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Organisation Européene pour des Recherches Astronomiques dans l'Hémisphère Austral
Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

ESO - European Southern Observatory
Karl-Schwarzschild Str. 2, D-85748 Garching bei München

Very Large Telescope

VIMOS Mask Preparation Software
VMMPS Cookbook

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Prepared	M. Kissler-Patig, G. Marconi	23/12/06	
		Date	Signature

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Change Record

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Issue 3.0	05/07/03	some	update
Issue 4.0	14/09/03	App. B	example of curved slit entry in .adp
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		App. B	
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		App. A	Correction to the format of the catalogues
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Issue 80.1	29/09/07	Sect. 2.2	Explained about SPOC adding proper credit
		Sect. 2.5	Added section with systems supported.
		Sect. 6	Added footnote with Marina's workaround.
		Sect. 8.1	Added some more recommendations about reference objects.
		Sect. 9	Added footnote with SPOC bug description.
	03/12/2007	Sect 13	Added Marina's feedback
Issue 82	21/06/2008	checklist	Added Marina's feedback

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Contents

1 Introduction

1.1 Scope of this document

The document intends to help, step by step, an astronomer to define scientific masks for multi-object spectroscopy with VIMOS. It is written in a linear fashion and is supposed to be followed step by step, i.e. section by section.

1.2 Contents of this document

The document contains only the minimum knowledge on VMMPS needed to define an astronomical mask. It does not describe the full tool in details, nor describe any observing procedure in MOS mode with VIMOS.

1.3 Abbreviations and Acronyms

CCD	Charge Coupled Device
DMD	Data Management Division
ESO	European Southern Observatory
OB	Observing Block
P2PP	Phase II Proposal Preparation
QC	Quality Control
SM	Service Mode
SPOC	Slit Positioning Optimization Code
TIO	Telescope and Instrument Operator
USD	User Support Department
VIMOS	VIsual Multi-Object Spectrograph
VLT	Very Large Telescope
VM	Visitor Mode
VMMPS	ViMos Mask Preparation Software

2 Read this first: The VMMPS philosophy – my catalog in my castle

2.1 What does VMMPS do?

VMMPS is a software that, in the end, produces a file that you must attach to any of your VIMOS multi-object spectroscopy OBs. That file, called Aperture Definitions in Pixels (ADP) file, contains the list of all slits (positions, sizes, shapes) that will be milled into that particular mask. The file contains this information in pixels coordinates, and hosts in addition the transformation (that it got from the pre-image header) on how to transform that particular x,y values into millimeters on the mask. Further, that file has as well all the necessary pointing information obtained from the pre-imaging.

Creating these ADP files is your goal. As an input, you need the VIMOS pre-image and a catalog of objects. And how to get from there to your desired output product is all explained step by step below...

NOTE that VMMPS handles separately each quadrant. You will have to run VMMPS 4 times to produce one full set of masks to be attached to 1 OB (the software helps you somewhat to do that). The important point here is that you will have to prepare for VMMPS an input set (catalogs(s) and image) for each quadrant.

2.2 This is *not* FIMS - you have little chance for interaction

Many MOS users will be familiar with FIMS, the software that helps you defining masks for FORS. VMMPS is very different. The main reason being that VMMPS was conceived as a tool to define masks for surveys. Unlike FIMS it will hardly allow you to allocate slits manually. Instead, it will automatically optimize the slit assignment for object in your catalog. Of course, you can pick some or even all objects by hand, but it will cost you time and nerves and the allocation will not be optimized in terms of numbers. It is long term objective of ESO to harmonize the mask preparation tools between VIMOS and FORS after a few periods of VIMOS observations, of experience and of feedback from the users.

At the heart of vmmps is SPOC, the Slit Positioning Optimization Code, described by Bottini et al. (PASP 117, 996 (2005)). Given a catalog of objects, SPOC maximizes the number of observable objects in a single exposure and computes the corresponding slit positions. It does so by solving a very complex 2D combinatorial problem.

2.3 The importance of your catalog

VMMPS fully relies on your **catalog** to contain exactly the objects that you want to observe. In VMMPS you have hardly any freedom to set priorities for your preferred objects. Your catalog should contain all and only the objects you really want to observe. VMMPS will optimize the allocation of slits for you such as to *maximize the number of objects observed from your catalog*, assuming that you have no favorites.

In summary, VMMPS relies *heavily* on your catalog. Thus, instead of using your brain intensively while running VMMPS, rather *use your intellectual power and scientific judgment to create a smart input catalog*. Your catalog is the most important item in the process.

2.4 The different catalogs that you can come with

We distinguish between two different scenarios.

1. Prior to pre-imaging with VIMOS you know already which objects you want to obtain spectroscopy for and have precise astrometry for them. E.g. you were running an imaging survey with a wide field imager and have identified your candidates on a given astrometric system.

   You are in the case of a `contributed catalog` + `VIMOS pre-image catalog`.

   This catalog must have precise *relative* astrometry for all objects **and** for a number of reference stars. It is important that the astrometry of the science objects and the reference stars are on the same system. You will now obtain pre-imaging with VIMOS, extract from there a short list of objects detected on the VIMOS image (the `VIMOS pre-image catalog`) and VMMPS will help you to bring your `contributed catalog` onto the VIMOS coordinate system.

2. You only know which objects or type of objects you are after, but have no list with precise RA,DEC for your objects. E.g. you rely on the VIMOS pre-image to determine the objects you will obtain spectroscopy for.

   You are in the case of a `VIMOS catalog`.

   This catalog is obtained directly from the VIMOS image using your favorite analysis tools [1]. It takes coordinates in detector x,y as well as any other parameter you want to convey and can be used right away by VMMPS (provided that it has the right format, see below).

2.5 System requirements

VMMPS is distributed as pre-compiled binaries for Linux RedHat 9. It is known to work in Fedora Core 3. It is known to not run in Fedora Core 6.

[1] We recommend Sextractor (Bertin & Arnouts 1996, A&AS 117, 393) without getting any royalties for it, but because it serves well the purpose and you will recognize some similar structures/parameters

3 Step 0 (most crucial): Getting ready – preparing your catalogs

This step is done outside VMMPS. But as mentioned above, it is the most important one.

3.1 What you need

- **for each quadrant** one VIMOS pre-image processed by the ESO pipeline, and
- EITHER **for each quadrant** a `VIMOS catalog`
- OR a `contributed catalog` (it can be one catalog including objects on all 4 quadrants, or be four catalogs – one per quadrant), *together* with, **for each quadrant** a `VIMOS pre-image catalog`

3.2 The format of the catalogs

All catalogs accepted by VMMPS have plain ASCII format. **The file name should not use the extension .dat as this causes the program to crash.** Use of .cat or .data should work.

Some example are given in Appendix A.

The input format is:

- a header line with column names in upper case.

  There is no preferred order for the columns, but see below for mandatory and reserved columns and names.

  The first line is interpreted as the header line.

  Header entries are separated by any number of blanks or tabs.

  A <return> marks the end of the header line.

- the data sorted in columns.

  Columns on a given row are separated by any number of blanks/tabs.

  The number of columns and their order is defined by the number of entries and their order in the header. No empty field is allowed, you will get a friendly warning if some are present.

  The first row after the header line defines the beginning of the data, the last row defines the end of data. Each row must end with a <return>.

  Note that no blank lines are allowed in the catalogs, and you will get a friendly warning if any is present.

3.3 Getting your `contributed catalog` into the right format

Assuming that you are in case 1, you need to prepare the two catalogs described in the this and the next section.

The contributed catalog contains all the objects that you wish to observe, plus (or including) enough bright objects that can serve for the cross-correlation with the VIMOS pre-image catalog and as reference stars for aligning the mask on the sky. All objects shall have very good (± 0.1") *relative* astrometric coordinates (RA,DEC) on a single astrometric system. Further, all objects should have good (± 2") absolute astrometry.

The **mandatory columns** in the contributed catalog are (in upper case and in the following order):

- ID defining an identifier which *must be unique and integer number*.
- RA, the right ascension of the object.
- DEC, the declination of the object. RA and DEC entries are allowed in 2 formats:

  - decimal degrees

  - hh:mm:ss.s (including semi-colons)

The **optional columns** whose names are reserved are:

- CROSS is, for each object, either 1 if that object shall be used for the cross correlations, or 0 if it shall not (e.g. if it is too faint, too elongated, ...)
- FLAG shall be one of (upper or lower case) C - compulsory; R - reference; F - forbidden; S - select-able (no blank entry is supported, any other flag will be replaced by S - select-able)
- A_ARCSEC the semi-major axis in arcsec
- B_ARCSEC the semi-minor axis in arcsec
- PA the position angle (E of N in degrees)

  The latter three will be used to compute the object size in pixels along the x direction of the detector (i.e. along the slit).

Any other columns whose names do not match the above ones.

Notice only that the names X_IMAGE and Y_IMAGE are **forbidden** in the `contributed catalog` – they are used/computed later. If these are present, the software will kindly reject your catalog until you removed them.

All columns present in the `contributed` (input) catalog will be carried over to the output catalog. Some columns will be used to generate new columns in the output catalog (see below Step 2).

The example of a `contributed catalog` is given in the appendix.

3.4 Preparing your VIMOS pre-image catalog

The VIMOS pre-image catalog accompanies the contributed catalog with the only purpose to transform the RA,DEC coordinates into x,y coordinates. This automatically corrects for any distortion in the VIMOS optics, and most importantly for the mask manufacturing: for x,y the transformation into mm on a physical mask is known (we have determined that for you and stored the information in the pre-image header).

You need in the VIMOS pre-image catalog a small number (e.g. 50 or more) of objects that are also in your contributed catalog. In the VIMOS pre-image catalog you shall have the x,y coordinates of these objects obtained from exactly the same VIMOS pre-image as you will input into VMMPS. Note that the more good objects are in common between the two catalogs, the better the result of the cross-correlation, i.e. the transformation from RA,DEC to pixels will be.

Since the objects will be used for cross-correlation, their position in pixel coordinates shall be as good as possible. Therefore, make sure that you selected bright (S/N>10), unsaturated, if possible point like objects on the VIMOS pre-image.

This comparatively short list of objects shall be written in an ASCII file with the **mandatory columns** (in upper case, and in the following order):

- ID an identifier which *must be unique and integer number*,
- X_IMAGE the x–coordinate in pixels on the VIMOS pre-image
- Y_IMAGE the y–coordinate in pixels on the VIMOS pre-image

Any other column is allowed but will be ignored and not carried over to the output catalog of the cross-correlation (see Step 2).

The example of a VIMOS pre-image catalog is given in the appendix A.

3.5 Getting your `VIMOS catalog` into the right format

Assuming that you are in case 2, you only need to prepare a `VIMOS catalog`.
The VIMOS catalog can:

- either be obtained as an output of the cross-correlation task (in which case you do not have to worry: it will have the right format)
- or be produced directly by the user (that's you) from the VIMOS pre-image.

The **mandatory columns** are (in upper case and in the following order):

- ID an identifier which *must be unique and integer number*,
- X_IMAGE the x–coordinate in pixels on the VIMOS pre-image
- Y_IMAGE the y–coordinate in pixels on the VIMOS pre-image

The **optional columns** whose names are reserved are:

- FLAG shall be one off C - compulsory; R - reference; F - forbidden; S - select-able (no blank entry is supported, any other flag will be replaced by S - select-able)
- X_WORLD
- Y_WORLD, the coordinates of the object in the world coordinate system (not used by VMMPS)
- A_IMAGE the semi-major axis in pixels
- B_IMAGE the semi-minor axis in pixels
- THETA_IMAGE the position angle (in degrees positive x-axis is 0, positive counter-clockwise) of the object
- X_RADIUS the object size in the x (spatial) direction of the detector.

A_IMAGE, B_IMAGE and THETA_IMAGE are used to compute X_RADIUS. The column X_RADIUS is used when one or more of A_IMAGE, B_IMAGE, THETA_IMAGE are not given, otherwise it is overwritten. If X_RADIUS, and any one of A_IMAGE, B_IMAGE, THETA_IMAGE is missing, the object size in x is set to 10 pixels. If X_RADIUS > 45 pixels, the object is automatically flagged as forbidden by the software. [2]

Any other columns can be added with any names. The catalog later allows to constrain with any number of criteria on any number of columns the select-able objects. So typically, you might want to add color, magnitude or may other columns that you might want to use as selection criteria to the catalog.

An example is given in the appendix A.

[2] The reason for this is that the manufacturing machine can cut slits of max. 20" length, which translate into 150 pixels, and that you are allowed to add 10" (50 pixels) sky on each side.

3.6 Getting your input VIMOS `pre-image` ready

Good news: your VIMOS pre-image processed by the ESO pipeline is ready as it is to be accepted by VMMPS.

Bad news: if your image is not a VIMOS `pre-image`, or if the VIMOS pre-image was not processed by the ESO pipeline, or if you had the bad idea to modify the pre-image even in the slightest detail (e.g. you had 3 dithered pre-images and combined them), etc... VMMPS will not work, or in the worse case will seem to work but you will never see your objects through your slits. Indeed, your x,y coordinates will be transformed into mm for the mask manufacturing using the transformation in the image header, assuming that we deal with original x,y system. If you have translated, re-scaled, re-binned the image, this transformation will not be valid anymore.

Just make sure that your input to VMMPS is an original, untouched VIMOS pre-image processed by the ESO pipeline. Also make sure that this pre-image is the one you used to obtain the coordinates for your `VIMOS pre-image catalog` **or** `VIMOS catalog`**.**

If you would like to learn a little about the background of all this, read further this section. If you are just lazy and happy with the information so far, go ahead and jump now to Step 1.

Some Background: One of the VIMOS calibrations consists of using a pinhole mask to determine accurately the transformation between millimeters on mask and coordinates on the CCD (we know at which mm we cut the holes in the mask, and we measure the x,y coordinates of the holes on the image processed by the ESO pipeline). This transformation is stored and updated on the instrument workstation. Now, when your VIMOS pre-image gets taken, this transformation, valid at that particular moment, is stored in the header of your VIMOS pre-image. Thus, with the help of that transformation, you (or rather VMMPS) know how to go from the x,y coordinates of that image to position in mm on the mask (i.e. position on the focal plane). The combination of the transformation in that header and the coordinates in that image allows to determine the precise mm coordinates for the mask. Should you use transformation and x,y from different images, the result would not be correct anymore. Thus the importance to derive the coordinates from exactly the image that will be fed to VMMPS and from which the transformation will be taken.

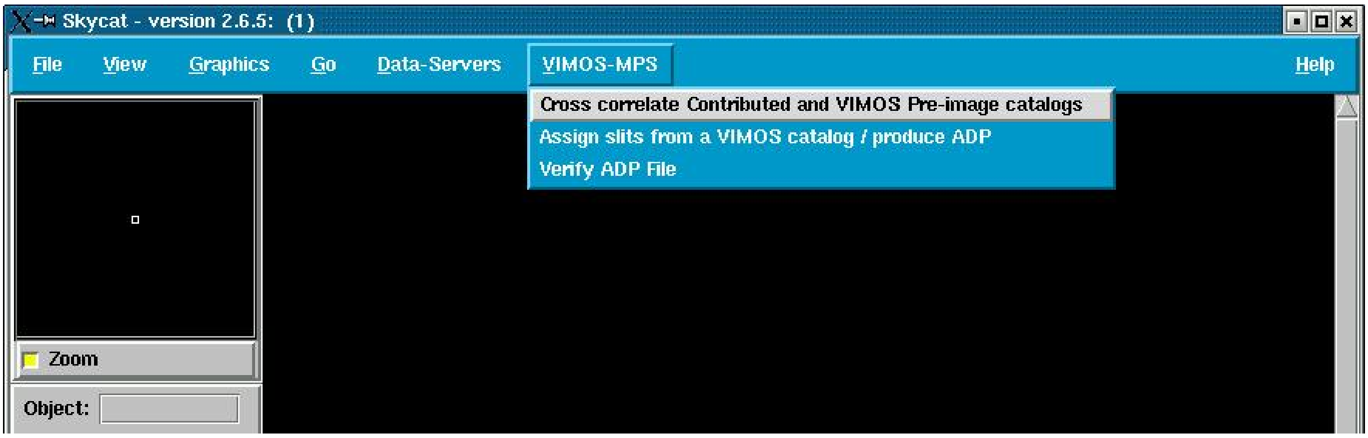
4 Step 1: What is your starting point?

Are your sure you fulfilled Step 0? If you have not suffered at least a little bit while preparing your catalog, if you have not thought twice whether you had the right objects in there, there is a good chance that you will suffer a serious headache before Step 8. So take your time re-thinking about your catalog. Read through Step 0 again, it is worth it, we believe that it will actually *save* you time.

OK, enough warnings, if you went carefully through Step 0, you are ready to start VMMPS. To do so, type:

```
> vmmps &
```

and you should see the following window pop-up (if you are a regular skycat/RTD user, this will look very familiar to you, but notice the new plug-in in the top bar – 'VIMOS-MPS' or VMMPS for people who like acronyms of acronyms):



What to do next depends on the type of catalog you have prepared.

4.1 You have your own "pre-VIMOS" catalog of objects: the `contributed catalog` case

- proceed with Step 2

The VMMPS task of defining slits only accepts `VIMOS` catalogs, and you need to produce one. Do not panic, VMMPS has a built-in task to help you doing so using your `contributed catalog` together with a `VIMOS pre-image catalog` and a VIMOS pre-image.

What you have is a list of RA and DEC of your objects (a `contributed catalog`), and the VIMOS pre-image freshly out of the ESO pipeline. Make sure that the relative astrometry in your catalog is very good and that your list actually also contains, on the same astrometric system, a good number of objects that appear on the VIMOS pre-image (e.g. a list of only $z = 6$ emission line galaxies will probably *not* allow you to do a nice cross-correlation with the VIMOS pre-image catalog – you might want to add a few $V = 12 - 16$ mag stars).

Run your favorite source detection algorithm on the original, pipeline processed VIMOS pre-image. Make sure that you retain only point source with S/N>20 or so, and store all this in a `VIMOS pre-image catalog`.

Make sure that you prepared the three above ingredients according to Step 0, and move now to Step 2.

4.2 You obtained your catalog completely from a VIMOS image: the `VIMOS catalog` case

- Jump to Step 3

If you are sure that you have a `VIMOS` catalog for each quadrant fulfilling the requirements of Step 0, just identify the corresponding associated VIMOS pre-image for each of the 4 quadrants. You are ready to jump right into the mask definition, move to Step 3.

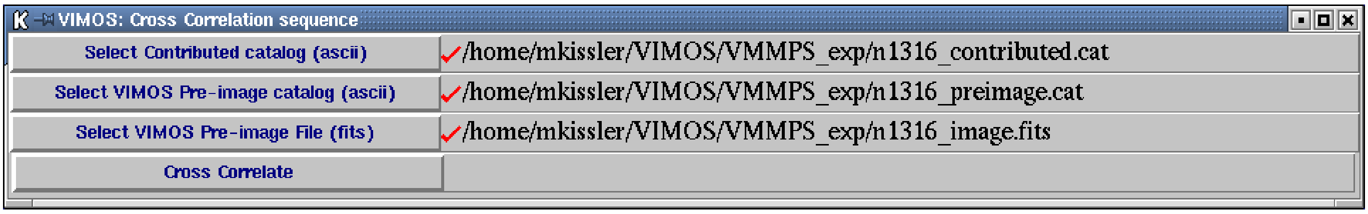
5 Step 2: Transforming with VMMPS your `contributed` catalog into a `VIMOS catalog`

This is a necessary step, but quite painless if you followed the instructions of Step 0.

¿From the pull-down menu 'VIMOS-MPS' (see Step 1), select the task 'Cross correlate Contributed and VIMOS pre-image catalogs'. You will see popping up the following 'VIMOS: Cross Correlation sequence' window (here under KDE/Linux):

This window asks you to input (in that order) the catalogs and the image. Just click from top to bottom and follow the instruction. Once you have filled the last item:

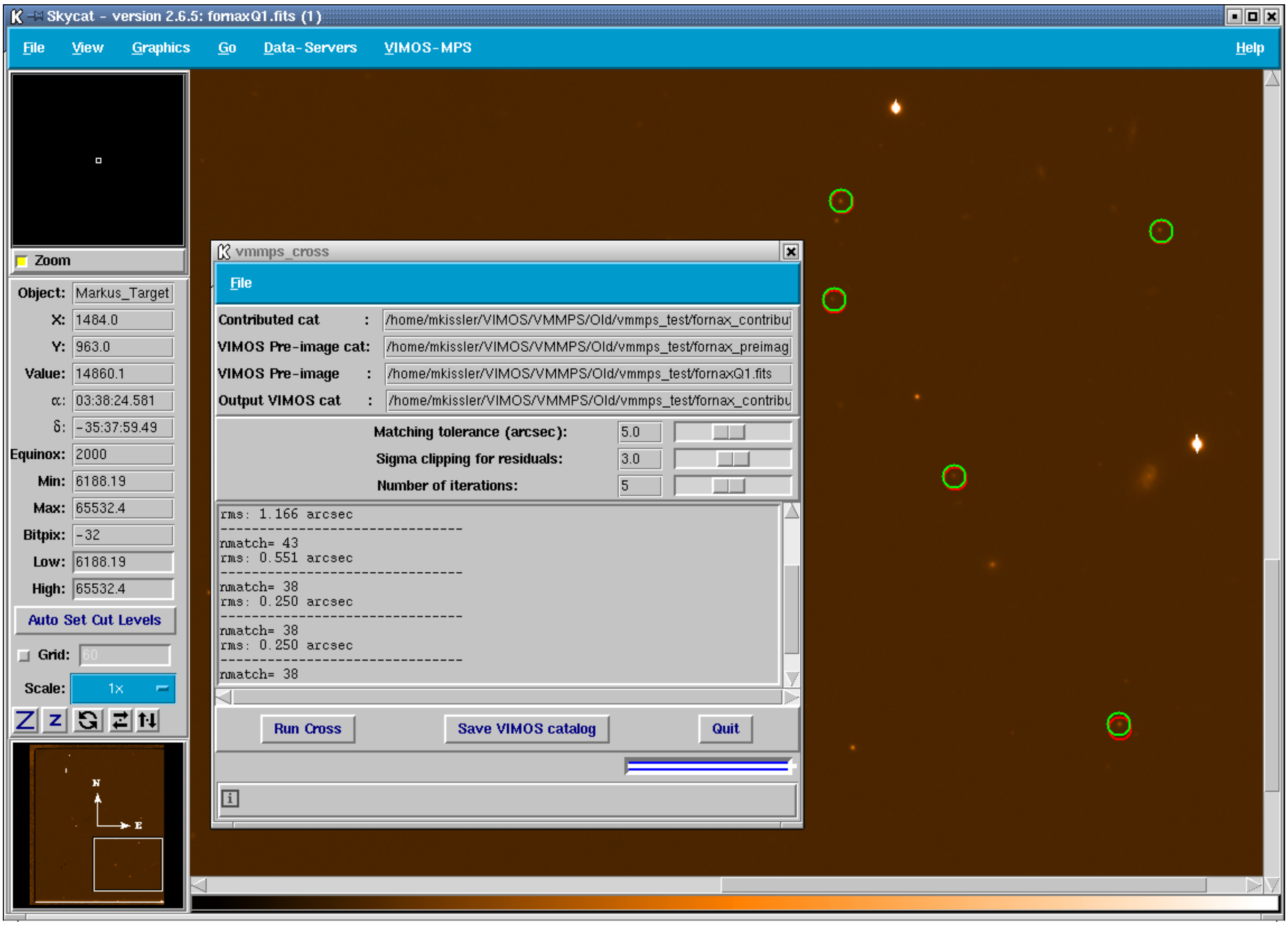
- that window will look as shown below,
- the selected VIMOS pre-image will appear in the display



and after you have clicked on the button 'Cross-correlate':

- the above window will disappear, and
- the window 'vmmps_cross' will pop-up

You will then get something like this:



The 'vmmps_cross' window summarizes your input (top part) and awaits your tuning of the cross-correlation parameters. At the beginning, the bottom part is empty.

The cross-correlation parameters are:

- **the matching tolerance in arcsec**: what is the maximum difference in position that you want to allow between VIMOS pre-image and contributed catalog to still consider two objects to be the same?

  If your astrometry in the contributed catalog is perfect, pick a small value (you are sure that if VIMOS pre-image and contributed catalog position do not agree by say 2" the objects cannot be the same). Remember, however, that the VIMOS pre-image suffers from optical distortion, differential atmospheric refraction etc, i.e. the position in the VIMOS pre-image catalog will not be perfect.

  If you suspect the absolute astrometry of your contributed catalog to have a systematic offset, use a larger value (e.g. 5"). This should take care of it and allow to find matching stars. The danger are mis-identifications: if the RMS of the final transformation is large, this might have happened. Try then to go back to smaller values.

- **the Sigma clipping for residuals**: the task will find a number of objects in common between VIMOS pre-image and contributed catalog. It will compute the position difference in the two catalogs and some objects (e.g. mismatches) will show high values. Define with this parameter when such an object will be rejected from the final fit.

- **the Number of iterations**: the task will compute a first transformation for the objects in the contributed catalog, applied it and if the number of iterations is > 1 restart the cross-correlation to compute a new transformation. Depending on the number of out-layers, distortions in the field, the final transformation might significantly improve with a few iterations. If you see no clear improvement in RMS between two successive passes, you probably reached the necessary number of iterations.

Once you have set the parameters, click 'Run Cross' to run the cross correlation. You will get the log/output of the task display in the lower part of the window.

The log tells you how many objects were found in your VIMOS pre-image (nref) and contributed (ncross) catalog, respectively. Do not forget that you can set a column CROSS in your contributed catalog and only the objects with CROSS=1 will be used for the matching and counted in ncross. E.g. you can safely put any faint high-z galaxy to CROSS=0 in the contributed catalog since it is unlikely to find a match in the VIMOS pre-image catalog.

On the display, you will find marked the objects finally used for the transformation `nmatch` (green), as well as the objects that were found to have a counter-part in the first pass but were rejected later (red). This helps you to visually inspect whether the task did something meaningful.

The log tells you further, for each iteration, how many objects were found to match, and what the RMS of the transformation (in arcsec) is for these objects.

You can readjust the parameters and run the task again and again and again until you are satisfied (if you cannot reach that spiritual stage, press 'Quit'). Once you are happy with the precision of the transformation (we recommend a RMS of the order of 0.2" or lower), click on 'Save Vimos Catalog' and, guess what, it will save your contributed catalog as a VIMOS catalog. The **name of the output** is composed of the name of your `contributed catalog` followed by `_vm.cat`, that is

`<name of contributed catalog>_vm.cat`.

You can now use this catalog to define slits (Step 3).

A brief word on the output: it has a format complying with the one described in Step 0. It will contain all the objects of your contributed catalog. It will still have all the columns that you defined in the contributed catalog, **plus** two columns (X_IMAGE, Y_IMAGE) giving in pixels the object coordinates in the reference system of the pre-image. The advantage is that these latter coordinates can now be transformed into mm in the focal plane, i.e. mm coordinates on the mask, by using the CCD-to-Mask transformation present in the header of the pre-image.

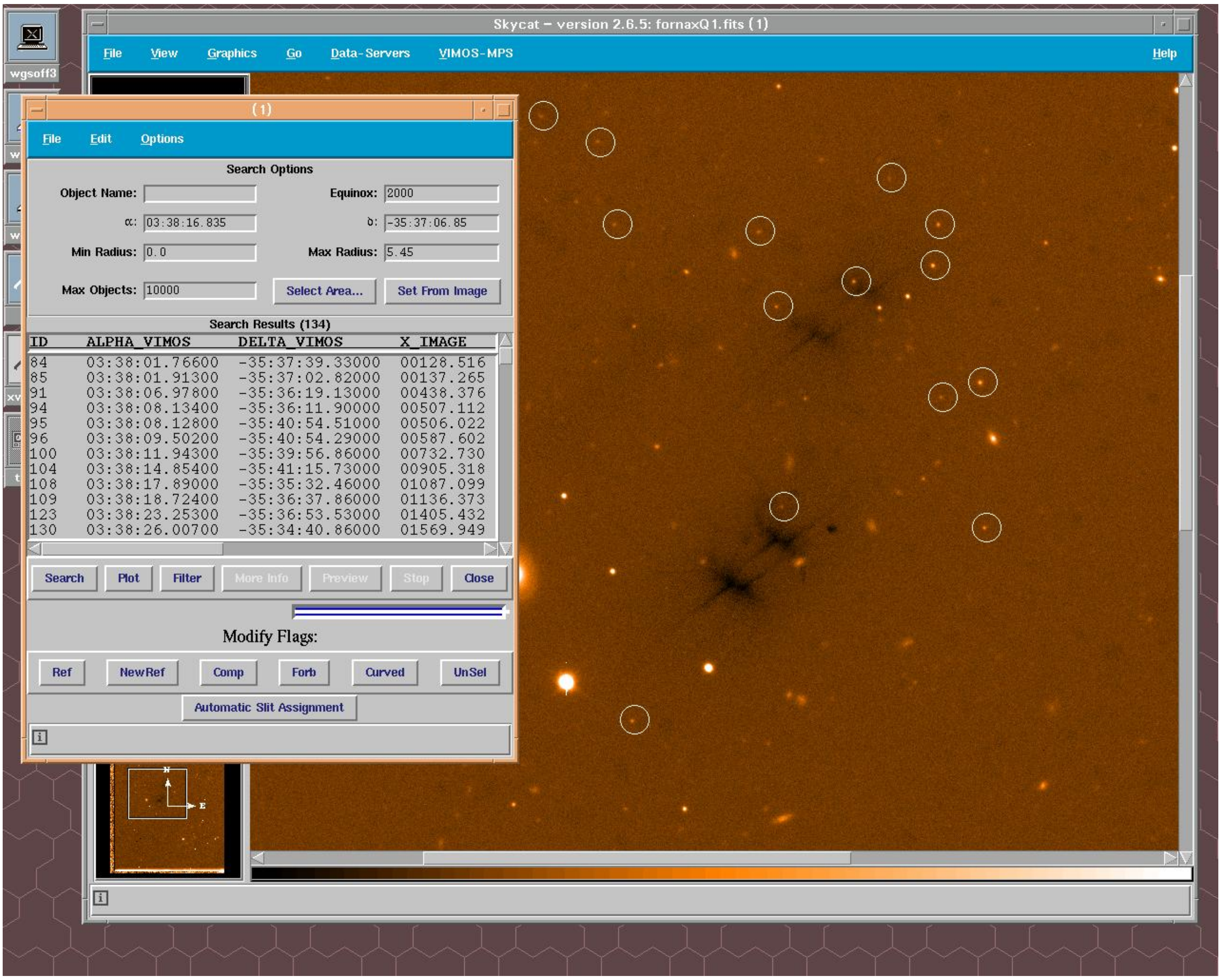
6 Step 3: Starting VMMPS for mask definition

At the beginning of this step, make sure that your display is blank (safest way) by selecting 'Clear' in the 'File' pull-down menu of `skycat` or be sure that the image displayed is indeed the pre-image that you want to use for this step.

You have your VIMOS catalog ready? Then go ahead and selected in the main window from the pull-down menu 'VIMOS-MPS' the task 'Assign slits from a Vimos catalog / produce ADP'.

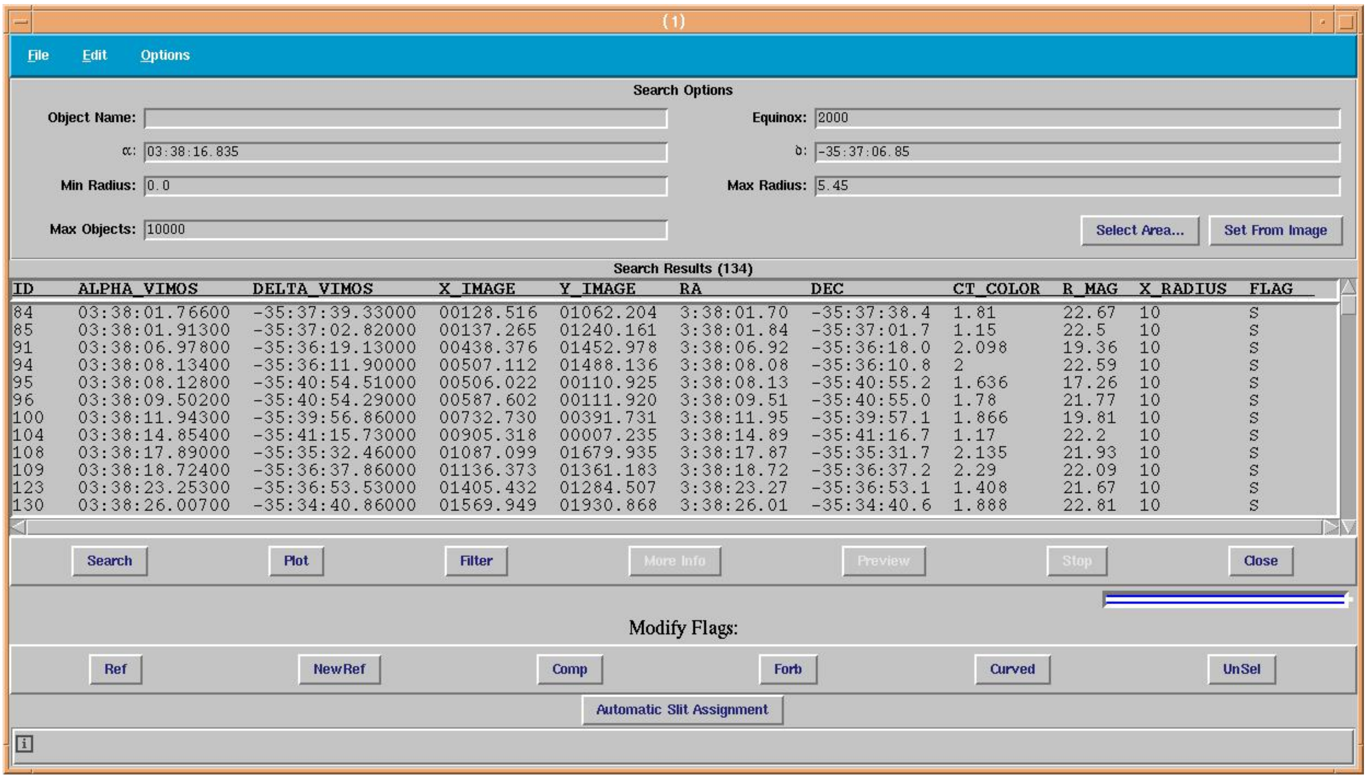
You will be asked to select your VIMOS catalog and the associated VIMOS pre-image. The latter will appear in the display and all objects in your catalog will be marked as white circles. The VIMOS catalog will be shown in a separate window[3].

Your screen will look like this:



[3]There are reports of a possible bug loading the image in some circumstances. See Section 13.

Let's focus on the catalog window. We dragged it a little wider to see all columns. That window displaying your catalog might look like this:



Your catalog has internally been transformed into `skycat` format and is now displayed with the standard `skycat` catalog window.

This window shows all objects in given radius (5.45 arcmin by default) from the center of your pre-image. The data section in the middle of the window allows you to look at your catalog, check values for given objects, etc. A click on an object in the image display will highlight that object in the catalog an allows you to examine its entries.

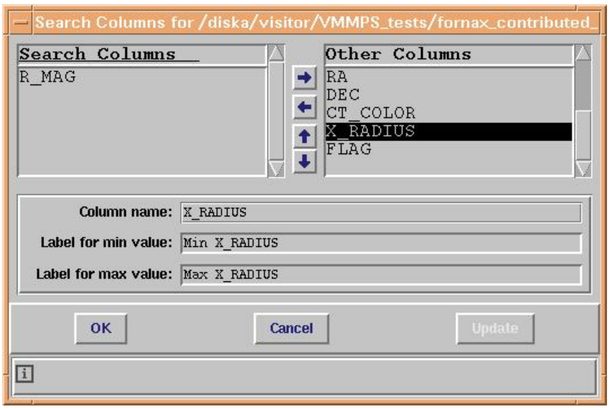
The main purpose of the catalog window is to edit interactively the column 'FLAG', that was added by VMMPS (and set to 'S': select-able for all objects) if not present in your input catalog. How and why to edit this column is explained in Step 5, and uses the lower part of the window ('Modify Flags').

The other purpose of this window is to allow you all operations permitted on skycat catalogs (editing values for selected objects, searching for objects, etc). We do not expect you to need these and therefore recommend to you not to use, mis-use or ab-use of them. Except maybe for an object selection explained in Step 4, but this is optional. If you are satisfied with what you see, move directly to Step 5.

7 Step 4 (optional): Re-arranging your VIMOS catalog

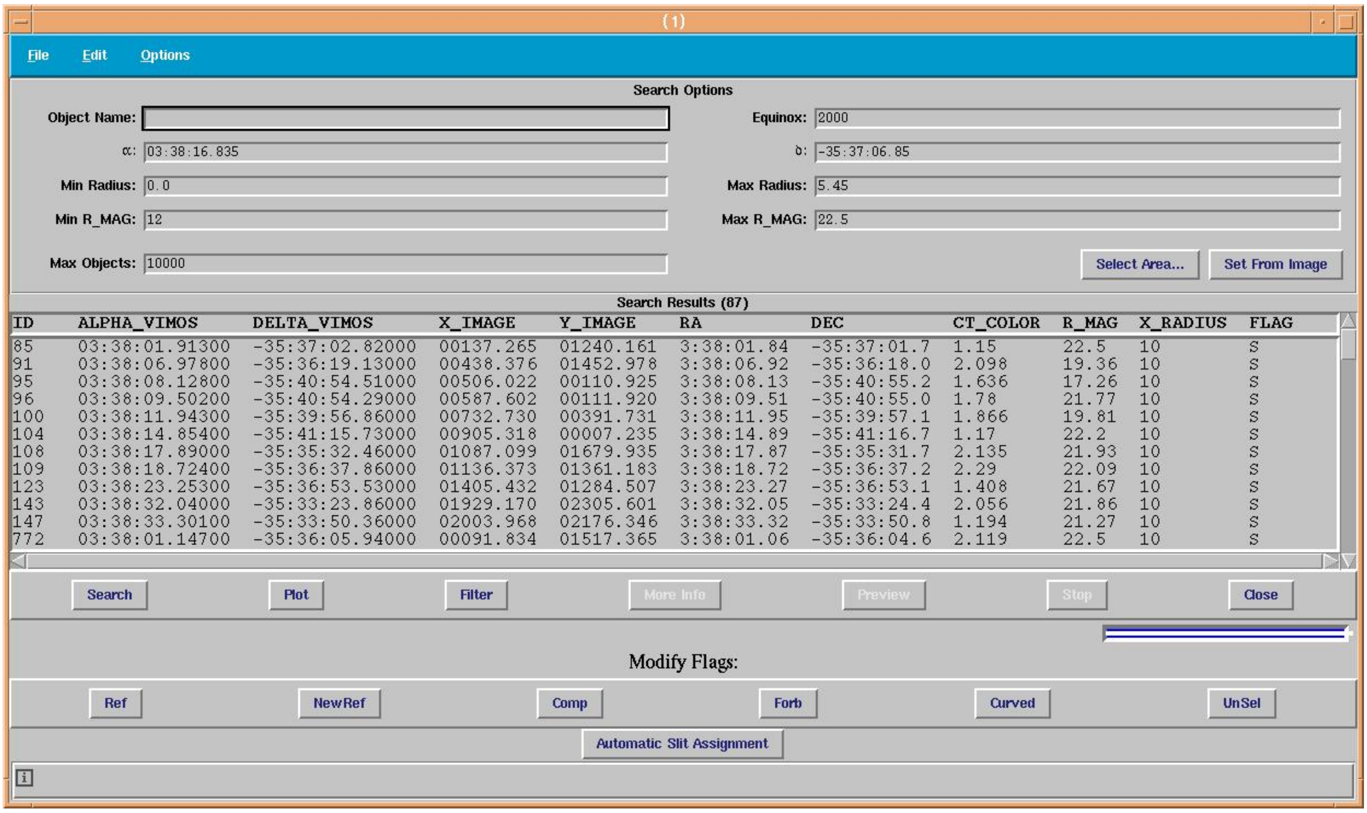
This step is optional. You can skip it and move directly to Step 5.

In case you are not fully satisfied with all objects in your catalog, you have the chance to re-arrange it somewhat. To do so, you must have the column(s) on which you want to constrain your objects in the catalog, and you must have made up your mind which range you want to allow for this columns. If this is fulfilled, go in the catalog window to the pull-down menu 'Options' and select 'Set Search Columns...'. The following window will pop-up:



At this point, you should chose the column(s) on which you want to select your catalog. Click on the column name in the right sub-panel, then click on the left arrow in the central bar: the selected column name(s) should appear in the left sub-panel. Ignore the lower part of that window, you can use it for indicative purposes, but you are not expected to fill in any values at this point.

Once all the columns you wish to select on are in the left sub-panel, click 'OK'. The pop-up window will disappear, and your catalog window will get updated as shown in the example below:



Here we have chosen to select according to the R magnitude (say we changed our mind and decided to allow slits only for objects brighter than 22.5, despite the fact that our VIMOS catalog contains objects down to $R \sim 24$).

Notice the two new fields in the upper part of the window saying "Min R_MAG" and "Max R_MAG". Enter there the values on which you want to select the catalog and hit return, or click on 'Search' below the data field.

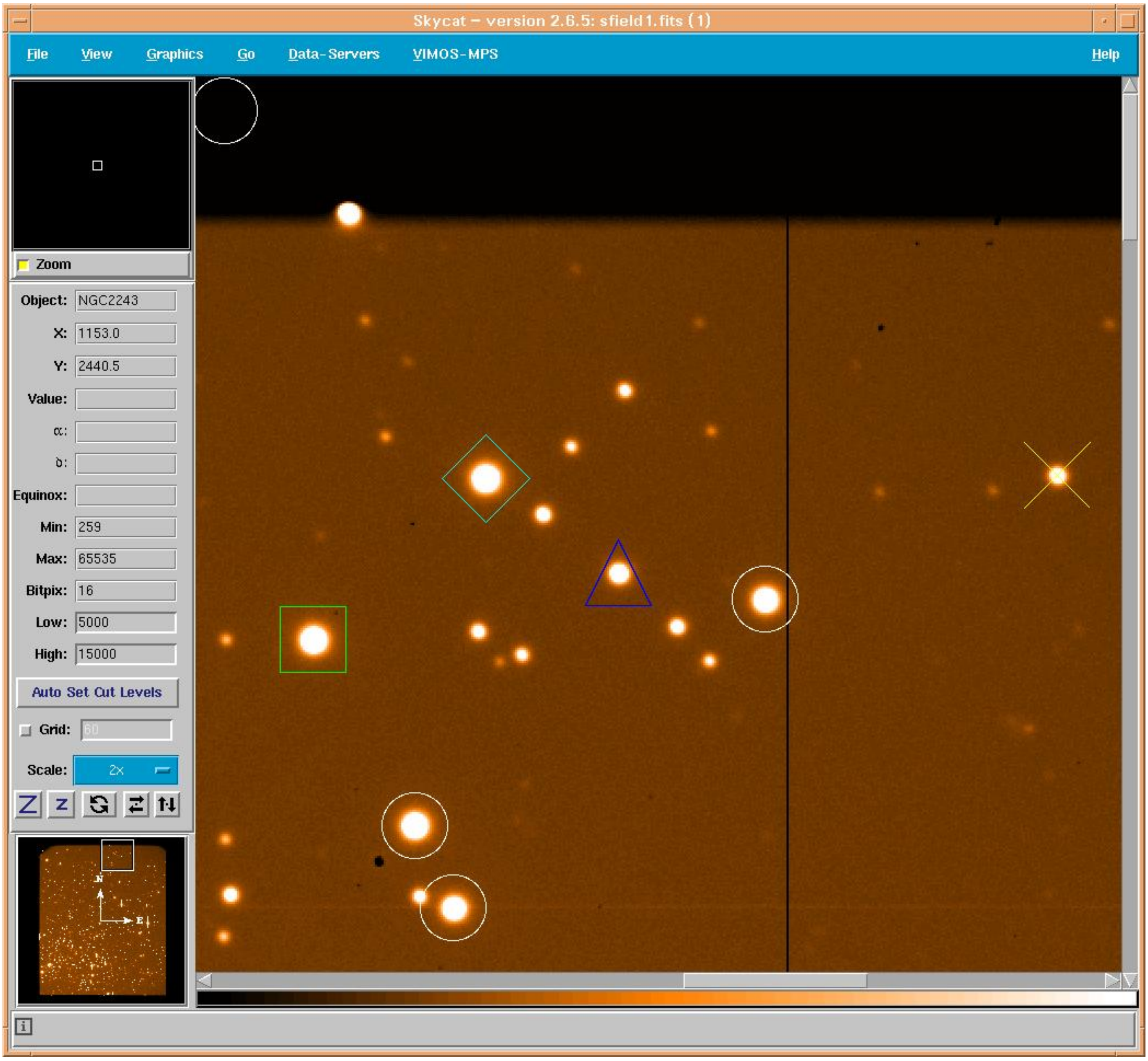
The catalog display will be updated, as well as the overlay on the image. They will now show only objects fulfilling the new selection criteria. And only these objects will be used for assigning slits in the next step.

8 Step 5: First pass – defining special objects

Alright, if you made it to here, you are ready to assign some slits to some objects. You are doing well so far. In VMMPS, you will first assign all special objects before the rest of the space will be filled automatically with objects. We have 5 types of special objects:

- reference objects (cyan diamonds)
- new reference objects (cyan diamonds)
- compulsory objects (blue triangles)
- forbidden objects (yellow crosses)
- curved slits (green squares)

They are all illustrated in the example below.



The way to assign one of these is the same for all types:

- in the image display, click on the object you want to assign a special type. That object must be in the catalog, i.e. have a white circle around it (exception: new reference objects). The white circle will be highlighted
- in the catalog window, under "Modify Flags", click on the button corresponding to the type you want to assign to the object (e.g. you just clicked in the image on a object that you want to be a reference, so click now on the button 'Ref') – curved slit is a special case described in more details below
- in the catalog window, the object will be highlighted. You can check whether in the column 'FLAG' the type was changed from S (select-able) to the new type (e.g. R for reference)
- repeat the above steps as often as you need

After this operation, you will have updated the 'FLAG' column in you catalog. You are ready to pass to Step 6. Be reminded that at this point all objects with X_RADIUS > 45 pix will be flagged as forbidden.

Note that instead of doing this interactively inside VMMPS, you could have created earlier in the input catalog the column 'FLAG' and assigned the right types (except for curved slits) to the objects.
E.g. if you knew in advance which ones would be your reference objects, you could have created a column 'FLAG' in the input catalog and set it to 'R' for these objects, 'S' for all others.

Once you launch the automatic slit assignment (Step 6), the task will allocate the slits in the above order of priority, i.e. first put boxes around the reference objects, then try to fit all compulsory objects, then try to fit all curved slits, and than finally assign 'normal' slits as many other objects as possible (the latter is described in Step 6).

But first, let's have a closer look at each type of special objects.

8.1 Reference objects

Reference objects are relatively bright objects that will show up **but not saturate** on the acquisition image of 10–30 sec (i.e. typically $R \sim$ 12–16) and that are used to center the masks.

When selected, the reference objects gets its FLAG parameter set to 'R'. These objects are put by the software in each mask produced for that quadrant before any other object gets allocated a slit. The reference objects are assigned a 4"×4" box.

Remember that in VIMOS the masks of the 4 quadrant are absolutely stiff with respect to each other. Thus, in theory, it would be enough to have 1 reference object per quadrant, or even only 1 quadrant with reference objects. **The software only checks for 1 reference object in your catalog and lets you get away with it. However, we recommend to allocate 3 to 4 reference objects per quadrant in a triangular pattern.** With some experience, you will also 'put them out of the way' of slits or slit rows (e.g. in the field corners). These reference stars will allow you or the astronomer on duty to verify that indeed no single mask is tilted with respect to the three other ones. Make sure that these reference objects are centered in their respective boxes as the acquisition software will use the position of these objects for a first estimate of the offset needed to be applied to the telescope to center the mask.

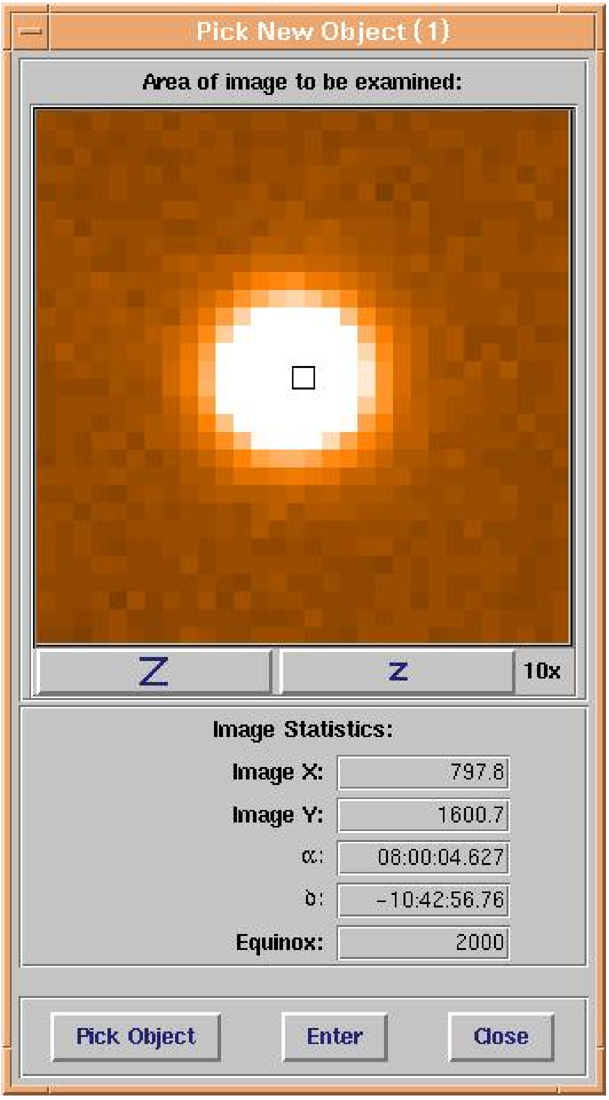
If you intend to observe very faint objects which will only become visible after the combination of many exposures then assign a few slits per quadrant to brighter objects which will serve as a sanity check for the observer. The presence of those objects in the resulting spectral frame will indicate that indeed everything went fine with the observations.

8.2 New reference objects

It can happen, that no object in your catalog is suited as reference star. In that case, you can add reference stars directly from the image. This should not be the default mode, since the centering algorithm used by `skycat` is a simple Gaussian fit and might not return as accurate coordinates as your favorite source detection program. The whole alignment procedure on sky might become less precise than with a well prepared catalog including reference stars on the same system as your scientific targets.

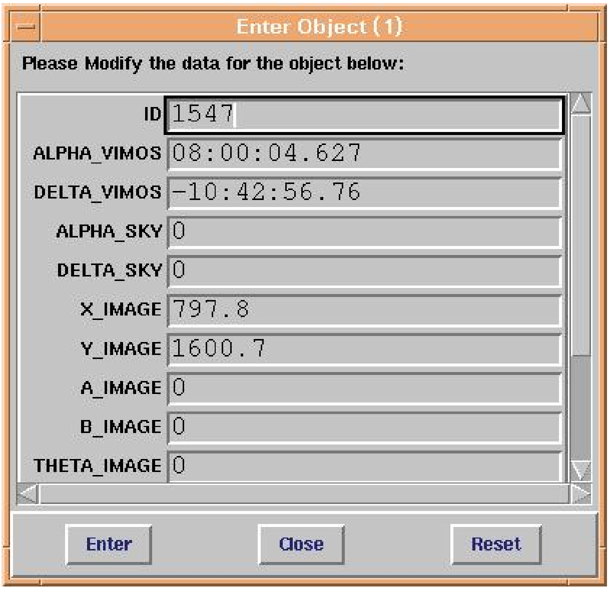
The procedure to pick new reference stars is a little different than the one described above, since obviously you cannot click on a highlighted object in the image display.

In order to select new reference stars, just click on the button 'New Ref'. This will pop-up a 'Pick New Object' window (see below). Move the cursor in the image display onto the object you want to select and click. Then select 'ENTER' in the panel below, to enter the object in the catalog.



You will be asked to confirm the ID for this object (taken as the highest current ID+1):

And you have the opportunity to change from the default values all other entries for all columns:



The new object appears at the bottom of your object list in the catalog window.

Note that the task is called 'New Ref' because this is the only case we consider useful, but in principle, once the object is in the catalog, you could change its flag to any allowed value.

8.3 Compulsory objects

You can flag a few objects as being the top priority. These objects will be allocated slits immediately after reference objects have been defined on the mask, i.e. VMMPS will make sure that they get slits allocated if not blocked by a reference object. If two compulsory object block each other, VMMPS will allocate one in this mask and the other in the next mask of the series (if applicable).

To flag an object as compulsory, select the button 'Comp' after having clicked on the object in the image display. The 'FLAG' of the object will be set to 'C' (Compulsory) in the catalog.

If you added a column 'FLAG' in your input catalog, this flag can be used to set high priorities.

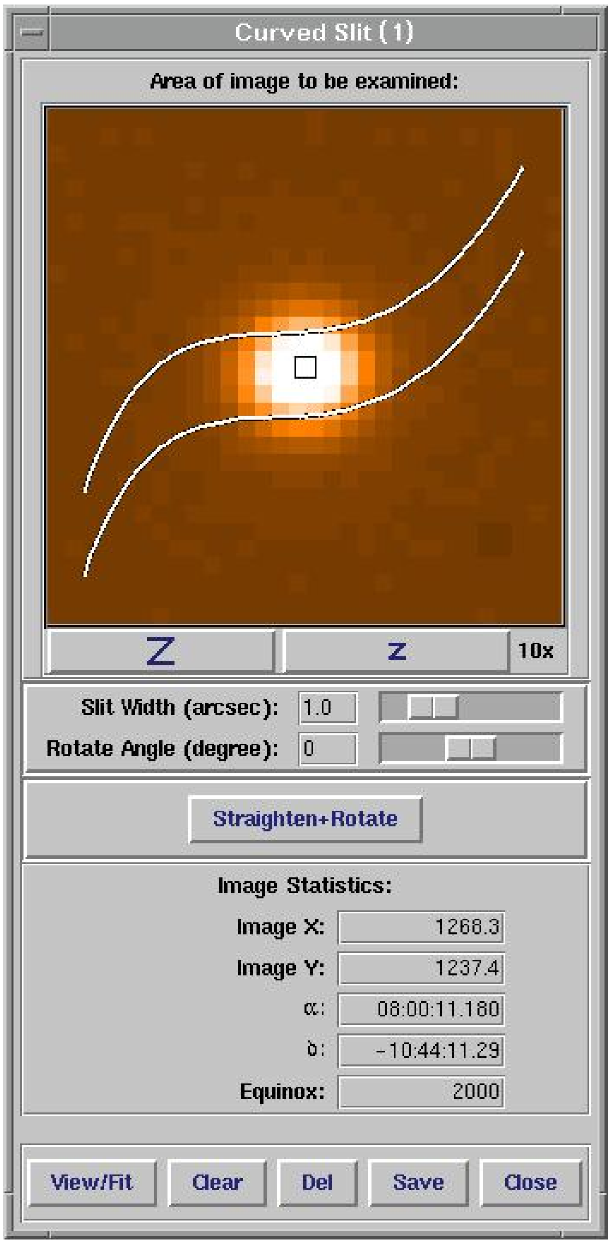
8.4 Forbidden objects

You can exclude individual objects from the automatic slit assignment task. To do so, select the button 'Forb' after having clicked on the object in the image display.
If the 'FLAG' of an object is set of 'F' (Forbidden), that object will not be considered for slit assignment. This has the same effect as removing the object from the catalog.

The cases in which you might need this are rare, it application useful when you use the same catalog for different purposes. E.g. imagine that you use a single catalog to prepare masks for two different grisms and that you have a few objects for which blue spectra are useless. These objects could be flagged manually forbidden when preparing the masks for the blue grisms and save you the time to duplicate the catalog.

8.5 Curved slits

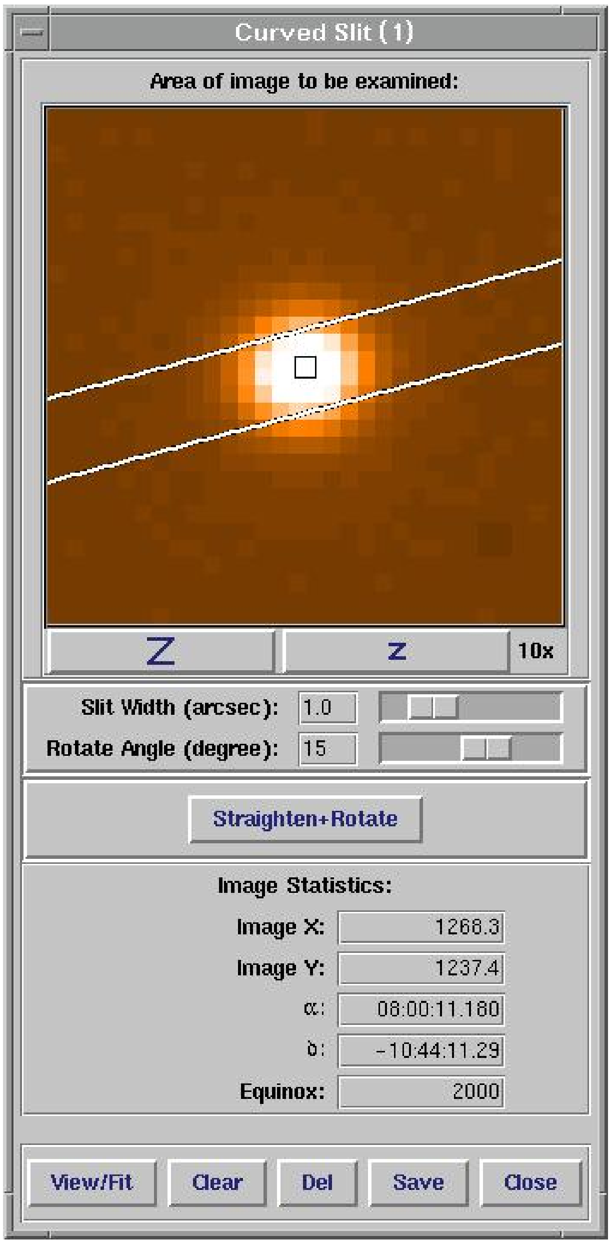
You have the possibility to define curved or tilted slits. To do so, click on the button 'Curved'. This will pop-up the 'Curved Slit' window (essentially a Pick Object skycat window with several special features):



Once you clicked on the object in the image, it appears in the 'Curved Slit' window and you can define the curved slit. To do this, click in the little display to define the points through which the curved slit should pass (start with a point centered on your object maybe). Once you have defined a few points, click on 'View/Fit' and the slit will appear.

Note that at any given x, the Δy is kept constant to warranty constant slit width / dispersion along the slit. You can modify the slit width by using the slit width bar (or type in directly the value in the associated box) and click 'View/Fit' again.

If you wished a straight slit, just click 'Straighten+Rotate' after having clicked 'View/Fit'. If you wish to give the slit a given position angle, use the 'Straighten+Rotate Angle' bar (or type in directly the value in the associated box) and click on 'Rotate'. Remember that in normal pre-imaging, North is left (-x on detector) and East is up (+y on detector), thus a positive angle here is measured from north (0) to west (+90, which by the way would make very limited sense).



Once you are happy with you curved slit, click 'Save'. This will update the 'FLAG' of the object to 'A' (for Curved in Suavely or Serbo-Croatian) and store the fit parameters.

8.6 Unselecting objects

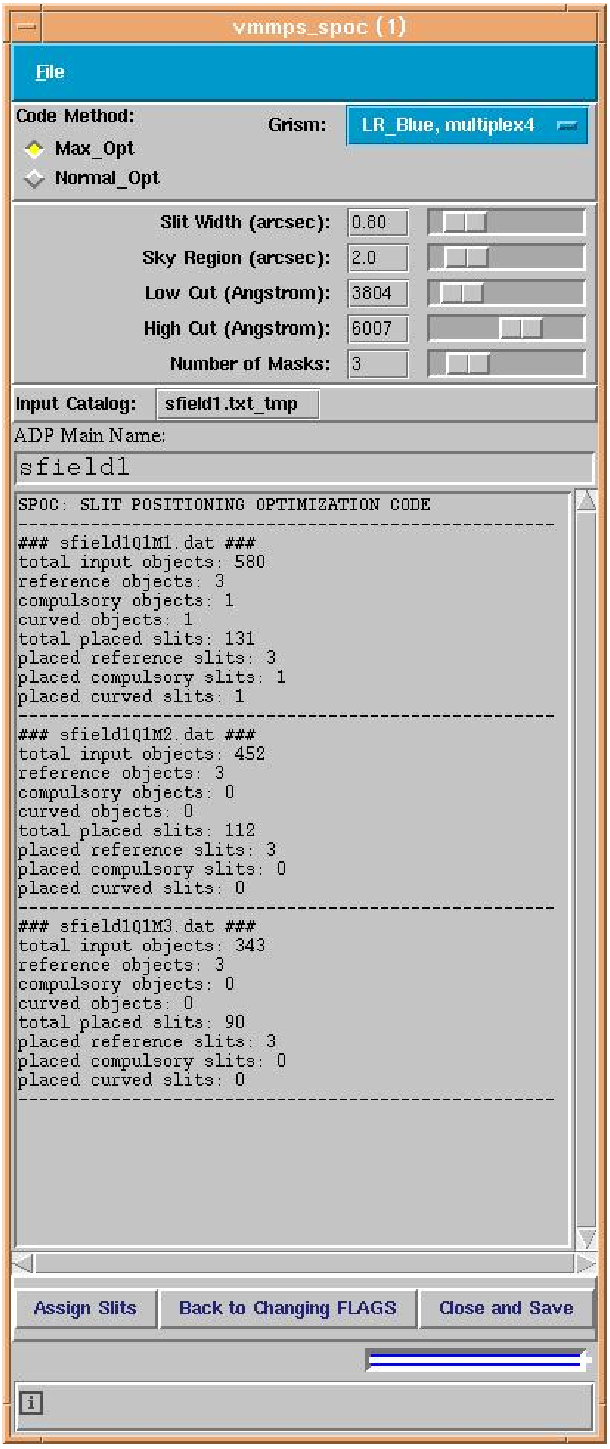
You can, at any time, reset a 'FLAG' to 'S' (select-able), i.e. erase the special flag you allocated to a object.

To do this: click on a special object then click on the button 'UNSEL'. If you look now in the catalog, the 'FLAG' has been reset to 'S'.

9 Step 6: The automatic slit assignment – your first ADP draft

Once you have at least defined a few reference objects, and modified all other flags of your choice in Step 5, you can let VMMPS assign all the slit automatically (the relaxing part).

Select in the catalog window, at the very bottom, 'Automatic Slit Assignment'. This will open the following pop-up window (with the central sub-panel empty to start with):



Here you should define several parameters:

- **The Code Method**: Maximum or Normal Optimization (yeah, you think maximum is always best but wait). The Maximum optimization mode is more efficient in terms of number of placed slits, but favors the smallest (X_RADIUS) objects. The Normal Optimization is less efficient in terms of number of slits ($\sim 10\%$ less) but does not bias against large objects. If you have only point source, go for Maximum. If you have extended objects, you might want to use the Normal optimization to avoid biases in your survey.

- **The Grism**: the task needs to know the Grism for two reason. First, in order to define correctly the wavelength range; second in order to define the multiplexity (LR grism allow up to 4 slits in dispersion direction, the MR grism up to 2). The selection of the grism will automatically set-up the minimum and maximum wavelengths in the widgets below, such that your spectra have the maximum length on the detector around the zero-deviation wavelength of the grism.

- **The slit width (arcsec)**: this will define the slit width for all objects (except for reference objects defined by a fixed 4" box and curved slits for which you have defined the slit width separately).

- **Sky Region (arcsec)**: defines the *minimum* sky region that VMMPS will allocated on each side of your object in the slit. The pipeline requires at least 1.8 arcsec. More will reduce the number of position-able slits, but increase your sky subtraction capabilities later.

- **Low / High Cut (Å)**: define the wavelength range that you need, i.e. the common length of the spectra. As mentioned under 'Grism' the value set are giving you the maximum spectral length (∼500 pixels in LR mode, ∼2000 pix in MR mode, ∼4000 pix in HR mode), centered around the zero-deviation wavelength of the grism. The software will guarantee that length for all spectra. On the other hand, this will constrain the physical region on the mask in which it can place slits. E.g. if you pick the full range in HR mode, only sources in a narrow band in the middle of the detector will be picked. It is thus a good idea to reduce the range to the strict minimum you need. This will allow to select more objects.

- **The Number of Masks**: you can produce one or more masks for a given field. If more than one mask is selected, the reference objects will be placed in *all* masks, the other special objects allocated in order of priority. The task will fill the first masks with slits, then the second with objects that have not been allocated yet and so forth.

- **The Main Name of your ADP**: this name will be extended by the quadrant number, the mask number and the grism name when your ADP files get written on disk.

Once you have set up all the above parameters, you can 'Assign Slits' at the bottom of the window. This will produce a log, shown in the middle sub-panel, telling you how many select-able stars were found in the catalog, the number of special objects, the total of different placed slits[4].

If you are satisfied with the results, click 'Close and Save' and move on to Step 7.

[4]Sometimes the algorithm fails with an ungraceful core dump. See Section 13.

If you wish to change parameters again, just do so and run 'Assign Slits' again. If you think that you screwed something fundamental up (hey, you really forgot reference objects?) then go back to Step 5 by clicking 'Back to Changing FLAGS'.

• **Dirty Trick**: with that title, it will be the most read section of the cookbook, but beware!

If you are interested in a redder or bluer spectral region than offered by default by the software, you can, instead of using the widget bar in 'Low/High Cut', type in numbers directly in the boxes. If this results in a larger range than offered by default, the software will not be able to allocate any slit. However, if you are, say, only interested in the very blue part of the spectra, you could type in e.g. lower cut 3700 Å and upper cut 4500 Å. The software will then place the slits in a band at the top of the detector (dispersion direction is y, with red at top) and this will make sure that the full blue end of all spectra lands on the detector [5].

Now here is where you can completely screw up: the values you type in here will only constrain the software on where to put slits, but will, of course, not influence their physical length (we will not order new blocking filters for you :-) so in case of multiplexity in the dispersion direction, handle these parameters with care in order to avoid contamination along the dispersion direction.

If you have no clue of what this is all about, you should probably not try the dirty trick.

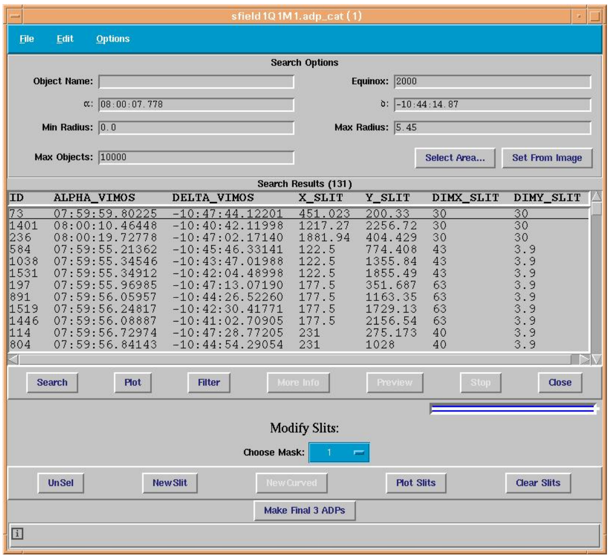
[5]The VIMOS instrument web pages give a good overview of the wavelength range you can expect for each grism as a function of the slit position on the mask. Did we mention that our web pages are great? Have you read them carefully?

10 Step 7 (optional): Fine tuning / last corrections

This step is optional. You can skip it and move directly to Step 8.

The end of Step 6 triggers your old catalog window to disappear and a new one to appear, as well as the display to be updated.

The new catalog window looks as below, and is composed of as many virtual layers as you defined masks for this quadrant. You can step from window to window under ‘Modify Slits:’, ‘Choose Mask’ and use the pull-down widget that also indicates on which mask you are currently working.



At this point your ADP has been written, and you could proceed without changes to Step 8. Optionally, if you have the feeling that you should modify a few slits, proceed with this Step but be careful (you are about to try to optimize an optimization).

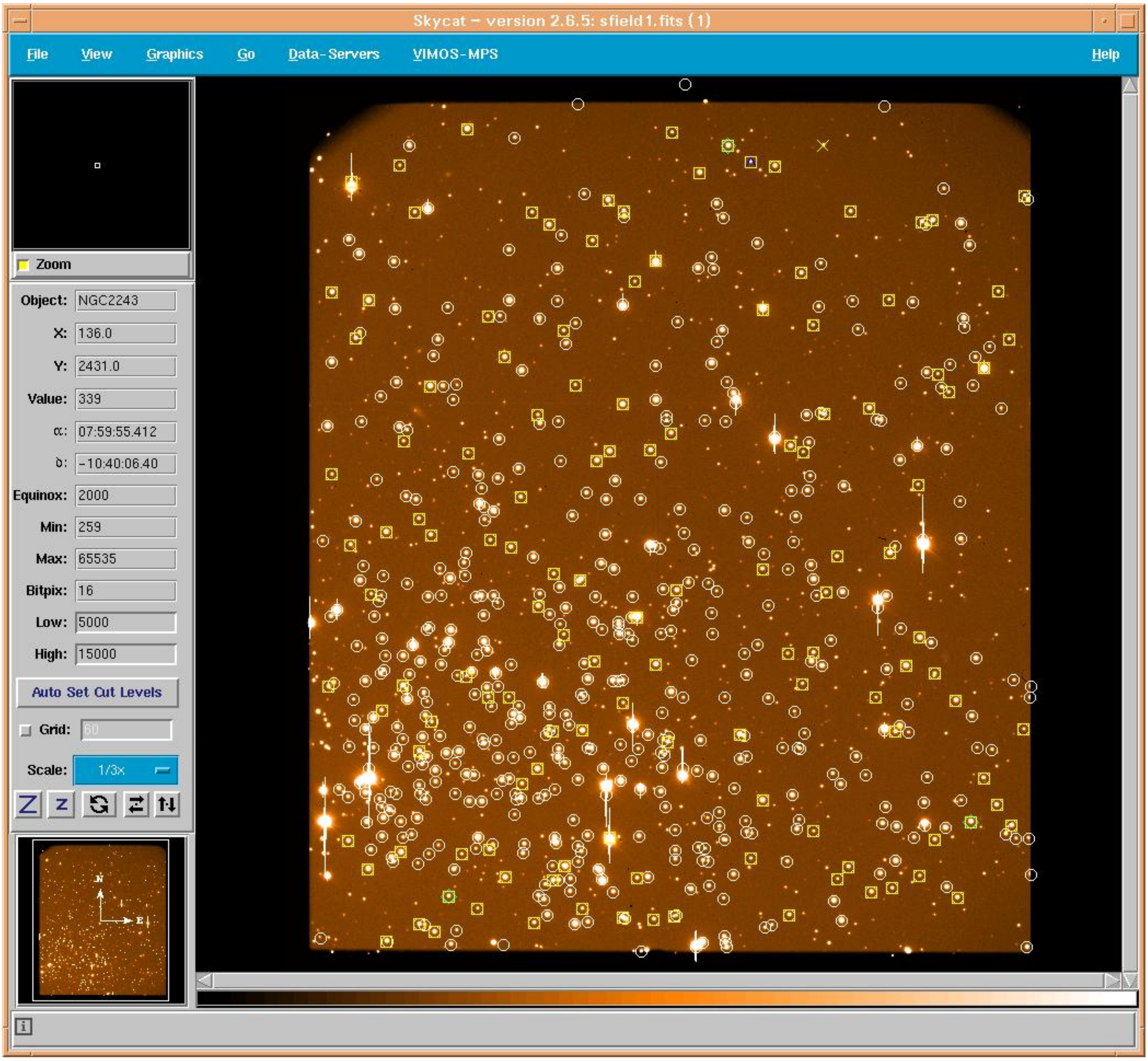
The window lists all objects that have been allocated slits in this mask. You can now do the final (careful!) fine tuning by unselecting some slits (‘Unsel’) and/or adding some slits (‘New Slit’), following the procedure that should start to be familiar to you by now, interacting with the display (finish by pressing ‘Enter’ in the Pick-Object window). The new slit will be created with default values: the slit width will be the one that you defined in Step 6 during the automatic slit assignment; the slit length defined by the X_RADIUS of the new object added to the minimum sky region defined in Step 6. Note that in low resolution slits that overlap in dispersion direction get common slit width in Step 6 (to facilitate sky subtraction with second order contamination), *but this is not automatically done here*. Also, there is no check for slit overlap, so be extremely careful.

You can edit/modify the values for the new object. A new row with that object will appear at the end of the catalog in main catalog window and the entries for this object can be modified by you. To do this, click on the row with the new object (that gets highlighted then) and go to the pull-down menu ‘Edit’ to choose ‘Edit selected object...’. This opens a window that allows you to change any entry for that object – typically you want to change only the values of DIMX_SLIT (slit length) and DIMY_SLIT (slit width). If in doubt, use the values of the other objects in the catalog as reference. Once you are done, click on ‘Enter’, verify that the values have been updated in the catalog, and click on 'Close'. A good practice is then to 'Plot Slits' and visually inspect whether your new slit has the right length (i.e. dimension in x) or whether it is overlapping/touching other slits. Remember to be generous with space between slits, as you have to respect some physical mask stability criteria.

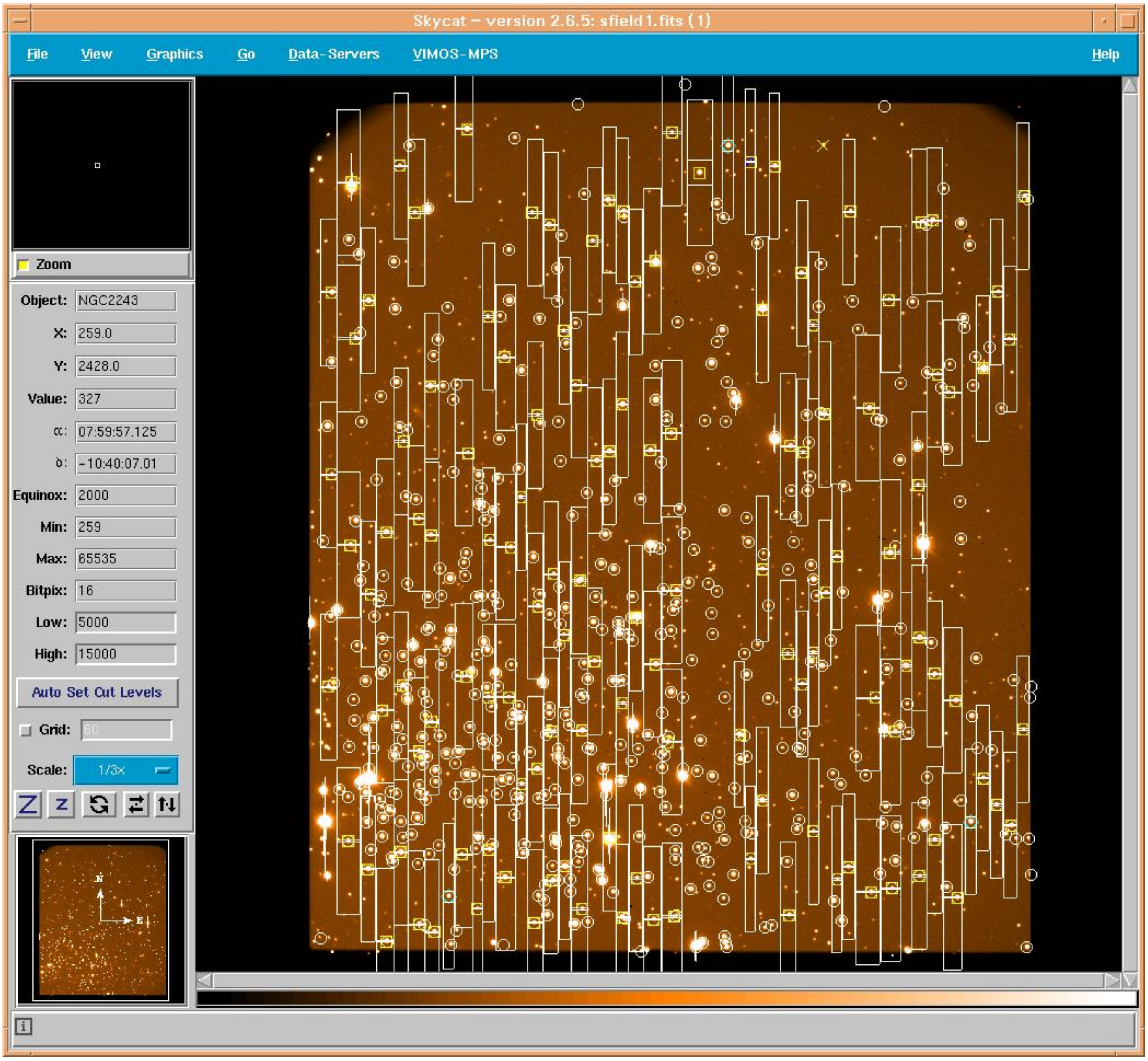
We caution again from doing to many modifications at this point (none should be necessary!) since it is much easier to screw things up here than to improve them. Remember that the task already optimized the allocation. If you modify anything, be sure that you are still respecting all constraints (including contamination issues along the dispersion direction, calibration issues, pipeline requirements, ...). If you have any doubts, do not modify anything, that mask is certainly good enough already.

The software **will not** check whether your new slits are overlapping in the spatial or spectral direction with already allocated ones.

The display now shows all objects in your input catalog marked with white circles, and the objects for which slits were allocated in this mask with yellow squares (special objects are not marked any longer as such).



You can use the button 'Plot Slits' and 'Clear Slits' to overlay the actual slits and expected spectral range.

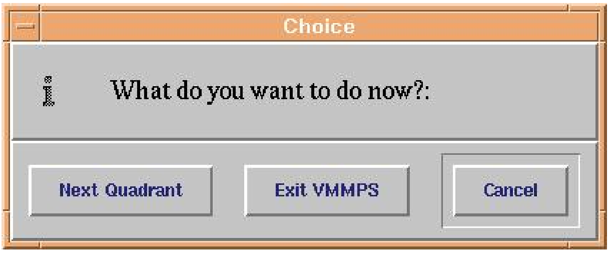


Once you have made the last modifications you can move on to the next mask of the series as described above ('Choose Mask'), and once you are through with all masks, proceed to Step 8. You are almost there...

11 Step 8: Writing your final ADP – you have succeeded

Once you are happy with all slits in all masks for this quadrant, click on 'Make final X ADPs' where X indicates the number of masks you have defined and for which ADP files will be written.

A last pop-up window will appear:



and ask you whether you want to restart a VMMPS pass e.g. with the next quadrant; exit VMMPS after saving all results; go back to Step 7 (you forgot something...).

Depending on your choice, you will go back to Step 1, go have a coffee or go back to Step 7, respectively. In the first two cases, you will have created ADP files ready to be attached to OBs.

CONGRATULATIONS!

IMPORTANT: note that an APD file edited "by hand" (e.g., changing the slit width with a text editor) will **not** be accepted by p2pp. Based on the slitlets position and size, a checksum parameter is calculated when you create the ADP files, and verified again when the ADP file is attached to an OB. If an inconsistency is found, the ADP file will not be accepted by p2pp.

12 Loading/verifying previously defined mask

A simple way to come check the ADP your produced is offered in the 'VMMPS' pull-down menu (3rd item): 'Verify ADP file'.

By selecting this task, you will be asked for an input ADP file and the corresponding pre-image. Similar to the slit assignment task, it will display the pre-image and open a catalog window, this time containing only the objects allocated in that given Mask.
You can then as in Step 7 overlay/clear the slits with the buttons 'Plot Slits' and 'Clear Slits'.

Under no circumstances edit the ADP file by hand[6].

[6]You could, in theory, edit interactively the ADP file, but you would then deserve what you would get: namely no objects in the slit.

13 Troubleshooting and known problems.

Here are some 'features' that we have encountered for you. We are grateful for anyone sending us more 'features'. Remember that an expert is the one who has already made all mistakes himself, you can save some time by using this list in case of problems...

We only assume that you have install the software properly. Especially checked whether your command `skycat` points indeed to the right version, that your environment variables have been set correctly, the right Tcl/Tk libraries are being used,etc. Since these have been our main sources of frustration when we debugged the software. These will typically have the effect of not opening some windows, not showing the plug-in in skycat, etc.

OK, so let's assume that you have used your particular version of VMMPS successfully in the past, but now you are in trouble with that particular $#%@#!! set of catalogs/images.

13.1 Cross-correlation task

- The circles surrounding the objects used and discarded during the cross-correlation are not properly displayed in the image. See section 5. This does not mean that the cross-correlation went wrong, you need to go to step 3 to visualize further the results of the transformation of your `contributed` catalog.
- You have run the cross-correlation but not objects were found in common (Bummer!). Check if:
  – your input catalogs have all the mandatory columns
  – there is an overlap of objects between your `contributed` and your `VIMOS pre-image catalog`
  – you have up-loaded the right pre-image, which is used to make the link between `contributed` and `VIMOS pre-image catalog` coordinates.
- Your final transformation gives RMS>1" (hmmm....)
  – are you sure that your contributed catalog has a good astrometry? Especially that it does not suffer from any distortions?

13.2 Automatic slit assignment

- VMMPS currently does not check for the presence of reference objects (see section 8.1). It is required that at least one reference object is defined per ADP file, and your OBs will be rejected by the User Support Department if this is not the case.
- You loaded pre-image and catalog, but hardly any (no) object appears in the catalog window or is marked in the display.
  – check in the catalog window the 'Max Radius'. It happened to us that with the columns X_WORLD and Y_WORLD in the catalog, `skycat` decided to pick its own Max Radius, which produced the funniest effect (OK, you are not in a mood of laughing right now, never mind). Try changing by hand the Max Radius to something really big (2700?).

- The classical one: you pressed during step 6 the button 'Assign Slits' but of the gazillion of objects in the catalog, none was assigned a slit.
  – you might have been too ambitious in the common wavelength range. Try reducing it.
  – check the flags in your catalog (there are not all F for some reason, aren't they?)

- Curved slits: you picked the object and are now clicking madly in the 'Curved Slit' window to determine the fancy curved slit, but no little dots appear. We have not found out why this happens every now and then, but we know that even if you do not see them, they are there (spooky). Try defining a few (virtual) points and click 'View/Fit' that should work.

- There are occasions in which the subroutine/algorithm used to optimize the slit positioning, SPOC, does not converge. In such cases you will see a core dump message. If this happens for some of your masks please contact ESO's User Support at usd@eso.org for a possible workaround.

13.3 Other problems

- There are reports of a possible bug: the image is displayed but a pop-up message appears stating "ERROR: Fits file VIMOS image", after which one can not proceed with the cross-correlation. If that happens the user can try to load the image again using the Open sub-menu of the File menu in the skycat main window. If that does not work, please contact ESO's User Support at usd@eso.org.

A Examples of catalogs

A.1 A contributed catalog

The following shows an example of a contributed catalog. Note that all mandatory columns (ID, RA, DEC) are in, as well as a couple of optional reserved columns (X_IMAGE,Y_IMAGE), and a few user columns (VI_color, V_MAG). All these will be carried over to the output of the Cross-correlation task (i.e. stored in the resulting VIMOS catalog that will serve as input to VMMPS).

```
 ID       RA          DEC           VI_color     V_MAG
 1     3:21:46.54 -37:13:43.9        1.751       23.26
 2     3:21:49.01 -37:11:32.2        1.948       23.35
 3     3:21:50.53 -37:15:04.7        1.774       23.53
 4     3:21:56.17 -37:07:29.6        1.599       23.17
 5     3:21:56.27 -37:16:22.5        1.927       23.37
 6     3:21:57.11 -37:13:26.3        1.063       23.26
 7     3:21:58.51 -37:11:34.0        1.198       23.44
 8     3:21:58.65 -37:13:54.4        1.372       22.83
 9     3:22:02.05 -37:05:41.3        1.399       23.3
10     3:22:03.02 -37:08:21.6        1.924       22.41
11     3:22:03.31 -37:08:08.7        0.8833      23.15
12     3:22:03.69 -37:11:45.7        0.9918      23.31
13     3:22:03.98 -37:07:01.0        1.462       23.08
14     3:22:04.55 -37:10:33.4        1.101       23.39
15     3:22:05.18 -37:09:13.1        1.393       22.9
16     3:22:06.29 -37:20:40.4        1.095       23.09
17     3:22:08.03 -37:05:37.7        1.592       23.19
18     3:22:08.23 -37:06:39.4        0.9589      22.85
19     3:22:08.47 -37:13:56.4        1.662       22.5
20     3:22:10.81 -37:14:42.0        1.694       23.58
21     3:22:11.01 -37:16:31.6        1.664       23.53
22     3:22:11.92 -37:17:40.3        1.725       23.41
23     3:22:12.28 -37:18:52.5        1.103       23.54
24     3:22:12.39 -37:11:01.7        1.383       22.79
25     3:22:13.73 -37:11:56.5        1.203       23.3
26     3:22:14.66 -37:15:55.2        0.8767      23.32
27     3:22:15.96 -37:13:32.6        1.283       22.39
28     3:22:15.99 -37:10:53.6        1.441       23.32
29     3:22:16.20 -37:15:47.4        1.217       22.99
30     3:22:19.93 -37:17:35.5        1.712       23.24
...
```

A.2 A VIMOS pre-image catalog

The VIMOS pre-image catalog was obtained by running our favorite source detection algorithm on the original VIMOS pre-image processed by the ESO pipeline. The output was just plain x,y detector coordinates, we added manually a unique ID. That list, together with the transformation matrix in the header of the pre-image, will be transformed into ra,dec and cross-correlated with the contributed catalog. This will in turn allow to determine the best transformation from ra,dec of the contributed catalog to x,y in pixel coordinates.

```
ID     X_IMAGE    Y_IMAGE
 1      76.554    497.854
 2      78.566    258.963
 3     100.714     83.548
 4     445.282     69.524
 5    1589.924     51.424
 6     767.057    126.705
 7    1391.149    121.832
 8     229.290    137.767
 9     800.180    157.851
10    1010.375    156.611
11    1351.326    177.466
12     980.319    184.649
13     548.496    182.759
14    1534.235    204.140
15    1310.024    208.284
16     823.662    233.845
17     209.727    220.367
18     706.188    228.008
19    1797.688    243.397
20    1936.794    250.302
21    1996.330    245.786
22    1046.128    251.701
23    1737.622    249.215
24    2018.013    246.191
25    1851.735    266.140
...
```

A.3 A VIMOS catalog

The following shows an example of a VIMOS catalog.

```
ID X_IMAGE  Y_IMAGE A_IMAGE B_IMAGE THETA_IMAGE    MAG   MAGERR
1   233.036 549.141  66.651  4.305     -89.9      7.4464  0.0001
2   891.844 360.569  53.105  7.911     -87.4      7.9803  0.0002
3   100.238  84.054  60.828 24.763     -10.0     11.2455  0.0053
4   601.006  67.561 428.910  9.910      -0.6      9.9766  0.0027
5  1708.843  51.041 104.712 12.829      -1.9     99.0000 99.0000
6   978.752  48.620  12.126  4.303     -12.4     12.7846  0.0047
7  1209.031  74.048  28.632  6.684      -2.3     10.1976  0.0008
8  1212.790  59.548  18.403  5.147      -5.5     10.3681  0.0007
9  1127.769  61.476  21.994  6.201     -89.3      8.5845  0.0002
10 1146.020  73.446  10.094  8.440     -36.7      9.5569  0.0003
11  797.370 124.978   4.882  3.866     -87.6     10.2443  0.0003
12  456.249  66.226  35.585  7.872       3.8     10.2253  0.0010
13  993.617  51.635  19.266 10.830      16.2     99.0000 99.0000
14 2036.250  59.659  58.085  8.955      -0.7     10.4253  0.0012
15  281.472  76.981  10.187  7.927     -33.5     10.6445  0.0008
16  412.076 102.149   4.210  3.252      89.7     11.2830  0.0006
17  882.229 477.262  35.568  3.459      89.9      8.0405  0.0001
18  179.795  30.820   1.176  0.901       8.0     17.1447  0.0356
19 1205.669  89.548   4.645  2.893       6.0     11.3859  0.0007
20 1527.264 133.530   3.779  3.458     -75.3     10.6818  0.0003
21  871.428 246.348   9.820  4.277      89.1      9.4710  0.0002
22 1458.521 103.164   2.132  2.078     -22.0     13.4509  0.0025
23  370.528 123.550   2.785  2.643     -55.8     11.4401  0.0005
24  472.827 106.763   2.265  2.148     -53.4     12.7780  0.0014
25  934.416 137.586   3.261  2.952      52.2     11.0887  0.0004
26  385.186 121.721   2.487  2.315     -55.9     12.1251  0.0008
27 1317.302 113.621   2.276  2.197      -3.6     12.4142  0.0010
28  926.796 142.882   3.188  2.830      63.5     11.0968  0.0004
29  832.140 129.522   2.786  2.713     -17.4     11.4509  0.0005
30  975.537 113.508   2.163  2.068     -10.8     13.0277  0.0017
...
```

B Example of an ADP file

Your final ADP file should look something like this. It starts with a few PAF/INS keywords defining the file itself. In then adds the crucial telescope/pointing parameters, before describing for which instrument configuration the ADP has been created. It then gives the most important part: the CCD to Mask transformation. Only then comes the part describing first the reference objects and then all slits defined for this mask, with all curved slits appearing at the very end (and an example is appended here).

```
PAF.HDR.START
PAF.TYPE "paramfile"
PAF.ID "073.A-0602C+3.18+2004-05-12T15:50:59.001+1"
PAF.NAME "wfi16_vm_LR_Red_M1Q1.adp"
PAF.DESC "ADP: Aperture Definition File in Pixel"
PAF.CRTE.NAME "vmmps-3.22+"
PAF.CRTE.DAYTIM "2004-05-12T15:50:59.001"
PAF.LCHG.NAME ""
PAF.LCHG.DAYTIM ""
PAF.CHCK.NAME ""
PAF.CHCK.DAYTIM ""
PAF.CHCK.CHECKSUM "954768746"
PAF.HDR.END
INSTRUME "VIMOS"
OCS.CON.QUAD "1"
INS.FOCU1.TEMP "12.31496"
INS.ADF.TYPE "MOS"
INS.ADF.VERSION "3.22+"
INS.ADF.UNIT "PIXEL"
INS.ADF.ID "wfi16_vm_LR_Red_M1Q1.adp"
INS.ADF.COMMENT ""
INS.MASK1.ID "-1"
TPL.FILE.DIRNAME "$INS_ROOT/$INS_USER/ADF"
TPL.FILE.KEEP "T"
DATE-OBS "2004-04-20T06:57:05.802"
TEL.GS1.ALPHA "191457.06000"
TEL.GS1.DELTA "-460255.35599"
TEL.GS1.PPOS "NEG"
ADA.POSANG "90"
TEL.TARG.ALPHA "191427.80880"
TEL.TARG.DELTA "-460426.61600"
TEL.TARG.EQUINOX "2000."
TEL.TARG.NAME ""
INS.ADF.GRISM.NAME "LR_Red"
INS.ADF.GRISM.SPECTLEN "640"
INS.ADF.SKYREG "1.8"
INS.REF.NO "1"
INS.ARC.NO "0"
```

```
INS.SLIT.NO "46"
INS.SHU.NO "4"
INS.SHU1.POSL "0"
INS.SHU1.POSH "769"
INS.SHU2.POSL "769"
INS.SHU2.POSH "1549"
INS.SHU3.POSL "1549"
INS.SHU3.POSH "2249"
INS.SHU4.POSL "2249"
INS.SHU4.POSH "2440"
PRO.CCD.MASK.DAYTIM "2004-03-25T19:21:18.334"
PRO.CCD.MASK.TEMP "14.490387"
PRO.CCD.MASK.X0 "-131.872451572"
PRO.CCD.MASK.XX "0.11921553"
PRO.CCD.MASK.XY "-0.00010888833"
PRO.CCD.MASK.X_0_0 "-0.18869123"
PRO.CCD.MASK.X_0_1 "0.00054856849"
PRO.CCD.MASK.X_0_2 "-4.812277e-07"
PRO.CCD.MASK.X_0_3 "1.3219545e-10"
PRO.CCD.MASK.X_1_0 "0.00022477421"
PRO.CCD.MASK.X_1_1 "-5.4715579e-07"
PRO.CCD.MASK.X_1_2 "5.5136728e-10"
PRO.CCD.MASK.X_1_3 "-1.8931227e-13"
PRO.CCD.MASK.X_2_0 "-8.3582309e-08"
PRO.CCD.MASK.X_2_1 "3.428154e-10"
PRO.CCD.MASK.X_2_2 "-4.1386207e-13"
PRO.CCD.MASK.X_2_3 "1.420323e-16"
PRO.CCD.MASK.X_3_0 "-6.977006e-12"
PRO.CCD.MASK.X_3_1 "-5.0065001e-14"
PRO.CCD.MASK.X_3_2 "8.499529799999999e-17"
PRO.CCD.MASK.X_3_3 "-2.9409612e-20"
PRO.CCD.MASK.Y0 "-126.018852108"
PRO.CCD.MASK.YY "0.11921683"
PRO.CCD.MASK.YX "7.9496414e-05"
PRO.CCD.MASK.Y_0_0 "-0.20919197"
PRO.CCD.MASK.Y_0_1 "0.00026838485"
PRO.CCD.MASK.Y_0_2 "-6.4661712e-08"
PRO.CCD.MASK.Y_0_3 "-1.2921672e-11"
PRO.CCD.MASK.Y_1_0 "0.00039152516"
PRO.CCD.MASK.Y_1_1 "-1.644576e-07"
PRO.CCD.MASK.Y_1_2 "-7.9799032e-11"
PRO.CCD.MASK.Y_1_3 "6.9466793e-14"
PRO.CCD.MASK.Y_2_0 "-2.9800619e-07"
PRO.CCD.MASK.Y_2_1 "-4.8490222e-11"
PRO.CCD.MASK.Y_2_2 "1.4704649e-13"
PRO.CCD.MASK.Y_2_3 "-6.7603913e-17"
PRO.CCD.MASK.Y_3_0 "8.9077175e-11"
PRO.CCD.MASK.Y_3_1 "7.827672800000001e-15"
```

```
PRO.CCD.MASK.Y_3_2 "-3.7850445e-17"
PRO.CCD.MASK.Y_3_3 "1.8410463e-20"
INS.REF1.TYPE "SQUARE"
INS.REF1.ID "22595"
INS.REF1.OBJ.RA "243.9472351074219"
INS.REF1.OBJ.DEC "-6.144344329833984"
INS.REF1.X "1017.37"
INS.REF1.Y "1153.78"
INS.REF1.DIMX "30"
INS.REF1.DIMY "30"
INS.SLIT1.TYPE "RECTANGLE"
INS.SLIT1.ID "27467"
INS.SLIT1.OBJ.RA "244.0057983398438"
INS.SLIT1.OBJ.DEC "-6.09309196472168"
INS.SLIT1.X "108"
INS.SLIT1.Y "2175.15"
INS.SLIT1.DIMX "58"
INS.SLIT1.DIMY "4.88"
INS.SLIT2.TYPE "RECTANGLE"
INS.SLIT2.ID "27313"
INS.SLIT2.OBJ.RA "243.9036865234375"
INS.SLIT2.OBJ.DEC "-6.095680713653564"
INS.SLIT2.X "161"
INS.SLIT2.Y "394.478"
INS.SLIT2.DIMX "44"
INS.SLIT2.DIMY "4.88"
INS.SLIT3.TYPE "RECTANGLE"
INS.SLIT3.ID "26930"
INS.SLIT3.OBJ.RA "243.9173889160156"
INS.SLIT3.OBJ.DEC "-6.101338863372803"
INS.SLIT3.X "263"
INS.SLIT3.Y "633.422"
INS.SLIT3.DIMX "38"
INS.SLIT3.DIMY "4.88"
INS.SLIT4.TYPE "RECTANGLE"
INS.SLIT4.ID "26695"
INS.SLIT4.OBJ.RA "243.9308166503906"
INS.SLIT4.OBJ.DEC "-6.104647159576416"
INS.SLIT4.X "312"
INS.SLIT4.Y "867.445"
INS.SLIT4.DIMX "56"
INS.SLIT4.DIMY "4.88"
INS.SLIT5.TYPE "RECTANGLE"
INS.SLIT5.ID "26710"
INS.SLIT5.OBJ.RA "243.9892578125"
INS.SLIT5.OBJ.DEC "-6.10461950302124"
INS.SLIT5.X "312"
INS.SLIT5.Y "1886.62"
```

```
INS.SLIT5.DIMX "56"
INS.SLIT5.DIMY "4.88"

....
....

INS.SLIT38.TYPE "CURVE"
INS.SLIT38.ID "1294"
INS.SLIT38.OBJ.RA "54.63366317749023"
INS.SLIT38.OBJ.DEC "-35.58836364746094"
INS.SLIT38.X "1934.2"
INS.SLIT38.Y "1748.86"
INS.SLIT38.DIMX "72.6812"
INS.SLIT38.DIMY "72.68"
INS.SLIT38.BEZIER.DY "3.41463"
INS.SLIT38.BEZIER.AX "0"
INS.SLIT38.BEZIER.BX "0"
INS.SLIT38.BEZIER.CX "72.6812"
INS.SLIT38.BEZIER.XX "1897.86"
INS.SLIT38.BEZIER.AY "0"
INS.SLIT38.BEZIER.BY "0"
INS.SLIT38.BEZIER.CY "37.0329"
INS.SLIT38.BEZIER.YY "1734.33"

....
....

INS.SLIT46.TYPE "RECTANGLE"
INS.SLIT46.ID "26017"
INS.SLIT46.OBJ.RA "243.9325103759766"
INS.SLIT46.OBJ.DEC "-6.108108043670654"
INS.SLIT46.X "381.9"
INS.SLIT46.Y "897"
INS.SLIT46.DIMX "18.78"
INS.SLIT46.DIMY "9"
```

C User check list

You can use this list to go step by step through the process and tick off each step one by one.

□ Step 0 (most crucial): Prepare you catalog(s) and image(s)

You have prepared carefully your catalog(s) and have the corresponding VIMOS pre-images ready. You thought carefully of the objects in your catalog: only objects you do not mind having a slit allocated to them are in there, VIMOS pre-image and contributed catalogs have common objects, you did not modify your VIMOS pre-image, ...

□ Step 1: Chose the right task to start with

According to your input catalog you go – to Step 2 if you have a VIMOS pre-image and contributed catalog; to Step 3 if you have a VIMOS catalog

□ Step 2: From VIMOS pre-image and contributed catalog create a VIMOS catalog

Skip this step if you have already a `VIMOS catalog`

□ Step 3: Starting VMMPS for mask definition

(**□ Step 4 (optional): re-arranging your VIMOS catalog**)

□ Step 5: First pass – defining special objects

Have you been careful and defined at least 3 reference objects per quadrant?

□ Step 6: The automatic slit assignment – your first ADP draft

Spend some time thinking of your parameters. Tip: select only the wavelength range you really need.

(**□ Step 7 (optional): Fine tuning / last corrections**)

Only go through this step if you are sure to know what you are doing.

□ Step 8: Writing your final ADP

And remember never to edit this file by hand. Make finding charts after pressing "Plot Slit" button, by selecting "File->Make Finding Chart" menu.

YOU ARE DONE!