



Spitzer Space Telescope

Leopard User's Guide Version 9

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1 Introduction

Welcome to Leopard, the Spitzer Science Center Data Archive interface. The Leopard software is available to download from the Proposal Kit page at the Spitzer Science Center web site (<http://ssc.spitzer.caltech.edu/propkit/spot/>). You will need to use Leopard to access both public, non-proprietary data products and data products resulting from your approved observing program.

Leopard is a JAVA-based client-server software package based on the same architecture as Spot, the Spitzer Planning Observations Tool. If you are comfortable using Spot, you are already familiar with many features of Leopard. This User's Guide provides information about the various features within Leopard. You can use Leopard to query specific observations from the Spitzer Archive, select various data products desired, and choose from direct data delivery to local disk or staged FTP for data delivery.

The Release Notes that are packaged with the software provide additional information about computer platforms supported for this version, performance issues, and a list of known bugs. A list of bugs/issues is updated regularly on the Proposal Kit web page (<http://ssc.spitzer.caltech.edu/propkit/spot/>).

To make using Leopard easier, we recommend that you:

1. *Read the Release Notes that are packaged with the software (or download them from the web page). Some, but not all, of that information is repeated here.*
2. *Check the known bugs/issues list on the web page.*

You can find the resources you need to help you analyze Spitzer data at the Data Archives and Analysis webpage (<http://ssc.spitzer.caltech.edu/archanaly/>) on the main SSC website. These resources include the data handbooks for the three Spitzer instruments (IRS, IRAC, MIPS), the data release status page, and links to the advance data products software and documentation, aka the post-BCD software.

Please email us at the Spitzer Science Center (SSC) Helpdesk (help@spitzer.caltech.edu) with any questions or comments.

2 This Release of Leopard

This is the ninth release of the Leopard software. Future releases will incorporate more features as they are implemented. This release contains features, such as searching the Spitzer Archive with basic search parameters, selecting various data product types for retrieval, and two data download options – direct data delivery (preferred) or staged FTP.

You may notice that Leopard looks a lot like Spot, the Spitzer Planning Observations Tool. Leopard is based on the same JAVA architecture as Spot and shares many of the

same features. If you are comfortable with using Spot, you are already familiar with many of the features of Leopard.

Several items have changed in this version of Leopard. In addition, we have added a number of new features. We have attempted to encapsulate in the list below the most obvious changes that affect users the most:

- Background calculation output format modified.
- Inclusion of all Legacy Science enhanced data products in the Popular Products query.
- Inclusion of “Select All” button in Query by Campaign/Observer.
- Inclusion of IRS Staring and Spectral Mapping quicklook previews.
- Depth-of-Coverage overlay now uses observation date, when available.
- Catalog data available for image overlays from the VizieR service (in beta).
- Visualization: Load FITS images from a URL.
- Visualization: Load images from NVO Simple Image Access Protocol (SIAP) sites.
- Visualization: Slice Tool now handles image overlay layers.
- Visualization: Allow for creation of blank image for overlays.
- Visualization: Removed 10° limit on Depth-of-Coverage overlays for MIPS Scan AORs.
- Visualization: Allow for Depth-of-Coverage overlays for IRAC Post-Cryo Mapping AORs.
- Various other improvements and bug fixes.

There are two issues to note for this release of Leopard:

1. If a data download fails, check your hard disk space. Leopard cannot tell if you have filled up your disk space, so an incomplete data download may be due to a full disk on your computer.
2. Read the README files that come with the data download. They will indicate if the download was successful or if there were problems.

3 Minimum Recommended Hardware Configurations

Leopard is written in the JAVA language and therefore requires lots of memory and a fast processor in your computer. If you run it on a system with less memory or processor power than our minimum recommended configuration, the software may work but it is likely to be slow and you will probably see window redraw/refresh problems. While we suggest minimum hardware configurations, we recommend that users have more RAM (512 MB or above) and a fast processor if you plan on intensive use of the visualization features within Leopard. The minimum recommended hardware configurations are:

3.1 Sun Workstations: Sun Ultra 5 with 256 MB RAM

If you are not using the visualization features in Leopard then it may run acceptably on an Ultra 1 with 256 MB of RAM.

3.2 Windows PC (2000, NT, XP): 512 MB RAM**3.3 Windows PC (Vista): 1 GB RAM****3.4 Linux PC: 256 MB RAM**

We have done limited testing on Linux systems running with a Pentium 2 processor at 266 MHz and 256 MB of RAM, as well as with a Pentium 3 processor and 256 MB of RAM.

3.5 Mac: OS 10.4, 512 MB RAM; OS 10.5, 1 GB RAM

We have tested Leopard on a G4 processor with 512 MB RAM under OS 10.4, and it runs acceptably. However, we recommend 1 GB RAM for OS 10.5 (Leopard).

4 Operating System Configurations Supported

Please read the Release Notes (packaged with the software or available on the web page) for more details on operating system issues, particularly with respect to window managers. The majority of the testing for this version of Leopard has been done under Solaris 2.8, Windows XP, Linux, and Mac OSX. We do not anticipate major problems with other flavors of Windows. Except for Mac, the versions of Leopard in this release come with JAVA 1.5.

4.1 UNIX: Solaris 2.8+

The software has been tested on Solaris 2.8 and 2.10.

4.2 Windows: NT, 2000, XP, Vista

The functionality of the software has been tested using Windows XP. Minimal testing has been completed using other versions of Windows, but we do not anticipate problems. Due to security measures for Windows Vista, you will need system administration privileges for software installation. To allow auto-update under Windows Vista, use the right mouse button when clicking on the Leopard icon, and select "Run as Administrator." You can click on the icon and run Leopard normally thereafter.

4.3 Linux: RedHat 8.0, 9.0; Fedora Core; Enterprise

Leopard on Linux runs acceptably on RedHat 8.0, 9.0. We tested distributions 'straight out of the box.' We ran the GNOME windowing environment. We know that Leopard does NOT run properly with the fvwm2 window manager (all JAVA Swing programs seemed to hang) or KDE. Leopard also appears to run well under Fedora Core, although we have not yet fully tested Fedora Core 4 or 5. Undoubtedly, there will be various Linux OS under which Leopard will not run successfully. For example, we are not supporting Spitzer Pride for 64-bit Linux machines. You will need to install the 'generic' package and download your own Java; see the Installation webpage.

4.4 Mac: OS X

Leopard requires JAVA 1.5, so Mac OS 10.4 or 10.5 is required. (**Note: Leopard will no longer run under Mac OS 10.3.**) Apple offers JAVA 1.5 (JAVA 2 Standard Edition [J2SE] 5.0) as a software update. By now, nearly all Mac OS 10.4 or 10.5 systems should be running JAVA 1.5, unless you have not allowed software updates to run over a year or so. You may need system administration privileges for software installation.

5 Installing and Starting Leopard – Part of Spitzer Pride

With this release we continue the tradition of the Spitzer Pride – Spot V18 and Leopard V9. Spot and Leopard share many of the same JAVA files and so are packaged together as Spitzer Pride. Spot/Leopard should be installed on the computer where you want to run them. The start-up script is not configured to allow it to run on an X-terminal. You can run them across a Sparc network if it is installed on a disk that is nfs mounted across the network. We run Spot and Leopard in this fashion at the SSC. The first step is to download the software from the SSC Proposal Kit web page onto your hard disk (<http://ssc.spitzer.caltech.edu/propkit/spot/>).

5.1 Windows Installation

After downloading the software, double-click on the Spitzer-pride18-windows.exe file to install. After installation, click on the Leopard icon to start Leopard.

5.2 Solaris or Linux Installation

1. Go to the directory where you installed the Spitzer-pride18-solaris.sh or Spitzer-pride18-linux.sh file. You must have write permission in this directory and should have at least 200 MB of free disk space.
2. At the UNIX/Linux prompt, type **chmod +x Spitzer-pride18-solaris.sh** (or Spitzer-pride18-linux.sh) to make the file executable.
3. Type **./Spitzer-pride18-solaris.sh** (or Spitzer-pride18-linux.sh) to run the installation script.
4. When the script asks you for the directory name where you want to install Spitzer-pride, be sure to type the full directory path, e.g., **/scr/user/my_pride**. *Make sure the directories exist before you try to install it there.* If you are in the directory **/scr/user/** and just type **my_pride**, it will tell you that the directory name must start with a slash.
5. If desired, add this directory to your \$PATH: **setenv PATH (\$path /scr/user/my_pride)**
6. Type the name of the program (**spot** or **leopard**) to launch it.

5.3 Mac Installation

Click on the link for the software package, offered as a disk image (.dmg) file. Drag the Spitzer-pride folder icon from the pop-up window onto your local disk into whichever directory you want to install the software. For instance, you may wish this to be the Applications folder. Double-click on the program to install it. Click on the Leopard executable (.app file) to start Leopard. **NOTE: Please be sure that Subscriber**

application file (subscriber.app) is in *the same directory* as the Leopard application; otherwise, you will not be able to start up Subscriber and download data.

5.4 Leopard Automatic Update

The automatic update feature from the Options menu will allow the client side of Leopard to update itself if it detects that a newer version is available at the SSC. Leopard will access the updated files at the SSC via the Internet and will automatically install them on your computer. Auto-update is the default setting when you first install Spitzer Pride. If you turn this feature off, or decline an auto-update at any time, Leopard will remember that you have turned it off. We strongly encourage users to leave auto-update turned on and to accept auto-updates when they occur. Note, to allow auto-update under Windows Vista, use the right mouse button when clicking on the Leopard icon, and select "Run as Administrator." You can click on the icon and run Leopard normally thereafter.

6 General Information

6.1 Client-Server Software Interactions

The Leopard software that you download onto your computer acts as the 'client' and requests information over the network from the 'server' software located at the SSC. An Internet connection to contact the servers is required to query the Spitzer data Archive, download Spitzer data, and download astronomical images and catalogs.

When the servers are accessible by Leopard, the net-up symbol (Figure 1) will appear at the bottom of the main Leopard window.



Figure 1: The net-up symbol means Leopard can access the SSC servers. The net must be up to query the Spitzer data Archive, retrieve data, or download images or catalogs.

If your computer is not connected to the Internet, or if our servers are temporarily down (usually for a time on Tuesdays for maintenance), the net-down symbol (Figure 2) will appear at the bottom of the main Leopard window.



Figure 2: The net-down symbol means Leopard cannot access the SSC servers.

Check the Release Notes if you are using a Windows PC and never see the net-up symbol. This has been noted in two instances and the fix is described in the Release Notes. If you see the net-down symbol and believe that Leopard should be connected to the servers, please send email to the Spitzer Science Center Helpdesk at help@spitzer.caltech.edu. We do not provide 24-hour support for the SSC servers. We have computer support available weekdays during business hours, so if our servers go down late Friday evening, they may not come back up until Monday morning.

6.2 On-line Help and Tool Tips

In addition to the Release Notes and this User's Guide, on-line help for Leopard is available from the Help menu in the main Leopard window. There are also help buttons throughout the program that connect directly to applicable help files.

On-line help is also available in the form of 'tool tips,' one-sentence messages that appear whenever the cursor is placed over a field or button for longer than 3 seconds (Figure 3). Tool tips are used to define acronyms, expand abbreviations, and provide data entry instructions.

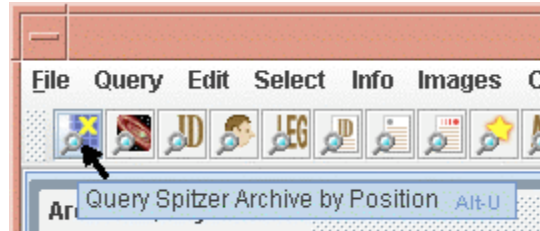


Figure 3: A "tool tip" is displayed by placing the cursor over the "X Marks the Spot" icon. This icon brings up the dialog to query the archive by position.

6.3 Troubleshooting

The current list of known bugs and issues is updated regularly and kept on the Proposal Kit web page from which you downloaded this software. If you think you have found a bug, before reporting it, please check the bugs list and the troubleshooting section of the Release Notes to discover if it is a 'feature' we already know about. Also check the appropriate section of this Guide to understand what the software is doing.

If you find a real bug, then please do let us know about it.

1. Email a description of the problem to the Spitzer Science Center Helpdesk at help@spitzer.caltech.edu.
2. Include the hardware configuration you are using (e.g., SunBlade 100, 512 MB).
3. Please attach the Leopard log file. Each time you run Leopard it creates a file called 'leopard_DATE_TIME.log'. The log files can be found in the default directory created when you install the software. The default directories are (yes, in the spot directory. There is no separate leopard directory for these files.):

Solaris/Linux/Mac	/home/<username>/spot
Windows ME	c:\spot
Windows NT/2000/XP	c:\Documents and Settings\{username}\Application Data\Spot
Windows Vista	c:\Users\[username]\AppData\Roaming\spot

The text showing in any error windows that pop up in Leopard should show up in the log file as well.

7 Leopard Menus

Leopard has nine menus that provide the tools needed to access the Spitzer Archive. section 7.11 gives a single page summary of all the Leopard menu items. The menus provide the following functions.

7.1 File Menu

The main querying windows are accessed from this menu.

7.1.1 Download Selections [ctrl-D]

This menu item becomes active if you have selected data to download from the Archive. Use it to begin the download process. You now can opt to unpack and delete the archive zip file: Click on “Unzip and Delete after downloading” in this dialog window.

7.1.2 Save AOR List

Once you have performed an archive query, you can save to local disk the Archive Query Results shown in the main Leopard window. The dialog that opens when you select this utility is shown in Figure 4.

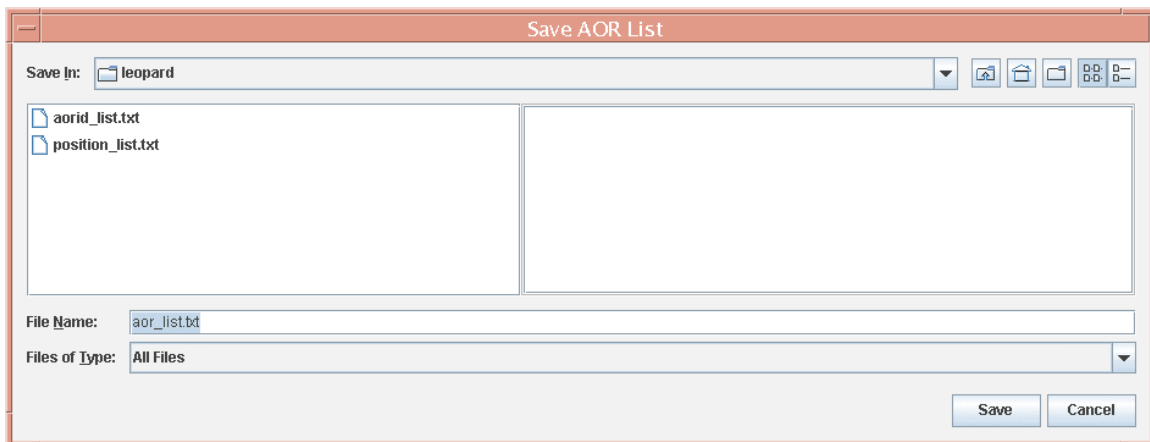


Figure 4: The dialog for saving to local disk a text file containing the Archive Query Results listed in the main Leopard window.

The actual format of the output contained in the file will look like the example shown below.

```
# List of AORs from Spitzer Archive
# Generated by Leopard on: 10/20/2005 15:51:30
```

PID	ReqKey	AOT Type	Status	Release Date	Coordinates	Target Name
159	5504000	IRAC Mapping	nominal	Jun-24-2004	13h29m56.71s,+47d13m12.6s	NGC5194_95
159	5504256	IRAC Mapping	nominal	Jun-24-2004	13h29m56.71s,+47d13m12.6s	NGC5194_95
159	5572608	MIPS Scan Map	nominal	Aug-06-2004	13:29:52.7,+47:12:13	NGC5194_95
159	5572864	MIPS Scan Map	nominal	Aug-06-2004	13:29:52.7,+47:12:13	NGC5194_95
159	5594624	MIPS SED	nominal	Jun-14-2005	13:29:52.7,+47:11:43	NGC5194
159	5594880	MIPS SED	available		202.49833333333333d,47.26	NGC5195
159	9480192	IRS Mapping	nominal	Jul-02-2004	13h29m52.7s,+47d11m43s	NGC5194
159	9487360	IRS Mapping	nominal		13h29m59.6s,+47d15m59s	NGC5195
159	9492992	IRS Mapping	nominal	Jul-02-2004	13h29m59.6s,+47d15m59s	NGC5195
159	9512704	IRS Mapping	nominal	Jul-02-2004	13h29m52.7s,+47d11m43s	NGC5194

7.1.3 Save Current Plotted Image as FITS file

If you are currently displaying an image in Leopard selected from the Images menu, this will save the image as a FITS file. It does not save any overlays, just the image.

7.1.4 Save Current Plotted Image & Overlays to JPEG, GIF, BMP, or PNG

If you are currently displaying an image in Leopard selected from the Images menu, this will save the image, along with any overlays, as a GIF, JPEG, BMP (bitmap), or PNG format file.

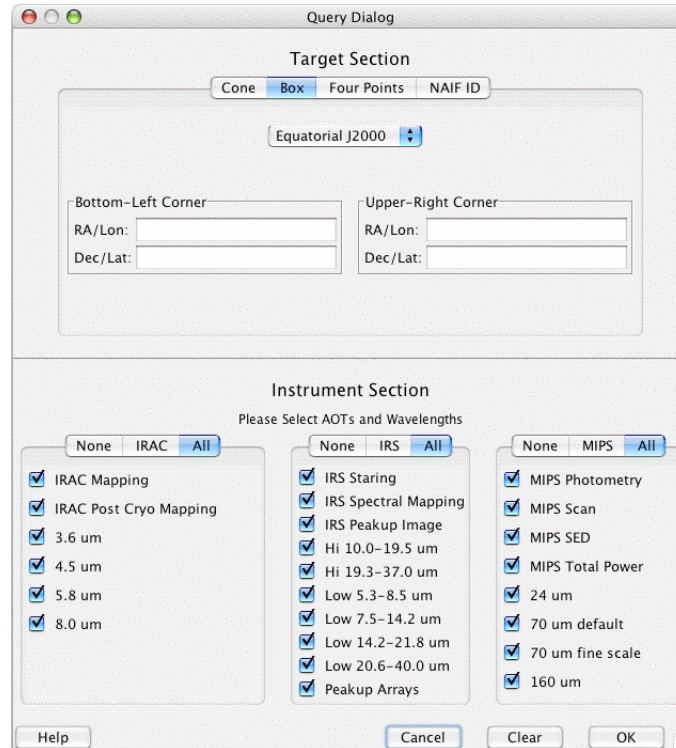


Figure 5: The Query Archive dialog, showing the inputs for a box search, where you specify the sky positions of the bottom left and upper right corners of the box.

7.1.5 Login to Spitzer Archive [ctrl-L]

Use this function to log into the Spitzer Archive to retrieve proprietary data. You must be the PI or Technical Contact of an approved Spitzer program to log into the archive. Users requesting Spitzer data in the public domain do not need to log into the Spitzer Archive. When logged in, your account information is shown in the bottom left corner of the Leopard main window.

7.1.6 Logout from Spitzer Archive [ctrl-O]

Use this function to log out from the Spitzer Archive. Leopard will ask if you are sure you want to log out. Select OK to complete the log out process.

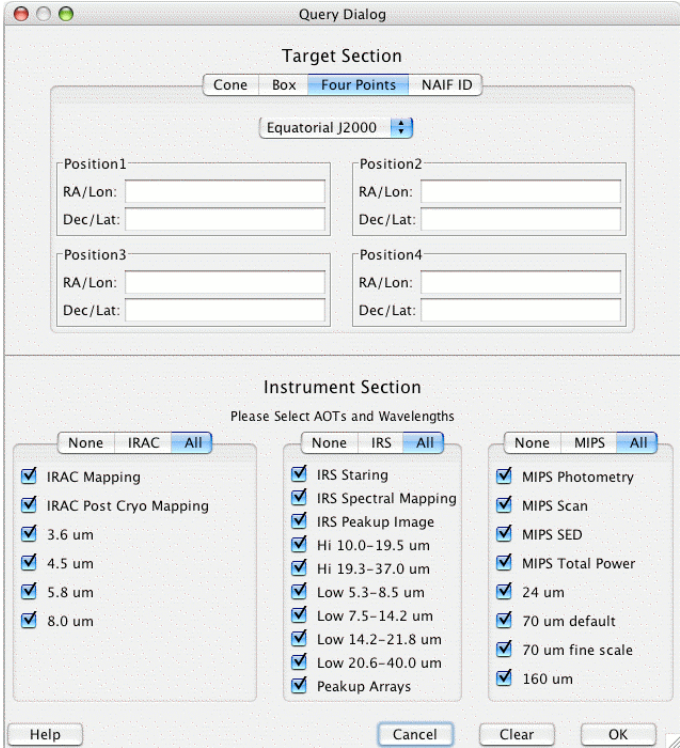


Figure 6: The Query Archive dialog, showing the inputs for a four points search, where you specify the positions of the four points of a region on the sky.

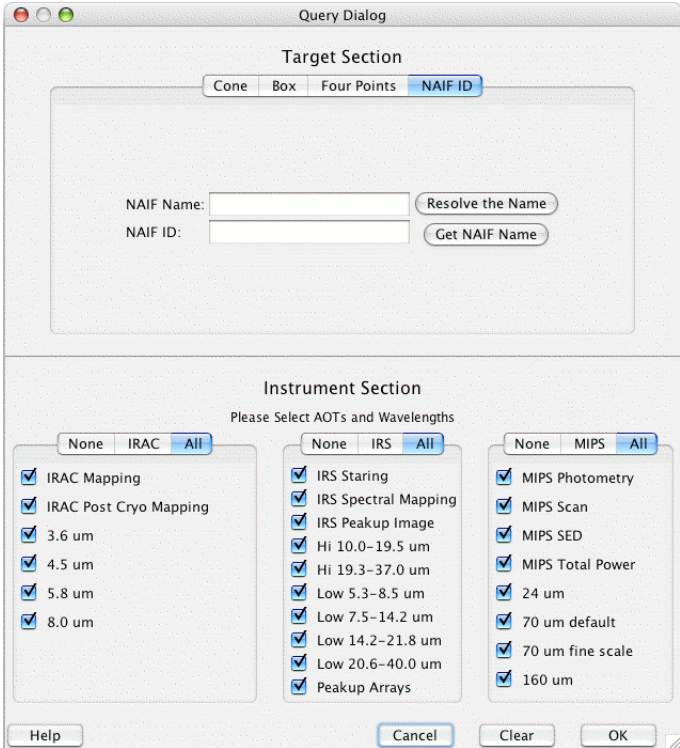


Figure 7: The Query Archive dialog, showing the inputs for a search for a moving target, where you specify the NAIF name or ID of the target.

7.1.7 Change Password to Spitzer Archive [ctrl-W]

This function allows you to change your Spitzer Archive password. You must be logged into the Spitzer Archive for this function to be active. Enter your old password, new password, and confirm the new password.

7.1.8 Quit [ctrl-Q]

Select this option to exit the Leopard program.

7.2 Query Menu

7.2.1 By Position [ctrl-U]

This function opens a window to allow entry of Archive query parameters. You can now perform not only a cone search with a user-specified radius (default, 5') around a target position (see Figure 52), but also search with a box where you have specified the sky positions of the box's bottom left and upper right corners (Figure 5), a search within four sky position points (Figure 6), and a search by NAIF ID (Figure 7). For a cone search, it is recommended that you not simply use a target name for an Archive query, but resolve the name, via NED or SIMBAD, to obtain the actual target position, or enter the position by hand. This is because approved Spitzer observing programs are NOT required to use standard or well-known target names in their AORs.

7.2.2 By Program

If you know the Program ID number of a specific observing program, you can query the archive for data from that program using this query archive dialog (see Figure 54).

7.2.3 By AOR ID [ctrl-R]

If you know the unique AOR ID (aka AOR Key or Request Key) of a Spitzer observation, you can use this dialog window to quickly enter the number and retrieve information from the Archive about that AOR.

7.2.4 By Campaign/Observer

You can search for all the data from a given instrument campaign (Figure 9). Leopard will return with a dialog window with a list of programs observed during that campaign. To choose a program or programs from the list, click "Selected" next to the Program ID number and then click "OK."

Either for all campaigns or for a given campaign, you can also search for all the data obtained by a given observer (Figure 9). Observers' names are listed in alphabetical order. Simply click on an observer's name in the pulldown list. Leopard will return with a dialog window with a list of programs corresponding to that observer. To choose a program or programs from the list, click "Selected" next to the Program ID number and then click "OK." Note: Currently all names beginning with "de," "van," and "von" are toward the end of the list.

7.2.5 FLS and Legacy Programs [ctrl-P]

This function opens a dialog to allow you to select the AOR IDs and non-proprietary data products from the First Look Survey and all 26 Legacy Science Programs.

7.2.6 AOR ID List Query [ctrl-S]

The user can query the Spitzer Archive by reading in a file containing a list of unique AOR IDs (AOR Keys or Request Keys). The AORs will be grouped into a list of programs that contain those AORs. The user can select the desired AORs from the program(s) in the main Leopard window. The format of the input ascii file is simple. Request keys are listed one per line; lines which start with “#” are treated as comments.



Figure 8: The Campaign/Observer Query Archive dialog, showing the input for a search by a given observing campaign.

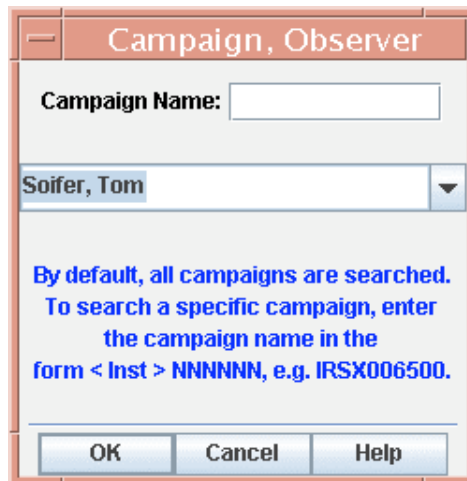


Figure 9: The Campaign/Observer Query Archive dialog, showing the input for a search by specific observer.

An example:

```
# this is the list of user-specified AOR IDs (request keys)
```


1234567
2345678

7.2.7 Fixed Target List Query

Leopard can read in a list of fixed (inertial) targets and then query the Spitzer Archive for each target entry in the list. A sample file is shown below and the required format of the file is described. Leopard will name resolve from the target list: The keyword "NAME-RESOLVER," can be input at the top of the list, with values either "ned" or "simbad." If the target list with this keyword included contains a line consisting only of a target name, the name resolver is contacted via the Internet to retrieve the positional information. Additionally, an optional search radius, in arcminutes, can be input with keyword "RADIUS." The default search radius is 1'. As a new feature, the last column of the list query can be used optionally to specify an individual instrument (i.e., IRAC, MIPS, IRS) or an individual AOT or mode (e.g., MIPS-SED, IRS Spectral Mapping SL2).

An example target list looks like the following:

```
COORD_SYSTEM: Equatorial      # Equatorial (default), Galactic, or Ecliptic
EQUINOX: J2000                # B1950, J2000 (default), or blank for Galactic
NAME-RESOLVER: NED           # NED or Simbad (default)
RADIUS: 3                     # RADIUS is in unit arcmin
#
# The possible Instrument/AOT types (INS_AOT) and syntax are:
# MIPS, MipsPhot, MipsScan, MipsSed, MipsTp,
# MIPS24, MIPS70, MIPS160
# MipsPhot24, MipsPhot70, MipsPhot70Fine, MipsPhot160
#
# IRAC_ALL, Irac, IracPC (NOTE: The IracPC mode is currently unavailable!)
# IRAC_ALL1, IRAC_ALL2, IRAC_ALL3, IRAC_ALL4
# Irac1, Irac2, Irac3, Irac4
# IracPC1, IracPC2
#
# IRS, IrsMap, IrsStare, IrsPeakupImage
# IRS_SL, IRS_SL1, IRS_SL2, IRS_LL, IRS_LL1, IRS_LL2,
# IRS_SH, IRS_LH, IRS_PU
# IrsStare_SL, IrsStare_SL1, IrsStare_SL2, IrsStare_LL, IrsStare_LL1, IrsStare_LL2,
# IrsStare_SH, IrsStare_LH, IrsStare_PU
# IrsMap_SL, IrsMap_SL1, IrsMap_SL2, IrsMap_LL, IrsMap_LL1, IrsMap_LL2,
# IrsMap_SH, IrsMap_LH, IrsMap_PU
#
#Name  RA/LON   DEC/LAT  PM-RA PM-DEC EPOCH  INS_AOT
"NGC 001" 12h34m23.45s 34d23m56.2s 2.3  3.4 1950.3  MIPS
"NGC 001" 12h34m23.45s 34d23m56.2s 2.3  3.4 1950.3  MIPSSD
NGC2222 23.56d  34.456d  2.3  3.4 1950.3  IRAC
NGC3333 23.56h  34.456d  2.3  3.4 1950.3  IRS
NGC3333 23.56h  34.456d  2.3  3.4 1950.3  IRSMAP
NGC3333 23.56h  34.456d  2.3  3.4 1950.3  IRSSTARE
```

```

NGC4444 "12 34 12.23" "34 23 45.45"
m31
legacy "17 18 00" "59 30 00"
m32
m33    simbad

```

- The first two keywords give the coordinate system and equinox for all the positions in this list; these keywords are optional.
- The list columns are separated by *spaces*. If there are spaces in the values for a column, double quotes are needed surrounding the value. This is particularly true for name resolving.
- Any lines starting with the pound sign (#) will be treated as comments.
- Proper motion for RA and DEC, in arcseconds, are not required, may only be entered for Equatorial coordinates, and must always be supplied in RA and Dec pairs.
- If the value for the fourth column is larger than 1900.0, it is interpreted as the epoch. If it is smaller than 1900.0 it is assumed to be a proper motion, as discussed above. The epoch field need only be entered for equinox B1950 coordinates.
- You need to make separate lists/files for Equatorial J2000, Equatorial B1950, Galactic, Ecliptic J2000, and Ecliptic B1950 coordinates, because the first two keywords define the coordinate system for the entire file. These can then be read into Leopard one file at a time.
- If only a name is listed in the first field, and a name resolver is specified (in the example above, “ned”), the resolver will be contacted for positional information. NED has a more forgiving name resolver, so a name string without spaces, e.g., “NGC4321,” can be resolved. However, with SIMBAD, if a target name has a space, don’t remove that space; instead, place the whole name string within double quotes for the resolver to work.

You can create targets in the format required by Leopard with a text editor and then read in these files.

7.2.8 Moving Target List Query

Leopard can read in lists of single moving targets. The format for the input file must follow these rules:

- Comments must start with # or !.
- Each line should have at most 2 elements. The first element is the NAIF Name and the second is the NAIF ID if both elements are present.
- If only one element is provided, it is assumed to be the NAIF ID if it is all numbers (put it in double quotes, if it is a name). If the one element has characters other than numbers, it is assumed to be the name.
- If there are spaces in the name, put the entire name inside double quotes.
- The NAIF ID should NOT be in quotes.

If only one element is on the input line, Leopard will attempt to resolve the missing Name or ID. Spot will issue a warning message if a given name does not resolve a NAIF ID (and no entry for the object will appear in the target list). If both Name and ID are provided, both will be used as they appear on the input line.

An example moving single target list looks like the following:

```

“my targ name” 12345678
Mars_barycenter 4
Dione 2000106
604
2000159
Jupiter

```

7.2.9 Popular Products Query

This function opens a window to allow you to select general Popular Products in the archive, including original Legacy Science Program data by campaign and enhanced data products, First Look Survey (FLS) data products, and certain GTO program data products.

7.2.10 Query Legacy Ancillary Data Archive [ctrl-A]

This function opens a window to allow you to select original Legacy Science Program Ancillary Data from the Archive. 2MASS Lockman Hole, FLS, and SWIRE ancillary data are currently available for download. Clicking on the Region Overview buttons on the right side of the window brings up another window that shows the regions covered in the surveys.

7.3 *Edit Menu*

7.3.1 Delete selected AORs [ctrl-X, delete]

This function will be active if AORs are selected in the Archive Query Results window.

7.3.2 Delete Checked Popular/Ancillary Data

This function will delete all Popular Product or original Legacy Science Program Ancillary Data that are selected in the Archive Query Results window.

7.3.3 Delete All AORs

This will clear ALL of the AORs in the Archive Query Results window. **This action is NOT reversible.**

7.3.4 Delete All Targets

This will clear ALL of the targets in the Target List. **This action is NOT reversible.**

7.3.5 Update All AORs

This will update the information (e.g., release date) for all the AORs currently listed in the Archive Query Results window. (This is a handy utility if you tend to leave Leopard open continuously over long time periods.)

7.3.6 Hide AORs with no Archive Data

If selected, only those AORs with Archive data will be displayed in the Archive Query Results window.

7.3.7 Filter Archive AOR Results

The AORs displayed in the Archive Query Results window can be filtered by date (Figure 10). The default setting is for no filtering. Filtering can be either by release date (the date on which the data from the AORs become public) or by schedule date (the date on which the AORs were executed). You can also select AORs from a single campaign by entering the start and end dates for that campaign. The format for entering the dates is “year month day,” e.g., 2005 Jan 15.

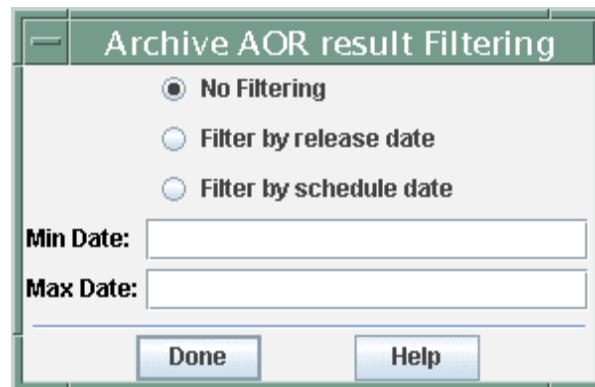


Figure 10: The dialog for setting the filtering by date of the list of AORs shown in the Archive Query Results window.

7.3.8 Mark all AORs as not Queued or Downloaded

Leopard remembers which AORs have been downloaded in one session. If you want to download the same data products again this function will start the download over again.

7.3.9 Undo [ctrl-Z]

This function undoes the last action performed by Leopard.

7.4 Select Menu

This function allows you to select or unselect all or parts of AORs for each of the three instruments – IRAC, IRS, and MIPS.

7.4.1 Enable All Selected [ctrl-E]

Select all the wavelengths for all the AORs that are highlighted in the main Leopard window.

7.4.2 Disable All Selected

Unselect all the wavelengths for all the AORs that are highlighted in the main Leopard window.

7.4.3 Enabled IRAC

Select all or some of the wavelengths for all the IRAC AORs that are highlighted in the main Leopard window.

7.4.4 Disabled IRAC

Unselect all or some of the wavelengths for all the IRAC AORs that are highlighted in the main Leopard window.

7.4.5 Enabled MIPS

Select all or some of the wavelengths for all the MIPS AORs that are highlighted in the main Leopard window.

7.4.6 Disabled MIPS

Unselect all or some of the wavelengths for all the MIPS AORs that are highlighted in the main Leopard window.

7.4.7 Select All IRS

Select all available modules for all the IRS AORs that are highlighted in the main Leopard window.

7.4.8 Unselect All IRS

Unselect all available modules for all the IRS AORs that are highlighted in the main Leopard window.

As the user selects/deselects AORs, the check boxes in the Retrieve Wavelengths field in the main Leopard window will reflect this.

7.5 *Info Menu*

7.5.1 Detail Information [ctrl-I]

This function opens a window displaying the detailed observing parameters, data products size, programmatic information, and data quality comments for the selected AOR.

7.5.2 Target List

This function brings up a window containing the target information for AORs in the Archive Query Results window.

7.5.3 Spitzer Archive History

This provides a chronological list of milestones for the Spitzer Archive that may be of interest to the user.

7.5.4 Memory Monitor

This dialog shows how much memory (bytes) JAVA has allocated (total memory) and how much of that allocation is currently available (free memory). We are using this

mainly as a debugging tool to determine when JAVA is having trouble with the memory allocation, mainly on Sun Workstations.

7.6 Images Menu

Images from a variety of different wavelengths of your target region can be downloaded and displayed within Leopard. Catalog, coordinate grid, Spitzer focal plane, target position, and AOR area coverage overlays are available from the Overlays Menu. The visualization functionality is discussed in section 9. Leopard reads and writes FITS format files. The images available are:

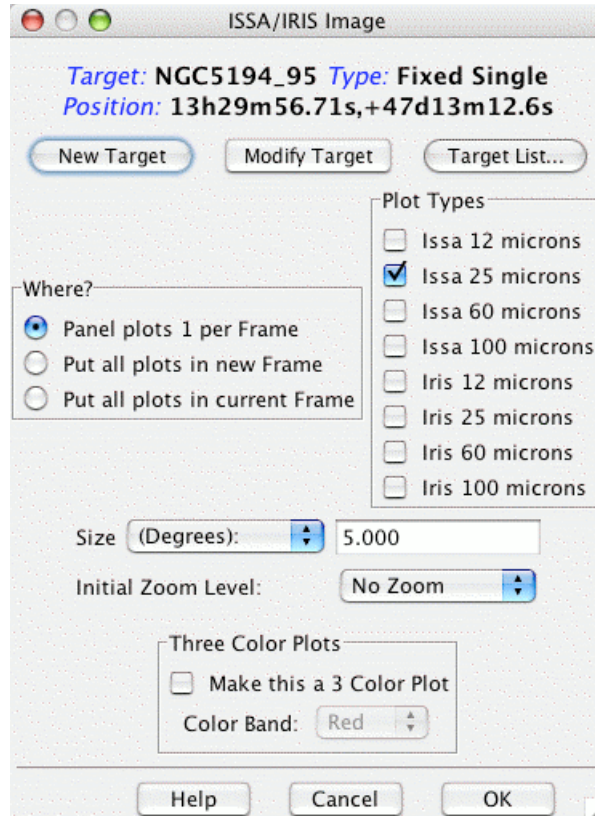


Figure 11: The ISSA/IRIS dialog that allows selection of IRAS images for display in Leopard. You may select 12, 25, 60, and/or 100 μm images. Three choices for how the images are displayed are available from the “Where?” box. You enter the size (1° -- 12.5° on a side) and the initial zoom level. You can also create three-color (RGB) image composites.

7.6.1 ISSA/IRIS – IRAS Sky Survey Atlas

The ISSA images are IRAS Sky Survey Atlas maps at 12, 25, 60, and 100 μm that will help you characterize the sky at mid-infrared wavelengths. Note however, that these images have had zodiacal light contributions removed. A newer generation of IRAS images, called IRIS, benefits from better zodiacal light subtraction, calibration, better destriping, and zero levels compatible with DIRBE. As a new feature of Spot, these images are also now available. For more details about IRIS, see <http://www.cita.utoronto.ca/~mamd/IRIS/>. Input the desired image size (in arcseconds,

arcminutes, or degrees), and select the desired initial zoom level (no zoom, “2X,” “3X,” etc.). These images are served directly from IRSA, the InfraRed Science Archive (<http://irsa.ipac.caltech.edu/>).

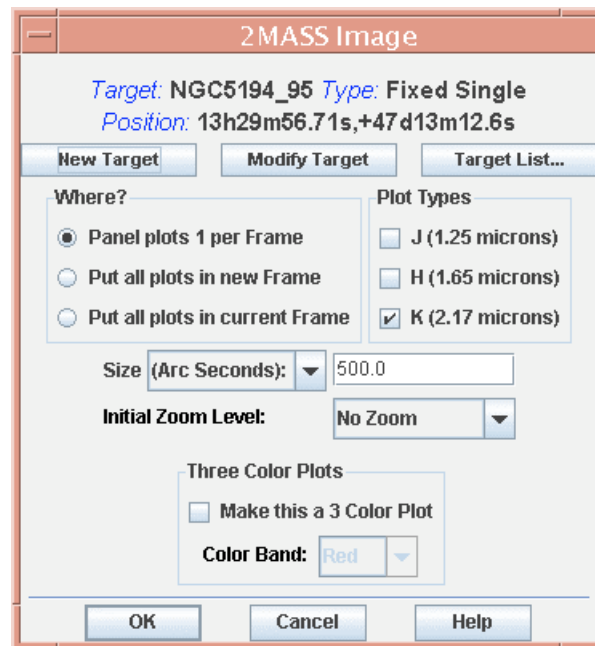


Figure 12: The dialog that allows selection of 2MASS J, H, or K_s-band images for display in Leopard. You enter the size (50"–500", 0.83'–8.33', or 0.014°–0.139° on a side) and the initial zoom level. You can also create three-color (RGB) image composites.

The dialog for ISSA/IRIS image selection is shown in Figure 11. The target buttons allow you to select or change the desired target region. Three choices for how the images are displayed are given in the “Where?” box. The default is to put each image into its own frame. All the plots may alternatively be put into the same frame, stacked on top of each other. This saves space on a small screen. You can also create three-color composite images in Leopard (see section 9.1.5).

The displayed ISSA/IRIS image may not be the full size requested. The images are stored and returned as ‘plates’ with a limited overlap. The ISSA/IRIS server picks the best plate by maximizing the distance from the target to the nearest edge of the plate. This edge may still be close enough to the target that the displayed image will appear to have one side “shaved off”, or the target may not be centered in the image but off to one side.

If you already have existing images displayed, you may also select to have the new ones stacked into that frame. If you utilize this feature, you must remember that the plate scales for the images from the different servers are very different. For instance, ISSA/IRIS images are 1°–12.5° on a side, while 2MASS images are 50"–500" on a side.

7.6.2 2MASS – Two Micron All Sky Survey

The 2MASS images are also served from IRSA. You can select J, H, and/or K_s band. At this time, large area mosaics of the images are not available; only single Atlas Images will be retrieved in the region specified. Even though these are full-fidelity images, they should not be used directly for photometry. Use the 2MASS catalogs for detailed source information. The image selection dialog is shown in Figure 12. Choices in target, image size, image location, zoom, and three-color composites, analogous to those for the ISSA images, are available.

7.6.3 MSX – Midcourse Space Experiment

The MSX A, C, D, and E mid-infrared images are provided here. The image selection dialog is shown in Figure 13. For more information on the MSX mission, see <http://www.ipac.caltech.edu/ipac/msx/msx.html>. Choices in target, image size, image location, and zoom, analogous to those for the ISSA images, are available.

At this time, all MSX FITS headers define Galactic North to be “up.” As such, MSX images may appear to be rotated with respect to other images that define Equatorial North to be “up.” Leopard does not rotate images, but AOR overlays will appear the way they will be observed, regardless of coordinate system.

7.6.4 DSS – Digitized Sky Survey

The optical Palomar Sky Survey images are provided here. They are served from the Space Telescope Science Institute (http://archive.stsci.edu/cgi-bin/dss_form). The image selection dialog is shown in Figure 14. Choices in target, image size, image location, zoom, and three-color composites, analogous to those for the ISSA images, are available. If you require an image larger than 30' on a side, please get it directly from the DSS web page and then load it as a local FITS file (section 7.6.9).

7.6.5 SkyView – SkyView image data

The multiwavelength SkyView ground- and space-based image data are provided here. They are served from NASA's High Energy Astrophysics Science Archive Research Center (HEASARC; <http://heasarc.gsfc.nasa.gov>). The image selection dialog is shown in Figure 15. Choices in target, image size, image location, zoom, and three-color composites, analogous to those for the ISSA images, are available. Variable image size limits apply. For some image data, if you require an image larger than Leopard's maximum limit for those data, please get the image directly from the HEASARC web site and then load it as a local FITS file (section 7.6.9).

7.6.6 NED – NASA/IPAC Extragalactic Database

Leopard will display a list of images that are available for the target from NED (<http://nedwww.ipac.caltech.edu>). The search uses the target name, not the target coordinates to locate an image in the database. An example is shown in Figure 16. If Leopard cannot find the image by target name, you will have to retrieve it directly from NED and load it as a FITS file (see section 7.6.9).

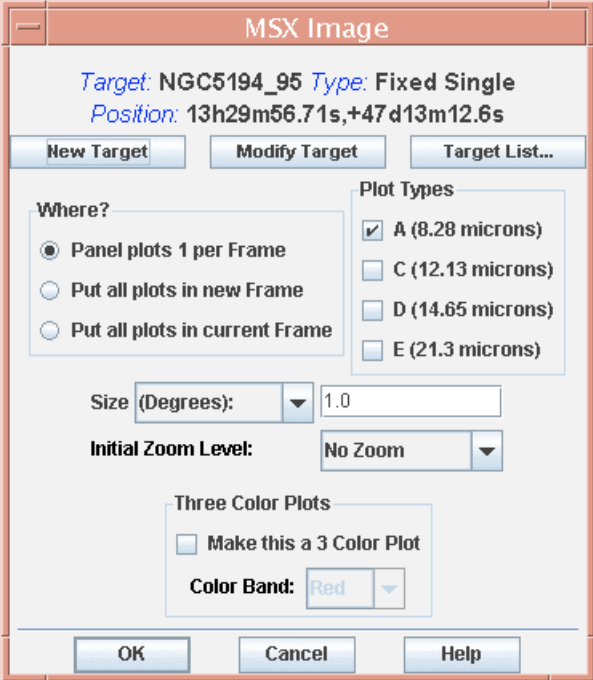


Figure 13: The dialog that allows selection of MSX A, C, D, and E-band images for display in Leopard. You enter the size (360"–5400", 6'–90', or 0.1°–1.5° on a side) and the initial zoom level. You can also create three-color (RGB) image composites.

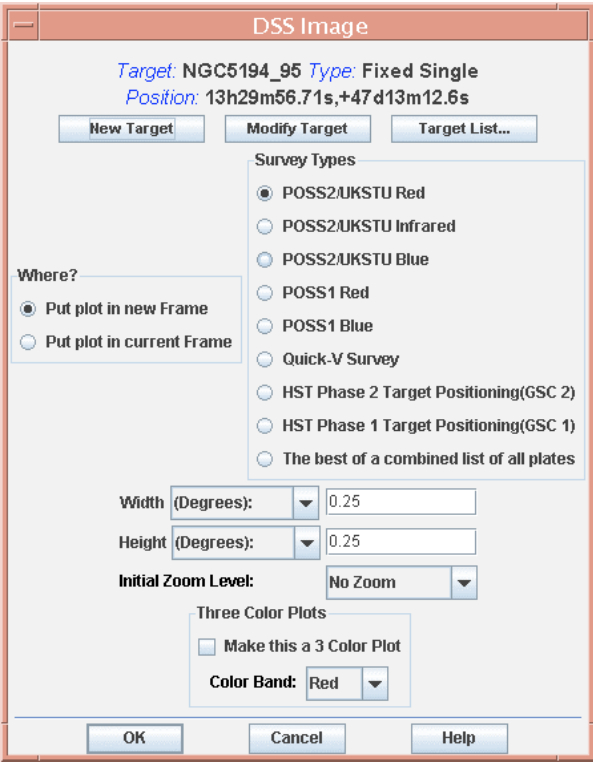


Figure 14: The Digital Sky Survey image selection dialog is shown. You enter the size (57.6"–1800", 0.96'–30', or 0.016°–0.5° on a side) and the initial zoom level. You can also create three-color (RGB) image composites.

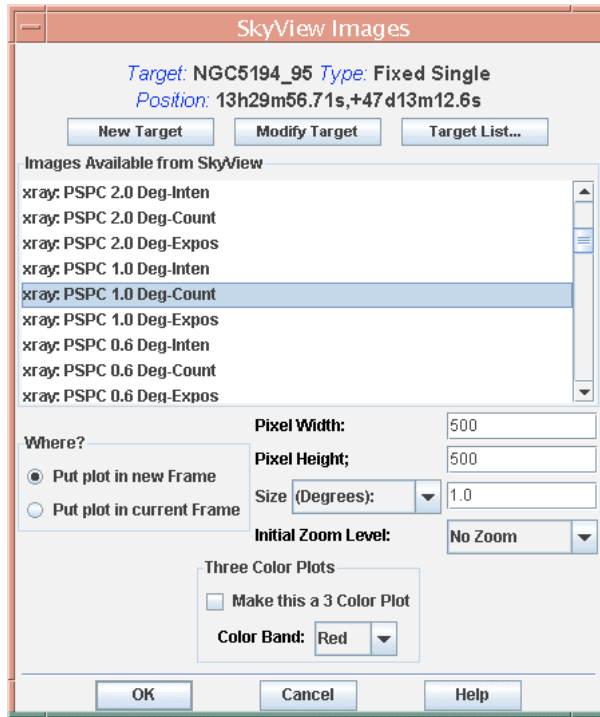


Figure 15: The SkyView image selection dialog is shown. You enter the size (in arcseconds, arcminutes, or degrees on a side) and the initial zoom level. You can also create three-color (RGB) image composites.

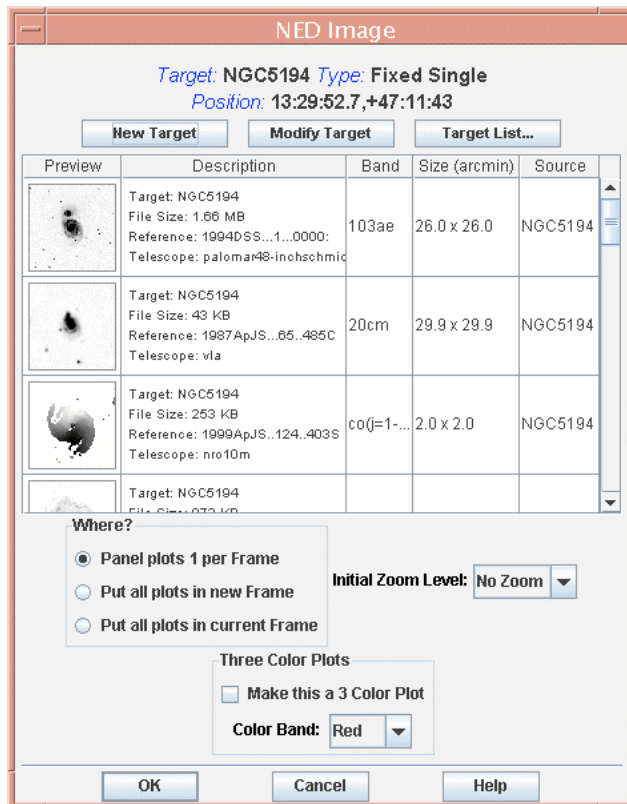


Figure 16: The listing of the images available from NED for the example target name (M31). You enter the initial zoom level. You can also create three-color (RGB) image composites.

7.6.7 ISO Archive

Leopard will display a list of images that are available for the target from the Infrared Space Observatory (ISO) Data Archive (<http://www.iso.vilspa.esa.es/ida/>). This service is still preliminary and will be improved in future releases. For the moment, only the ISOCAM CAM01 photometric images are served. An example is shown in Figure 17.

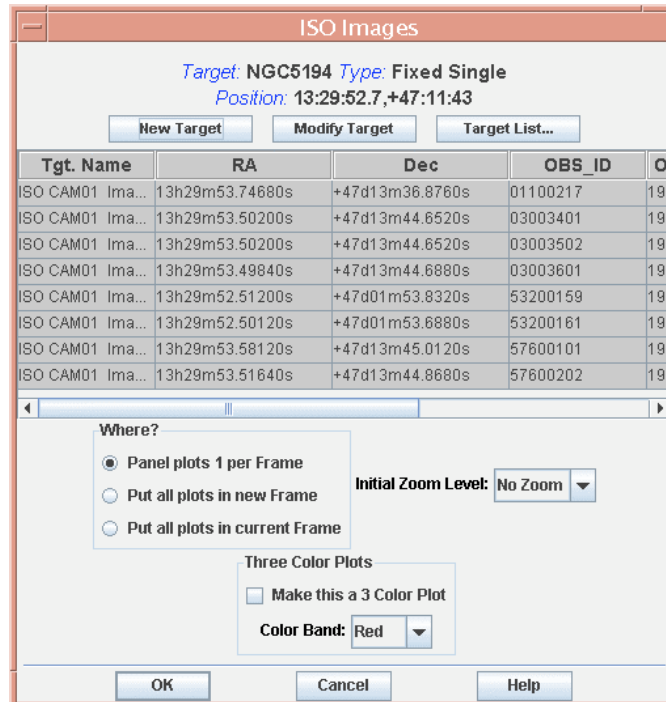


Figure 17: The listing of the images available from the ISO Archive for the example target name. You enter the initial zoom level. You can also create three-color (RGB) image composites.

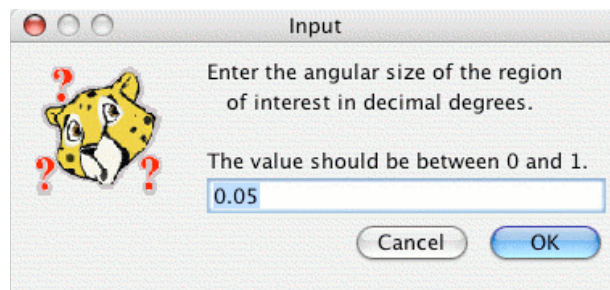


Figure 18: When searching for NVO images near your target position, first specify the size of the region of interest over which Spot can search.

7.6.8 NVO Image

Leopard will now retrieve images from repositories registered with the National Virtual Observatory (NVO). The images are queried and retrieved via Simple Image Access Protocol (SIAP), defined in <http://www.ivoa.net/Documents/WD/SIA/sia-20040524.html>. When you first select this option, a dialog, as shown in Figure 18, opens, in which you can enter the size of the region of interest around your target in decimal degrees. You can then narrow the NVO query by spectral coverage, as shown in Figure 19; the default is “Multi,” for multiwavelength coverage. You can further narrow the search to available

matching resources for the chosen spectral coverage, as shown in Figure 20. Then, click OK.

Each SIAP site is queried individually, one by one. The list of matching resources grows as sites are queried. The image search can take several minutes to complete. The search is performed in the background and does not prevent you from performing other operations.

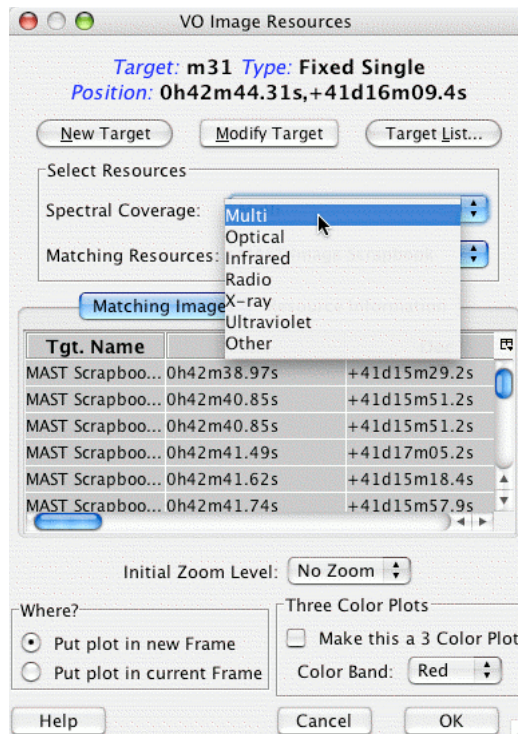


Figure 19: The available options for spectral coverage when searching for NVO images near your target position. You enter the initial zoom level. You can also create three-color (RGB) image composites.

7.6.9 FITS File

Leopard can also display any images that have been obtained from another image server or that you have taken yourself. Leopard also reads gzipped FITS files and FITS files with extensions. There must be world coordinate system keywords in the header for the positional information to be accurately read. Data from most modern telescopes should be handled well. Note that the available computer system memory limits the size of a FITS image that may be loaded into Leopard. Loading large FITS images may compromise the memory left available for other Leopard functions. The images selection dialog is shown in Figure 21.

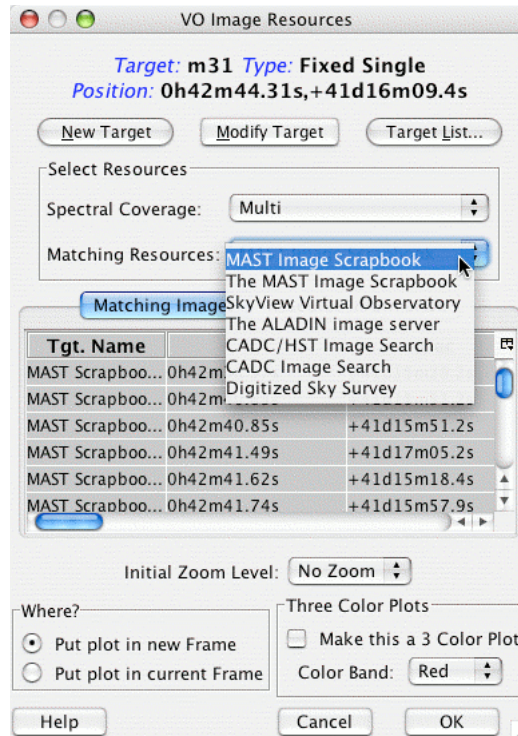


Figure 20: The available list of NVO image resources for the given spectral coverage that you have selected, as shown in Figure 19. You can enter the initial zoom level. You can also create three-color (RGB) image composites. Click “OK” to complete the image search.

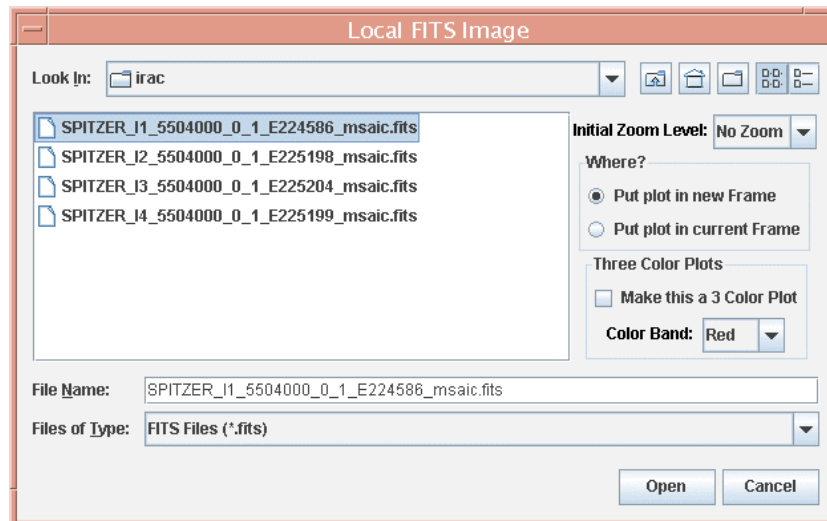


Figure 21: The image selection dialog for reading in a local FITS file. This utility will also read in gzipped FITS files and FITS files with extensions. You can enter the initial zoom level. You can also create three-color (RGB) image composites.

7.6.10 FITS file from URL

Leopard can also now display FITS images available from any web-based image server for which an address can be specified by a Universal Record Locator (URL). Spot also reads gzipped FITS files and FITS files with extensions. There must be world coordinate system keywords in the header for the positional information to be accurately read. Data

from most modern telescopes should be handled well. Note that the available computer system memory limits the size of a FITS image that may be loaded into Spot. Loading large FITS images may compromise the memory left available for other Spot functions. The images selection dialog is shown in Figure 22.

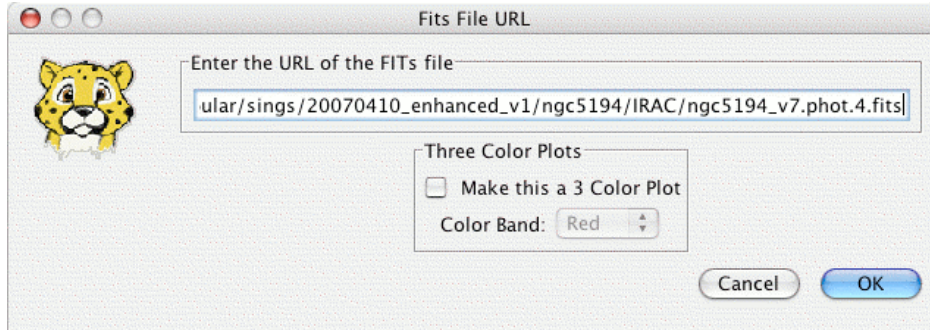


Figure 22: The image selection dialog specifying the URL of a FITS file. This utility will also read in gzipped FITS files and FITS files with extensions. You can create three-color (RGB) image composites.

7.6.11 All Sky Images

Select from DIRBE 4.9, 60, and 140 μm and ISSA All Sky Images. These are particularly useful for visualizing moving targets with high apparent rates. The selection dialog is shown in Figure 23. Note that the ISSA All Sky Image is a low-resolution IRAS composite which has been smoothed to $0.5^\circ \times 0.5^\circ$ resolution. Unlike the individual ISSA plates, it contains the zodiacal background component, but it should not be used for background estimates if small-scale structure is important. The DIRBE images do provide reliable background estimates for the Galactic and extragalactic background components, and are accurate for the zodiacal light background expected if you observe your target at 90° solar elongation. However, if you observe your target near the inner edge of the OPZ at 80° solar elongation, the real zodiacal light values could be higher by approximately 20%. If the object is observed at the outer edge of the OPZ at 120° solar elongation, the real zodiacal light values could be fainter by 50%, when compared with the value read from the map. If accurate background estimates are crucial for your observation, we **STRONGLY** recommend that you use the values obtained from “Background” button in the Target window.



Figure 23: The selection dialog for All Sky Images.

7.6.12 Blank Image

Leopard can also now provide a blank “background” image on which to display overlays (see section 7.7). The width and height, in pixels, of the blank image can be specified. The pixel scale can be set as either the native Depth of Coverage overlay pixel scale, the 2MASS image pixel scale, the ISSA plate scale, or any other pixel scale you specify. The images selection dialog is shown in Figure 24.

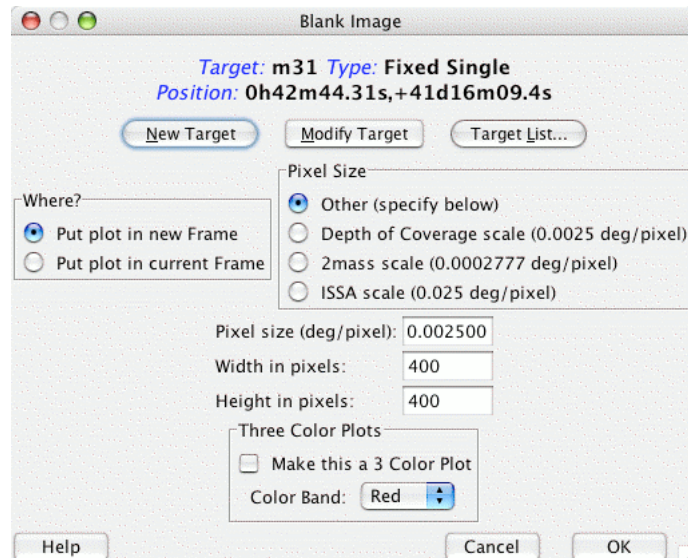


Figure 24: The selection dialog for specifying a blank image. You can select the size of the image in pixels, as well as the pixel scale. You can create three-color (RGB) image composites.

7.7 Overlays Menu

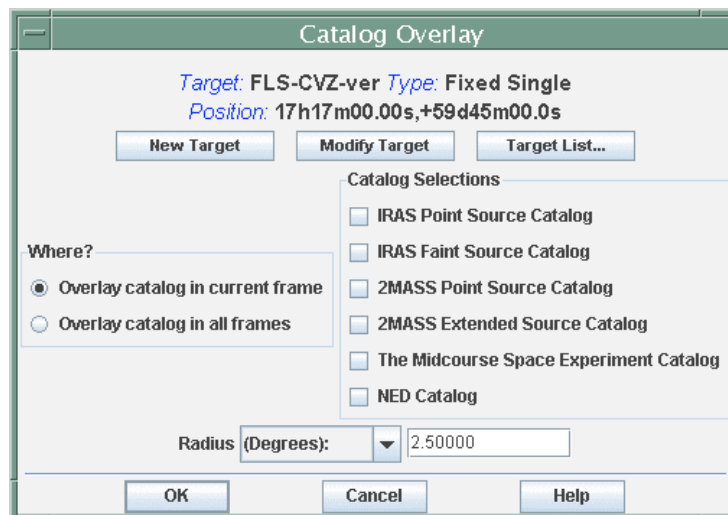


Figure 25: Leopard currently serves six IPAC catalogs that can be overlaid onto the image display.

7.7.1 Catalogs from IPAC

Leopard currently serves six catalogs from IPAC servers whose sources can be overlaid onto the image display. From the dialog (Figure 25) you select the catalog and appropriate search radius for sources. These catalogs are served from IRSA, like the

ISSA and 2MASS images. The text catalogs are cached, like the images, to your designated cache directory.

7.7.2 Catalogs from HEASARC

Leopard currently serves a large number and range of catalogs from HEASARC whose sources can be overlaid onto the image display. From the dialog (Figure 26) you select the catalog and appropriate search radius for sources. The text catalogs are cached, like the images, to your designated cache directory (see section 7.8.6).

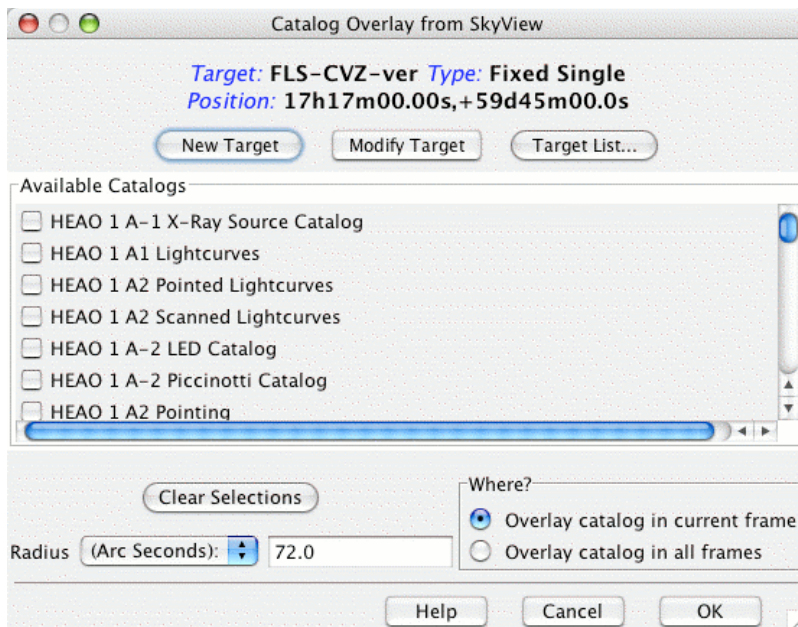


Figure 26: Leopard currently serves catalogs from HEASARC that can be overlaid onto the image display.

7.7.3 Catalogs from VizieR (beta)

As a new feature, Leopard now serves a large number and range of catalogs from VizieR whose sources can be overlaid onto the image display. From the dialog (Figure 27) you select the catalog and appropriate search radius for sources. The text catalogs are cached, like the images, to your designated cache directory (see section 7.8.6). This catalog access is in a beta version; you should limit the size of your search radius (less than 100", unless the data content is small) and only works with target names that are Simbad resolvable.

7.7.4 Catalog File

Leopard can also overlay a catalog file from a local disk if it is in the modified IPAC table format. A description of the *modified IPAC table format* is provided below. From the dialog (Figure 28) you select the catalog file. The file should have the 'tbl' extension so that Leopard knows it is an IPAC table. The format is comprised of three parts: keywords, column headers, and data in columns.

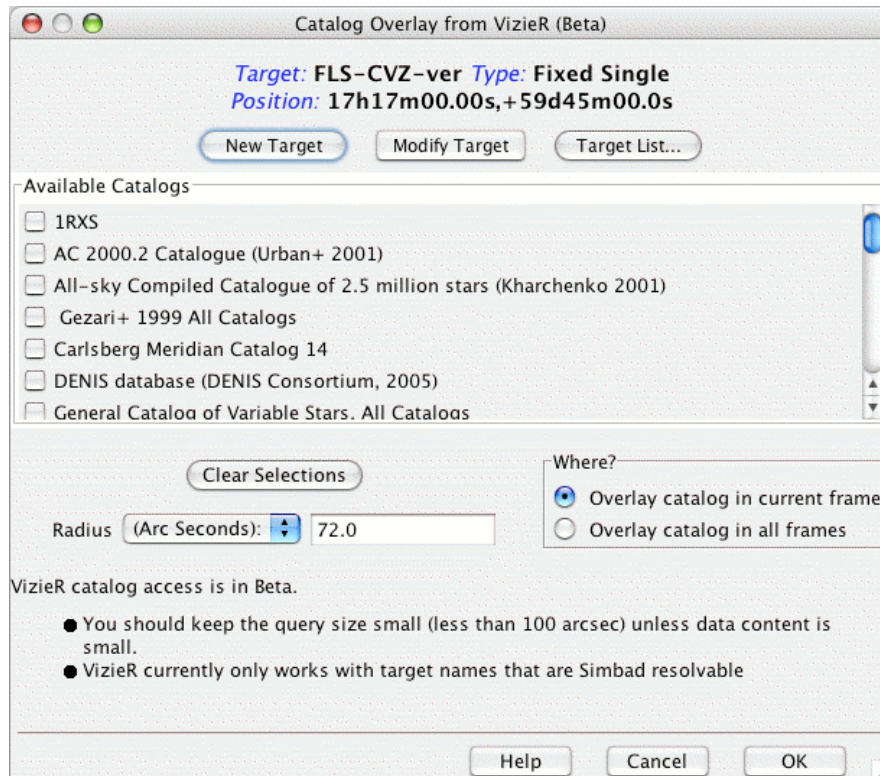


Figure 27: Leopard currently serves catalogs from VizieR that can be overlaid onto the image display.

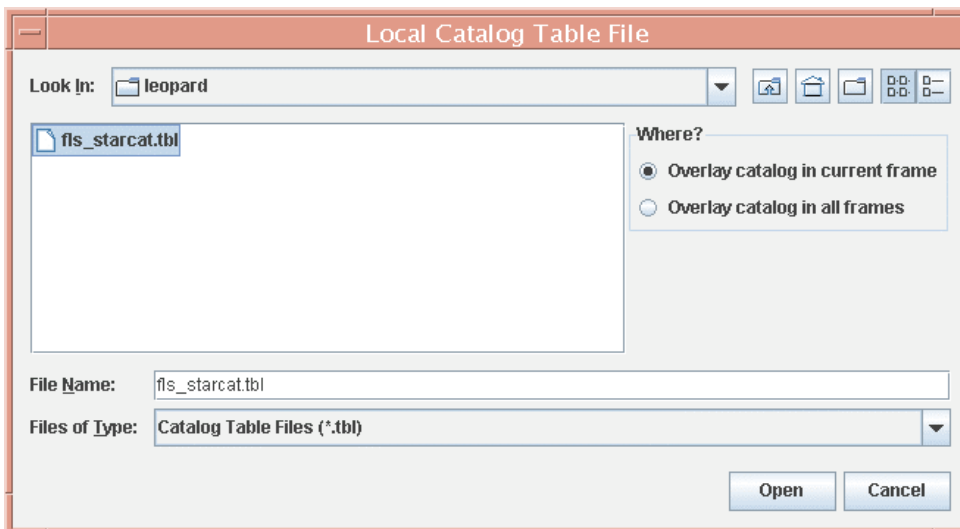


Figure 28: This dialog will allow you to select a local catalog file, in the modified IPAC table format, to overlay onto your images.

7.7.4.1 Keywords

Keywords start with a back-slash (\). There should be no space between the back-slash and the keyword. For example:

```
\ORIGIN = 'IPAC Infrared Science Archive (IRSA), Caltech/JPL'
\fixlen = F
\RowsRetrieved = 215
```

The required keyword is `\RowsRetrieved` that tells how many lines of data are in the file. The keywords are placed first in the file, and they must be followed by column header lines.

7.7.4.2 Column Headers

The column headers describe the name, data type, and units of the tabular data.

```
| name1      | name2  |
| data type | double |
| unit      | degrees|
| null1     | null2  |
```

The three required columns are:

```
|      name|      ra|      dec|
|      char| double| double|
|          | degrees| degrees|
|      null|      null|      null|
```

All four column header lines are required. Every column owns the rightmost bar, except for the first which owns two bars.

7.7.4.3 Sample IPAC Table File

```
\RowsRetrieved =          10

|      fscname|      ra|      dec|      fnu_12|      fnu_25|      fnu_60|      fnu_100|
|      char| double| double| double| double| double| double|
|          | degrees| degrees|      Jy|      Jy|      Jy|      Jy|
|      null|      null|      null|      null|      null|      null|      null|
F23545+2632  359.2639  26.8250  0.221  0.112  0.126  1.100
F23548+2633  359.3554  26.8394  0.173  0.103  0.554  1.219
F23567+2659  359.8219  27.2697  1.298  0.315  0.152  0.838
F23568+2554  359.8425  26.1917  0.070  0.111  0.303  0.848
F23574+2800  359.9940  28.2814  0.112  0.054  0.228  0.951
F23561+2901  359.6731  29.3036  0.091  0.118  0.249  0.616
F23570+2846  359.8954  29.0547  0.224  0.130  0.146  0.465
F23554+2822  359.5090  28.6531  0.202  0.149  0.310  2.078
F23555+2735  359.5287  27.8722  0.098  0.170  0.234  0.840
```

Note: IRSA has developed a tool that will help you transform a regular ASCII table into IPAC table format. See <http://irsa.ipac.caltech.edu/applications/TblReformat>.

7.7.5 Crop

This is not so much an overlay, as a means to crop the size of an image displayed in the Image window. Crop creates a cropped copy of the image, while maintaining the original image. See section 9.1.6. Clicking on the icon in the image and overlay manipulation tool bar will activate this tool (see section 8.1).

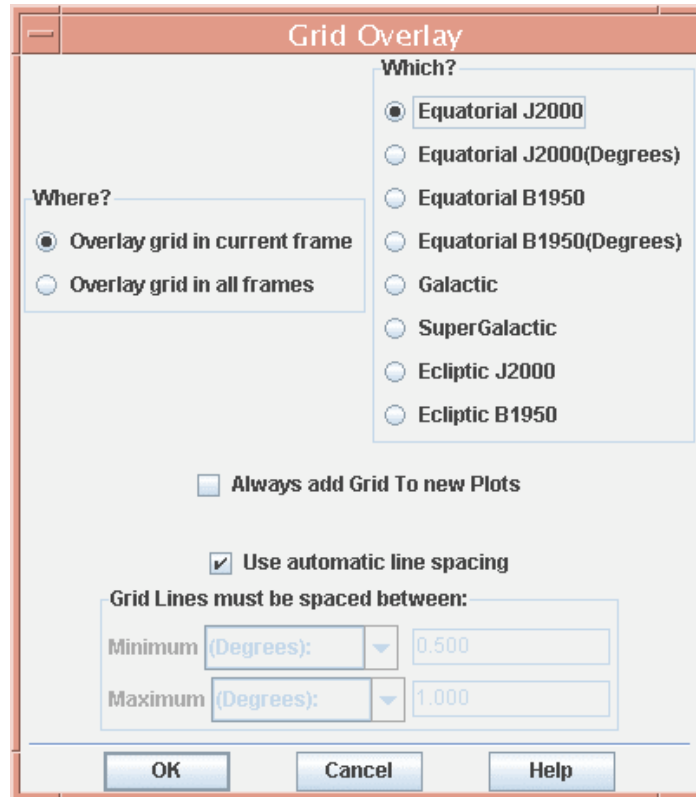


Figure 29: The coordinate grid overlay dialog allows selection of the desired type of grid.

7.7.6 Grid...a.k.a Coordinate Grid Overlay

Leopard will overlay a variety of coordinate grids onto the image display. From the dialog (Figure 29), you select the type of grid and where to display it. You can also force Leopard to overlay a coordinate grid on every image displayed, as well as control the spacing of the grid lines. Clicking on the icon in the image and overlay manipulation tool bar will activate this utility.

7.7.7 Distance Tool

Once this item is selected, the left mouse button can be used to click and drag a line across a region on your image. The length of the dragged line in selected units is then displayed both on the plot and in tabular form. Clicking on the icon in the image and overlay manipulation tool bar will activate this utility.

7.7.8 Slice Tool

This tool will produce a “slice” of an image, i.e., the radial distribution of flux as a function of position on the image. See section 9.6. Clicking on the icon in the image and overlay manipulation tool bar will activate this tool.

7.7.9 Area Statistics Tool

As a new feature in Leopard, this tool will generate statistics from an image, i.e., the maximum, minimum, mean, and integrated fluxes, as well as the flux centroid and flux-weighted centroid, within either a circular or rectangular user-specified area. See section

9.1.7. Clicking on the icon in the image and overlay manipulation tool bar will activate this tool.

7.7.10 Mark Object on Plot/User Created Catalog

This tool allows to you selectively mark and label points of interest on your image plot. You can save the marks to a catalog file (in IPAC table format) to local disk. This user-created catalog later can be read back into Leopard to overlay. Clicking on the icon in the image and overlay manipulation tool bar will activate this utility.

7.7.11 Current Fixed Target

Leopard places a red box onto the current fixed target position in the displayed images. It also marks each offset position (in celestial coordinates) with a red plus sign if you have a cluster target type. Clicking on the icon in the image and overlay manipulation tool bar will activate this utility.

7.7.12 Add Moving Target

This option allows you to visualize the tracks of moving targets. See section 9.7.4.9.

7.7.13 Image Overlays

You can overlay an ISSA, 2MASS, MSX, DSS, NED, or a FITS file from disk onto your current image. Wavelength or generation (DSS) options are the same as for normal image display. See section 9.5.

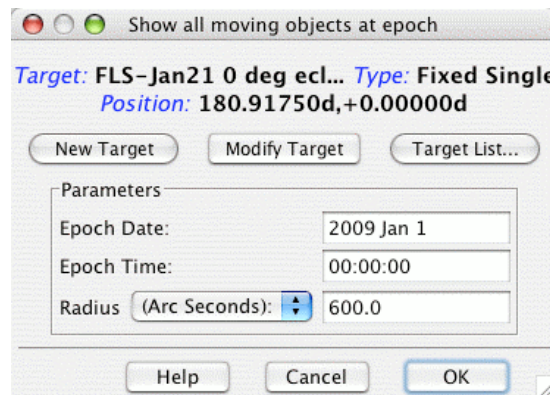


Figure 30: The dialog for overlaying the positions of all known moving objects within a given search radius at a given epoch on an image.

7.7.14 Show All Known Moving Objects at a Date

You can obtain a list of all the known moving objects within a given search radius (in arcseconds, arcminutes, or degrees) for a given field at a given epoch. The search is conducted on the JPL Horizons database for moving objects. The retrieved list of moving objects is then overlaid on an image. The dialog for specifying the search radius and epoch is shown in Figure 30. An example image overlay is shown in Figure 31.

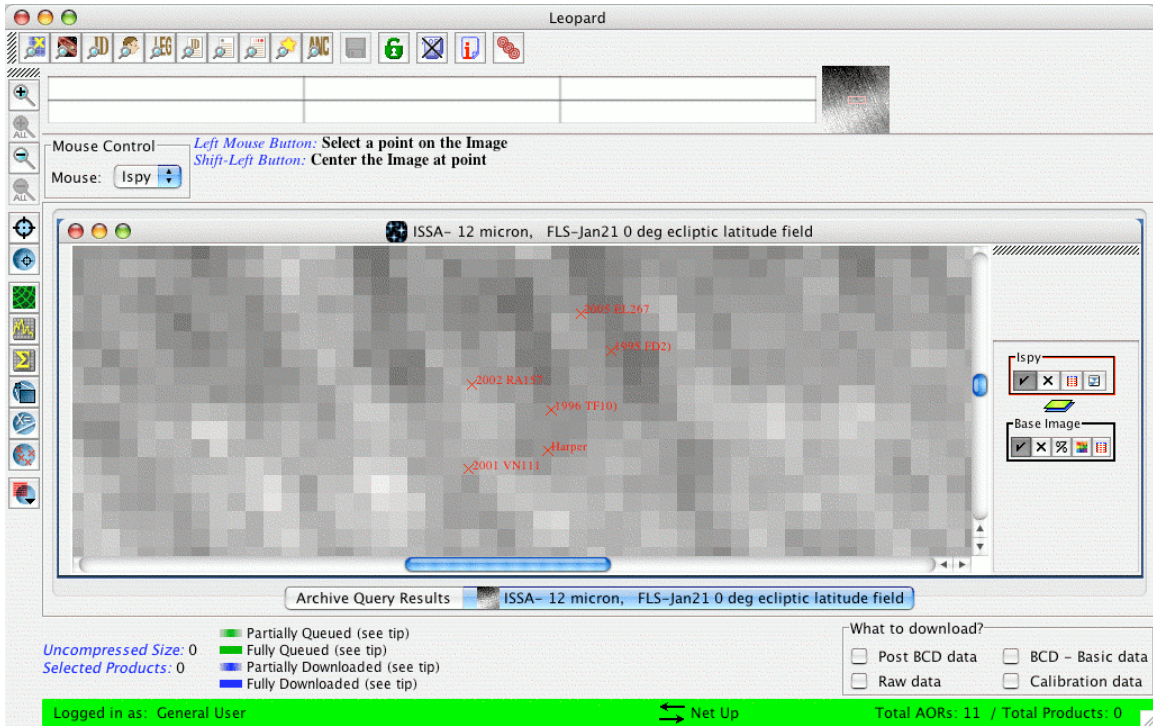


Figure 31: An example of the known moving object overlay. In this example, seven asteroids are shown overlaid on the ISSA 12 μ m plate.

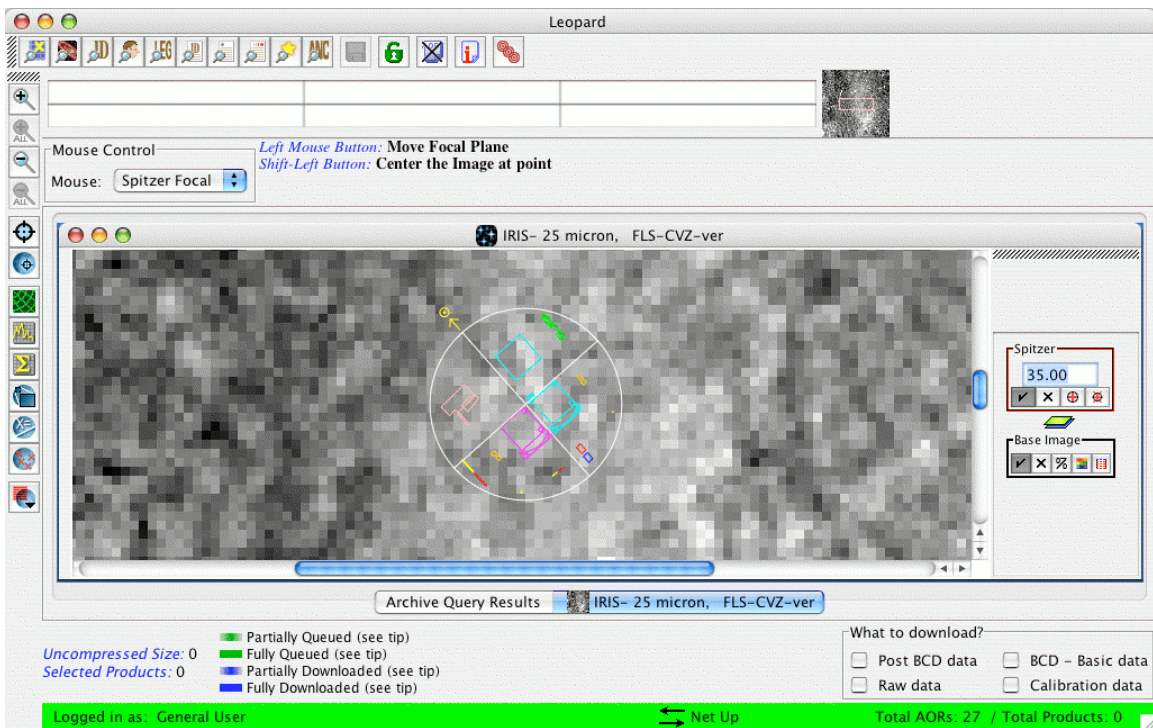


Figure 32: An overlay of the Spitzer Focal Plane is shown on an ISSA 25 μ m image. The desired position angle (e.g., 35), in degrees east of north, is entered into the field in the Focal Plane box.

7.7.15 Spitzer Focal Plane

This item allows you to overlay the Spitzer Focal Plane at any position and specified angle onto the current image (Figure 32). When selected, the focal plane is drawn over the current image, centered on the current target position, and a box of controls is added to the side bar of the current image. The position angle (degrees east of north of the projected Spitzer-to-sun vector) of the focal plane can be rotated by entering the value in degrees in the small entry field in the layer and hitting Return. To move the focal plane overlay to somewhere else in the image, click the mouse at the desired point in the current image.

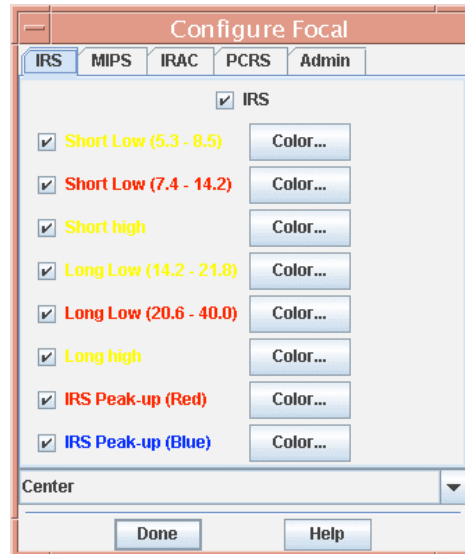




Figure 33: The configuration of the focal plane overlay is controlled from this dialog. You can select the colors of the instrument FOV overlays and also select which FOVs are shown. The pull down menu at the bottom allows you to select which instrument FOV will be centered on the image where you click the mouse.

To change the colors of the instrument fields-of-view (FOV), where the focal plane is centered, and which instrument fields-of-view are shown, click the focal plane configuration  icon in the Spitzer Layer box on the sidebar. This brings up the dialog shown in Figure 33. You can turn off/on any instrument FOV or change their display colors here. To select which FOV in the focal plane is centered where you click the mouse, use the pull down menu at the bottom of this dialog. Click on the diffraction spike control icon () to display the spikes. The diffraction spikes move and rotate when you move or rotate the Spitzer focal plane.

7.7.16 Generic Focal Plane

This allows you to overlay a user specified square or circular ‘focal plane’ onto your image. The dialog is shown in Figure 34.

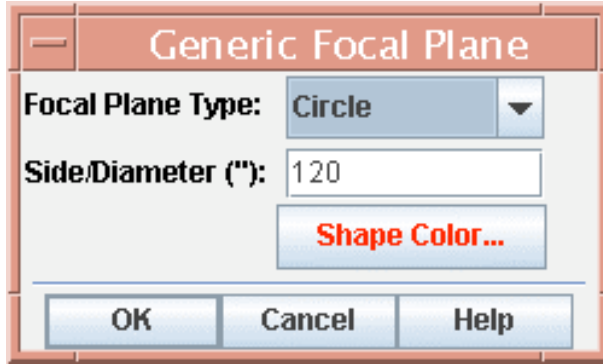


Figure 34: The generic focal plane selection dialog allows the user draw a square or circle, of user-selected size and orientation, onto an image.

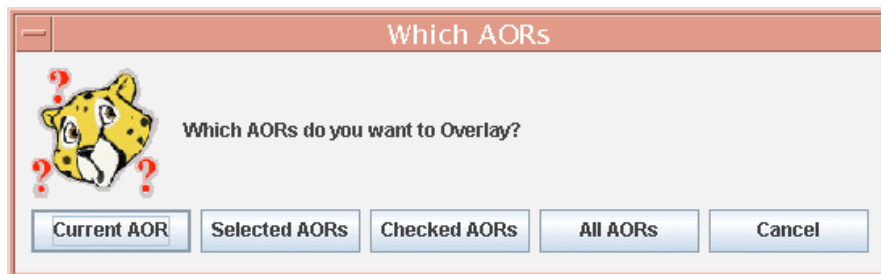


Figure 35: The dialog for selecting which AORs to overlay on an image.

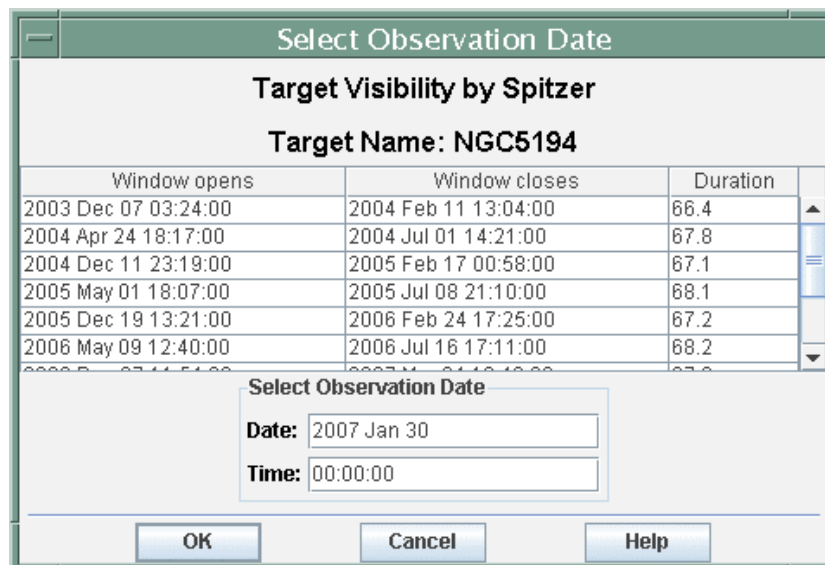


Figure 36: The dialog for plotting unscheduled AORs is shown. It shows the visibility windows for the target, as well as a date in the middle of the next available visibility window (the default). If you want to plot the AOR for a particular observation date within any visibility window, enter it here. Click on any visibility window to automatically select its mid-date. Click OK for the overlay.

7.7.17 AORs on Images

This function allows you to overlay the area coverage for one or more AORs onto the displayed images. When AOR overlay is selected, the dialog shown in Figure 35 asks you which AORs to overlay: the current one, only selected AORs, only AORs checked in the

Archive Query Results window, or all AORs currently loaded in Leopard. Next, if an AOR has not yet been scheduled, the dialog window, shown in Figure 36, displays the visibility windows for the target, as well as a date in the middle of the next available visibility window. If you want to plot the AOR for a specific observation date within any visibility window, enter that date here. Clicking on any visibility window will automatically select the mid-date in that window. Or, just select the default. Click OK for the overlay. For an AOR that have already been executed, the overlay in Leopard will be done by default for the observation date for that AOR, and the visibility window dialog will not appear. See section 9.7. Leopard must be connected to the Internet to do the overlay, as it contacts the SSC AIRE and Visibility servers to get the correct orientation and sky positions for the overlay.

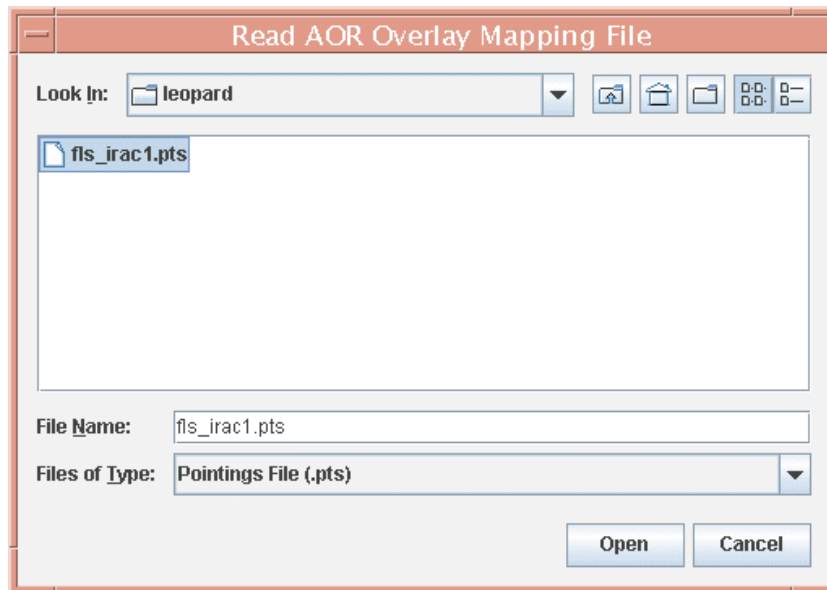


Figure 37: The dialog for reading in a user-specified AOR map file.

7.7.18 Read AOR Overlay Mapping File

You can save the pointings table for an AOR overlay to local disk (see section 9.7.2). This file can be read back into Leopard at a later time for overlaying on images. The dialog for reading the file into Leopard is shown in Figure 37. Currently, only the overlay for one AOR at a time can be read in.

7.7.19 Show Spitzer OPZ

The OPZ is the Operational Pointing Zone. It defines where Spitzer can safely point and execute observations. When you select this overlay Leopard will bring up a dialog window and ask you to select an observation date (a default date is provided). Leopard will connect to the servers at the SSC to determine where the OPZ crosses your displayed image. If the OPZ does not cross the image, Leopard will ask if you would like to display an All Sky image to see how far away your displayed image is from the OPZ. Leopard will then show you the OPZ on the All Sky image (Figure 38).

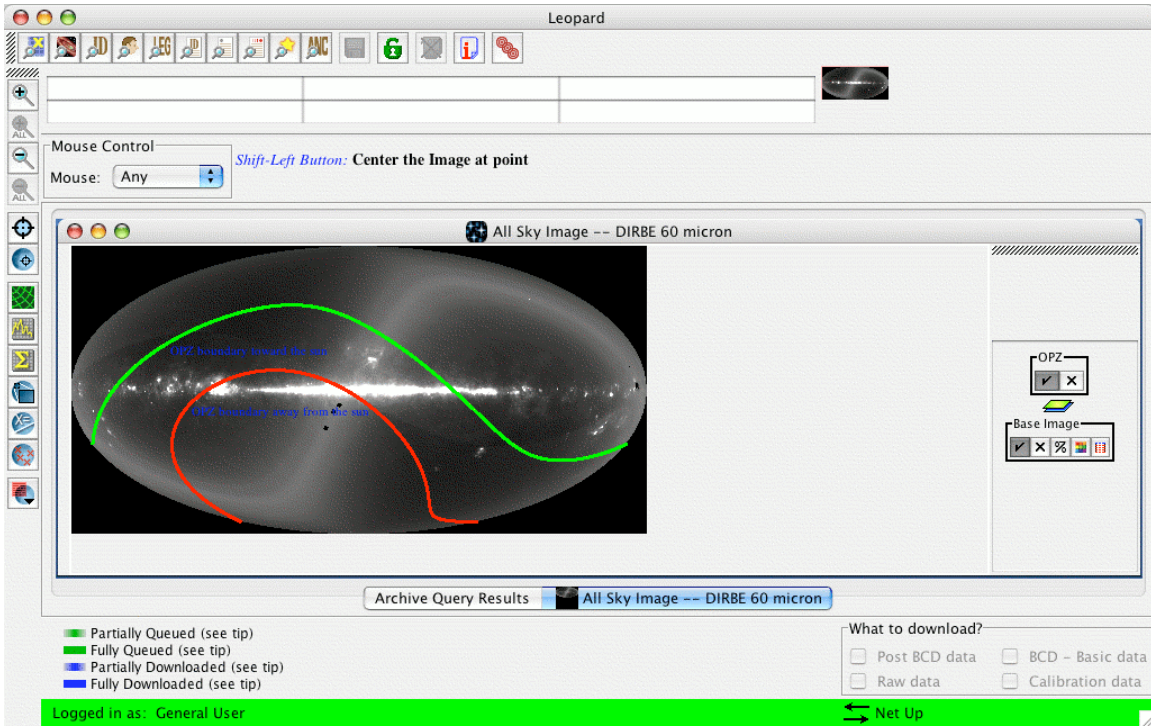


Figure 38: An overlay of the Spitzer Operational Pointing Zone (OPZ) on the All Sky image for the middate (2006 Sep 12) of the effective mission window.

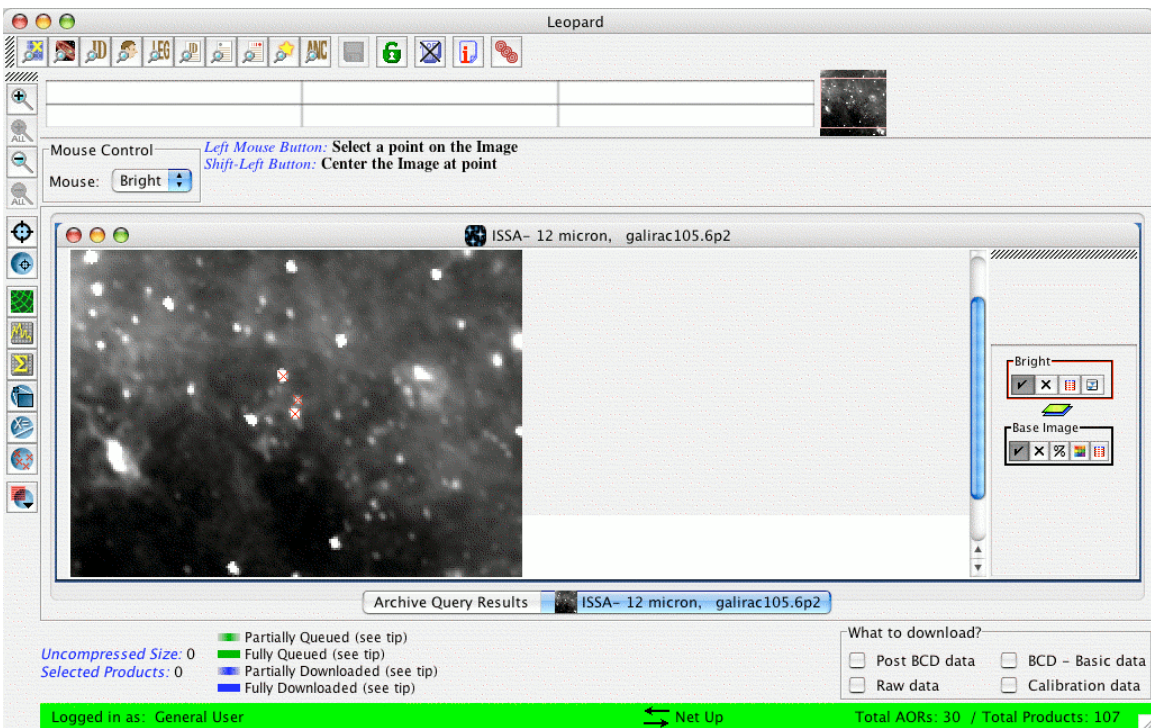
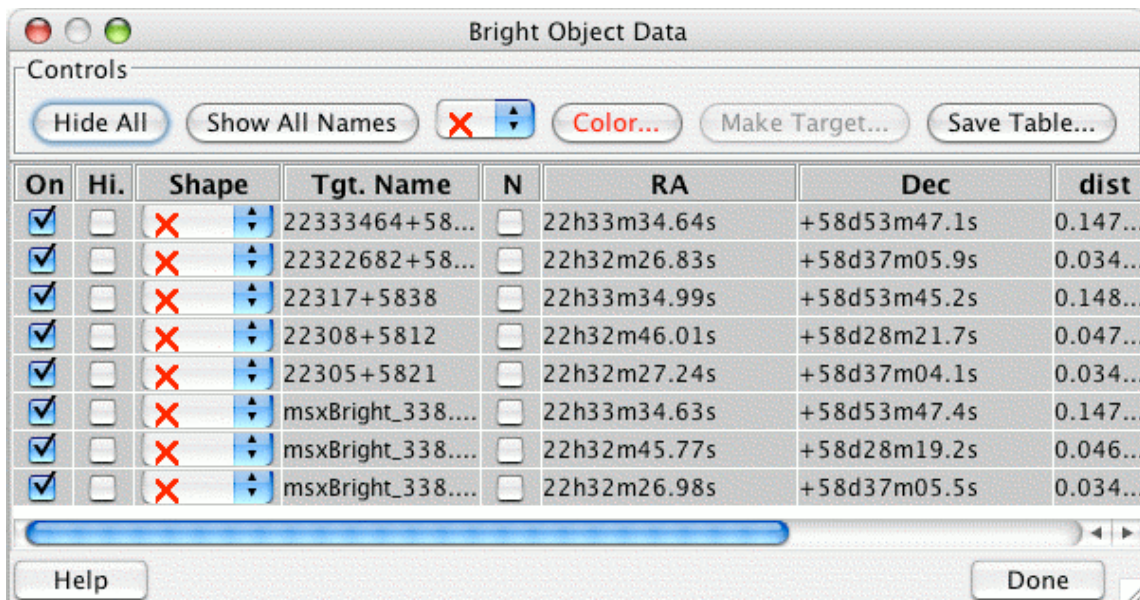


Figure 39: An overlay of bright objects is shown on an ISSA 12 μ m image of a Galactic FLS field.

7.7.20 Spitzer Bright Objects for AOR

Spitzer observations can be compromised by the presence of a bright object in or near your target field. You can obtain from the SSC database an overlay of the known bright inertial objects that may be within or near the field covered by an AOR. Detailed information and a very similar set of bright object lists can be found at <http://ssc.spitzer.caltech.edu/documents/brightobj/>. Generally, these are objects that may have had a negative impact on the quality of the observations and possibly those that followed in the observing schedule. For IRAC AORs, this utility searches for bright objects within a radius 10' of the aperture center. For IRS AORs, this utility searches more tightly to the area covered by the AOR, depending on the module (currently excluding Peak-up Imaging). For MIPS AORs, it searches for bright objects within very nearly the exact area covered by a PH-SR, SED, Total Power, or Scan observation. An example is shown in Figure 39, where bright sources have been overlaid on an ISSA plate of a field covered by one IRAC AOR of the Galactic FLS. A detailed listing of these sources, including object name, position, and brightness information, can then be obtained, as shown in Figure 40. The bright object data can then be saved to a file on local disk, by pressing the Save Table button and entering in the resulting dialog a file name and local disk directory.



On	Hi.	Shape	Tgt. Name	N	RA	Dec	dist
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	22333464+58...	<input type="checkbox"/>	22h33m34.64s	+58d53m47.1s	0.147...
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	22322682+58...	<input type="checkbox"/>	22h32m26.83s	+58d37m05.9s	0.034...
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	22317+5838	<input type="checkbox"/>	22h33m34.99s	+58d53m45.2s	0.148...
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	22308+5812	<input type="checkbox"/>	22h32m46.01s	+58d28m21.7s	0.047...
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	22305+5821	<input type="checkbox"/>	22h32m27.24s	+58d37m04.1s	0.034...
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	msxBright_338...	<input type="checkbox"/>	22h33m34.63s	+58d53m47.4s	0.147...
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	msxBright_338...	<input type="checkbox"/>	22h32m45.77s	+58d28m19.2s	0.046...
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	msxBright_338...	<input type="checkbox"/>	22h32m26.98s	+58d37m05.5s	0.034...

Figure 40: The detailed listing of bright objects shown in Figure 39.

7.7.21 Show Depth of Coverage Maps on Current Image

Depth of Coverage (DoC) maps allow you to visually see how many frames were taken in the area covered by an AOR, independent of any frame exposure time. You must be connected to the Internet to access the SSC servers to use this feature. For an AOR that has already been scheduled or executed on a particular date, Leopard will assume this date for the overlay. Otherwise, you will be presented with the dialog window shown in Figure 41. Enter a date of observation and choose which aperture(s) you wish to have mapped. Click 'Ok'. Leopard will access the SSC servers to determine the orientation of the map on the chosen observation date and overlay the DoC map. Drag the cursor over

the map. The *number of frames* covering each sky position will appear in the small window in the DoC layer (Figure 42). You can change the opacity (☐ icon) of the background image or overlay to more clearly see the depth of coverage map. Click the color table control (☐ icon) to select a different color table for the DoC map.

Depth of Coverage maps do not work well near the poles. Our method of creating the depth of coverage maps creates misleading or incorrect results when the declination is greater than about $\pm 88^\circ$. More specifically, the method breaks down (the errors become noticeable) when the requested range of right ascension is greater than 10° . Leopard will return an error message if it detects that the user is requesting a depth of coverage map too near the poles.

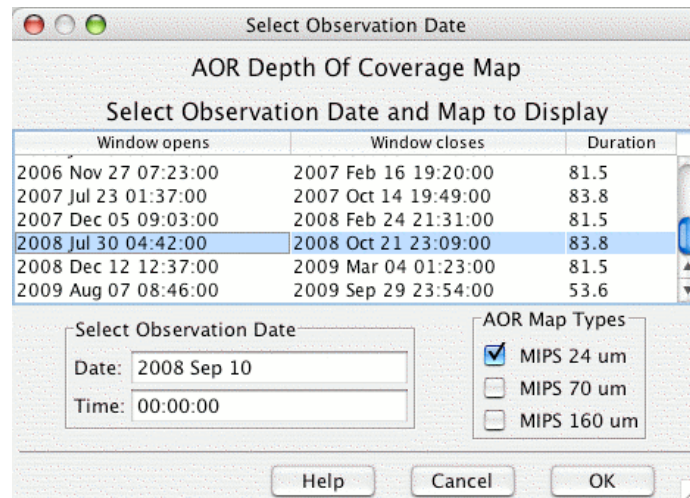


Figure 41: Dialog window for a depth of coverage map for a MIPS scan, as an example. The AOR Map Types shown in the lower right of the dialog will change depending on which apertures or modules are selected for the AOR.

7.8 Options Menu

7.8.1 Use Automatic Leopard Version Update

The default for this is 'Yes'. When enabled, if an update for Leopard is available, you will be asked if you would like to update your software (approximately 2 minutes after you start Leopard with an Internet connection). If selected, Leopard will download the update and install it on your computer. The update will 'take effect' the next time you start up Leopard (exit Leopard and start it again if you wish to access the update immediately), or when you allow Leopard to restart automatically. It is recommended that you allow auto-updates.

7.8.2 Sort by Dec, then RA

This option allows you to sort the Target column in the Archive Query Results window first by declination, and then by right ascension. Sorting on a column is achieved by clicking on the column heading (see section 8.2). The default setting is to sort first on right ascension, and then declination.

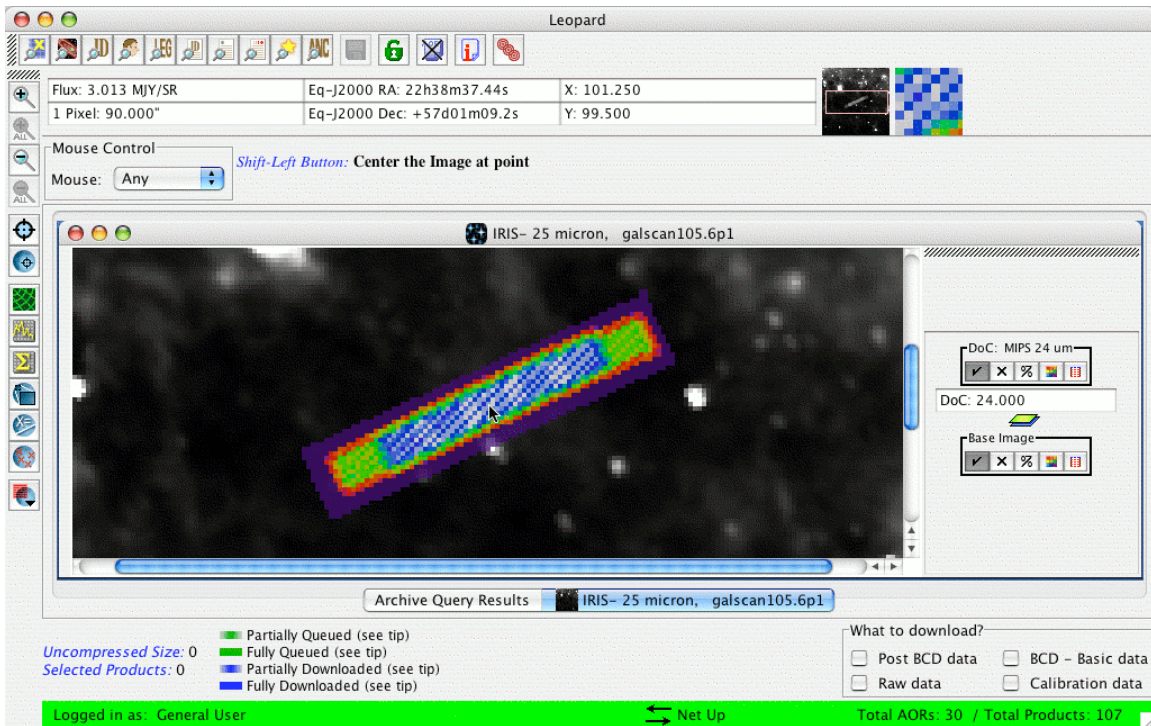


Figure 42: Depth of coverage map for a 24 μm observation. The 'depth' of the map, or number of frames, is shown in the small box in the DoC layer as you move your mouse over the image. To more clearly see the DoC layer you can adjust the opacity icon of either the image or the DoC map. Click the color table control icon to change the color table.

7.8.3 Visualization: Spitzer Focal Plane Options

This option brings up the same dialog window as described in the Spitzer Focal Plane Overlay. Refer to section 7.7.14 and Figure 33 for details.

7.8.4 Visualization: Coordinate System Prefs

This function allows you to select a default coordinate system displayed in the tables in Leopard.

7.8.5 Visualization: Readout Prefs

When displaying an image, just below the main icon bar, Leopard returns three different pairs of values for the cursor position (Figure 43). On the far left is the flux or DN value for the pixel and the pixel scale. **NOTE: For the ISSA/IRIS images, these values are correct. For the 2MASS images, the DN returned does not contain scientific value as these images have been lossy compressed. Use the 2MASS catalogs for accurate scientific data values.** In the center and right boxes, two user-selected values are displayed for the present cursor position. The Readout Prefs dialog is how you select those values. For example, you can display the equatorial and ecliptic coordinates, or any coordinate system versus image pixel. The read-out works for both the main image display and the thumbnail display shown to the right of the read-out boxes.

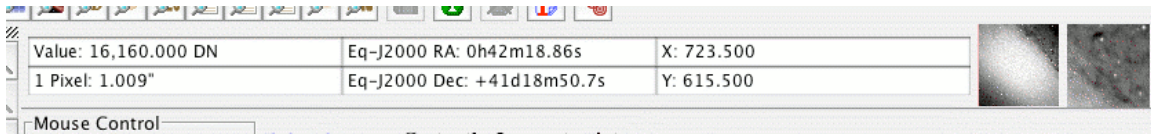


Figure 43: Display of the three different pairs of values for the cursor position on the image currently being displayed. On the far left are the flux or DN value and the pixel scale. In the center and right are displayed two different user selected coordinates. The format of these two columns is selected from the Readout Prefs item in the Options menu.

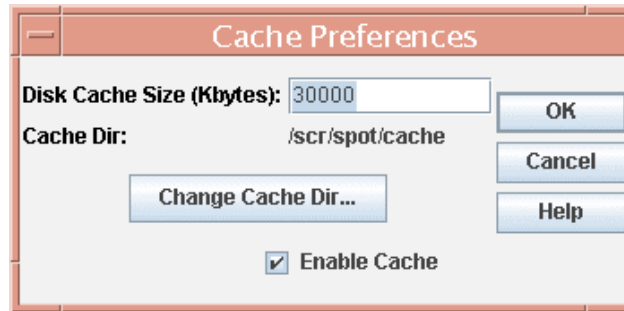


Figure 44: The size and location of the disk cache directory, where Leopard stores images retrieved from remote servers, is controlled from this dialog. It is selected from the OPTIONS menu.

7.8.6 Cache Prefs

Leopard caches the images that it retrieves from remote servers to the local disk so that the images are available locally the next time you ask Leopard to display them. This saves time and network traffic. The first time you retrieve an image, Leopard will ask you to designate a cache directory. You can change the location or size of the disk cache directory from this dialog (Figure 44).

7.8.7 Network Proxy Setup

If you select this option, you will see two options- Direct Connect to Internet and Manual Proxy Configuration. If your institution has a firewall or proxy server in place you will want to select the Manual Proxy Configuration option and fill in the appropriate values for HTTP and HTTPS proxy ports and hosts, as well as proxy user name and password. It is recommended that you check with your systems administrator for the proper values though these can often be found by checking "Preferences"/"Options" and then "Advanced" and then "Proxies" in your internet browser.

7.8.8 Use Large Control Icons

This option makes larger the layer control icons for both images and overlays in the Images window, for better visibility.

7.8.9 Visualization: Show Mouse Help [shift-ctrl-M]

If you check this box, Leopard will display messages in the region above the Images that provide help for using the mouse. For example, if you put your cursor over the image thumbnail (Figure 43, far right), it tells you that you can move the image by using the left mouse button.

7.8.10 Visualization: Show Side Bar on Current Frame [shift-ctrl-B]

This allows you to manage your screen real estate. If you are working on a very small screen, you may wish to turn off the sidebars, which allow you to manipulate overlays, on the right hand side of the current image. This option allows you to show and hide the sidebar.

7.8.11 Visualization: Show Side Bar on All Frames [ctrl-B]

This allows you to manage your screen real estate. If you are working on a very small screen, you may wish to turn off the sidebars, which allow you to manipulate overlays, on the right hand side of all displayed images. This option allows you to show or hide the sidebars.

7.9 Window Menu

7.9.1 Archive Query Results

This option allows you to bring forward the archive query results window, if it is not currently active in the main Leopard window. This is very useful for managing Leopard if you are displaying several images and going back and forth between them and the Archive Query Results table.

7.9.2 Open Images Windows

This option allows you to bring forward the window of a currently open image, if it is not currently active in the main Leopard window. The names of all images currently open and displayable in Leopard are listed in the Windows menu. You can select each of these images with this option. This is very useful for managing Leopard if you are displaying several images and going back and forth between them and the Archive Query Results table.

7.10 Help Menu

7.10.1 Overview

This is the access point to the Leopard's on-line help. Please also see the Leopard Release Notes, as well as the additional information available on the SSC Proposal Kit web page.

7.10.2 Resources for Data Analysis

This utility brings up a window that points you to the main website for all Spitzer data analysis resources (Figure 45).

7.10.3 Tip Of The Day

Controls the viewing of Leopard's Tips. You can turn on/off the display of the Tip Of The Day. You can also browse through the Tips.

7.10.4 About

This function reports the version of Leopard running on your computer and URL and ports used to connect to the SSC servers.

In the next section we provide a summary list of the functions available from all of the Leopard menus.

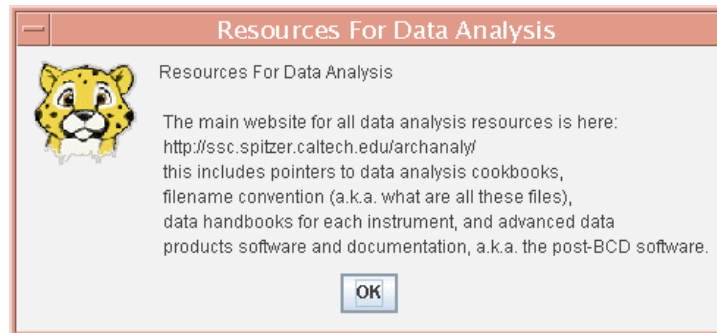


Figure 45: Selecting the Resources for Data Analysis under the Help menu brings up this window, listing the website for all Spitzer data analysis resources.

7.11 Leopard v9 Menu Command Summary

FILE MENU

Download Selections [ctrl-D]
 Save AOR List
 Save Current Plotted Image as FITS File
 Save Current Plotted Image & Overlays to JPEG,GIF, BMP, or PNG
 Login to Spitzer Archive [ctrl-L]
 Logout from Spitzer Archive [ctrl-O]
 Change password to Spitzer Archive [ctrl-W]
 Quit [ctrl-Q]

QUERY MENU

By Position [ctrl-U]
 By Program
 By AOR ID [ctrl-R]
 By Campaign/Observer
 FLS and Legacy Programs [ctrl-P]
 AOR ID List Query [ctrl-S]
 Fixed Target List Query
 Moving Target List Query
 Popular Products Query
 Query Legacy Ancillary Data Archive [ctrl-A]

EDIT MENU

Delete selected AORs [ctrl-X, Delete]
 Delete Checked Popular/Ancillary Data
 Delete All AORS
 Delete All Targets
 Update All AORS
 Hide AORs with no Archive data
 Filter Archive AOR Results
 Mark all AORs as not Queued or Downloaded
 Undo [ctrl-Z]

SELECT MENU

Enable All Selected [ctrl-E]
 Disable All Selected
 Enabled IRAC
 Disabled IRAC
 Enabled MIPS
 Disabled MIPS
 Select all IRS
 Unselect all IRS

INFO MENU

Detail Information [ctrl-I]
 Target List
 Spitzer Archive History
 Memory Monitor

IMAGES MENU

ISSA Image
 2MASS Image
 MSX Image

- DSS Image
- SkyView Image
- NED Image
- ISO Archive Image
- NVO Image
- FITS File Image
- FITS file from URL
- All Sky Images
- Blank Image

OVERLAYS MENU

- Catalogs from IPAC
- Catalogs from HEASARC
- Catalogs from Vizier (beta)
- Catalog File
- Crop
- Grid [ctrl-G]
- Distance Tool [shift-ctrl-D]
- Slice Tool
- Area Statistics
- Mark Objects on Plot/User created catalog
- Current Fixed Target
- Add Moving Target
- Image Overlays
- Show all Known Moving Objects at a Date
- Spitzer Focal Plane
- Generic Focal Plane
- AORs on Images
- Read AOR Overlay Mapping File
- Show Spitzer OPZ
- Spitzer Bright Objects for AOR
- Show Depth of Coverage Maps on Current Image

OPTIONS MENU

- Use Automatic Leopard Version Update
- Sort by Dec then RA
- Visualization: Spitzer Focal Plane Options
- Visualization: Coordinate System Prefs
- Visualization: Readout Prefs
- Cache Prefs
- Network Proxy Setup
- User Large Control Icons
- Visualization: Show Mouse Help [shift-ctrl-M]
- Visualization: Show Side Bar on Current Frame [shift-ctrl-B]
- Visualization: Show Side Bar on All Frames [ctrl-B]

WINDOW

- Archive Query Results
- Open image windows...

HELP

- Overview...
- Resources for Data Analysis
- Tip Of The Day...
- About...

8 Leopard Main Screen

8.1 Icons

Leopard uses several icons as shorthand for commonly used functions that are also available under the Menus. They are shown in Figure 46. From left to right the icons are:

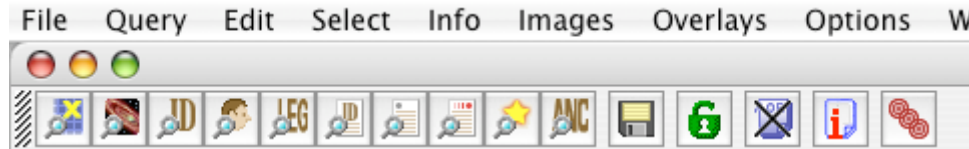
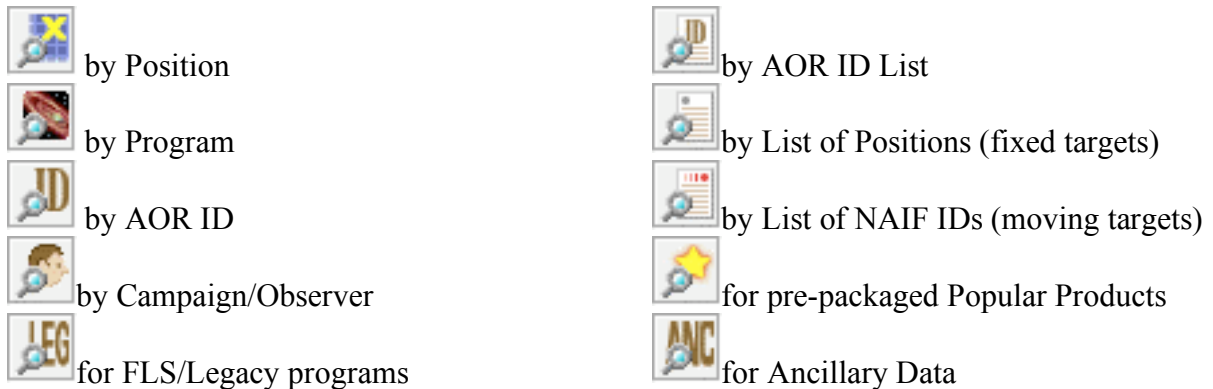
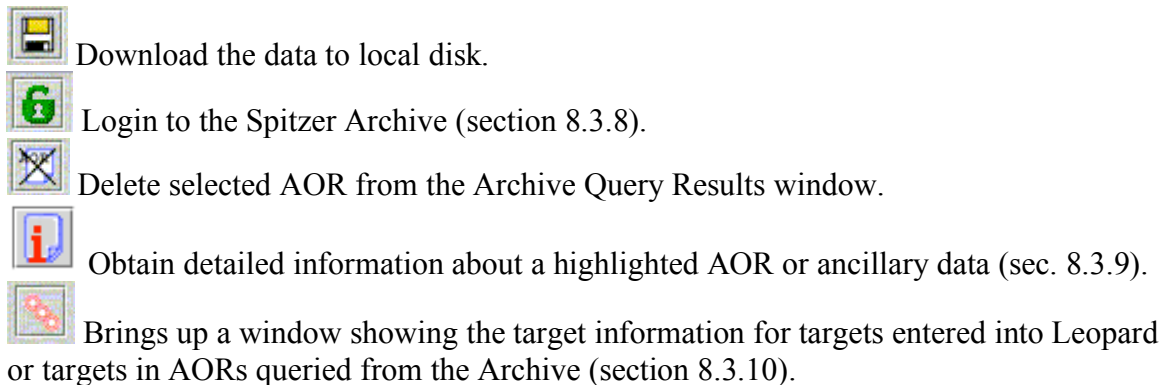






Figure 46: The menus and icon bar on the Leopard main screen provide access to the various functions within Leopard.

There are a number of Query Archive shortcut icons:



The other icons consist of:



The image manipulation icons will appear on the left-hand side of the Leopard window whenever you display images (Figure 47). Click on the icons to activate them. The magnifying glass icons are all for zooming your images in or out. This icon  zooms in the current image, and this one  zooms out. These icons,  and , apply the zoom to all the images stacked in the active frame (if you have only one image per frame, the










ALL buttons will not be active). The crosshair icon  centers the current target in the middle of the current image frame.



Figure 47: The zoom and centering icons will appear on the left of the Leopard window whenever images are displayed.

In addition, a number of overlay options are now available from this tool bar. This icon  will overlay the current fixed target position on an image. This icon  will draw a coordinate grid on the image. This icon  will extract a slice of flux between two points on the image. This icon  will compute statistics in either a circular or rectangular area on the image. This icon  will crop the image. This icon  will allow you to determine the distance between two points on an image. You can add marks on an image and create your own catalog by clicking on this icon . Finally, this icon  provides you with a pulldown menu from which you can select other images to overlay on the current image.

8.2 Archive Query Results Window

The list of AORs queried from the Archive loaded into Leopard is shown on the main window (Figure 48) in the Archive Query Results window. For each AOR, it lists in columns:

- Unique AOR Label
- Target Name, as entered by the observer
- Target Position
- Database Request Key (AOR ID)
- Retrievable Wavelengths
- Status of the AOR within the Archive

- Version of the pipeline used to process the data
- Observing Mode (Instrument used in the AOR)
- Date released into the Archive
- Date scheduled for observations
- Preview image of the data

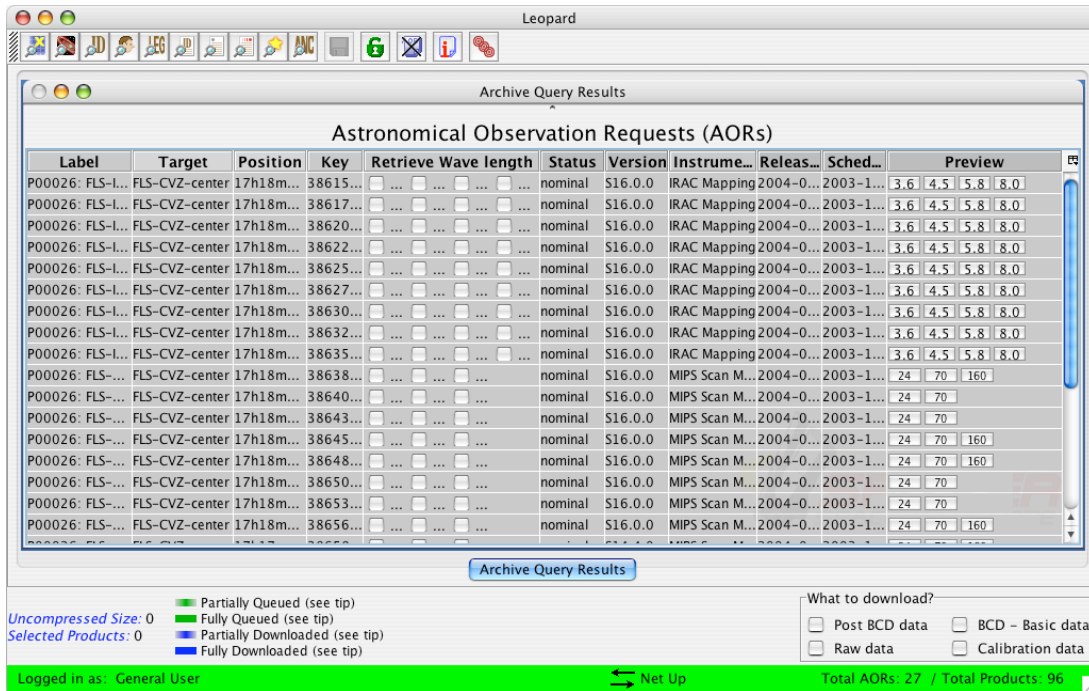










Figure 48: The main screen shows the Archive Query Results window, displaying AORs queried from the Archive.

Tables formatted in the JAVA language have several features that can be exploited while using Leopard. The columns can be rearranged by clicking on and dragging the column headers. Simply clicking on a column header enables sorting of the table by the column contents. When the header is clicked upon, red or blue arrows appear next to the column header. The red arrow  signifies sorting in increasing order, and the blue arrow  indicates sorting in decreasing order. No arrow means that the list is returned to its original order. Click on the column header to do the sorting. You may delete an AOR by selecting it and clicking on the Delete Current AOR button. By clicking and dragging on the edge of the header cell, you can change the width of the column.

The small icon  in the upper right hand corner (yellow button  in the upper left hand corner for Macs) will iconify the Archive Query Results window and leave the Leopard screen clear. The slightly larger icon  in the upper right hand corner (green button  in the upper left hand corner for Macs) will minimize and  maximize the area of the Leopard screen covered by the Archive Query Results window. The icon  in the upper right corner of the AORs table in the Archive Query Results window allows you to control which columns appear in the window. An example is shown in Figure 49. When you click on the icon, the menu of available columns appears toward the right side of the

window. Simply toggle on or off any of the columns by clicking next to the column name. In the example in the figure, we have turned off the Status and Schedule Date columns. To restore all columns to be displayed in the window, click on the Reset table to Factory settings option.

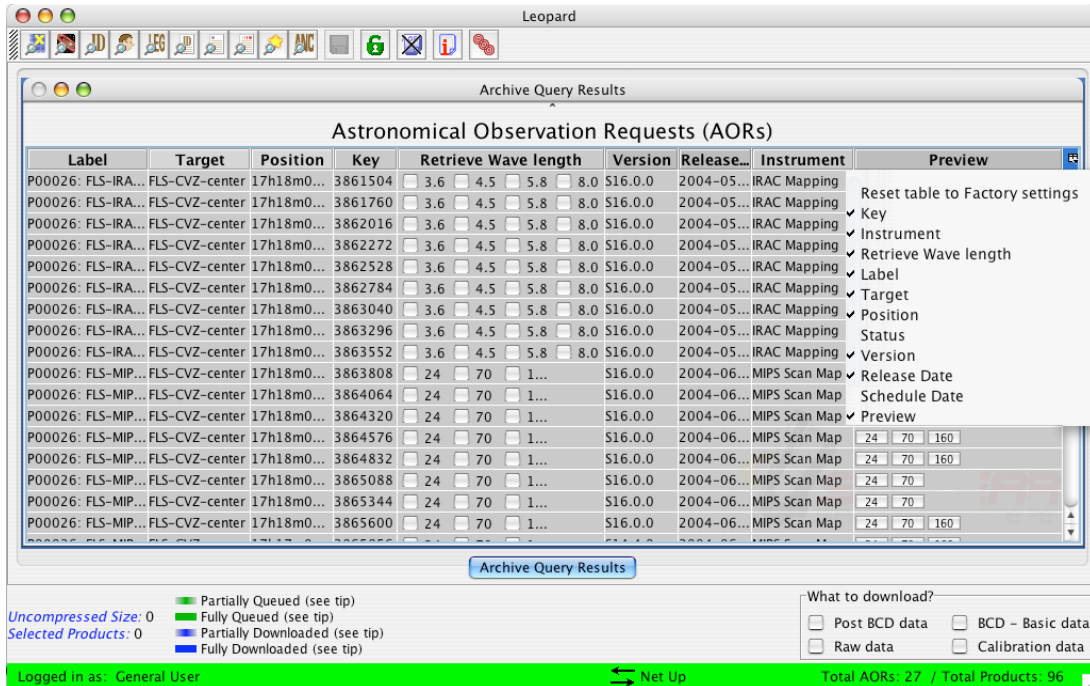


Figure 49: An example showing a “custom” display of columns turned off or on, using the columns control feature toward the upper right corner of the AORs table.

The Version column indicates which version of the processing pipeline has been used for the data. In the Preview column, for image data (from IRAC, MIPS, and IRS Peak-up Imaging), you will see icons in that column that resemble those shown in Figure 50. The icons represent the wavelength at which the image data were obtained. The Previews are lossy-compressed renditions of the post-BCD image mosaics, if available. *They are intended only for “quick-look” purposes.* Previews are **now** available for IRS Staring or Spectral Map AORs. An example of a preview is shown in Figure 51. For image previews image layer control will also appear, to allow you to change the preview image contrast, etc. See section 9.1 for a detailed discussion of image manipulation.

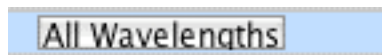


Figure 50: An example of the preview icons that may appear in the Preview column of the AORs table for spectral data. In this case, the AOR included IRS Staring in several modules. Click on the button to bring up a “quick-look” preview of the data in the dialog window shown in Figure 51.

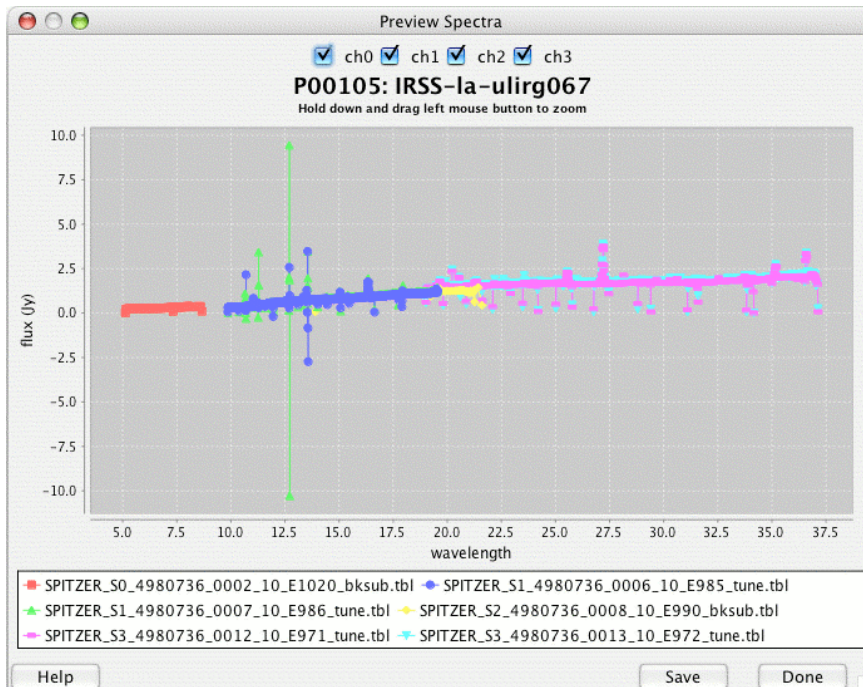


Figure 51: An example “quick-look” preview of IRS Staring data in all four modules.

8.3 Main Functions

8.3.1 Spitzer Archive Query

Querying the Spitzer Archive for data for specific targets or specific observing programs can be accomplished from the Query menu pulldown. Selecting, for example, a query By Position will open the Query dialog box. Figure 52 shows an example entry in the Target Section of the dialog for a cone search. Figure 53 shows an example list of programs resulting from the query. To choose individual programs from the list, click “Selected” next to the Program ID number and then click “OK.” To select all of the programs in the list, click “Select All.” Figure 54 shows an example entry in the Program Section of the dialog when querying By Program. For both types of queries, you can select all, some, or none of the specific bands, modes, or modules of the three Spitzer instruments. You can also query By Campaign and/or Observer (see section 7.2.4).

8.3.2 AOR ID Query

You can query the Spitzer Data Archive by specific database AOR request key values, when known. The Query -> By AOR ID menu pulldown or clicking on the By AOR ID shortcut icon will result in a dialog shown in Figure 55, for entering a single request key value.

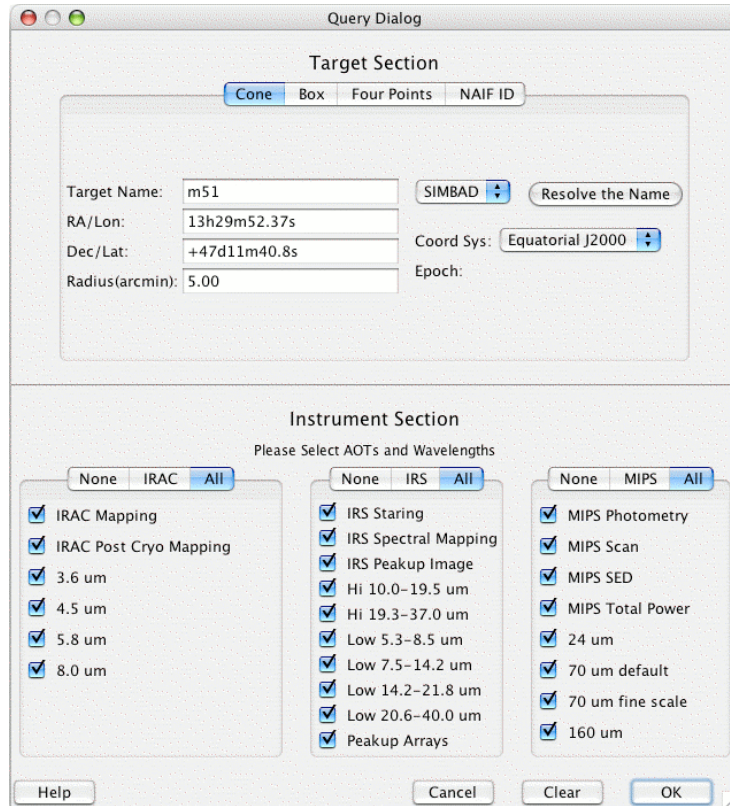


Figure 52: The Query Archive dialog, showing a specific target entered into the Target Section of the box.

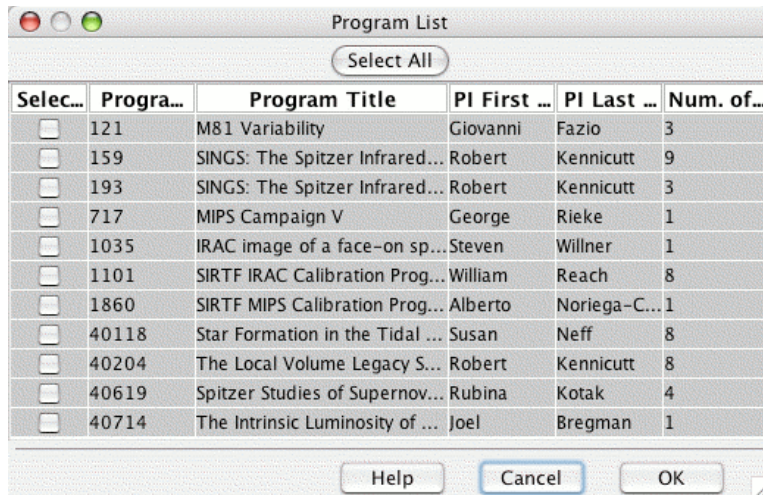


Figure 53: An example list of all programs with AORs within the search radius around the target position (see Figure 52). To select individual programs in the list, click “Selected” next to the program ID number and then click “OK” (or hit return). To select all of the programs in the list, click “Select All” toward the top of the window.

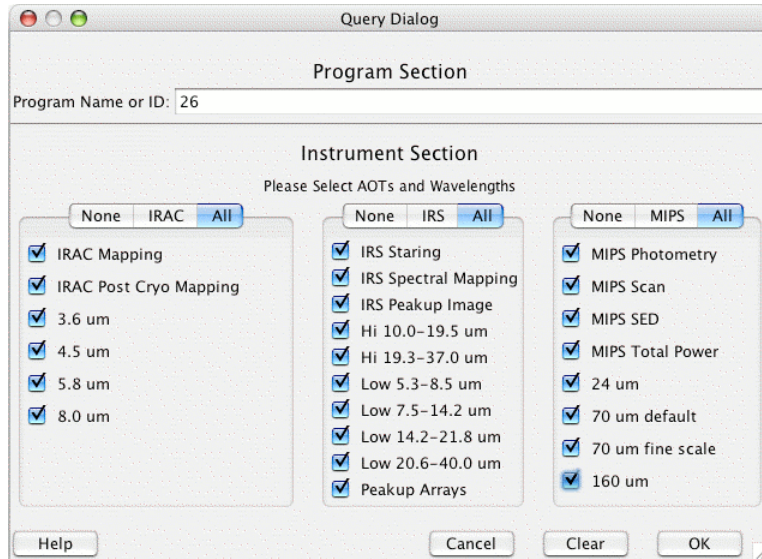


Figure 54: The Query Archive dialog, showing a specific program name or ID entered into the Program Section of the box.

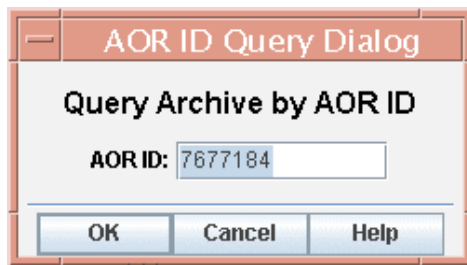


Figure 55: The AOR ID Query dialog box. A specific AOR request key can be entered, and the results of the query are returned to the main Leopard window.

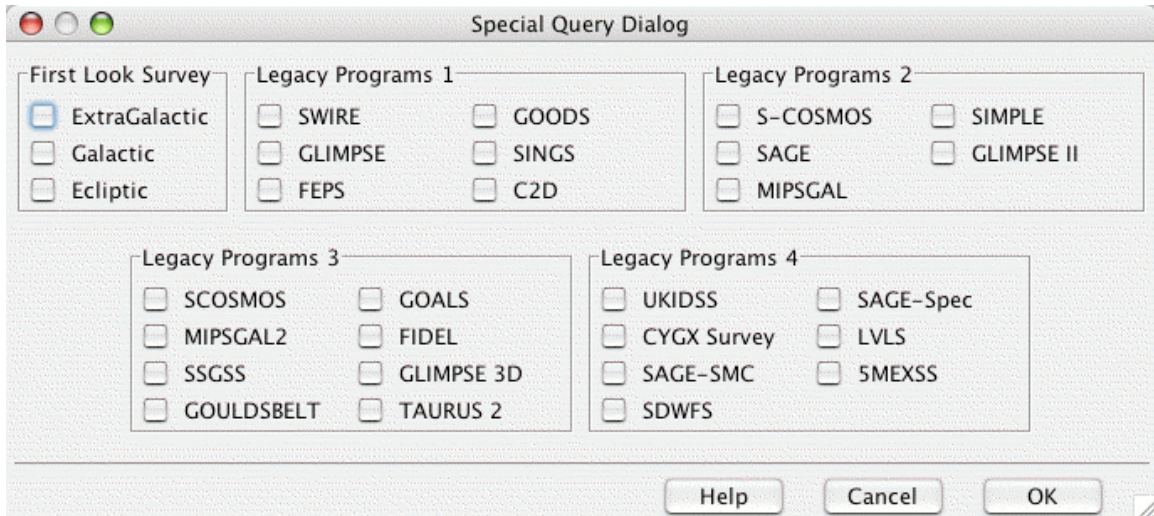


Figure 56: The FLS/Legacy Program Data Products Query dialog.

8.3.3 FLS and Legacy Program Data Products Query

Querying the Spitzer Archive for the various special Archive Data Products, specifically from the FLS and the Legacy Science Programs, can be accomplished either from the Query -> FLS and Legacy Programs menu pulldown or by pressing the FLS/Legacy Programs Query shortcut icon. Figure 56 shows the dialog. You can obtain the observational data corresponding to the list of AORs.

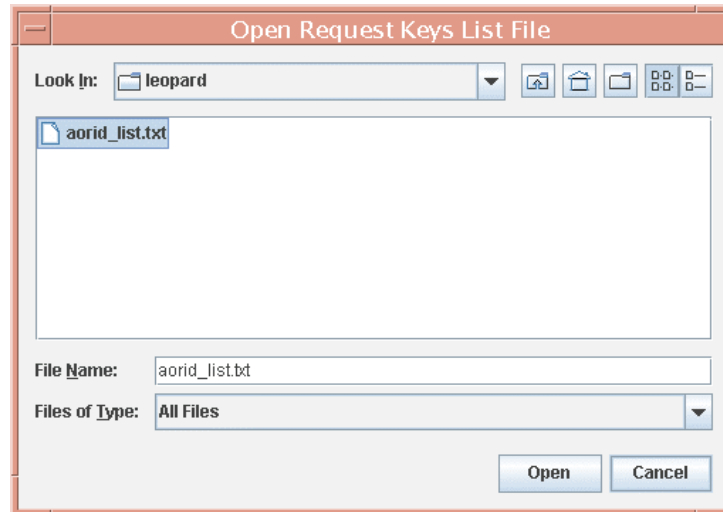


Figure 57: The AOR ID List Query dialog box. An ASCII file containing a sequential list of AOR IDs can be specified from a directory on local disk, and the results of the list query are returned to the main Leopard window.

8.3.4 AOR ID List Query

The Query -> AOR ID List Query menu pulldown or clicking on the By AOR ID List shortcut icon will result in a dialog (Figure 57), showing your local disk directories, from which you can select from your local directory a user-provided ASCII file, or simply enter the file name, which lists each request key one per line (see section 7.2.6). This file is then uploaded via Leopard to the SSC, where the results of the query are listed in the main Leopard window.

8.3.5 Fixed and Moving Target List Queries

The Query->By List of Positions menu pulldown or clicking on the By List of Positions shortcut icon will result in a dialog (Figure 58), showing your local disk directories, in which you can select from your local directory a user-provided ASCII file, or simply enter the file name, which lists names or positions of specific targets one per line (see section 7.2.7). This file is then uploaded via Leopard to the SSC, where the query results in a list of programs, analogous to Figure 53. Similarly, the Query->By List of NAIF IDs menu pulldown or clicking on the By List of NAIF IDs shortcut icon will result in a dialog (Figure 59), showing your local disk directories, in which you can select from your local directory a user-provided ASCII file, or simply enter the file name, which lists names or NAIF IDs of specific targets one per line. This file is then uploaded via Leopard to the SSC, where the query results in a list of programs, again analogous to Figure 53. If, for any of the targets, no programs are found with AORs within the search radius, Leopard will show you an error window that looks like Figure 60. In the error

window Leopard tells you the line number of the target search or searches that failed to match up with an existing program or programs.

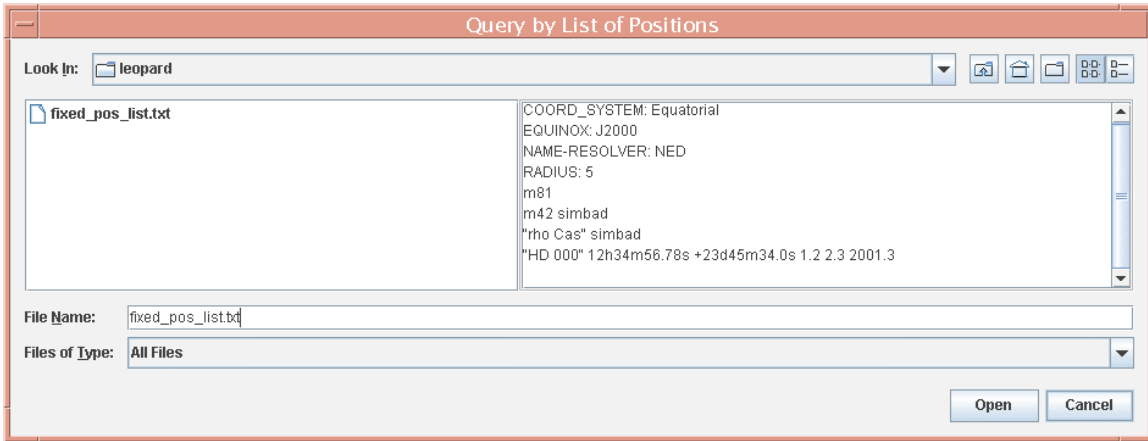


Figure 58: The Query by List of Positions dialog box. An ASCII file containing a sequential list of target positions can be specified from a directory on local disk (see section 7.2.7), and the results of the list query are returned to the main Leopard window.

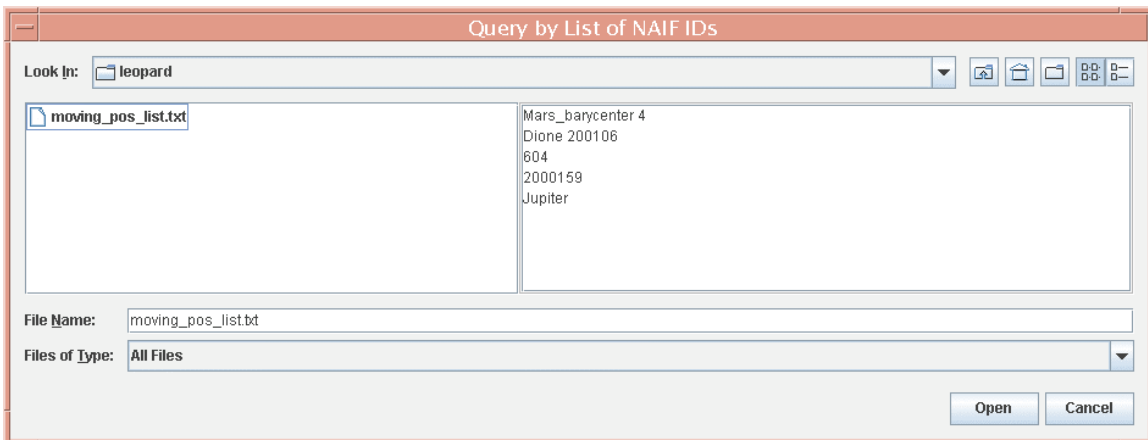


Figure 59: The Query by List of NAIF IDs dialog box. An ASCII file containing a sequential list of target NAIF names or NAIF IDs can be specified from a directory on local disk, and the results of the list query are returned to the main Leopard window.

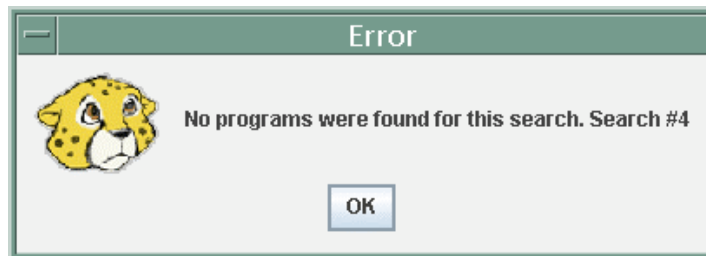


Figure 60: The Query by List of Positions or Query by List of NAIF IDs will return an error window like this if no programs are found within the search radius of a target, or with the NAIF name or ID. The window lists the line number of the target with no match.

8.3.6 Popular Products Query

Querying the Spitzer Archive for general Popular Products, i.e., the Legacy Science enhanced data products, can be accomplished either from the Query -> Popular Products menu pulldown or by pressing the Query Popular Products shortcut icon. Figure 61 shows the dialog that allows you to select the various available data products. The available selections shown in this dialog will be constantly updated as the data are posted by the SSC.

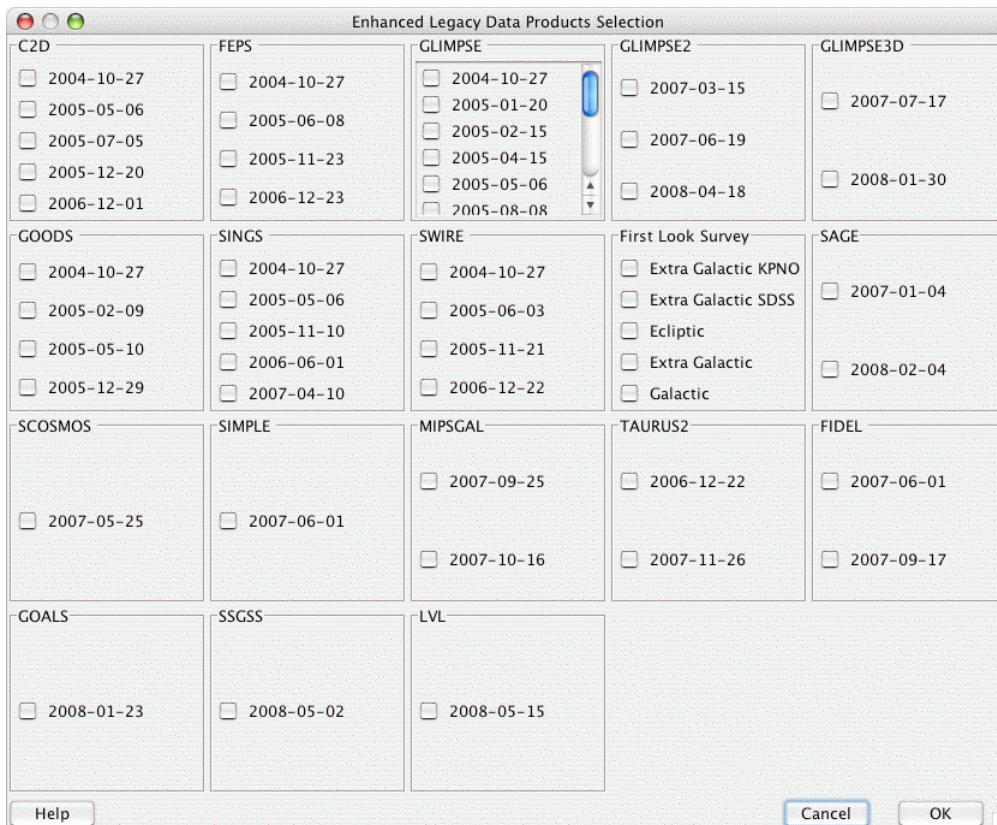


Figure 61: The Popular Products Query dialog, as of the Leopard v9 release date. The contents of this query dialog are constantly being updated.

8.3.7 Legacy Ancillary Data Archive Query

Querying the Spitzer Archive for the Ancillary Data Products from the original Legacy Science Programs can be accomplished either from the Query -> Query Legacy Ancillary Data Archive menu pulldown or by pressing the Query for Ancillary Data shortcut icon. These Ancillary Data Products are served through the NASA/IPAC Infrared Science Archive (IRSA; see <http://irsa.ipac.caltech.edu>). Figure 62 shows the dialog, in this example we wish to obtain a 1° radius circular section of the Spitzer First Look Survey (FLS) ancillary VLA data (see more details at the FLS page, <http://ssc.spitzer.caltech.edu/fls/>; the coordinates of the center of the section are shown in the dialog). After clicking 'OK' in the dialog, Figure 63 shows the results of the query in the Leopard main window.

In the list of the query results shown in Figure 63, to the far left you can click the “Get” box and to the far right is the “Retrieve Now” column, where you can select “Click to Show Catalog.” Figure 64 shows the results of obtaining the catalog data. From this dialog you can then save this data table to disk (by clicking on “Save Table”), or as shown in Figure 65, display the ancillary data on an image, in this case the IRIS 25 μm image showing the FLS field.

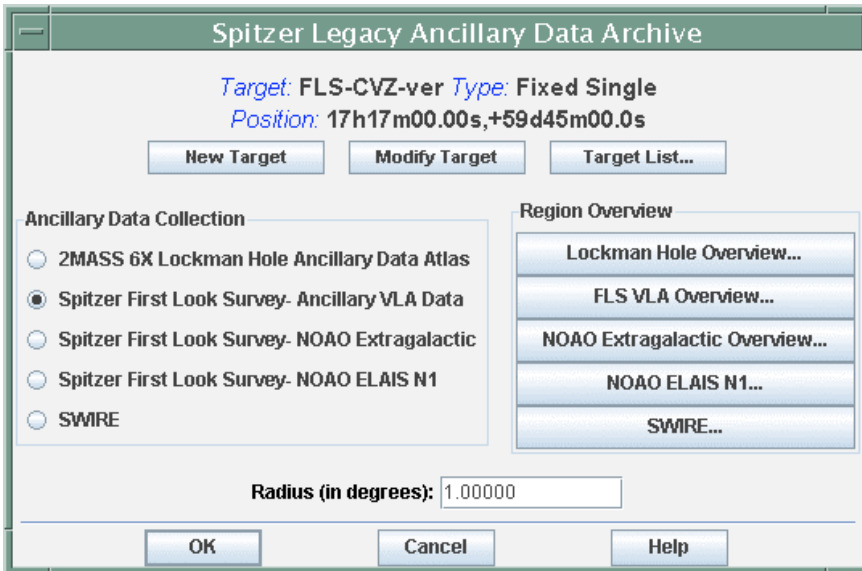


Figure 62: The Spitzer Legacy Ancillary Data Archive Query dialog.

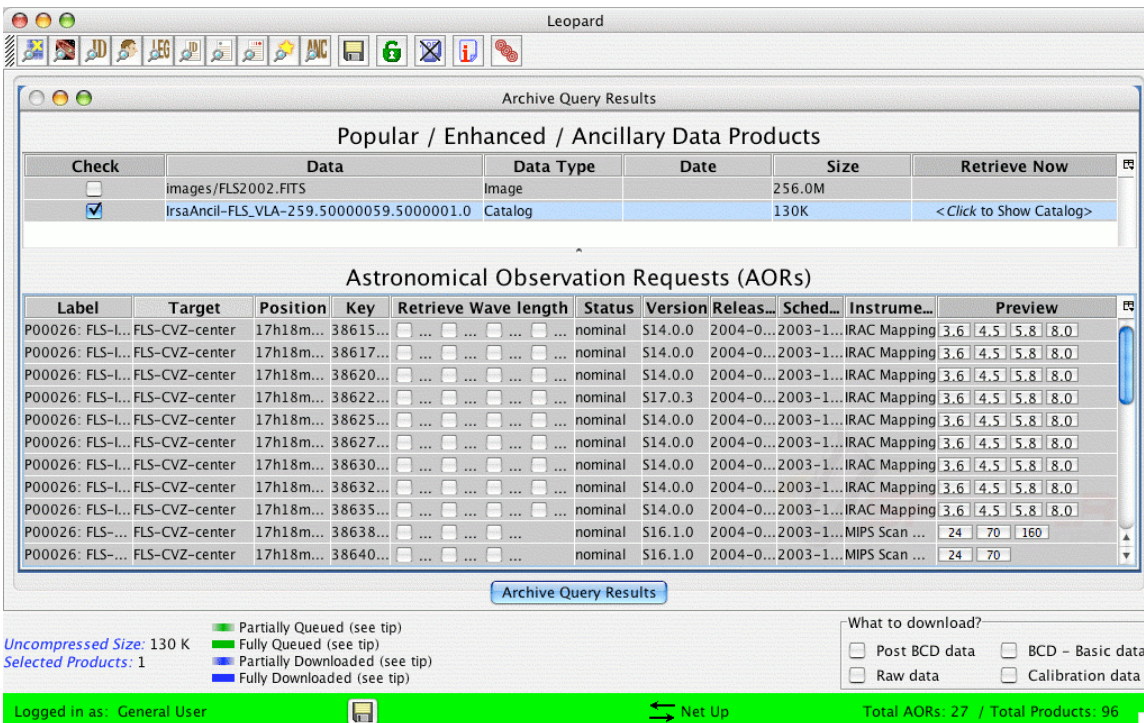


Figure 63: The main Leopard window, showing the results of the example in Figure 62, the selection of the Spitzer First Look Survey ancillary VLA data.

On	Hi.	Shape	Tgt. Name	N	RA	Dec	cnt
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m09.35s	+59d26m40.3s	942
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m11.46s	+59d32m00.5s	955
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m12.73s	+59d36m44.4s	961
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m15.74s	+59d23m31.5s	967
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m22.59s	+59d35m08.5s	996
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m23.00s	+59d37m29.3s	997
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m24.87s	+59d29m48.5s	1,000
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m25.79s	+59d22m12.0s	1,001
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m25.71s	+59d39m59.8s	1,005
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m27.31s	+59d28m40.0s	1,011
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m29.67s	+59d32m33.5s	1,015
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m30.91s	+59d28m23.1s	1,024
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m33.80s	+59d21m19.5s	1,030
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m34.72s	+59d18m18.9s	1,033
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m36.54s	+59d44m56.4s	1,054
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m40.74s	+59d26m42.1s	1,064
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m46.08s	+59d17m34.6s	1,084
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m47.41s	+59d18m44.0s	1,091
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	17h14m47.19s	+59d21m59.7s	1,093

Figure 64: The dialog, listing the results of the example in Figure 62, the selection of the Spitzer First Look Survey ancillary VLA catalog data. See section 15.4 of the Spot User's Guide for detailed discussion of the format of the dialog box.

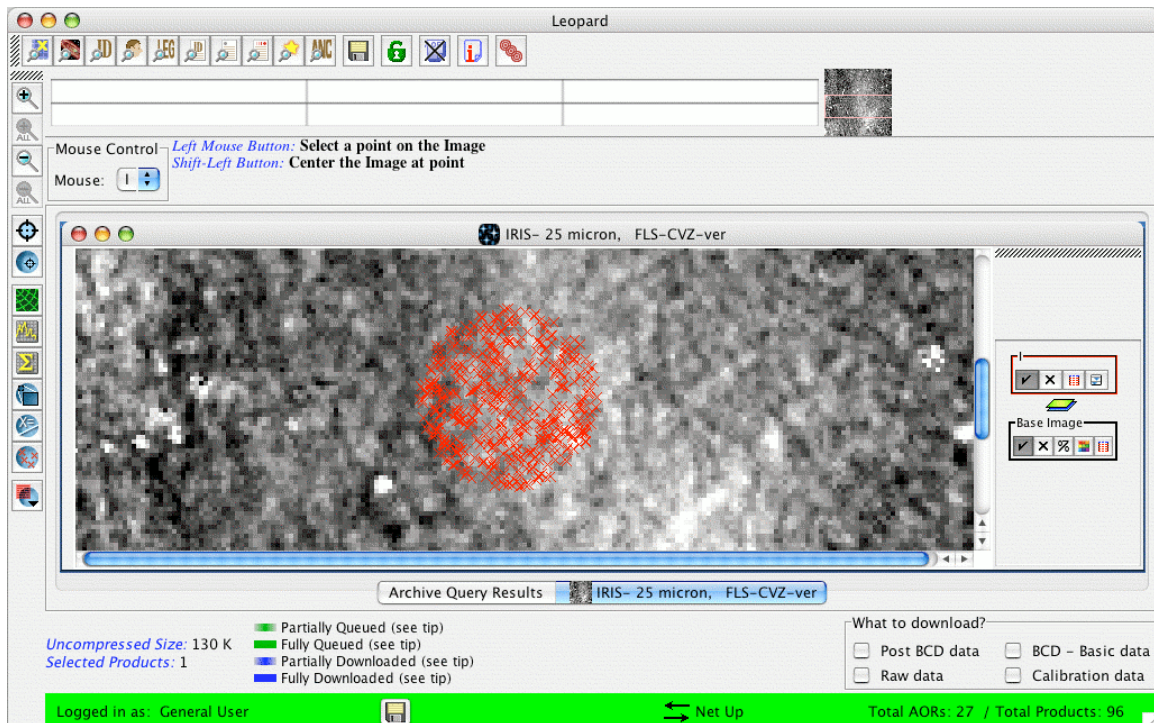



Figure 65: The main Leopard window, showing the example ancillary data listed in Figure 64 overlaid on the IRIS 25 μ m image containing the FLS field. To the far right of the displayed ISSA image are two layer control boxes.

In Figure 65, you can see two boxes to the far right of the displayed image, shown in Figure 66. These are layer control boxes, one of which controls the base image (the displayed ISSA image), and one that can allow you to constrain the range of parameters for the data overlaid on the image. See section 9 for a more detailed discussion of image

overlays and layer controls. Figure 67 shows the dialog that pops up when you click the far right icon  in this layer control box. In this example the dialog shows controls that would allow the user to set the minimum and maximum source counter number, 'cntr,' for the ancillary VLA radio data.

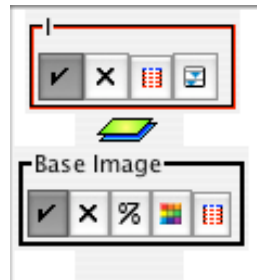


Figure 66: The two layer control boxes, one controlling the base image and the other, labeled 'I,' controlling the image overlay window.

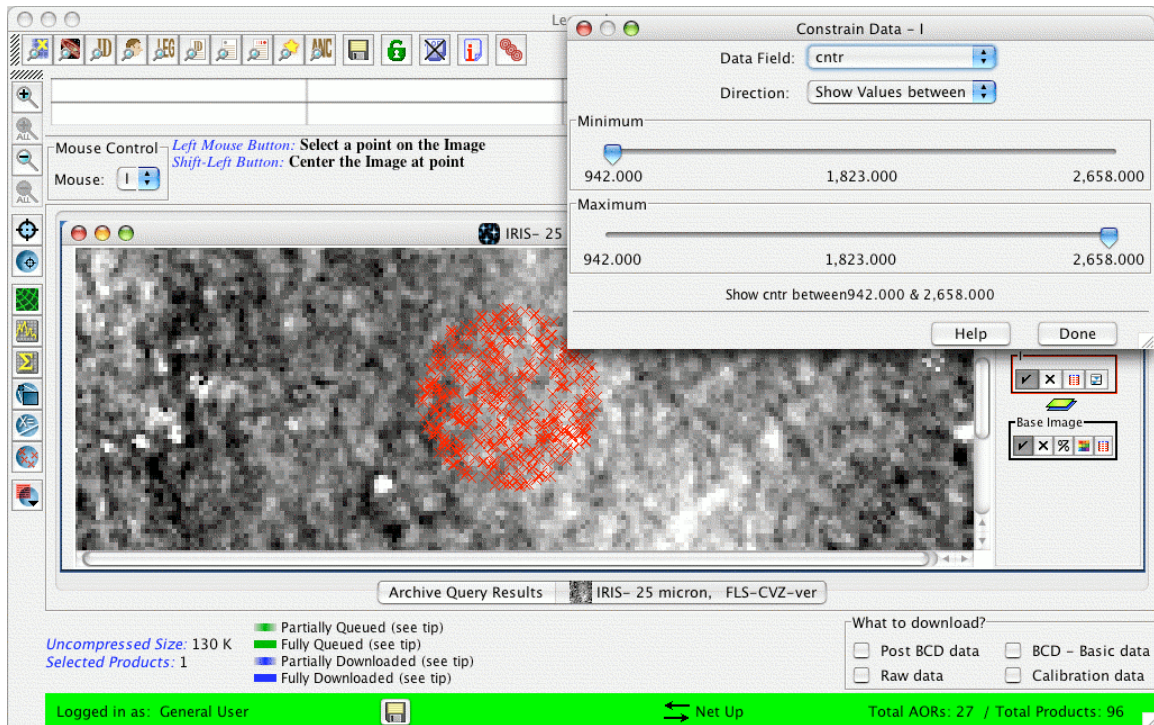


Figure 67: Within the layer control box labeled 'I' shown in Figure 66, clicking the icon to the far right will bring up the dialog shown here, which allows the user to constrain the various parameters of the ancillary data. In this example, the range of the data counter number, 'cntr,' can be adjusted in the dialog box.

8.3.8 Login to Spitzer Archive

You can login to the Spitzer Data Archive either from the File -> Login to Spitzer Archive menu pulldown or by clicking on the Spitzer Archive Login shortcut icon. This login is required for obtaining proprietary data. Non-proprietary data do not require a login. Figure 68 shows the dialog for entering your user name and password to obtain your data. The user name and password are issued to you by the SSC for your specific

Spitzer program data. (**Note:** These are not the same as your proposal username and password.) You will be notified by the SSC when your proprietary data are in the Archive. To logout of the archive, use the File -> Logout from Spitzer Archive menu pulldown. Additionally, you can change your password using the File -> Change Password to Spitzer Archive menu pulldown.



Figure 68: The Spitzer Archive Login dialog. The SSC provides you with the user name and password for your proprietary data. The user name shown here is purely illustrative.

8.3.9 Detail Information

You can obtain detailed information about the AOR or ancillary data (see section 8.3.7 and Figure 63) that you have highlighted by clicking on the AOR or ancillary data entry in the main Leopard window. This can be accomplished from the Info -> Detail Information menu pulldown or by clicking on the Detail Information shortcut icon. Figure 69 shows the detail information dialog, in this case for the FLS AOR. Clicking on the tabs toward the top of the dialog box will provide different types of information about the AOR or ancillary data, including the AOR parameters, the size (in bytes) of the available data, the program information (specifically, the program PI information and abstract), comments about the data quality by the SSC Data Quality Analysis (DQA) team, and a preview visualization of the basic calibrated data (BCDs).

You can roughly estimate what the total integration time is for an AOR from the “Params” tab, by looking at the “frame time,” “number of frames,” “number of cycles,” etc., but to far more precisely estimate the total integration time per pointing, you should use this information in conjunction with that from the Depth of Coverage image overlay (see section 7.7.21).

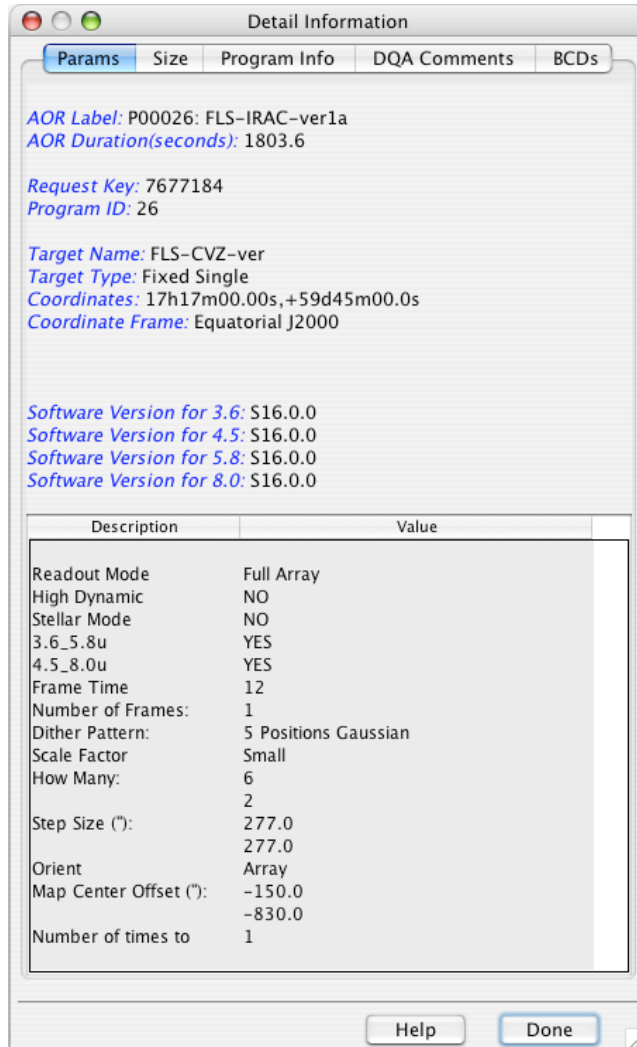


Figure 69: The Detail Information dialog. Clicking on the tabs toward the top of the box provides various types of information about the AOR or ancillary data.

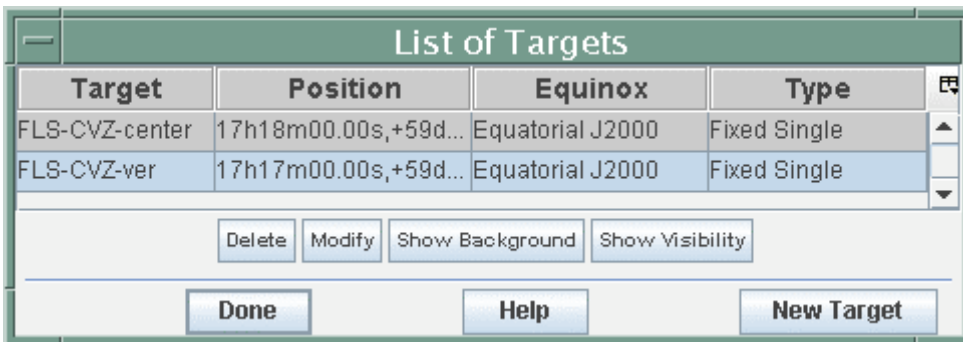


Figure 70: The List of Targets dialog.

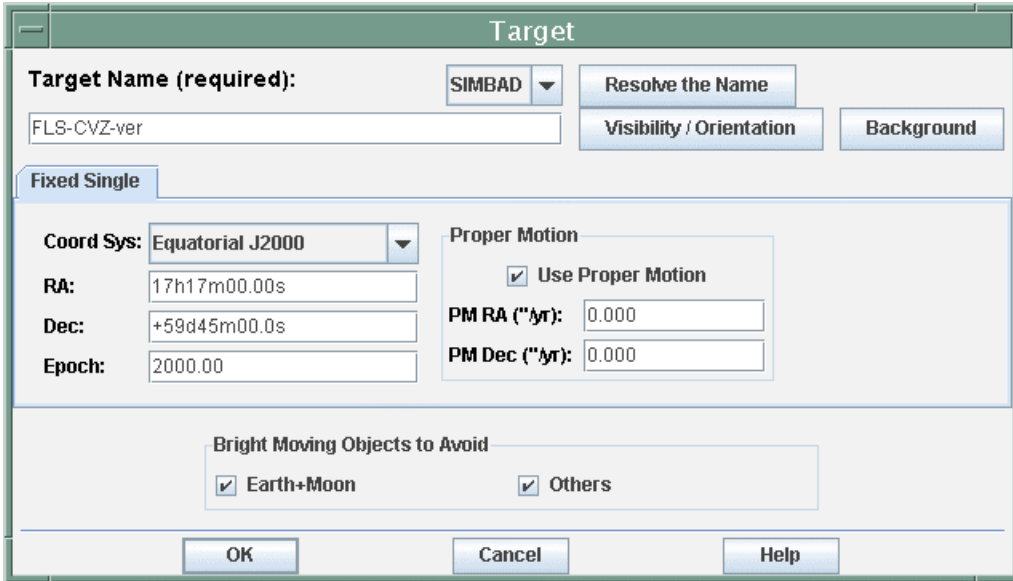


Figure 71: The Target dialog, in this case, for a fixed single target.

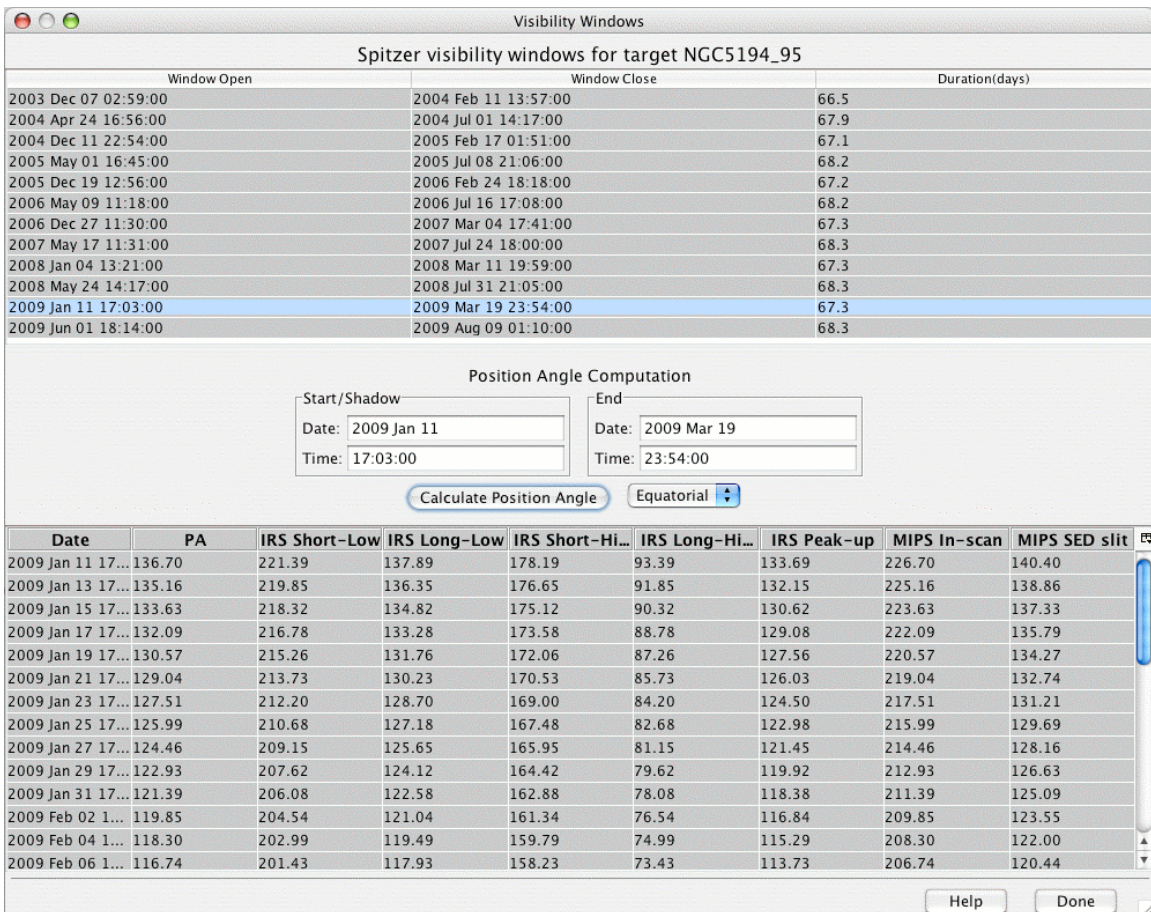



Figure 72: The visibility window/orientation dialog, in this case, for a fixed single target.

8.3.10 List of Targets

This feature is analogous to the target list feature in Spot. When AORs are listed in the Archive Query Results window, clicking on the Target List icon (), or, alternatively, using the Info -> Target List menu pulldown, will result in the list of targets corresponding to those AORs (Figure 70). Targets in the list can be deleted individually by highlighting them one at a time and then clicking the Delete button. You can also delete all targets in the list using the Edit -> Delete All Targets pulldown. Click on the Modify button to bring up the target dialog shown in Figure 71. To obtain visibility window and orientation information on the target, press the Visibility/Orientation button in this dialog (see the Spot User's Guide, section 10.7 for a more detailed discussion on target visibility windows). The visibility window/orientation dialog, shown in Figure 72, will list a target's visibility windows and, for a given date (typically, the date the AOR was executed), will calculate the position angles for the various FOV when you press the Calculate Position Angle button. To estimate the sky background for the target, press the Background button in the target dialog (Figure 71), and the dialog shown in Figure 73 will appear. You can then calculate the background, by pressing the Do Estimate button, for any wavelength (in μm) and for either a specific date or over the range of dates that the target is visible to Spitzer (see the Spot User's Guide, section 10.7). Once the visibility windows/orientation and/or background have been estimated, you can list these values by pressing the Show Visibility or Show Background buttons in the List of Targets dialog in Figure 70.

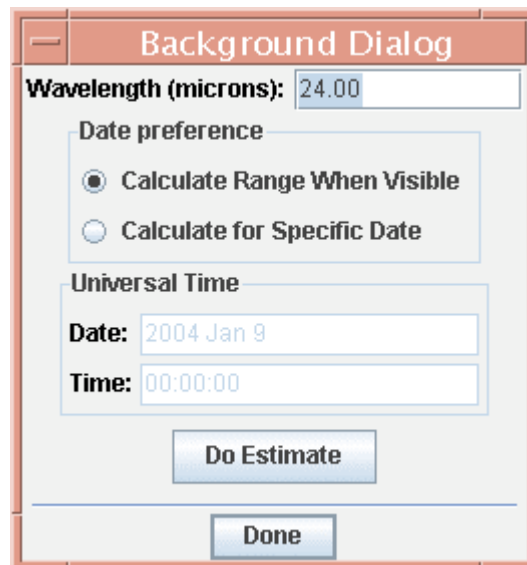


Figure 73: The background dialog, in this case, for a fixed single target.

8.4 Bottom Bar

At the bottom of the main screen (Figure 48), Leopard provides information about the currently selected AOR dataset(s), as well as information about the status of the network and the total number of AORs in the window (Figure 74). The information provided includes:

- **The number and size, in bytes, of selected data products** for download to local disk.
- **Queue/download status** of data requested from the Archive.
 - *Partially queued:* You have requested a part of a data product, and it has been queued for download. Note that you do not have to request all the available data for this product. For example, you may have requested only the raw data, but not the BCD data.
 - *Fully queued:* All data available for this product have been queued for download.
 - *Partially downloaded:* You have requested part of a product, and it has been downloaded to local disk. Note that you do not have to request all the available data for this product. For example, you may have requested only the raw data, but not the BCD data.
 - *Fully downloaded:* All data for this product have been downloaded to local disk.
- **Data product type options** (Raw, BCD, Post-BCD, Calibration) to download.
- **Disk Icon** - If you have selected data to download from the Archive, the diskette icon will appear in the bottom bar of the main window. You may begin the download process by clicking this icon, clicking the disk icon in the upper icon bar, or selecting the File -> Download Selections pulldown menu.
- **Net Icon** - The Net Up or Net Down words and symbols give you the current status of your connection to the servers at the Spitzer Science Center, if you are connected via the Internet. If the network is down, or you are working offline, you can still enter target information into Leopard and display images or catalogs you have cached or have locally on disk. You cannot query the Spitzer Archive, obtain target background estimates, visibility windows, orientation information, or load new images or catalogs from the server if the network is down.
- **Total AORs/Total Products** – If you queried AORs from the Archive, on the far right of the bottom bar, Leopard reports how many AORs are currently loaded, and how many possible data products (wavelengths) are possible to download.

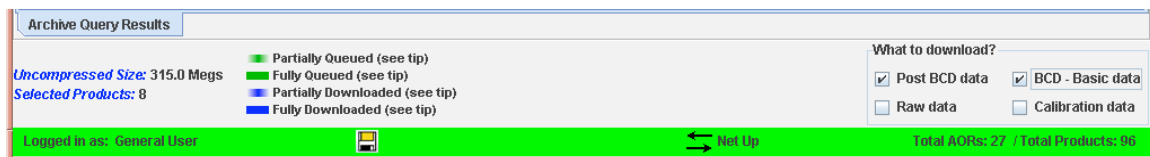


Figure 74: The bottom of the main Leopard window, showing the results of an Archive query.





9 Target and AOR Visualization

In this section, we describe the Leopard capabilities for visualizing the sky at target positions. Overlaying the area coverage of an AOR is discussed in section 7.7.17. Descriptions of the Images and Overlays menu functions are discussed in sections 7.6 and 7.7. In this section, we walk through examples using Leopard's visualization capabilities in assessing AORs.








9.1 Displaying and Manipulating Images

To visualize the sky at a target position, you can go directly to the Images menu and select the appropriate sky image(s). In sections 7.6.1 and 7.6.4, we showed how to download IRAS images and Digital Sky Survey (DSS) images. In Figure 75 we show what the Leopard screen would look like after downloading an IRIS 25 μm image and a DSS Second Generation image. The frame with the DSS image is the currently active frame. If you display multiple images within a frame, the tabs along the bottom of the frame allow you to toggle between the images in the frame.

9.1.1 Image Control

To zoom the image in or out, use the magnifying glass icons on the left of the Leopard window (Figure 75; see also Figure 47). The  icon will zoom in the current image, and the  icon will zoom out. The  and  icons will apply the zoom to all the images in the selected frame. To move the image around in the frame you can use the scroll bars on the frame or move the positioning box on the thumbnail image.

9.1.2 Image Window Control

When using the visualization tools, we suggest that you maximize your Leopard window to fill your computer screen. The displayed image space can then be maximized by clicking the maximize icon  in the upper right hand corner of the image frame. However, if you need to place more than one image in the Leopard window, you can minimize the image by clicking the minimize icon . (The Mac equivalent is the green button  in the upper left hand corner.) The iconify icon  will place the image icon at the bottom of the Leopard window (the Mac equivalent is the yellow button  in the upper left hand corner). To delete the image window, click on the delete icon  in the upper right hand corner (the Mac equivalent is the red button  in the upper left hand corner).

9.1.3 Cursor Readout

When you move your cursor over an image the flux, pixel scale, and two sets of coordinate values are displayed below the Leopard icon bar. See section 7.8.5 to select which coordinate values Leopard returns in these displays. **For ISSA/IRIS images, Leopard returns flux values in MJy/Sr in the left-most readout below the icon bar. For 2MASS images, you should not rely on the DN readout for photometry. Use the 2MASS catalogs for accurate photometric measurements.**

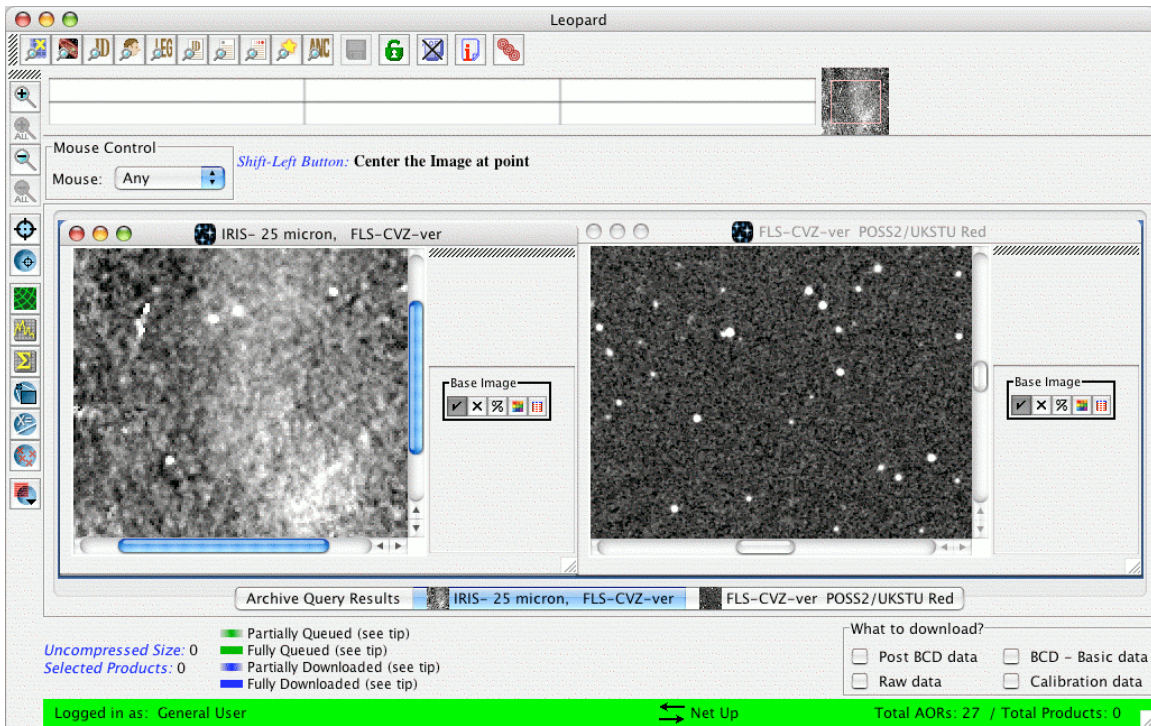


Figure 75: The Leopard screen after downloading ISSA 25 μm and DSS Second Generation images.

9.1.4 Layer Control

The side bar to the right of the image frames (Figure 75) shows a box that says “Base Image” with show/hide layer , delete layer , opacity control and image header icons in it. If you click the show/hide layer icon, Leopard hides or shows the image. If you click the delete layer icon, the image layer in the frames will be deleted. The opacity control icon brings up an image opacity control dialog. This allows you to control how opaque will be the image layer. This is very useful if you have a second image as an overlay in a frame (not ‘loaded’ in the same frame, *overlaid* as in Overlay -> Image Overlays from the Leopard menus). The color table control icon brings up a dialog allowing you to adjust the color table for the image.

The side bar contains the controls of image and overlay layers. You can create several layers and then hide or show them with the show/hide layer icons without having to recreate them each time. Each overlay introduces a new layer control box on the side bar. The Base Image layer does not need to be the bottom layer. You can move it between other overlays in the frame by clicking on any part of the layer control box and dragging it between layers to where you want it.

9.1.5 Three-Color Image Display

Leopard provides you with the ability to produce three-color composite image display for overlays. The three images are read individually into the ‘red,’ ‘green,’ and ‘blue’ (RGB) color planes to produce the composite. To produce a composite, first select an image from the Images menu. Then, select “Make This a 3 Color Plot” in the Three Color Plots box in the Image window (see, e.g., Figure 21). Choose the color plane into which you wish to read the image. In Figure 76 we illustrate this with a generic FITS file, in this

case, a Spitzer image of M51 from the SINGS Legacy program. The IRAC Channel 1 (3.6 μm) image is read into the blue color band.

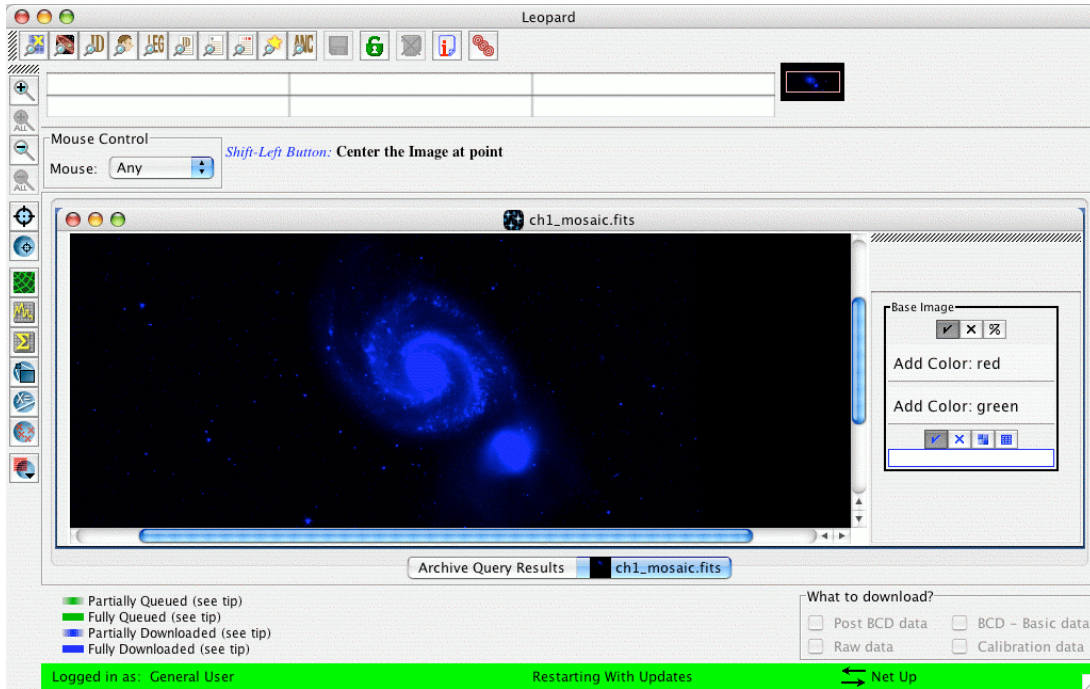


Figure 76: A single FITS image (in this case, the Spitzer SINGS Legacy project 3.6 μm image of M51) mapped into the blue color band. Note at right of the image the layer control box allowing you to add other images into the remaining color bands.

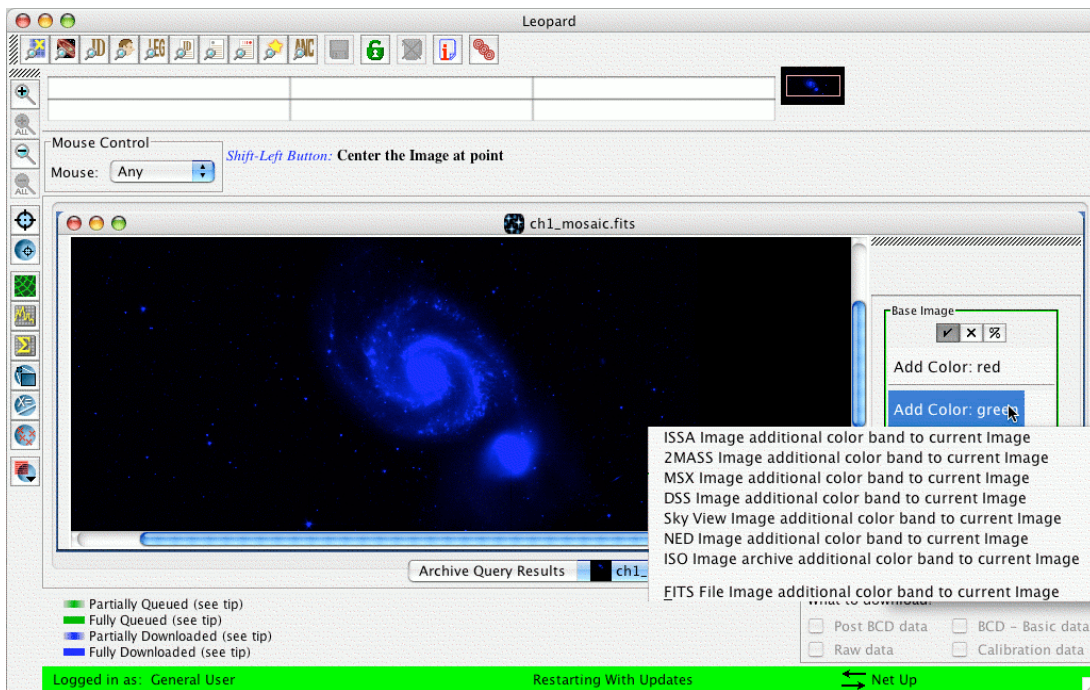


Figure 77: The menu of images that can be added into the next color plane. The image mapped into the additional color band does not necessarily need to be of the same type. Any of the images listed can be selected.

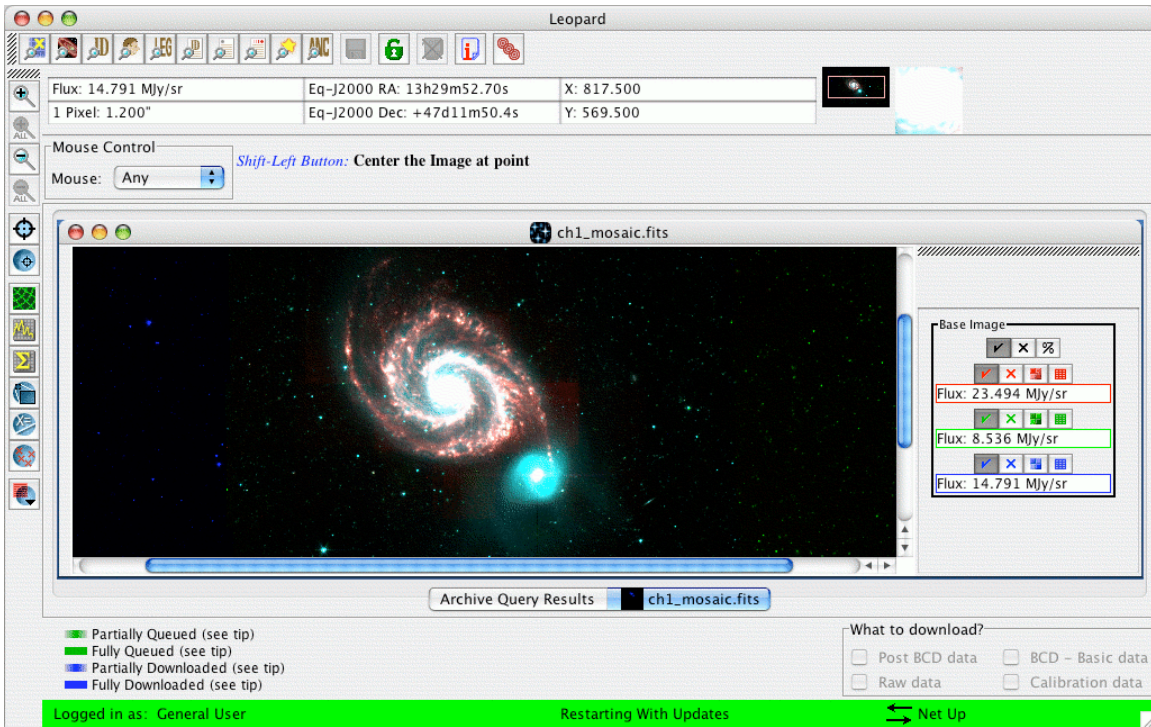


Figure 78: The full three-color composite image display of the M51 Spitzer IRAC data.

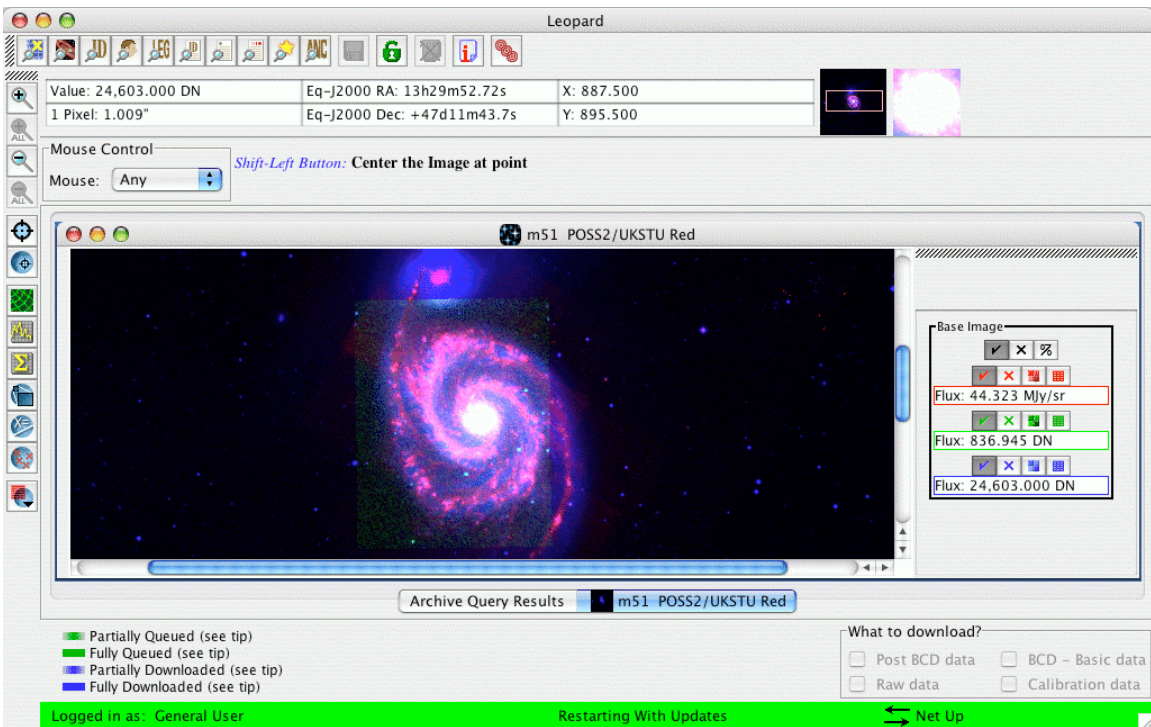


Figure 79: A three-color composite image display for M51 – the DSS image is mapped into blue, the 2MASS K_s image is mapped into green, and the Spitzer IRAC 8.0 μm image into red.

To read in another image and map it into another color plane, for instance, green, select the “Add Color: green” item in the layer control box shown in Figure 76 for the base image. This results in a menu from which you can select the next image in the composite (Figure 77). In this case, we will select the Channel 2 (4.5 μm) Spitzer image of M51 to map into green. Finally, we will select the Channel 4 (8.0 μm) image to map into the red. The resulting three-color composite is shown in Figure 78. The three images do not necessarily need to be from the same image source. You also do not need to use all three color planes. For instance, the composite shown in Figure 79 is assembled from the DSS image of M51 mapped into the blue band, the 2MASS K_s image mapped into green, and the IRAC 8.0 μm image mapped into red. Note that Leopard will automatically perform any transformations for the images, so that they are registered to a common reference frame, using the WCS information in each of the image headers. You can use the layer controls for each image to show/hide the layer, delete the layer, or adjust the color table for the layer.

9.1.6 Cropping Images

The Crop utility under the Overlays menu (and also along the image manipulation and overlays tool bar) allows you to crop an image in the Images window. As illustrated in Figure 80, once the utility is selected, simply drag your cursor across the image, while holding the left mouse button, and a red box will be drawn, delineating the image section you wish to crop. Releasing the mouse button will result in a cropped copy of the original image, as shown in Figure 81, with the original image left intact.

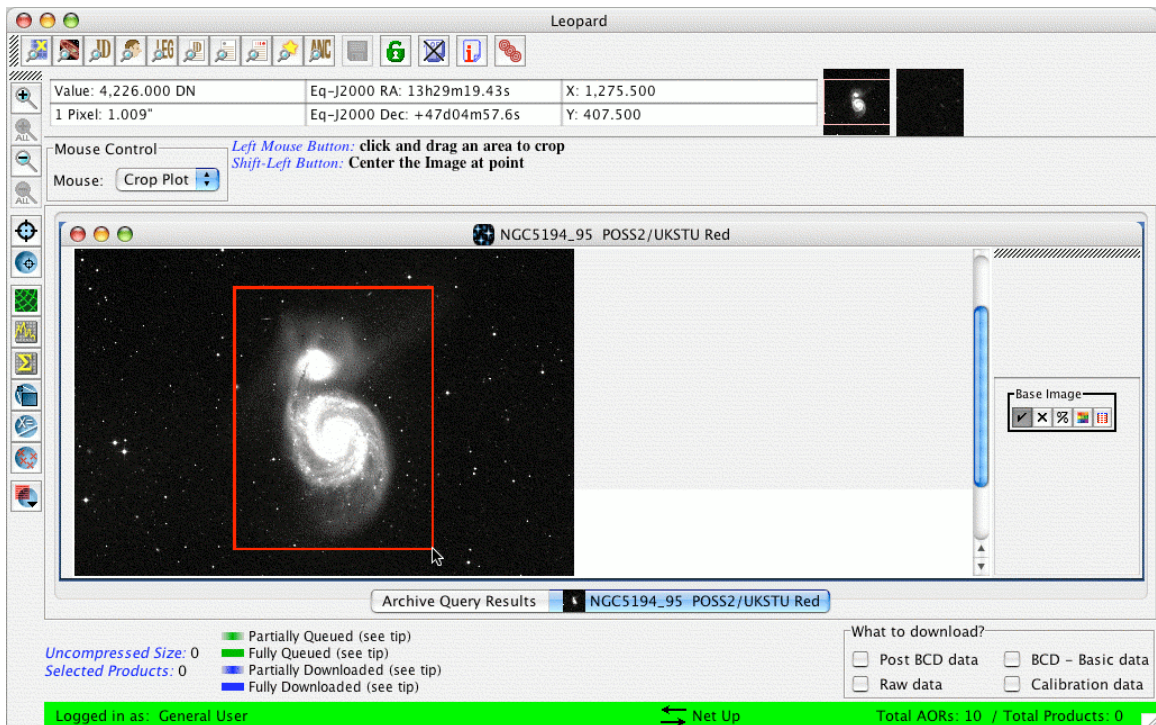


Figure 80: Once the Crop utility under the Overlays menu (also the Crop icon in the image manipulation and overlays tool bar, along the left side) has been selected, drag the cursor across the image, while holding the left mouse button, as shown in the figure.

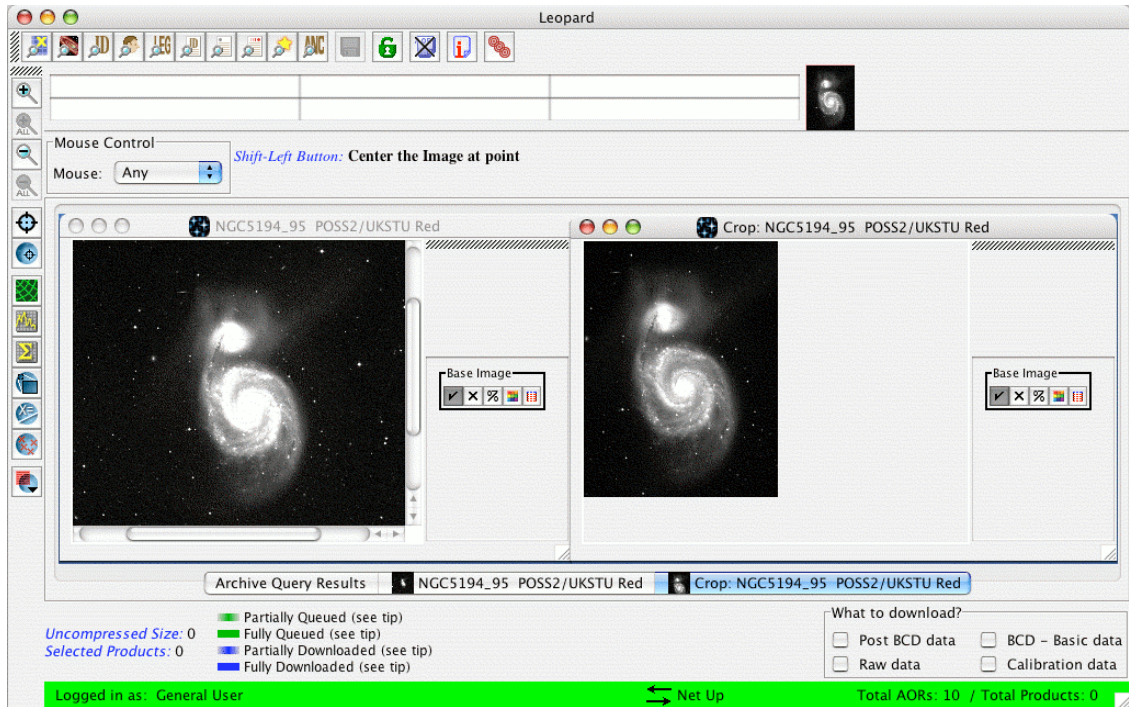


Figure 81: Using the Crop utility, a cropped copy of the original image is created, after selecting the image section to be cropped (see Figure 80). The Use Large Control Icons option has been set in this example.

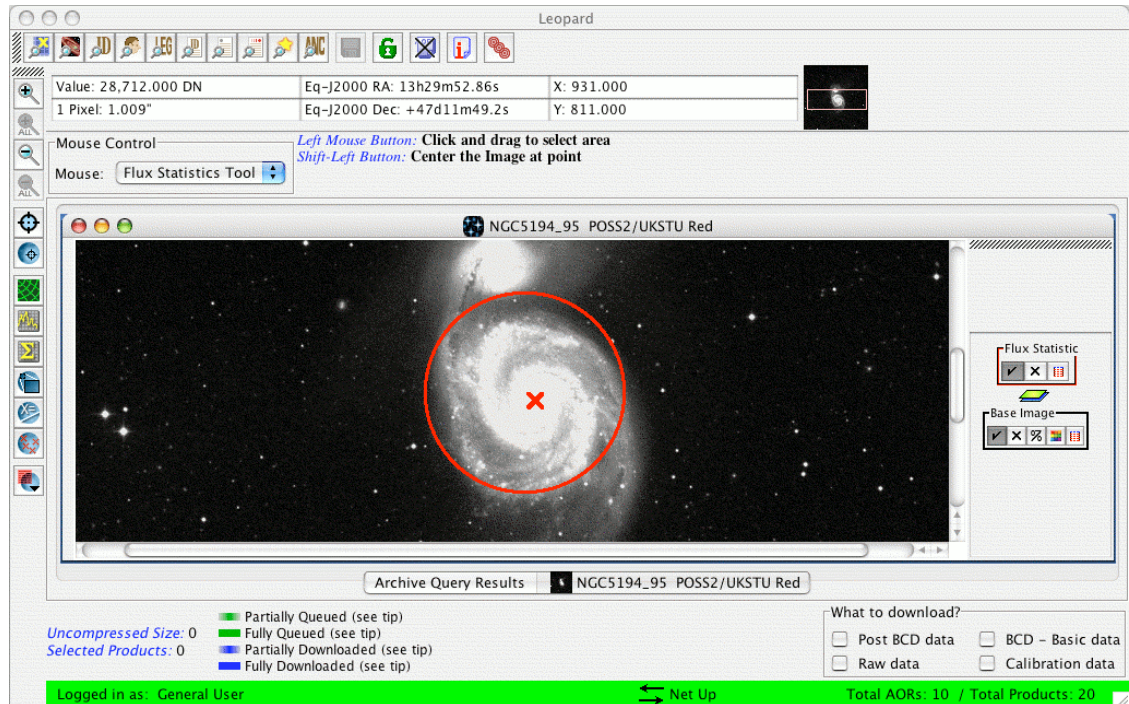


Figure 82: Once the Area Statistics utility under the Overlays menu (also the Area Statistics icon in the image manipulation and overlays tool bar, along the left side) has been selected, drag the cursor across the image, while holding the left mouse button, as shown in the figure. This will result in an aperture being drawn on the image. Releasing the mouse button will open the results dialog shown in Figure 83. A red “X” appears on the image when one of the quantities in the dialog is highlighted.

9.1.7 Measuring Area Statistics

The Area Statistics utility under the Overlays menu (and also along the image manipulation and overlays tool bar) allows you to draw either a circular or rectangular aperture on an image in the Images window. As illustrated in Figure 82, once the utility is selected, simply drag your cursor across the image, while holding the left mouse button, and a red aperture will be drawn, delineating the image section you wish to define as the area over which the statistics will be computed. Releasing the mouse button will result in a dialog window, as shown in Figure 83. The quantities that are computed within the defined area are the mean flux (and the standard deviation from that mean), the integrated flux, the maximum and minimum fluxes, and the aperture and flux-weighted centroids. Moving the mouse over any of the latter four quantities in the dialog will result in a red "X" showing the position for that quantity on the image. The pulldown menu within the dialog allows you to select either a circle or rectangle to define the aperture.

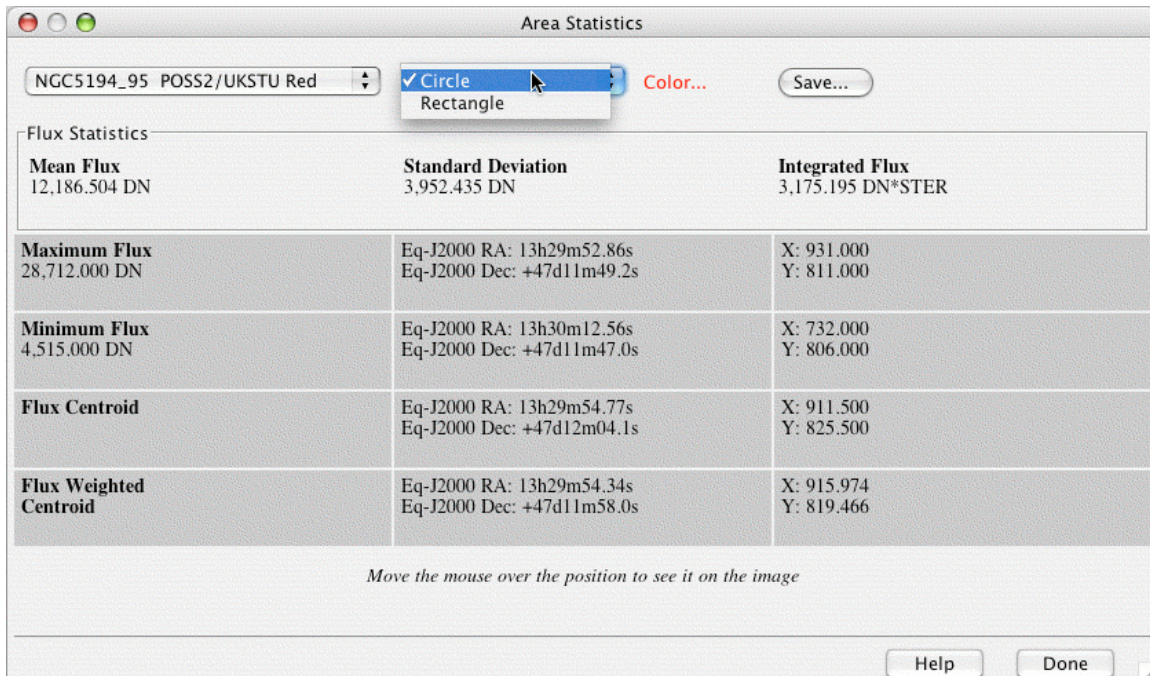


Figure 83: Using the Area Statistics utility, the dialog window in the figure opens, showing the resulting statistics within the aperture drawn in Figure 82. The pulldown menu toward the top of the window allows you to select either a circular or rectangular aperture.

9.2 Current Fixed Target Overlay

To see the position of your target on the current image, select Current Fixed Target from the Overlays menu (section 7.7.7). Leopard will display a red box at the coordinate position of the target you currently have selected from the target list. The current target is always listed in the Leopard bottom bar. In Figure 84 we show the current target for the FLS field marked on the ISSA 25 μm and DSS images. Another layer control has now been added to the side bars. You can show or hide the Target box with the show/hide layer icon and delete this overlay with the delete layer icon.

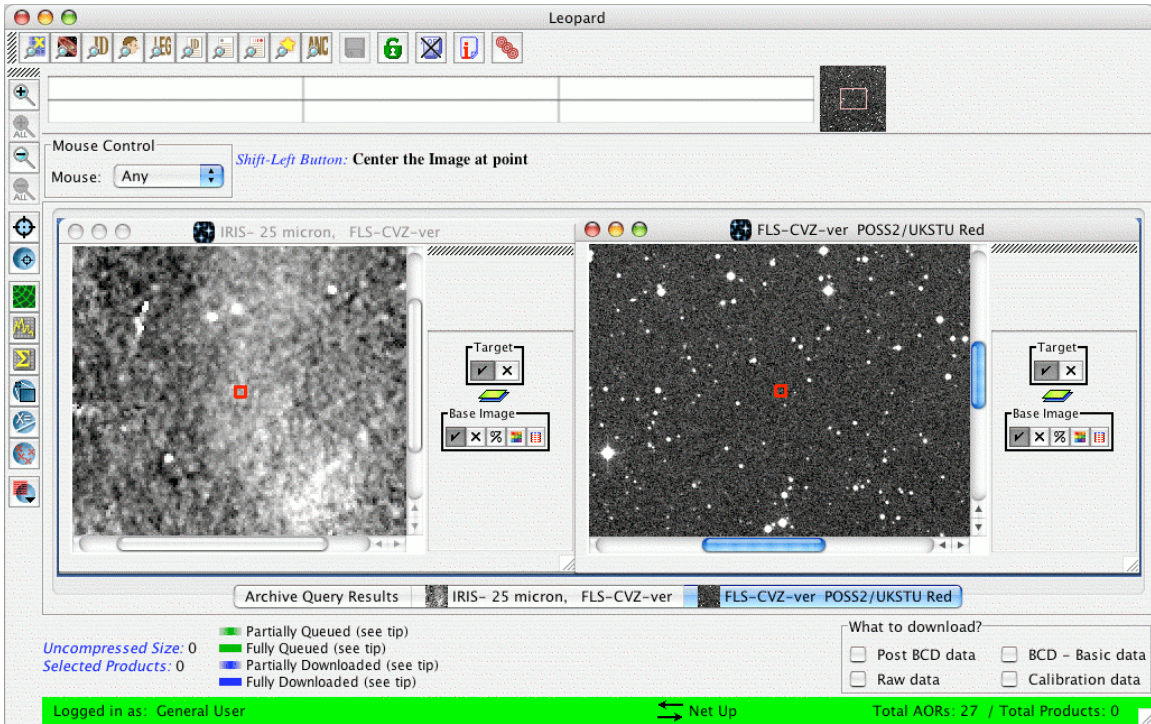


Figure 84: The current target position is marked on the IRIS 25 μm and DSS images by the red box.

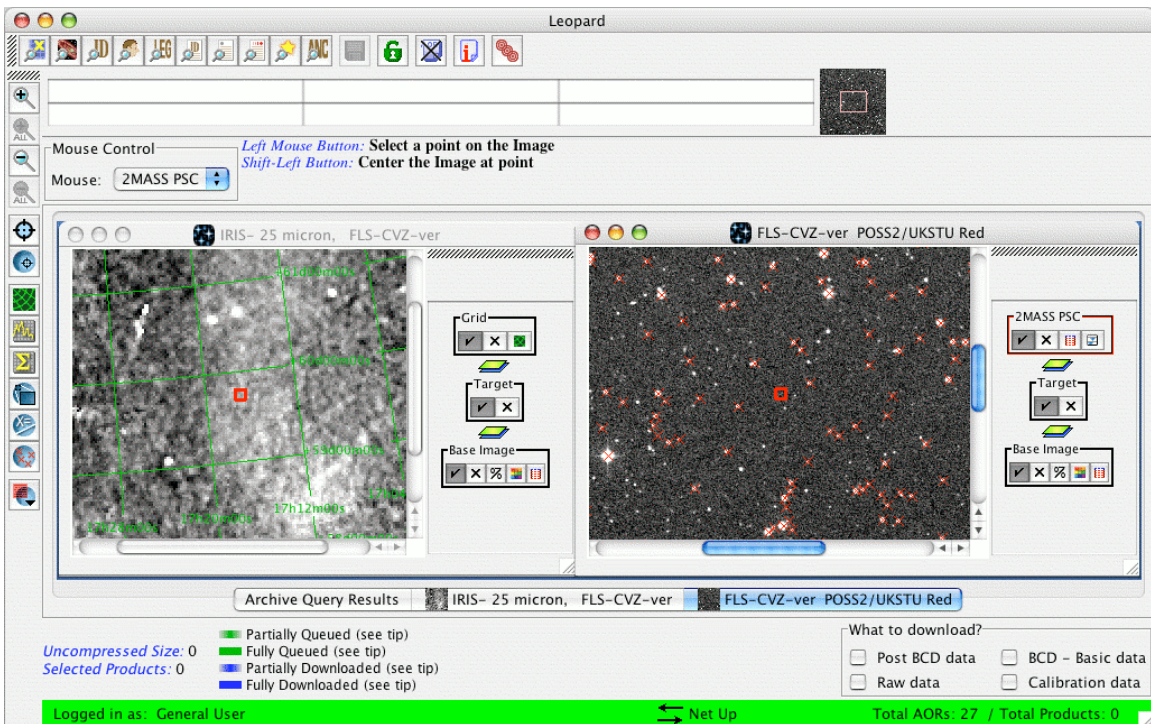





Figure 85: The left frame shows an equatorial J2000 (degrees) coordinate grid overlaid on the IRIS 25 μm image. The right frame shows the 2MASS Point Source catalog overlaid on the DSS image.

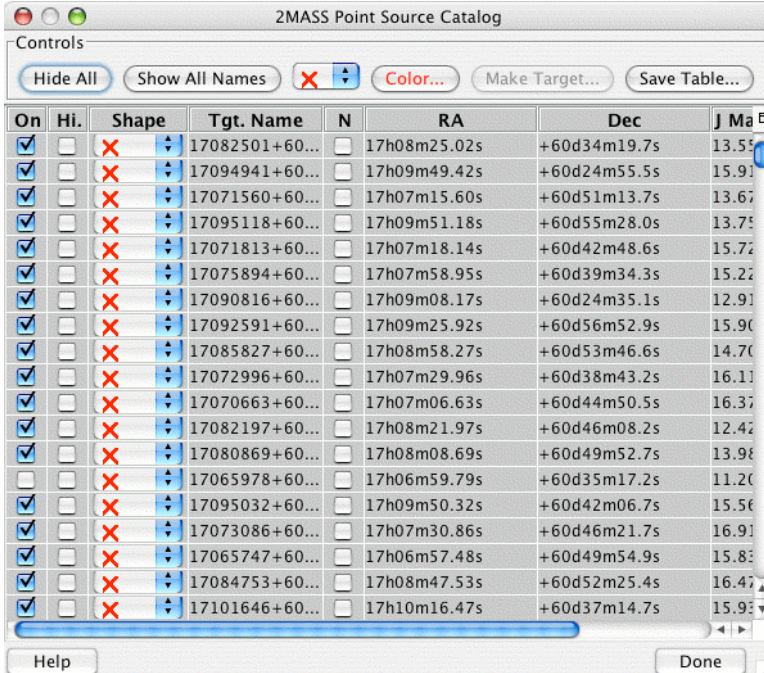
9.3 Overlaying a Coordinate Grid

The result from selecting Grid from the Overlays menu (section 7.7.5) and choosing an equatorial J2000 coordinate grid for the IRIS 25 μm image is shown on the left in Figure

85. The additional layer control labeled 'Grid' has also appeared in the side bar. In addition to the show/hide layer and delete layer icons, there is now a coordinate grid control icon . Clicking on this brings up a dialog where you can change the type of coordinate grid shown in the overlay.

9.4 Overlaying a Catalog

In Figure 25 we show the dialog that allows selection of the (IPAC) catalog overlays. The results of the selection in the figure (2MASS Point Source catalog with a 2.5° search radius) are shown in the right image (DSS) displayed in Figure 85. The layer control for the catalog has the name of the catalog, 2MASS PSC. There are four boxes in the layer control that allow you to do various things: The usual hide/show and delete layer icons are now joined by a catalog table  icon and constrain data  icon.



On	Hi.	Shape	Tgt. Name	N	RA	Dec	J Ma
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17082501+60...	<input type="checkbox"/>	17h08m25.02s	+60d34m19.7s	13.55
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17094941+60...	<input type="checkbox"/>	17h09m49.42s	+60d24m55.5s	15.91
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17071560+60...	<input type="checkbox"/>	17h07m15.60s	+60d51m13.7s	13.67
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17095118+60...	<input type="checkbox"/>	17h09m51.18s	+60d55m28.0s	13.75
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17071813+60...	<input type="checkbox"/>	17h07m18.14s	+60d42m48.6s	15.72
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17075894+60...	<input type="checkbox"/>	17h07m58.95s	+60d39m34.3s	15.22
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17090816+60...	<input type="checkbox"/>	17h09m08.17s	+60d24m35.1s	12.91
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17092591+60...	<input type="checkbox"/>	17h09m25.92s	+60d56m52.9s	15.90
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17085827+60...	<input type="checkbox"/>	17h08m58.27s	+60d53m46.6s	14.70
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17072996+60...	<input type="checkbox"/>	17h07m29.96s	+60d38m43.2s	16.11
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17070663+60...	<input type="checkbox"/>	17h07m06.63s	+60d44m50.5s	16.37
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17082197+60...	<input type="checkbox"/>	17h08m21.97s	+60d46m08.2s	12.42
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17080869+60...	<input type="checkbox"/>	17h08m08.69s	+60d49m52.7s	13.98
<input type="checkbox"/>	<input type="checkbox"/>		17065978+60...	<input type="checkbox"/>	17h06m59.79s	+60d35m17.2s	11.20
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17095032+60...	<input type="checkbox"/>	17h09m50.32s	+60d42m06.7s	15.56
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17073086+60...	<input type="checkbox"/>	17h07m30.86s	+60d46m21.7s	16.91
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17065747+60...	<input type="checkbox"/>	17h06m57.48s	+60d49m54.9s	15.83
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17084753+60...	<input type="checkbox"/>	17h08m47.53s	+60d52m25.4s	16.47
<input checked="" type="checkbox"/>	<input type="checkbox"/>		17101646+60...	<input type="checkbox"/>	17h10m16.47s	+60d37m14.7s	15.93

Figure 86: The table of the data in the catalog overlay shown on the right in Figure 85. You can manipulate which objects are marked and how they look from this dialog.

Click on the catalog table icon and a list, such as that seen in Figure 86, will appear. Each object in the catalog found within your specified search radius is listed. As with other target lists you can sort the columns by clicking on the column headers (once for sorting up, twice for down, and a third click will return you to the original order of the catalog). The color and shape scheme for the catalog overlay allow a few kinds of selecting and highlighting so some explanation is needed. When a catalog is overlaid all the objects' marks in the catalog are 'On' (checked in the 'On' box) and shown with the default red color. Clicking on a line in the catalog will activate that object's mark as 'selected'. The color of that object's mark will change to yellow -- the 'selected' color. Clicking on another line in the catalog will turn the color of that object's mark to yellow and the first object's mark will change color back to what it was previously.

You can highlight certain objects in the catalog by clicking on the 'Hi' box for the object. At first the object's mark will turn yellow (the 'selected' color since you clicked on it). When you click on another object in the catalog, the first object's mark will turn blue, the highlight color. Both the selected and highlighted colors of object's marks appear when the object is On ('On' box is checked). If you 'Hide All' or otherwise turn off various objects in your catalog, selecting or highlighting them will not turn the marks back on with the appropriate color. They must be 'On' for selecting or highlighting to work. The Color box at the top of the Catalog Window controls the color of the object's marks when they are On ('On' box is checked). It does not change the color of selected or highlighted marks. This will be the color of object's marks when the objects are 'On' but not otherwise highlighted or selected.

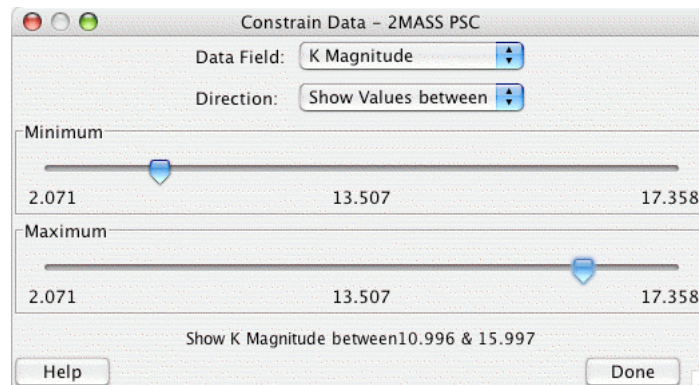



Figure 87: This dialog allows you to select the ranges of the data in the table currently displayed in the overlay. This example selects K band sources with magnitudes between about 11 and 16.

The constrain data icon will bring up a dialog with sliders, which allow you to easily select the range of data to display, or to exclude, for your table for a given data field. An example is shown in Figure 87 that selects K_s-band magnitudes between about 11 and 16.

9.5 Overlaying an Image

It is possible to overlay one image onto another by selecting Image Overlays in the Overlays pulldown menu. Once you have selected your base image from the Images pulldown menu, the Image Overlays menu allows you to select another image (either ISSA, 2MASS, MSX, DSS, SkyView, NED, or a user-selected FITS image from local disk) to overlay on the base image. The opacity of each image can be controlled using the opacity control dialog that pops up when you press the  icon in the layer control box for each image. In Figure 88 we show an example of a Spitzer IRAC image overlaid on a DSS image. In this example, the opacity of the top layer has been adjusted to 25%, and the bottom layer, 90%. You can vary an image's opacity by adjusting the slider on the control. You can continue to overlay additional images, if desired. Also, you can perform these image overlays in color (red, green, or blue), by selecting "Make This a 3-Color Plot" when overlaying an image. The three-color image visualization described in section 9.1.5 is analogous to this utility.

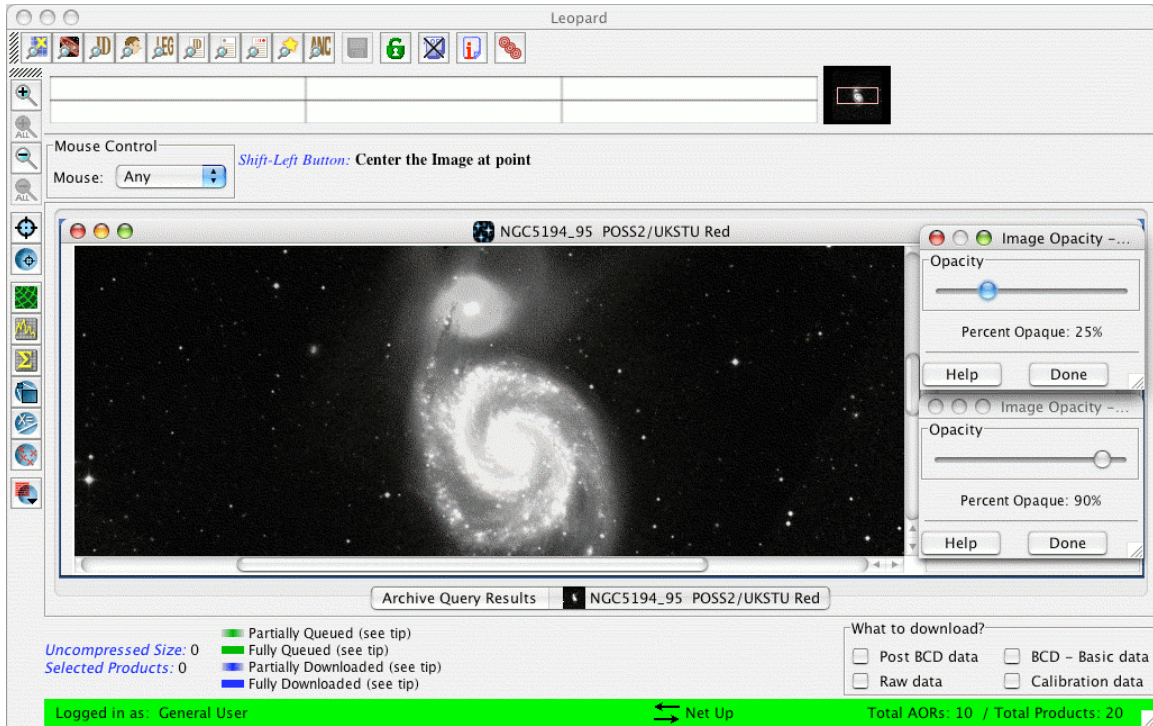


Figure 88: An example of Image Overlays. Here we have overlaid a Spitzer IRAC image on a DSS image of a famous Messier object. The opacity of each image can be adjusted using the opacity control. In this example, the opacity of the top layer has been adjusted to 25%, and the bottom layer, 90%.

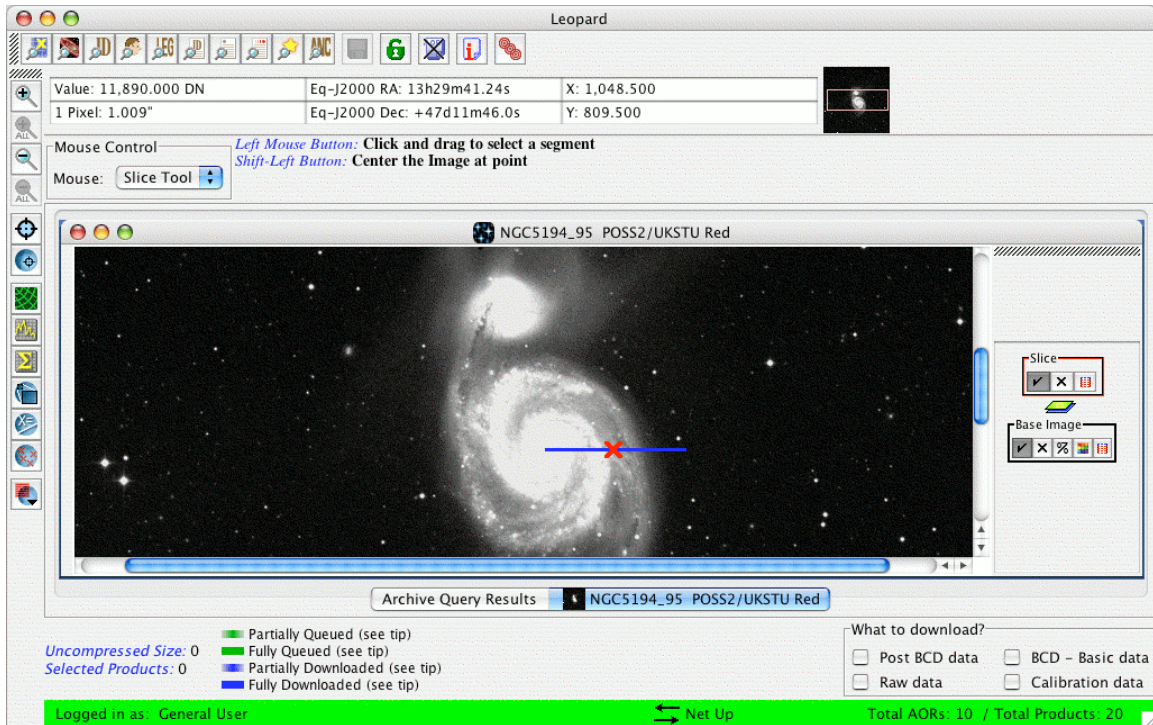


Figure 89: Once the Slice Tool under the Overlays menu (also the Slice Tool icon in the image manipulation and overlays tool bar, along the left side) has been selected, drag the cursor across the image, while holding the left mouse button, to produce the image slice.

9.6 Using the Slice Tool

You can extract a “slice” of an image, i.e., the radial distribution of flux as a function of position on the image. After selecting the Slice Tool utility under the Overlays menu (also available on the image manipulation and overlays tool bar along the left hand side), drag the cursor along an image, as shown in Figure 89. The slice tool dialog window will pop up (Figure 90) as a result. Moving the red “X” with your cursor along the slice in the Images window will show you the position along the slice in the slice tool dialog window. Moving your cursor in the slice tool dialog window along the slice, from point to point, will show you the position along the slice on the image. Letting the cursor linger on any data point in the dialog window will show you the flux value, and position, at that point. Also shown in the dialog window is the total spatial distance of the slice, in the distance units you select. Holding the right mouse button will bring up a menu of options: You can set the properties of the slice, save the slice image to local disk, zoom in and out along the slice, and set the range of parameters for the slice. You can also save the slice data (the table of flux versus position) to local disk by clicking on the “Save Data” button in the window.

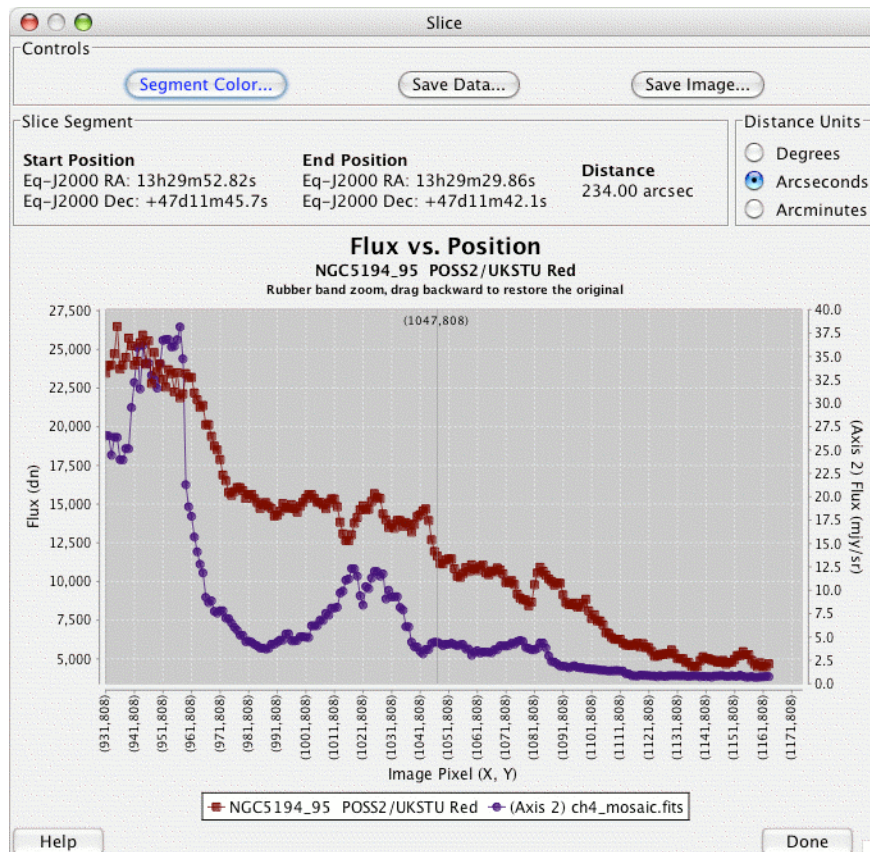


Figure 90: Once you have traced out your image slice, the Slice Tool dialog window will open, showing the slice. Holding the cursor over any of the points shows the position and flux for that point. Holding down the right mouse button brings up a menu of options for zooming in or out on the plot, as well as saving it to local disk. A slice of each overlaid image in Figure 88 is shown.

9.7 Overlaying AORs

Descriptions of how to overlay the Spitzer focal plane and AORs were given in sections 7.7.14 and 7.7.17. We now provide some examples that explain in more detail how to use the AOR visualization features. Overlaying the area footprint of an AOR will be particularly useful to assess the quality and success of the execution of the AOR, specifically about the AOR covering or avoiding particular features on the sky and how the AOR was oriented on the sky on the observation date (or any other date). A more complete set of overlay examples can be found in the Spot User's Guide, section 15.7.

9.7.1 Features of AOTs when Overlaying an AOR

There are features of the detector arrays, apertures, or distortions that may appear when you visualize AORs. Here is a brief summary by instrument:

9.7.1.1 Features in IRAC Visualizations

The boxes depicted in each overlay are an average of each FOV for the IRAC instrument. Because there are two detectors per FOV, there are slight offsets for each detector relative to the average FOV. See the Spitzer Observer's Manual for details on the true positions of each detector. Observers should use these visualizations with care.

The 'crescents' and 'rhomboids' are X-filled boxes displayed beside each aperture. Scattered light will fall onto the detector if a bright source happened to fall within these tiny regions. If you are planning to analyze data for a target that has nearby bright objects, you will want to assess whether these bright objects fell into these small regions. See the IRAC Data Handbook for more details.

9.7.1.2 Features in IRS Visualizations

The IRS peak-up observations (the IRS peak-up array aperture) are included in the overlay, if peak-up is selected in the AOR. Once the peak-up is performed, the peak-up arrays continue to appear in the AOR visualization as rectangles with an X in them. The peak-up is not shown if a peak-up was not selected. The PCRS peak-up is not visualized if it was selected. Note that peak-ups are only performed on the peak-up target, not on each target within a cluster target type.

IRS Staring observations perform 2 'dithers' per aperture, going from 1/3 of the way in the slit to 2/3 of the length of the slit. These dithers appear in the visualizations

9.7.1.3 Features in MIPS Visualizations

The 70 μm array as viewed on the sky represents the missing side B. Missing sections from the 70 and 160 μm arrays are also represented.

The dither positions for MIPS Photometry/Super-resolution were optimized for performance after launch. A description of all available dithers can be found in the MIPS chapter of the Spitzer Observer's Manual.

MIPS SED mode performs two dithers in the slit, similar to the IRS Staring mode. The MIPS Total Power mode visualization resembles the Photometry/Super-resolution mode (additionally, the option exists to show or hide parallel data obtained in this mode).

Using the images in the figures from the above sections, we provide several examples of overlaying an AOR here.

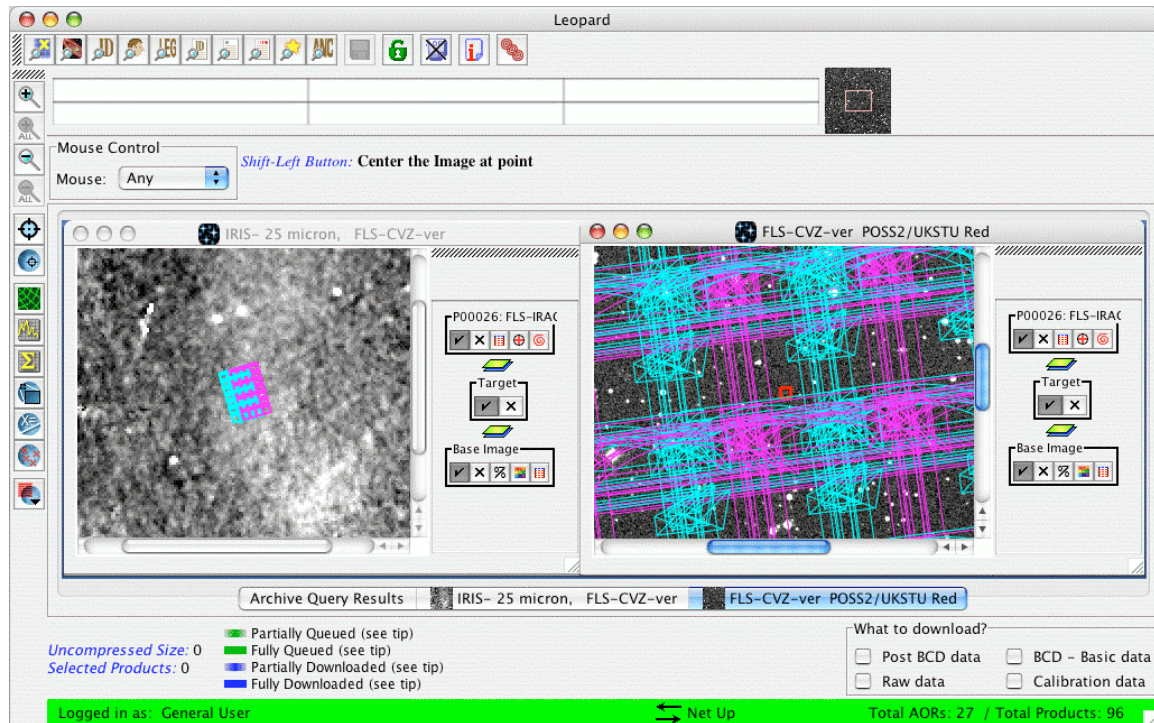




Figure 91: The overlay of an IRAC Mapping AOR on a 12 μm ISSA image and a DSS image.

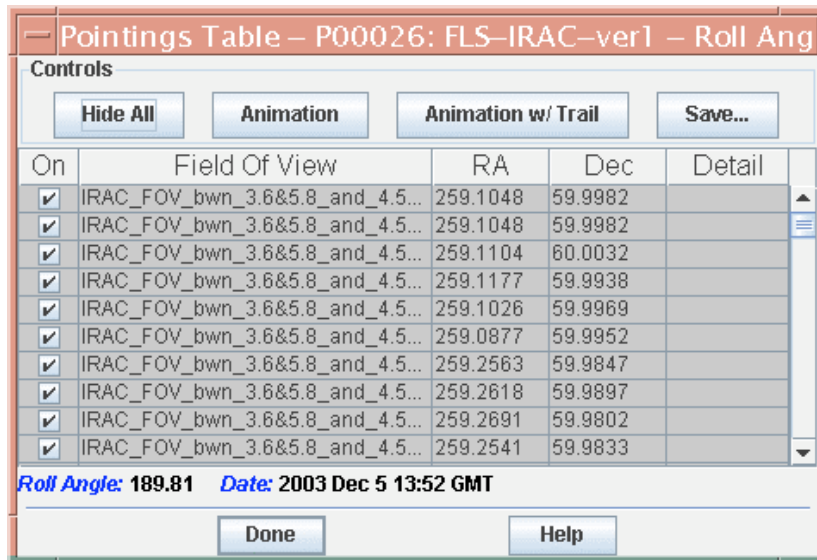
9.7.2 Overlaying a Single AOR

As an example of overlaying an AOR, we show a IRAC mapping AOR, which uses full array mode, both FOVs turned on, a 7 \times 4 map with a 5-position Gaussian small-offset dither, and a 12-second frame time.

After selecting the AOR and displaying the images, we select the AORs on Current Image option from the Overlays menu. Because this AOR has already been scheduled (and executed), the overlay for the AOR will be for that scheduled date. The area coverage for the AOR is now displayed in Figure 91. The area covered by the AOR is shown on both the 5 $^\circ$ ISSA image and the 0.5 $^\circ$ DSS image. Clearly, for large maps, you can only really see what the sky coverage is in the larger image. Note that for an AOR that has not yet been scheduled, a visibility window dialog, similar to what is shown in Figure 72, appears. You can enter the default observation date (the mid-date within the visibility window), however, any date within a visibility window can be entered.

Layer controls for the AOR overlays appear in the side bars of the displayed images. These are indicated with the AOR label. The pointings table icon  in the layer control allows you to modify how the AOR overlay is displayed. If you click on it, the resulting

dialog is shown in Figure 92. Each box drawn in the overlay has a corresponding line in this table. The FOV selected here in each case is the IRAC position, between the two arrays, which is the FOV for mapping in full array mode with both FOV selected. These can be individually turned on and off with the checkboxes, or you can use the animation buttons to see how the overlay is created, one box at a time. The 'Animation' button will cycle through each IRAC FOV box in the overlay. The 'Animation w/Trail' button will perform the same task, but will "freeze" each FOV on the image as the animation progresses. You see the full overlay built up one exposure at a time. The focal plane configuration icon  will bring up a small dialog window, in which you can choose to turn off one or more of the aperture FOV in the displayed AOR.



On	Field Of View	RA	Dec	Detail
<input checked="" type="checkbox"/>	IRAC_FOV_bwn_3.6&5.8_and_4.5...	259.1048	59.9982	
<input checked="" type="checkbox"/>	IRAC_FOV_bwn_3.6&5.8_and_4.5...	259.1048	59.9982	
<input checked="" type="checkbox"/>	IRAC_FOV_bwn_3.6&5.8_and_4.5...	259.1104	60.0032	
<input checked="" type="checkbox"/>	IRAC_FOV_bwn_3.6&5.8_and_4.5...	259.1177	59.9938	
<input checked="" type="checkbox"/>	IRAC_FOV_bwn_3.6&5.8_and_4.5...	259.1026	59.9969	
<input checked="" type="checkbox"/>	IRAC_FOV_bwn_3.6&5.8_and_4.5...	259.0877	59.9952	
<input checked="" type="checkbox"/>	IRAC_FOV_bwn_3.6&5.8_and_4.5...	259.2563	59.9847	
<input checked="" type="checkbox"/>	IRAC_FOV_bwn_3.6&5.8_and_4.5...	259.2618	59.9897	
<input checked="" type="checkbox"/>	IRAC_FOV_bwn_3.6&5.8_and_4.5...	259.2691	59.9802	
<input checked="" type="checkbox"/>	IRAC_FOV_bwn_3.6&5.8_and_4.5...	259.2541	59.9833	

Roll Angle: 189.81 Date: 2003 Dec 5 13:52 GMT

Figure 92: IRAC Overlay pointings table for the AOR described below and displayed in Figure 91.

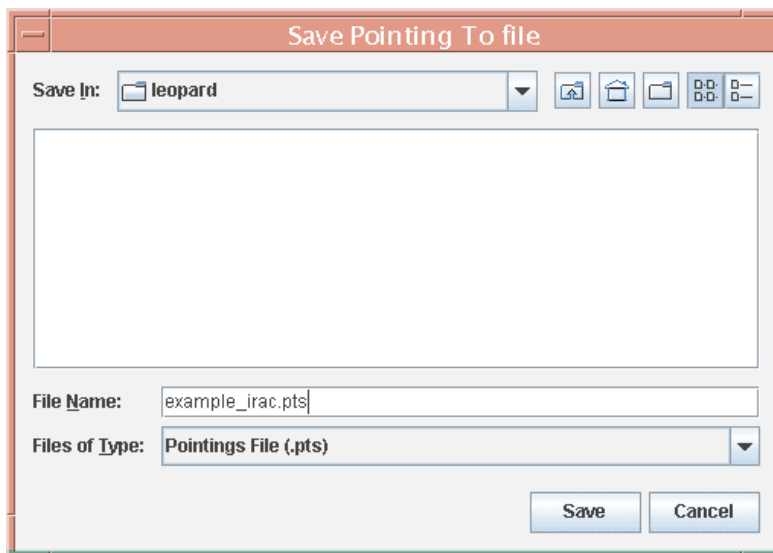



Figure 93: The dialog for saving to a file on local disk the information from the pointings table for the AOR overlay shown in Figure 92. This file can later be read back into Leopard, using Read AOR Overlay Mapping File option in the Overlays pull-down menu.

You can save to local disk the contents of the pointings table. Clicking on the Save button in the pointings table results in the dialog shown in Figure 93. Here, a file name and directory on local disk can be specified, before saving the “.pts” file. This file can later be read back into Leopard, as described in section 7.7.18. Currently, each overlaid AOR must be saved one at a time to separate files.

You can change the date for the overlay by pressing the replot  icon, which again brings up a target visibility window dialog (see Figure 72). Simply enter a new date and time for the overlay, and the AOR overlay will likely change, due to any different roll angle of the spacecraft for the new date. The overlay will then look like Figure 94.

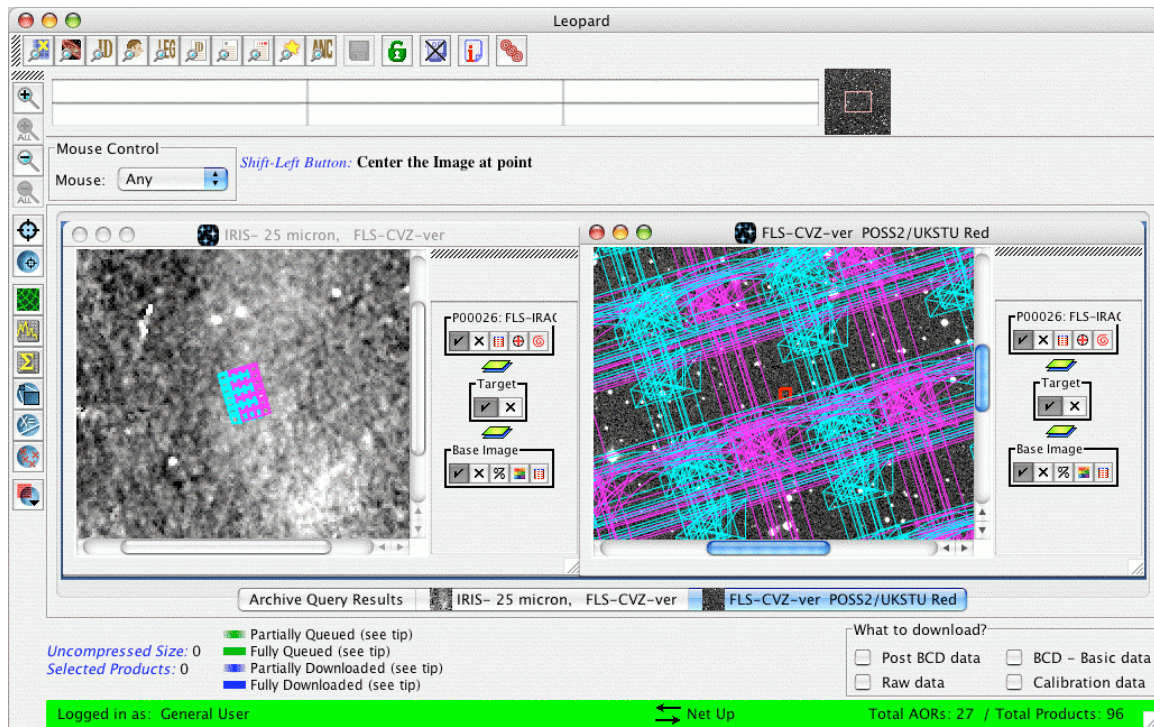


Figure 94: IRAC overlay of an IRAC Mapping AOR on a 12 μm ISSA image and a DSS image. The AOR is shown on the DSS image for a different date than in Figure 91.

9.7.3 Overlaying Multiple AORs

You can overlay multiple AORs on an image at one time. See section 7.7.17 and Figure 35. The AORs will be overlaid for their observation dates. If one or more AORs has not yet been scheduled, you will see a dialog, as shown in Figure 95, which asks if the same observation date within a visibility window can be applied to each of the unscheduled AORs to be overlaid. If we select to overlay both the example IRAC mapping AOR and also a MIPS Scan AOR (a medium scan with 10 scan legs) from the same observing program for the same field, the result is what is shown in Figure 96. Obviously, more than one AOR must be listed in the main Leopard Archive Query Results window for this utility to apply.

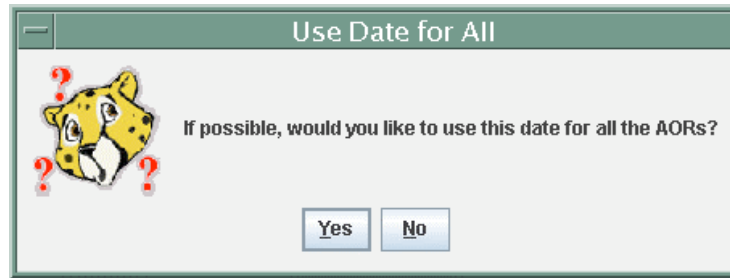


Figure 95: The dialog that follows selection of the date for visualization when attempting to overlay more than one AOR at a time on an image.

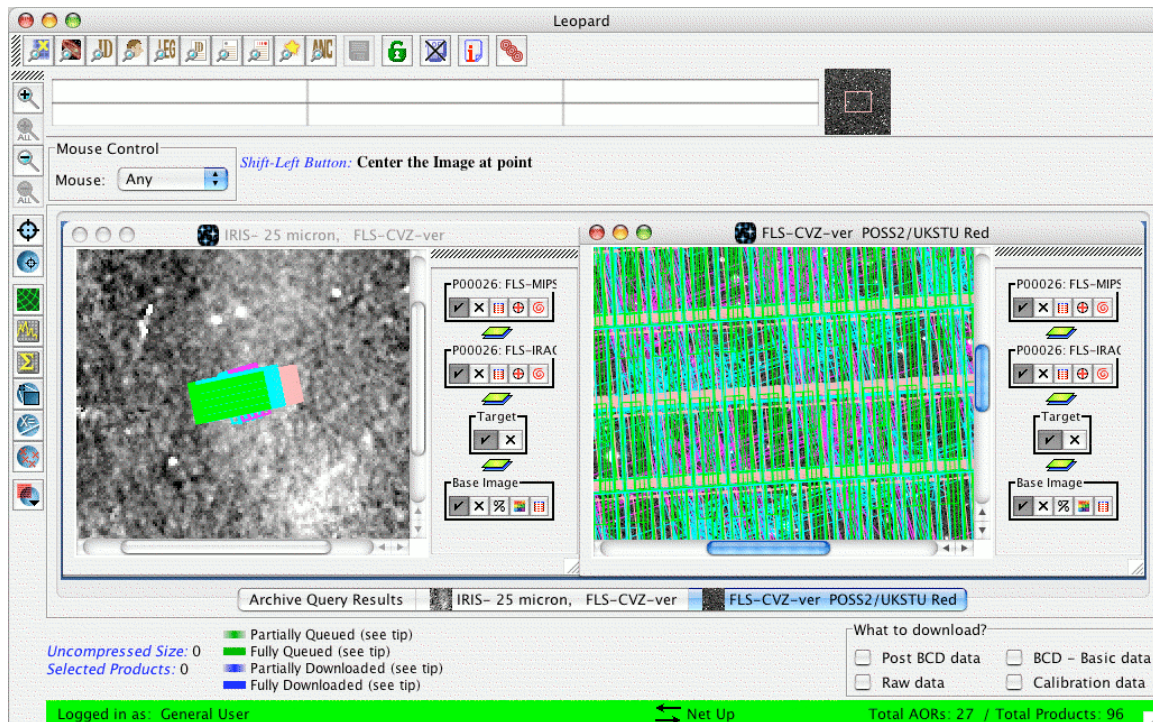


Figure 96: The overlay of both the IRAC Mapping AOR and a MIPS Scan AOR on the IRIS 25 μm image and the DSS image on the same date for visualization.

9.7.4 Displaying Moving Target AORs

To evaluate completed or pending Spitzer solar system observations, Leopard provides the capability to display the position of moving targets on the infrared sky as a function of date and time. In addition, the user can also visualize the position of a moving object with respect to the Spitzer focal plane, instrument apertures, diffraction spikes, and other nearby moving objects. Visualization of a Spitzer AOR for a moving target is supported, and shows the positions on the sky of individual data frames within an AOR, taking into account both the spacecraft and moving object's motion. Visualization of an AOR in the object's rest frame is currently not explicitly supported for moving targets, but can be mimicked by selecting a position and its corresponding date from the object's orbital path, and entering this as a fixed target position.

These capabilities are provided to allow the user to evaluate moving target observations with Spitzer at the executed or available backgrounds/times for observation, and by being able to visualize the AOR pattern across the sky and the effect of nearby bright objects on the observation.

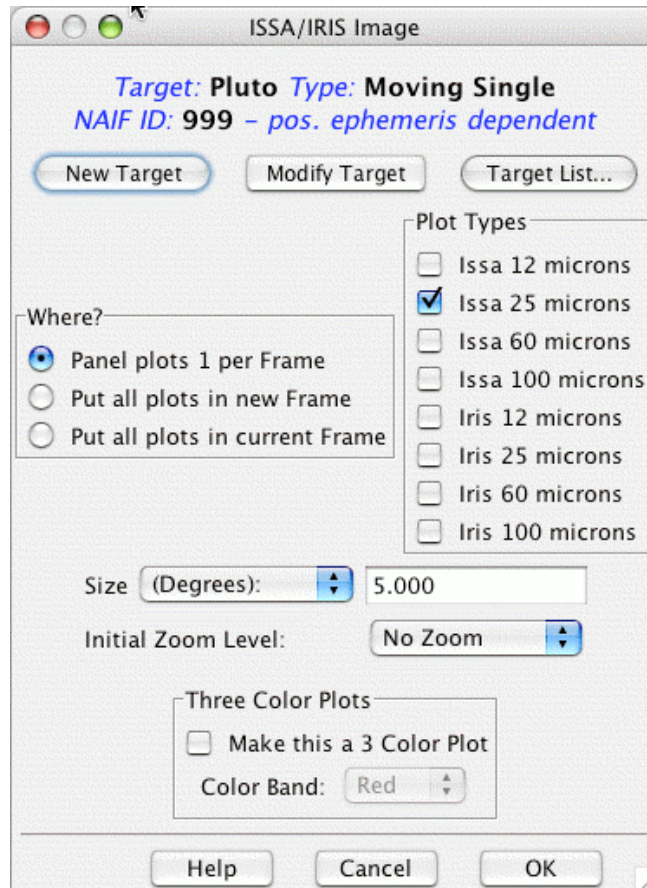


Figure 97: The dialog box for requesting an ISSA image of the sky background for Pluto.

9.7.4.1 Selecting a Background Sky Image

For a moving target AOR, select "Images" from the menu bar and select the type of image you would like to have used to show the background of the target. Section 7.6 describes the types of images that can be used, including a user-provided FITS image, with some important caveats on their suitability for quantitative background estimates. Note that if the observations are of a rapidly moving object, such as a comet or near-Earth asteroid on close pass to Earth, it may be more instructive to select the All Sky Images option (section 7.6.11), at least until you can determine the extent of the object's path across the sky. Generally, though, requesting the ISSA/IRIS plates with the default parameters is a good starting point for visualization (Figure 97).

9.7.4.2 Selecting an Observation Date

Once a type of background image has been selected, you will be asked to enter an observation date to allow Leopard to select the correct background image on which to display the target (Figure 98). In the Select Observation Date window that appears,

Leopard will display the visibility windows for the object. Enter a date within the visibility window periods (or click on any visibility window in the dialog to automatically select the window's mid-date), choose the number of points on the orbital track that you would like Leopard to label, and click on OK.

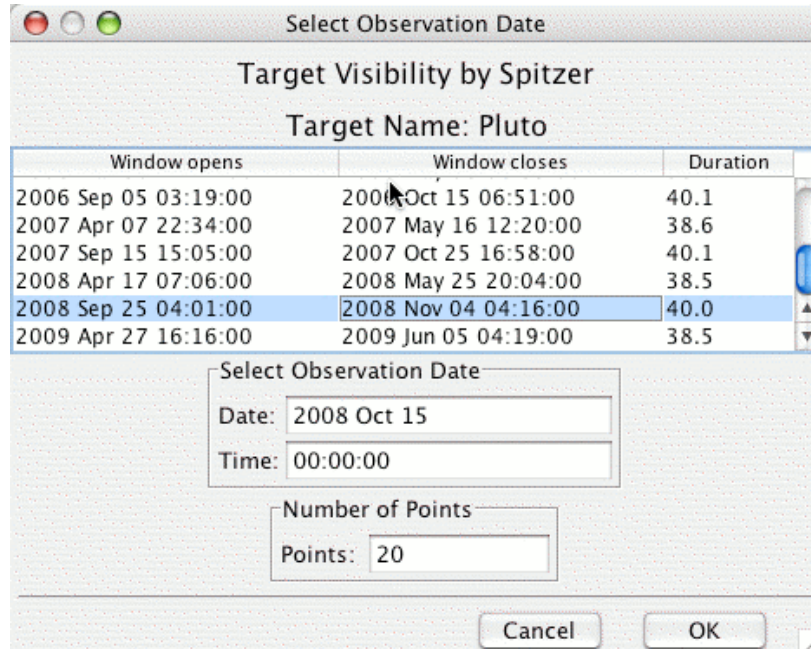



Figure 98: Target Visibility dialog for Pluto. The Number of Points allows you to choose the number of date points Leopard will display for your moving target. You can then animate through the track of the moving target on the displayed image.

If you are displaying on an ISSA, 2MASS, DSS or NED image, the track of the object across that image on the date specified should now be visible in the Leopard window (Figure 99). If you are displaying on an All Sky Image, you will need to go to the Overlays menu and select Add Moving Target before the track will be displayed.

9.7.4.3 Highlighting Points and Displaying Date Markings on a Moving Target Trajectory

Now you have an infrared image of the sky with the path of your object across it centered on the observation date you entered. On the lower right side of the Leopard window, notice that there are two groups of small icons (Figure 100), one labeled "Base Image" and the other labeled with the target name. The icon is a toggle that turns each display component on and off. The will *delete* the component with which it is associated (use with caution!). If you do inadvertently delete something you had merely wanted to switch off for a moment, you can only recover it by going through the original steps required to display that component.

There is a cluster of mini-icons associated with the object name in the side bar. Clicking on the catalog table icon  (the rightmost mini-icon in the "Pluto" box shown in Figure 100) will display a list of dates and positions for the moving target (Figure 101).

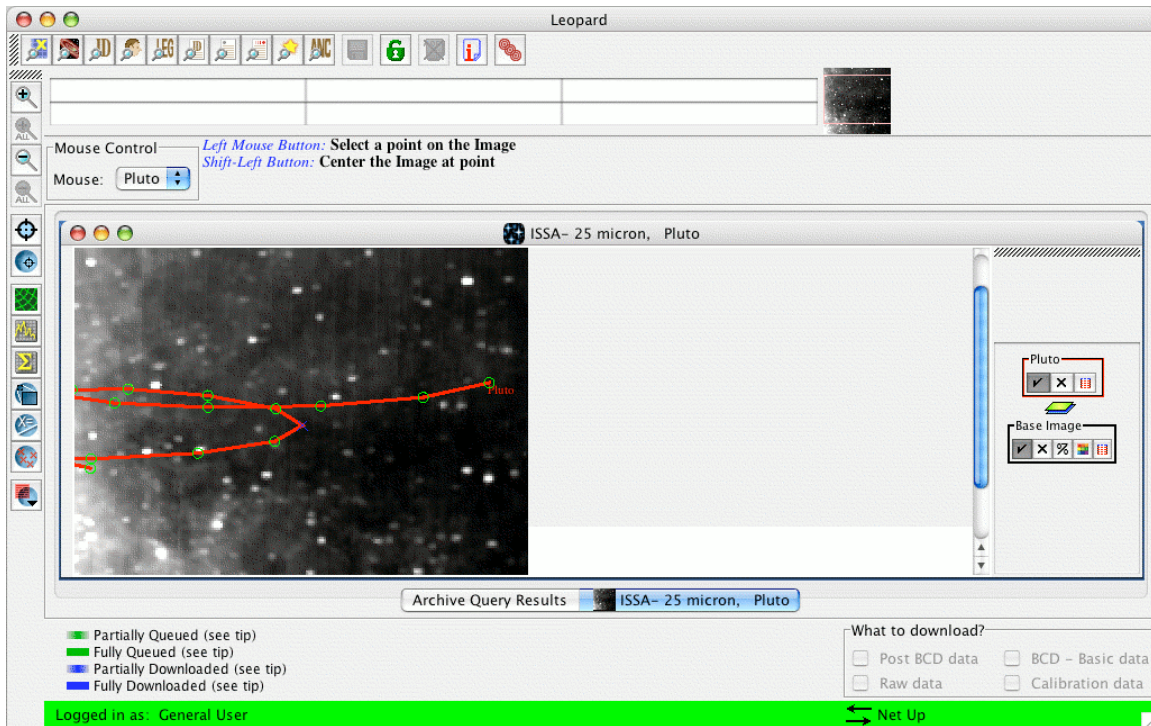


Figure 99: Displayed track of Pluto on an ISSA plate background. The Number of Points selected was 20.


In this display, "Hide All Points" will remove the point markings from the trajectory (once "Hide All Points" has been clicked, it will be replaced with "Show All Points" so that this button acts as a toggle).

The first column of the table allows you to select which points to display by toggling the check mark on or off. The "Hide Path" toggle button will remove the trajectory but leave the points, if desired. The second column, marked "Hi", allows you to selectively highlight points (and dates, see below). The current selected point is highlighted in one color, and previously highlighted points are given a different color. The third column allows you to change the shape of the plotted points.

The "Show All Dates/Hide All Dates" toggle button will label each of the points on your trajectory with the date. A subset of the dates can be displayed by toggling the check mark under the "Show Date" column. The RA/Dec. positions for the selected dates are shown in the table. However, RA, Dec., and underlying flux at any point on the image (and the trajectory) can be determined by moving the cursor over the image and reading the position from the table just under the menu icons in the main Leopard window. Clicking on the Line Color or Point Color buttons allows interactive selection from color tables for line and point color. The Save Table button allows the user to save the table text (i.e., the date, RA and Dec.) as a plain text file to local disk.

9.7.4.4 Adding Your Own Marks/Labels to a Trajectory or Image

If you want to add your own marks to a trajectory or image, select "Mark Object on Plot/User created catalog" from the Overlays menu on the Leopard main menu bar. Then

use the left mouse button to add marks to the image or trajectory. Leopard will record the RA and Dec of the positions marked, which can be accessed under the list icon  in the "Marks" box now on the right of your image display (Figure 102). Labels for the points marked can also be entered (in the User Marks "Name" field) and will be added to the image display when the user clicks the "Done" button on the Marks catalog window. The list of marks can be saved to a table on local disk, by clicking the Save Table button and specifying a table name and local disk directory in the resulting dialog.

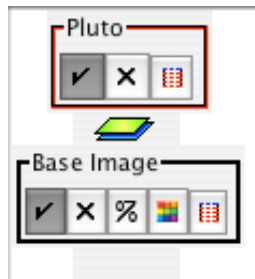


Figure 100: Icons associated with each layer drawn in the visualization frame. In this case there is an ISSA Image and the track of Pluto is overlaid. Clicking the check mark will 'hide' the layer. Clicking the 'X' will delete it. Clicking '%' will allow you to modify the opacity of the displayed image. Clicking the color grid will allow you to modify the color table options for the displayed image.

On	Hi.	Shape	Tgt. Name	N	RA	Dec
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2007 Oct 31 0...	<input type="checkbox"/>	17h45m24.80s	-16d53m03.7s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2007 Dec 4 23...	<input type="checkbox"/>	17h48m24.82s	-17d04m03.2s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2008 Jan 8 23...	<input type="checkbox"/>	17h53m07.16s	-17d11m27.3s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2008 Feb 12 2...	<input type="checkbox"/>	17h58m19.76s	-17d13m55.6s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2008 Mar 18 2...	<input type="checkbox"/>	18h02m40.48s	-17d11m52.0s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2008 Apr 22 2...	<input type="checkbox"/>	18h04m58.79s	-17d07m20.7s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2008 May 27 2...	<input type="checkbox"/>	18h04m39.82s	-17d03m19.7s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2008 Jul 1 23...	<input type="checkbox"/>	18h02m03.04s	-17d02m27.2s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2008 Aug 5 23...	<input type="checkbox"/>	17h58m21.07s	-17d06m05.2s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2008 Sep 10 0...	<input type="checkbox"/>	17h55m11.61s	-17d14m00.3s
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		2008 Oct 15 0...	<input type="checkbox"/>	17h53m56.43s	-17d24m39.7s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2008 Nov 19 0...	<input type="checkbox"/>	17h55m12.41s	-17d35m39.9s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2008 Dec 23 2...	<input type="checkbox"/>	17h58m46.05s	-17d44m28.7s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2009 Jan 27 2...	<input type="checkbox"/>	18h03m43.98s	-17d49m11.8s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2009 Mar 3 23...	<input type="checkbox"/>	18h08m49.45s	-17d49m17.9s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2009 Apr 7 23...	<input type="checkbox"/>	18h12m41.41s	-17d45m56.9s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2009 May 12 2...	<input type="checkbox"/>	18h14m17.09s	-17d41m40.0s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2009 Jun 16 2...	<input type="checkbox"/>	18h13m15.59s	-17d39m15.9s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2009 Jul 21 23...	<input type="checkbox"/>	18h10m12.29s	-17d40m42.5s
<input checked="" type="checkbox"/>	<input type="checkbox"/>		2009 Aug 26 0...	<input type="checkbox"/>	18h06m30.08s	-17d46m25.5s

Figure 101: List of dates and positions for Pluto. This dialog box will appear if you click on the catalog table icon under 'Pluto' in Figure 100.


9.7.4.5 The Distance Tool

This tool can be used at any time during moving target visualization, but is particularly useful when you want to determine the approximate angular separation of a moving target and a nearby fixed target, or two moving targets on a given date. To activate it, go to the Overlays menu on the Leopard main menu bar and select "Distance Tool." Now use the left mouse button to select a point and drag to another point. A colored line should appear, denoting the distance that you dragged the cursor, and the distance in arcseconds will be displayed above the line (Figure 103).


Note that estimating the distance between two moving targets using this tool is only valid between points on the two trajectories that correspond to the same date. We have exact date point matching for two moving bodies in Leopard. With this "hand drawn" tool, it is possible to estimate separation distances to an accuracy of a fraction of an arcsecond, when compared with the calculated ephemeris positions. However, if you require separation estimates to higher accuracy, we strongly recommend that you calculate these separations using JPL's Horizons software. For instructions on how to use Horizons to assist with Spitzer observation planning, please see the instructions provided on the Spitzer Science Center web site on the Proposal Kit page.

9.7.4.6 Displaying the Spitzer Focal Plane

To display the Spitzer Focal Plane to scale, go to the Overlays menu in the main Leopard menu bar and select "Spitzer Focal Plane." The focal plane to scale will appear on your image. Clicking the left mouse button at a position on the image will re-center the focal plane at the click point. Note the cluster of mini icons labeled "Spitzer" that have appeared on the right of the image window (Figure 104). The box with the number in it shows the position angle of the focal plane. The focal plane is generated at a default position angle of 0.0° . To visualize the focal plane on a particular date for AORs that have not yet been scheduled, use the Visibility/Orientation capability in the Modify function of the Leopard Target List window, after selecting the moving target (see section 8.3.10). Determine the position angle for the Spitzer focal plane on the desired date. You can then enter that position angle into the box in the "Spitzer" layer control to re-orient the focal plane display. In the example in the figure, a position angle of 35° has been entered.

The focal plane configuration icon  in the "Spitzer" layer allows you to toggle apertures on and off and change the color of the displayed apertures. See the Spitzer Observer's Manual for a full description of the apertures on the focal plane. The arrow pointing to the Sun symbol in the focal plane display denotes the Spitzer-Sun direction, as projected on the sky.

9.7.4.7 Displaying the Spitzer Diffraction Spikes

Once you have the Spitzer focal plane displayed on your image, clicking the rightmost small icon under the "Spitzer" layer, the diffraction spike show/hide icon , will display the Spitzer diffraction spikes for the position angle entered in the "Spitzer" layer box (Figure 105). Again, like the focal plane itself, these diffraction spikes can be

repositioned by clicking the left mouse button on the desired center. They can be rotationally repositioned only by entering a new position angle.

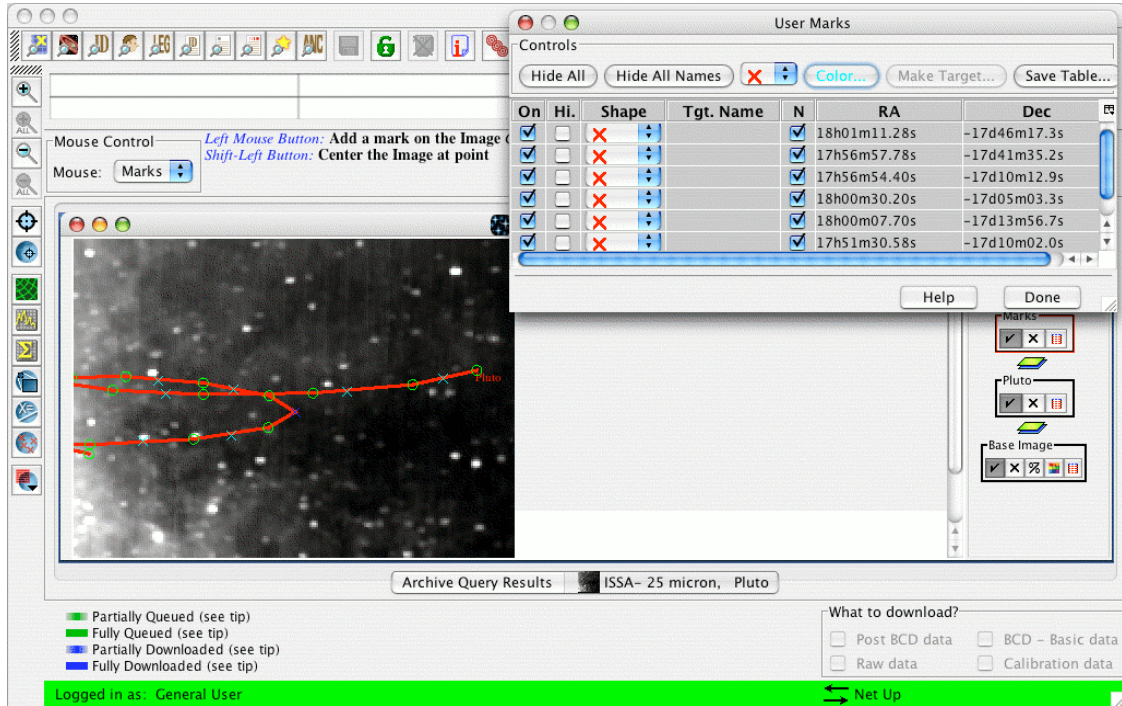


Figure 102: Adding marks to an Image. Another layer called "Marks" is added to the frame. Clicking on the list icon under "Marks" will bring up the dialog box of User Marks.

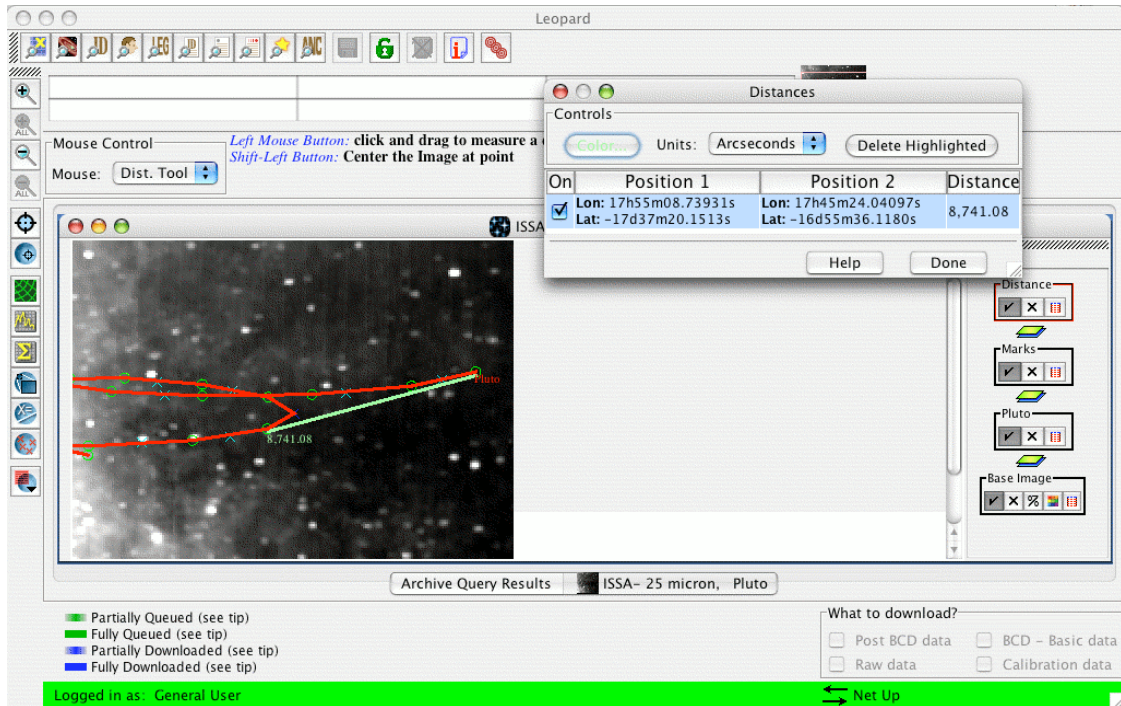


Figure 103: The Distance Tool in action. The blue arc indicates the distance between the two selected points. The distance, in arcseconds, is displayed on the image. Detailed information can be brought up in the Distance dialog box.

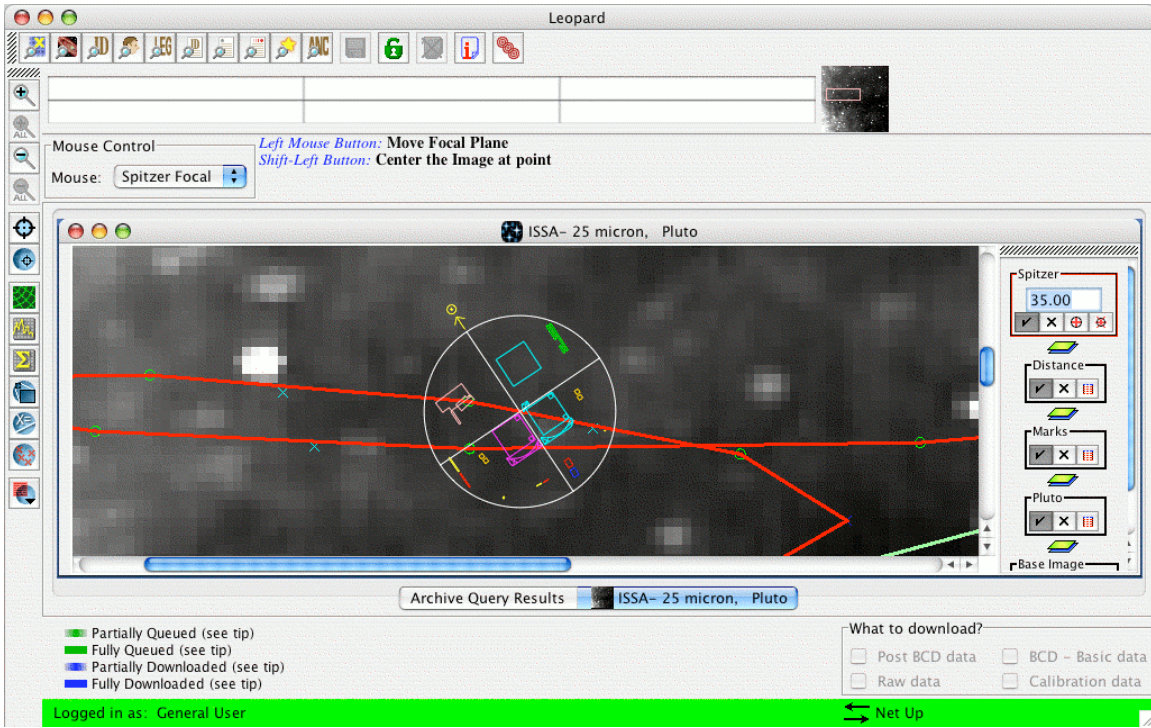


Figure 104: Displaying the Spitzer Focal Plane. A position angle of 35° is shown.

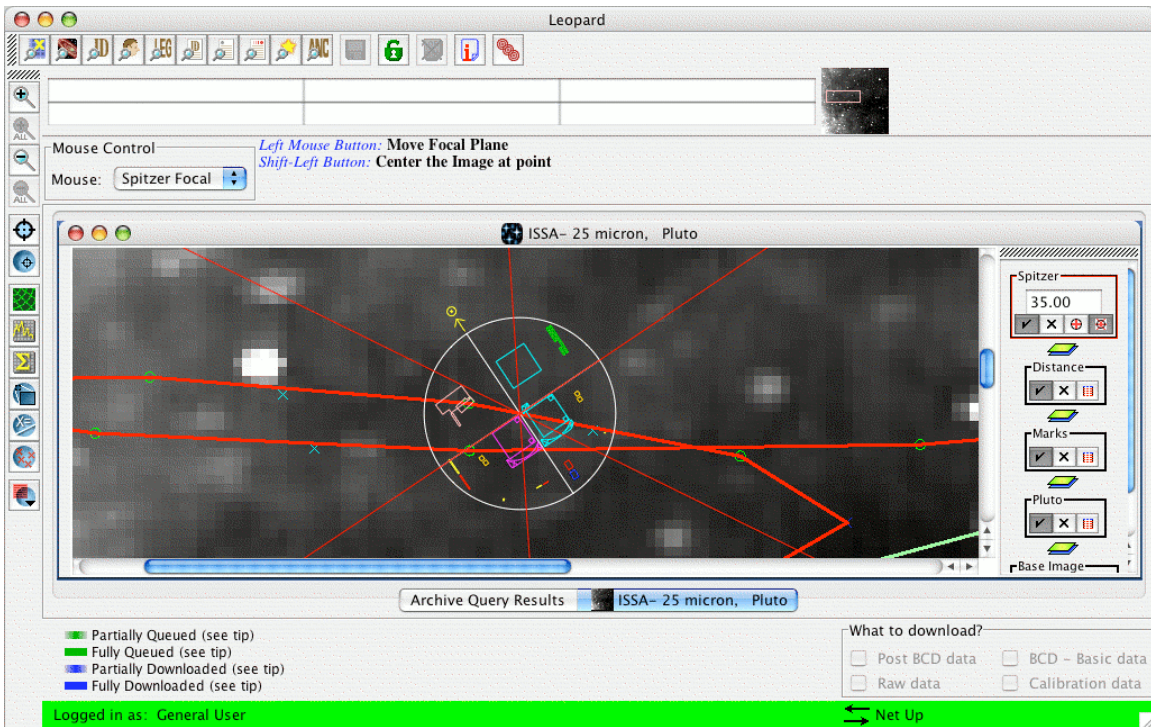







Figure 105: The Spitzer diffraction spikes can be toggled off and on when displaying the focal plane, and can be translationally repositioned to, for example, indicate the direction of diffraction spikes from a nearby bright object on a date you plan to observe.

9.7.4.8 Displaying an AOR

Once you have selected a moving target AOR in the Archive Query Results window, you can display this AOR on your image for either the scheduled date or a user-specified date (if the AOR has not yet been scheduled). For moving targets, the AOR display shows not only the spacecraft pointing and mapping motions, but also the combined effect of the moving target's track on those pointings. For a rapidly moving object, you may be able to see the actual elongation of a mapping pattern in the direction of the object's motion. Leopard does not yet explicitly support visualization of a moving target AOR *in the object's rest frame*. However, this can be mimicked to a limited extent by entering a dummy fixed target that corresponds to the object's position at the desired observing time. However, for a rapidly moving object (typically comets near perihelion or near-Earth asteroids) this "fixed target" approximation will provide a clearer visualization of the map extent around the target object, but unlike the moving target visualization described above, it will not accurately display the background in each AOR frame.

Next, select AORs on Current Image from the Overlays menu on the Leopard main menu bar. You will be asked if you want to plot the same visibility date for the moving target that you currently have plotted (Figure 106). If you don't want to do that, select "No", and you will be asked to supply a different date. Your requested AOR will appear on the image, and a set of icons associated with that display will appear on the right-hand side of the image window (layer controls). As for the layer controls, the  icon will toggle the display of the AOR, the  icon will delete the AOR display, and the  icon opens a table that lists all the AOR pointings. Individual pointings can then be selectively toggled on/off in the table. This window also gives the position angle for the AOR on the date specified. Furthermore, this window allows animation of the AOR - displaying the instrument aperture pointings in the sequence that they will be executed on-board the spacecraft. The "Animation" button shows the pointings, one after the other, and the "Animation w/ Trail" button shows the successive pointings, but leaves a trail showing the apertures for all previous pointings in the sequence.

Multiple AORs for the same moving target can be displayed (e.g., an IRAC and a MIPS AOR). You may wish to 'check' off the previous AOR using the  icon (but not remove, which is done by clicking on the  icon) when doing this, to clearly see the new AOR overlaid.


Leopard should now display the AOR on the image as shown in Figure 107. In this example we are overlaying a MIPS Photometry AOR of Pluto. The different colored apertures correspond to the two different MIPS fields-of-view. Click on the MIPS display layer control pointings icon . Select Animation w/Trail. Note that, in general, the instrumental mapping path that may take a zig-zag shape on the sky, as compared to what would be expected for a fixed target. This is because the spacecraft tracking of the moving target is being superimposed on the instrumental mapping motions. Note that the Spitzer pipeline has the capability to take these frames and recreate the map of the target in the target's rest frame. This will be a rectilinear map with the tracked extended target reassembled as a continuous image, but with the disjoint pieces of sky background that you may see.



Figure 106: When attempting to overlay AORs on an image for a moving target, this dialog appears indicating that the track for the target is already plotted on the image and asking whether or not to use the current moving target date.

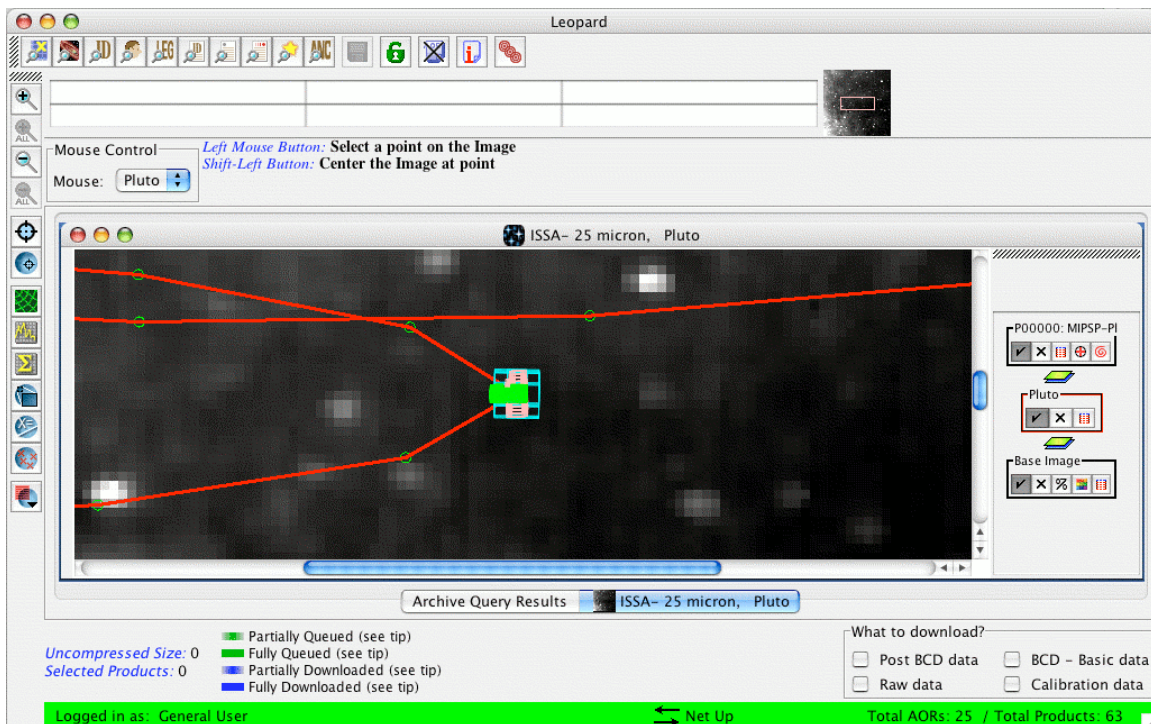


Figure 107: A MIPS AOR of Pluto is shown. Note that the observation may generally show a slight zig-zag shape, due to movement of the target during the observation, especially for rapidly moving targets.

9.7.4.9 Add Moving Target

Planetary satellite and other observers may wish to display not only the science target of an AOR, but also the relative position of a nearby moving target (e.g., the parent planet for a satellite). You should enter the second target into Leopard via the List of Targets dialog (Figure 108), by clicking on the New Target button in that dialog and entering the new target's name in the target entry dialog shown in Figure 109. If you click the Resolve to NAIF ID button, Leopard will look up the NAIF ID for the target name. If the name corresponds to more than one NAIF ID, a dialog such as that shown in Figure 110, will ask you to choose the NAIF ID you desire.



Figure 108: The List of Targets dialog, showing the four target positions for observations of Titan from the selected program.

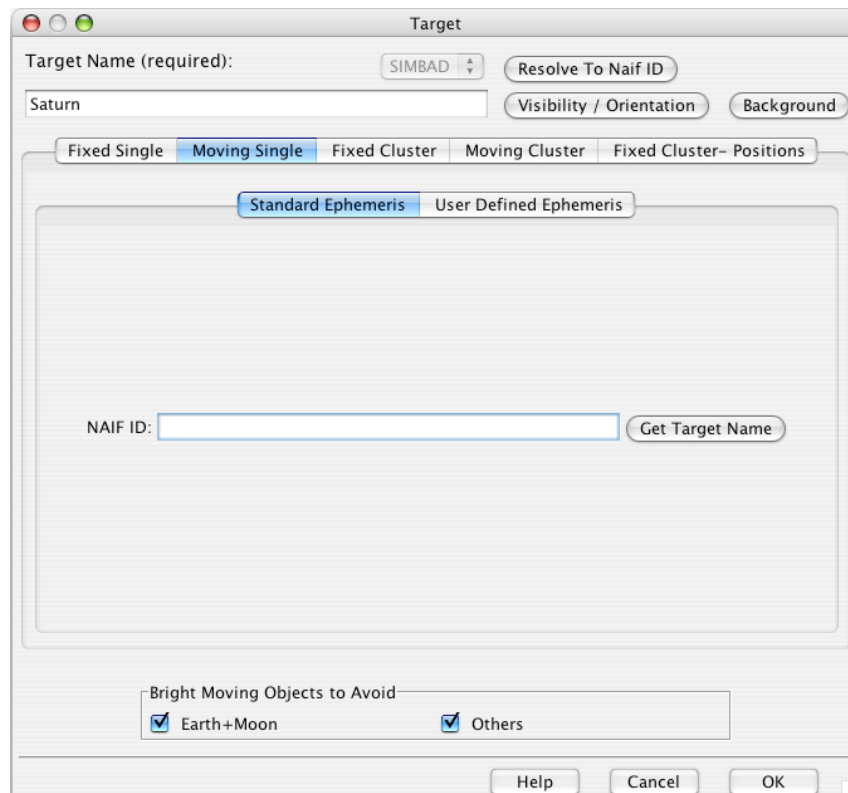


Figure 109: The target entry dialog. Here you can enter a moving target name and attempt to resolve it by its NAIF ID. In this case, we have entered ‘Saturn.’

See the Spot User's Guide, section 10.3, for a more detailed discussion of moving target entry. In summary, for either moving single or cluster targets, you may enter either a standard ephemeris specified by the NAIF ID number or a user-defined ephemeris for objects not yet in the NAIF database. For targets in the NAIF database, enter either the NAIF ID or the target name, and Leopard will return the appropriate target name or NAIF ID number when you click on the Resolve the Name button. A list of NAIF IDs and names recognizable to Leopard can be found on the Spitzer Proposal Kit web page. It is also possible to use the JPL DASTCOM database (<http://ssd.jpl.nasa.gov/sbdb.cgi>) to interactively search for NAIF IDs (called “SPK-IDs” on the DASTCOM database) and names. If the name you enter is used by more than one object in the NAIF database, Leopard will provide you with a list of NAIF IDs from which to select. It is important to

select the correct NAIF ID for your object, as the NAIF ID is the single identifier Spitzer uses to provide ephemeris information.

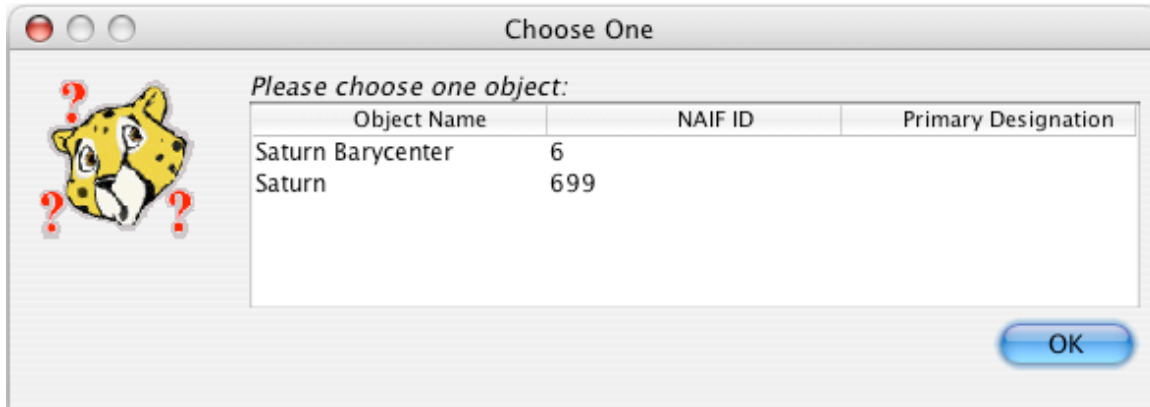


Figure 110: The choices of NAIF ID numbers for Saturn are shown. It is important to select the correct NAIF ID for your object, as the NAIF ID is the single identifier Spitzer uses to provide ephemeris information.

For targets not yet in the NAIF database, you may enter the orbital elements. The entry dialog is shown in Figure 111. *Orbital elements should be specified with a reference frame of FK5/J2000.0.* The following heliocentric ecliptic elements to specify the orbit of a user-defined object are required:

- Epoch: The Julian ephemeris date (Time Dynamic Barycenter) of the osculating elements.
- T: Perihelion Julian Date.
- ω : Argument of perihelion with respect to the ecliptic (degrees).
- Ω : Longitude of the ascending node with respect to the ecliptic (degrees).
- Eccentricity: Eccentricity of the orbit (in the range 0 to 1).
- Perihelion Distance: Perihelion distance for the orbit (in AU).
- Inclination of Orbit: Inclination of the orbit with respect to the ecliptic (degrees).

We do not yet have an automatic way to use these elements to generate an ephemeris within Leopard. Consequently, if you need a user-defined ephemeris, please contact the Spitzer Helpdesk (help@spitzer.caltech.edu) with your orbital elements and request generation of a Leopard-readable ephemeris. We will generate a temporary ephemeris for you and give you a dummy NAIF ID number to use within Leopard, so that you can generate visibility information, etc., for your target. Note that it is required for the orbital elements to be entered with respect to an ecliptic and mean equinox of J2000.

After entering the NAIF ID or target name into the target entry window, select the level of bright object avoidance you would like Leopard to include when calculating the visibility of your target. Then, click on the Visibility/Orientation button in the upper right-hand quadrant of the target entry window. If Leopard has access to the ephemeris corresponding to the NAIF ID of your object, it will now calculate the periods during which your object is visible to Spitzer. If bright object avoidance is selected, Leopard will

modify the visibility windows to avoid times when a bright object is near your target object (if appropriate).

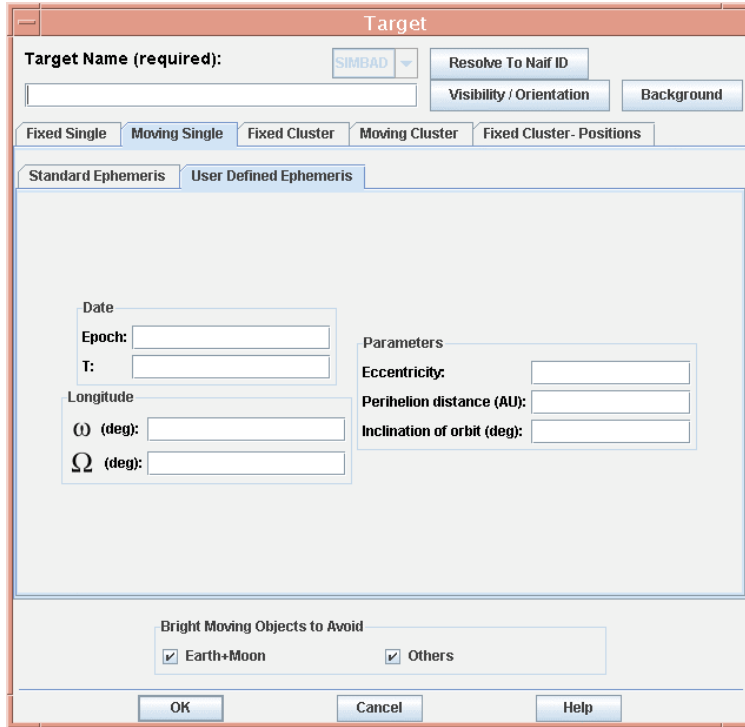


Figure 111: The entry dialog for a moving single target with a user defined ephemeris. This is where you enter a target that does not yet have a NAIF ID number.

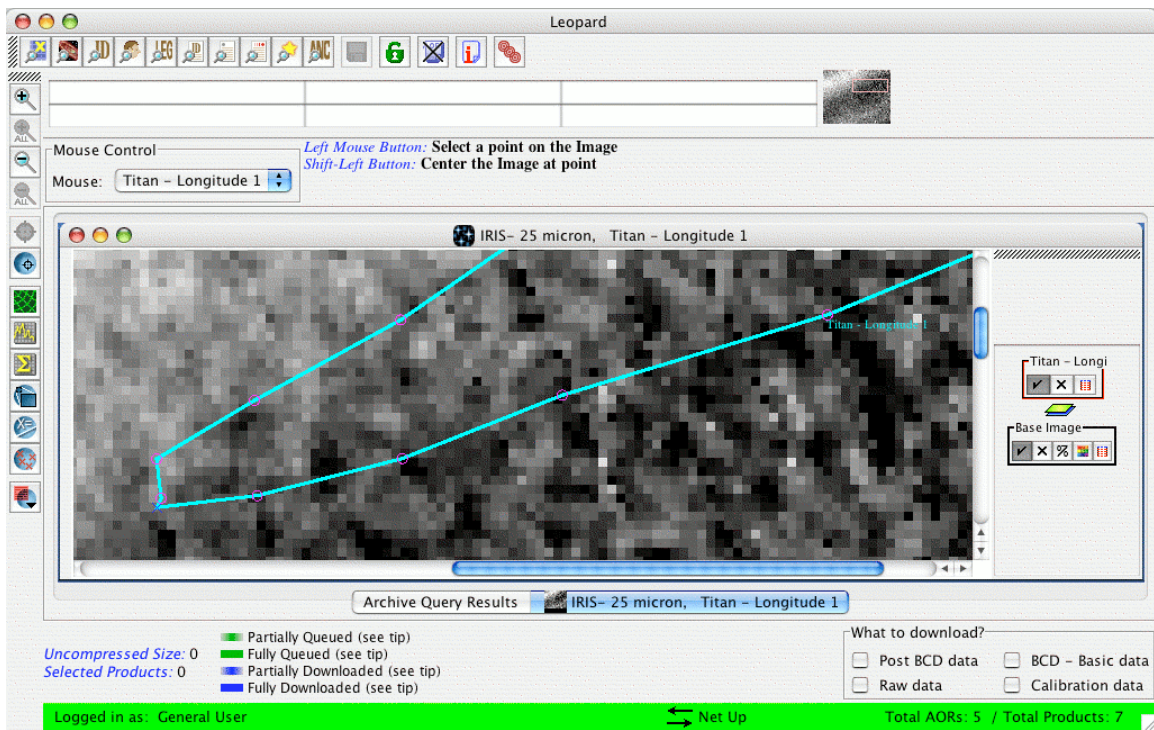


Figure 112: Displayed track of Titan on an IRIS plate background. The Number of Points selected was 20.

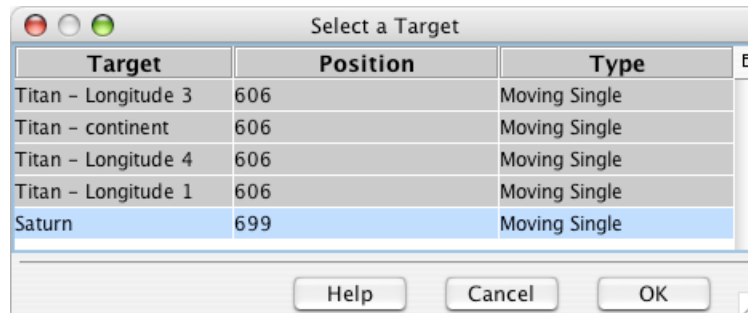


Figure 113: The Add Moving Target overlay dialog. With this utility, you can add the tracks of one or more moving targets on the track of a primary moving target. Simply highlight one or more of the entries in the list and click “OK.” In this example, we select Saturn.

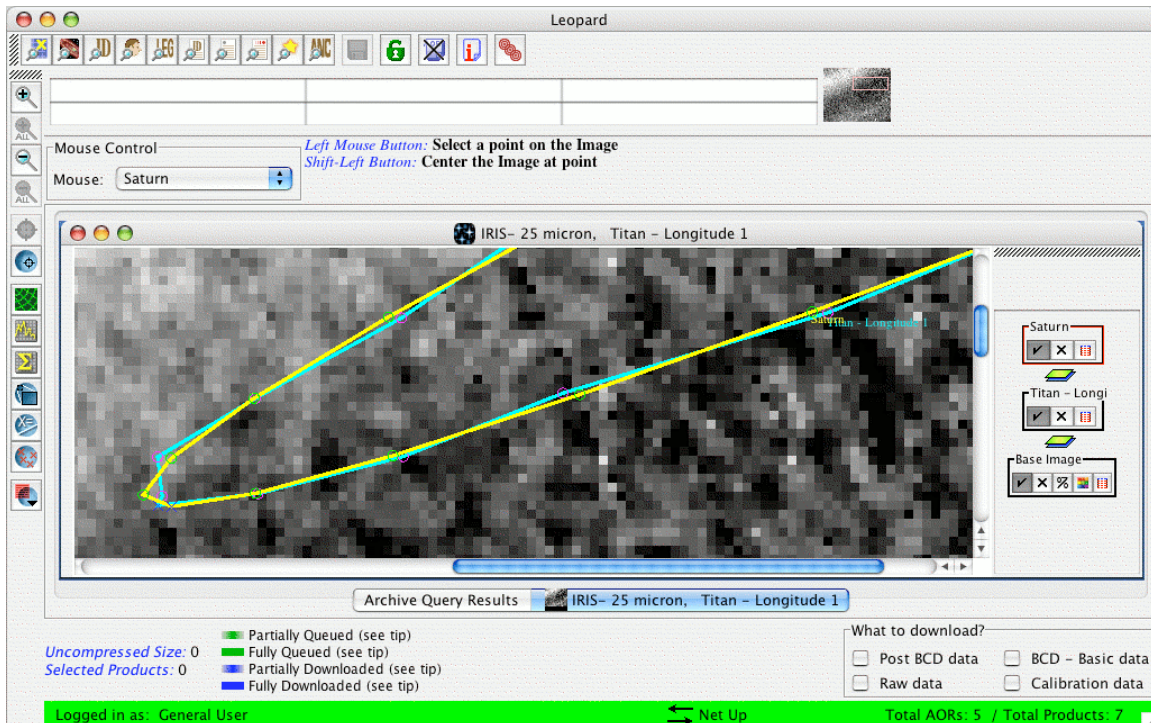


Figure 114: Displayed tracks of Titan and Saturn on an IRIS plate background. Each of the points are for the same dates for both moving objects overlaid on the image.

As an example, we consider Titan and its host planet, Saturn. First, we perform a Query by NAIF ID for all programs that have observed Titan. This results in a GTO program (pid 71), and we select one of the four targetings of Titan from the List of Targets (Figure 108). Next, we show an overlay of Titan's track on an IRIS 25 μm image. Once again, we are asked to enter an observation date to allow Spot to select the correct background image on which to display the satellite. The track of the satellite across the image on the date specified is visible in the Leopard image window (Figure 112). To overlay the track of Saturn along with the track of Titan, select the Add Moving Target utility under the Overlays menu. The resulting dialog is shown in Figure 113. Generally, you can select all or some of the target positions in the list (in this case, we have selected only one, Saturn) by highlighting the entries in the dialog and clicking “OK.” The planet's track is then overlaid on the image, along with its moon (Figure 114). The points shown for Saturn are for the same dates as those of Titan.

If your second target does NOT cross the image in the date range specified for the first target, Leopard will display a window to that effect, and ask you whether you would like to see the position of the second target relative to the first on an All Sky image. The sky patch labeled "Sky Image" will show the image area that contains your first target, and your second target will be labeled by name, elsewhere on the All Sky Image.

9.8 Visualizing the BCDs

For any observed AOR in a program, you can visualize the individual BCDs produced by the AOR, by clicking on the BCDs tab in the Detail Information window (see section 8.3.9). An example is shown in Figure 115. Clicking on the "Retrieve all BCDs" button results in a dialog window, shown in Figure 116. Near the top of that dialog window is a pulldown menu to select an image on which to overlay the BCDs. Select the image type of your choice from the menu and click "View All." A dialog window, similar to the image dialog windows discussed in section 7.6, will appear, where you can customize the parameters (image size, desired wavelength, etc.) for the image. (Currently, ISSA images are not available.) Click "OK," and the image, with a representation of the individual BCDs overlaid on it, will appear in the Images window (Figure 117). Note that the individual BCD numbers show up in the overlay.

If you then click on any location within the BCD overlay, previews of the BCDs that cover that location will appear in the overlay (Figure 118). The overlay layers for these individual BCD previews appear along the right hand side in the Image window. These layers can be manipulated in the fashion described in section 9.1.4.

Returning to the Detail Information window and the listing of the BCDs, if you highlight any of the BCDs listed here, you will see this highlighting represented in the BCD image overlay (see Figure 119). Note: you can highlight more than one listed BCD. If you then click on the "Display Selected BCDs" in this window, a preview of any of the highlighted BCDs will appear in the Images window (Figure 120). Using the Save Current Image as FITS File under the File menu (see section 7.1.3), you can save the full-resolution BCD FITS file to local disk. You could download all of the BCD data for a given AOR in this manner. However, it is likely faster and more convenient to use the Download Selection utility under the File menu, along with Subscriber, to download all of the BCD data (see section 10 for an example).



Figure 115: The Detail Information dialog. The BCDs button is highlighted and selected in this dialog. In this example we wish to overlay the BCDs that were produced by this IRS Peak-Up Imaging AOR. You can do this by clicking on the “Retrieve all BCDs” button in the dialog window.

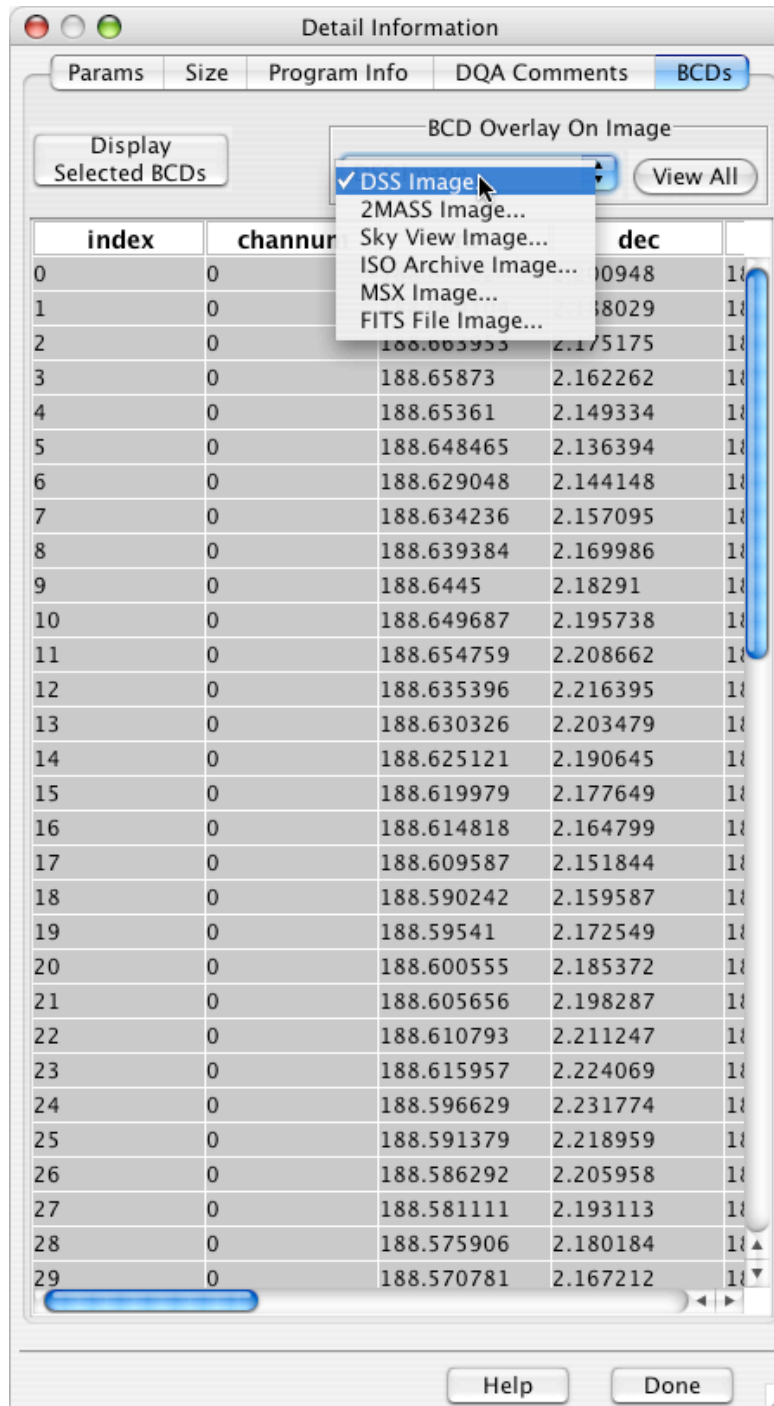


Figure 116: The Detail Information dialog, showing the list of individual BCDs, by index number, channel number, and sky position. Near the top of the dialog window is a pulldown menu for selecting the image type on which we will overlay a preview of the BCDs.

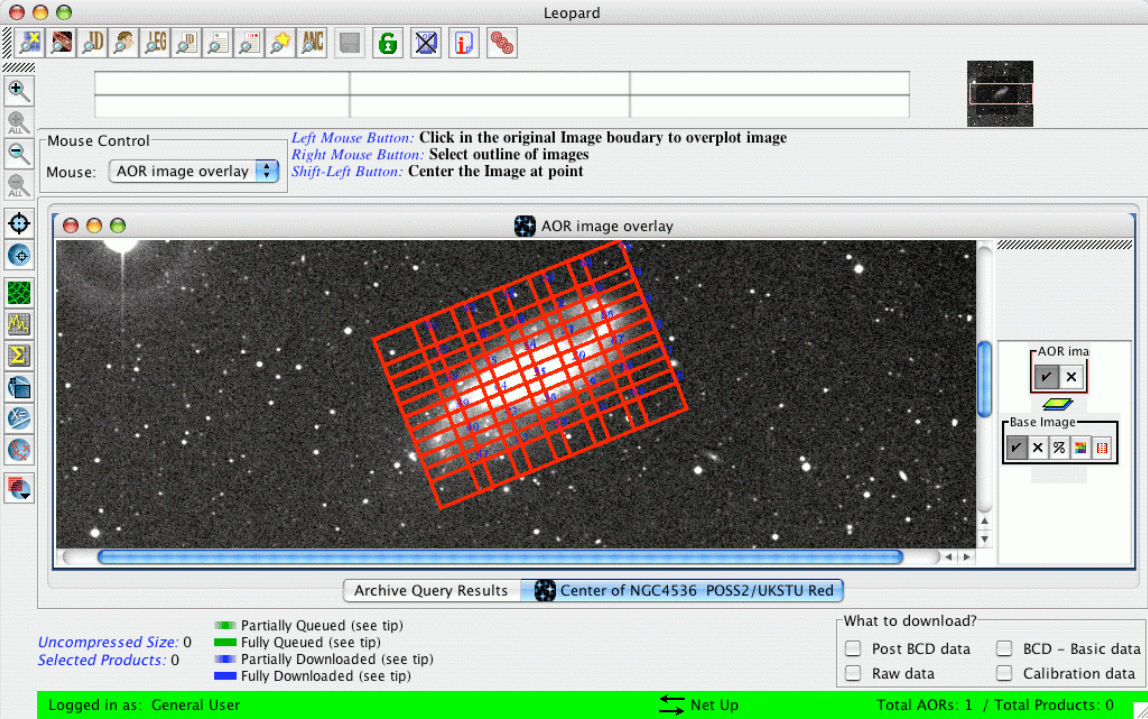


Figure 117: The overlay of all of the BCDs, in red, that were produced by the AOR on a DSS image. The BCD numbers are shown in blue on the overlay.

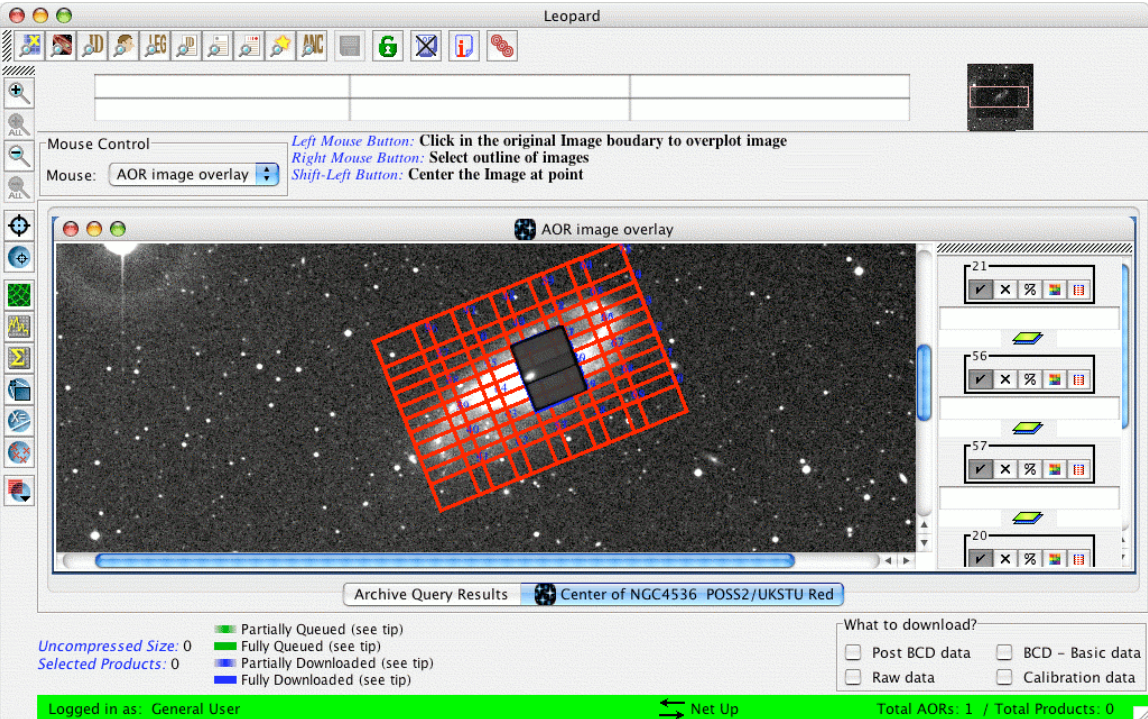


Figure 118: Clicking at any location within the BCD overlay, shown in Figure 117, will then retrieve and overlay the footprints of all of the BCDs that cover that location. The individual BCD overlay layers appear to the right hand side of the Image window.

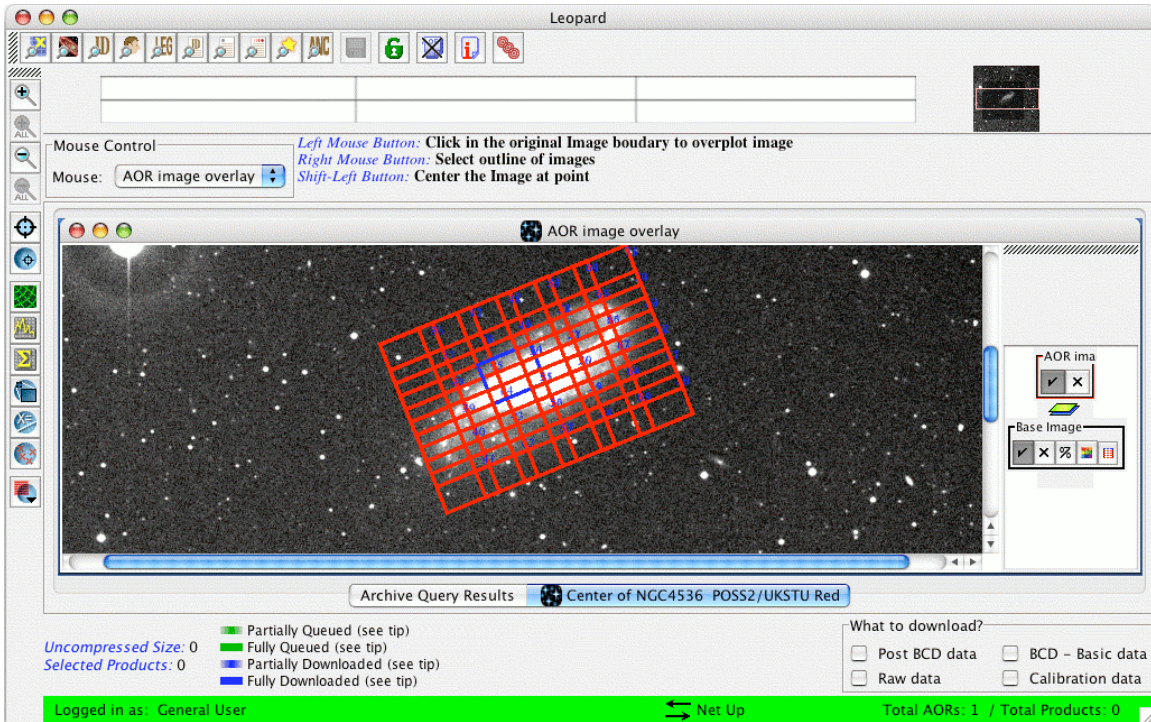


Figure 119: Highlighting any of the BCDs listed in the Detail Information window will highlight that BCD's overlay, with blue outlines, in the Image window. In this case, we highlighted BCD #50.

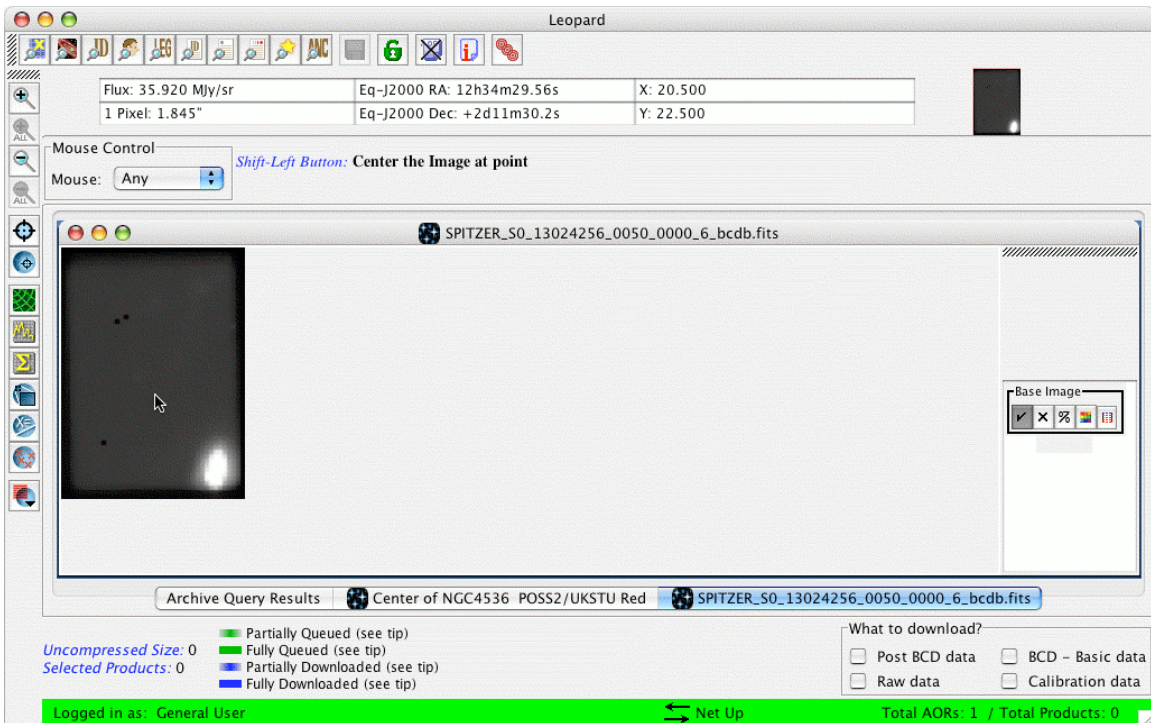


Figure 120: Highlighting any of the BCDs listed in the Detail Information window and then clicking on the “Display Selected BCDs” button will bring up a preview of that BCD, or BCDs (you can select more than one), in the Image window. In this example we have selected BCD #50. Using the Save Current Plotted Image as FITS File utility under the File menu, you can save the actual BCD FITS files to local disk.

10 An example Leopard Session – Querying the Spitzer Archive

This section walks through an example of requesting data from the Spitzer Archive. In this example we want to obtain the data products for the Extragalactic component of the First Look Survey. The Extragalactic FLS is program ID number 26 (program name: fls_extragal) in the Spitzer database; for more information, see <http://ssc.spitzer.caltech.edu/fls/>.

1. Select Query -> By Program from the menu pulldown. The dialog shown in Figure 54 will appear.
2. In the Program Section of that window, enter “26” into the field. Next, select the “All” tab for all three instruments, under the Instrument Section (the Extragalactic FLS included only IRAC and MIPS observations). Click “OK” at the bottom of the window.
3. Leopard will access the SSC servers to query the Spitzer Archive and return a Program List (Figure 121), listing the information (Program ID, title, PI Name, and number of AORs), in this case, for program 26. Be sure this program is selected in the Program List window, by clicking on “Selected.” Clicking “OK” will return the list of AORs in the Archive Query Results window.

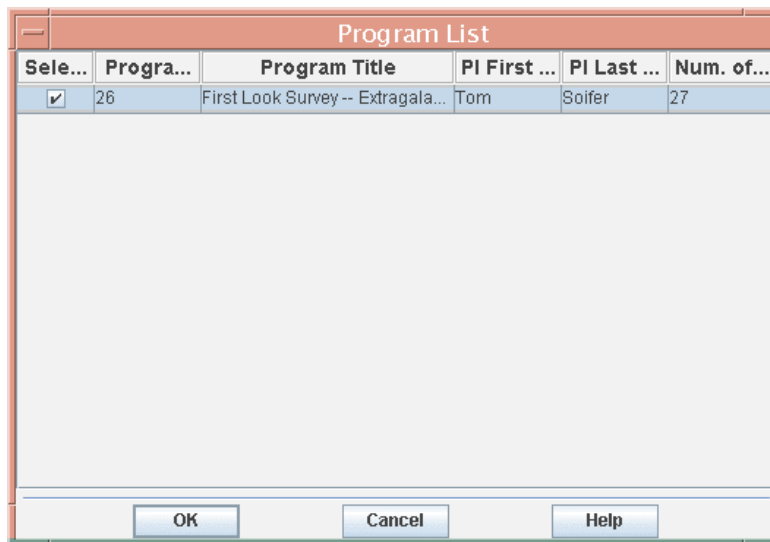


Figure 121: The Program List window, showing the information for Program ID 26.

4. Click on the line that contains the desired AOR; in this example, the AOR with Label “P0026: FLS-IRAC-ver1a.” This highlights the line, selecting it as the active AOR in the Archive Query Results window (Figure 122).

Archive Query Results

Astronomical Observation Requests (AORs)

Label	Target	Position	Key	Retrieve Wave length	Version	Status	Releas...	Sched...	Instrum...	Preview
P00026: FLS-...	FLS-CVZ-ce...	17h18m...	38640...	<input type="checkbox"/> 24 <input type="checkbox"/> 70 <input type="checkbox"/> 1...	S16.0.0	nominal	2004-0...	2003-...	MIPS Scan ...	24 70 160
P00026: FLS-...	FLS-CVZ-ce...	17h18m...	38643...	<input type="checkbox"/> 24 <input type="checkbox"/> 70 <input type="checkbox"/> 1...	S16.0.0	nominal	2004-0...	2003-...	MIPS Scan ...	24 70 160
P00026: FLS-...	FLS-CVZ-ce...	17h18m...	38645...	<input type="checkbox"/> 24 <input type="checkbox"/> 70 <input type="checkbox"/> 1...	S16.0.0	nominal	2004-0...	2003-...	MIPS Scan ...	24 70 160
P00026: FLS-...	FLS-CVZ-ce...	17h18m...	38648...	<input type="checkbox"/> 24 <input type="checkbox"/> 70 <input type="checkbox"/> 1...	S16.0.0	nominal	2004-0...	2003-...	MIPS Scan ...	24 70 160
P00026: FLS-...	FLS-CVZ-ce...	17h18m...	38650...	<input type="checkbox"/> 24 <input type="checkbox"/> 70 <input type="checkbox"/> 1...	S16.0.0	nominal	2004-0...	2003-...	MIPS Scan ...	24 70 160
P00026: FLS-...	FLS-CVZ-ce...	17h18m...	38653...	<input type="checkbox"/> 24 <input type="checkbox"/> 70 <input type="checkbox"/> 1...	S16.0.0	nominal	2004-0...	2003-...	MIPS Scan ...	24 70 160
P00026: FLS-...	FLS-CVZ-ce...	17h18m...	38656...	<input type="checkbox"/> 24 <input type="checkbox"/> 70 <input type="checkbox"/> 1...	S16.0.0	nominal	2004-0...	2003-...	MIPS Scan ...	24 70 160
P00026: FLS-...	FLS-CVZ-ver	17h17m...	38658...	<input type="checkbox"/> 24 <input type="checkbox"/> 70 <input type="checkbox"/> 1...	S16.0.0	nominal	2004-0...	2003-...	MIPS Scan ...	24 70 160
P00026: FLS-...	FLS-CVZ-ver	17h17m...	38661...	<input type="checkbox"/> 24 <input type="checkbox"/> 70 <input type="checkbox"/> 1...	S16.0.0	nominal	2004-0...	2003-...	MIPS Scan ...	24 70 160
P00026: FLS-...	FLS-CVZ-ver	17h17m...	38663...	<input type="checkbox"/> 24 <input type="checkbox"/> 70 <input type="checkbox"/> 1...	S16.0.0	nominal	2004-0...	2003-...	MIPS Scan ...	24 70 160
P00026: FLS-...	FLS-CVZ-ver	17h17m...	38666...	<input type="checkbox"/> 24 <input type="checkbox"/> 70 <input type="checkbox"/> 1...	S16.0.0	nominal	2004-0...	2003-...	MIPS Scan ...	24 70 160
P00026: FLS-I...	FLS-CVZ-ver	17h17m...	38668...	<input checked="" type="checkbox"/> 3.6 <input checked="" type="checkbox"/> 4.5 <input checked="" type="checkbox"/> 5.8 <input checked="" type="checkbox"/> 8.0	S16.0.0	nominal	2004-0...	2003-...	IRAC Map...	3.6 4.5 5.8 8.0
P00026: FLS-I...	FLS-CVZ-ver	17h17m...	38671...	<input checked="" type="checkbox"/> 3.6 <input checked="" type="checkbox"/> 4.5 <input checked="" type="checkbox"/> 5.8 <input checked="" type="checkbox"/> 8.0	S16.0.0	nominal	2004-0...	2003-...	IRAC Map...	3.6 4.5 5.8 8.0
P00026: FLS-I...	FLS-CVZ-ver	17h17m...	38673...	<input checked="" type="checkbox"/> 3.6 <input checked="" type="checkbox"/> 4.5 <input checked="" type="checkbox"/> 5.8 <input checked="" type="checkbox"/> 8.0	S16.0.0	nominal	2004-0...	2003-...	IRAC Map...	3.6 4.5 5.8 8.0
P00026: FLS-I...	FLS-CVZ-ver	17h17m...	38676...	<input checked="" type="checkbox"/> 3.6 <input checked="" type="checkbox"/> 4.5 <input checked="" type="checkbox"/> 5.8 <input checked="" type="checkbox"/> 8.0	S16.0.0	nominal	2004-0...	2003-...	IRAC Map...	3.6 4.5 5.8 8.0
P00026: FLS-I...	FLS-CVZ-ver	17h17m...	76769...	<input checked="" type="checkbox"/> 3.6 <input checked="" type="checkbox"/> 4.5 <input checked="" type="checkbox"/> 5.8 <input checked="" type="checkbox"/> 8.0	S16.0.0	nominal	2004-0...	2003-...	IRAC Map...	3.6 4.5 5.8 8.0
P00026: FLS-I...	FLS-CVZ-ver	17h17m...	76771...	<input checked="" type="checkbox"/> 3.6 <input checked="" type="checkbox"/> 4.5 <input checked="" type="checkbox"/> 5.8 <input checked="" type="checkbox"/> 8.0	S16.0.0	nominal	2004-0...	2003-...	IRAC Map...	3.6 4.5 5.8 8.0

Archive Query Results

Uncompressed Size: 0
Selected Products: 0

Partially Queued (see tip)
Fully Queued (see tip)
Partially Downloaded (see tip)
Fully Downloaded (see tip)

What to download?
 Post BCD data BCD - Basic data
 Raw data Calibration data

Logged in as: General User Net Up Total AORs: 27 / Total Products: 96

Figure 122: The main Leopard window, showing that the "P00026: FLS-IRAC-ver1a" AOR has been highlighted, after we have clicked on this AOR entry.

- We desire to download the data from IRAC 3.6 and 8.0 μm , so these wavelengths in the "Retrieve Wavelengths" column are checked.
- In the lower right corner of the Leopard window, we select the type of desired data products, selecting the BCD and Post-BCD data. In the lower left corner of the window will appear the estimated size of the data products selected, in Megabytes (Figure 123). We should check to make sure there is sufficient local disk space for a successful download.
- Click on the shortcut icon (diskette) for "Download Selections" (or select this option from the File Menu). A window appears with two possible download options (Figure 123). In this example, we select direct download and clicks "OK." A window appears, allowing us to specify the directory where the data will be deposited (Figure 124). The local directory file structure can be browsed, to select the appropriate directory, and then the user should click "Open."
- Leopard starts up the Subscriber tool and a Subscriber window appears (Figure 125). The color of the Retrieve Wavelength column changes depending on the download status. The key to the colors is indicated to the lower left of the Leopard window. The column for that AOR turns completely green when the AOR has been queued for downloading (Figure 126). When all the data are delivered the Retrieve Wavelength column for the AOR will turn blue (Figure 127). The Subscriber window also indicates the query and download status during the process. If the download process will take quite some time, we can exit Leopard,

and the Subscriber window will stay open and continue to query and deliver the data to local disk.

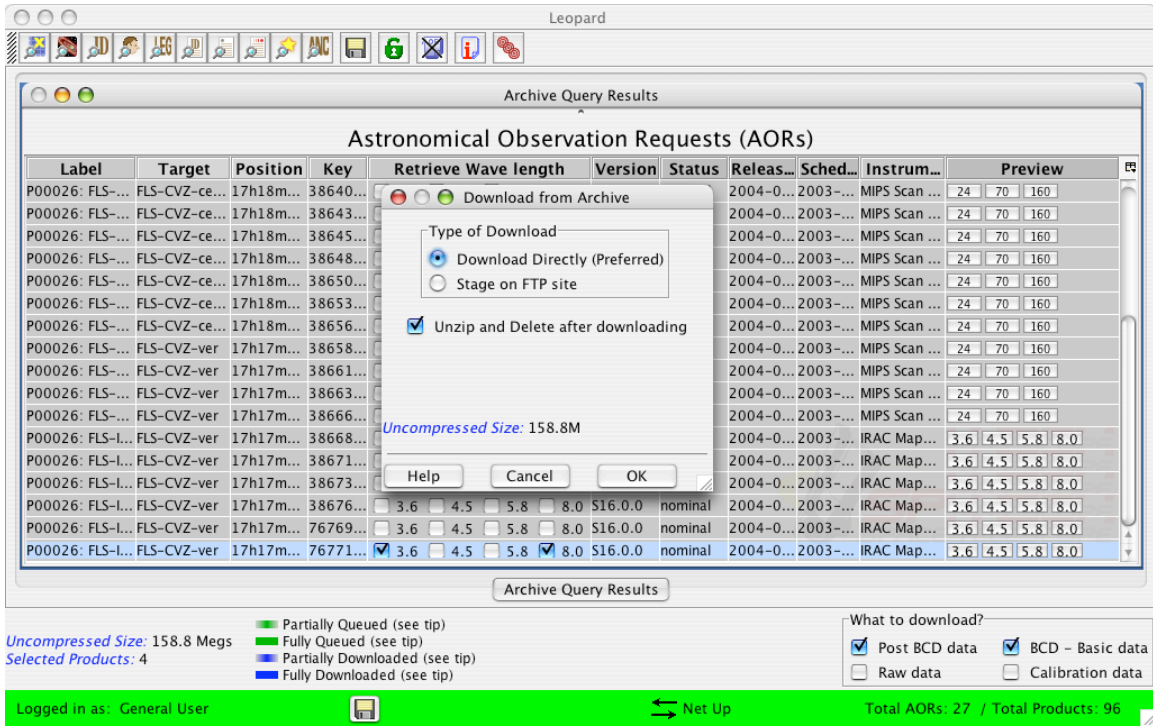


Figure 123: The main Leopard window, showing that the 3.6 and 8.0 μm wavelength bands, and the Post-BCD and BCD data, have been selected for the chosen AOR. Also shown is the dialog with the two download options, which pops up when the Download Selections diskette icon is clicked at the bottom of the Leopard window; downloading to local disk is the preferred option.

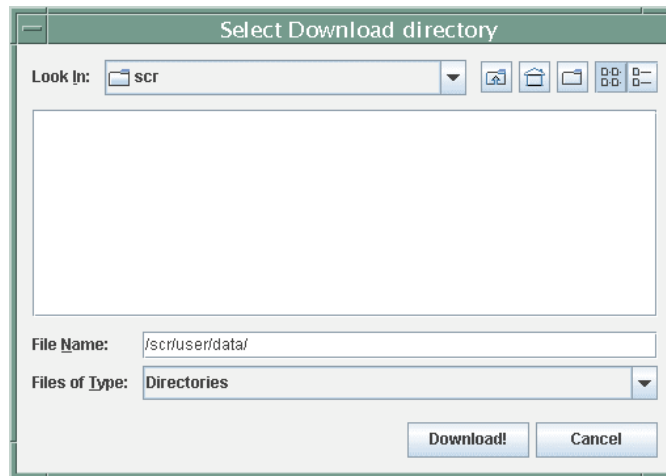


Figure 124: The Select Download directory dialog, which opens when we select direct download to local disk. We can then enter the full path for the directory in which the data will be downloaded. Clicking "Open" will start the download.

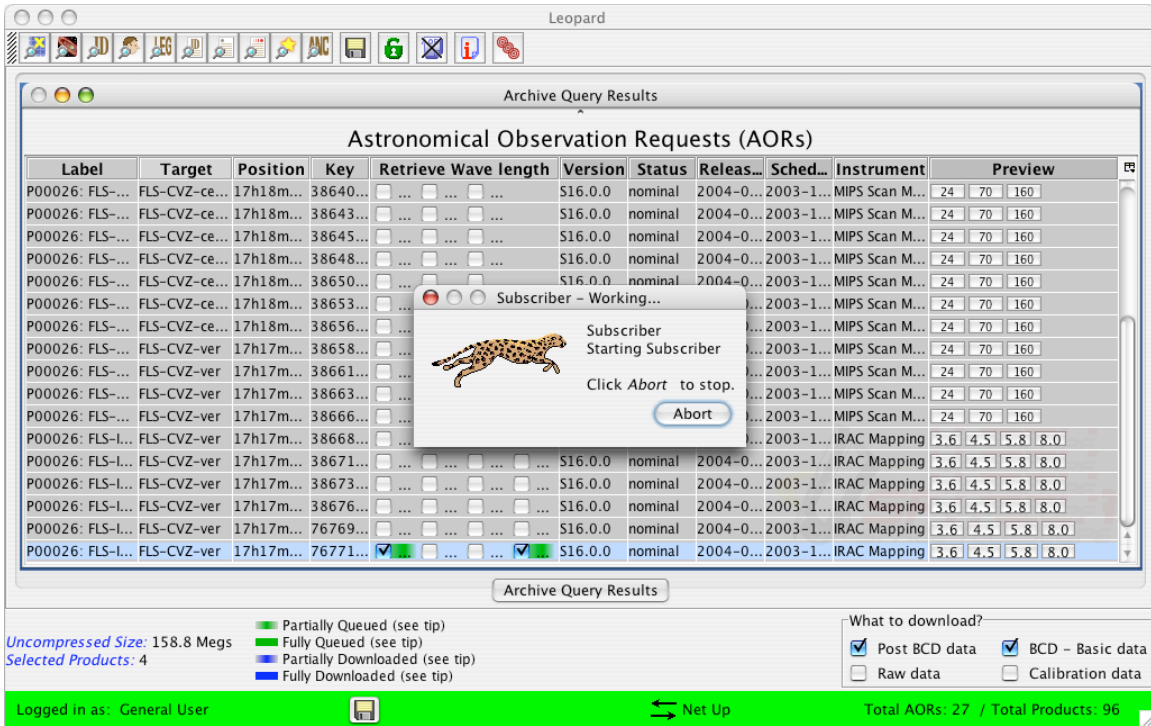


Figure 125: The main Leopard window, showing that the Subscriber window has been launched.

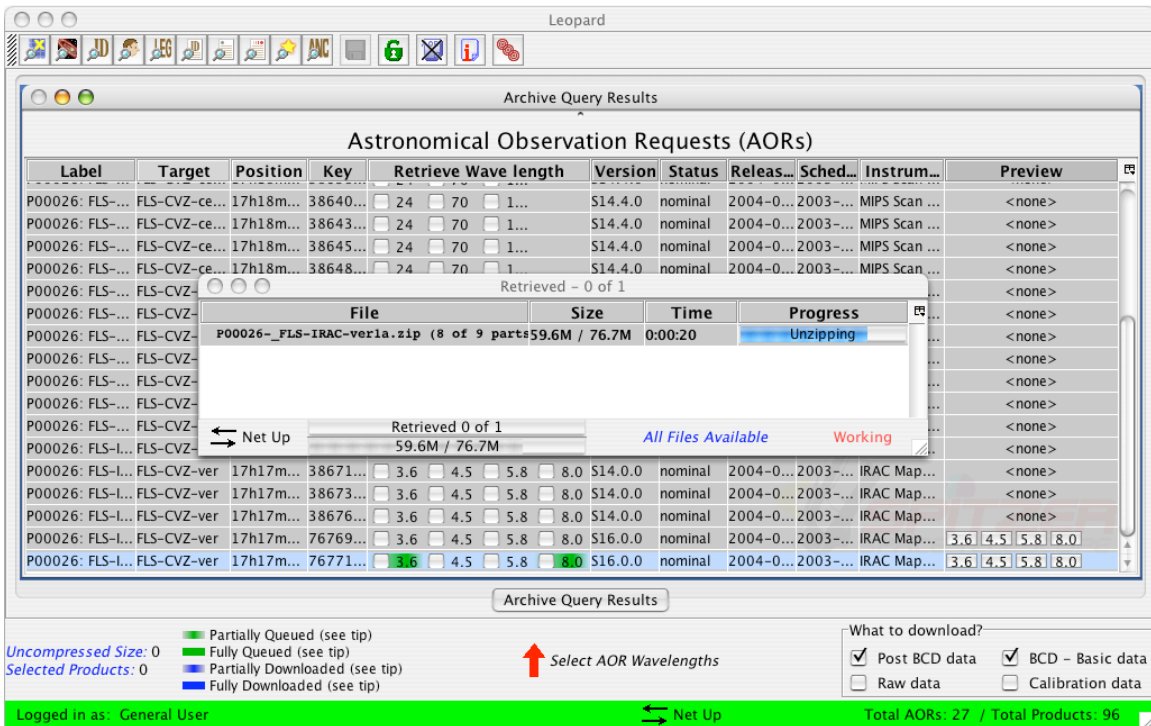


Figure 126: The main Leopard window, showing the status of the partial data product download for the data. The green color indicates that the download has been queued. A box also opens showing the progress of the data download to local disk.

The screenshot shows the Leopard software interface. The main window is titled 'Archive Query Results' and displays a table of 'Astronomical Observation Requests (AORs)'. The table has columns: Label, Target, Position, Key, Retrieve Wave length, Version, Status, Releas..., Sched..., Instrum..., and Preview. A 'Subscriber' window is overlaid on the table, showing a file download progress for 'P00026_FLS-IRAC-ver1a.zip (9 parts)' with a size of 73.5M and a time of 0:00:25. The download status is 'Done'. A 'Net Up' window is also visible, showing 'Retrieved 1 of 1' files and 'All Files Downloaded'. The bottom status bar shows 'Logged in as: General User', 'Net Up' status, and 'Total AORs: 27 / Total Products: 96'. A legend at the bottom indicates download statuses: Partially Queued (green), Fully Queued (green), Partially Downloaded (blue), and Fully Downloaded (blue). A 'What to download?' section has checkboxes for 'Post BCD data', 'BCD - Basic data', 'Raw data', and 'Calibration data'.

Figure 127: The main Leopard window, showing that the partial data product download is now complete. This is indicated by the blue color for the download status of the 3.6 and 8.0 μm wavelengths.

- Finally, we can go to the local data directory and unzip the delivered file. We should read the README file in each product's subdirectory to ensure the data download completed successfully ... just in case.

Important items to note: If you have multiple AORs in the Archive Query Results window and have selected various wavelengths for retrieval for various AORs, the data product types you choose will be delivered (if they exist) for ALL the wavelengths for all of the AORs. You cannot choose to download just the BCD products for one AOR and the BCD and Post-BCD products for another AOR within the *same* download session. You can download them serially within one Leopard session, selecting the first AOR and its products, request the download, and while that is occurring, select the other AOR and its data products.

The SSC encourages Spitzer Archive users to select the 'Download Directly' option for data delivery. Our FTP staging disk area is only so large, and delivery of your requested data may be delayed if the FTP area is too full to contain your request. This is particularly true for MIPS BCD data!