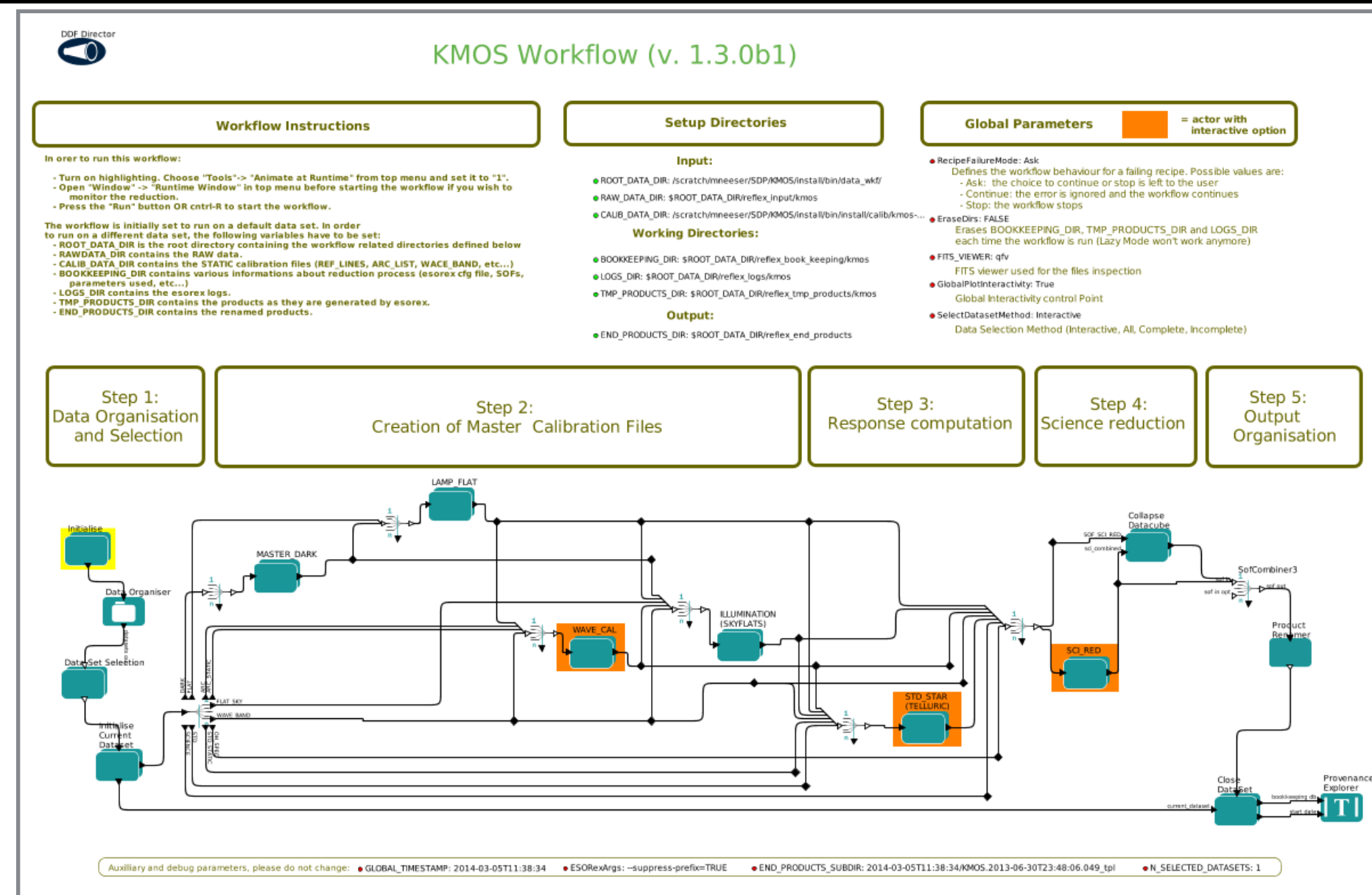
ESO Reflex makes pipeline recipes accessible to the general user

- each Reflex workflow has been designed and tested by instrument & pipeline experts
- easy to use (do not need to be an expert)
- learn the pipeline & instrument by “doing” (workflows work with tutorial data right out of the box)
- visual understanding

Design Goals

- will organize the data for you
- pipeline will run with a single *click*
- you can monitor the progress of the workflow
- will do the book-keeping for you
- will allow user interaction and modification of pipeline parameters
- allows insertion of User procedures in any language

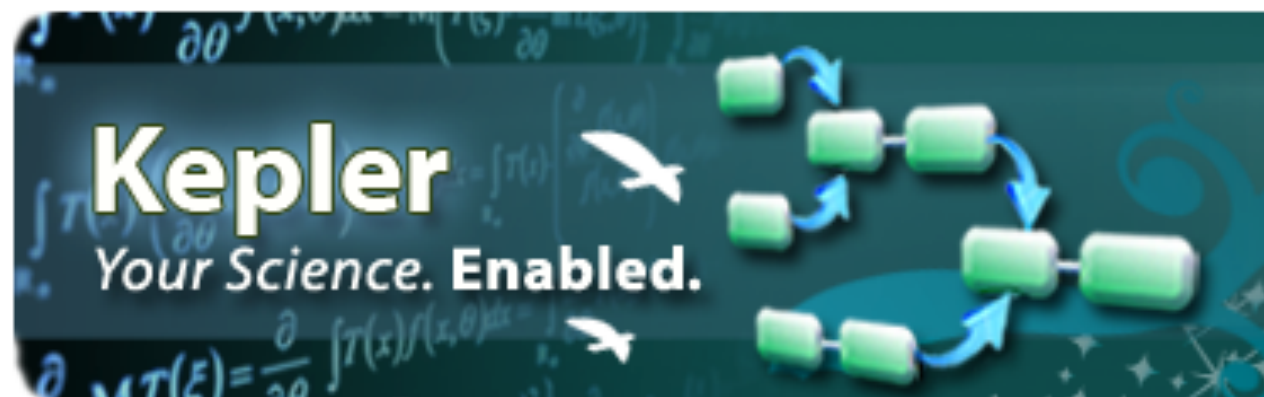
ESO Reflex is now the recommended environment to run VLT pipeline recipes



KMOS Reflex Workflow

Reflex is based on the Kepler Workflow engine

- <https://kepler-project.org>
- Kepler is freely available under the BSD license.
- used in the life sciences, engineering, climate sciences, ecology, geology, and now in astronomy.
- provides a graphical user interface (Java) to create workflows.





ESO Reflex

List of current and future ESO Reflex Workflows:

- FORS (imaging, spectroscopy, and MOS)
 - KMOS
 - MUSE
 - SINFONI
 - UVES
 - VIMOS (MOS)
 - XSHOOTER

 - HAWK-I
 - VIMOS (imaging)
 - VIRCAM
 - FLAMES-GIRAFFE
 - VISIR

 - ESPRESSO
 - SPHERE
 - GRAVITY
 - MATISSE
- ==> by the end of 2015

All **new** ESO instruments are required to be delivered with a pipeline & Reflex workflow



ESO Reflex

Documentation and links:

Reflex start-up page: <http://www.eso.org/sci/software/reflex/>

Reflex paper: http://www.eso.org/sci/software/pipelines/documents/reflex_aa.pdf

available workflows & pipeline manuals: <http://www.eso.org/sci/software/pipelines/>

Installation:

start here: http://www.eso.org/sci/software/pipelines/#installation_instructions

for Linux:

Fedora 20/21/22: — installation rpm's

all others: — download *install_esoreflex* script and execute on the command line;
follow the instructions to download and install the workflow of your choice

Mac OS 10.9+: — install using *macports*

— <http://www.eso.org/sci/software/pipelines/installation/macports.html>



ESO Reflex: getting started

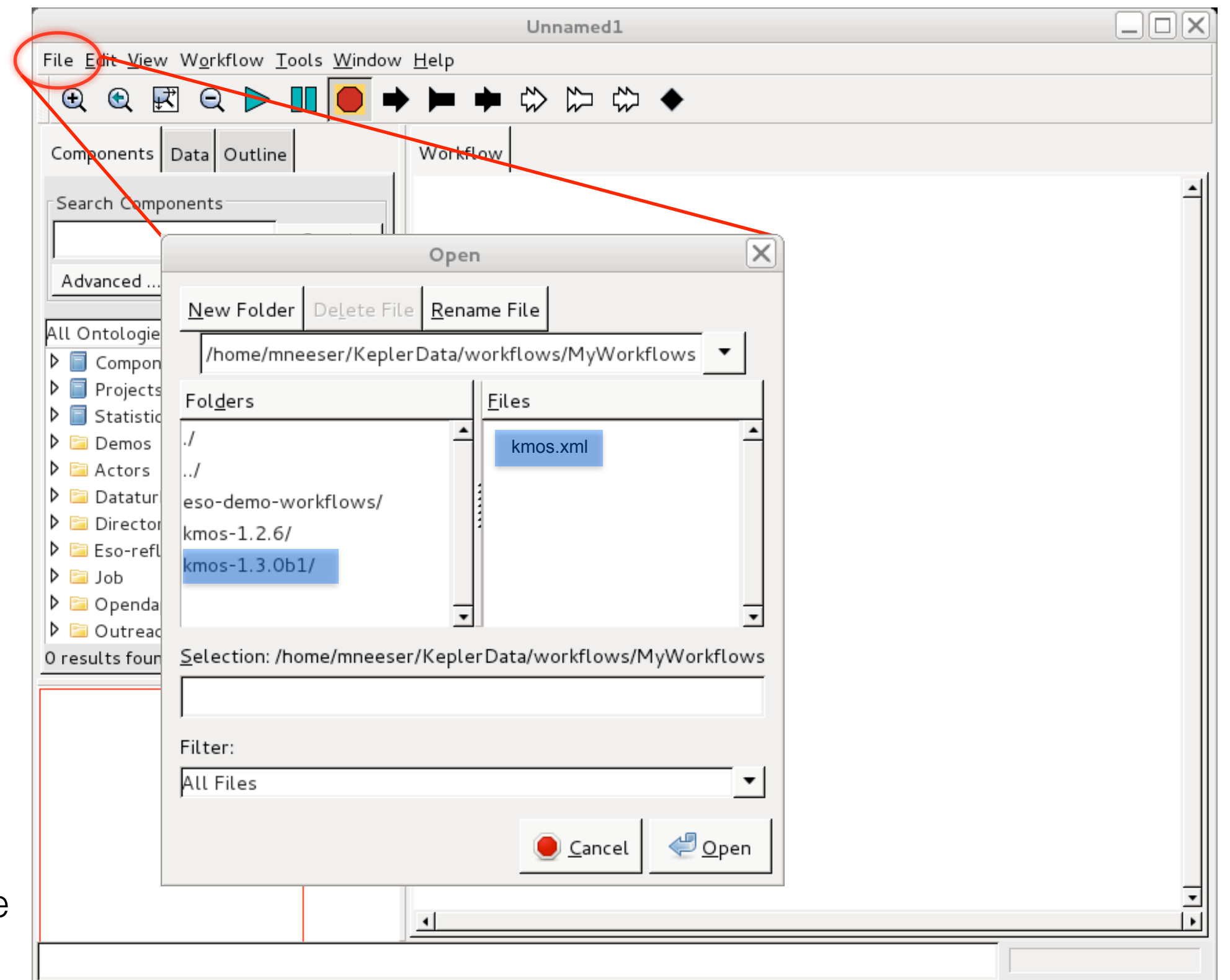
each Reflex workflow installation includes:

- the instrument pipeline
- a demonstration data set
- the Reflex workflow (as an .xml file)
- a tutorial manual

initialise via the command line:

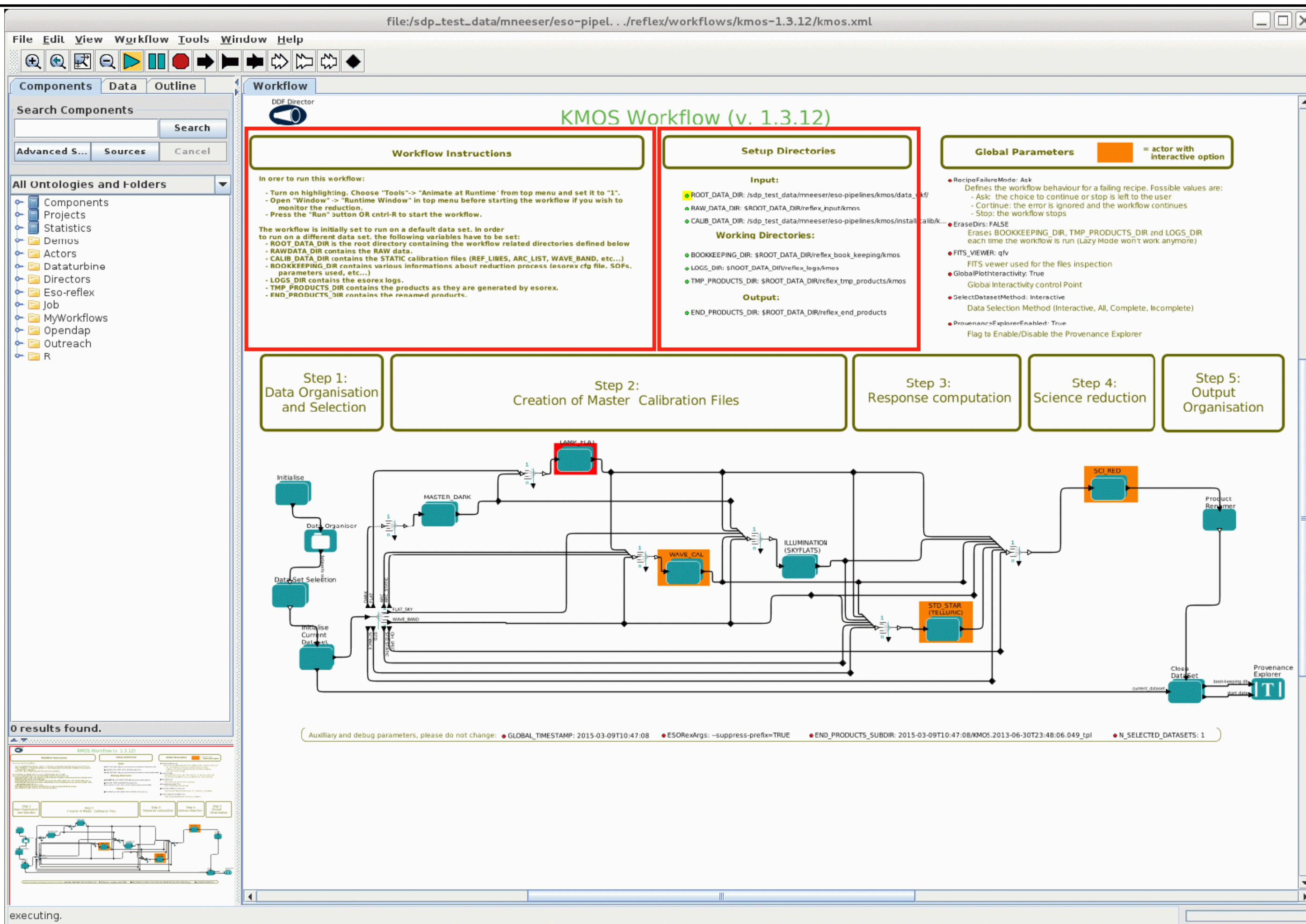
`./esoreflex &`

- begins with an empty viewer.
- select <instrument>.xml to initialise the workflow.




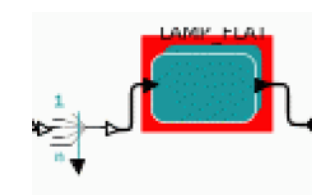


ESO Reflex: a summary of the main features

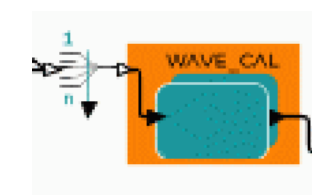


e.g. the KMOS Reflex Workflow

- to run the demonstration data set just click start: 
- to run the workflow on your own data follow the instructions to change the setup directories



high-lighted Actor shows where in the workflow you are



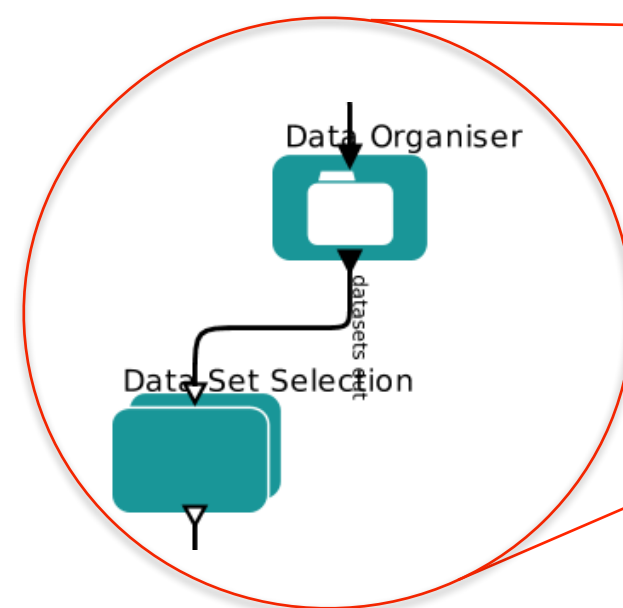
indicates an Actor with an interactive option



ESO Reflex: a summary of the main features

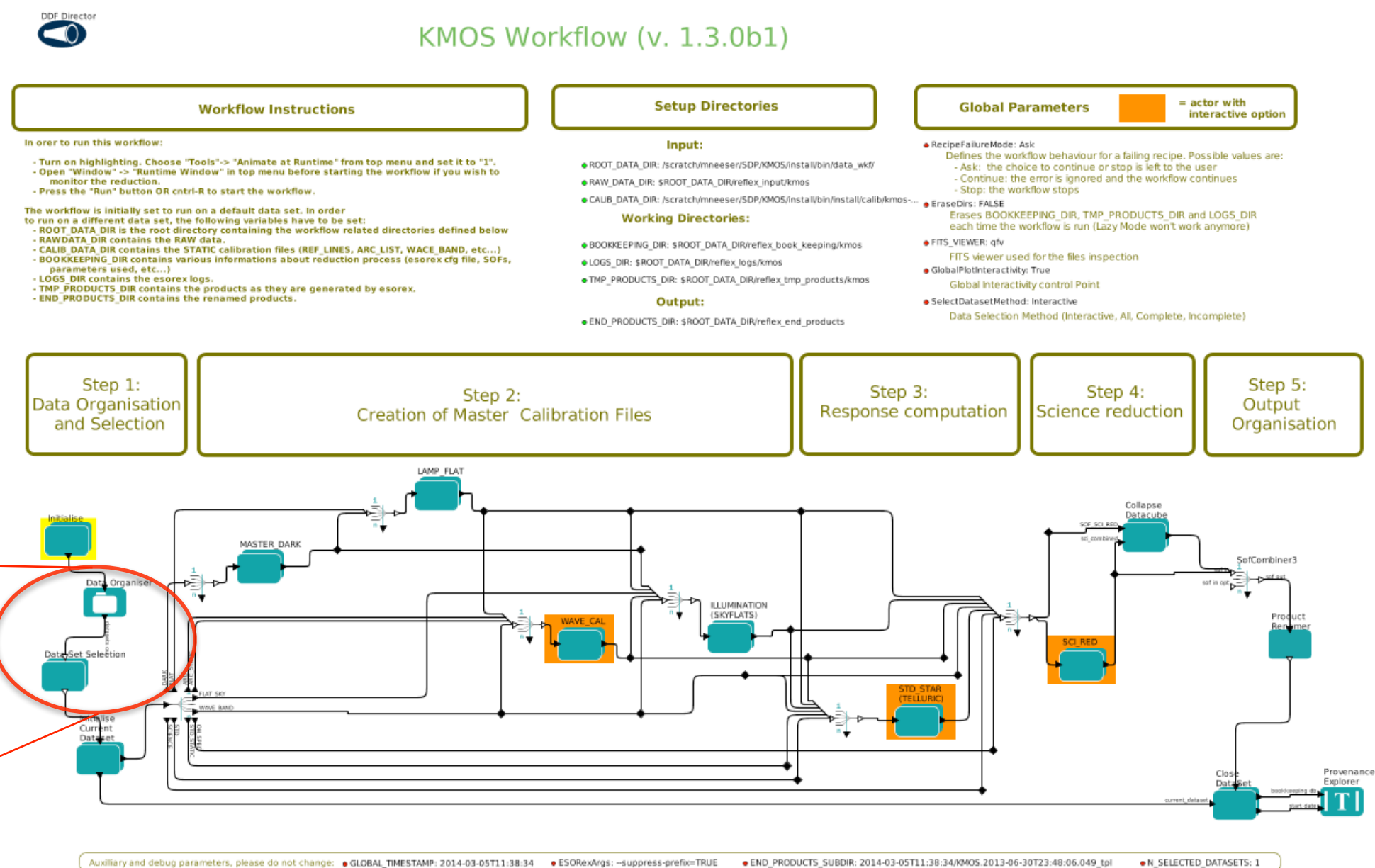
• DataOrganiser

- organises all input data (science & calibrations) into groups (datasets) that can be processed independently by the workflow.
- Each dataset has a tree structure and represents the complete calibration cascade.
- The datasets are organised, classified, and associated using the data headers
- ==> any science frame will be optimally matched to its required calibration frames (e.g. for KMOS it will:
DIT-matched darks, arc lamps, flats, ArNe
line lists, illumination correction flats, telluric standard stars, atmospheric models, spectral type look-up tables, etc.)



• DataSetSelection

- will list all unique data sets found by the DataOrganiser and allow the user to select which ones to process.





ESO Reflex: a summary of the main features

then, the pipeline processing begins:

- **Master Dark**

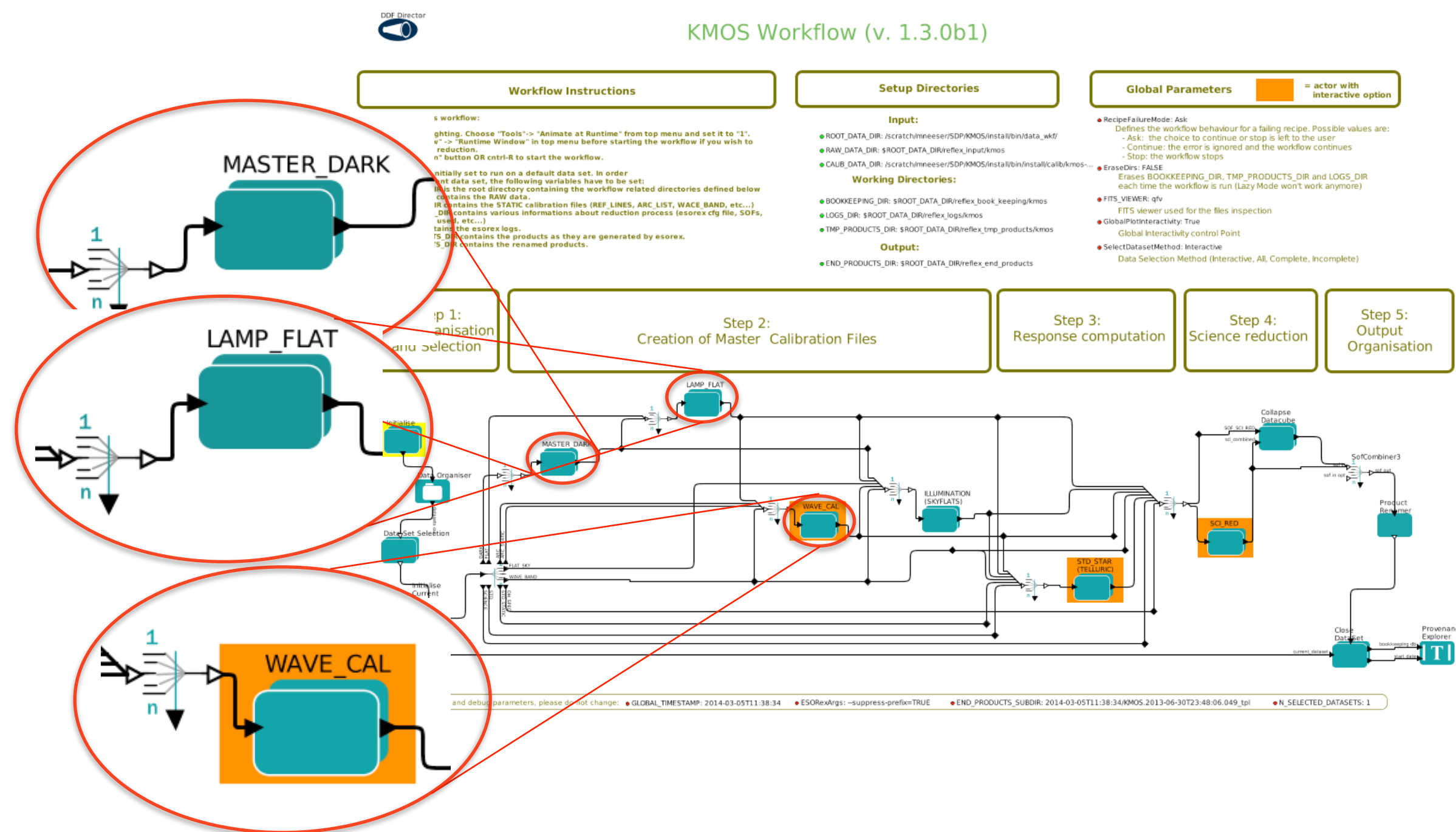
- the DIT-matched raw darks are processed into master dark frames and hot pixel masks.

- **Lamp Flat**

- the filter-matched lamp flats are processed into master flat frames and cold pixel masks.

- **Wavelength Calibration**

- a wavelength solution is found for the filter-matched arc frames, which are then processed into reconstructed arc line frames and a wavelength solution look-up frame.





ESO Reflex: a summary of the main features

Interactive Actors

- **Wavelength Calibration**

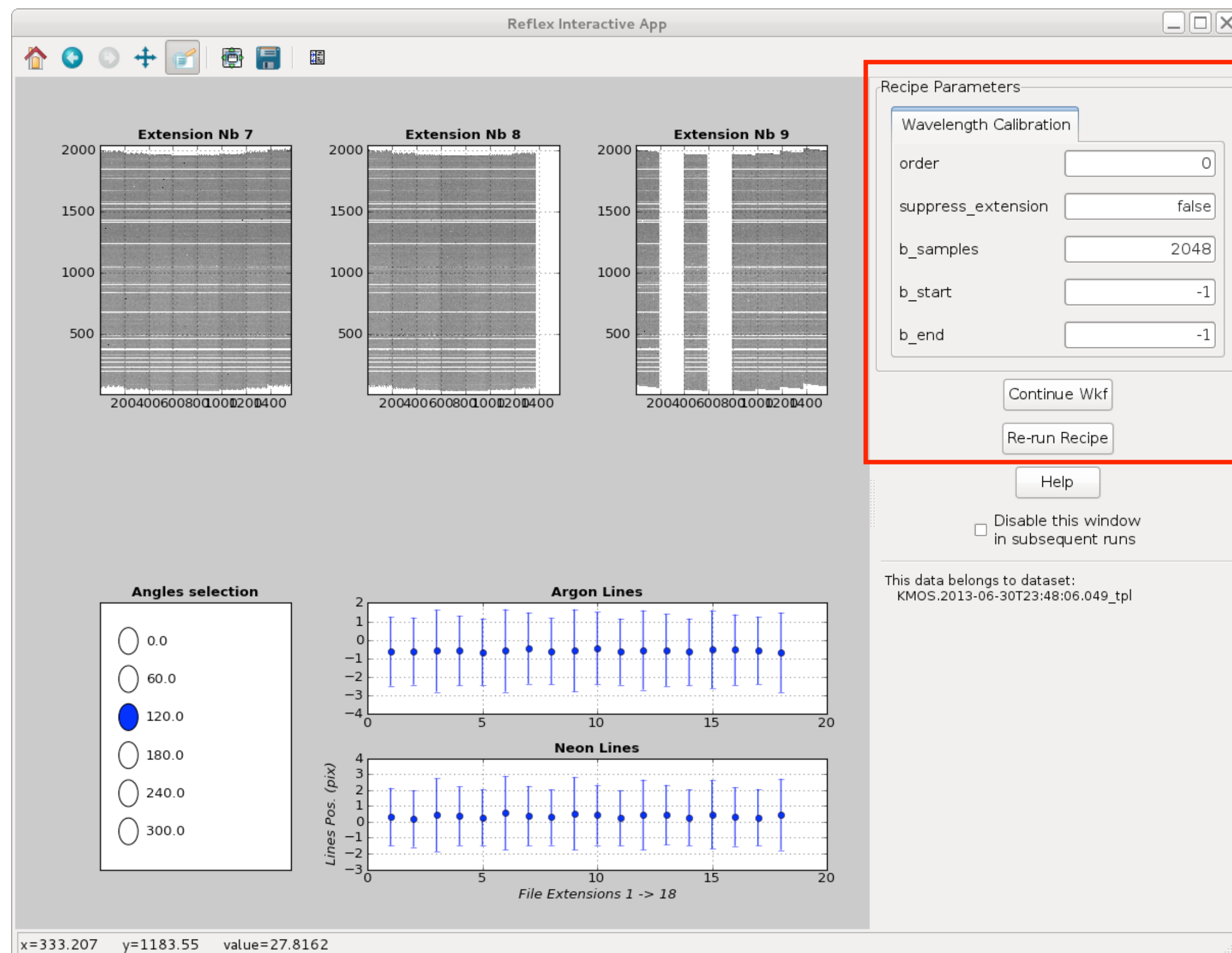
- reveals reconstructed arc lamp frames for each detector and can be selected for each of the six calibration rotator angles (0°, 60°, 120°, 180°, 240°, and 300°)

mouse-over reveals pipeline
QC keyword values

```
ESO QC ARC AR POS MEAN: -0.620317
ESO QC ARC AR FWHM MEAN: 1.867742
ESO QC ARC NE POS MEAN: 0.313877
ESO QC ARC NE FWHM MEAN: 1.823414
```

Modifiable pipeline parameters

can be changed and re-run in pipeline to
optimise results.





ESO Reflex: a summary of the main features

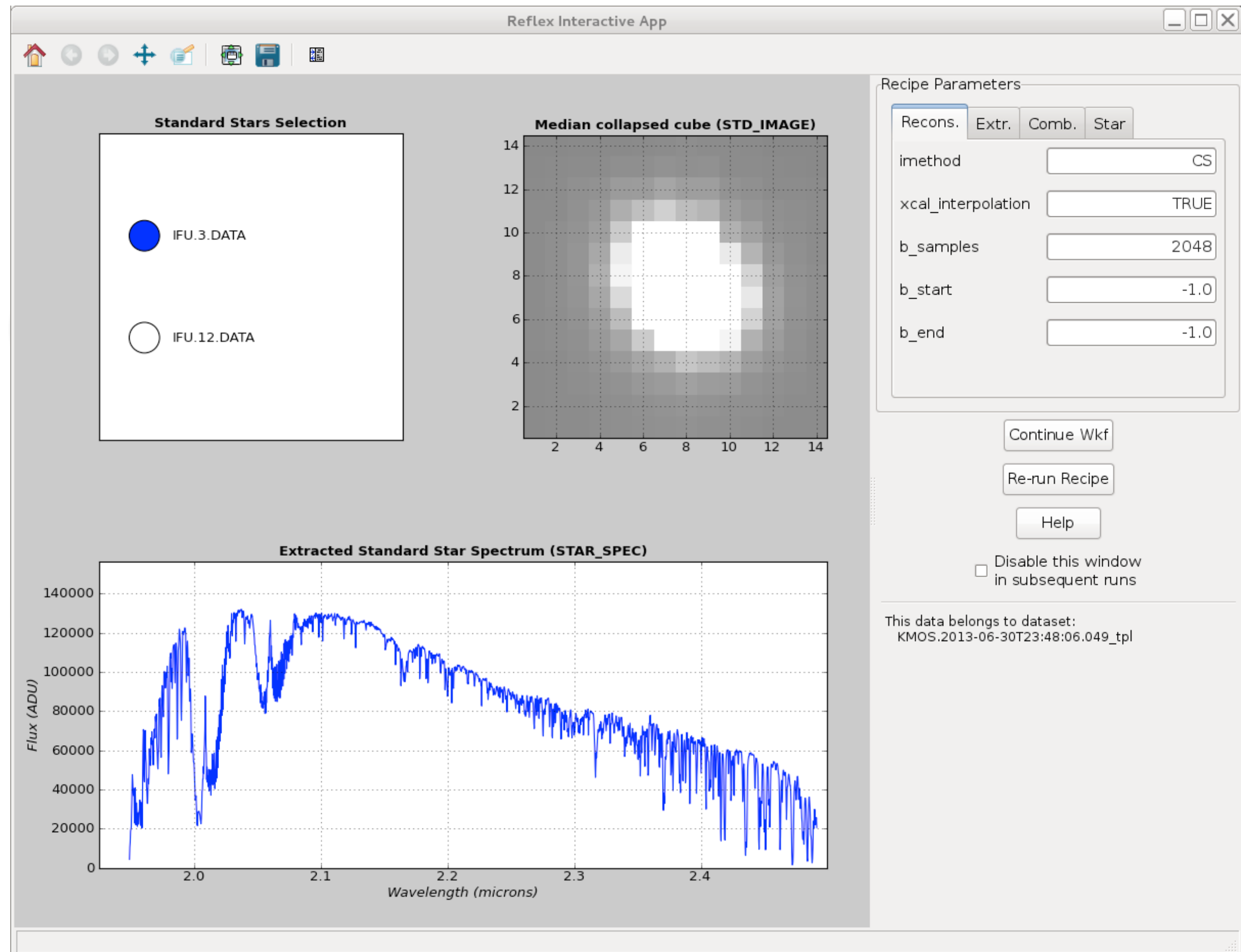
the processing continues:

- **Illumination Correction**

- filter-matched sky flats are used to compute an illumination correction for each IFU.

- **Telluric Standard Star**

- filter-matched standard star fields processed into a median cube-collapsed image and an extracted spectrum.



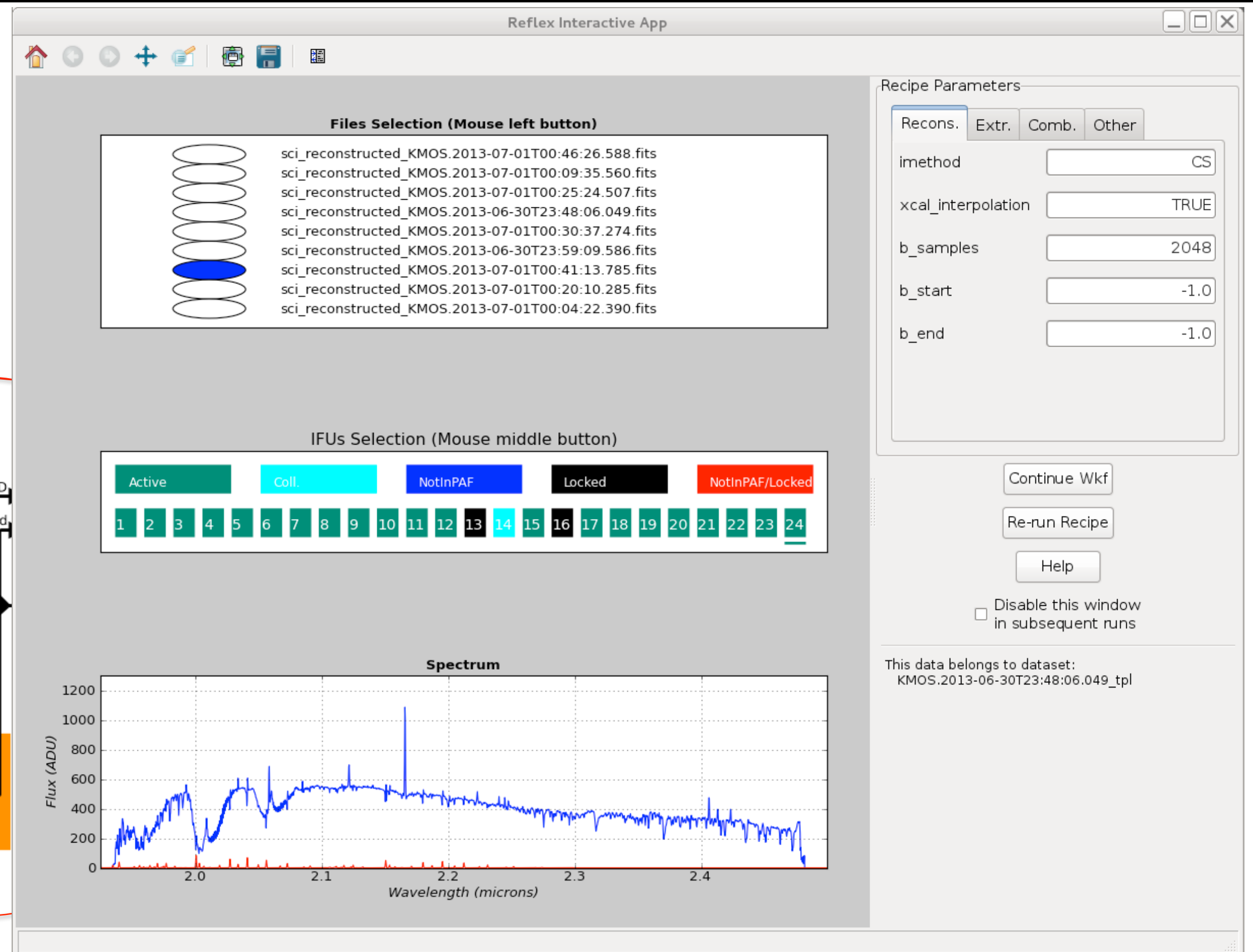
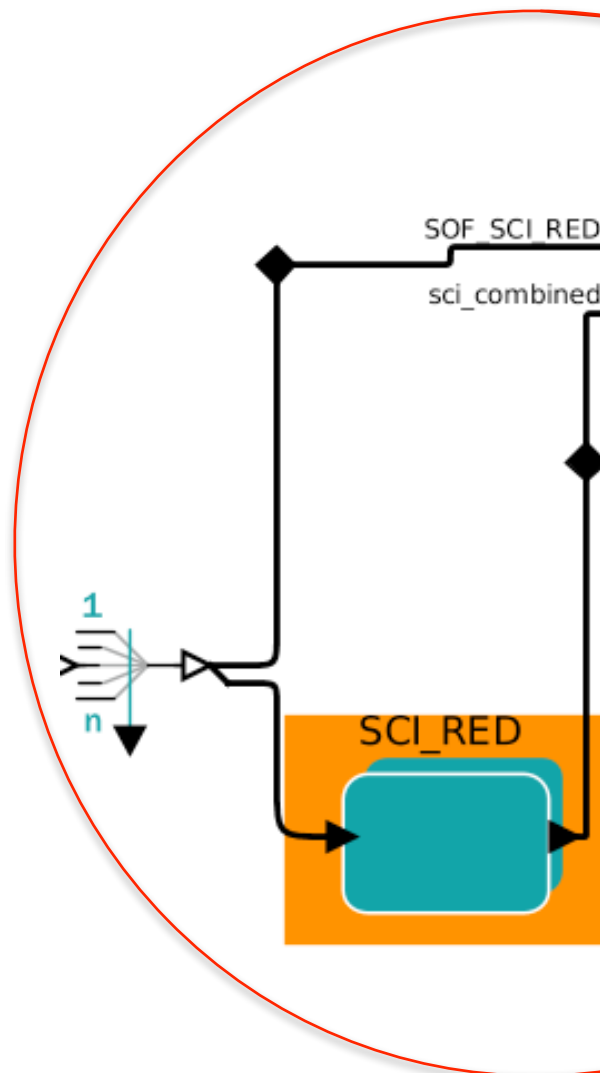


ESO Reflex: a summary of the main features

the processing continues:

- **Science Reduction**

- science frames are flat-fielded, wavelength calibrated, illumination corrected (optional), flux-calibrated (optional), reconstructed and combined.





ESO Reflex: a summary of the main features

- **Product Provenance**

- the Reflex workflow finishes with a product provenance window in which all pipeline products can be tracked to the raw & calibration frames that were used in their creation.

Product Provenance

Search products

☐ Last
☐ All
☒ From
To

Dataset	Date
❏ KMOS.2013-06-30T23:48:06.049_tpl	2013-11-12T11:37:1
❏ SCI-GUM43_MAKE_IMAGE_16.fits	
❏ SCI-GUM43_SCI_COMBINED_7.fits	
❏ SCI-GUM43_EXP_MASK_2.fits	
❏ SCI-GUM43_SCI_RECONSTRUCTED_5.fits	
❏ SCI-GUM43_MAKE_IMAGE_6.fits	
❏ SCI-GUM43_SCI_RECONSTRUCTED_8.fits	
❏ SCI-GUM43_SCI_COMBINED_1.fits	
❏ SCI-GUM43_SCI_RECONSTRUCTED_4.fits	
❏ SCI-GUM43_SCI_RECONSTRUCTED_3.fits	
❏ SCI-GUM43_SCI_COMBINED_5.fits	
❏ SCI-GUM43_MAKE_IMAGE_17.fits	
❏ SCI-GUM43_EXP_MASK_15.fits	
❏ SCI-GUM43_MAKE_IMAGE_18.fits	
❏ SCI-GUM43_SCI_RECONSTRUCTED_1.fits	
❏ SCI-GUM43_EXP_MASK_6.fits	

Provenance Tree	Category
❏ sci_reconstructed_KMOS.2013-07-01T00:25:24.507.fits	SCI_RECONSTRU
❏ KMOS.2013-06-30T23:48:06.049.fits	SCIENCE
❏ kmos_wave_band.fits	WAVE_BAND
❏ KMOS.2013-07-01T00:30:37.274.fits	SCIENCE
❏ KMOS.2013-07-01T00:09:35.560.fits	SCIENCE
❏ KMOS.2013-07-01T00:04:22.390.fits	SCIENCE
❏ KMOS.2013-07-01T00:35:55.867.fits	SCIENCE
❏ KMOS.2013-07-01T00:46:26.588.fits	SCIENCE
❏ KMOS.2013-06-30T23:53:23.571.fits	SCIENCE
❏ KMOS.2013-07-01T00:20:10.285.fits	SCIENCE
❏ KMOS.2013-07-01T00:14:52.379.fits	SCIENCE
❏ KMOS.2013-07-01T00:41:13.785.fits	SCIENCE
❏ KMOS.2013-07-01T00:25:24.507.fits	SCIENCE
❏ KMOS.2013-06-30T23:59:09.586.fits	SCIENCE
❏ master_flat_KKK.fits	MASTER_FLAT
❏ star_spec_KKK.fits	STAR_SPEC
❏ illum_corr_KKK.fits	ILLUM_CORR
❏ lcal_KKK.fits	LCAL
❏ KMOS.2013-06-27T02:48:12.603.fits	ARC_ON
❏ kmos_wave_band.fits	WAVE_BAND
❏ KMOS.2013-06-27T02:46:24.832.fits	ARC_ON
❏ KMOS.2013-06-27T02:47:18.086.fits	ARC_ON
❏ KMOS.2013-06-27T02:50:01.906.fits	ARC_ON
❏ KMOS.2013-06-27T02:49:06.959.fits	ARC_ON
❏ kmos_ar_ne_list_k.fits	ARC_LIST

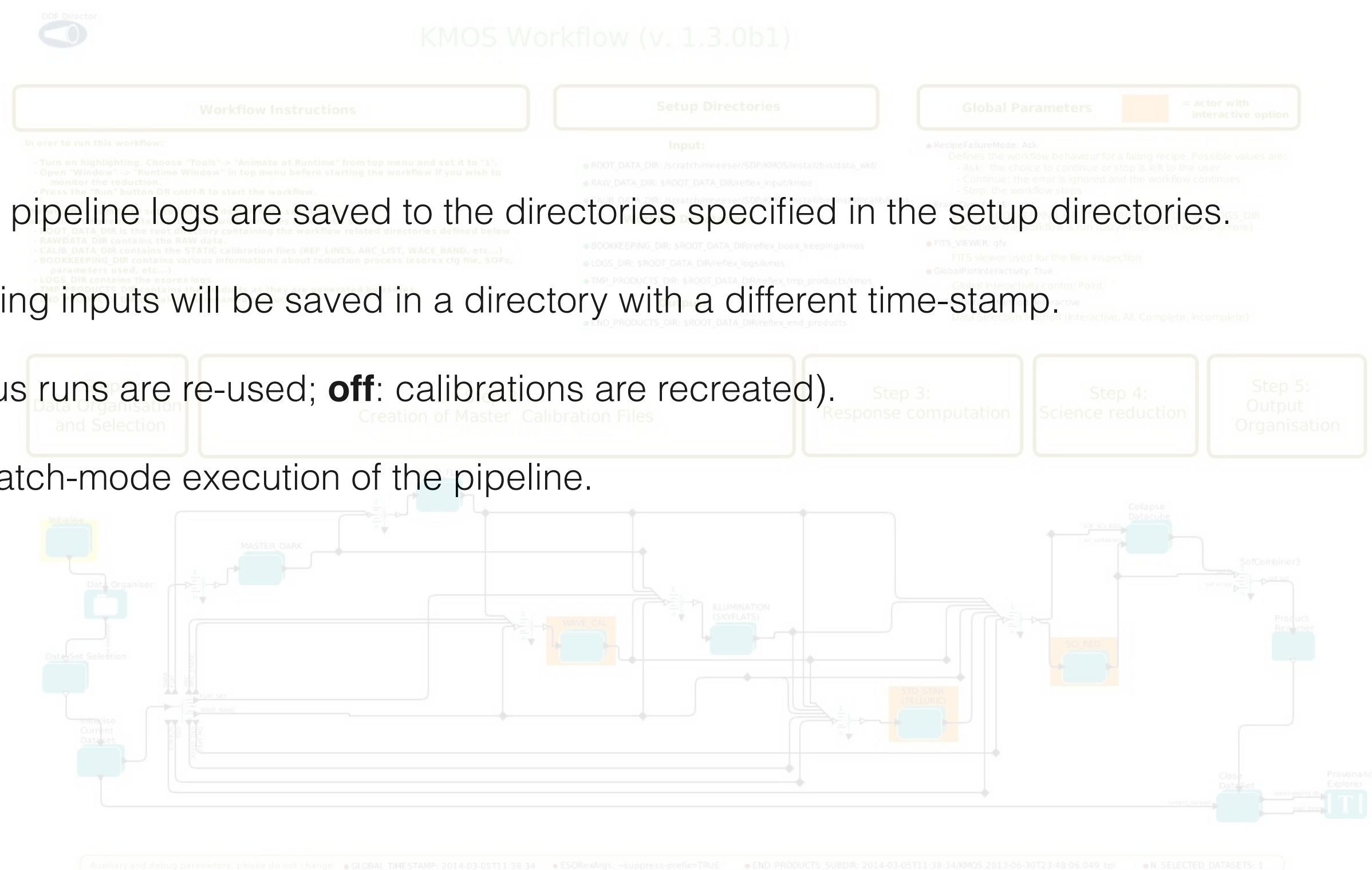
Keyword	Value
SIMPLE	T
BITPIX	8
NAXIS	0
EXTEND	T
ORIGIN	USM
DATE	2013-06-27T02:48...
TELESCOP	ESO-VLT-U1
INSTRUME	KMOS
OBJECT	WAVE,LAMP
RA	164.493074
DEC	-24.55103
EQUINOX	2000.0
RADECSYS	FK5
EXPTIME	4.0000000
MJD-OBS	56470.11681253
DATE-OBS	2013-06-27T02:48...
UTC	10092.000
LST	59287.265
PI-COI	UNKNOWN
OBSERVER	UNKNOWN
ORIGFILE	KMOS_SPEC_CAL17...
HIERARCH.ESO.ADA.A...	120.00001
HIERARCH.ESO.ADA.A...	NEG
HIERARCH.ESO.ADA.A...	119.99912
HIERARCH.ESO.ADA.G...	OFF
HIERARCH.ESO.ADA.P...	0.00000
HIERARCH.ESO.DET.A...	F
HIERARCH.ESO.DET.A...	F
HIERARCH.ESO.DET.A...	ngciracqH2RG4 -m...
HIERARCH.ESO.DET.A...	F



ESO Reflex: a summary of the main features

Results and Products:

- all pipeline products, book-keeping, and pipeline logs are saved to the directories specified in the setup directories.
- each run through the workflow with differing inputs will be saved in a directory with a different time-stamp.
- Lazy Mode (**on**: calibrations from previous runs are re-used; **off**: calibrations are recreated).
- interactive actors can be turned off for batch-mode execution of the pipeline.





ESO Reflex: a summary of the main features

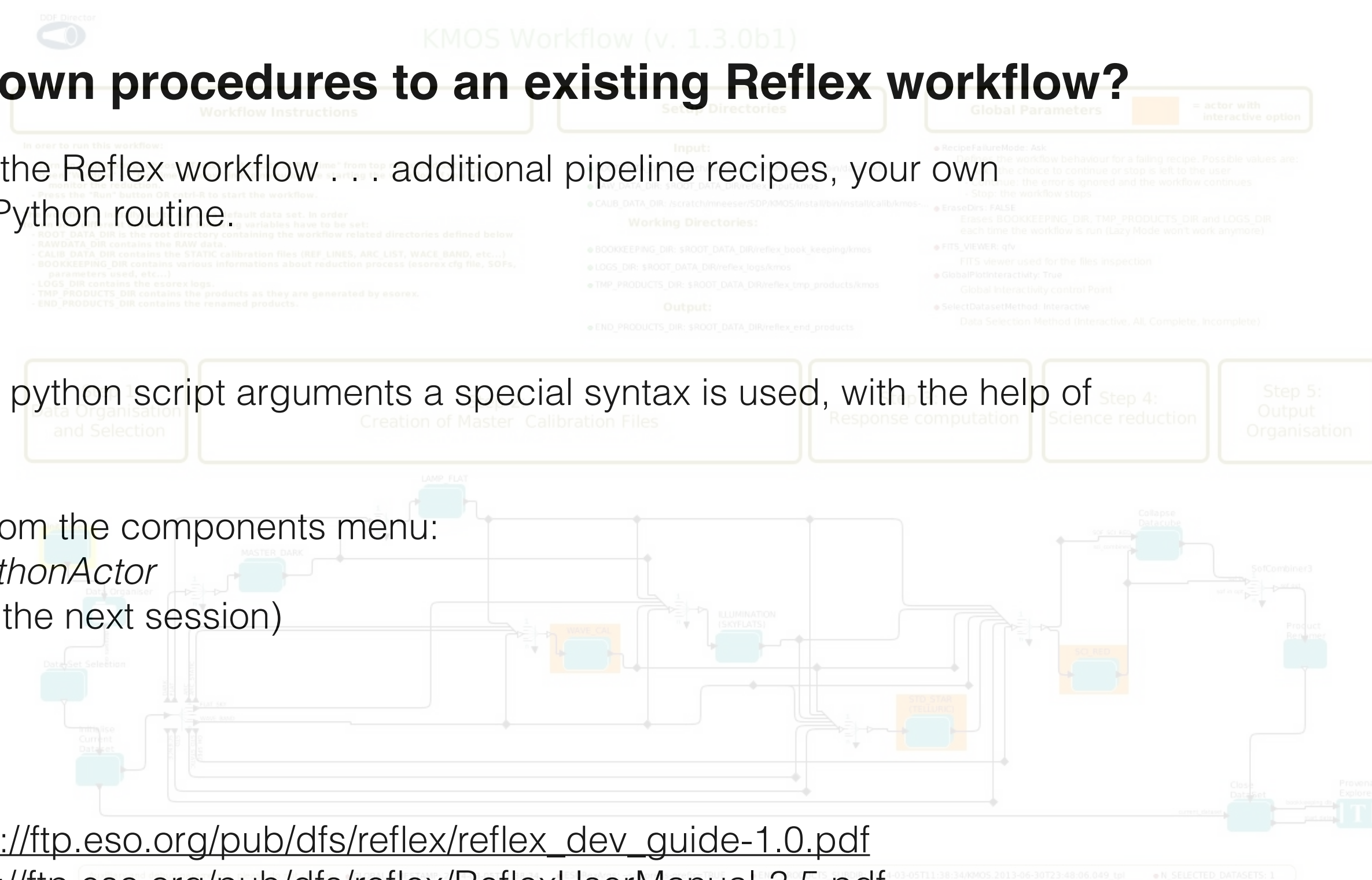
What if you want to add your own procedures to an existing Reflex workflow?

- it is possible to add your own scripts to the Reflex workflow . . . additional pipeline recipes, your own C routine, IDL script, or, easiest of all a Python routine.
- e.g. execute generic python code:
 - translate from/to Reflex ports to/from python script arguments a special syntax is used, with the help of

In an open Reflex workflow, select from the components menu:
ESO-reflex —> *Scripting.kar* —> *PythonActor*
(I will give a demonstration of this in the next session)

For more details see:

Reflex Workflow Development Guide: ftp://ftp.eso.org/pub/dfs/reflex/reflex_dev_guide-1.0.pdf
Reflex User Manual: <ftp://ftp.eso.org/pub/dfs/reflex/ReflexUserManual-3.5.pdf>





The ESO Archive and Reflex Pipeline Workflows

(or, how do I get data and process it too?)

Mark Neeser (ESO)





Outline

Part 1: In Theory

Getting Data from ESO:

- the contents of the ESO Science Archive Facility (SAF)
- how to access the archive for high-level science data or for raw data

Using Data from ESO:

- Reflex workflows and ESO pipelines
- Reflex workflow basics
- installing Reflex
- a summary of the main features of Reflex


Part 2: In Practise

A Practical Demonstration of:

- retrieving raw data from the ESO archive
- retrieving science products from the ESO archive
- running the HAWK-I Reflex workflow




A Demonstration of the ESO Archive



European
Southern
Observatory

ESO — Reaching New Heights in Astronomy



PublicScienceUser PortalIntranetContactSite Map

Go!

Science Users Information > Science Archive Facility > Data Portal

30 Jul 2015

Science Archive Facility

Data Portal

User Portal Login

Data Access Control

ESO Data

Hubble Space Telescope Data

Virtual Observatory Tools

Catalogues, Plates and DSS

Tools and Documentation

Related External Services

ESO & HST Image Galleries

News and Updates

FAQ

ESO Data Access Policy

Data Portal

The ESO Science Archive Facility contains data from ESO telescopes at La Silla Paranal Observatory, including the APEX submillimeter telescope on Llano de Chajnantor. In addition, the raw UKIDSS/WFCAM data obtained at the UK Infrared Telescope facility in Hawaii are available.

The Principal Investigators of successful proposals for time on ESO telescopes have exclusive access to their scientific data for the duration of a proprietary period, normally of one year, after which the data becomes available to the community at large. Please read the [ESO Data Access Policy](#) statement for more information, along with the [relevant FAQs](#).

Browsing the archive does not require authentication, but to request and download data you have to log in to the [ESO User Portal](#). Please [acknowledge the use of archive data](#) in any publication.

Latest News and Updates

- New Release of Gaia-ESO Spectroscopic Public Survey Data (22 Jul 2015)
- Processed calibration files for VLT instruments now available in ESO Archive (20 Jul 2015)
- New user guide describing the reduced data products accessible via the ESO Science Archive Facility published (18 May 2015)

More news ...

To browse the archive

Currently, **raw data** and various types of **data products** can be reached via different interfaces:

Category	Access Point	Data collection	Data Type	Instruments
LPO Raw Data	Raw data query form (all instruments) Instrument specific query forms Direct retrieval of raw data by file name	All ESO raw data	Various	Many La Silla Paranal instruments
LPO Data Products <i>[Description of reduced data products types]</i>	Phase 3 main query form Phase 3 imaging query form Phase 3 spectral query form Phase 3 VIRCAM-specific query form	Phase 3 Data Products (ESO public surveys; ESO pipeline-reduced products; Large programs: GOODS, zCOSMOS; etc.)	Currently, Imaging and Spectroscopy	Various Pipeline products for UVES, XSHOOTER, HARPS, and more to come.
	Catalogue Facility query interface	Phase 3 Catalogues [ESO User Portal authentication required also when browsing]	Catalogues	Various
	FEROS and HARPS-Polarimetry pipeline processed data query form	FEROS and HARPS-Polarimetry pipeline processed data	Spectroscopy	FEROS, HARPS-Polarimetry, HARPS reduced calibrations (other HARPS see Phase3 above)
	Other Advanced Data Products (available only as downloadable packages, no query form)	Various (30 Doradus, Corot, GaBoDs, etc.)	Spectroscopy Imaging Flux maps	FEROS WFI APEX
	Science Verification, Commissioning, EIS, etc. (no query form)	Full list of available data packages	Various	Many
APEX Quick Look Products	APEX query form	APEX	Heterodyne, Bolometer	APEX-2A, LABOCA, SABOCA, SHeFI
LPO Schedule	Scheduling query form	ESO Observing Programme Information and Scheduling		All La Silla Paranal instruments, including APEX
ALMA Data	ALMA Science Archive	All ALMA data	Cube	ALMA

archive.eso.org

ESO/IAU-Opticon Summer School 2015



A Demonstration of the HAWK-I Reflex Workflow

