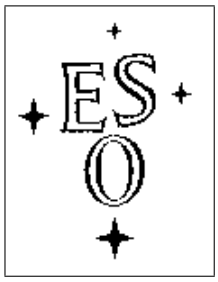


EUROPEAN SOUTHERN OBSERVATORY

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

ESO Survey Telescopes

Survey Area Definition Tool
SADT Cookbook for VST

Issue 1.0, Date 15/07/2011

	Name	Date	Signature
Prepared	Michael Hilker	15 July 2011	
Approved	Francesca Primas		
Released	Fernando Comerón		

This page was intentionally left blank

Change Record

Issue/Rev.	Date	Section/Parag. affected	Reason/Initiation/Remarks
Issue 1.0	15/07/11	all	First release, for SV and Dry Runs

This page was intentionally left blank

Contents

1 Introduction

1.1 Scope of this document

The document explains the necessary steps an astronomer has to perform to define an area on the sky that shall be covered by observations with the ESO Survey Telescope VST. 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 basic knowledge on SADT needed to define a survey. This version of the Cookbook is tailored for observations with VST only. It describes the main functionalities of the tool, but does not describe the installation of the tool (see the SADT web page for that) nor the use of its output files for the further phase 2 preparation with P2PP for Public Surveys. For those actions please consult the following web pages:

http://www.eso.org/sci/observing/phase2/SMGuidelines/SADT.html

http://www.eso.org/sci/observing/phase2/SMGuidelines/SADT/SADTInstall.html

http://www.eso.org/sci/observing/phase2/P2PPSurveys.html

1.3 Contact information

In case of specific questions related to SADT and its use together with P2PP for Public Surveys please contact the ESO User Support Department via this email address:

usd-help@eso.org

1.4 Credits and acknowledgements

The SADT is part of the UK's software in kind contribution on joining ESO and was written by members of STFC's United Kingdom Astronomy Technology Centre, an establishment of the Science and Technology Facilities Council. Specifically (in time order) by: Martin Folger, Nuria Lorente, and Albert Heyrovsky. The above interacted closely with Jim Emerson (VISTA PI) who set the requirements and latterly modified some code.

1.5 Abbreviations and Acronyms

aO	active Optics (to differentiate it from AO=Adaptive Optics)
CCD	Charge Coupled Device
ESO	European Southern Observatory
GUI	Graphical User Interface
OB	Observing Block
P2PP	Phase II Proposal Preparation
PLASTIC	Platform for Astronomical Tool Interconnection
SADT	Survey Area Definition Tool
USD	User Support Department
VLT	Very Large Telescope
VISTA	Visible and Infrared Survey Telescope for Astronomy
VST	VLT Survey Telescope

2 Read this first: The SADT concept and limitations

2.1 What does SADT do?

SADT is software that, in the end, produces a file that you must import into P2PP for Public Surveys to generate the observation blocks (OBs) of your survey. That file, called **XML Survey Definition file** (or just XML file in the following), contains a list of all pointing positions for each dither position within a survey. The area covered by a set of dither positions at the same pointing is referred to as a **tile**. A single (or jittered) exposure at a certain dither position is sometimes called a **pawprint** in this cookbook. The concept of pawprints and tiles was introduced for observations with VISTA/VIRCAM which was the main driver for the development of SADT.

SADT also can provide the positions of suitable guide and wave front sensor (or active optics (aO)) stars for the default dither positions. SADT searches for these guide and aO stars using public star catalogs from the web. It iteratively adjusts the tile positions if insufficient guide/aO stars were found. Thus, SADT is an **auxiliary, but also mandatory tool** that facilitates the creation of the numerous OBs of a survey together with P2PP. SADT is not concerned about what observations are carried out at each position in a survey (except some input parameters regarding the dither and jitter pattern, see Sects. 3 and 4).

Creating one or several XML files is your goal. Before you start with SADT, you need to have a clear idea about your survey layout (boundaries, overlap) and observing strategy (dither pattern, jittering, etc., see Sect. 3.1). How to get from these input parameters to your desired output product is all explained step by step in this Cookbook.

2.2 Some important limitations of the tool

SADT supports the definition of areas using coordinate ranges or circles in different coordinate systems, like FK5 (J2000), Galactic or Ecliptic coordinates. However, not all kinds of coordinate definitions are appropriate for all areas on the sky, i.e. one should use circles and not coordinate ranges for areas with declinations/latitudes below -60 deg. Trying to define areas with coordinate ranges close to the poles of a coordinate system results in a wrong graphical representations of the tiles. Even when using circles and choosing the plot type 'South Polar Plot' some tile borders of tiles that cover the polar region might not be correctly represented in the display window, although the output files are correct.

A single pointing/tile defined directly on the Southern Galactic Pole is not possible with the current version of SADT (i.e. a small circle area centred on the pole). A possible work around is either to define a very large region that starts far from the pole or to make the tiles near the pole in another coordinate system with a different pole (e.g. Galactic or Ecliptic).

The tiles/pawprints within one survey area definition will all have the same orientation. If more than one orientation is needed within a survey, the total survey area has to be split up into several independent area definitions with different detector/tile orientations.

The SADT display does not show the location of any targets, like bright stars or extended galaxies. If one wants to avoid bright stars one either can define some sub-areas that shall be excluded from a survey area (see Sect. 5.2) or one can delete individual tiles after the definition of all tiles in a survey area (see Sect. 6.3). There exists the possibility to plot tiles (or overlay them on sky images) in Aladin or other VO tools communicating via a 'PLASTIC', hub (see Appendix B).

3 Step 0: Getting ready – define your survey layout and observing strategy

This step describes the preparations done outside SADT. Having all the following parameters and information in hand is an important prerequisite to successfully run SADT.

3.1 What you need

This Cookbook assumes that your are familiar with the instrument that you are using for the survey observations. In particular, you should know the layout of the detector array, i.e. the pawprint, and the total size of the tile you want to use to uniformly cover an area. A tile is a filled and fully sampled area of sky formed by combining multiple pawprints. Because of the detector spacing, the minimum number of pointed observations (with fixed offsets) required for reasonably uniform coverage of a OmegaCAM tile is 5 (the *diag* dither pattern). All this information can be found in the OmegaCAM User and Template Manuals, which can be downloaded from this web page:

http://www.eso.org/sci/facilities/paranal/instruments/omegacam/doc/

In the following the parameters that are relevant to SADT are summarized:

- **Borders of your survey or survey areas**: this can either be a coordinate range in right ascension/declination (in the FK5 (J2000) or FK4 (B1950) system) or longitude/latitude (in the Galactic or ecliptic system), or it can be a circle with a central coordinate (in either of the coordinate systems mentioned before) and a radius in degrees.
- **Orientation of the detector**: The orientation of the Y-axis of the detector with respect to the survey area can be chosen in steps of 90 degrees: 0, 90, 180 and 270 degrees. Note that within a survey area definition the detector orientation cannot be changed.
- **Overlap of adjacent tiles/pointings**: depending on your observing strategy you might want to change the default overlap of 10 arcsecs in X and Y to another value. SADT computes the position of the adjacent tiles/pointings taking the desired overlaps into account.
- **Dither pattern**: to fully cover an area by OmegaCAM pawprints, five pre-defined offsets are necessary. This is realized by the *diag* dither pattern which is described in the template description of the OmegaCAM/VST User Manual. This dither pattern is predefined in SADT. Please do not change the sizes of the dither offsets in the OBs! Further details see in Sect. 4.2.
- **Maximum jitter amplitude**: during the preparation of the OBs different jitter patterns with different maximum amplitudes can be chosen (see OmegaCAM Template Manual). SADT has to know the maximum jitter amplitude (+/-, i.e. from 0 to max or min) in order to reduce the search area for suitable guide and aO stars accordingly (such that none of the stars falls outside the autoguider and wave front sensor CCDs).

3.2 The Guide/aO star input catalog

SADT needs star catalogs in order to search for guide and active optics stars. The autoguider and wave front sensor CCDs are filtered in the same band as the science detectors. Four catalogs are selectable from a pull-down menu within SADT. Those are UCAC3, GSC-2, 2MASS and USNO.

Currently, the propagation of guide and active optics stars to the OBs is not supported (yet). Also the limiting magnitudes for valid guide/aO stars are not defined yet. Thus, although GSC-2 and 2MASS are the recommended catalogs, their choice will have no effect on the output files. For the Public Survey dry runs, please do not use the option of search for guide/aO stars.

3.3 Splitting the survey into survey areas

If you belong to the happy astronomers that got approved an ESO Public Survey that lasts over several years, you probably have a large area to cover (or a very deep field). In principle, you can define the whole survey area at once with SADT. Practically, your survey observations will be scheduled in semesters/periods, i.e. you will be asked to submit the OBs that correspond to the allocated total execution time per semester. Thus, a natural split of your total survey would be into individual survey areas that shall be covered in a certain observing period. Of course, the chosen areas should be observable in that semester.

Another reason for splitting the total survey into individual survey area definitions might be a different observing strategy in different regions, for example different filter sets, different exposure times, different dither/jitter patterns, etc. In this respect, be reminded that SADT is an auxiliary tool to help you in creating a large number of OBs that share the same structure.

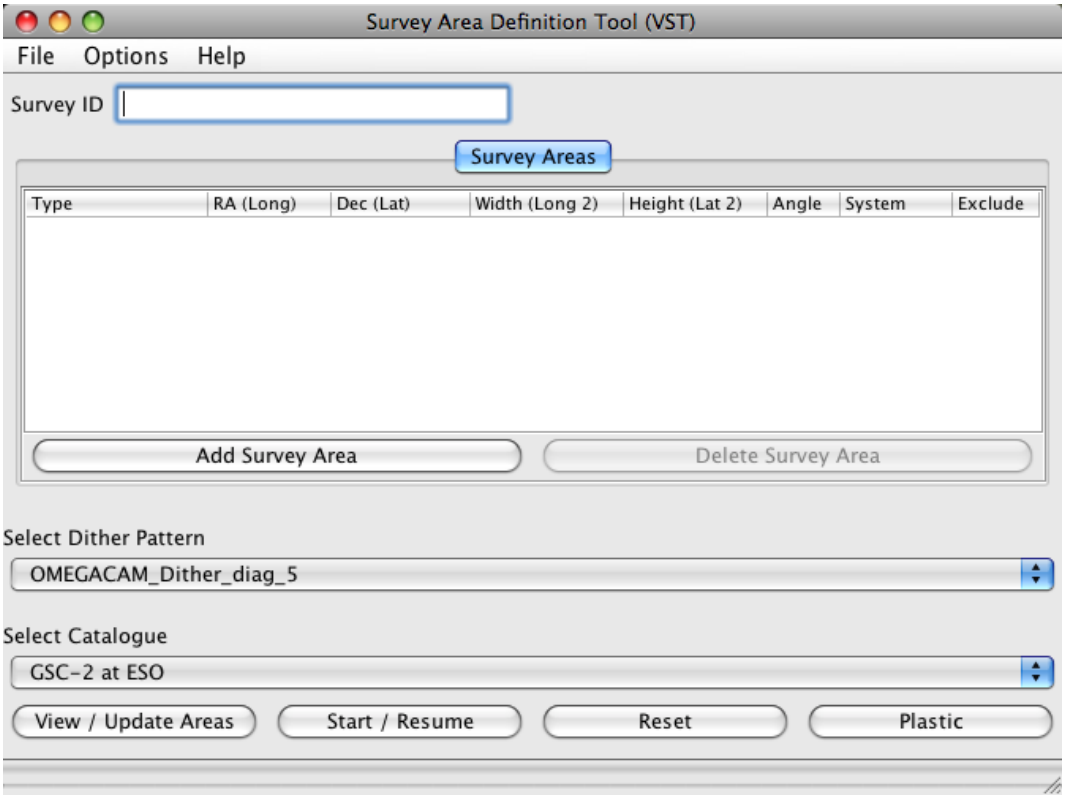
Yet another reason is to reduce the very long catalog search times for large surveys to manageable chunks.

4 Step 1: Starting SADT and setting some basic parameters

Do you have all the information ready pointed out in Step 0? Do you have installed SADT for VST and P2PP for Public Surveys on your machine? Did you set the correct path to P2PP's OmegaCAM instrument package (check the SADT installation web page if you do not know what this is about)? If yes, you are ready to start SADT. To do so go to the bin directory of your SADT installation and type:

```
> sadt -c vst &
```

and you should see the following window pop-up (here under Mac OS X):



This is the main SADT window, or SADT GUI (Graphical User Interface).

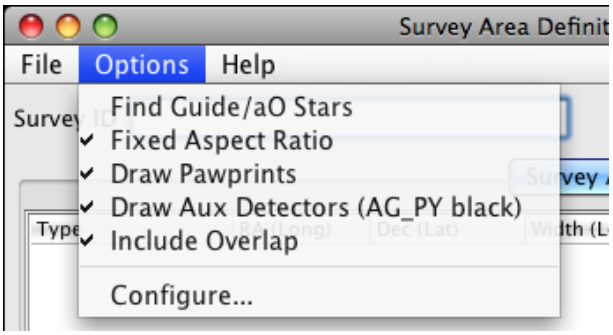
The first thing you can do is to give your survey area a name. Type this name into the 'Survey ID' field on the upper left, for example '*vst_survey*' (case A in the following). The output XML file will then get the name '*vst_survey.xml*'.

Note: The 'Survey ID' will also form part of the name of the OBs and parameter files created for your survey by SADT/P2PP, so use something brief but clear.

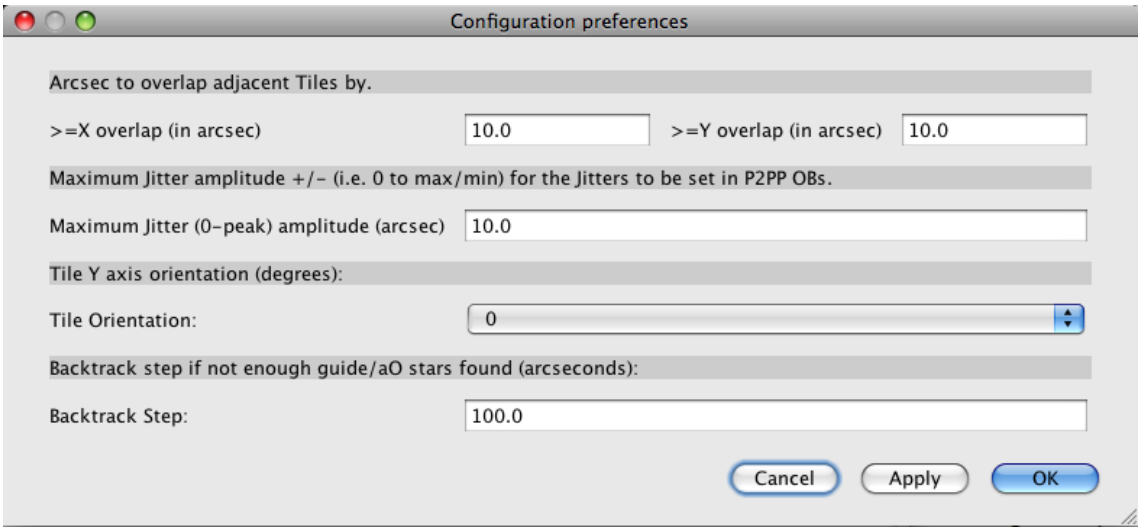
Next some basic parameters have to be set.

4.1 Configuration preferences

From the pull-down menu 'Options',



select the entry 'Configure...'. You will see popping up the following 'Configuration preferences' window:



- First, you can define the desired **overlap in X and Y** of the adjacent pointings. The overlap size is given in arcsecs. The following overlaps in X and Y should be applied for different situations:
  - **overlap X = 0, overlap Y = 0**: adjacent pointings just butt in X and Y, there is no overlap of tiles.
  - **overlap X > 0, overlap Y > 0**: adjacent pointings will overlap in X and Y by this amount.

  There will be a warning message if you enter values outside the ranges 0 to 120 and -330 to 390 for the X and Y overlap, respectively. This is to make you aware that the chosen values might not be the optimal ones. Note that this values are leftovers of the recommended tile overlaps for VIRCAM/VISTA observations.
- Second, you should define the **Maximum Jitter Amplitude** to be used in the OBs. It is defined as the largest modulus of all the offset values (in arcsecs) of a jitter pattern and then rounding up. The selectable jitter patterns, as defined via the 'Number of exposures',

are shown in the OmegaCAM/VST Template Manual. Note that the jitter offset may be scaled by the multiplicative factor *'Offset step size'* in the OB definition, so *'Maximum size of jitter'* would need to be multiplied by *'Offset step size'* if a value other than the default of 1.0 arcsec is used. A maximum jitter amplitude of 10 arcsec (the default value) is large enough to accommodate most of the pre-defined jitter patterns with '*Offset step size = 1*'.

Important note: If the maximum jitter amplitude is set larger than necessary, the area over which guide/aO stars will be sought will be smaller than necessary, which could be a problem especially in regions of low star surface density.

If the maximum jitter amplitude is set smaller than the actual maximum jitter amplitude used in the OBs some guide/aO stars may fall off the CCD during a jitter, causing the failure of the OB execution. This has to be avoided.

Thus, the maximum jitter amplitudes set in SADT **MUST not be smaller** than those values implicitly chosen for the OBs created in P2PP (by choice of 'Number of exposures' and 'Offset step size').

There will be a warning message if you enter a value outside the range 6.4 to 33.1. This is to make you aware that the chosen value might not be an appropriate one. Note that this values are leftovers of the recommended jitter values for VIRCAM/VISTA observations.

- Next, the **Tile Orientation** can be chosen from a pull-down menu to be 0, 90, 180 or 270 degrees. This rotates the detector with respect to the given survey area. The angle is defined counter-clockwise, with the positive Y-axis of the CCD array being at 0 degrees.

- Finally, the **Backtrack Step** defines the amount in arcsecs by which the SADT's guide/aO star search algorithm shifts a tile/pawprint back along the row of tiles/pawprints. The backtrack step is repeated until guide/aO stars are found or the previous tile/pawprint position is reached. Note that backtracking has the following effects: 1) more pointings may be needed than are found with the 'Find guide/aO Stars' selection set to 'Off' in the 'Options' menu; 2) the X boundaries of tiles/pawprints in adjacent rows will not match up (or Y boundaries in case of tile orientations of 90 ir 270 degrees); and 3) the pointing centres at the end of the process will differ from those at the start.

  There will be a warning message if you enter a value outside the range 20 to 531. This is to make you aware that the chosen value might not be an appropriate one. A change of less than 20 arcsec would lead to many backtrack steps in low density regions, and thus might slow down the tiling process considerably. A value larger than 531 arcsec would shift the field by more than the size of the auxiliary detectors. **Note that the upper value is a leftover of the recommended maximum backtrack step overlaps for VIRCAM/VISTA observations.**

Confirm all your settings by clicking the 'OK' button.

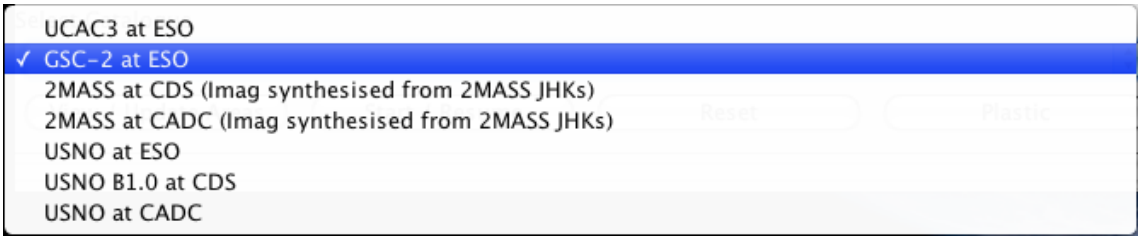
Important note: SADT does not remember the last values used when it was last shutdown so these options will need to be set each time SADT is started up.

4.2 Further basic settings

In the main SADT window you have two pull-down menus in the lower half, one to set the dither pattern, the other to choose a catalog.

Select Dither Pattern: In this pull-down menu you have to define the dither pattern you want to use for your observations. This dither pattern should be the same as used in the OBs. **It must not be changed in P2PP later!** The different dither patterns, their acronyms and their sequences of offsets are explained in detail in the OmegaCAM/VST Template Manual.

Note that the the three lower entries should not be used. They are leftovers from the *Tile* scheme of the SADT version for VISTA. These will be skipped in the next version of SADT for VST.



Catalogs: The second pull-down menu allows you to choose the catalog that shall be used by SADT to search for appropriate guide and aO stars.

Note that the guide/aO star CCDs have filters that match in their central wavelength those of the science detectors, except for u-band observations, for which the filter for the auxiliary CCDs is most sensitive in the b-band.

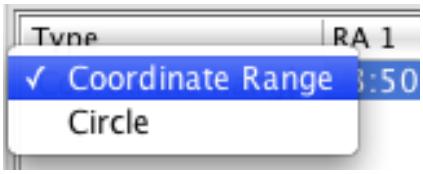
Most catalogs do not provide magnitudes in all the filter bands used by VST/OmegaCAM. The magnitude limits for valid guide/aO stars as given in the configuration file are preliminary estimates. They might not work for stars with extreme colours, i.e. a very red star probably will be too faint as guide star for u or b-band observations.

Note that, currently, the propagation of guide and active optics stars to the OBs is not supported (yet). Also the limiting magnitudes for valid guide/aO stars are not defined yet. Thus, although GSC-2 and 2MASS are the recommended catalogs, their choice will have no effect on the output files.

5 Step 2: Defining the survey area – coordinate systems and display options

This step helps you to get used to the different possibilities of defining a survey area and to view it in different coordinate systems. Experienced SADT users might just want to enter their coordinates and jump to step 3.

In the main SADT GUI click the button 'Add Survey Area'. A line with different columns will appear under the 'Survey Areas' folder. From the pull-down menu in the 'Type' column, first select the area type you want to use:

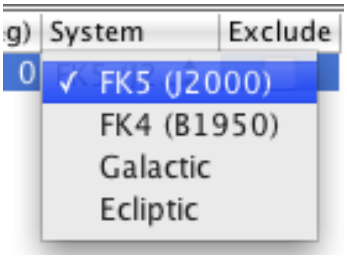


- **'Coordinate Range'** allows you to enter the lower and upper bounds of the chosen coordinate system (see below). No rotation angle of your survey area can be entered when choosing this type.
- For the option **'Circle'** enter the central coordinate of the area and a diameter in degrees. Although it is allowed to enter an angle this has no effect on the orientation of the tiles, thus this parameter can be neglected.

The descriptions in the column headers running rightwards from 'Type' change according to the 'Type' in the row selected for that 'Type'.

Note: There will inevitably be significant problems in automatical contigious coverage of areas defined as coordinate ranges, especially at high Dec/Latitude because: (i) coordinate ranges actually define differently shaped areas at different declinations/latitudes, and (ii) the SADT aligns the bottoms of coordinate range tiles along lines of constant Dec/Latitude (or at an angle relative to Dec/Latitude). Therefore, **it is recommended that circles are used as the most reliable way to cover areas close to the South pole region efficiently**.

The next parameter you want to select is the type of coordinate system in which your area will be defined. From the pull-down menu in the 'System' column you can select one of these options:



- **FK5 (J2000) (default):** requires input in RA and Dec.
- **FK4 (B1950):** requires input in RA and Dec.

- **Galactic:** requires input of Longitude and Latitude.
- **Ecliptic:** requires input of Longitude and Latitude.

The descriptions in the column headers running rightwards from 'Type' change according to the 'System' in the row selected for that 'Type'.
In most cases, either the 'FK5 (J2000)' or the 'Galactic' system should suffice.

The entry fields for all coordinate and size related parameters (RA, Dec, Lon, Lat, Width, Height, Diameter and Angle) can be activated by a fast double click with the left mouse button. Just overwrite the default values or move with your arrow keys or left mouse button to the digit you want to edit/change. The value input is only saved when the cell is closed. Press carriage return to close the cell, or single click elsewhere to achieve the same effect. Here are some important conventions you should be aware of:

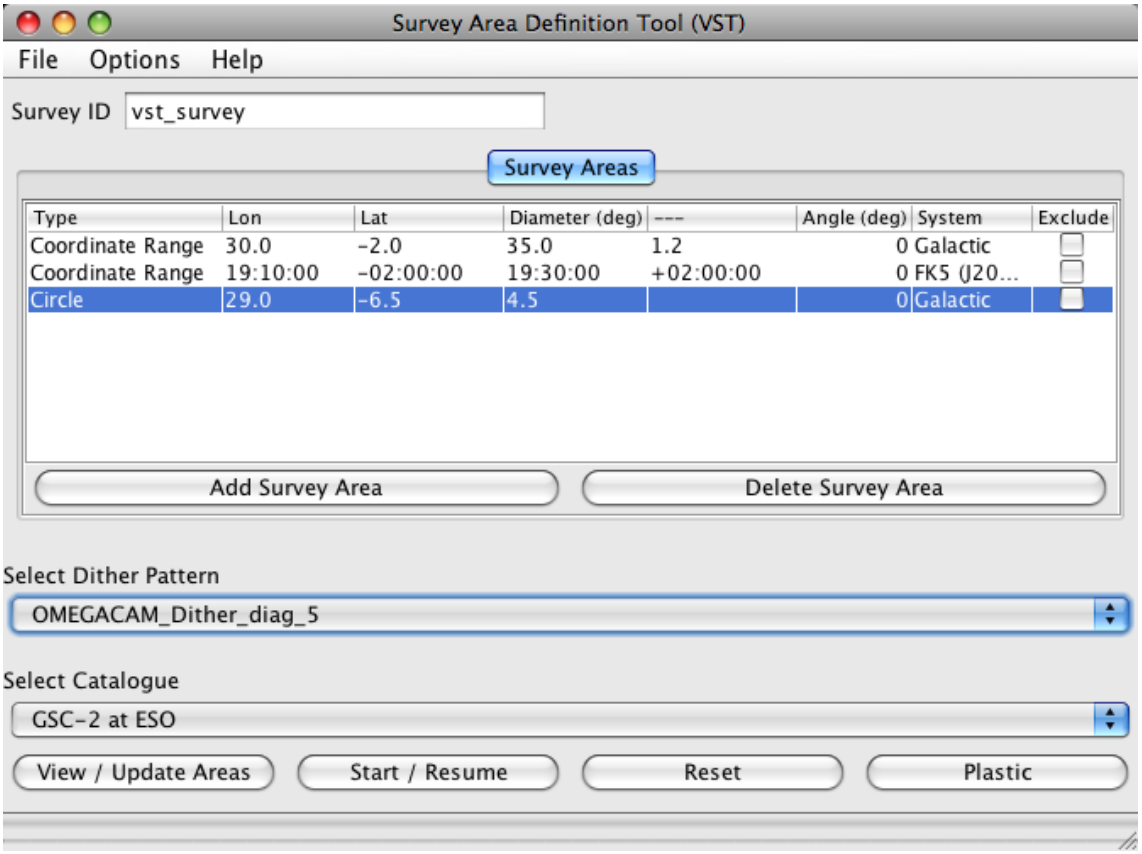
- For **RA and Dec** coordinates use the format "**HH:MM:SS.SS**" or "**HH MM SS.SS**". For **Longitude and Latitude** definitions use **decimal degrees** (**not** decimal hours).
- The (position) **angle** (in degrees) on the sky is the angle between North in the selected coordinate system and the 'Height' axis of the survey area. It has the usual convention: North=0 deg, East=90 deg. It only applies to the area definition in geodesic rectangles which is not supported in this SADT version for VST observations.
- Regardless of the input coordinate system used, the tiles in the output XML files are specified in RA, Dec (J2000) for use at the telescope (although named "long=.." and "lat=...").

The survey area that you want to save in the end does not have to be restricted to one definition of a coordinate range or circle. You can add as many areas as you like, and they can be of different types. Just click the 'Add Survey Area' button again and a new entry line will appear. You even can exclude sub-areas from a larger area or from further processing in SADT by clicking the checkbox of the 'Exclude' field, the rightmost item in the column headers. If you are not happy with one of your area definitions you can delete this area by clicking on the 'Delete Survey Area' button and confirming the deletion. After deleting an area click on 'View / Update Areas' to refresh the display.

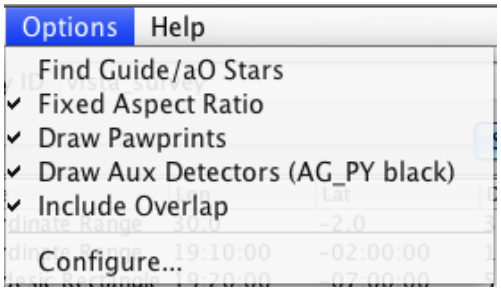
In the next two subsections, we give two examples of survey area definitions and describe the different viewing options.

5.1 Case A: defining and displaying a non-contiguous area

Under the name '*vst_survey*' we defined three sub-areas using different area types and different coordinate systems. Our definitions look like this:



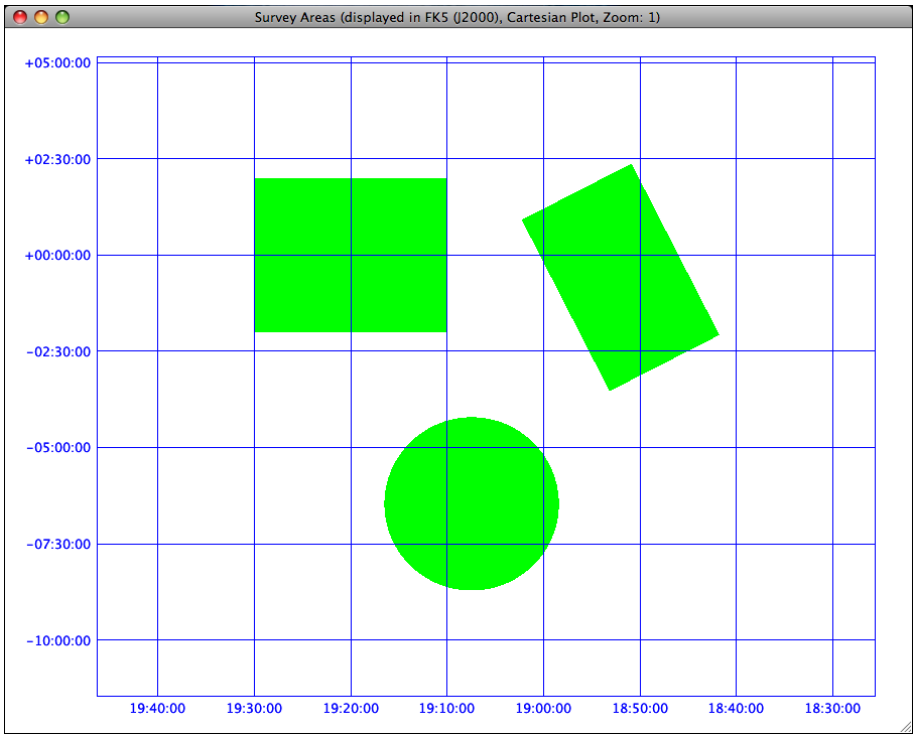
To have a quick look on the layout of these area definitions first make sure that the checkboxes in the 'Options' menu (at the top of the main window) are correctly set. When clicking the 'Options' button you get the following list of checkboxes:



- **Find Guide/aO Stars:** if you don't want to perform a (time-consuming) guide/aO star search in your first attempt to define a survey area and see the tiling, leave this box unchecked (the default when starting SADT). Check this box only if you think that the survey area definitions are finalized. **Note that for the dry runs this box should not be checked!**
- **Fixed Aspect Ratio:** by default this box is checked. This allows you to see your survey area on the same scale in the X and Y coordinate. If not checked the smaller side of your area will be scaled such that the display window is homogeneously filled. This parameter has only an effect on the SADT plotting in the display window.

- **Draw Pawprints:** by default this box is checked. If you want to see only the tile borders (without pawprints) you can uncheck this box. Still the pawprint centres are shown as dots. For very large survey areas this might be the preferred option.
- **Draw Aux Detectors:** by default this box is checked. You will see the location of the auxiliary detectors for guiding and wave front sensing. This option only works if the 'Draw Pawprints' box also is checked. The autoguider CCD on top of the positive Y axis of the detector array is painted in black. This allows a clear identification of the pawprint orientation (see example in Sect. 5.3). You might want to uncheck this box for large survey areas.
- **Include Overlap:** this option only matters if your total area definition contains sub-areas that are excluded (see our Case B, Sect. 5.2). Tiles which lie partially in an included survey area and partially in an excluded survey area are included (box checked). Otherwise they are excluded (box unchecked). By default this box is checked.
- **Configure ...:** the configuration preferences already were explained in Sect. 4.1.

Now is the time to display our area definitions. We chose the 'Fixed Aspect Ratio' option ticked. By clicking the button 'View / Update Areas' on the lower left in the main SADT window the following 'Survey Areas' window will pop up:



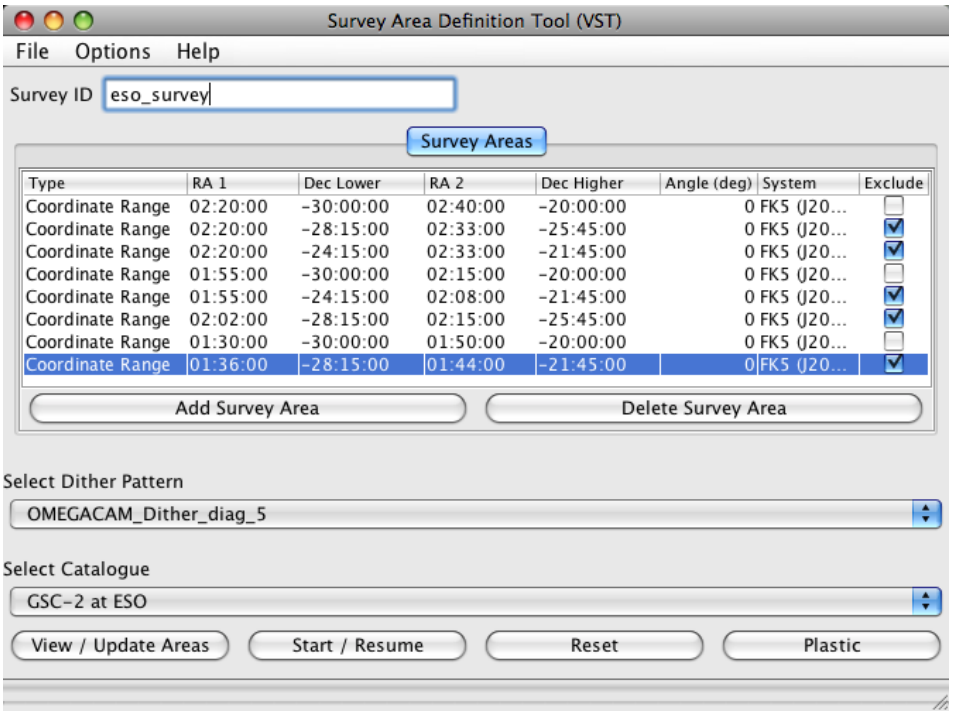
In the header of this window you see the actual 'Display Coordinate System', 'Plot Type' and 'Zoom' option. How to change these display options is explained in Sect. 5.3.

As seen, pressing the 'View / Update Areas' button allows viewing of survey areas specified in the text box without generating pawprints and allocating the guide/aO stars (even if the 'Find Guide/aO Stars' checkbox is ticked.

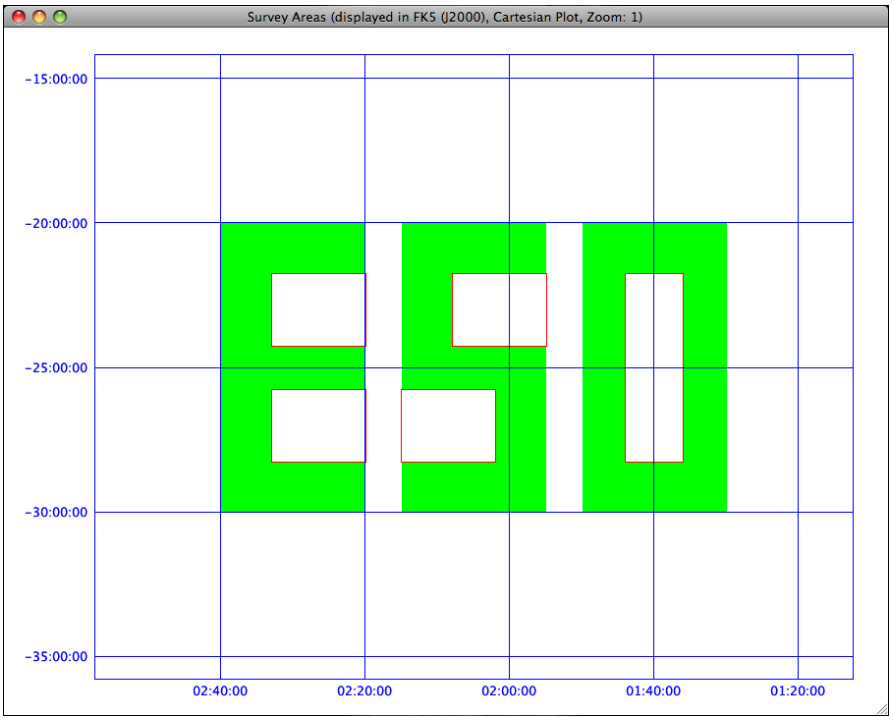
Also use 'View / Update Areas' after making a change to the survey areas defined in the 'Survey Areas' table.

5.2 Case B: defining and displaying an area with exclusions

Our second case, which we call '*eso_survey*', consists of three independent coordinate ranges and five sub-areas that were excluded from those three main areas. For excluding the sub-areas, the corresponding checkboxes in the 'Exclude' column were ticked. All coordinates were defined in the FK5 (J2000) coordinate system. The survey area definitions look like this:



Clicking the 'View / Update Areas' button and having the 'Fixed Aspect Ratio' box in the 'Options' menu ticked and the 'Include Overlap' box unticked gives the following result in the display window:



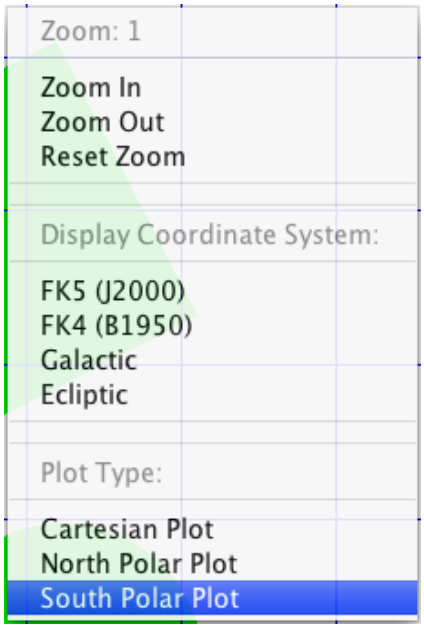
Surprise, surprise! What a nice survey area!

5.3 Display options

The display window offers different options to change the display coordinate system and plot type, and to get positional information. All these options are triggered by cursor commands.

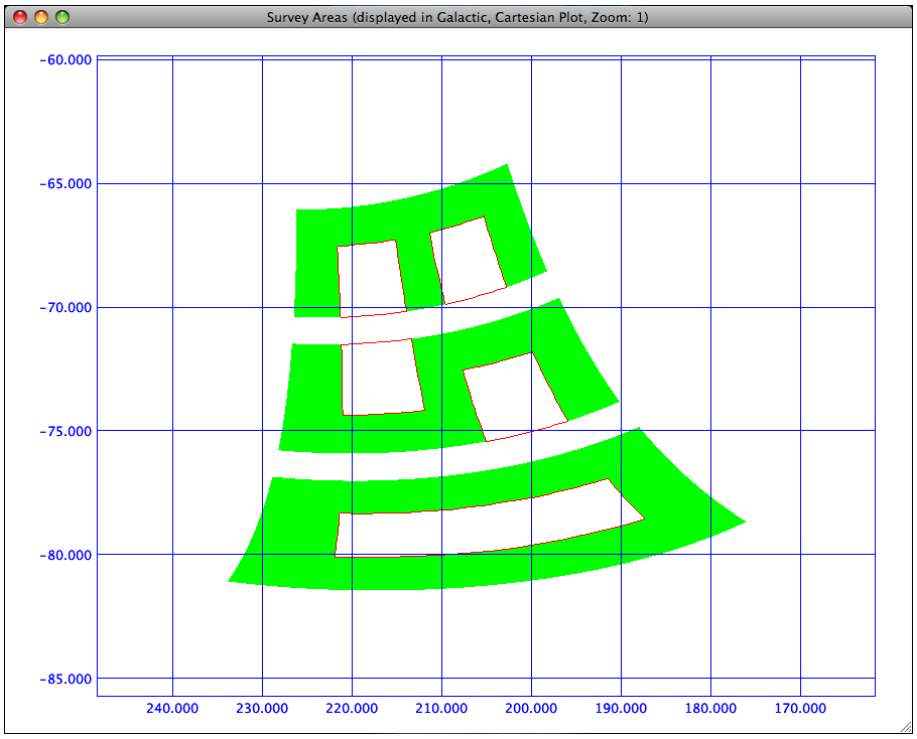
Keeping the **middle mouse button** pressed on the display window will pop-up a line below the display window which shows the coordinates at the cursor position in the current coordinate system. To get information on another cursor position you have to release the middle mouse button first and then move to the desired position pressing the middle button again.

A click on the **right mouse button** on the display window (except in a selected, cyan tile) will pop-up a menu with the following options:

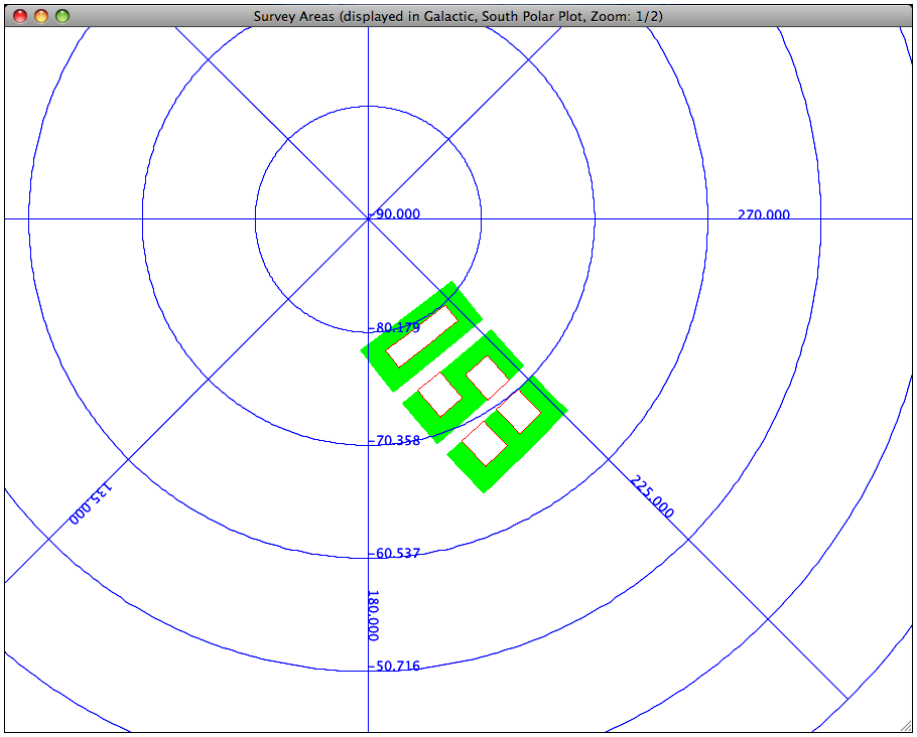


- **Zoom:** the number indicates the actual zoom factor (in steps of factor 2 from 1/16 to 1024, 1 is the default). You can either tick the checkbox 'Zoom In' or the checkbox 'Zoom Out' which will directly bring you back to the display window. A click with the left mouse button will perform a 'zoom in' or 'zoom out', centred on the cursor position. To get back to the default display for your survey area choose the 'Reset Zoom' option in the 'Zoom' menu.
- **Display Coordinate System:** here you can choose the coordinate system in which you want to have displayed your survey area. The options are the same as in the SADT main GUI (see Sect. 5). The default is the 'FK5 (J2000)' coordinate system. Note that the choice of a coordinate system **only** affects the displayed plots. It is **not** converting the coordinates displayed in the 'Survey Areas' table between systems. In most cases, you probably want to use for displaying the same coordinate system you used for the coordinate definition in the main GUI.
- **Plot Type:** The default is 'Cartesian Plot'. But you also can choose a 'North Polar Plot' or 'South Polar Plot', both with respect to the chosen 'Display Coordinate System'. Those representations are very useful if your areas are close to one of the poles. Needless to say that the plot type 'North Polar Plot' makes no sense if your area is defined at negative declinations/latitudes, and vice versa.

To illustrate the effect of changing the coordinate system, the area '*eso_survey*' as defined in Sect. 5.2 (Case B) is shown here in Galactic coordinates (with 'Fixed Aspect Ratio' unticked and as Cartesian Plot):

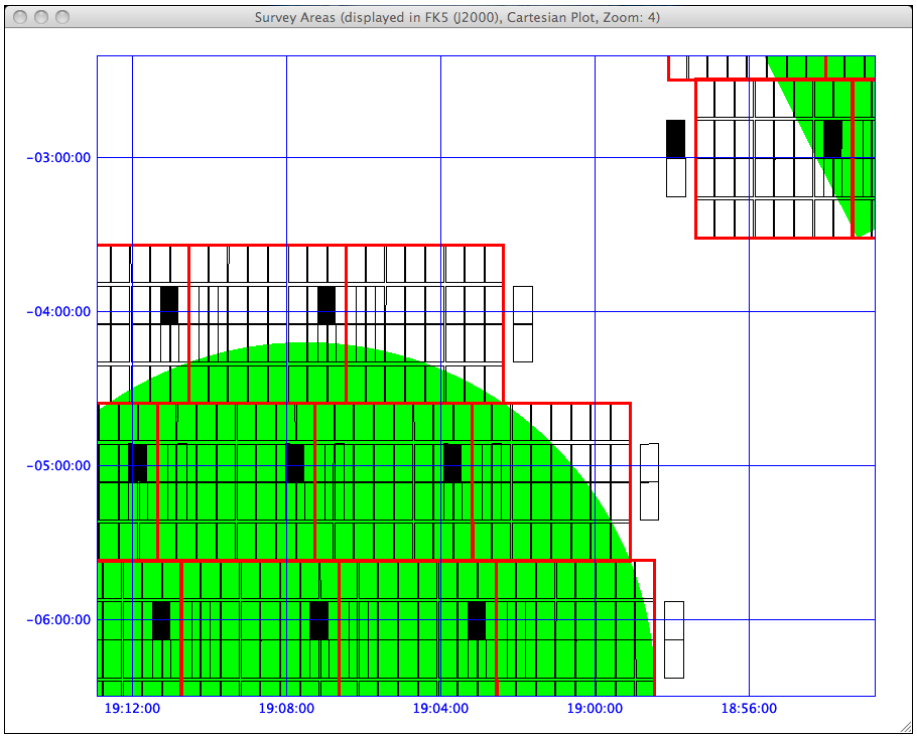


And just for fun, the same area in 'Galactic' coordinates as 'South Polar Plot' , the 'Fixed Aspect Ratio' ticked and zoomed once out (factor 1/2):



Note that this area is located close to the Galactic South Pole, a region that has a low density of foreground stars, and thus finding suitable guide/aO stars may be difficult (see Sect. 7.2).

As a last example we show here the '*vst_survey*' area (Case A) zoomed in by a factor 4 and with the checkbox 'Draw Aux Detectors' in the 'Options' menu ticked. This was done after Step 3 was performed (see Sect. 6.1).



As explained in Sect. 5.1 the black, solid rectangles show the positions of the autoguider CCDs above the detector array (positive Y axis).

An important note on the interpretation of shapes displayed:

SADT's default display is simple Cartesian, not a spherical projection. Shapes of areas plotted must be interpreted with this in mind. The shapes seen will also depend on the 'System', 'Type', 'Aspect Ratio' and values set, and the projection used. Be careful not to jump to incorrect conclusions about your tiles based on the plots. Some examples are:

- In the Cartesian plot a 'Geodesic Rectangle' and a 'Coordinate Range' will look similar close to the equator, however near the pole a range will still look like a rectangle, whereas a geodesic rectangle will look like a slice. **Note that geodesic rectangles are not supported by the current version of SADT for OmegaCAM/VST!**
- In a 'Cartesian Plot' a coordinate range defined in a particular coordinate system appears as a rectangle in the survey area display only if the same coordinate system is selected as display coordinate system.
- Equivalent (but different) considerations arise when plotting in 'South Polar' projections.

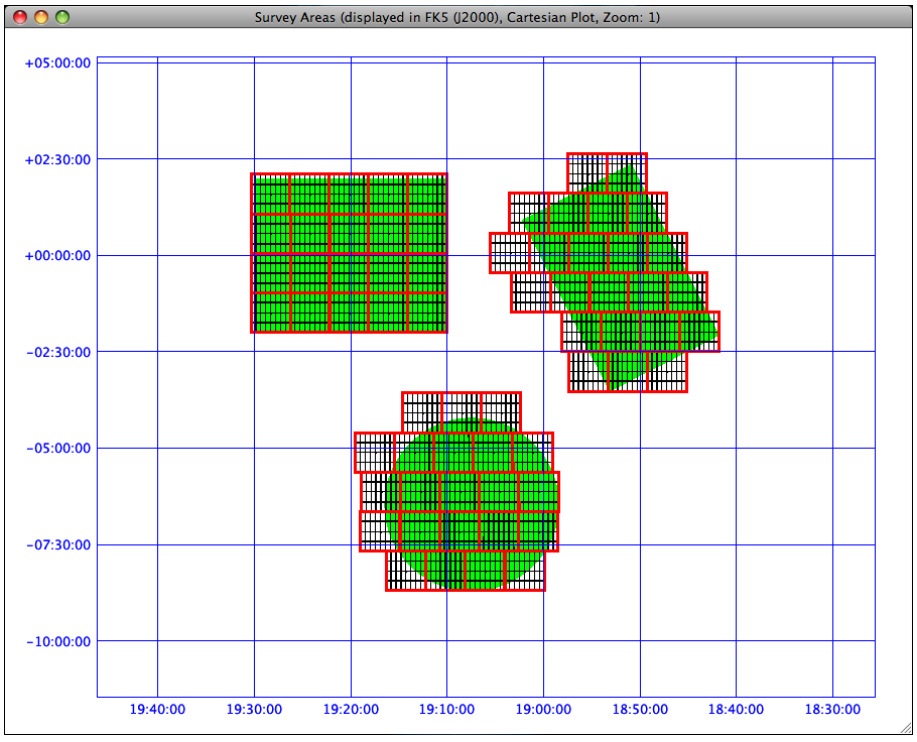
6 Step 3: Tiling the survey area – a first test run and some tile operations

If you are happy with the definition of your survey areas, you now probably want to see how the pointings/tiles will get distributed across the areas, and approximately how many pointings/tiles you need to cover them. Still, at this point we do not intend to search for guide/aO stars which is the most time-consuming procedure of the SADT session. So please leave the 'Find Guide/aO Stars' checkbox in the 'Options' menu of the SADT GUI unticked.

Again, we will demonstrate the allocation of tiles to the survey areas for our two examples, Case A and Case B.

6.1 Case A: Tiling of non-contiguous survey areas

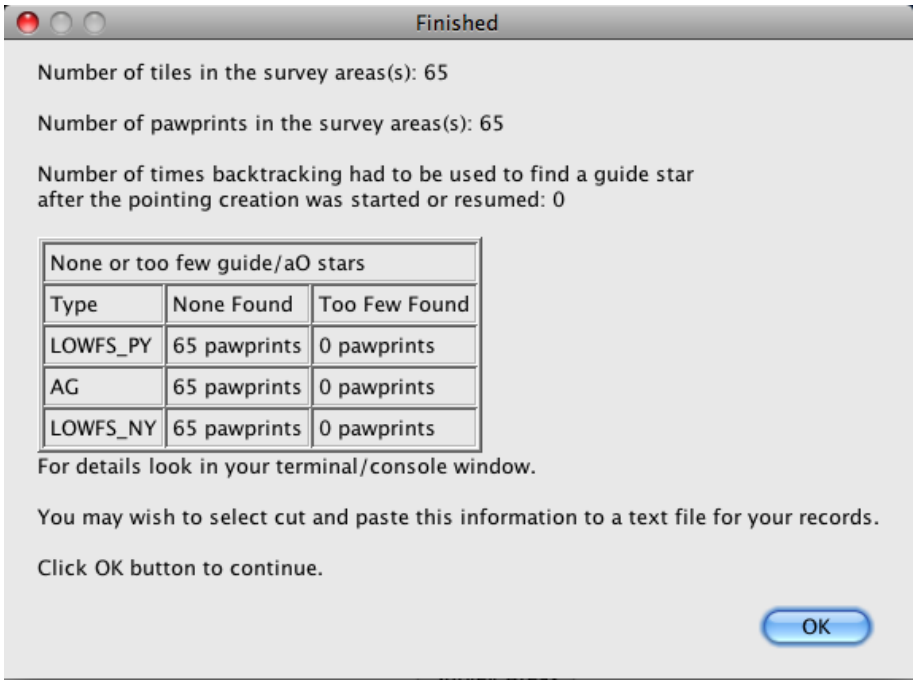
The survey area '*vst_survey*' was defined in Sect. 5.1 and we had a look at the layout by choosing the 'View / Update Areas' button. Now, click the button 'Start / Resume' in the lower part of the SADT GUI and you will see the following in the display window:



Note: The allocation of tiles always starts in the lower right hand corner of the area to be filled (South-West corner in case of RA/Dec coordinates). First the lower row is filled from right to left, and then the next row up (higher Dec) is filled from right to left (increasing RA). This is continued until the area is filled. In this example the 'OMEGACAM_Stare' dither pattern was used and the checkbox for drawing the auxiliary detectors was unticked.

At the same time the tiles are shown in the display window there will pop-up two new windows: 1) the 'Guide Star Acquisition' window which is empty at this stage because we unticked the option

of finding guide/aO stars, and 2) a window called 'Finished' which shows a summary of the tile allocation.
In our case the 'Finished' window looks like this:



As you can see our '*vst_survey*' needs 65 pawprints to cover the full area (although with some gaps since no dither pattern was chosen). The further information about backtracking during the guide star search and the corresponding statistics table makes no sense in case the 'Find Guide/aO Stars' option is unticked.
To continue with any other action you have to confirm the tile generation by clicking the 'OK' button in the 'Finished' window.

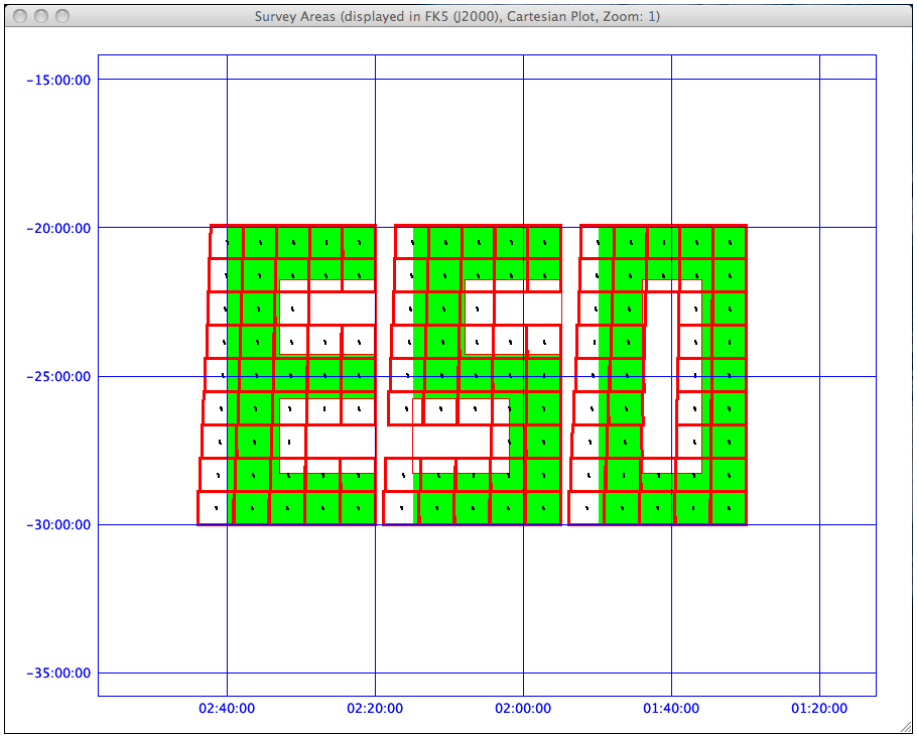
The allocation of tiles can be stopped, resumed and after finishing reset. For that use the buttons in the lower row of the SADT main GUI and the 'Stop' button in the 'Progress' pop-up window . Their functionalities are summarized here:

- **Stop:** A 'Progress' pop-up window will appear when starting the tiling. You can press the stop button in this window at any time if you are not happy with the tiling process.
- **Start / Resume:** This begins or resumes the process of filling the defined survey areas with tiles/pawprints, and – if 'Find Guide/AO Stars' option on the 'Options' menu is on – it starts/resumes finding guide/aO stars.
- **Reset:** This resets the plots and deletes any tiles/pawprints made. It does not affect the surveys defined in the main GUI – just the display. The user is asked to confirm the reset in a pop-up window. **Note that** it is sometimes necessary to use 'Reset' before finding guide/aO stars will work (e.g if they have just been toggled on).

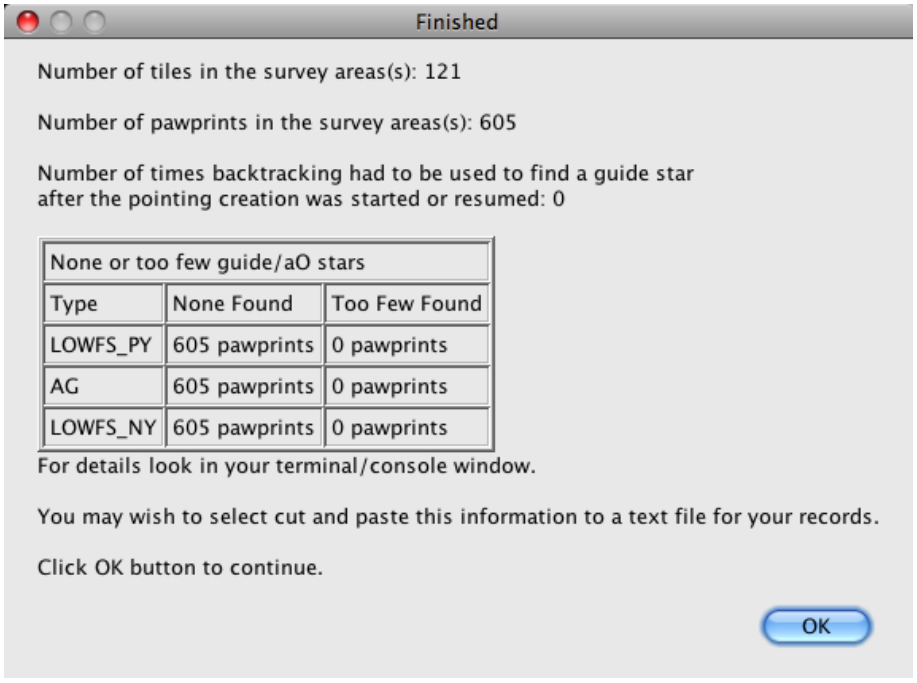
Note: Users are advised to be careful to use 'Stop' and 'Resume' as there have been reports that some material may sometimes be lost during a Start/Stop/Resume sequence. Check that tiles or guide/aO stars have not gone missing around the sky position you pressed 'Stop' at.

6.2 Case B: Tiling of areas with excluded sub-areas

Our case B is the '*eso_survey*' (see Sect. 5.2). As for case A, we do not select the 'Find Guide/aO Stars' option. We just want to see the proposed tiling by clicking the 'Start / Resume' button (with 'Fixed Aspect Ratio' ticked and 'Draw Pawprints' unticked):



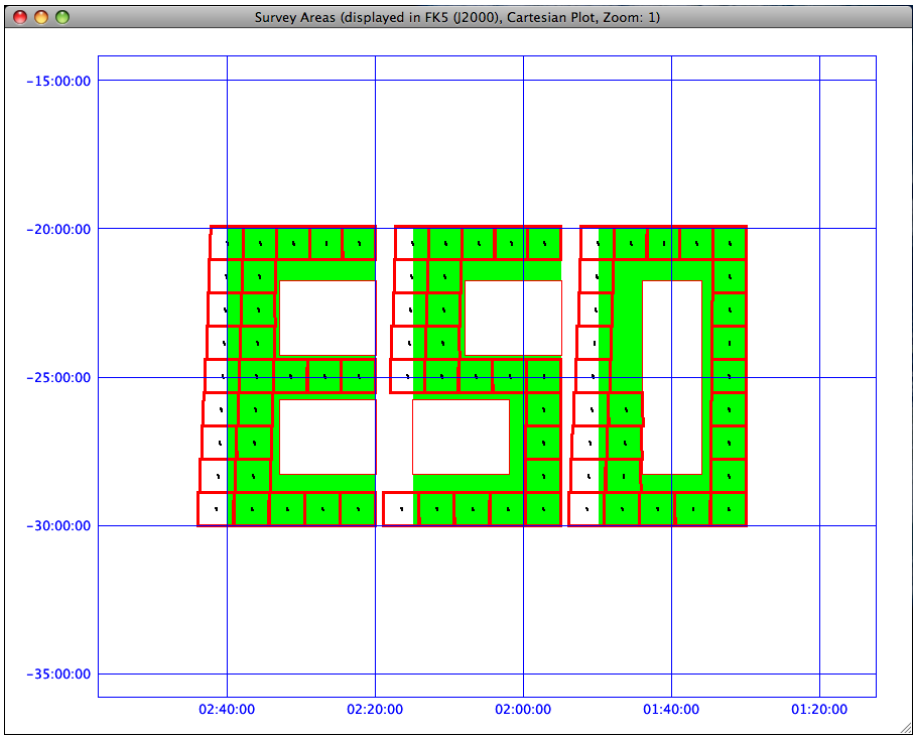
The corresponding 'Finished' window looks like this:



121 pointings (tiles) with 5 dithered exposures (pawprints) each are needed to cover the full 'ESO' area. To continue with any other action confirm the tile generation by clicking the 'OK' button.

Maybe you are not happy with some pointings that only cover a small fraction of the desired area but are mostly located in the excluded sub-areas. One option to avoid the tiling of excluded areas is to untick the 'Include Overlap' checkbox in the 'Option' menu. After unchecking the box you will see a pop-up window telling you to 'Reset' and 'Start' again the tile allocation for the option to come into effect. This window will pop-up every time you modify the settings.

So, just confirm this pop-up window by clicking the 'OK' button, and then press the 'Reset' button in the main SADT window. Another pop-up window assures that you don't delete the calculated tiles by accident. So, please confirm by clicking 'Yes' that you would like to continue with the new tile calculation. Finally, click the 'Start / Resume' button. You will see the following:



Most probably, this also is not what you wanted. In the next section it will be explained how you can manually delete some selected tiles in the display window.

6.3 Tile operations in the display window

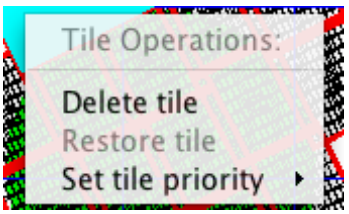
Once you have created the tiles with the 'Start / Resume' button, you have various possibilities to manipulate the tiles with mouse clicks on the display window:

- **Select tiles:** Click with the left mouse button on a tile. It will be highlighted by a cyan colour. The selection of that tile disappears if you click on another tile which will be selected instead. If you want to select multiple tiles you have two options: 1) Press the left mouse button down and each tile you touch while moving the mouse will be selected; 2) Keep the Ctrl-button pressed while selecting further tiles with a mouse click or dragging the mouse along tiles (for Mac OS X: press the Ctrl-button once when selecting the first tile, then release the Ctrl-button and select other tiles with the left mouse button; finish the selection by pressing the Ctrl-button once again).

  Note that the selection does not work if the 'Zoom In' or 'Zoom Out' checkbox are ticked. Also, the selection disappears if you use the display options of the right mouse button, like zooming or changing the display coordinate system, while tiles are selected.

- **Deselect tiles:** To deselect all tiles click with the left mouse button outside the survey area, but within the display window. To deselect an individual tile press the Ctrl-button while clicking on the tile (for Mac OS X: release the Ctrl-button after deselection of the first tile and finish the deselection by pressing the Ctrl-button once again).

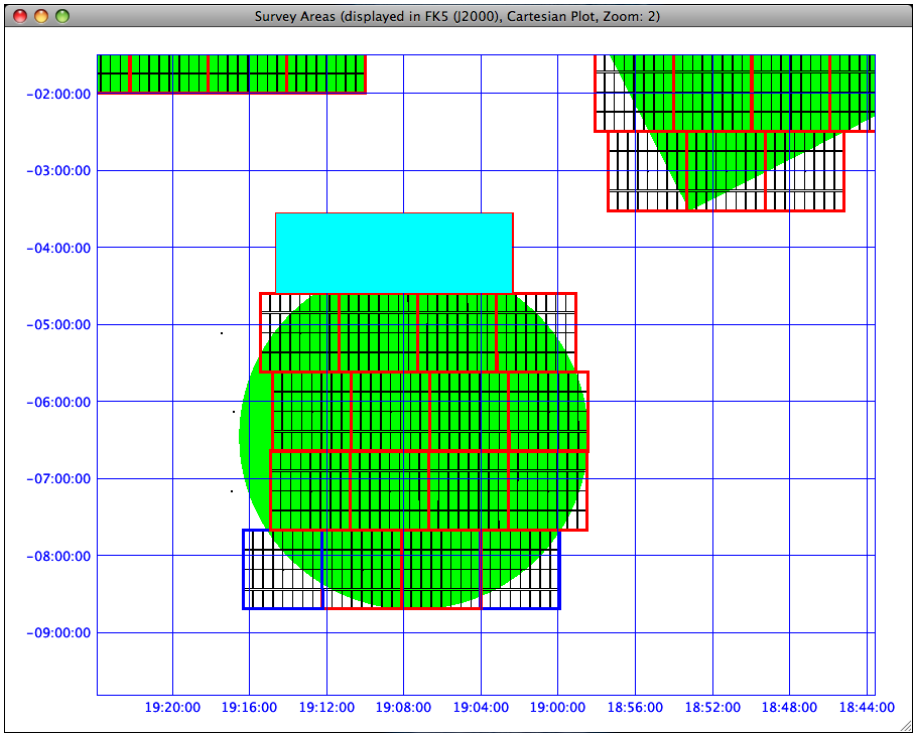
- **Tile operations on selected tiles:** Selected tiles can be deleted, restored (with or without a priority) or have an (internal) 4 step priority. Click with the right mouse button on a selected tile. A pop-up window labeled 'Tile Operations' will appear:



  - **Delete selected tiles:** Select 'Delete Tile' and the tile is removed leaving marked only the location of the centre of each pawprint.
  - **Restore deleted tiles:** First, click with the left mouse button on a deleted tile (i.e. that only shows the centres of the pawprints). Then click with the right mouse button on that tile and select in the pop-up window 'Restore Tile'. The pawprint patterns appear again. You also can restore a tile with a certain priority. To do so choose 'Restore tile with priority' in the pop-up window an select a priority in the pull-down menu.
  - **Set tile priority:** Click the right mouse button on a selected tile. When choosing 'Set tile priority' a pull-down menu with four priority levels from 0 to 3 will appear. Those levels are colour-coded. The tile borders will be represented in the chosen colour. This action applies to all tiles that are highlighted in that moment.

Note that the allocated priorities have no affect on the OB priority of that tile. This information is not transferred to P2PP! Priorities can only be used for displaying purposes.

In the following figure we show an example for tile operations. We zoomed on the circle area of the '*vst_survey*'. The three most left pawprints of that area were deleted, only the central positions of the pawprints are visible as dots. The three upper right tiles were selected, and thus are highlighted by a cyan colour. The two tiles with blue borders got the priority 2.



An important note: The tile operations are not saved automatically. For example, deleted tiles can be recovered by the 'Restore' option. In order to save the results of the tile operations (deletions and priorities) choose 'Save As ...' in the 'File' menu. You might want to give that area definition a new name, in case you regret some of your deletions at a later stage.

7 Step 4: The search for guide and aO stars – the final tiling procedure

Note: this step should not be performed for the Public Survey early science (dry) runs!

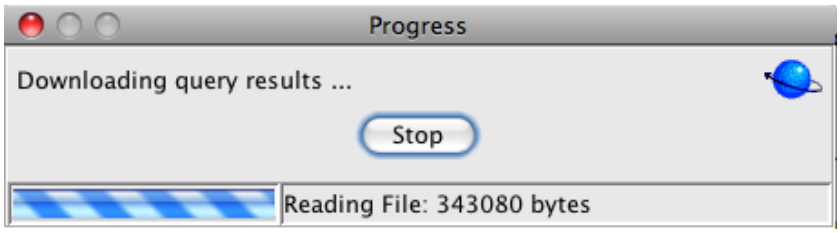
Now the time has come to perform the final run of SADT which includes the search for guide and aO stars. Make sure that you selected the appropriate catalog: GSC-2 or one of extended 2MASS catalogs, i.e. '2MASS at CDS (Imag synthesised from JKHs)', are the recommended choice at the moment (**although during the early phases of VST observations no guide and aO stars will be propagated to the OBs**)! In the 'Options' menu tick the checkbox 'Find Guide/aO Stars'. Before you start the tiling click on the 'Reset' button in the lower row and confirm the pop-up window 'Delete existing tiles/pawprints?' by clicking on 'Yes'. The tiles from the dry-run will disappear.

In the following, we again show the tiling process including the search for guide and aO stars for our two examples, Case A and Case B.

7.1 Case A: a smooth tiling run near the Galactic plane

Having successfully executed steps 1 to 3 and having pressed the 'Reset' button, we see our defined areas of the '*vst_survey*' in green in the display window.

Press the 'Start / Resume' button in the main SADT window. The following 'Progress' pop-up window will appear:



You can press the stop button at any time if you are not happy with the tiling process. To resume the guide/aO star search press the 'Start / Resume' button in the main SADT window again. Pressing the stop button may also be necessary if the internet connection to the catalog is slow, or the run is taking longer than expected. After hitting the stop button it is possible to save intermediate results to an XML file by choosing the 'Save As ...' task in the 'File' menu (see Sect. 8). This file can later be opened again using the 'Open' task in the 'File' menu. The generation of pawprints can then be resumed where it had stopped before.

Apart from the 'Progress' window, the 'Guide Star Acquisition' window is now active and shows the search of guide/aO star in each detector. The borders of the detectors are given as black rectangles for the Autoguider CCDs and black squares for the active Optics CCDs. The different colours for the catalog stars and the background of the window have the following meaning:

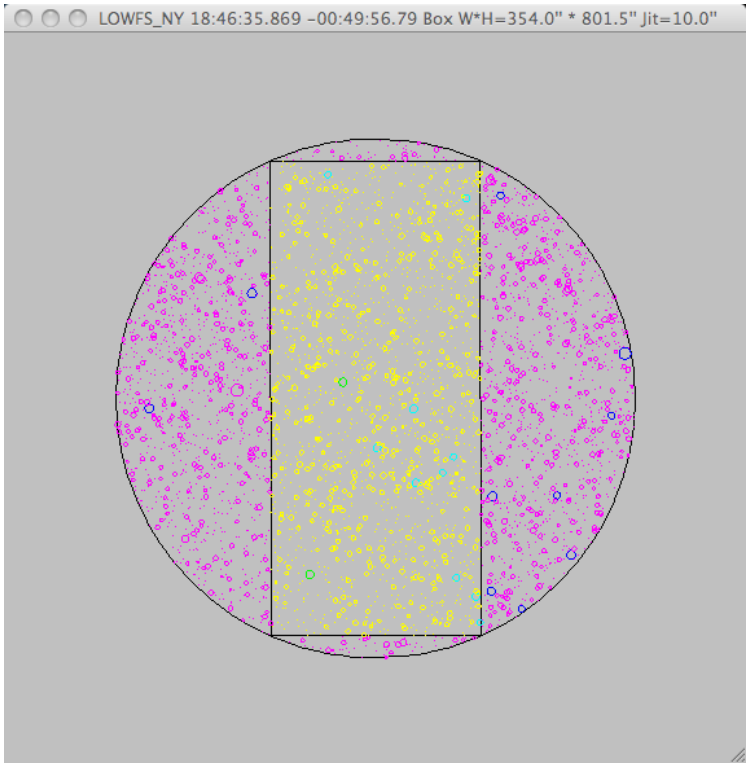
- Colour of stars:
  - **cyan:** Star is in the detector range and has the right magnitude range, it is valid.
  - **yellow:** Star is in the detector range but is invalid because of wrong magnitude range.

  - **blue:** Star is valid, but not in the detector range.
  - **magenta:** Star is not in the detector range and not in the valid magnitude range.
  - **green:** Stars that finally are selected as guide/aO stars. These are only shown if suitable stars on all guide/aO detectors have been found.

- Background colour:
  - **grey:** Normal mode of operation, no backtracking needed.
  - **red:** No guide/aO star found yet, backtracking.
  - **pink:** Backtracking was successful.
  - **red and yellow flash:** No guide/aO star was found. The backtracking was unsuccessful. This pawprint is left without a full set of at least one guide star and one aO star on each active Optics CCD.

Note: when pressing the 'Stop' button in the 'Progress' window its background colour might be red, although backtracking is not really executed. Similarly, the detector display might sometimes stay red even though backtracking has already finished.

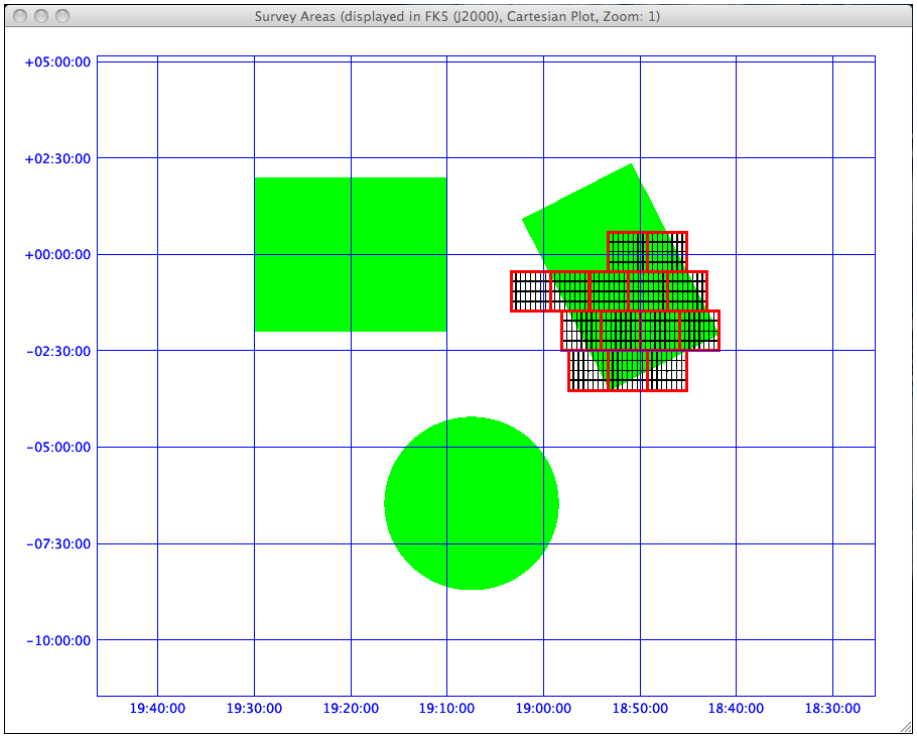
This figure shows an example for the search of guide stars for the '*vst_survey*' area:



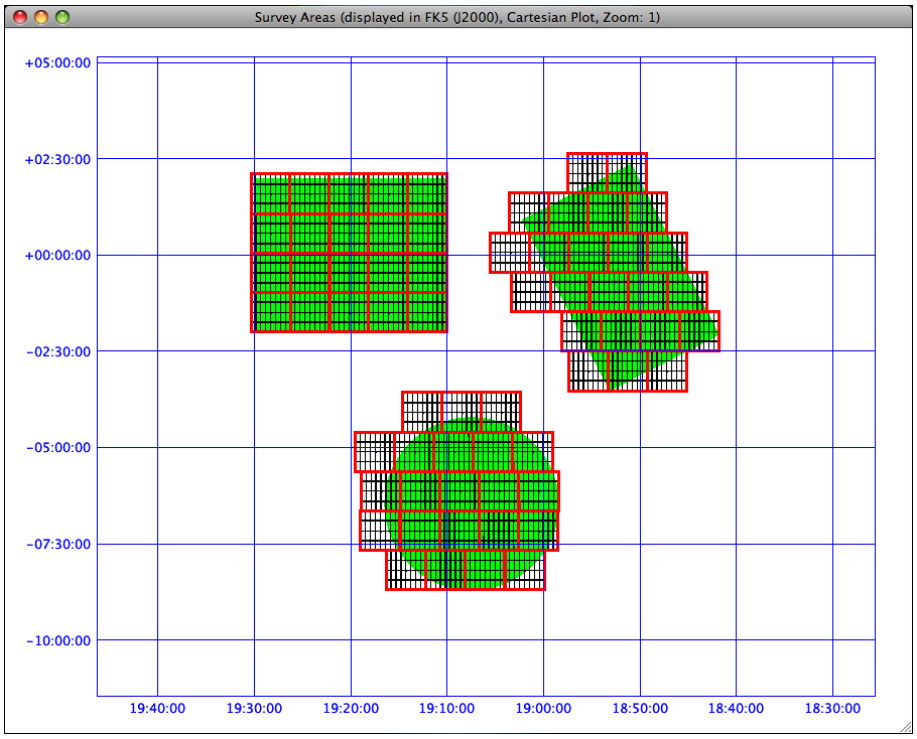
12 suitable guide stars were found for this autoguider CCD. The one that will be selected will be coloured green in the next instance.

Note: The autoguider and wavefront sensor detectors will (if you don't have a slow connection to the catalog) flash by very fast so it will usually be too quick to see much. A log of difficulties encountered (i.e. information about backtracking and rejection/acceptance of guide/aO stars) appears in the terminal window from which you started SADT. The output can be controlled via parameters in the *sadt.cfg* file (see Appendix C.2).

The progress of the tiling is also shown in the display window. In the following figure we show a snapshot of the moment when 14 pawprints already have successfully been assigned to the upper right survey area.

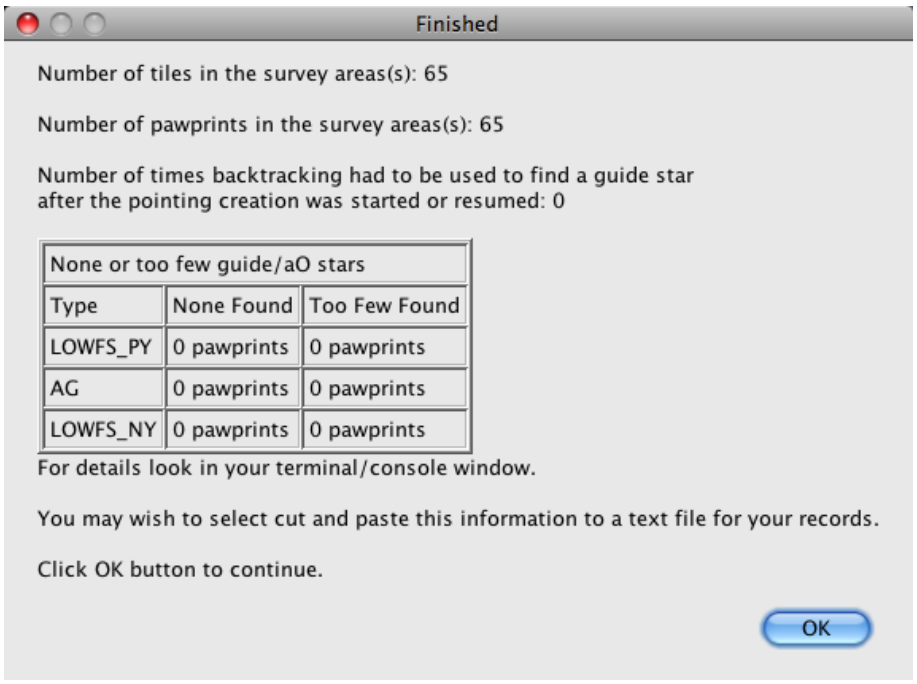


After the search for guide/aO stars has finished the tiling of our '*vst_survey*' looks like this:



There is no difference to the tiling of our dry-run (see Sect. 6.1), since for all pointings suitable guide/aO stars were found without the need of backtracking.

This is confirmed in the 'Finished' window where the statistics of pawprints, tiles and backtracking are given:



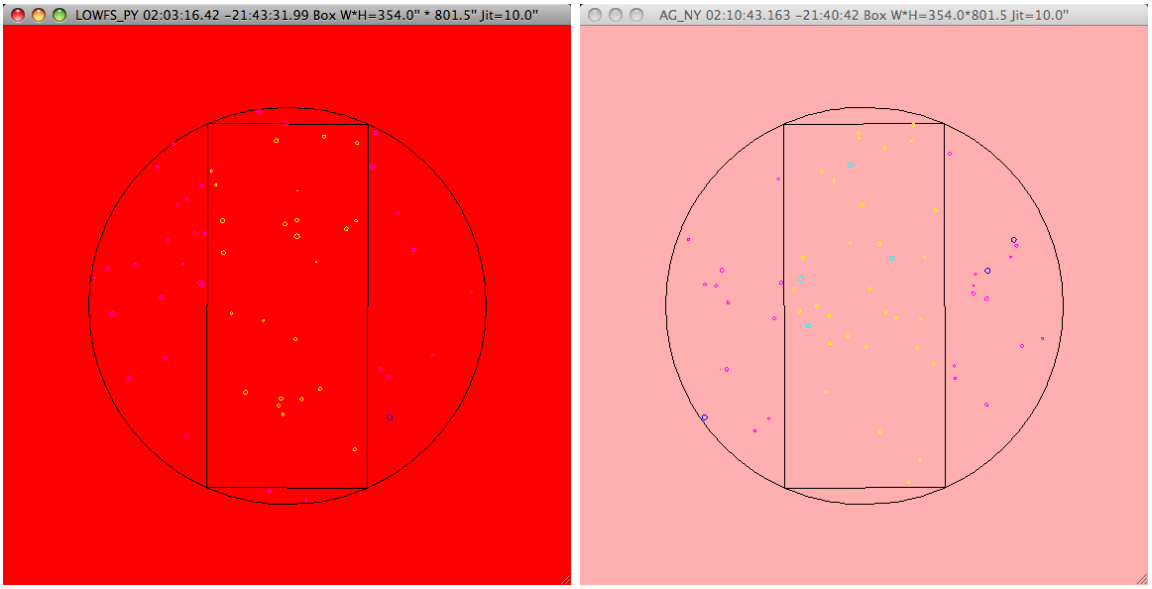
For none of the pointings backtracking had to be used to find a guide star. If you are happy with the results you should confirm this window by pressing 'OK'.

At this point, you also have the possibility to use the tile operations as explained in Sect. 6.3. Maybe you want to delete one or more tiles before you save the final survey area definition.

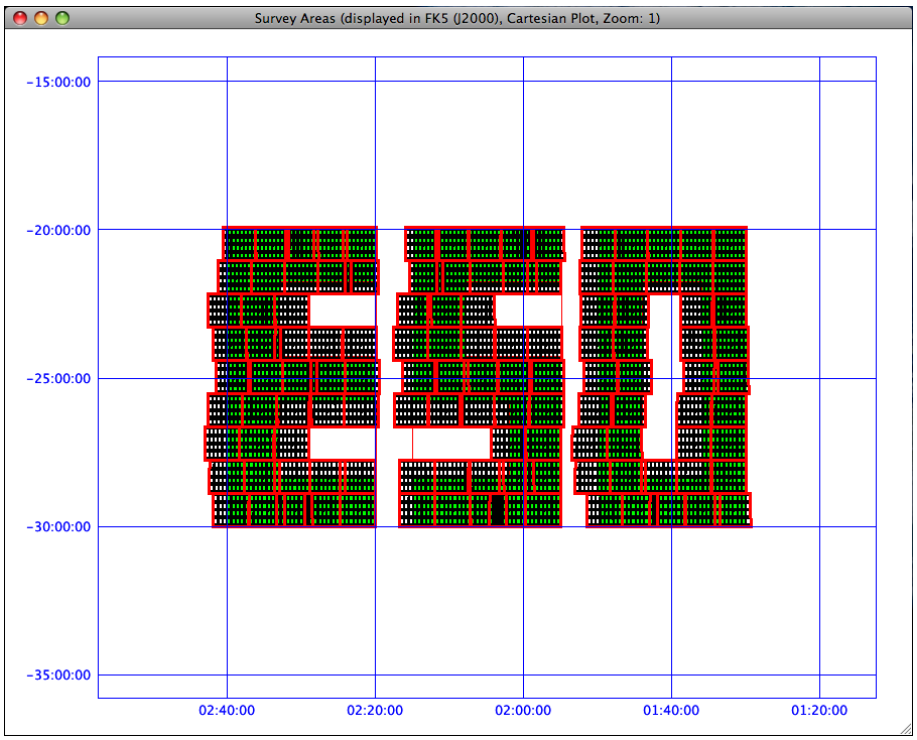
7.2 Case B: a tiling run close to the Galactic pole

The '*eso_survey*' is close to the Galactic pole. Therefore, the stellar density is not the highest. Indeed, when searching for guide/aO stars by pressing the 'Start / Resume' button in the main SADT window, the 'Guide Star Acquisition' window often turns red. This indicates that no guide and/or aO star was found in the originally foreseen tile position. The pawprints are shifted by the 'Backtrack Step' (an adjustable parameter in the 'Configure...' menu, see Sect. 4.1), and the search is started again. This is repeated until enough guide/aO stars have been found.

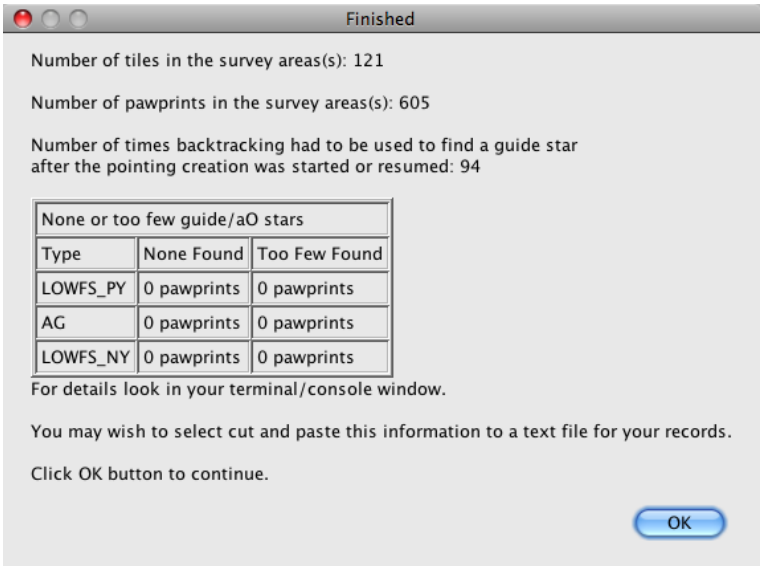
The following figure shows two snapshots of the guide/aO star search where backtracking is needed (red background, left) and backtracking was successful (pink background, right):



The effect of the frequent backtracking on the final tiling can be seen in the display window:



Many rows are shifted with respect to the original tiling without the search for guide/aO stars (see Sect. 6.2). Also the 'Finished' window confirms the difficult search for guide/aO stars:



Still the number of pointings is the same as originally envisioned (=161 tiles). However, backtracking had to be used 94 times to find an appropriate guide or aO star.

Note that the magnitude limits for the catalog used (GSC-2 in this case) are not the final ones yet. Depending on the appropriate values, which will be defined after intensive testing on the telescope, more or less backtracking might be needed for the same area.

The resulting tiling seems not optimal, but there is not much one can do about this. Maybe you can try whether better results can be obtained (with less backtracking steps) if one shifts the total survey area a bit towards North or South (in case of the equatorial coordinate system). Since backtracking only uses the East-West direction there is some unexplored area north and south of the auxiliary detectors.

Also, to clean up the tiling you might want to delete some heavily overlapping tiles or tiles at the periphery of the survey areas. You can do that with the tile operations (see Sect. 6.3).

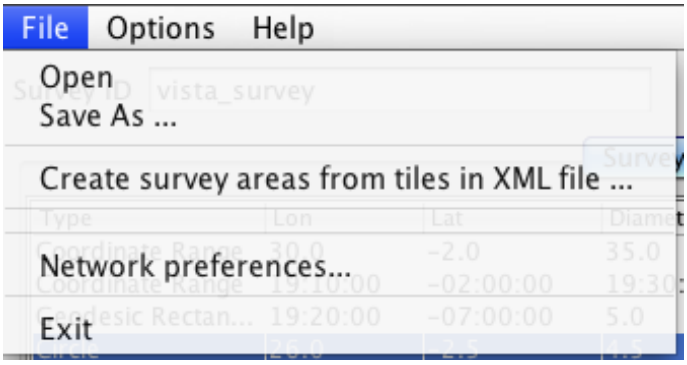
Always, before starting a new guide/aO star search with new parameters, press the 'Reset' button and confirm that you really want to delete the previously created tile/pawprint pattern.

8 Step 5: Saving, opening, and other file options

You are nearly done! CONGRATULATIONS!

The only action left is to save your results, and go on with the OB preparations using P2PP for Surveys. The 'File' menu offers some options to save and re-open your results.

Save: Assuming that you are happy with the final tiling of your survey – including the search for guide and aO stars – you now should save the results. Do so by selecting 'Save As ...' in the 'File' menu:



The pop-up window 'Save' will appear. There you can give the XML file a new name (but it must have the suffix '.xml') and can choose the directory in which it should be saved. Confirm by pressing the 'Save' button on the lower right of that window.

Of course, you already can save any intermediate step before the final tiling in the course of your SADT session.

Note that the saved file will not include any deleted tiles or excluded survey areas.

Open: Maybe some days later you want to revise the survey area or delete some unnecessary tiles. Just press 'Open' in the 'File' menu and select the XML file in the pop-up browser window. In case you already had loaded a survey area, you will first be asked whether you want to replace the current survey area by a new one.

It is important to note that, as soon as 'Start/Resume' is pressed, SADT starts to generate a new set of tiles/pawprints from scratch overwriting in memory those that were produced before! In particular, when 'Start/Resume' is pressed after a previously saved XML file has been read back in with 'Open' any changes made to the tiles that SADT originally generated will be lost.

For example, a user who kept the same survey area but generated a complex geometry with many deleted tiles would find that SADT would recompute all the tile positions based on the survey area, and the previous, manually made changes would be undone.

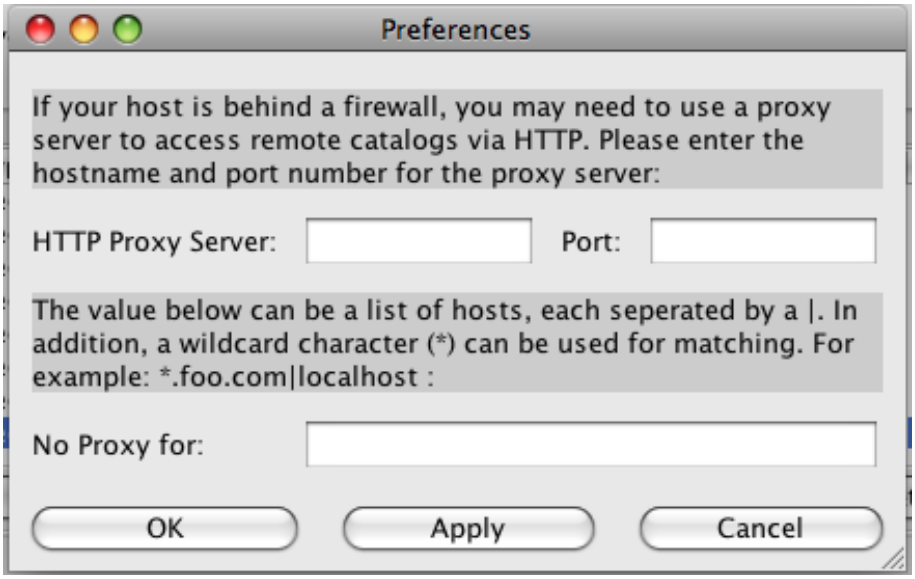
Create survey areas from tiles in XML file: This feature converts tiles within a survey area saved in an XML file into multiple survey areas, one for each tile. To do so select an (already saved) XML file containing the survey areas and tiles that you wish to work on again in SADT. You will be prompted for the name of an output XML file. The resulting output file will define each individual tile as its own survey area containing a single geodetic rectangle, thereby protecting each tile from being changed by SADT's tiling algorithms. For each survey area tileOverlapX and

tileOverlapY will be set to zero, but the original tile overlaps will remain preserved in the positions of the geodetic rectangle survey area/tiles. You can then work with the converted file as with any other VISTA SADT XML file.

This option might be useful for users that want to preserve their tile positions *fixed* within their survey areas, so that the area is not retiled (and the user's work adjusting it undone) when SADT is next asked to tile the survey (e.g. to find guide/aO stars for a complex set of tiles).

You can then work with the converted file as with any other VISTA SADT XML file.

Network Preferences..: Specify a proxy server if required (e.g. in connection with a firewall) in this pop-up window:



Exit: Exit the SADT program. It is important to note that the parameters set in the menus are not stored within SADT between invocations of it. Be sure to save your work as an XML file or note your settings.

A XML files

Viewing XML files:
After tile and guide/aO star generation VST's XML files can become very long. To view them it is recommended that you use a viewer/editor that recognises XML structures and allows them to be collapsed to a shorter more readable form, e.g. a web browser such as Firefox.

XML schema:
The XML schema is included as *cfg/vst/sad.xsd* in the directory *sadtdirectoryname/cfg/vst*. The schema must be recognized by P2PP when it imports XML files made in SADT.
Users must not edit this file!

Structure of SADT XML files:
The XML file is structured as follows for a VST survey:

<SURVEY> element
which contains one or more
<SURVEY_AREA> elements
which contain one or more
<TILE> elements
which each contains (typically 5)
<PAWPRINT> elements
which each contains
<REFSTARS> elements
giving coordinates and magnitudes of the guide and aO stars
which are converted into .paf files attached to the OB
</REFSTARS>
</PAWPRINT>
</TILE>
</SURVEY_AREA>
</SURVEY>

In the following four subsections we give examples for different aspects of the XML files created by our '*vst_survey*' (Case A, see Sect. 5.1).

In Appendix A.1 it is explained how one can create a XML file with pre-defined coordinates that can be imported to SADT.

A.1 Example: Survey areas (no tiles yet)

As an example the XML file saved for the survey areas of the *vst_survey* (see Sect. 5.1) after pressing the 'View/Update' button is as follows (using Firefox as a viewer):

```
- <SURVEY backtrackStep="100.0" id="vst_survey" ip="OMEGACAM-1.31" maxJitter="10.0" tileAngle="0"
  tileOverlapX="10.0" tileOverlapY="10.0">
    <SURVEY_AREA coordSys="Galactic" exclude="false" lat1="-2.0" lat2="1.2" long1="30.0" long2="35.0"
    number="1" posangle="0.0000" type="Coordinate Range"/>
    <SURVEY_AREA coordSys="FK5 (J2000)" exclude="false" lat1="-02:00:00" lat2="+02:00:00"
    long1="19:10:00" long2="19:30:00" number="2" posangle="0.0000" type="Coordinate Range"/>
    <SURVEY_AREA coordSys="Galactic" exclude="false" lat="-6.5" long="29.0" number="3"
    posangle="0.0000" radius="4.5" type="Circle"/>
  </SURVEY>
```

Witin each defined type < /> parameter sets are written in alphabetical order. The meaning of these should be clear from earlier section of this Cookbook except for:

<SURVEY_AREA number="" – an integer ID counter for each survey area.

Creating a XML file from pre-defined coordinates:

It might happen that you have a list of pre-defined coordinates (maybe even not spatially fully connected) which should be covered by a tile (or pawprint) each.

In principle, it is possible to create a proper XML file outside SADT that then can be loaded into SADT to search for the aO/guide stars.

Maybe, first define a single dummy survey area in SADT and – without performing the tiling and search for guide/aO stars, just press the 'View / Update Areas' button – save this area with 'Save As ...' in the 'File' menu into a dummy XML file.

Then create (copy) for each coordinate in your list the <SURVEY_AREA> element, obeying the structure as given in the figure above, i.e. one <SURVEY_AREA> element per line. Replace the 'long' values by the RA (or longitude) values in your list, and the 'lat' values by the corresponding DEC (or latitude) values.

Also make sure that all other entries in the <SURVEY> and <SURVEY_AREA> elements are correctly set, like backtrack step (should be 0), tile angle, tile overlaps in X and Y, survey area position angle, etc.

Please note that the procedure of self-made XML files is meant only for expert SADT users who fully understand the XML schema!

A.2 Example: survey areas (with tiles but without guide/aO stars)

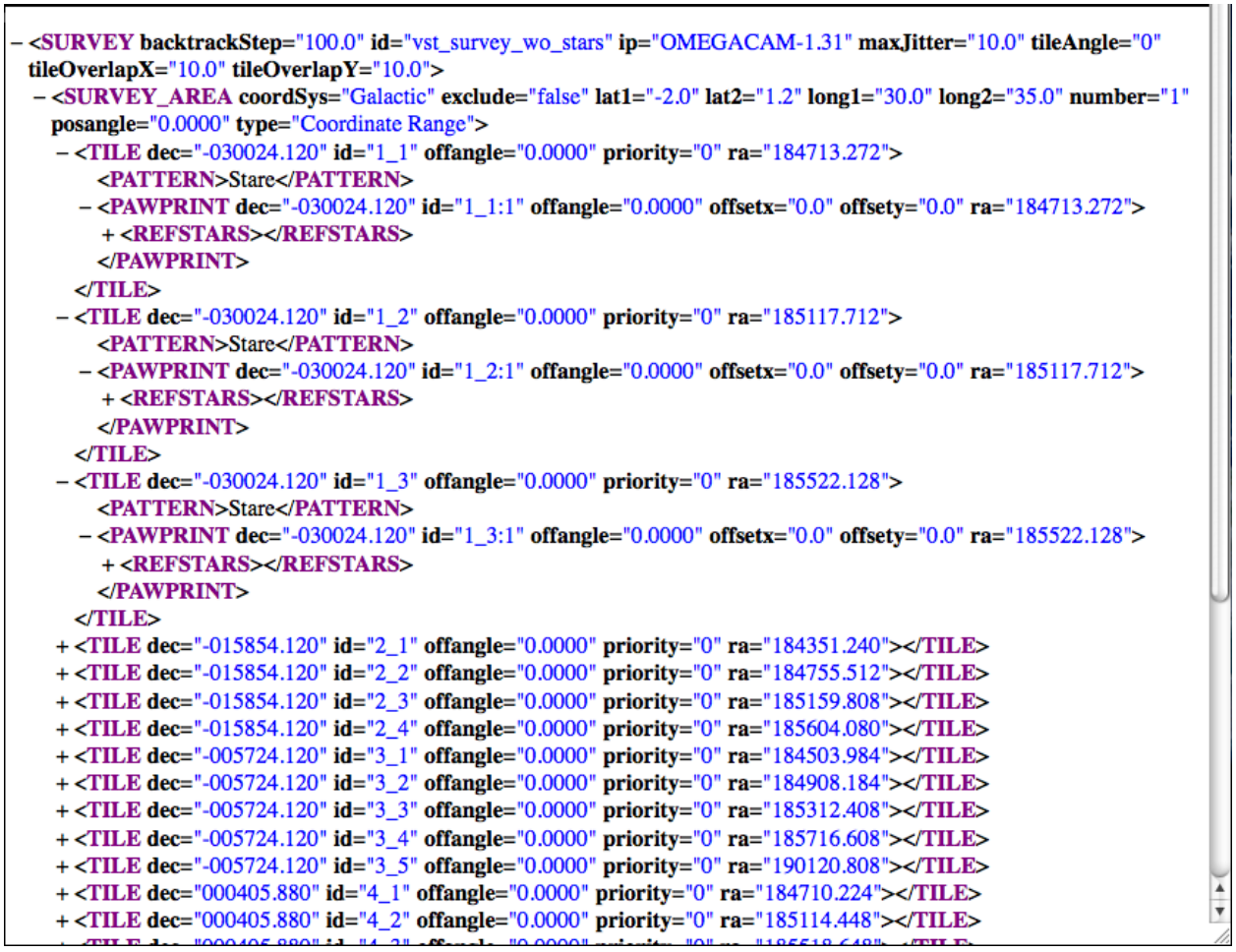
A more complex example of an XML file for the tiles defined in Sect. 6.1 (Case A) is given below (using Firefox as the viewer). The guide/aO star finding is switched off, and everything under the tile elements and the three last survey areas is collapsed:

```
- <SURVEY backtrackStep="100.0" id="vst_survey_wo_stars" ip="OMEGACAM-1.31" maxJitter="10.0" tileAngle="0"
  tileOverlapX="10.0" tileOverlapY="10.0">
   - <SURVEY_AREA coordSys="Galactic" exclude="false" lat1="-2.0" lat2="1.2" long1="30.0" long2="35.0" number="1"
     posangle="0.0000" type="Coordinate Range">
      + <TILE dec="-030024.120" id="1_1" offangle="0.0000" priority="0" ra="184713.272"></TILE>
      + <TILE dec="-030024.120" id="1_2" offangle="0.0000" priority="0" ra="185117.712"></TILE>
      + <TILE dec="-030024.120" id="1_3" offangle="0.0000" priority="0" ra="185522.128"></TILE>
      + <TILE dec="-015854.120" id="2_1" offangle="0.0000" priority="0" ra="184351.240"></TILE>
      + <TILE dec="-015854.120" id="2_2" offangle="0.0000" priority="0" ra="184755.512"></TILE>
      + <TILE dec="-015854.120" id="2_3" offangle="0.0000" priority="0" ra="185159.808"></TILE>
      + <TILE dec="-015854.120" id="2_4" offangle="0.0000" priority="0" ra="185604.080"></TILE>
      + <TILE dec="-005724.120" id="3_1" offangle="0.0000" priority="0" ra="184503.984"></TILE>
      + <TILE dec="-005724.120" id="3_2" offangle="0.0000" priority="0" ra="184908.184"></TILE>
      + <TILE dec="-005724.120" id="3_3" offangle="0.0000" priority="0" ra="185312.408"></TILE>
      + <TILE dec="-005724.120" id="3_4" offangle="0.0000" priority="0" ra="185716.608"></TILE>
      + <TILE dec="-005724.120" id="3_5" offangle="0.0000" priority="0" ra="190120.808"></TILE>
      + <TILE dec="000405.880" id="4_1" offangle="0.0000" priority="0" ra="184710.224"></TILE>
      + <TILE dec="000405.880" id="4_2" offangle="0.0000" priority="0" ra="185114.448"></TILE>
      + <TILE dec="000405.880" id="4_3" offangle="0.0000" priority="0" ra="185518.648"></TILE>
      + <TILE dec="000405.880" id="4_4" offangle="0.0000" priority="0" ra="185922.872"></TILE>
      + <TILE dec="000405.880" id="4_5" offangle="0.0000" priority="0" ra="190327.072"></TILE>
      + <TILE dec="010535.880" id="5_1" offangle="0.0000" priority="0" ra="184916.320"></TILE>
      + <TILE dec="010535.880" id="5_2" offangle="0.0000" priority="0" ra="185320.616"></TILE>
      + <TILE dec="010535.880" id="5_3" offangle="0.0000" priority="0" ra="185724.912"></TILE>
      + <TILE dec="010535.880" id="5_4" offangle="0.0000" priority="0" ra="190129.208"></TILE>
      + <TILE dec="020705.880" id="6_1" offangle="0.0000" priority="0" ra="185122.392"></TILE>
      + <TILE dec="020705.880" id="6_2" offangle="0.0000" priority="0" ra="185526.832"></TILE>
     </SURVEY_AREA>
   + <SURVEY_AREA coordSys="FK5 (J2000)" exclude="false" lat1="-02:00:00" lat2="+02:00:00" long1="19:10:00"
     long2="19:30:00" number="2" posangle="0.0000" type="Coordinate Range"></SURVEY_AREA>
   + <SURVEY_AREA coordSys="Galactic" exclude="false" lat="-6.5" long="29.0" number="3" posangle="0.0000"
     radius="4.5" type="Circle"></SURVEY_AREA>
  </SURVEY>
```

Within the <Tile /> element the 'id' is constructed as *TileRowNumber_TileColumnNumber* where the rows and columns start at 1,1 in the bottom right hand corner of each survey area.

A.3 Example: Pawprint

The same ouput file as in the subsection above is displayed next, showing the expanded first pawprint of the first three tiles (using Firefox as a viewer):



Within the <Pawprint /> element the 'id' is constructed as *Tile_ID:PawprintNumber*.

A.4 Example: Refstars

The <Refstars /> element of the first pawprint of the first tile from the same ouput file as in the examples before is shown below expanded fully (again using Firefox as a viewer):

Here the unique 'ID' is derived by adding the date and time to the parameter file (paf) name. The name consists of *SurveyID(examp_app2)-SurveyAreaNumber(1)-TileID(1_1)-PawprintID*.

B Plotting tiles/pawprints in Aladin

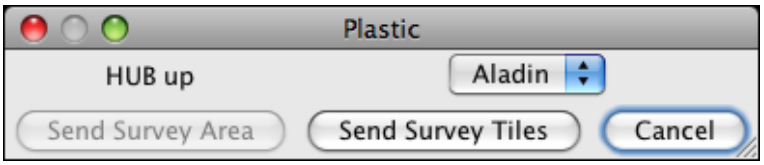
Aladin (http://aladin.u-strasbg.fr/) is an interactive sky atlas allowing the user to visualize digitized astronomical images, superimpose entries from astronomical catalogs or databases, and interactively access related data and information from the *Simbad database*, the *VizieR service* and other archives for all known sources in the field.

SADT can export tiles for plotting in Aladin. SADT does this using a PLASTIC manager. PLASTIC, the PLatform for AStronomical Tool InterConnection (http://plastic.sourceforge.net/), is a VO protocol for communication between client-side astronomcal applications.

Once you have created tiles, you should be able to send them to Aladin from SADT's PLASTIC dialog. Note thate Aladin should be started, with PLASTIC hub manager, (on the same machine as the SADT) **before** you attempt to export any tiles to Aladin.

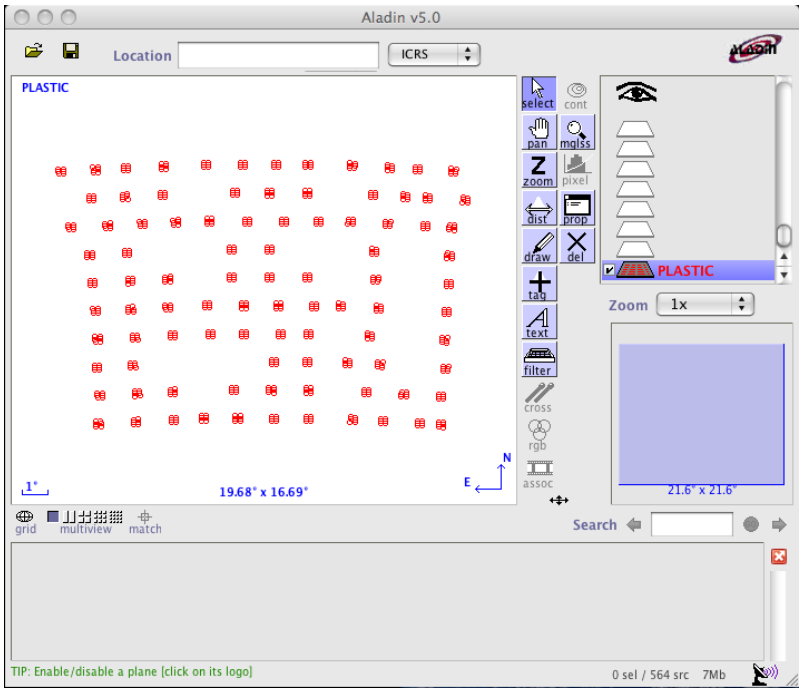
Aladin V4 and V5 launched a PLASTIC manager by default, Aladin V6 will by default launch a SAMP internal hub and not a PLASTIC internal hub. To launch PLASTIC internal hub you have to specify in advance the "-plastic" parameter on the Aladin command line (http://aladin.u-strasbg.fr/java/FAQ.htx#ToC34).

The 'Plastic' button in the SADT GUI brings up a PLASTIC dialog box:

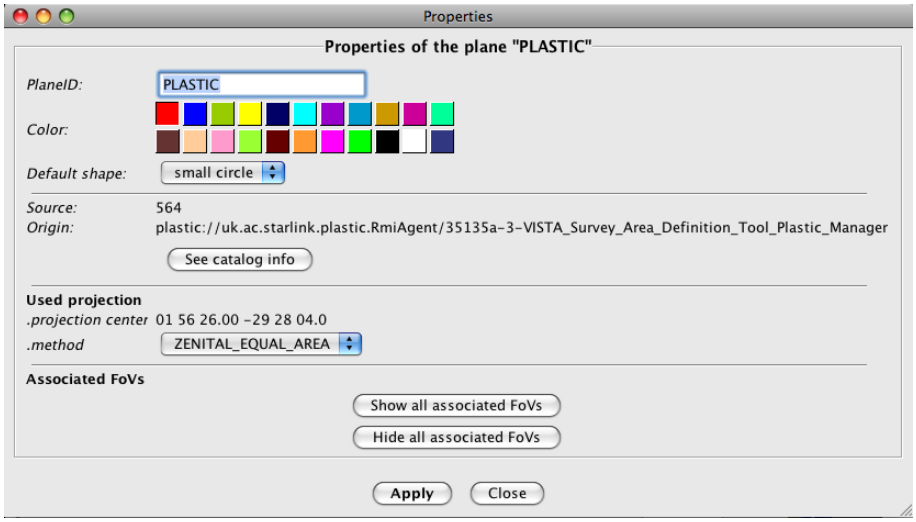


From this dialog it is currently only possible to send survey tiles (not survey areas) to Aladin. All the pawprints are sent over and you should see their centres in Aladin. If other PLASTIC managers are running in addition to Aladin the tiles can be exported to these by choosing between Aladin and the other tools using the selection button at the upper middle right of the above 'Plastic' window.

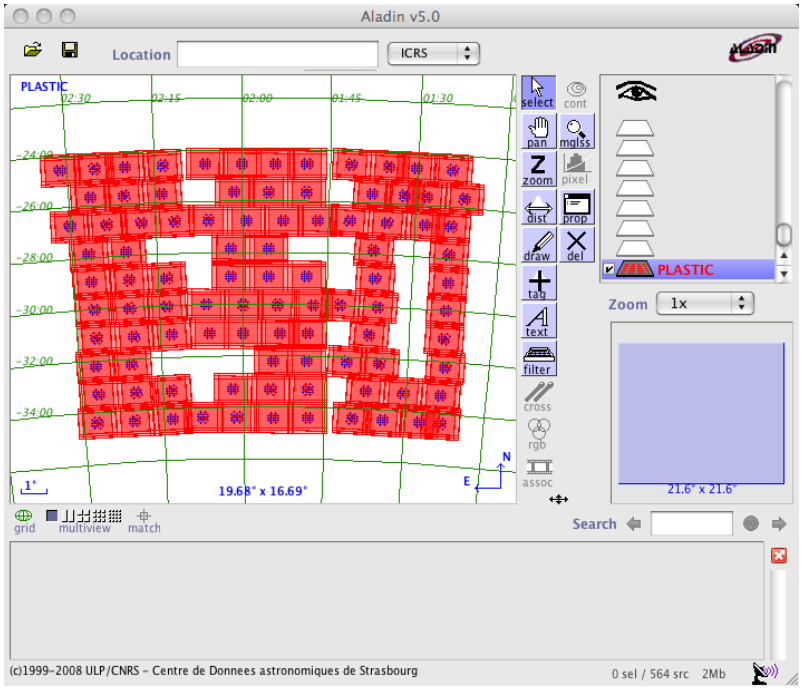
Here we show how Aladin displays the pawprint centres of the 'ESO' (VISTA) survey as rhombi:



If you want to see the outlines of the pawprints rather than just their centres, you have to click the right mouse button over the PLASTIC plane on the right hand side of Aladin, and open the 'Properties' window of the plane with the pawprints:



Clicking on 'Show all associated FoVs' should now show the outline of the boundary of each (VISTA) tile (but not the individual detectors):

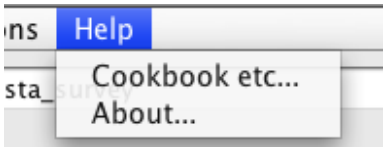


It also is possible to overlay the tiles onto an image of the field loaded into Aladin.

Disclaimer: ESO is not supporting the PLASTIC interface actively. If the export of SADT XML files to Aladin or other VO tools fails due to the further development of those tools, ESO is not responsible for finding a solution for the user. In the future, ESO might develop another ESO-internal tool to view the defined tiles and survey areas on a sky map.

C Help menu and configuration files

Clicking on the 'Help' menu in the SADT GUI brings up the following window:



- **Cookbook etc...:** Refers the reader to the ESO web page of SADT from which the SADT Cookbook can be downloaded.
- **About...:** Gives the version number of SADT and the VIRCAM Instrument Package it uses, and some developer information, together with terms and conditions of use, and a disclaimer. To get downloaded the newest version of SADT for VST please visit the ESO SADT web page:

  http://www.eso.org/sci/observing/phase2/SMGuidelines/SADT.html

C.1 Instrument package settings for SADT

The file *default.isf* in the OmegaCAM Instrument Package contains, inter alia, some information that SADT reads. Much of it is about the geometry of the CCDs and will not be discussed here.

Another part deals with parameters that SADT (optionally) reads, separately for each of the 2 autoguider and 2 wavefront sensor CCDs, which defines how SADT will find the potential guide/aO stars in the catalogs it is searching. The relevant values and their settings are:

Parameter Name	Value	Description of value
NUMIN	1	Minimum number of stars SADT should find
NUMAX	5	Maximum number of stars SADT should find
SEPMIN	10.0	Minimum separation (arcsec) from neighbouring stars whose magnitude difference is less than MAGDELTA
MAGDELTA	2.5	Smallest acceptable magnitude difference to neighbouring stars within distance SEPMIN. The aO/guide stars are only selected if any neighbours they might have within SEPMIN are at least MAGDELTA fainter than themselves.
MAXECC	0.3	(for GSC-2 only) Maximum eccentricity allowed
MINPMER	5.0	Minimum value of proper motion / proper motion error ratio for which SADT applies proper motion correction. If total proper motion is <MINPMER times its total error then the guide star is not proper motion corrected by SADT. Guide stars are not rejected based on their proper motion regardless of whether or not the proper motion is corrected.
MINMAG (LOWFS)	11.0	Brightest acceptable aO star for this chip
MINMAG (AG)	10.0	Brightest acceptable guide star for this chip
MAXMAG (LOWFS)	15.0	Faintest acceptable aO star for this chip
MAXMAG (AG)	16.3	Faintest acceptable guide star for this chip

The user **must not** change any of those settings!

C.2 Configuration Files

The directory *sadtdirectoryname/cfg/vst* contains the XML schema (**sad.xsd**) defining the format of the XML files SADT writes for ingestion by P2PP. The same directory contains two configuration files in which various configuration parameters are set:

sadt.cfg: Configures most default parameters in SADT. An explanation of all these parameters is provided in the *sadt.cfg* file itself. Most of them should not be changed by the user. However, some might influence the performance of the guide/aO star search, and thus might be altered for difficult survey areas by expert users. **Warning:** if you are not sure about what you are doing you should not change the default values of the parameters in the *sadt.cfg* file. Any loss of time during the execution of OBs that may be caused by inappropriate modifications of the parameters in this file will be subtracted from the allocated time for your observing run.

The level of information that is logged to the console can be regulated by several parameters that can be toggled on or off. In the following the most important parameters for the user are listed (the default values are given in brackets):

- MAX_JITTER (10.0): Maximum amount of jitter (in arcsec). This value should only be changed via the 'Configure...' panel in the 'Options' menu.
- TOGGLE_MAG_FROM_IP (false): The magnitude limits for guide and aO stars are either taken from the instrument package (= true) or from this configuration file (= false). If you choose any catalog other than GSC-2 it is important that this parameter is set to 'false', since the magnitude limits are optimized for the different reference magnitudes of the catalogs.

Note that the parameters shown in the following still are those used for VISTA observations. They will be updated for the use with VST in the next SADT version.

Selection parameters for UCAC3:

- CCD.AG_PY.MINMAG_UCAC3 (10.7), CCD.AG_NY.MINMAG_UCAC3 (10.7), CCD.AG_PY.MAXMAG_UCAC3 (17.0), CCD.AG_NY.MAXMAG_UCAC3 (17.0): magnitude limits for guide stars. **Do not change!**
- CCD.LOWFS_PY.MINMAG_UCAC3 (11.7), CCD.LOWFS_NY.MINMAG_UCAC3 (11.7), CCD.LOWFS_PY.MAXMAG_UCAC3 (15.7), CCD.LOWFS_NY.MAXMAG_UCAC3 (15.7): magnitude limits for aO stars. **Do not change!**
- TOGGLE_CHECK_UCAC3_2MASSID (true): entry in 2MASS catalog; source accepted if id2MASS > 0.
- TOGGLE_CHECK_UCAC3_CLBL (false): SuperCosmos star/galaxy classifier and quality flag; source accepted (= true) if clbl $= 2$. Tests have shown that this parameter invalidates too many suitable stars. Therefore, its default value is set to 'false'.
- TOGGLE_CHECK_UCAC3_DOUBLE (true): Double star check; source accepted if double star flag $= 0$.
- TOGGLE_CHECK_UCAC3_LEDA (true): LEDA galaxy match flag; source accepted if leda $= 0$.

- TOGGLE_CHECK_UCAC3_NU1 (true): Number of CCD images used for this star; source accepted if nu1 > 0.
- TOGGLE_CHECK_UCAC3_TYPE (true): Star/galaxy classifier; source accepted if type $= 0$ or 1.

Selection parameters for 2MASS:

- CCD.AG_PY.MINMAG_2MASSJ (10.1), CCD.AG_NY.MINMAG_2MASSJ (10.1), CCD.AG_PY.MAXMAG_2MASSJ (16.4), CCD.AG_NY.MAXMAG_2MASSJ (16.4): magnitude limits for guide stars. **Do not change!**
- CCD.LOWFS_PY.MINMAG_2MASSJ (11.1), CCD.LOWFS_NY.MINMAG_2MASSJ (11.1), CCD.LOWFS_PY.MAXMAG_2MASSJ (15.1), CCD.LOWFS_NY.MAXMAG_2MASSJ (15.1): magnitude limits for aO stars. **Do not change!**
- TOGGLE_CHECK_2MASS_QFLG (true): 2MASS quality flag; source accepted if QFLG = A or B.

Selection parameters for GSC2:

- CCD.AG_PY.MINMAG_GSC2 (10.0), CCD.AG_NY.MINMAG_GSC2 (10.0), CCD.AG_PY.MAXMAG_GSC2 (16.3), CCD.AG_NY.MAXMAG_GSC2 (16.3): magnitude limits for guide stars. **Do not change!**
- CCD.LOWFS_PY.MINMAG_GSC2 (11.0), CCD.LOWFS_NY.MINMAG_GSC2 (11.0), CCD.LOWFS_PY.MAXMAG_GSC2 (15.0), CCD.LOWFS_NY.MAXMAG_GSC2 (15.0): magnitude limits for aO stars. **Do not change!**
- TOGGLE_CHECK_GSC2_ELLIPTICITY (true): Ellipticity check; source accepted if eccentricity < 0.3.
- TOGGLE_CHECK_GSC2_CLASS (true): Star/galaxy classifier; source accepted if class $= 0$.
- GSC2_REMOVE_DOUBLES (true): SADT filters out erroneous double entries in GSC-2.
- GSC2_REMOVE_DOUBLES_DIST (1.0): Maximum distance in arcsec of two GSC-2 entries that are interpreted as double entries.

Selection parameters for USNO:

- CCD.AG_PY.MINMAG_USNO (10.0), CCD.AG_NY.MINMAG_USNO (10.0), CCD.AG_PY.MAXMAG_USNO (16.3), CCD.AG_NY.MAXMAG_USNO (16.3): magnitude limits for guide stars. **Do not change!**
- CCD.LOWFS_PY.MINMAG_USNO (11.0), CCD.LOWFS_NY.MINMAG_USNO (11.0), CCD.LOWFS_PY.MAXMAG_USNO (15.0), CCD.LOWFS_NY.MAXMAG_USNO (15.0): magnitude limits for aO stars. **Do not change!**

Note that if a parameter is not present in one of the catalogs (value = -999), this parameter is ignored as selection criterium, i.e. the source is accepted if none of the other existing parameters would reject it.

Control parameters for the logging to the console:

- TOGGLE_PRINT_VALID_CONSOLE (false): prints coordinates of valid (accepted) stars in the rectangular area of the CCD.
- TOGGLE_PRINT_INVALID_CONSOLE (false): prints coordinates of invalid (rejected) stars in the rectangular area of the CCD.
- TOGGLE_PRINT_OUTOFRANGE_CONSOLE (false): prints coordinates of valid and invalid stars that are contained in the circular search area but not in the rectangular area of the CCD.
- TOGGLE_PRINT_ACCEPTED_STARS_AT_STAGE_CONSOLE (false): prints output whenever a star is accepted, including the tests passed.
- TOGGLE_PRINT_PROPER_MOTION_CONSOLE (false): prints coordinates of stars with information on proper motions, and whether the proper motion was taken into account or not.
- TOGGLE_PRINT_MAG_REJECTED_STARS_CONSOLE (false): prints coordinates of all stars that are rejected because they lie outside the acceptable magnitude range.
- TOGGLE_PRINT_OTHER_REJECTED_STARS_CONSOLE (true): prints coordinates of all stars that are rejected because of reasons other than not falling in the acceptable magnitude range.

skycat.cfg: The guide/aO stars are searched in a selected catalog over the internet, and *skycat.cfg* sets up the available catalogs that appear in the catalog choice box of the SADT.

The list of catalogs available in SADT is a selection on entries of *serv_type: catalog* contained in the standard *skycat.cfg* in Dec 2009. In principle SADT can also read other catalogs that can be read by tools such as GAIA and JSkyCat. Adding a new catalog can be done as follows:

- Create/copy/edit a *skycat.cfg* file such as this distribution's.
- Put all the catalogs you want to use into the *skycat.cfg* file.
- Edit the entry jsky.catalog.skycat.config=../cfg/skycat.cfg in the *sadt.cfg* file of this SADT distribution so that the value of *jsky.catalog.skycat.config* is the path of the *skycat.cfg* you want to use.
- GAIA/SkyCat/JSky catalogs can be online as well as in a local file conforming with the

  GAIA (http://star-www.dur.ac.uk/ pdraper/gaia/gaia.html) /

  SkyCat (http://archive.eso.org/cms/tools-documentation/skycat) /

  JSky (http://archive.eso.org/cms/tools-documentation/jsky/)

  catalog conventions.

  Note that the use of local GAIA/SkyCat/JSky catalogs has not been tested.