EUROPEAN SOUTHERN OBSERVATORY

Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral

Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

VERY LARGE TELESCOPE

Reflex KMOS Tutorial

VLT-MAN-ESO-19500-....

Issue 0.5

Date 2013-06-25

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Released:			
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Change record

Issue/Rev.	Date	Section affected	Reason/Initiation/Documents/Remarks
0.1	2013-06-25	All	first release.
0.2	2013-07-15	§3	Description of demo data.
0.5	2013-09-20	§7 §6	Revision of product data description and description of interactive mode.

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Contents

1 Introduction And Scope

Reflex is the ESO Recipe Flexible Execution Workbench, an environment to run ESO VLT pipelines which employs a workflow engine (Kepler[1]) to provide a real-time visual representation of a data reduction cascade, called a workflow, which can be easily understood by most astronomers. This document is a preliminary tutorial designed to enable the user to employ the KMOS workflow to reduce his/her data in a user-friendly way.

A workflow accepts science and calibration data, as delivered to PIs in the form of PI-Packs (until October 2011) or downloaded from the archive using the CalSelector tool[2] and organises them into DataSets, where each DataSet contains one science object observation (possibly consisting of several science files) and all associated raw and static calibrations required for a successful data reduction. The data organisation process is fully automatic, which is a major time-saving feature provided by the software. The DataSets selected by the user for reduction are fed through the workflow which executes the relevant pipeline recipes (or stages) in the correct order. Full control of the various recipe parameters is available within the workflow, and the workflow deals automatically with optional recipe inputs via built-in conditional branches. Additionally, the workflow stores the reduced final data products in a logically organised directory structure and employing user-configurable file names. This tutorial deals with the reduction of KMOS IFU observations only via the KMOS Reflex workflow. The user is referred to the KMOS user manual (Cirasuolo 2013[3]). More information on the instrument itself as well as a summary of available documentation, recent news, and tools, can be found at the ESO instrument web pages [4]. A brief description of the KMOS data flow is given in Davies 2012[5])

The quick start section (see Section 4) describes the minimum effort to get started, and it makes up only two pages of text in this tutorial. User support for this software is available by sending enquiries to usd-help@eso.org.

[1]https://kepler-project.org
[2]http://www.eso.org/sci/archive/calselectorInfo.html
[3]available at: http://www.eso.org/sci/facilities/paranal/instruments/kmos/doc
[4]http://www.eso.org/sci/facilities/develop/instruments/kmos.html
[5]available at: http://www.mpe.mpg.de/389507/davies-7735-254x.pdf

2 Software Installation

The software pre-requisites for `Reflex 2.4` may be found at:
`http://www.eso.org/sci/software/pipelines/reflex_workflows/`.

To install the `Reflex 2.4` software and demo data, please follow these instructions:

1. From any directory, download the installation script:

   ```
   wget ftp://ftp.eso.org/pub/dfs/reflex/install_reflex
   ```

2. Make the installation script executable:

   ```
   chmod u+x install_reflex
   ```

3. Execute the installation script:

   ```
   ./install_reflex
   ```

   and the script will ask you to specify three directories: the download directory `<download_dir>`, the software installation directory `<install_dir>`, and the directory to be used to store the demo data `<data_dir>`. If you do not specify these directories, then the installation script will create them in the current directory with default names.

4. You will be given a choice of pipelines to install. Please specify the numbers for the pipelines you require, separated by a space, or type "A" for all pipelines.

5. To start `Reflex`, issue the command:

   ```
   <install_dir>/bin/reflex
   ```

   It may also be desirable to set up an alias command for starting the `Reflex` software, using the shell command `alias`. Alternatively, the `PATH` variable can be updated to contain the `<install_dir>/bin` directory.

3 Demo Data

Together with the pipeline you will also recieve a demo data set, that allows you to run the `Reflex KMOS` workflow without any changes in parameters. This way you have a data set to experiment with before you start to work on your own data.

Note that you will need a minimum of ~5 GB, ~9 GB and ~2.5 GB of free disk space for the directories <download_dir>, <install_dir> and <data_dir>, respectively.

The raw input consists of a single SCIENCE OB of the HII, star-formation region Gum 43 (RCW 65) executed in NOD to SKY mode, and includes the raw calibration frames: darks, lamp flats, arc lamps, and flux standards. The static calibration files (arc line lists, atmosphere model, OH spectral lines, and arc reference lines) are included in the pipeline distribution. The raw tutorial data set is summarized in table 3.1.

Table 3.1: The KMOS Reflex workflow tutorial data set

File	DPR.CATG	DPR.TYPE	INS.GRAT1.ID	DET.SEQ1.DIT
KMOS.2013-06-27T02:30:02.036.fits	CALIB	FLAT,OFF	K	3.0000000
KMOS.2013-06-27T02:30:13.935.fits	CALIB	FLAT,OFF	K	3.0000000
KMOS.2013-06-27T02:30:26.009.fits	CALIB	FLAT,OFF	K	3.0000000
KMOS.2013-06-27T02:33:25.442.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:33:37.272.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:33:49.244.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:34:42.585.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:34:54.500.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:35:06.539.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:35:59.909.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:36:11.744.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:36:23.588.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:37:17.002.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:37:27.878.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:37:40.018.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:38:33.399.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:38:45.321.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:38:57.219.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:39:50.556.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:40:02.535.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:40:14.442.fits	CALIB	FLAT,LAMP	K	3.0000000
KMOS.2013-06-27T02:42:34.927.fits	CALIB	WAVE,OFF	K	4.0000000
KMOS.2013-06-27T02:45:31.613.fits	CALIB	WAVE,LAMP	K	4.0000000
KMOS.2013-06-27T02:46:24.832.fits	CALIB	WAVE,LAMP	K	4.0000000
KMOS.2013-06-27T02:47:18.086.fits	CALIB	WAVE,LAMP	K	4.0000000
KMOS.2013-06-27T02:48:12.603.fits	CALIB	WAVE,LAMP	K	4.0000000
KMOS.2013-06-27T02:49:06.959.fits	CALIB	WAVE,LAMP	K	4.0000000
KMOS.2013-06-27T02:50:01.906.fits	CALIB	WAVE,LAMP	K	4.0000000
KMOS.2013-06-28T22:21:22.894.fits	CALIB	FLAT,SKY	K	5.0000000
KMOS.2013-06-28T22:21:57.131.fits	CALIB	FLAT,SKY	K	30.0000000
KMOS.2013-06-28T22:22:36.403.fits	CALIB	FLAT,SKY	K	30.0000000
KMOS.2013-06-28T22:23:14.587.fits	CALIB	FLAT,SKY	K	30.0000000
KMOS.2013-06-29T05:25:36.594.fits	CALIB	OBJECT,SKY,STD,FLUX	K	10.0000000
KMOS.2013-06-29T05:26:08.050.fits	CALIB	OBJECT,SKY,STD,FLUX	K	10.0000000
KMOS.2013-06-29T05:26:34.039.fits	CALIB	OBJECT,SKY,STD,FLUX	K	10.0000000
KMOS.2013-06-30T14:52:42.168.fits	CALIB	DARK	YJ	100.0000000
KMOS.2013-06-30T14:54:30.888.fits	CALIB	DARK	YJ	100.0000000
KMOS.2013-06-30T14:56:19.580.fits	CALIB	DARK	YJ	100.0000000
KMOS.2013-06-30T14:58:08.242.fits	CALIB	DARK	YJ	100.0000000
KMOS.2013-06-30T14:59:56.907.fits	CALIB	DARK	YJ	100.0000000
KMOS.2013-06-30T23:48:06.049.fits	SCIENCE	OBJECT,SKY	K	300.0000000
KMOS.2013-06-30T23:53:23.571.fits	SCIENCE	OBJECT,SKY	K	300.0000000
KMOS.2013-06-30T23:59:09.586.fits	SCIENCE	OBJECT,SKY	K	300.0000000
KMOS.2013-07-01T00:04:22.390.fits	SCIENCE	OBJECT,SKY	K	300.0000000
KMOS.2013-07-01T00:09:35.560.fits	SCIENCE	OBJECT,SKY	K	300.0000000
KMOS.2013-07-01T00:14:52.379.fits	SCIENCE	OBJECT,SKY	K	300.0000000
KMOS.2013-07-01T00:20:10.285.fits	SCIENCE	OBJECT,SKY	K	300.0000000
KMOS.2013-07-01T00:25:24.507.fits	SCIENCE	OBJECT,SKY	K	300.0000000
KMOS.2013-07-01T00:30:37.274.fits	SCIENCE	OBJECT,SKY	K	300.0000000
KMOS.2013-07-01T00:35:55.867.fits	SCIENCE	OBJECT,SKY	K	300.0000000
KMOS.2013-07-01T00:41:13.785.fits	SCIENCE	OBJECT,SKY	K	300.0000000
KMOS.2013-07-01T00:46:26.588.fits	SCIENCE	OBJECT,SKY	K	300.0000000

4 Quick Start: Reducing The Demo Data

For the user who is keen on starting reductions without being distracted by detailed documentation, we describe the steps to be performed to reduce the science data provided in the KMOS demo data set supplied with the `Reflex 2.4` release. By following these steps, the user should have enough information to attempt a reduction of his/her own data without any further reading:

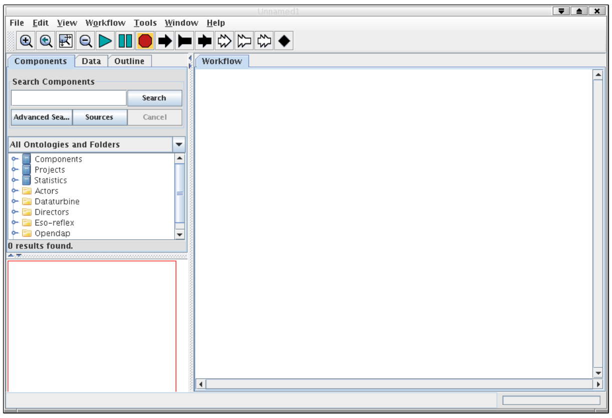

Figure 4.0.1: *The empty* `Reflex` *canvas.*

1. Start the `Reflex` application:

   ```
   reflex &
   ```

   The empty `Reflex` canvas as shown in Figure 4.0.1 will appear.

2. Now open the KMOS workflow by clicking on `File -> Open File`, selecting the file `Kmos.xml` in the file browser. You will be presented with the workflow canvas shown in Figure 4.0.2. Note that the workflow will appear as a canvas in a new window.

3. To aid in the visual tracking of the reduction cascade, it is advisable to use component (or actor) highlighting. Click on `Tools -> Animate at Runtime`, enter the number of milliseconds representing the animation interval (100 ms is recommended), and click `OK`.

4. Under "Setup Directories" in the workflow canvas there are seven parameters that specify important directories (green dots). Setting the value of `ROOT_DATA_DIR` is the only necessary modification if you want to process data other than the demo data[6], since the value of this parameter specifies the working directory within which the other directories are organised. Double-click on the parameter `ROOT_DATA_DIR` and a pop-up window will appear allowing you to modify the directory string, which you may either edit directly, or use the `Browse` button to select the directory from a file browser. When you have finished, click `OK` to save your changes.

[6] If you used the install script `install_reflex`, then the value of the parameter `ROOT_DATA_DIR` will already be set correctly to the directory where the demo data was downloaded.

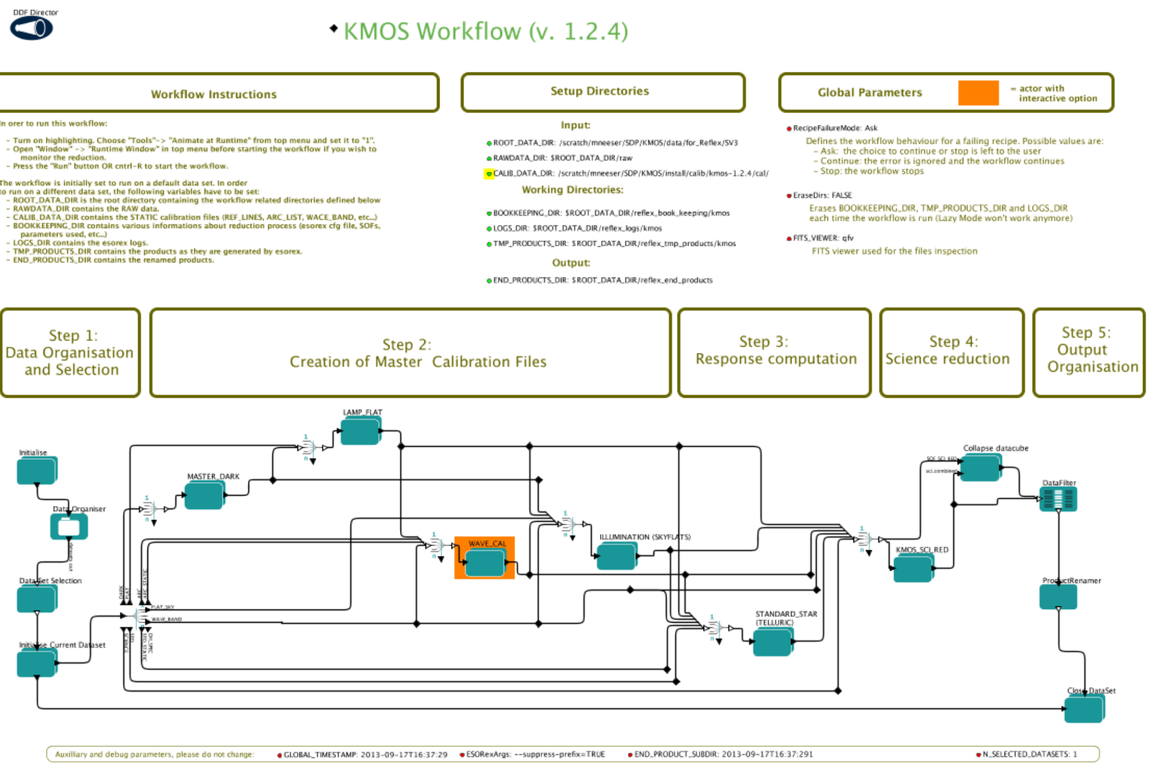

Figure 4.0.2: *KMOS workflow general layout.*

5. Click the ▷ button to start the workflow

6. The workflow will highlight the `Data Organiser` actor which recursively scans the raw data directory (specified by the parameter `RAWDATA_DIR` under "Setup Directories" in the workflow canvas) and constructs the DataSets. Note that the calibration and reference data must be present either in `RAWDATA_DIR` or in `CALIB_DATA_DIR`, otherwise DataSets may be incomplete and cannot be processed.

7. The `Data Set Chooser` actor will be highlighted next and will display a "Select Datasets" window (see Figure 4.0.3) that lists the DataSets along with the values of a selection of useful header keywords[7] namely the object name, OB execution number (OBS.ID), data category (DPR.CATG), data type (DPR.TYPE), and the filter and grism used (INS.FILT1.ID and INS.GRAT1.ID). The first column consists of a set of tick boxes which allow the user to select the DataSets to be processed, and by default all DataSets are selected.

8. Click the `Continue` button and watch the progress of the workflow by following the red highlighting of the actors. A window will show which DataSet is currently being processed.

[7] The keywords listed can be changed by right-clicking on the `DataOrganiser` Actor, selecting `Configure Actor`, and then changing the list of keywords in the second line of the pop-up window. Make sure that the `Lazy Mode` is not active and then click on `Commit` to save the change.

Figure 4.0.3: *The "Select Datasets" pop-up window.*

The final products of the reduction pipeline can be found in the directory `END_PRODUCT_DIR` that is defined in the "Setup Directories" section at the top of the workflow. The KMOS reconstructed science cubes can best be viewed using the CASA viewer tool. The tool can be downloaded from http://www.eso.org/sci/software/pipelines/ (see the entry "CASA 3D Viewer"). Loading the science data product labelled `SCI-GUM43_SCI_COMBINED.fits` should show a strong source through the data cube.

Intermediate pipeline products can be found in subdirectories of the `TMP_PRODUCT_DIR`.

Well done! You have successfully completed the quick start section and you should be able to use this knowledge to reduce your own data.

5 Reducing Science Verification Data

To reduce science verification data, simply change the path to the raw data directory defined at the top of the workflow labelled `Setup Directories` by double clicking on `RAW_DATA_DIR`. Then just re-run the workflow as for the tutorial demo data.

6 Optimising Your Results Through Workflow Interaction

In this section, we use the information from section 4 along with the KMOS demo data supplied with `Reflex2.4` to illustrate how to optimise the scientific products in terms of quality and S/N. This is work in progress and the contents of this section will grow as we gain experience and add functionality. Optimising the results is achieved by interaction with the workflow actors via interactive windows displayed at key data reduction points in the data flow, which enable iteration of certain recipes in order to obtain better results.

We recommend that the user has already carried out the reductions for all demo DataSets as described in Section 4, although this is not a pre-requisite to following this section. By doing this, the user will be taking advantage of the workflow Lazy Mode, with minimal waiting time between various pipeline recipe executions.

Please follow these steps in order to optimise the reductions for the KMOS demo data:

1. Carry out the first four steps described in the Quick Start Section 4.

2. In the KMOS workflow, the one interactive actor `Wavelength Calibration (WAVE_CAL)` is identifiable by an orange rectangle encompassing the actor name. The interactive mode is enabled by default. Should you wish to change that use `Open Actor` to get access to the the components of the interactive actors, then double-click on the composite actors, setting the "EnableInteractivity" parameter to `false`, and clicking `Commit` to save the changes to the workflow.

3. `Wavelength Calibration`: Figure 6.0.4 shows interactive window that will pop-up at the end of the execution of the *kmo_wave_cal* pipeline routine. The image panels at the top of the window show the reconstructed arc frames for each of the three detectors, at each of the six rotator angles (0, 60, 120, 180, 240, and 300 degrees). For each of these 18 frames, the relative average offset of the reconstructed arc lines are plotted in units of km/s for each of the Argon and Neon arc lines (bottom two plots).

   On the right-hand edge of the interactive window the user may modify a number of parameters to improve the wavelength calibration. The parameters and their description is given in table 6.1. If parameters have been changed, then clicking on the `Re-run Recipe` will re-exectute the *kmo_wave_cal* pipeline routine.

Table 6.1: Parameters that a user can manipulate within the `WAVE_CAL` interactive window

Parameter[1]	Value (default)	Explanation
–order	`0`	The polynomial order to use for the fit of the wavelength solution. The appropriate order is chosen automatically depending on the waveband. Otherwise an order of 6 is recommended, except for IZ-band, there order 4 should be used
–dev_flip	`FALSE`	Set this parameter to `TRUE` if the wavelengths are ascending on the detector from top to bottom
–dev_disp	`-1`	The expected dispersion of the wavelength in microns/pixel. If the default is not changed it will automatically be selected upon header keywords
–suppress_extension	`FALSE`	Suppress arbitrary filename extension. (if `TRUE` (apply) or `FALSE` (do not apply)
–b_samples	`2048`	The number of samples in wavelength for the reconstructed cube
–b_start	`-1`	The lowest wavelength [μm] to take into account when reconstructing (default of `-1` sets the proper value for the actual band automatically)
–b_end	`-1`	The highest wavelength [μm] to take into account when reconstructing (default of `-1` sets the proper value for the actual band automatically)

[1] All parameters, available to the *kmo_wave_cal* pipeline routine, have been included for use in the `WAVE_CAL` interactive window.

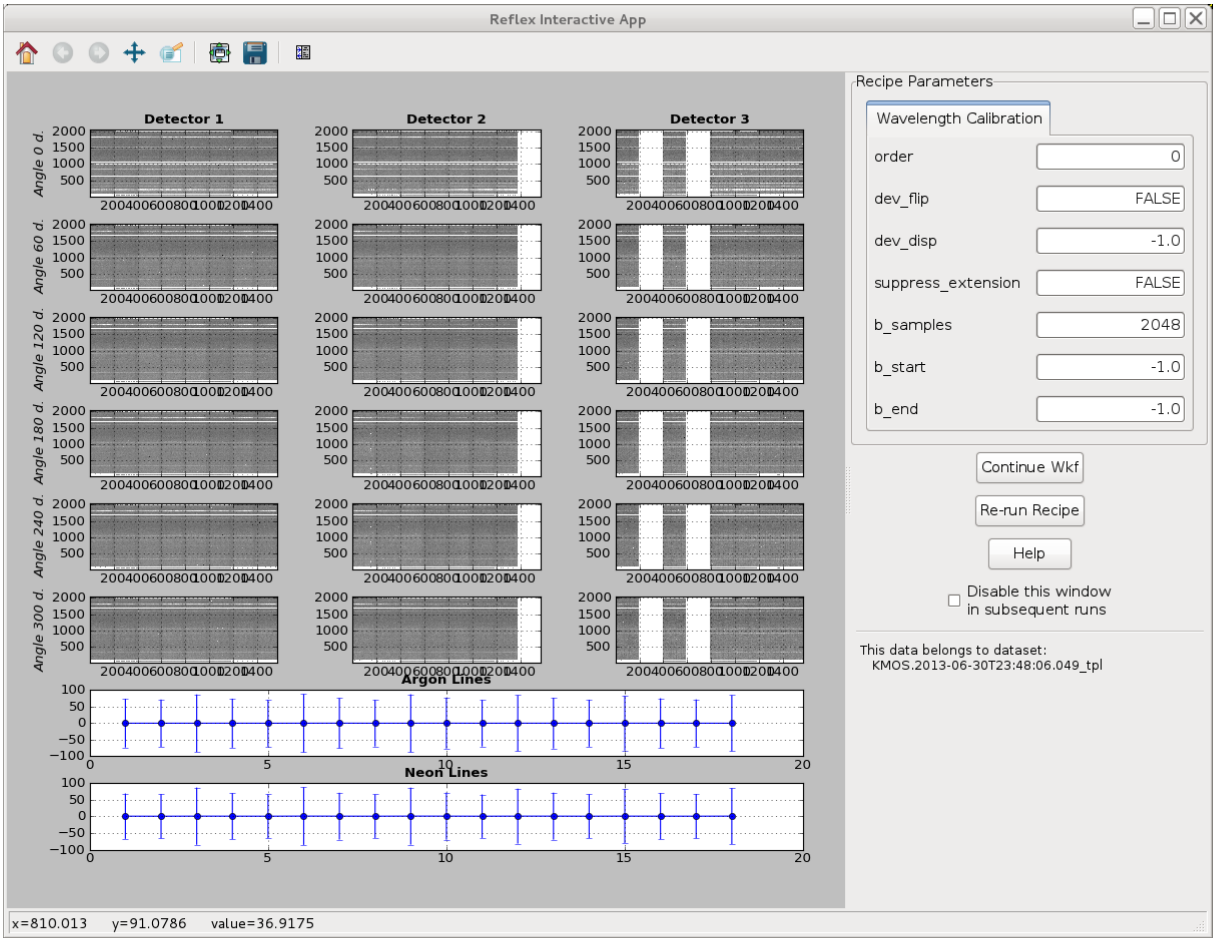

Figure 6.0.4: *The interactive window for the* `Wavelength Calibration` *actor for the KMOS tutorial data set..*

4. `In Development:` In future iterations of the KMOS Reflex workflow we will include interactive actors for the optimisation of the standard star and the science processing routines. Furthermore, a window will be designed that allows the user to view the status of each KMOS IFU (i.e. *active*, *not in PAF*, *locked*, etc.) and to select for which IFU data products should be displayed.

5. The panel of buttons at the top-left of the interactive window may be used to manipulate the displayed plots. The buttons have the following functions:

   -  - Reset all the plot ranges to their original values.
   -  - Undo the last modification of the plot ranges (if possible).
   -  - Redo the next modification of the plot ranges (if possible).
   -  - Selecting this button allows the user to use the mouse to shift the plot ranges by left-clicking on the target plot canvas and then dragging the mouse around while keeping the left mouse button held down, and releasing when ready.

-  - Selecting this button allows the user to zoom in on each plot by left-clicking on the target plot canvas to mark the top-left corner of a rectangle and then dragging the mouse to the bottom-right corner of the rectangle and releasing. The plot ranges will then be modified to match the rectangle that was defined. The following constraints can be made by holding simultaneously a key while pressing the left mouse button:

Constrain pan/zoom to x axis	hold X
Constrain pan/zoom to y axis	hold Y
Preserve aspect ratio	hold Ctrl

-  - Clicking this button opens a “Configure subplots” window that allows the user to adjust the spacing and positioning of the individual plots.
-  - Clicking this button opens a “Save to file” window which allows the user to save a screenshot of the current interactive window.
-  - Clicking this button allows the user to change the display levels of the 2-dimensional merged image by clicking on pixels within the 2-dimensional image (similar to `ds9`).

Use these buttons to inspect the plots in the interactive window in more detail.

6. Once the user is satisfied with the results, then clicking on the `Continue Wkf` button will continue with the rest of the workflow.

7. As noted in the Quick Start Section 4, the workflow will then proceed through its remaining processing steps and write out all pipeline products to the end products directory (specified by the parameter `END_PRODUCTS_DIR` under “Setup Directories” in the workflow canvas). The science data products from the tutorial data set are summarized in section 7 in table 7.2. The intermediate pipeline calibration products can be found in subdirectories of the `TMP_PRODUCT_DIR` and are summarized in section 7 and in table 7.1.

7 KMOS Reduced Data Description

A number of intermediate pipeline products from the tutorial data set can be found in subdirectories of the TMP_PRODUCT_DIR. These master calibration files are summarized in table 7.1.

Table 7.1: The KMOS Reflex workflow tutorial data set: calibration products

File	PRO.CATG	Description
kmos_dark:		
badpixel_dark.fits	BADPIXEL_DARK	preliminary bad pixel map (hot pixels)
master_dark.fits	MASTER_DARK	master dark frame including a noise map
kmos_flat:		
badpixel_flat_KKK.fits	BADPIXEL_FLAT	master bad pixel map (hot + cold pixels)
flat_edge_KKK.fits	FLAT_EDGE	fits table defining the edges of each IFU pseudo slit as derived from the screen flat frames
master_flat_KKK.fits	MASTER_FLAT	master flat-field frame including noise map
xcal_YJYJYJ.fits	XCAL	spatial solution lookup frame
ycal_YJYJYJ.fits	YCAL	spatial solution lookup frame
kmos_wave:		
det_img_wave_KKK.fits	DET_IMG_WAVE	resampled image of reconstructed arc frame
lcal_KKK.fits	LCAL	wavelength solution lookup frame
kmos_illum:		
illum_corr_KKK.fits	ILLUM_CORR	illumination correction to flat-filed
skyflat_edge_KKK.fits	SKYFLAT_EDGE	fits table defining the edges of each pseudo slit IFU as derived from the sky flat frames
kmos_std:		
star_spec_KKK.fits	STAR_SPEC	extracted star spectrum
std_image_KKK.fits	STD_IMAGE	collapsed standard star cube image
std_mask_KKK.fits	STD_MASK	masked pixels within the collapsed standard star cube image
telluric_KKK.fits	TELLURIC	normalized telluric spectrum including noise map

The final products of the reduction pipeline can be found in the directory END_PRODUCT_DIR that is defined in the “Setup Directories” section at the top of the workflow.

The science data products from the tutorial data set are summarized in table 7.2.

Table 7.2: The KMOS Reflex workflow science products from the tutorial data set (all K-band)

File	PRO.CATG	Description
SCI-GUM43_MAKE_IMAGE.fits	MAKE_IMAGE	the median collapse of the IFU #1 data cube along the wavelength direction.
SCI-GUM43_MAKE_IMAGE_1.fits	MAKE_IMAGE	the median collapse of the IFU #2 data cube along the wavelength direction.
SCI-GUM43_MAKE_IMAGE_2.fits	MAKE_IMAGE	the median collapse of the IFU #3 data cube along the wavelength direction.
SCI-GUM43_MAKE_IMAGE_3.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_4.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_5.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_6.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_7.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_8.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_9.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_10.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_11.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_12.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_13.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_14.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_15.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_16.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_17.fits	MAKE_IMAGE	"
SCI-GUM43_MAKE_IMAGE_18.fits	MAKE_IMAGE	". Only 19 IFU's were active in this OB.
SCI-GUM43_SCI_COMBINED.fits	SCI_COMBINED	reconstructed science cube (coadded dithers) including noise map created from IFU #1.
SCI-GUM43_SCI_COMBINED_1.fits	SCI_COMBINED	reconstructed science cube (coadded dithers) including noise map created from IFU #2.
SCI-GUM43_SCI_COMBINED_2.fits	SCI_COMBINED	reconstructed science cube (coadded dithers) including noise map created from IFU #3.
SCI-GUM43_SCI_COMBINED_3.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_4.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_5.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_6.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_7.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_8.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_9.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_10.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_11.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_12.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_13.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_14.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_15.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_16.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_17.fits	SCI_COMBINED	"
SCI-GUM43_SCI_COMBINED_18.fits	SCI_COMBINED	". Only 19 IFU's were active in this OB.
SCI-GUM43_SCI_RECONSTRUCTED.fits	SCI_RECONSTRUCTED	intermediate reconstructed and combined science cube including noise map for pointing #1.
SCI-GUM43_SCI_RECONSTRUCTED_1.fits	SCI_RECONSTRUCTED	intermediate reconstructed and combined science cube including noise map for pointing #2.
SCI-GUM43_SCI_RECONSTRUCTED_2.fits	SCI_RECONSTRUCTED	intermediate reconstructed and combined science cube including noise map for pointing #3.
SCI-GUM43_SCI_RECONSTRUCTED_3.fits	SCI_RECONSTRUCTED	"
SCI-GUM43_SCI_RECONSTRUCTED_4.fits	SCI_RECONSTRUCTED	"
SCI-GUM43_SCI_RECONSTRUCTED_5.fits	SCI_RECONSTRUCTED	"
SCI-GUM43_SCI_RECONSTRUCTED_6.fits	SCI_RECONSTRUCTED	"
SCI-GUM43_SCI_RECONSTRUCTED_7.fits	SCI_RECONSTRUCTED	"
SCI-GUM43_SCI_RECONSTRUCTED_8.fits	SCI_RECONSTRUCTED	"

8 Frequently Asked Questions

1. **Where are my intermediate pipeline products?**

   Intermediate pipeline products are stored in the directory <TMP_PRODUCTS_DIR> (defined on the workflow canvas) and organised further in directories by pipeline recipe.

2. **Can I use different sets of dark frames to calibrate my flat frames and science data?**

   Yes. In fact this is what is currently implemented in the workflow(s). The function of the `SofSplitter` is to investigate the incoming SoFs, sort them by "purpose", and create separate SoFs for each purpose. The `RecipeExecuter` then processes each of the SoFs independently. Finally, the `SofAccumulator` packs all the results into a single output SoF. It is this purpose that is used by the workflow to send the correct set of bias frames to the recipes for flat frame combination and science frame reduction, which may or may not be the same set of bias frames in each case.

3. **Can I launch `Reflex` from the command line?**

   Yes, use the command:

   ```
   reflex -runwf -nocache -nogui <workflow_path>/<workflow>.xml
   ```

   Note that this mode is not fully supported, and the user should be aware of two points. Firstly, the execution prompt is not returned after the workflow finishes, and therefore `Reflex` must be manually killed. Secondly, all the interactive windows will still appear (if activated in the workflow), so it is not suitable for batch processing.

4. **How can I add new actors to an existing workflow?**

   You can drag and drop the actors in the menu on the left of the `Reflex` canvas. Under `Eso-reflex -> Workflow` you may find all the actors relevant for pipeline workflows, with the exception of the recipe executer. This actor must be manually instantiated using `Tools -> Instantiate Component`. Fill in the "Class name" field with `org.eso.RecipeExecuter` and in the pop-up window choose the required recipe from the pull-down menu. To connect the ports of the actor, click on the source port, holding down the left mouse button, and release the mouse button over the destination port. Please consult the Reflex User Manual (Forchì 2012) for more information.

5. **How can I broadcast a result to different subsequent actors?**

   If the output port is a multi-port (filled in white), then you may have several relations from the port. However, if the port is a single port (filled in black), then you may use the black diamond from the toolbar. Make a relation from the output port to the diamond. Then make relations from the input ports to the diamond. Please note that you cannot click to start a relation from the diamond itself. Please consult the Reflex User Manual (Forchì 2012) for more information.

9 Troubleshooting

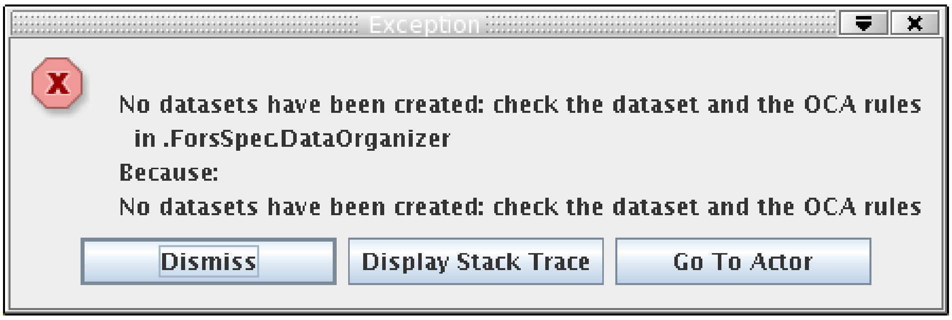

Figure 9.0.5: *TheDataOrganizer interactive window reports an error ":No DataSets have been created, check the data set and the OCA rules."*.

1. **I downloaded the data from the ESO archive, put them into a new directory, tried to run** `Reflex` **on them, but**

   (a) **it crashs**

   This may happen if one of the files was downloaded only partially (check for a file with the extension `fits.Z.part`. You will have to download that file again in order to have an uncorrrupted file (and remove the partial one).

   (b) **it fails with error message ":No DataSets have been created, check the data set and the OCA rules."(see Figure 9.0.5.)**

   This error may be due to the fact that the data provided by the ESO archive are compressed (`<filename>.fits.Z`). Please remember to uncompress the data before executing `Reflex`.

   (c) **all DataSets are greyed out in the DataSets interactive window.**

   The ESO archive used with CalSelector does not always supply all static calibration files. As a consequence some/all DataSets are greyed out because they were missing such required data.
   Missing static calibration should be found by `reflex` in
   `<install_directory>/calib/<pipeline_version>/cal`.

2. **The "Select DataSets" window displays my DataSets, but some/all of them are greyed out. What is going on?**

   If a DataSet in the "Select DataSets" window is greyed out, then it means that the DataSet that was constructed is missing some key calibration(s) (i.e. the DataSet is incomplete). To find out what calibration(s) are missing from a greyed out DataSet, click on the DataSet in question to highlight it in blue, and then click on the button `Inspect Highlighted`. The "Select Frames" window that appears will report the category of the calibration products that are missing (e.g. `MASTER_BIAS`). From this the user has then to determine the missing raw data (in this case bias frames). If static calibrations are missing the mechanism unfortunately does not work, but should be found by `reflex` in
   `<install_directory>/calib/<pipeline_version>/cal`

Acknowledgements

The Reflex team in alphabetical order consists of Pascal Ballester, Daniel Bramich, Vincenzo Forchì, Wolfram Freudling, César Enrique García, Maurice Klein Gebbinck, Andrea Modigliani, Sabine Moehler, Mark Neeser & Martino Romaniello.

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