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Applicable & Reference documents.

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Acronyms and Abbreviations

FITS Flexible Image Transport System

IDL Interactive Data Language

SED Spectral Energy Distribution

VLKB ViaLactea Knowledge Base

LUT LookUp Table

VisIVO Visual Interface with the Virtual Observatory

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1. Introduction

The present document is the user manual of the Vialactea Visual Analytic Client (following referred as Client). The Client, based on VisIVO[1] backbone, offers a 2D and 3D visual analytics environment allowing the astronomers to easily conduct research activities interacting in a simple way with the Vialactea Knowledge base and the Search&cutout service.

This manual has to be considered as integration document of the deliverables D5.1 [AD1] and D5.2 [AD2] of WP5.

Most of the technical implementation and architecture details of the designed software are fully described in [AD1] and [AD2]. Hence, this document is mainly focused on the functionalities available to the end users.

2. Set Up Configuration

At the first execution of the Client, the user is asked to setup the IDL path (select where the IDL binary executable is located, typically in OsX is /Applications/exelis/idl/bin/idl and in Linux is /usr/local/bin/idl) and the Tile path (select where the openlayers.html is located within the unpacked tiles.zip) as shown in the following figure. The user can also change anytime this setup selecting File → Settings in the menu bar of the Starting Window.

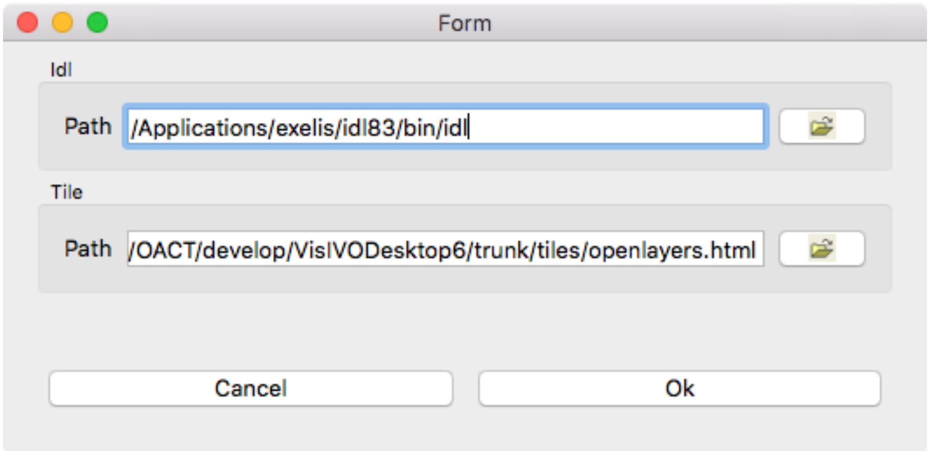

Figure 1. Setup window

3. Starting Window

The Starting Window shows an overview of a section of the galactic plane (longitude from -60° to +60° and latitude from -1° to 1°) to perform a visual selection of the region of interest. This allows the users to easily query and retrieve the desired FITS image from the Search&Cutout service (see fig.2).

[1] http://visivo.oact.inaf.it

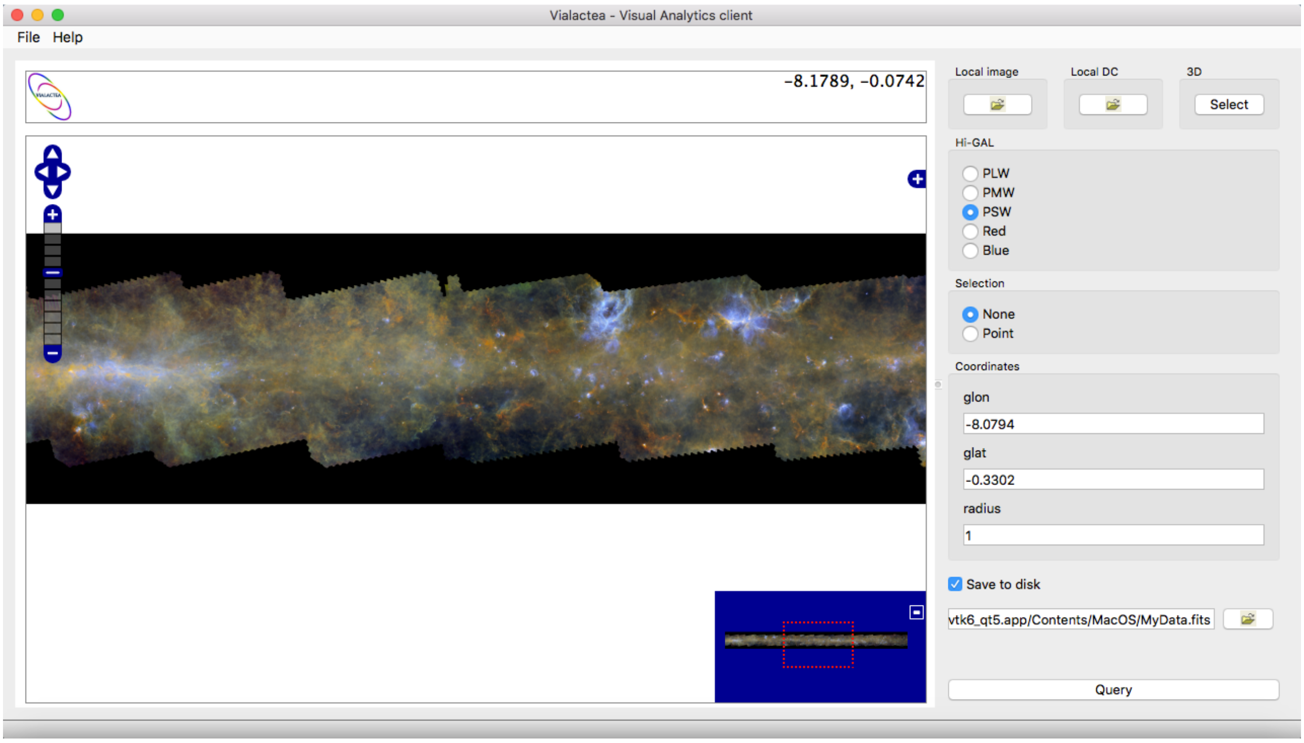

Figure 2. Starting window interface

The selection of the region of interest is, up to now, performed by choosing a point on the map and specifying the radius of selection in the dedicated box on the right part of the window. The maximum radius accepted by the *VLKB search & cutout service* is 2 degrees.

Clicking on the “Query” button the Client will open on a separate window the FITS image containing the user selected region that is used as starting point for performing the visual analytic operations.

If the user checks “Save to disk”, the image is saved locally for future uses of it, and then it can be re-loaded by clicking on the “Local Image” button.

The “Local DC” button allows the user to load and visualize a velocity datacube FITS file that is already stored on a local disk.

The “Select” button, under the 3D section allows the user to specify the range of coordinates on which to perform a 3D visualization of compact sources on the galactic plane.

4. 2D maps visualisation

Once the selected region has been downloaded or locally loaded from the Starting Window, the 2D maps visualization window is shown. The user can interact with the displayed image changing the palette used to map pixel values with colours. There are a set of predefined LUT embedded in the Client, for each of them is possible to select if use linear or logarithmic scale.

The image can be zoomed with mouse wheel and panned dragging it when the SHIFT button is pressed.

Contrast and saturation of the visualized image can be changed by keeping pressed the mouse left button and moving on the image. Passing the mouse over the image allows to display on the bottom of the window the pixel value, and coordinates expressed as pixel (X, Y), galactic (GLON, GLAT), fk5 (RA, DEC) and ecliptic (RA, DEC).

If the visualized map is downloaded from the Search&Cutout service, on the right panel a list of 2D maps and datacube available in the Vialactea knowledge base within the selected region are shown (following referred as VLKB items). In order to have an idea of the region covered by each of thess elements a footprint is visualized if the users click on one of this item (figure 3).

Furthermore, the user can interact with the image performing the following operations:

- Add an image as layer (see section 4.1)
- Compact sources visualization and analysis (see Section 4.2)
- Visualization of Filaments (see Section 4.3)
- Visualization of Datacubes (see Section 4.4)
- 3D Visualization (see Section 4.5)

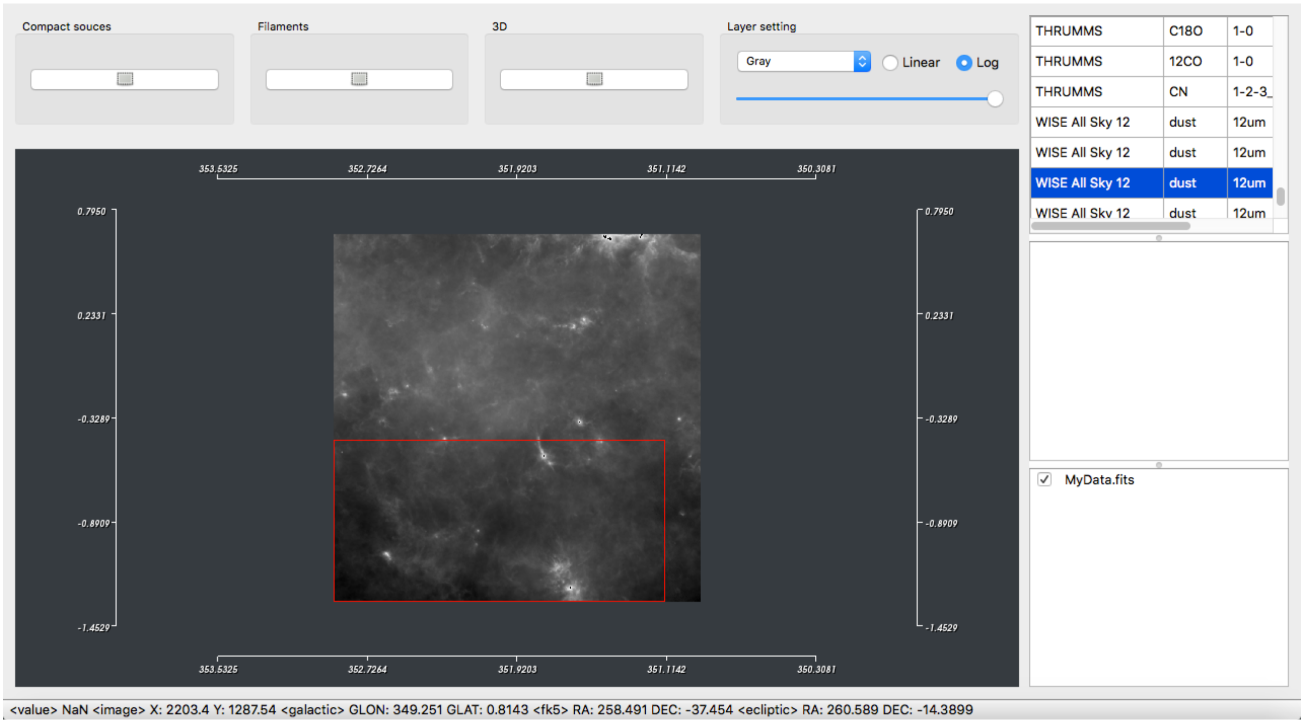

Figure 3: Visualization of the footprint of selected item

4.1. Add an image as layer

Double clicking on one of the VLKB items, if it is a 2D map image, it is added as new layer on top of the FITS images already displayed. The new layers are aligned (position, scaling pixel size, rotation) to the “image base” according to the information contained into their header.

Each layer is shown in the table (following referred as Layer items) in the bottom part of right panel. Using the checkbox on the left of each row within the Layer items, the user can activate or deactivate the visualisation of the relative layer. The opacity can be modified selecting a row in the Layer items and using the slider in the “Layer setting” located in the upper part of the window.

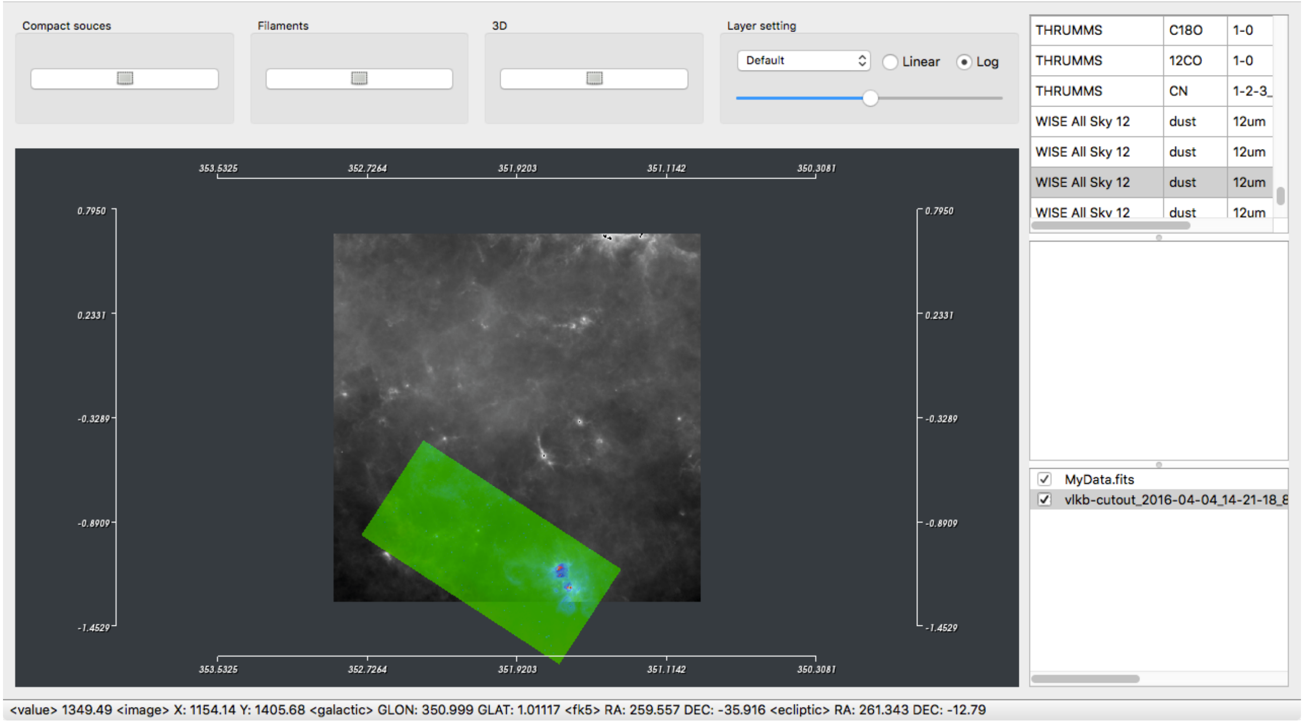

Figure 4: Visualization of a new layer image

4.2. Compact sources visualization

The user can display compact sources overlapped to the fits image.

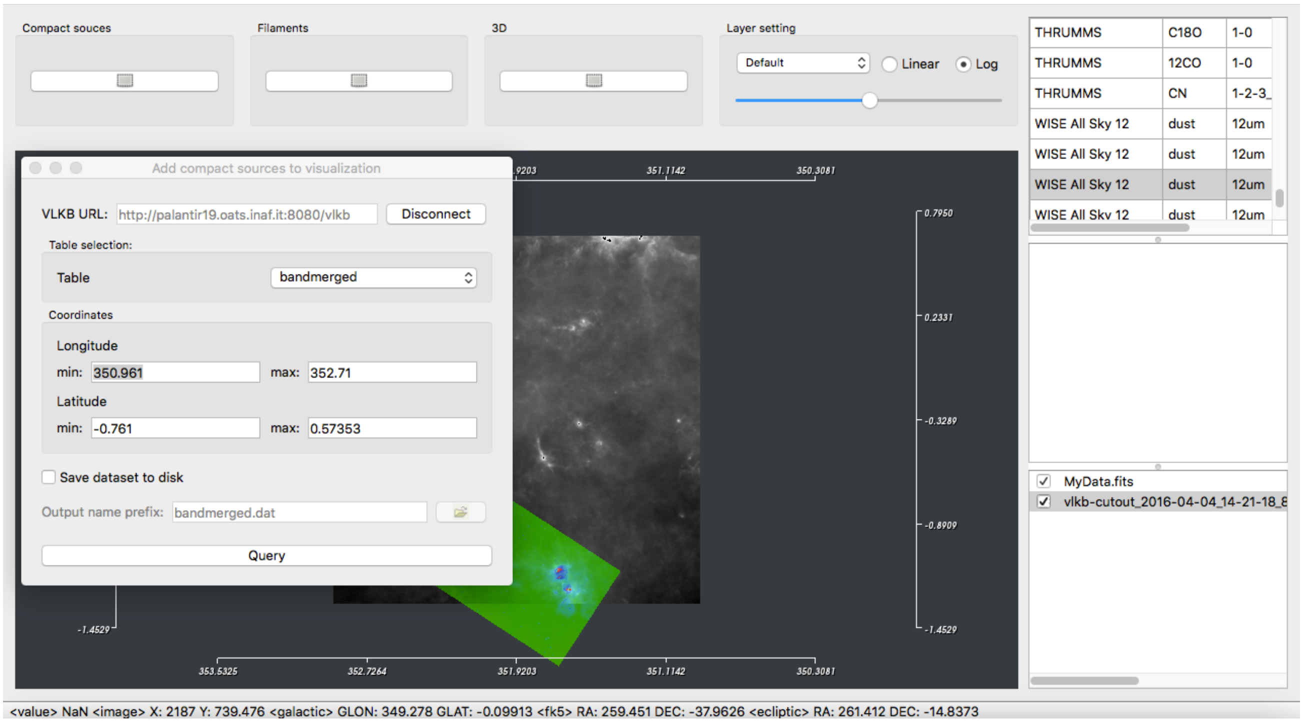

Figure 5. Adding compact sources from VLKB to visualization screen

If the user decides to retrieve compact sources dataset from the VLKB he/she should click on the “Compact Source” button (or use the shortcut cmd ⌘+R on OsX system or ctrl+R on Linux) and make a rectangular selection of the region of interest on the visualized image. The tool, extracting coordinates from the selection made by the user, queries the VLKB (see fig. 4) and automatically displays the compact sources on top of the image on which the user is doing the analytic operations (see fig.5). By default the Client queries the VLKB in order to obtain sources from bandmerged table. If the user wants to download and visualize the compact sources of just one band he/she can select the desired one from a dropdown list “Table” in the panel as show in figure 5.

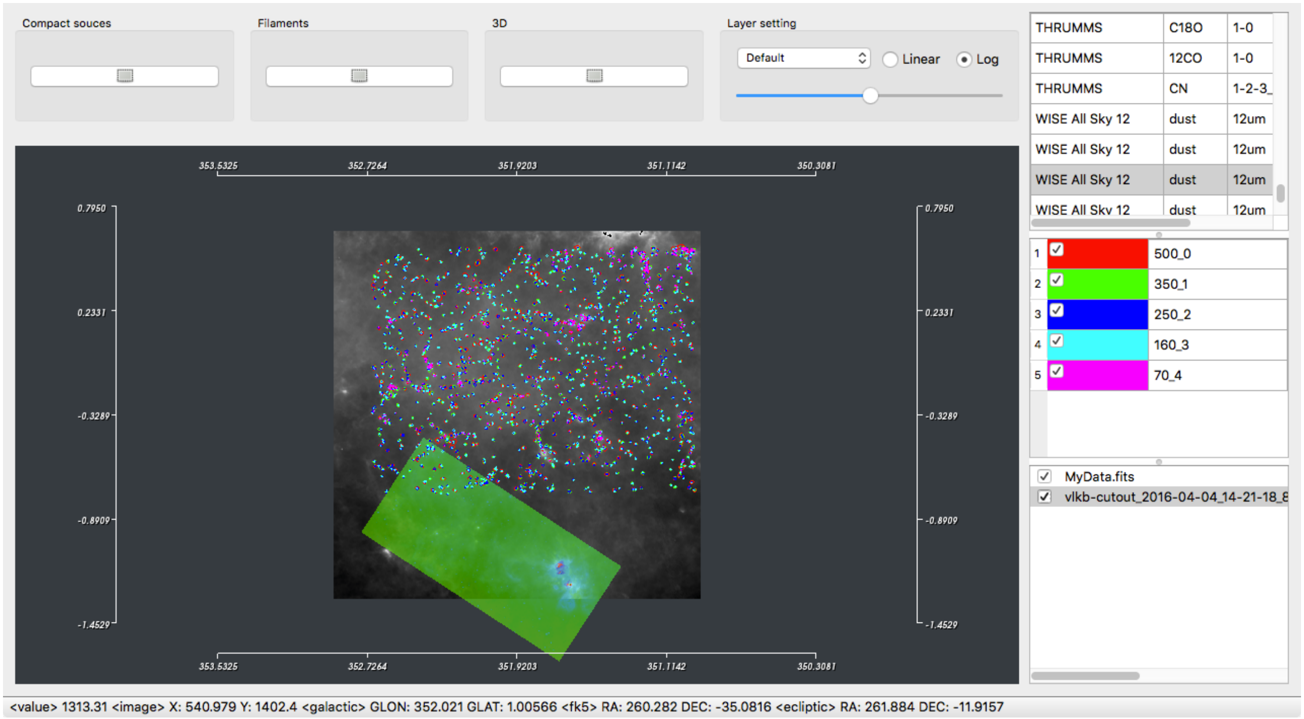

Figure 6. Visualization of compact sources from the VLKB

The compact sources are shown in different colours on the image depending on the relative wavelength (70 μm, 160 μm, 250 μm, 350 μm and 500 μm). As for the layers, using the checkbox in Layer element the user can select/de-select the compact sources to display. Double clicking on the coloured cell of each row, it is possible to change the colour of the sources in the visualization.

4.2.1. SED Analysis

From the menu bar going to Window → Select, or pressing the keyboard shortcut cmd ⌘+S on OsX system or ctrl+S on Linux, the user can select one or more of the visualized clumps to perform the SED analysis.

There are three different kind of fitting operations available, one for the fit with the theoretical models and two for the analytical fit. Fitting operations are performed from the menu bar selecting Action → Fit and then “Theoretical model” or “Grey-body” to perform the fit with the theoretical models or the analytical fits.

Fit operations are performed through the use of IDL[2] routines integrated, in a transparent way for the user, within the client of the visual analytics tool.

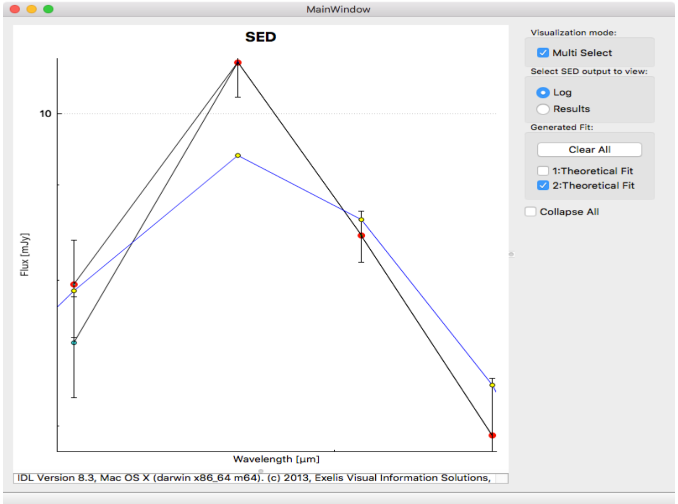

Figure 7. SED plot: in blue the theoretical fit performed on the selected SED

In the right panel the user can visualize the output log or the results of the computed SED fit. A list of SED appears once a new fit is performed so that the user can select/deselect the SED fit to visualize or press the "Clear All" button to remove all the plotted fits.

If the "Select" visualization mode is selected, the user can perform the fit only on the selected nodes on the graph.

In case the SED presents multiple associations the user can choose to sum the fluxes of counterparts obtaining the SED with a cumulative flux. This operation is done by checking "Collapse All" from the right panel. In figure 8 the SED drawn in red line is the collapsed one while the dashed lines are the original SEDs.

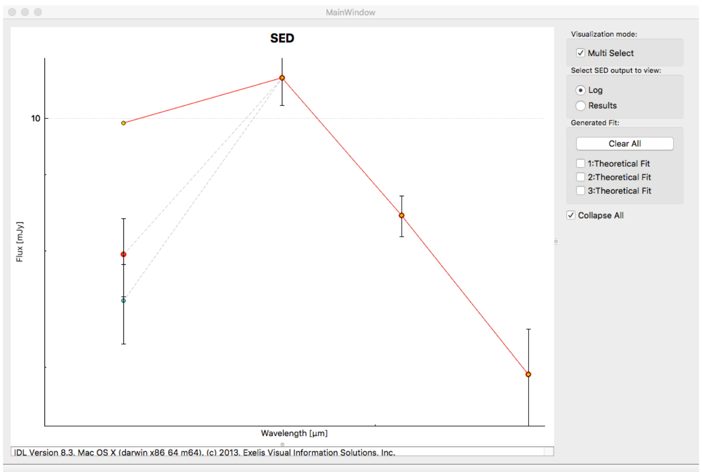

Figure 8. SED plot: in blue the theoretical SED that fit the collapsed one drawn in red

4.3. Filaments Visualization

Starting from the selected region, the filaments candidates stored within the VLKB, can be visualized by selecting the "Filaments" button on top of the window and making a rectangular selection. The filaments are

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2 http://www.exelisvis.com/ProductsServices/IDL.aspx

displayed on top of the image as shown in fig. 8. Using the checkbox in “Layer items” the user can visualize or remove the filaments from visualization. Double clicking the coloured cell it is possible to change the colour of the filaments.

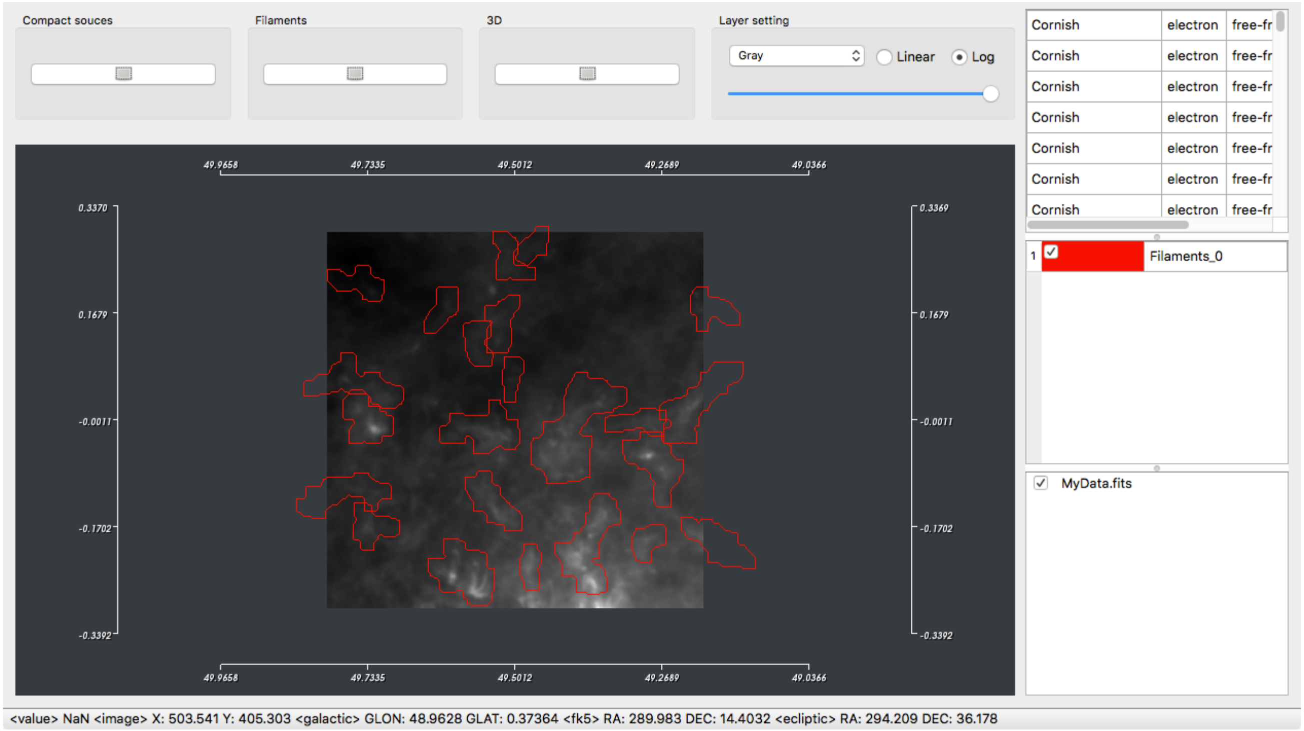

Figure 9. Filaments visualization

4.4. Datacube visualization

Selecting a radiocube from “VLKB items” on the visualization window (see fig. 3), the user can query the Search&Cutout service in order to get and visualize the datacube (see fig. 10).

The 3D datacube visualization (left panel) can be controlled by the mouse movements and pre-defined views (e.g. front, back or top) can be selected by the Camera Control buttons on the top panel of the window.

The 3D visualization can be zoomed with mouse wheel and panned dragging it when SHIFT button if pressed.

The 3D visualization of the datacube (see fig. 10) is rendered using isosurfaces algorithm with thresholds that the user can change in real-time using the slider “Threshold” located in the top panel.

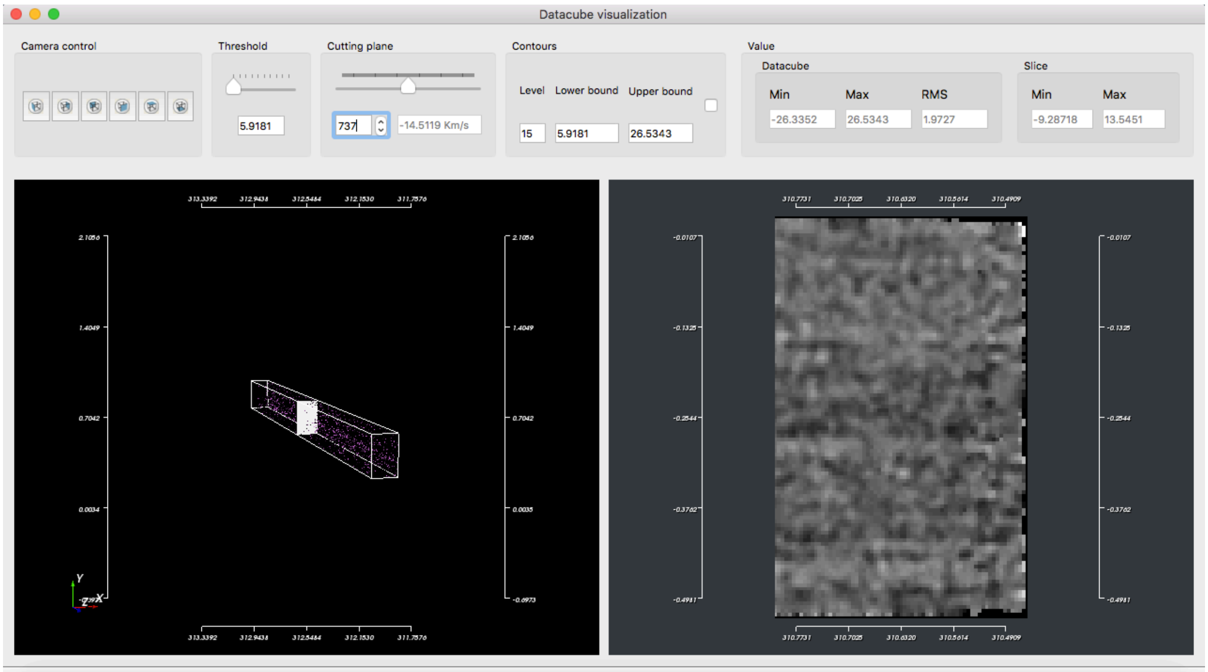

Figure 10. 3D datacube visualization

The right panel shows a single slice of the velocity datacube. With the "Cutting Plane" slider, the user can select which slice to visualize.

Contrast and saturation of the visualized slice can be changed by keeping pressed the mouse left button and moving on the image. Passing the mouse over the image allows to display on the bottom of the window the pixel value, and coordinates expressed as pixel (X, Y), galactic (GLON, GLAT), fk5 (RA, DEC) and ecliptic (RA, DEC).

If the checkbox in "Contours" is checked then the isocontours are displayed on top of the selected slice as shown in fig. 11. The contours are also reported on the 2D map image. Contours can be changed by selecting the "Level" and the Upper and Lower bound.

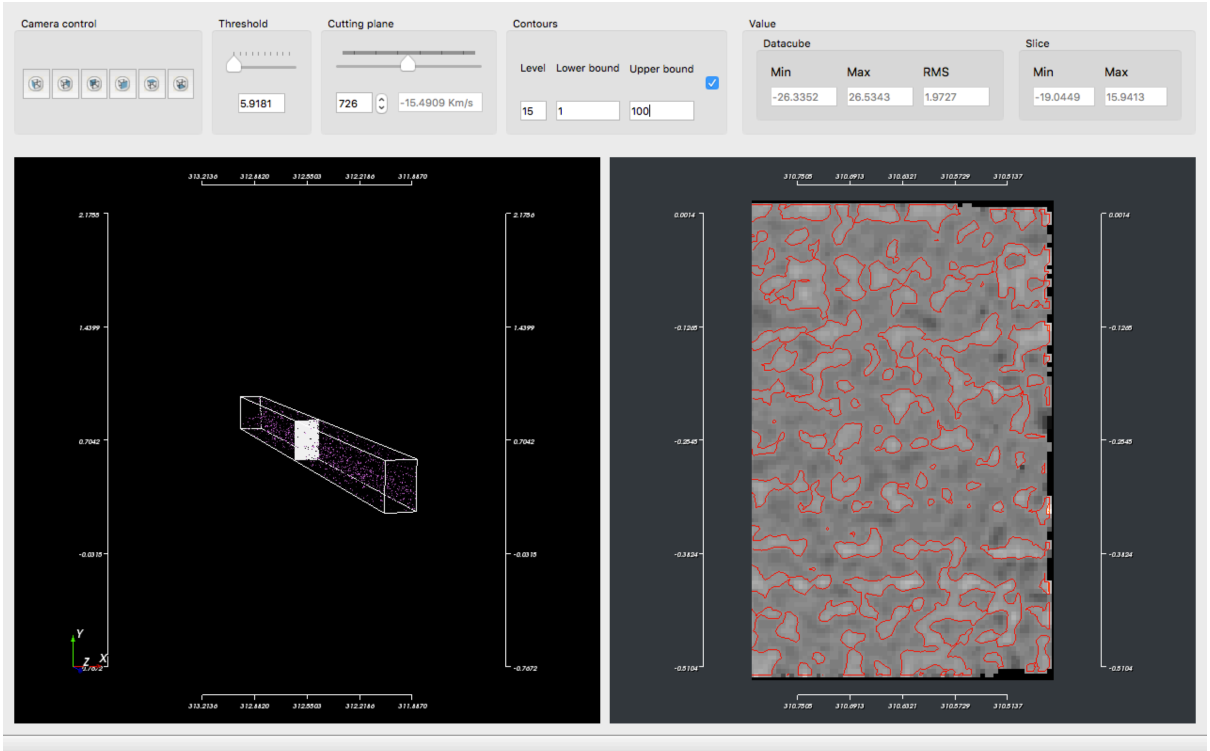

Figure 11. Contours display on the 3D datacube visualization

4.5. 3D Visualization for sources on galactic plane

The user can select a region of interest within the FITS image in order to query the VLKB obtaining a 3D visualization of compact sources on the galactic plane in that region (see fig. 11). Alternatively the 3D visualization can be performed by clicking on the 3D button of the Starting window (see fig. 2) and then choosing the longitude and latitude min – max bounds (in degrees) of the region of interest.

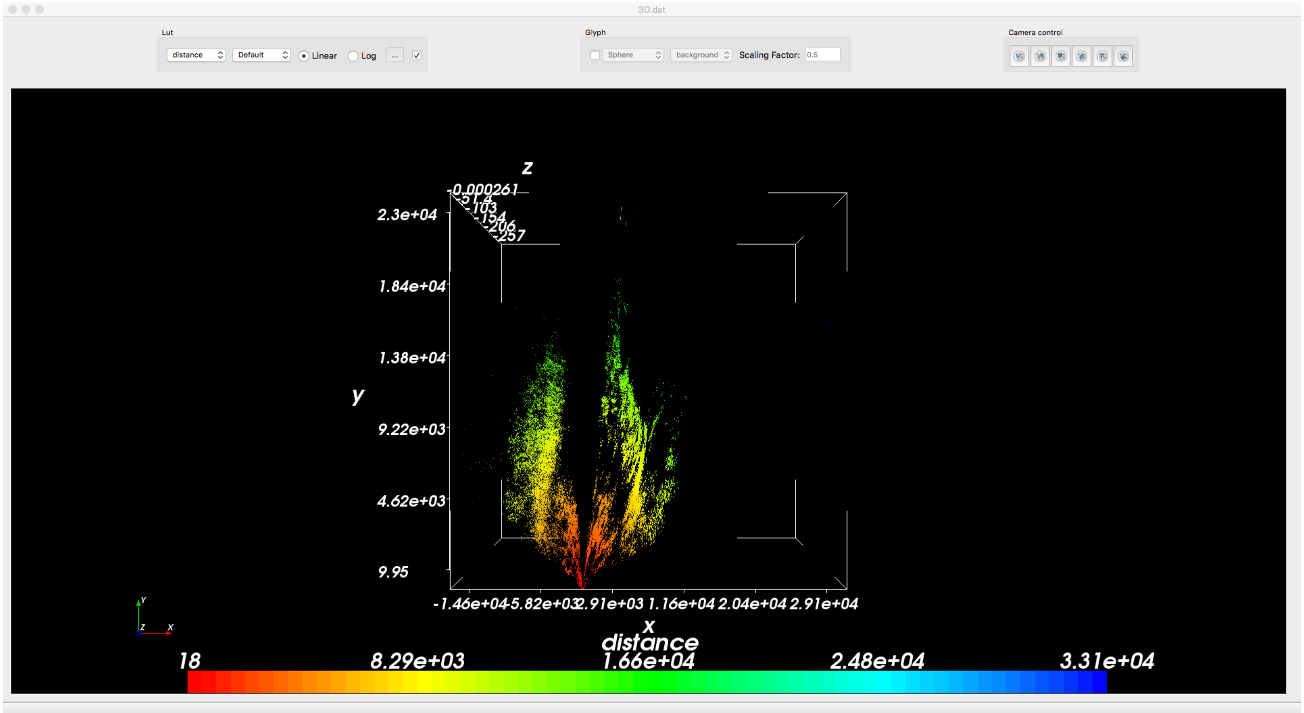

Figure 12. 3D Visualization of sources on galactic plane

The 3D view is interactive and the camera position can be moved with mouse operations. The Lut colormap scalar and type can be changed by selecting the corresponding checkbox and can be visualized in linear or logarithmic form.

If the number of visualized points is less than 1000 then the glyphs can be visualized on top of the points scaled according to the selected field.

Users can make a selection in the 3D visualization in order to extract the sources of interest. This selection is currently implemented as rectangular selection; the freehand selection is being under bug fixing.