Spitzer Heritage Archive Help

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Spitzer Heritage Archive: Overview

The Spitzer Heritage Archive (SHA) is the final repository for all of the data collected by Spitzer.

Note that there are also SHA video tutorials, available at the IRSA YouTube channel. Look for the playlist that combines all the SHA videos together.

Contents of page/chapter:

The Spacecraft and Instruments

The Spitzer Space Telescope (formerly SIRTF, the Space Infrared Telescope Facility), was launched into an Earth-trailing orbit on 25 August 2003, and ceased operations on 30 January 2020. Consisting of a 0.85-meter telescope and three science instruments, at the time of its launch, Spitzer was the largest infrared telescope ever launched into space. The instruments aboard Spitzer (IRAC, IRS and MIPS) obtained images and spectra at wavelengths between 3 and 180 microns, with spatial resolution ranging from 2 arcseconds at the shortest wavelengths to 40 arcseconds at the longest. More information on Spitzer is available.

Terminology

Telescope & Data Terminology

This archive of Spitzer data is called the Spitzer Heritage Archive, or the SHA.

An individual Spitzer observation sequence is an **AOR, or Astronomical Observation Request**. In certain cases (often calibration or sometimes science observations), you may also see an **IER, or Instrument Engineering Request**. Either one involves many individual frames.

The individual data frames that emerge, calibrated, from the Spitzer pipeline are **Level 1, or Basic Calibrated Data, or BCDs**.

The products that come from combining these individual data frames (such as mosaics of individual pointings) are **Level 2, or post-BCD, or PBCD data**.

Enhanced Products, or Level 3 data, come from combining AORs or doing post processing (such as synthetic photometry from spectra or source extraction from images). These can be contributed by the community, or generated by the Spitzer Science Center (SSC) itself.

One AOR may have **many** Level 2 (PBCD) files associated with it, and a **very large number** of Level 1 (BCD) files associated with it. Not every AOR may have enhanced products (Level 3) associated with it.

IRSA and the Spitzer Heritage Archive utilize technology developed for the Virtual Astronomical Observatory (VAO), funded by the National Science Foundation and the National Aeronautics and Space Administration under Cooperative Agreement AST-0834235.

Tool Terminology

The words in blue rectangles at the top are 'tabs.'

This icon in the upper left  pulls open a "drawer" from the left hand side which enables you to add or remove tabs from this top level (see below). Most of these tabs allow searching. The side drawer also can allow you to change the appearance (dark or light mode) (see below).

When you have results loaded into the Spitzer Heritage Archive, your browser window is divided into "**panes**", like "window panes." The contents of the panes depends on what you are doing with the tool, but could include an image pane, at least one table pane, and/or a plot pane. You can expand any of the window panes by clicking on the expand icon: 

Each of the three main kinds of 'panes' in the display has its own toolbox in its upper right corner which operates on things in that pane, and the basic functionality for each of these panes is covered elsewhere in this document:

◊ The Tables section covers (among other things) the tables toolbox


◊ The Plots section covers (among other things) the plots toolbox


◊ The Visualization section covers (among other things) the images toolbox

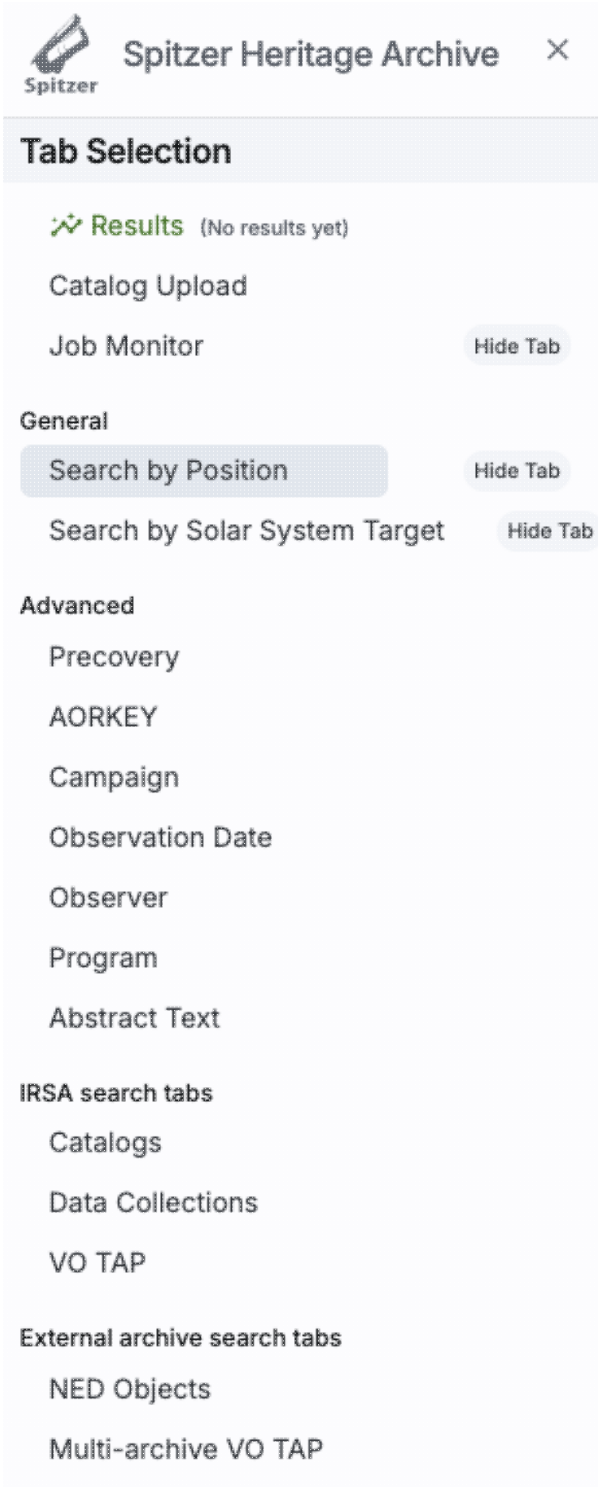

In the Spitzer Archive, you can search by position or orbital parameters for moving targets, or any of a number of other Spitzer-specific searches. Searching is in its own section.

Side Menu and Adding to the Tabs Menu

This icon  in the upper left pulls open a "drawer" from the left hand side; the top of it looks like this:

The highlighted bar ("Results" in this example) is the tab you have in the foreground on your main window. Catalog Upload

You can use this side menu to add (or remove) blue tabs from the top of your Spitzer Archive interface. By default, Results, Position Search, and Precovery Search are shown, along with the Job Monitor. You can also upload catalogs. href="searching.html">search by Abstract Text, AORKEY, Campaign, Moving Object, Observation Date, Observer, and Program.



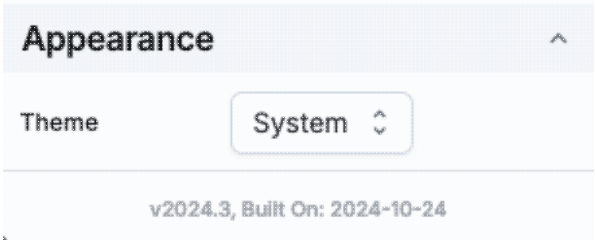
Under "IRSA search tabs," Catalogs and VO TAP search IRSA holdings.

Under "External archive search tabs," NED Objects and Multi-archive VO TAP (that is, a general TAP search) search other (non-IRSA) archives.

Click on the "Hide Tab" button to remove that corresponding tab.

Side Menu and Appearance

This icon  in the upper left pulls open a "drawer" from the left hand side; the bottom of it looks like this:



This controls the appearance of the tool in your browser -- do you want it to run as light mode, dark mode, or respect whatever preferences you have set on your system? Try out the different modes; you may have a preference!

User Login

In the far upper right, there is a link to log in. The Spitzer Heritage Archive can remember you when you return. (This mattered far more when there was proprietary data.) See the user registration section for more information.

Getting More Help

The "Help" icon leads you into this online help. There are also context-sensitive help markers throughout the tools ( ). You can also download a PDF version of this manual; look at the top left of the help window. (The PDF may be easier to search than the web pages; use your PDF reader's search function.)

You can submit questions to the IRSA Help Desk.

A set of frequently asked questions (FAQs) about the Spitzer Heritage Archive is here.

The IRSA YouTube channel has lots of short videos about IRSA tools.

Found a bug? The known bugs and issues in this version of the Spitzer Heritage Archive are listed here. If you think you have found a bug, before reporting it, please check this list, and read this online Spitzer Heritage Archive help. It may be a "feature" we already know about. If you have found a new, real bug, then please do contact us via the IRSA Help Desk. Please include your operating system version and your browser software and version. If you can, please also include any specific error message you may have gotten. (NB: In our testing, copying shortcuts worked on Windows and Linux; the command-C did not always work on Macs, but selecting and clicking the right mouse button often did when command-C did not.)

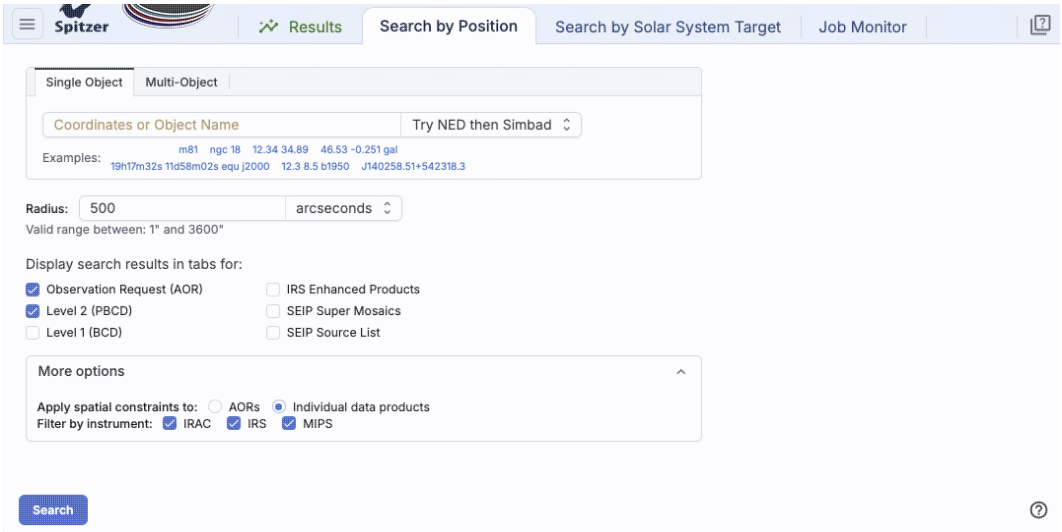
Spitzer Heritage Archive: Searching

There are many different options for searching the Spitzer Heritage Archive (SHA). Searching by position is the most commonly used option. In all cases, after entering your search parameters, click on the blue "Search" button to actually launch the search.

Contents of page/chapter:

Searching by Position (Spatial Constraints)

This search is the most common search performed on astronomical archives. Enter your central position and cone (circle) radius, then all observations (those meeting all the rest of your entered criteria) intersecting that cone are returned.



You may enter a target name, and have either NED-then-Simbad or Simbad-then-NED resolve the target name into coordinates (such as M17 or NGC6946). Alternatively, you may enter coordinates directly. These coordinates can be in decimal degrees or in hh:mm:ss dd:mm:ss format. By default, it assumes you are working in J2000 coordinates; you can also specify galactic, ecliptic, or B1950 coordinates as follows:

- '141.607 -47.347 gal' means 141.607, -47.347 degrees in galactic coordinates

- '42.76037 3.17750 ecl' means 42.76037, +3.17750 degrees in ecliptic coordinates
- '12h34m27.0504s + 2d11m17.304s Equ J2000" specifies the RA and Dec in J2000 coordinates
- '20h27m36.3467s +40d01m21.649s Equ B1950' specifies the RA and Dec in B1950 coordinates

As you are completing a valid coordinate entry, it echoes back to you what it thinks you are entering. Look right below the box in which you are typing the coordinates to see it dynamically change.

You specify the radius over which you want to search. You may enter this radius in arcseconds, arcminutes, or degrees; just change the drop-down option accordingly.

Tips and Troubleshooting

- Pick your search radius units from the drop-down first, and then enter a number; if you enter a number and then select from the drop-down, it will convert your number from the old units to the new units. There are both upper and lower limits to your search radius; the tool will tell you if you request something too big or too small.

You then need to select what kinds of results you want:

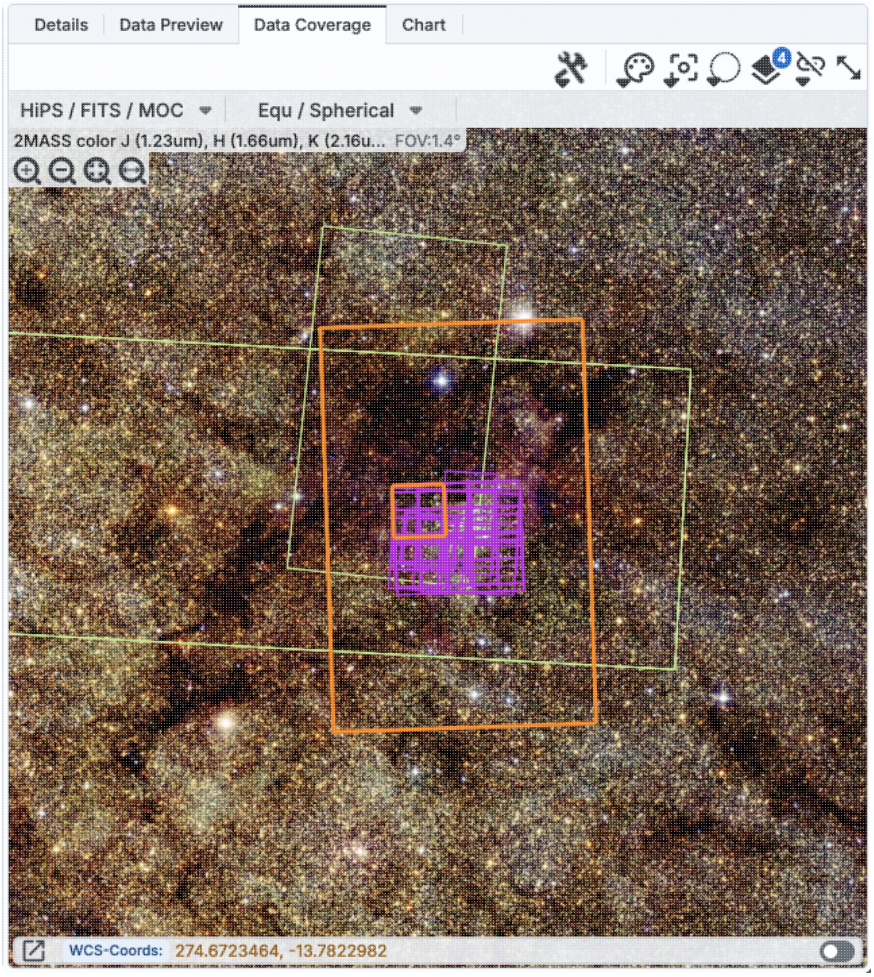
- Observation requests (AOR)
- Level 2 (PBCD)
- Level 1 (BCD)
- IRS Enhanced Products
- SEIP Super Mosaics
- SEIP Source List

Each of these results will be displayed in different tabs. (Definitions of these terms can be found in the Overview chapter.)

Under the "more options" triangle, you can apply the spatial constraints to AORs or individual data products, or ask for results from just one, two, or all three instruments.

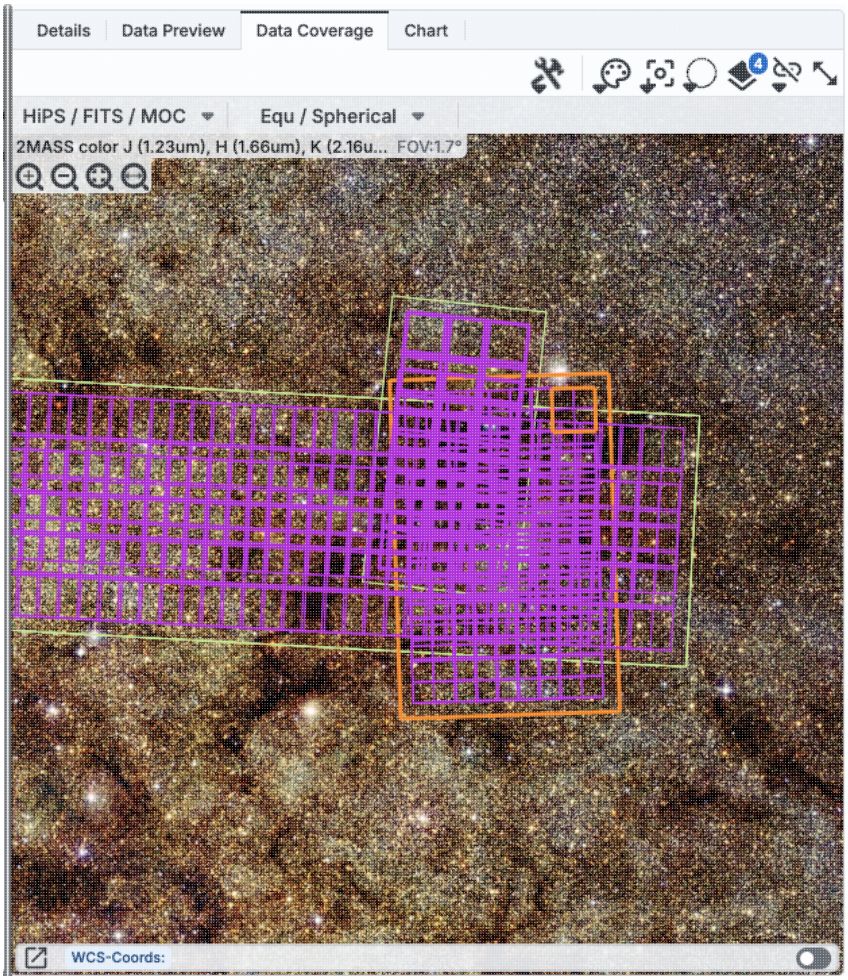
What does it mean to apply spatial constraints to AORs or individual data products?

This is probably best explained via a quick example. If we search for M16 using a 100 arcsecond radius, we return three IRAC AORs. The Level 2 PBCD mosaics are all returned, with the same footprint per AOR for all four channels shown on the coverage image, where one AOR is long and narrow, and the other AOR is more square, shown here as



green and orange polygons. However, if the spatial constraints are applied to the individual data products, only the BCDs meeting those constraints are returned (e.g, those within 100 arcseconds of the requested target) -- shown as purple polygons in the first visualization. If the spatial constraints are not applied to the individual data products, then all of the BCDs corresponding to each of those AORs are returned, shown as purple polygons in the second visualization.

If we download data from the AOR or Level 2 tab, and select Level 1 data there, we should get all of the BCDs. If we download data from the Level 1 tab for a constrained-by-position data product search, we should only get the limited BCDs as shown.

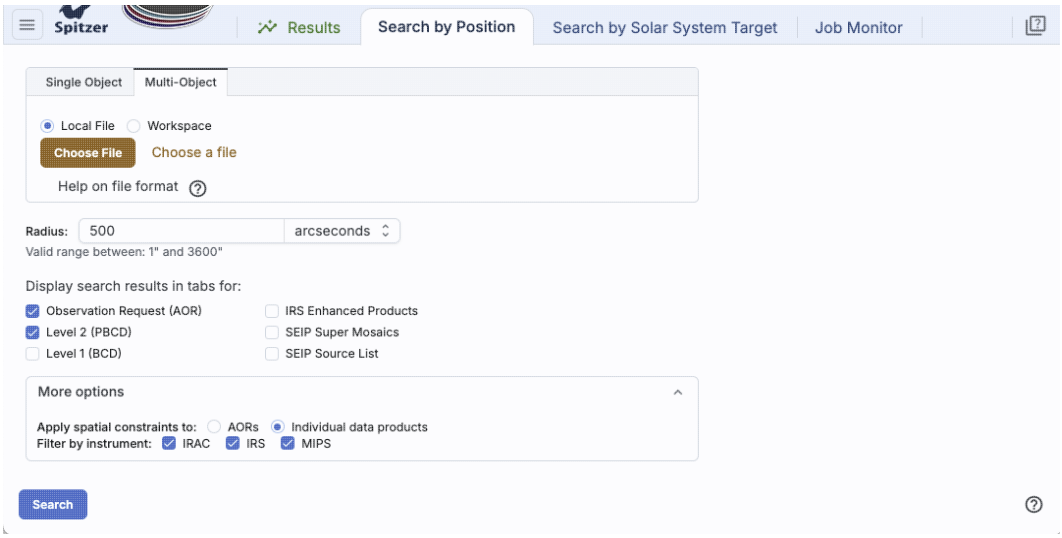


Tips and Troubleshooting

- For astronomers investigating Spitzer data for the first time, note that many investigators delivered high level science data products back to IRSA; try searching by position from the box in the upper left on IRSA's main page to see what data sets we have covering your position on the sky. (See also the first example here.)
- If you don't understand why you're getting the results you're getting, explore what is being returned in the coverage tab. (See also the third example here.)

Searching by Position in Batch Mode

The position search can also be executed in "batch mode" for a list of objects given in a file - select the Multi-Object tab from the search page.



You can load a file from your local disk or the IRSA Workspace. The file can be in any of three formats: comma-separated values (CSV), tab-separated values (TSV), or IPAC table format, which is basically ASCII text with headers explaining the type of data in each column, separated by vertical bars.

For IPAC table file format, the simplest possible input file looks like this example:

```
|              ra|             dec|
|          double|          double|
|             deg|             deg|
 266.461876096161 -28.9303475510113
 317.385694084404 -41.1537816217576
 267.210580557307 -27.7929408211594
 229.172700517754   0.2598861324350
 299.510225672473 -38.7735055243326
 213.945501950887  13.3596597685085
 262.341432853080 -23.7518928284717
 271.202769466020 -21.7274227022229
 291.167629785682 -29.2569222675305
 272.336516119634 -20.2761650442889
 237.391628608612   2.5906013137112
```

Note: Your uploaded table must have RA and Dec, not just target names.

Tips and Troubleshooting

Please use the IPAC Table Validator to check and reformat your input table before the table upload. If the table upload search still does not work properly, try the following :

- No hyphens allowed in column names, or in the filename! (Sometimes this seems to matter, or matter only for some things and not others, and sometimes it doesn't. If you are getting weird behavior, this is one thing to try.)
- Column names should be all in lower case, so "ra" not "RA" or "Ra" or "RA2000", etc., and same for "dec".
- No spaces after the last pipes in the header lines.
- No empty lines at the end of the input file.
- IPAC table files should end in ".tbl".
- Make sure there are not lots of extra whitespace (spaces, tabs, etc.) at the ends of lines, particularly the

header lines.
- Check for and remove odd non-standard characters like curly quotes or Greek letters, and other non-printing special characters (like tabs).
- If using the table verification service, name resolution may fail for some targets with Greek letters or other unusual characters -- provide coordinates for the troublesome names, or remove them.

After you have uploaded your list of targets, the rest of the search form looks the same as for the single position search.

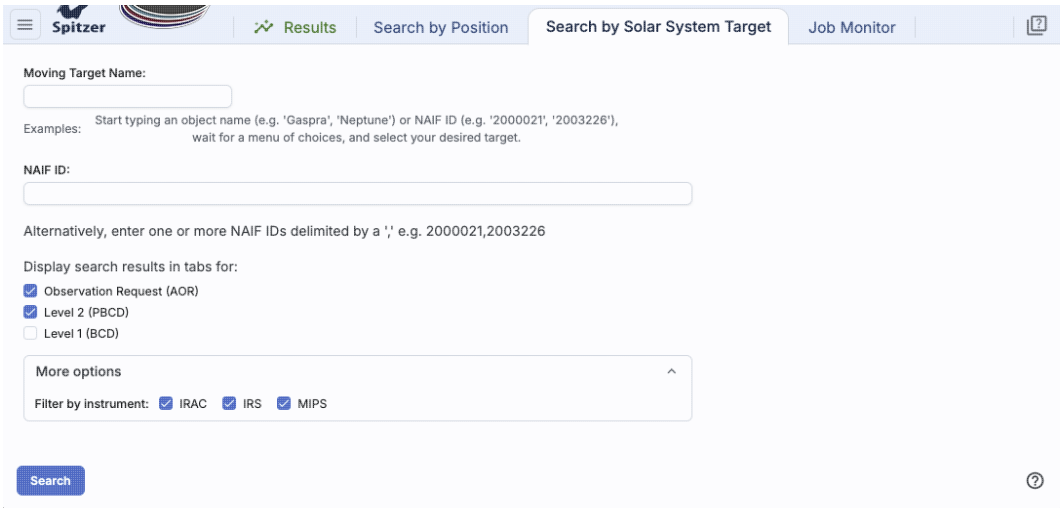
Tips and Troubleshooting

- For batch searches, if you want to use a different search radius for each target, add a column to the input table. If the table uploaded has a 'radius' column, the API will overwrite the single radius search and take the one specified in each row in the table.
- So that you can more easily tie results to input, when you get results back from a batch search, the input RA and Dec are columns appended to your results table.
- The maximum number of targets that can be requested in a batch search is 1000.

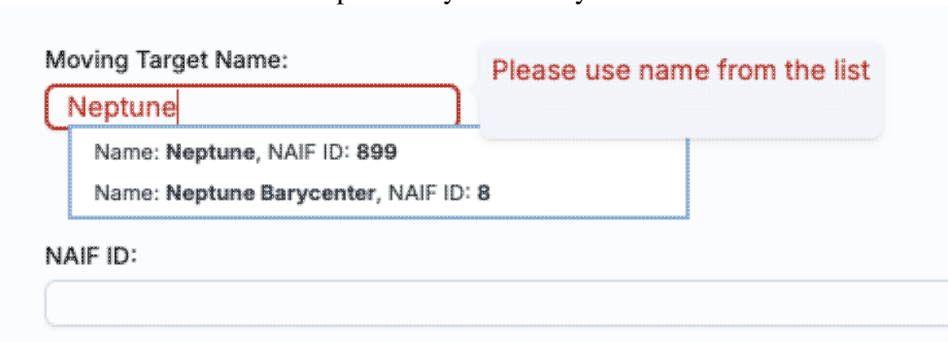
Searching by NAIF ID (for Solar System Objects, SSOs)

This search will retrieve data explicitly declared to be observations of these moving targets in the Spitzer database -- that is, the telescope 'knew' it was a moving target and tracked on the target. This means, for example, that observations of a moving target performed as a fixed-target observation of an RA/Dec will not appear, nor will serendipitous observations of a moving target that happens to appear in a fixed-target observation. To find such observations, see the section below on "Precovery." Note also that if incorrect target information was entered by observers, observations may not be retrieved.

You can search on the name of a moving target (Solar System Object, SSO), or the NAIF ID. The accepted naming conventions are the ones that have been approved for use by the CSBN and its predecessors. SSOs are assigned NAIF IDs, which are a unique integer identifier for known Solar System bodies. (See here or here for more about NAIF and NAIF IDs; in brief, every body in the Solar System has a number.) News reports occasionally use unofficial or unapproved names; you cannot use these names to access objects. For asteroid names, one can enter either the ID number, name or designation, e.g. 2, 887, 1917, Pallas, Alinda, Cuyo, 1981 QB, 1996 GQ, or 2010 CG18. It can also handle names with apostrophes and dashes like O'Connell and Pic-du-Midi. For comet names, one can enter either the whole name e.g., 10P *or* Tempel 2, 73P-B *or* Schwassmann-Wachmann 3, 2009 WJ50, or 2010 D1. (For experts: we are calling this API.)



If you know the NAIF ID, just type that in; if you know only the name, it will attempt to resolve the name for you into a NAIF ID. You may need to wait a second or two. You may need to carefully read what it is suggesting to make sure you have selected the NAIF ID you really want. For example, Neptune's NAIF ID is different than that for the Neptunian system's barycenter:



Even if only one suggestion is given, you need to explicitly select that suggestion in order to implement the search.

After selecting your NAIF ID, you then need to select what kinds of results you want:

- Observation requests (AOR)
- Level 2 (PBCD)
- Level 1 (BCD)

Each of these results will be displayed in different tabs.

Under the "more options" triangle, you can ask for results from just one, two, or all three instruments.

Tips and Troubleshooting: You need to select the NAIF ID, even if there is only one, in order to make the search work.

Moving Object Precovery

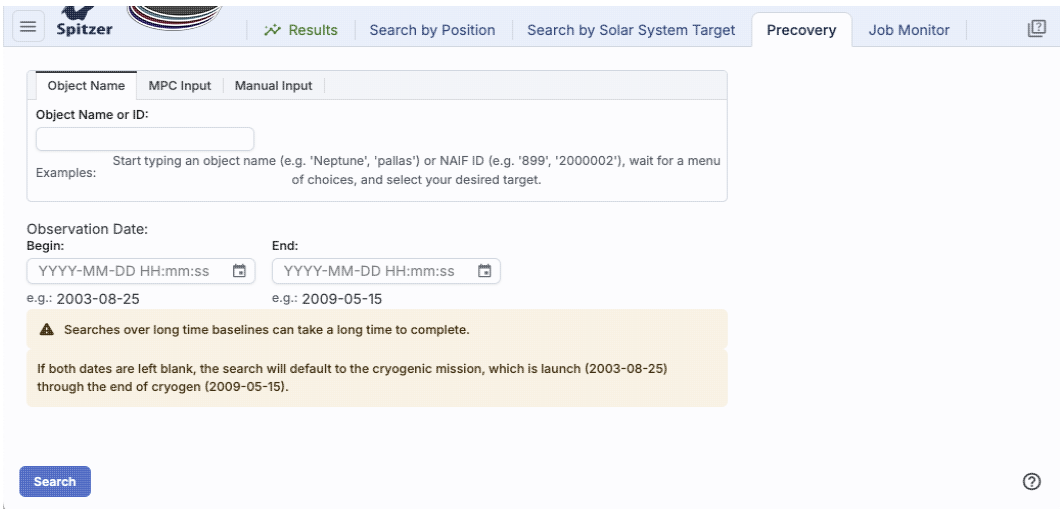
While many moving objects were deliberately observed over the course of the Spitzer mission, many also were serendipitously observed while conducting observations of other things. The Precovery search option enables

you to detemine if there are deliberate *or* serendipitous observations of a given object. (Note that this depends on having accurate orbital parameters and image positions/times to work.) The reason it's called "precovery" is because you can obtain pre-discovery images of a newly discovered object using this approach.

What the system is doing is using IRSA's Moving Object Search Tool (MOST), taking the orbital ephemeris (either searching for the ephemeris based on the name that you enter, or taking the orbital information you give it), calculating where the object was over the time range that you request (over the entire mission if date constraints are left blank), identifying the individual exposures in which it calculates that your object should be present, and returning to you all those data.

As a result, **requests over long time baselines can take a long time.** You can make a request that takes so much time that it times out, and you get no search results. In order to shorten search times, ask it to search over a smaller time baseline.

Searching by object name :



You can search by object names by entering the name in the "Object Name" field. It looks up the NAIF ID for you; select the NAIF ID corresponding to your object. The accepted naming conventions are the ones that have been approved for use by the CSBN and its predecessors. SSOs are assigned NAIF IDs, which are a unique integer identifier for known Solar System bodies. (See here or here for more about NAIF and NAIF IDs; in brief, every body in the Solar System has a number.) News reports occasionally use unofficial or unapproved names; you cannot use these names to access objects. For asteroid names, one can enter either the ID number, name or designation, e.g. 2, 887, 1917, Pallas, Alinda, Cuyo, 1981 QB, 1996 GQ, or 2010 CG18. It can also handle names with apostrophes and dashes like O'Connell and Pic-du-Midi. For comet names, one can enter either the whole name e.g. 10P *or* Tempel 2, 73P-B *or* Schwassmann-Wachmann 3, 2009 WJ50, or 2010 D1. (For experts: we are calling this API.)

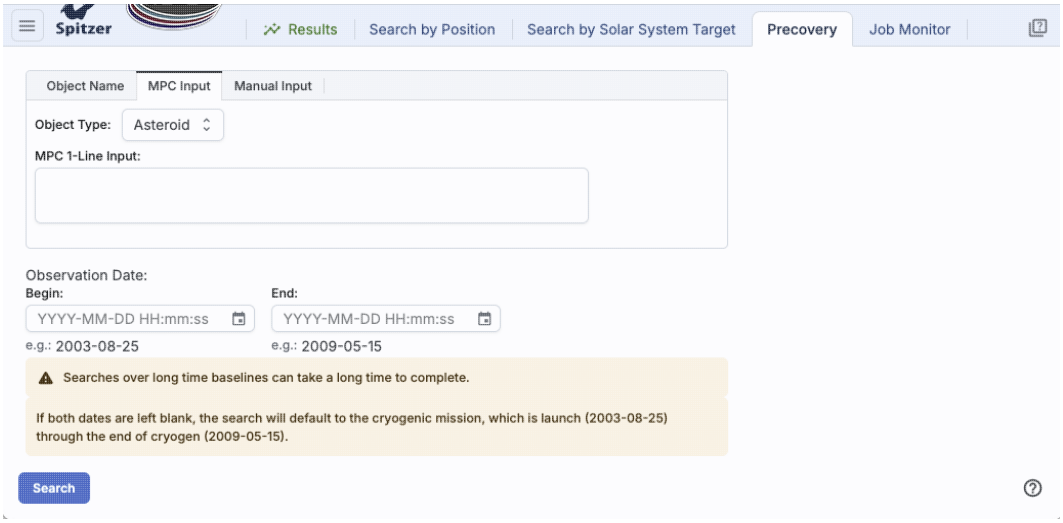
Tips and Troubleshooting

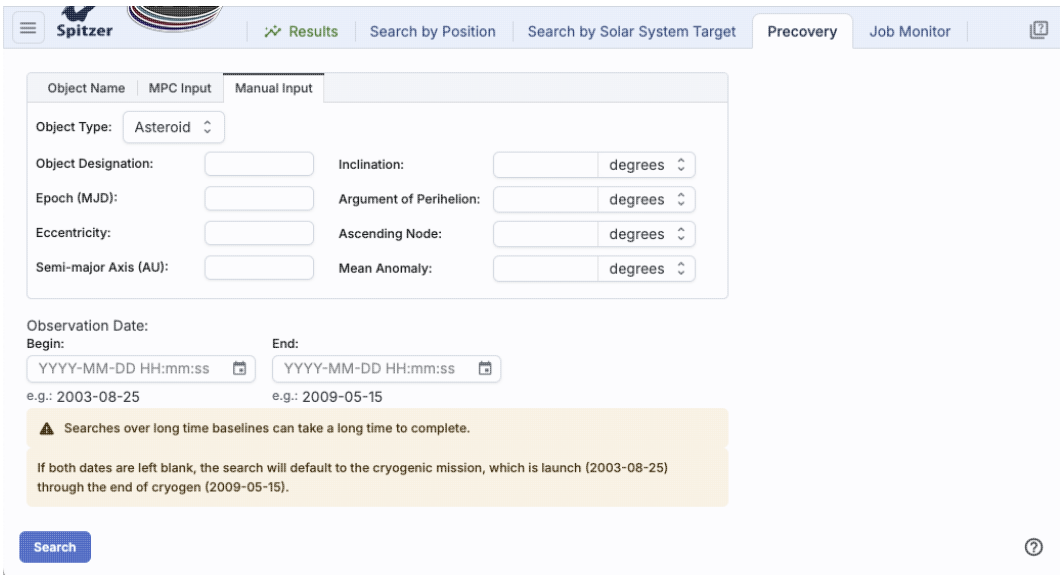
- It will take a second or two to turn the name into a NAIF ID. You can't search without a NAIF ID, so please just try to be patient and pick the NAIF ID from the list, even if it just gives you one option.

Searching by orbit (MPC or manual):

The search can be performed for comets or asteroids using the object name or the six orbital parameters

supplied by the user either individually or in the Minor Planet Center (MPC) one-line element format.





The standard six orbital elements for asteroids are *eccentricity (e), semimajor axis (a), mean anomaly (M), inclination(i), longitude of the ascending node ("Node"),* and *argument of perihelion (w)*. For comets, the elements are *eccentricity (e), perihelion distance (q), time of perihelion passage (Tp), inclination(i), longitude of the ascending node ("Node"),* and *argument of perihelion (w)*. Notice that for comets, *perihelion distance* is used instead of *semimajor axis* and *time of perihelion passage* is used instead of *mean anomaly*. The reason for replacing these two parameters is to allow for cases where long period comets have a parabolic or hyperbolic orbit. Other parameters you may see include mean motion (n), absolute magnitude (H), and slope parameter (G). A good description of the orbital parameters is given in JPL's Solar System Dynamics website.

You can search for objects by either inputting the orbital parameters by hand or by using a properly-formatted Minor Planet Center input string. This latter option allows the user to cut-and-paste a line directly from a table of orbital elements in MPC Format into the search field. There are a number of orbital element tables available at the MPC website, for example, observable NEO and observable comets. The complete list of minor planets can be found at the MPC Orbit (MPCORB) Database.

Information on the format of the element tables is given by following sites: minor planet format and comet format.

Observation Date (Begin and End):

You may provide a time baseline over which the search should be constrained. If left blank, it searches the entire Spitzer Heritage Archive. **Requests over long time baselines can take a long time.** You can make a request that takes so much time that it times out, and you get no search results. In order to shorten search times, ask it to search over a smaller time baseline.

Tips and Troubleshooting

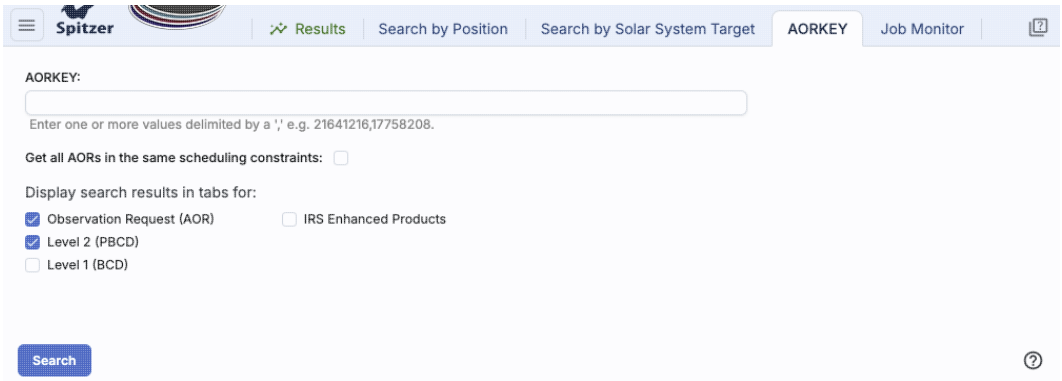
- Be cautious about using one-line or manually entered ephemerides in general but for comets in particular, as non-gravitational forces can render them irrelevant rapidly. Searching by object name is more likely to return results.
- An example to try that will return results in the SHA is the following manually entered parameters: designation=Karin, epoch in MJD=53724, eccentricity=e=8.136848767936521E-02, SMA=a=2.863363473756811, inclination=i=1.003191830335564, argument of perihelion=w=1.180729790805203E+02, ascending node=OM=2.546015989297557E+02, mean anomaly=MA=1.364457866568047E+02, observation dates 2005-12-01 to 2005-12-31.
- Searching over the entire Spitzer mission may result in a query that times out before yielding results. Try a shorter time baseline.

Searching by AORKEY

An AORKEY is a large integer that uniquely identifies the observation (AOR) within the Spitzer mission. All Level 1 (BCD) and Level 2 (PBCD) files carry with them the fingerprints of this AORKEY (in the filenames, in the directory structure, in the FITS headers, etc.). Specific AORKEYs should be listed in journal articles reporting on Spitzer results.

You can retrieve a specific observation by searching on this AORKEY. Note that a single AORKEY corresponds to a single AOR, so if you search on a single AORKEY, you will always get a single AOR in the AOR tab.

You can search for many AORKEYs at once by entering a list of them separated by commas.



Some observations were obtained with some scheduling constraints, e.g., 'observe this series of 8 AORs in this order within this time window.' In the AORKEY search panel, there is an option to retrieve all the other AORs

within the same scheduling constraint. **However, note that** some time series observations were obtained in the following manner. For a series of observations (a, b, c, d, e), a was tied to b with a particular constraint, b tied to c, c tied to d, and d tied to e. If you search on the AORKEY corresponding to observation b, and ask the SHA to give you all of the AORs constrained to that observation, it does exactly (and only) what you asked it to do -- b is tied to a and c, but not explicitly tied to d or e. So it returns to you observations a, b, and c, and not d or e.

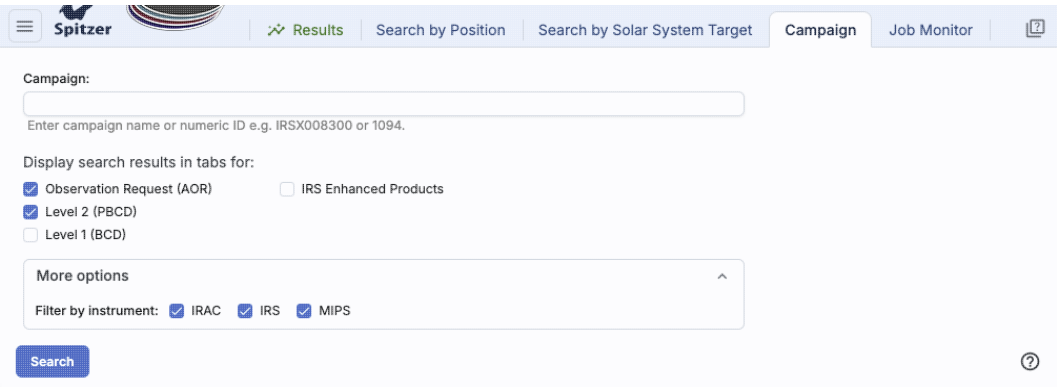
After typing in your AORKEY(s), you then need to select what kinds of results you want:

- Observation requests (AOR)
- Level 2 (PBCD)
- Level 1 (BCD)
- IRS Enhanced Products

Each of these results will be displayed in different tabs.

Searching by Campaign

In some cases, you may wish to browse all of the data taken during a specific campaign, e.g., to investigate bright object artifacts in your data from observations preceeding yours. This feature allows you to do exactly that. A complete list of Spitzer campaigns can be found at the Spitzer documentation.



Note that there are a few different ways to refer to a given Spitzer campaign, and the search only recognizes two of them. For example, IRS campaign 47 was run between 9 Jan 2008 and 23 Jan 2008. The formal campaign ID (which works in the search) is IRSX008300, and the search also works with the numerical id 1094 listed as synonymous with this campaign in the Spitzer documentation.

After typing in your campaign(s), you then need to select what kinds of results you want:

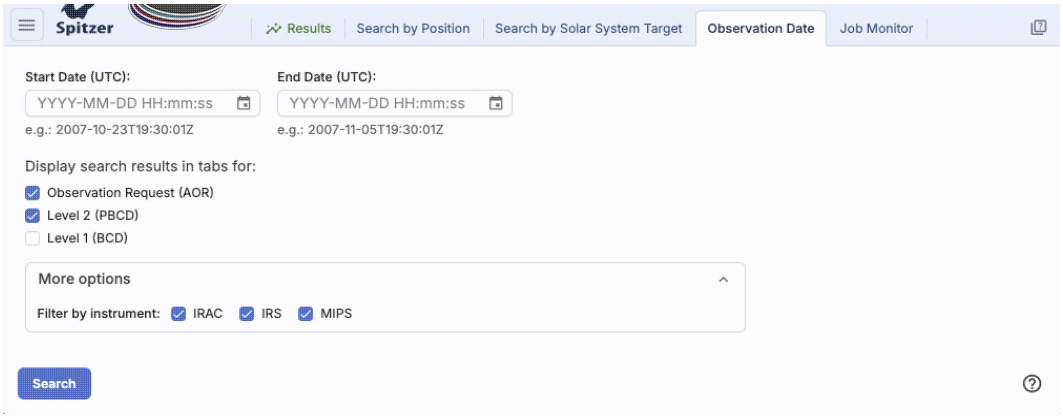
- Observation requests (AOR)
- Level 2 (PBCD)
- Level 1 (BCD)
- IRS Enhanced Products

Each of these results will be displayed in different tabs.

Under the "more options" triangle, you can ask for results from just one, two, or all three instruments.

Searching by Date Range

You can search for observations conducted between two dates. The dates must be specified in Universal Time (UT) and be in the format YYYY-MM-DD hh:mm:ss. The maximum date range allowable is relatively small; use large date ranges with caution because thousands of observations can be obtained via this search.



After selecting your date range, you then need to select what kinds of results you want:

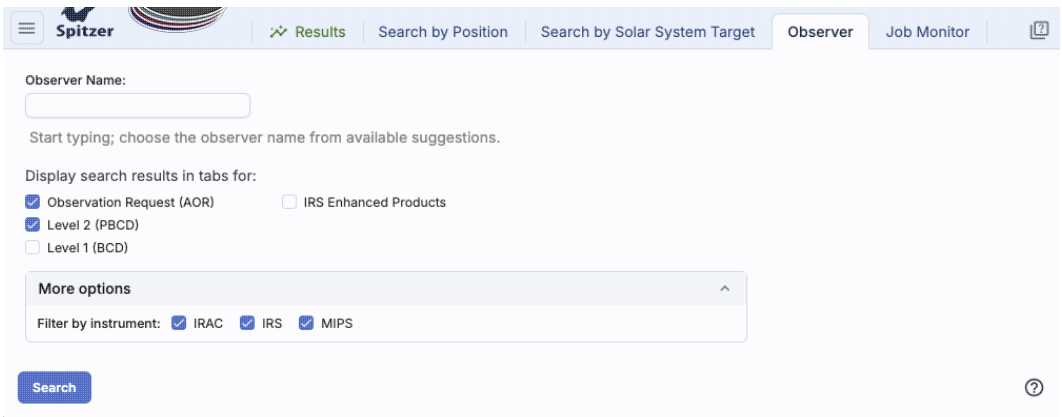
- Observation requests (AOR)
- Level 2 (PBCD)
- Level 1 (BCD)

Each of these results will be displayed in different tabs.

Under the "more options" triangle, you can ask for results from just one, two, or all three instruments.

Searching by Observer Name

You can search by name through all of the principal investigators for all Spitzer programs. Note that there is an auto-complete on this feature, which shows you available suggestions as you type in a string.



Note also that searching on any of the instrument PIs (Fazio, Houck, Rieke) or the Instrument Support Team leads (Reach/Carey, Latter/Noriega-Crespo, Armus) will return *many* programs tied to their guaranteed time (GTO) programs, or calibration programs from early in the mission.

To retrieve calibration programs during regular operations, search on "IRS Calibration" or "IRAC Calibration" or "MIPS Calibration."

After typing in the observer name, you then need to select what kinds of results you want:

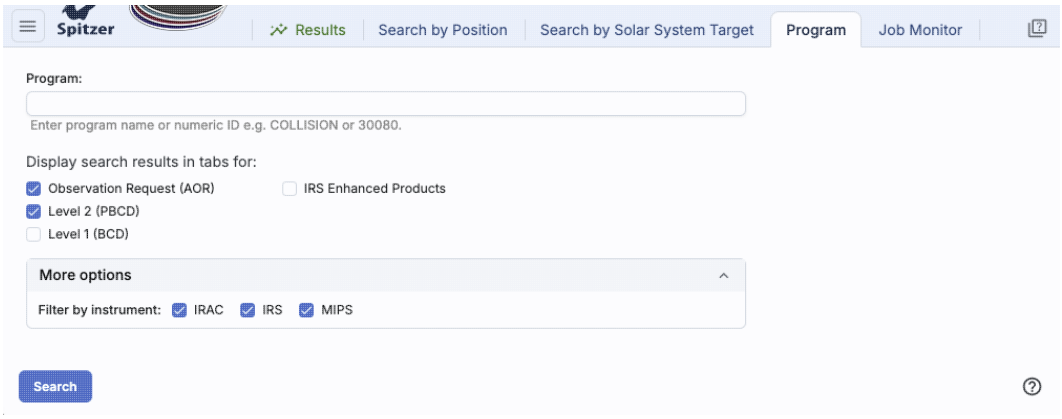
- Observation requests (AOR)
- Level 2 (PBCD)
- Level 1 (BCD)
- IRS Enhanced Products

Each of these results will be displayed in different tabs.

Under the "more options" triangle, you can ask for results from just one, two, or all three instruments.

Searching by Program

All of the observations that correspond to individual observing programs are grouped under a program identifier (PID). This program identifier can be both a string and a number. Either the string (assigned by the observer) or a number (assigned roughly by the order in which the original proposal was submitted) can be used to retrieve all of the observations that were part of that program. A complete list of all of the Spitzer programs can be found in the Spitzer documentation.



Note that some programs can include literally thousands of AORs, whereas others may be just one or two AORs. Note also that some large science programs may be split over multiple program IDs.

After typing in the program name, you then need to select what kinds of results you want:

- Observation requests (AOR)
- Level 2 (PBCD)
- Level 1 (BCD)
- IRS Enhanced Products

Each of these results will be displayed in different tabs.

Under the "more options" triangle, you can ask for results from just one, two, or all three instruments.

Searching by Abstract Text

You can search on a string through all of the Spitzer program abstracts. You can search on any text you would like, from principal investigator (PI) last names to instrument names to compound terms (such as "brown dwarf"). You can also use simple logic statements, e.g., "star formation -galaxy" means find all instances of the terms "star" and "formation" but not those that also use the word "galaxy." To enforce the appearance of a compound term, e.g., the word "star" next to the word "formation", enclose the term in quotes.

The results of this search are a list of programs; click on the title of the program, and then the search becomes a search by program.

More on Enhanced Products

The enhanced products that were created by the Spitzer Science Center (SSC) and available via tabs from the main search page are the IRS Enhanced products and the Spitzer Enhanced Imaging Products (SEIP).

There are *many* more enhanced products available at IRSA that were contributed by the community. There are a few different ways to find those products.

To obtain a high-level summary of any data (not just Spitzer) that are available at IRSA for any given position on the sky, try searching by position from the box in the upper left on IRSA's main page to see what data sets we have covering your position on the sky.

Data Collections is another tab that you can load from the side drawer ("hamburger menu"). This gives you access to images and spectra, and it has its own help page.

Catalogs at IRSA include a lot of catalogs delivered by various teams. If you use the catalogs tab, you can access these Spitzer-related catalogs by selecting 'Spitzer' for the 'project' menu. See the Catalogs chapter for more information.

In order to learn more about any enhanced data product, the particular values that are returned, how the data were reduced, its strengths and weaknesses, etc., please see the documentation corresponding to the products.

Spitzer Heritage Archive: Search Results

Results of a search of the Spitzer Heritage Archive appear in two different window panes, each of which could have several tabs.

Contents of page/chapter:

Terminology

Panes

The search results appear in two "panes" (like "window panes"). You can grab and drag the division between the two panes to change their relative sizes. The left is usually tables of search results and the right is usually images (or lists of images, or stuff about images, or plots).

Tips and Troubleshooting

- Note that each new search overwrites the results in the results tab -- that is, a second search doesn't *add* to the results tab; it *replaces* the contents of the results tab. This is different than some other IRSA tools.
- See here for more about the different kinds of data levels you could have searched for.

General Layout Information

The left pane of the search results contains lists of observations that met your criteria. The right pane of the search results contains more details of the observations. The right pane changes depending on what row you have selected (clicked on) in the left pane.

Left pane

The left pane initially has at least one and up to six tabs -- one called "AOR" that is a list of AORs, and then one for each data product you have selected. The columns are different in each tab. Each line includes basic information about the data product which fulfill your search critera.

Each tab is its own table, which behaves in the same way that tables throughout IRSA tools with this look and feel. See the Tables section for more details, but in summary you can change the width of the columns, sort by columns, filter by column values, hide columns, etc. Nearly all the tabs contain more information than is shown. To "turn on" a column, click on the gears and select the additional columns to show. More information on column selection in general can be found in the tables section.

The AOR tab provides the most compact view of the observations meeting your search criteria.

The data product tabs can each have more than one row per AOR. Level 2 (PBCD) data include mosaics or extracted spectra. Level 1 (BCD) data include individual exposures, so there can be

hundreds of these files per AOR. IRS Enhanced Products are not always available, even for IRS AORs, but when they are available, there is typically one per AOR. Similarly, SEIP Super Mosaics and SEIP Source List extractions are not always available, even for IRAC and MIPS AORs, but there can be many mosaics and thousands of sources when they are available.

The corresponding data can be downloaded by checking the box at the start of each row (or the box at the top of the column of boxes to select all) and clicking "Prepare download". (See the section on downloads for more information.)

Depending on what you do after your initial search (load catalogs, for example), you could add more tabs to both the left and the right window pane; see the catalogs section and/or the visualization section.

Right pane

The right pane of the search results contains several tabs that enable exploration of the data returned by your search. Click on a row in the left pane and the contents of the right pane change.

When the "AOR" tab is in the foreground on the left, the right side has four tabs:

◊ Details - summary of the line selected on the left.
◊ Depth of Coverage - representation of how many exposures were taken as a function of position on the sky. Note that this is number of exposures, not exposure time. Note, too, that this is often a multi-plane file, with a plane for each channel. The channel that is shown is indicated in the top left of the image window, for example this is channel 1 from an IRAC observation (where 4 channels are available):

◊ Data Coverage - a visual overview of the observations you have retrieved. (This tab is called just 'Coverage' in other tools, but because of the "Depth of Coverage" tab, it would be confusing to do this here.) After you have viewed the Coverage tab at least once, color swatches appear in each of the instrument tabs on the left; these colors correspond to the colors used in the Coverage tabs.
◊ Chart - a plot of the corresponding table on the left. Initially, this seems very boring, as it is just ra/dec of the targets of the observations, but eventually, you may find spectra or plots from catalogs in this tab. (More information about plots.)

When any other tab is in the foreground on the left, the right side has four slightly different tabs:

◊ Details - summary of the line selected on the left.
◊ Data Preview - (This is the tab that is different from when you have the "AOR" tab selected.) a preview of the data product you have selected on the left. It could be an image, table, or spectrum.
◊ Data Coverage - a visual overview of the observations you have retrieved. (This tab is called just 'Coverage' in other tools, but because of the "Depth of Coverage" tab, it would be confusing to do this here.) After you have viewed the Coverage tab at least once, color swatches appear in each of the instrument tabs on the left; these colors correspond to the colors used in the Coverage tabs.
◊ Chart - a plot of the corresponding table on the left. Initially, this may seem very boring, as it is just ra/dec of the reference RA/Dec of the data products in the foreground tab on the left, but eventually, you may find plots from catalogs in this tab. (More information about plots.)

Tips and Troubleshooting

◊ The Coverage image has lots of information as well as some special properties; go here for more information.

About Images
Interacting with images is covered in the visualization section; there are many sophisticated capabilities available.

About Tables
Interacting with images is covered in the tables section. You can manipulate columns and create new columns.

About Plots (or Charts)
Interacting with plots (sometimes called charts) is covered in the plots section. You can make some sophisticated plots.

About Spectra
Interacting with spectra in the SOFIA Archive is a special case of images, tables, *and* plots, and as such is covered in the spectra section; there are many sophisticated capabilities available.

About Catalogs
If you load a catalog into the tool, you will create a table and a plot and overlay the catalog on the images. If it is a large catalog, the catalog may be shown as hierarchical cells; see here for more information.

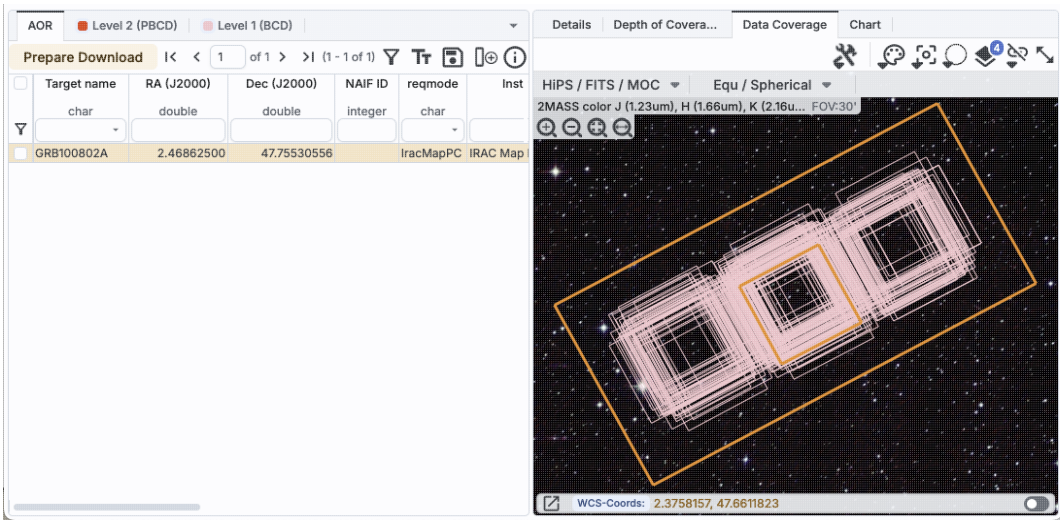
Tips and Troubleshooting

- The target name was provided by the original observer, and it may very well be confusing, cryptic, and/or misleading, intentionally or unintentionally.
- Additional columns may be available for any given tab -- see Tables section for how to turn on columns via the table options.
- For IRAC subarray data, only Level 1 (BCD) data are returned. There is no Level 2 product.
- Particularly in the case of MIPS, the arrays may be on and collecting data even if the telescope is being used to observe using one of the other fields of view in the instrument. For any given row, if the telescope was optimized for use of the field of view to which the specific file applies, then the "primary field" column is 1; other values indicate that this is serendipitous data.
- Since there can be files that are not images (such as tables of data), the "File Type" column lists the nature of the file. "Image" will be the most common.

Position Results

Here is an example of simple search results for a single position, PBCD and BCD, all default parameters:

The color swatches in the tab headings correspond to the colors used in the Data Coverage map. Individual BCDs are in pink, the the large polygon is the single big mosaic. Note that the currently selected rows are orange, and since the two PBCD mosaics have the same footprint, they both look orange.

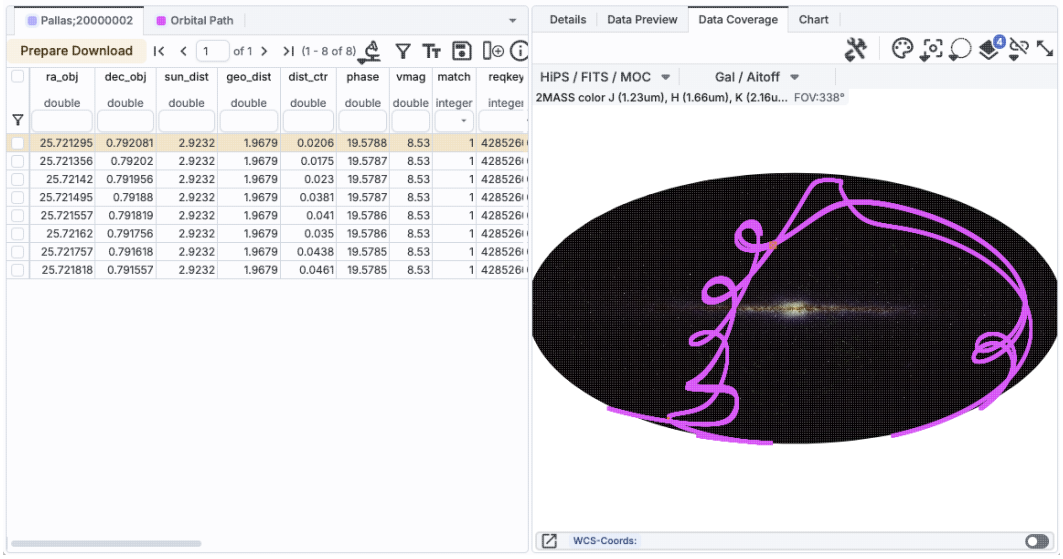


See this section for more complicated coverage image examples.

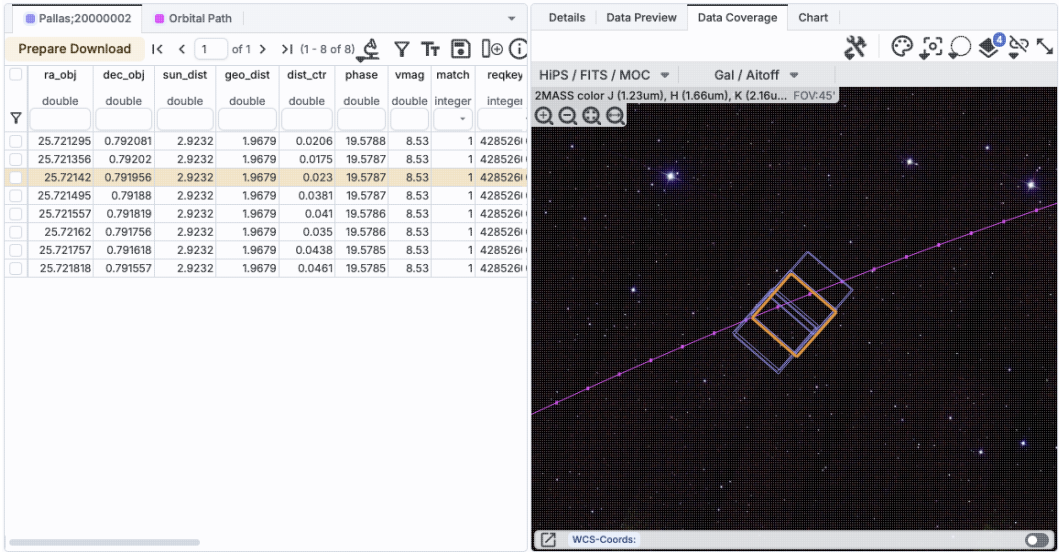
Solar System Object/Orbit Results

If you do a Solar System search, you will have different tabs. The tabs on the left will be the observations that match your search, and the calculated orbital path. The tabs on the right will be the same as for the data product tabs.

Here is an example of a precovery search result for Pallas, all other default parameters:



The magenta squiggle is the calculated Pallas orbit; it's very difficult to see the periwinkle Spitzer footprints until you zoom in:



Here, the periwinkle footprints are more visible on top of the track. The orange one is the currently selected one.

Downloading Data

Downloading is covered in separate section.

Spitzer Heritage Archive: Images

Spitzer data includes many FITS images, but the Spitzer Heritage Archive provides HiPS images for context setting. This chapter covers some basics about images, including an introduction to HiPS images and coverage images; visualization tools are covered in another chapter.

Contents of page/chapter:

Introduction

There are basically two kinds of images you can find in the Spitzer Heritage Archive, FITS and HiPS. More information about HiPS is in the next section below.

FITS images you may be most familiar with have a header and an image. But FITS images can be far more complicated, and occasionally, you can find Spitzer-related FITS files that are more complicated. A FITS file is a header plus a "data unit", or an HDU. A single HDU can be an image, a spectrum, a table, or a data cube. Thus, a single HDU can have multiple data planes. FITS files can have multiple HDUs, each of which can have multiple data plane. FITS files can also be a mixture of images and tables and cubes.

Much more detail about interacting with images in general can be found in the Visualization section.

HiPS Images: General Information & Definitions

HiPS stands for hierarchical progressive surveys, and these kinds of images are multi-resolution HEALPix images (where HEALPix stands for Hierarchical Equal Area isoLatitude Pixelation). (Also see IVOA docs on HiPS.) In practice, what this means is that you can interact with images of a very large chunk of sky, and as you zoom, the pixel size changes dynamically. HiPS images are fundamentally different than FITS images, and as such, what you can do with the HiPS images are different than what you can do with the FITS images.

The whole point of HiPS images is to provide on-demand resolution changes. Zoom out, and it loads large pixels. Zoom in, and it loads smaller pixels. HiPS images are designed to cover large areas of sky efficiently. If you need to visualize many degrees, this is the image type to use.

There are HiPS images from all over the world available via the web; the complete list of HiPS images available from the images search page includes (once the "IRSA Featured" checkbox is unchecked) many HiPS images from CDS.

HiPS images typically have the color and stretch set by the person who originally made them. The color table can be remapped within this tool. But, you cannot, in general, change the stretch of HiPS images with as much flexibility as you can with FITS images. This is why there may be multiple versions of some data sets in the list of HiPS images.

HiPS maps typically come with a **Multi-Order Coverage map (MOC)**. A MOC is a format developed by the International Virtual Observatory Alliance to specify sky regions. In this context, a MOC tells you via a simple boolean yes/no, is there sky coverage from this data set in this region. You can overlay a MOC from one data set onto a completely different data set's HiPS image.

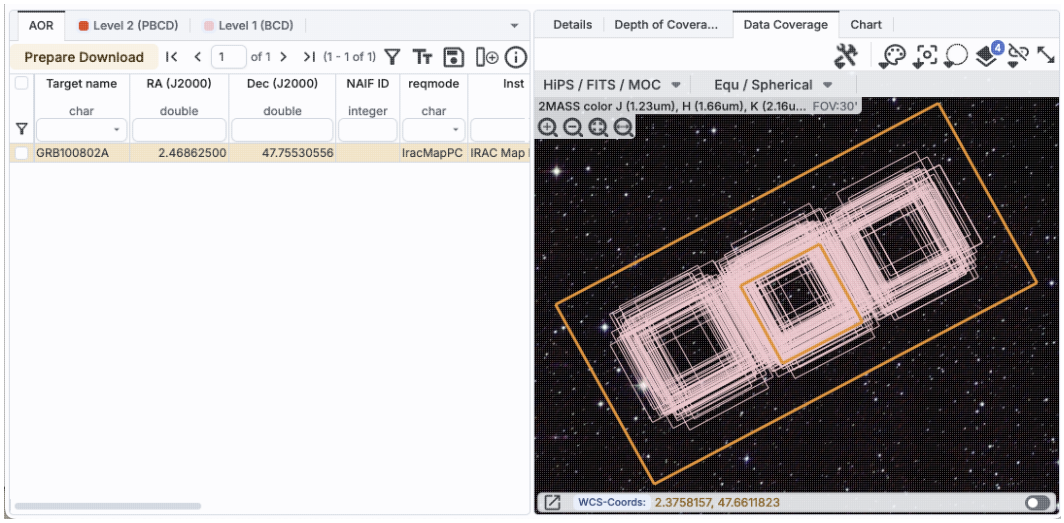
Things that define a HiPS image. When selecting a HiPS image, the tool gives you a table. The table that appears has several columns that summarize important things about the available HiPS images:

- Type - image (all that is available in this context)
- Properties - links to more information for that image
- Title - descriptive words for the HiPS image
- Waveband - Approximate wavelength range
- Coverage - Approximate sky coverage (100% or less) -- HiPS images often carry with them something referred to as "MOC", or multi-order coverage. This number gives an indication of the sky coverage of the data.
- Pixel scale - At the highest order (zoomed in the most), this is the pixel size
- HiPS Order - HiPS order, e.g., how deep you can zoom
- Frame - coordinate sytem, e.g., equatorial, galactic, etc.
- Release date - Date that HiPS image became available
- Dataset IVOA ID - Unique (worldwide) identifier for the dataset

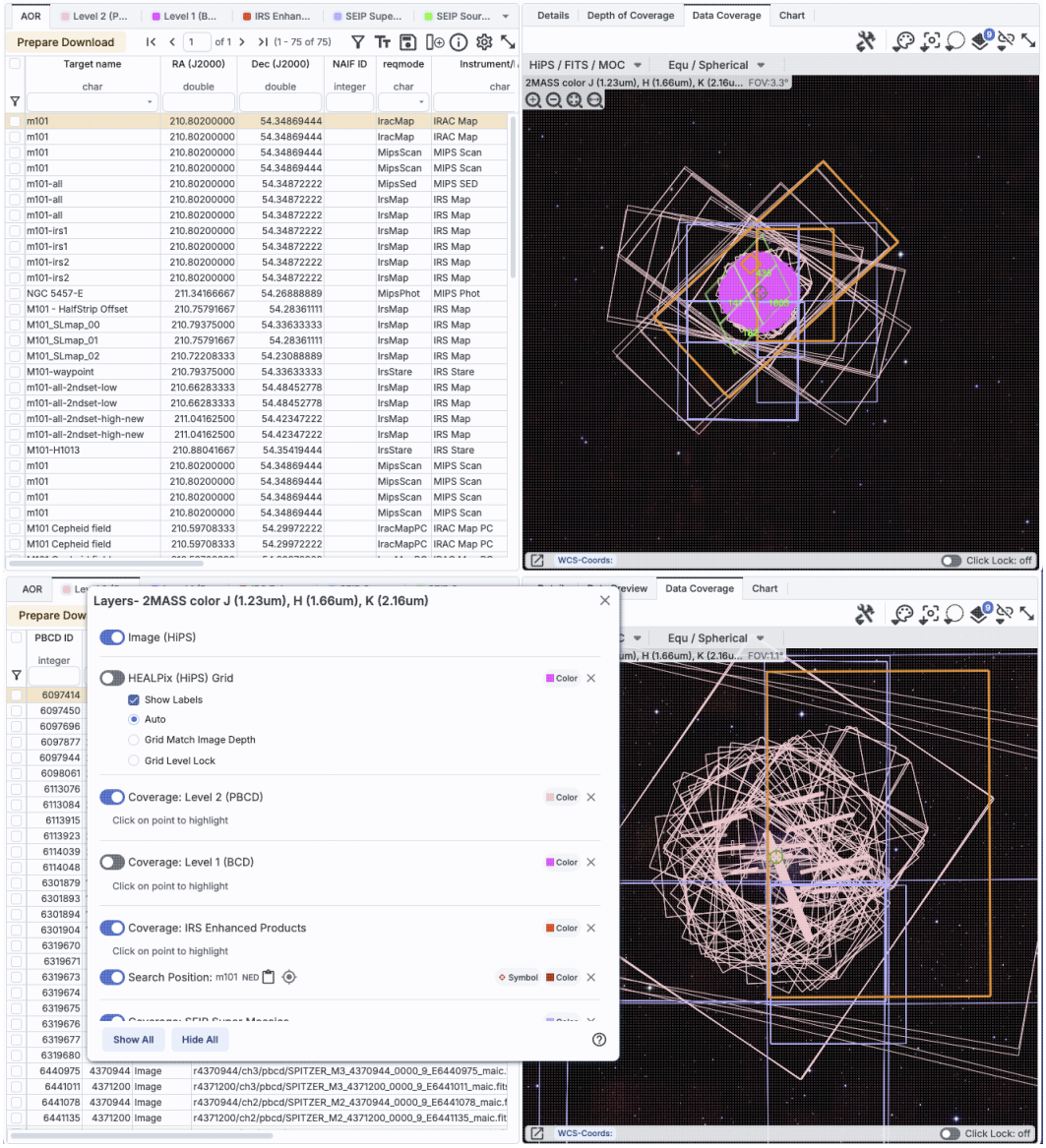
Coverage Image

The Spitzer Heritage Archive provides for you a "Data Coverage image" (which is just called a "Coverage Image" in other IRSA tools), which is basically a way for it (and you) to keep track of where you are working on the sky. This may initially be surprising.

This is a relatively simple coverage map. It is a 2MASS HiPS image. It has only the Level 2 (PBCD; the larger polygon) and the Level 1 (BCD; the smaller polygons) shown. The currently selected rows in each of the data product tabs is orange. Since both the Level 2 mosaics are the same size, they are identical on this scale, and it looks like there is only one in this view.



Here is a more complicated coverage map. It is also a 2MASS HiPS image. In the first screen shot, there are results for M101 in all 6 tabs. The color swatches in the tab headings correspond to the colors used in the Data Coverage tab.



However, two interesting things have happened. First, there are so many BCD frames (more than 16,000, it turns out), that the tool has given up trying to render each individual polygon, and has instead rendered all the ra/dec positions of all the BCDs as if it were a catalog -- the magenta circle cluster of points in the middle.

Secondly, the actual catalog, the SEIP Source List, has about 2500 points, but not only are there a lot of them, but they are packed tightly in the middle. As such, the hierarchical catalog representation has kicked in, and the catalog has been shown as four diamond-shaped

cells with a number showing how many catalog sources are found in each cell (141, 435, 1803, and 182). If you zoom in, the cells get smaller and smaller until individual sources are shown.

The second screenshot has the BCD positions and the SEIP catalog turned off, then zoomed in so that you can see the IRS slits in amongst the other PBCD footprints -- the slits are really there in the first image too, just hidden.

See the visualization section and the catalog section for much more information on interacting with images and catalogs.

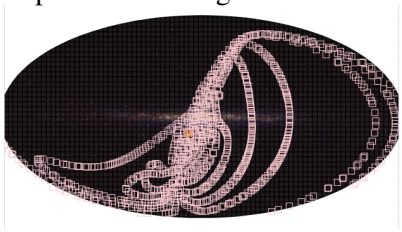
In all cases, you can interact with the coverage image in pretty much exactly the same way as you would any other image loaded into this tool; see the the visualization chapter for much more about those tools. The thing that makes a coverage image a little bit different than any other image you might load, however, is that it can automatically adapt, even beyond what a HiPS image can intrinsically do. The next subsection includes more details about how it can automatically change to accomodate your needs and zoom level.

Tips and Troubleshooting

- You can change the colors (and symbols) in the coverage image; see the visualization chapter.
- If there is no color swatch in the header of any given tab, there are no polygons on the coverage image (e.g., no observations were returned for that data product).
- The currently selected row will be highlighted orange, but this only works from data product tabs; nothing will change in the image if you change rows in the AOR tab.
- If there are too many image polygons to manage, the tool may fall back to showing just the positions of the data products it has retrieved. (Whether that is the central point or the lower left corner of the image

depends on the data product itself.)

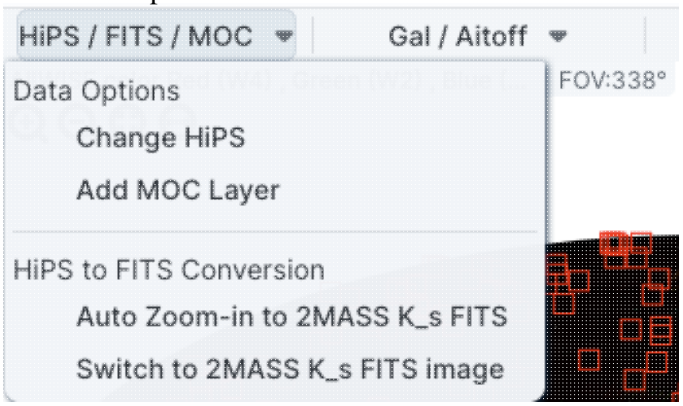
- If there are more than 1500 points, the tool may fall back to using hierarchical catalogs, which can be confusing.
- If you do a multiple target search, so that you can more easily tie results to input, when you get results back from a batch search, the input RA and Dec are columns appended to the end of your results tables.
- If you have done a search for a Solar System Object, you may also have a calculated orbit show up on the coverage tab. If you give it a nearby asteroid with a long time baseline, it can calculate impressive-looking orbits.



Upper Left HiPS menus

In the upper left of the coverage image, there are two drop-down menus.

The first drop-down menu looks like this.

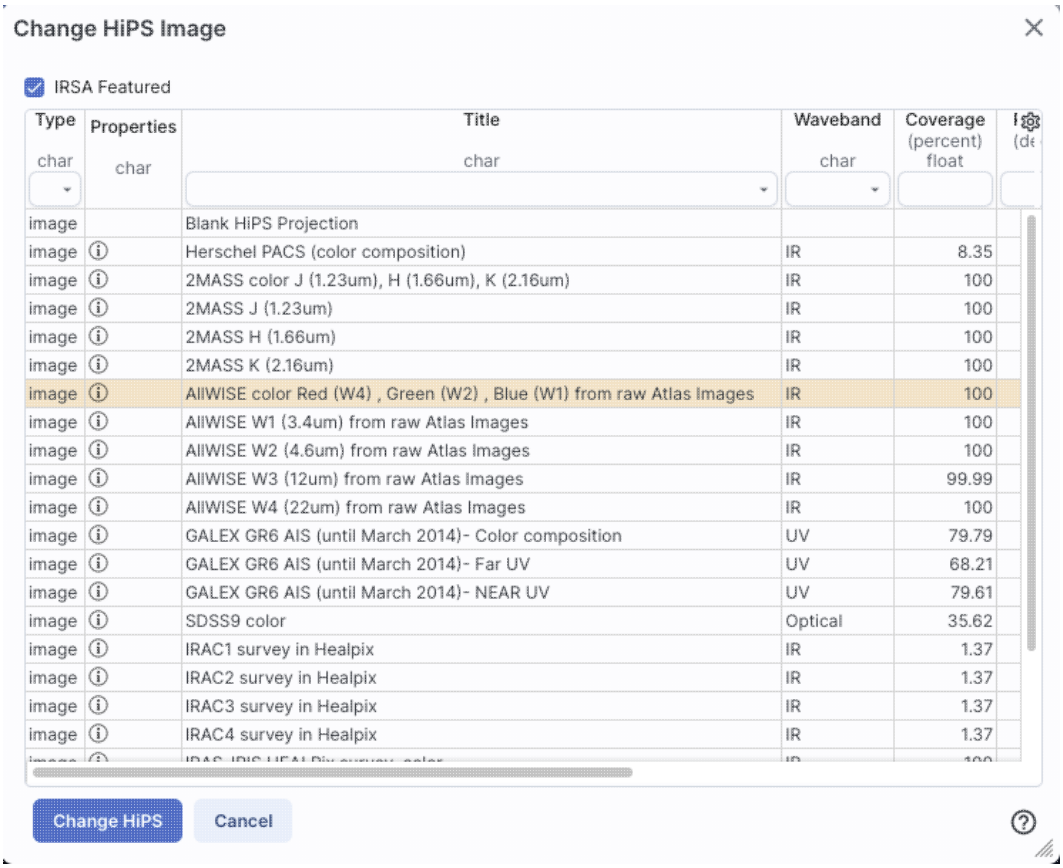


There are two sections here.

Under "Data Options", you can change what data are shown.

Change HiPS: Changing HiPS images

The choices made by any given creator of a HiPS image may result in any particular region being saturated or too faint to see. Color stretches are set by the creator of the HiPS map and cannot be changed; color tables can be somewhat changed by this tool, but that may be insufficient for your needs. If the HiPS map as shown does not suit your needs and you wish to change the HiPS image, click on the "HiPS/MOC" menu, and then click "Change HiPS". It brings up this pop-up:



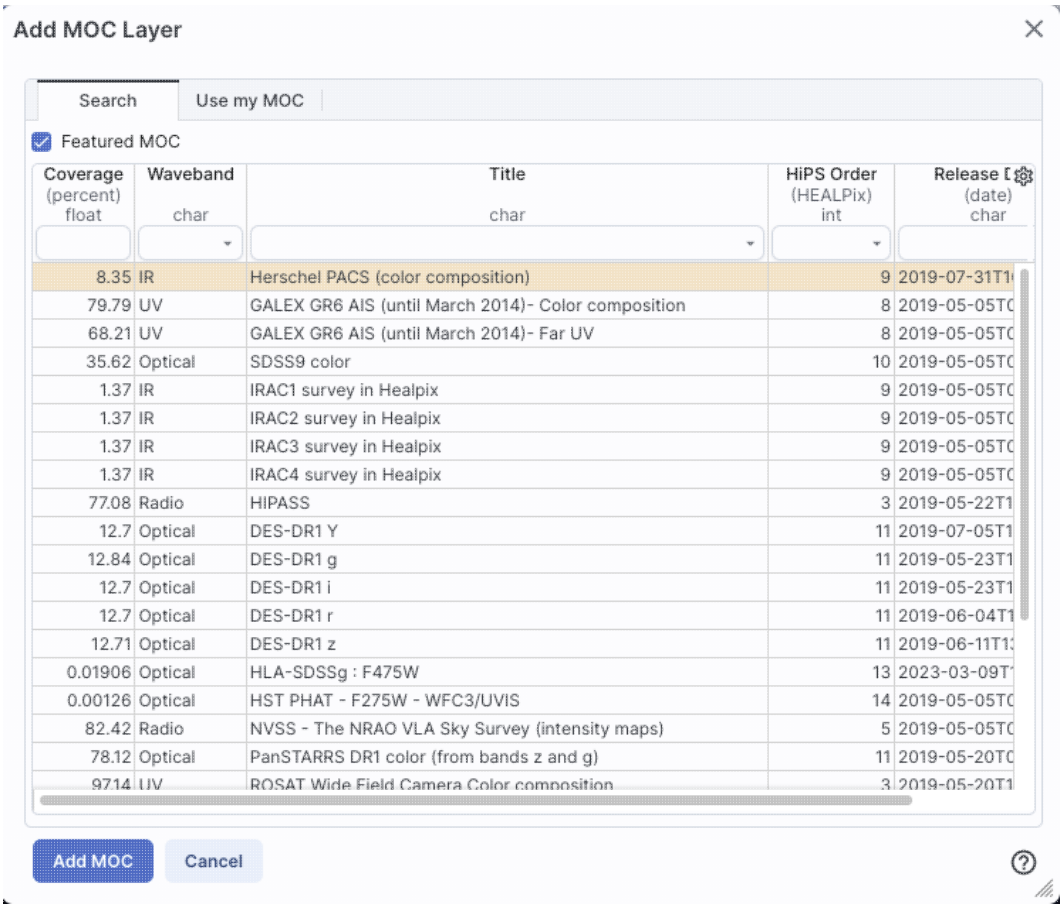
Type	Properties	Title	Waveband	Coverage (percent)	
char	char	char	char	float	
image		Blank HiPS Projection			
image	ⓘ	Herschel PACS (color composition)	IR	8.35	
image	ⓘ	2MASS color J (1.23um), H (1.66um), K (2.16um)	IR	100	
image	ⓘ	2MASS J (1.23um)	IR	100	
image	ⓘ	2MASS H (1.66um)	IR	100	
image	ⓘ	2MASS K (2.16um)	IR	100	
image	ⓘ	AllWISE color Red (W4) , Green (W2) , Blue (W1) from raw Atlas Images	IR	100	
image	ⓘ	AllWISE W1 (3.4um) from raw Atlas Images	IR	100	
image	ⓘ	AllWISE W2 (4.6um) from raw Atlas Images	IR	100	
image	ⓘ	AllWISE W3 (12um) from raw Atlas Images	IR	99.99	
image	ⓘ	AllWISE W4 (22um) from raw Atlas Images	IR	100	
image	ⓘ	GALEX GR6 AIS (until March 2014)- Color composition	UV	79.79	
image	ⓘ	GALEX GR6 AIS (until March 2014)- Far UV	UV	68.21	
image	ⓘ	GALEX GR6 AIS (until March 2014)- NEAR UV	UV	79.61	
image	ⓘ	SDSS9 color	Optical	35.62	
image	ⓘ	IRAC1 survey in Healpix	IR	1.37	
image	ⓘ	IRAC2 survey in Healpix	IR	1.37	
image	ⓘ	IRAC3 survey in Healpix	IR	1.37	
image	ⓘ	IRAC4 survey in Healpix	IR	1.37	

Things to note:

- To select a new image, click on the row corresponding to the new HiPS image you want, and click "Change HiPS" on the bottom left.
- To cancel without selecting a new image, click "Cancel."
- This is an interactive table, so all the filtering and column manipulation tools apply here too. You can filter down the columns to find the image you want to use.
- To learn more about each HiPS map, click on the i with the circle in the second column. It will spawn another window with standardized information about the HiPS map.
- By default, it shows HiPS maps corresponding to IRSA data collections. To see a more comprehensive list, unclick the box marked "IRSA Featured."
- A blank HiPS image (basically a blank canvas) is also available from the list of HiPS images.

Add MOC Layer: Adding a MOC Overlay

It is often useful to see what other data are available. Looking at a Herschel/PACS far-IR HiPS map? Overlay a Chandra MOC to see what X-ray data might be available to go with your IR data. Click on the "HiPS/MOC" menu, and then click "Add MOC Layer." It brings up this pop-up:



Things to note:

- Coverage (the first column) is the fraction of the sky covered by that MOC.
- To select a new MOC, click on the row corresponding to the new MOC you want, and click "Add MOC" on the bottom left.
- To cancel without selecting a new image, click "Cancel."
- This is an interactive table, so all the filtering and column manipulation tools apply here too. You can filter down the columns to find the image you want to use.
- By default, it shows MOCs likely to be most interesting for IRSA users. To see a more comprehensive list, unclick the box at the top left.
- If you have your own MOC FITS file, you may upload it via the "Use my MOC" tab on the top center.
- If you try to upload a MOC FITS file via the upload tab, it will behave as if you have uploaded it here.

Under "HiPS to FITS Conversion", you can control whether the viewer will automatically toggle between image types as needed.

By default, the coverage image is most likely a HiPS image. FITS images are best for small regions of the sky, and HiPS images are best for large regions of sky.

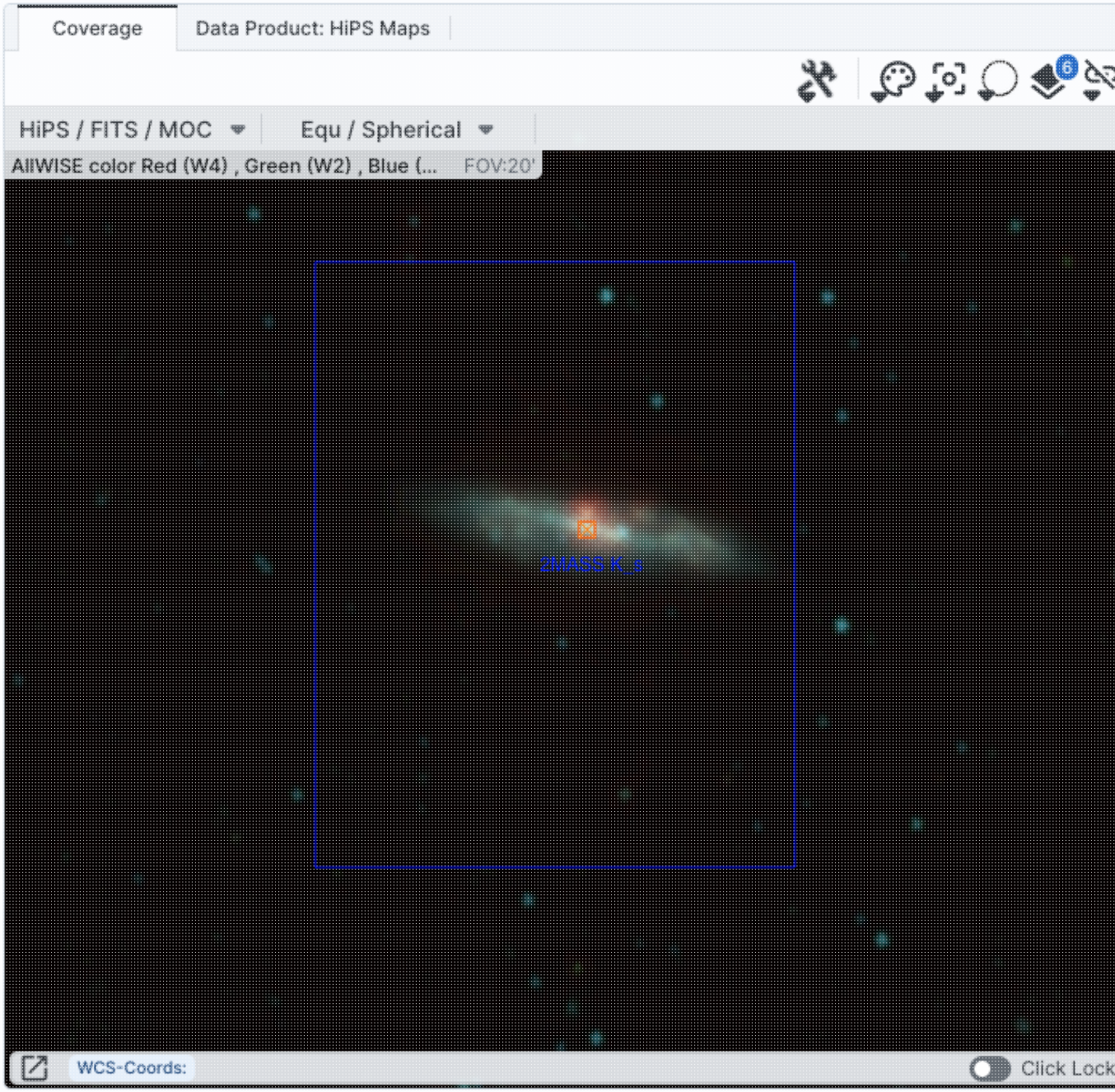
Auto Zoom-in to 2MASS K_s FITS:

If you select this, then when you zoom in very close to a target, it will automatically convert to a FITS image when you get close enough.

Switch to 2MASS K_s FITS image:

If you select this, then it will jump directly to a FITS image centered on the currently selected target.

Note that if you swap between HiPS and FITS and back again, it will include a region on the HiPS image that is the footprint of the FITS images you had just loaded. A label appears at the center of that footprint, which may be disconcerting if you are not zoomed out enough to see the region itself. Here is an example, zoomed out so it is more clear what is going on:



The second drop-down menu looks like this.

There are three sections in this menu.

Orientation

Under "Orientation", you can control whether the coordinates are in Galactic or Equatorial J2000 (RA/Dec). This can be used in conjunction with the image readout and/or the coordinate layer button (both described in the visualization section)

Center Galactic

If you select "Center Galactic", the HiPS image slews to put Galactic North up, the Galactic Center in the center of the field of view, and the Galactic Plane horizontally across your field of view. This is useful if you have been zooming or scrolling around to look at individual sources and need to bring it back to a familiar orientation quickly.

Projection

Under "Projection", you can control whether the display is in Spherical or Aitoff coordinates. Aitoff projection works better for all-sky displays.

Spitzer Heritage Archive: Visualization

A list of the data files meeting your search criteria are shown in the tabs that are the results of your search on the left. Where possible, the data files are shown on the right. When they are images, you can interact with them using the tools described on this page; you can also interact with the coverage image using the tools on this page. This section covers working with FITS (or HiPS) images; basic information about HiPS images is here. For data tables, tables and plots are covered in other sections. The colored circle that may be overlaid by default is the search position you submitted. You can add and overlay catalogs and add other layers to your image. See the Catalogs section for more on catalogs. If you would like to know more about visualization of spectra, see the Spectra section.

All of the interactive image visualization tools work the same basic way, and here we describe these basic options, in roughly the order in which you might encounter them in the window.

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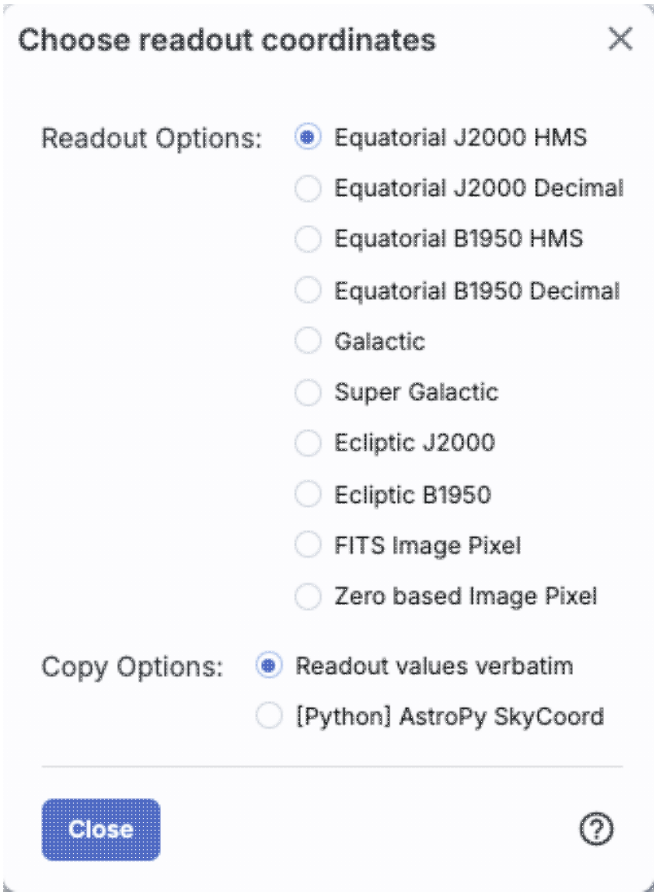
The FITS/HiPS Viewer

You can interactively explore the image with the mouse. Move your mouse over any image that is loaded into the viewer. Details about the image and, specifically, the pixel beneath your mouse cursor, appear along the bottom left of the image window. Some information is updated in real time (coordinates); some information (pixel value) is updated when you stop moving your mouse for a second or two. The image can be interactively investigated in this fashion.

You can change the units of what is being read out, in terms of coordinates or pixel values.

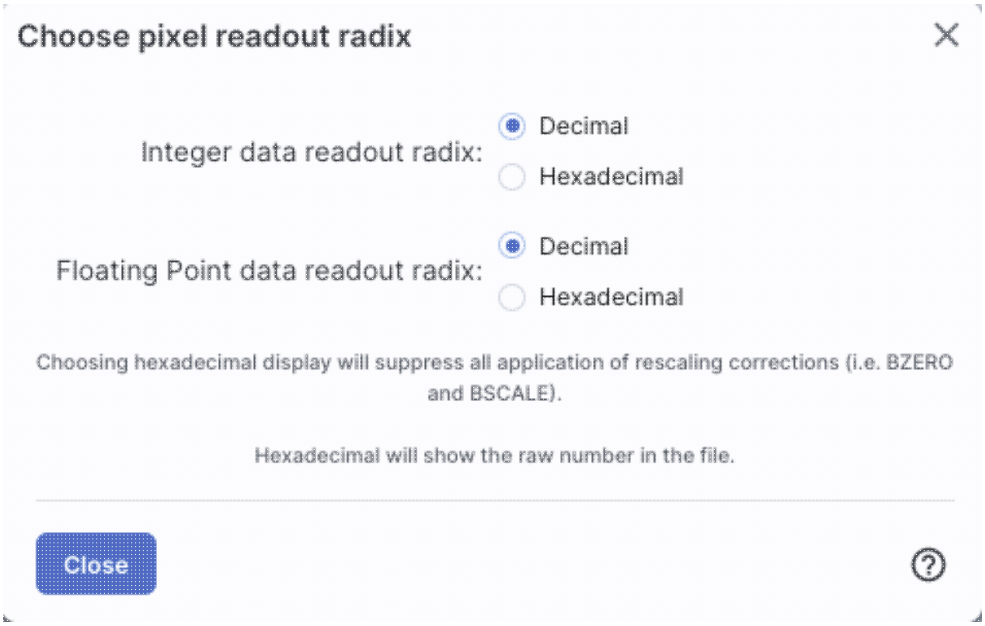
If you click on the label of the coordinates, "EQ-J2000" in the screenshot example above, you get this pop-up, from which you can choose the coordinates from among:

- Equatorial (RA/Dec) J2000 in hh:mm:ss ddd:mm:ss format
- Equatorial (RA/Dec) J2000 in decimal degrees
- Galactic in decimal degrees



- Equatorial B1950
- Ecliptic J2000
- Ecliptic B1950
- FITS Image Pixel
- Zero-based Image Pixel

If you click on the "click lock" toggle, the coordinates stop dynamically updating when you move your mouse, and they update only when you click on the image. When you do that, little clip boards appear next to each coordinate readout; clicking on those copy the position to your clipboard. From this pop-up window here as shown, you can control the format of the coordinates that are copied to your clipboard -- they can be as shown in the readout, or in the format that Python is expecting (for easy pasting into code).



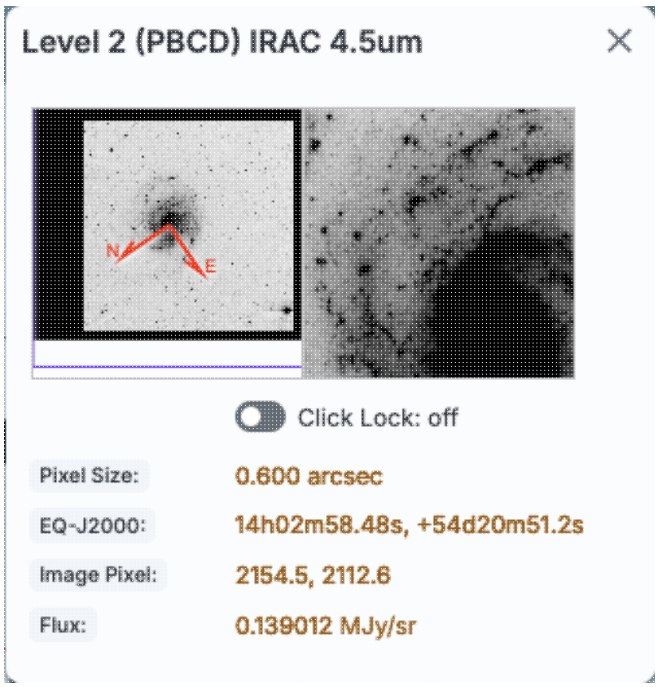
If you have a FITS image loaded, you have an additional readout. Click on the label of the readout, "Flux" in the tiny snippet of a screenshot example above, and you get this pop-up, from which you can choose the pixel readout from among:

- Integer data readout in decimal
- Integer data readout in hexadecimal
- Floating point data readout in decimal
- Floating point data readout in hexadecimal

If you choose the hexadecimal options, it will suppress all rescaling

corrections found in the header, like BZERO or BSCALE. It will just show you the raw binary number in the file. (For example, if the value in decimals is 5.13795757, the binary value in the file is 0x40a46a26; here is a conversion tool between decimal and hex.)

In the lower left of the images, if you click on this: , you get this pop-up. If you have a FITS image loaded, at the top of this pop-up, it shows the whole image; the orientation of the image is given with a compass rose. There is also a zoom-in of the image at the location under your cursor. Underneath that in the pop-up, whether you have a FITS or HiPS image loaded, you can get a readout of the pixel size, a readout of location on the image in two different coordinate systems, and a readout of the pixel value. You can change the units of those values by clicking on the name of the field: "Pixel Size", "EQ-J2000", "Image Pixel", and "Value". Each results in a pop-up, as above.



You can make the cursor 'stick' on a particular place on the image -- flip the "Click Lock: off" switch to "on" (either in the pop-up or in the lower right of the image window), and then click on the image at your desired location. When this is clicked, small "clipboards" appear near the position readout. Click on that icon to copy that position to your clipboard.

Image Information

The upper left corner of the loaded image has a label that tells you basic things about the image you are viewing. The telescope and/or instrument and/or channel and/or data release is first, in black. The field of view follows, in a paler font; this corresponds to the (horizontal) width of the image window. The currently selected image is outlined in brown; other images are outlined in grey.

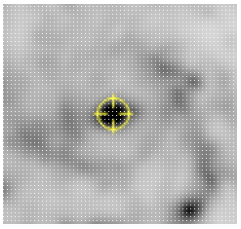
Sometimes, the label is simple. If it's a single-plane image, it tells you you the data product and the current field of view (FOV).

Spectra often won't have a field of view, but will tell you the filename or data product and the zoom factor.

If it looks something like this, with the arrows present, the file you are viewing has multiple planes. The arrows allow you to click through the image planes in the order they are loaded. The data shown are images, so there is a FOV as well.

The concept of coverage images (and the issues unique to them) are covered in another section, but the basic interactions with them are the same as for any other images. They are, however, HiPS images. Choices of what you can do and what you can manipulate with HiPS images can be different than your choices for FITS images, but are largely the same as discussed in the rest of this chapter. For HiPS images, the FOV is the angular size of the width of the HiPS viewer.

For all images, even if the image as displayed is smaller than the window, the FOV readout is the width of the window, not the image. If you shrink your browser screen, the FOV can get smaller because the viewer gets smaller. If you load more than one image, the FOV can get smaller because two viewers must fit in the same pane.


The target on which you searched is overlaid on the main image with a cross-hair marker, sometimes called a "reticle." You can remove this (or change its color) from the layers pop-up, described below.

Breaking Out of the Pane (and Going Back)

Panes: The search results screen is broken up into panes - the left is a list of items (observations or sources for loaded catalogs), and the right is images or spectra. If you have more than one image loaded in, the image pane may be further subdivided.

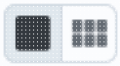
Make it big! For some purposes, it is useful to individually view just the table, or the images, or the plots, as large as possible. In any pane, this icon  appears in the upper right of the pane. Clicking on it will expand the pane into a larger window, as big as possible given your browser size.

Go back the way it was: 

The large "Close" arrow at the upper left is always available in the expanded views, and enables you to return back to the pane view.

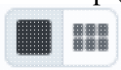
Also see the next section on image navigation. You have different image navigation options when you are in expanded view (as compared with the default view in a pane).

FITS Image Navigation



Single or Tiled Images

In the top (often upper left) of the images window pane, you may sometimes have these icons:



The first icon means "show images one at a time in this pane." The second icon means "show all the images I have loaded in groups of up to 12 at a time" (see below for more on this).

Paging through single image views

If you have many images loaded in and you choose to view many images at once, it will show up up to 12 images per page. It will then give you navigation aids at the top of the pane, like this:

In this example, images 1-12 of 807 images are shown. Use the arrows to navigate through the 68 'pages' of 12 images each.

Default views

For most results, the default view is one image at a time.

Expanded views

As noted above, if you click on this icon  , it makes the images pane take up the entire browser window. When you do that, you have different image navigation options:

The first icon (the big square) denotes "show one image at a time." The second icon (the cluster of four squares) denotes "show smaller images of all the images I have loaded at once," e.g., tiled images. The third icon brings up a pop-up window with a list of the images you have loaded.

When viewing one image at a time, you get additional choices for navigating through the list of images:

the arrows take you forward and backward; the dots tell you where in the list you are. The "Auto play" tickbox scrolls through the list automatically.

When viewing many images at once, you get a "scroll images" switch. If you toggle this on, then each image tile becomes bigger, and you can use your mouse to scroll up and down through the collection of images. If you are on a Mac, your scrollbar may be hidden until you try to scroll.

When viewing the list of images that are loaded in, the table behaves like any other table in this tool -- that is, it is searchable, sortable, etc. However, as of this writing, the wavelength column is not correctly populated.

Tips and Troubleshooting

◊ When going from the 'window pane' view to the 'expanded' view, the images pane will only show you the images that you can see in the window pane view. That is, if you are looking at one image in the images window pane when you hit 'expand', it will only give you access to one image in the expanded view (even if you have more than one loaded into the tool). If you are looking at 12 images (out of many) in the images window pane when you hit 'expand', it will only give you access to those 12 images image in the expanded view.

◊ When you are in the 'scroll images' view, and you try to scroll, if your mouse is in a currently active (selected) image (that is, highlighted in brown), then your image will zoom rather than scroll. Just move your mouse over to another image, and then your window will scroll rather than zoom. Or, find your scrollbar.

Image Toolbar (FITS and HiPS)

The image toolbox is always present as a row of tools associated with the images you have loaded, or that are loaded on your behalf. They're generally located above the images you have loaded, with most of them on the upper right. Letting your mouse hover over any of these icons will result in a "tool tip" that appears in order to remind you what the icon does. Most items apply equally to FITS and HiPS images, but some only apply to FITS images.

This is the image toolbox when you have clicked on a FITS image you have loaded:

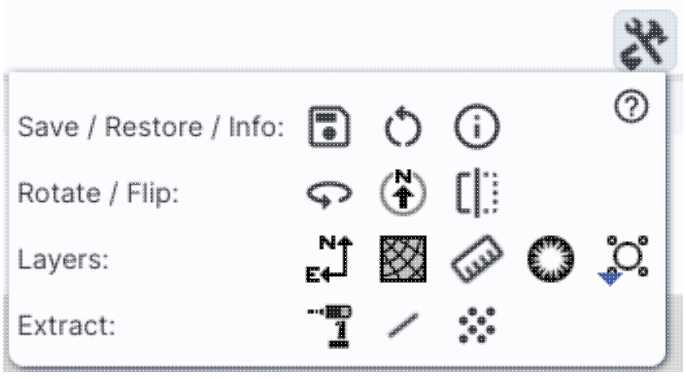
And, this is the image toolbox when you have clicked on a HiPS image you have loaded:

The two toolbars are different, but if the same icon appears, it has the same effect on the image. Many of the icons have a downward pointing black triangle, which means that there are additional options in a drop-down menu that appear when you click on the icon.

We now discuss each icon in the order in which they appear.

Tools drop down

The choices here look like this:



jump to save

jump to rotate

jump to layers

jump to extract

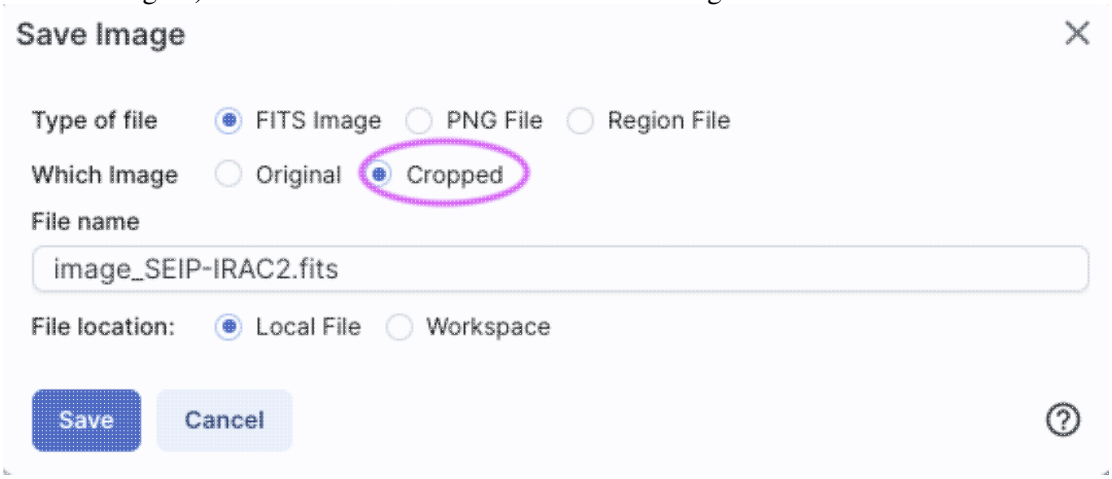
Saving the image

The diskette icon will allow you to save the current image. You can save files to your local disk or to the IRSA Workspace. Note that **you** control where the file is saved on your disk through your browser; your browser may be configured to store all downloads in a particular

location on your disk.

If the current image is a FITS file, you can save it as a FITS or PNG or regions file to your local disk. If it is a HiPS file, your only choices are PNG or regions file. Saved FITS images will not save the color stretches or overlays; it will just save the underlying FITS image. Saved PNG files WILL include any overlays or annotations you have placed on the image, but will not include the underlying FITS image. Saved regions files will not save the underlying image, but will just save the overlays as a DS9 Regions file. See the DS9 website for more information on the syntax of these DS9 region files.

Note that you can save the original or a cropped version of a FITS file; see the "select region" icon below to crop, then click on the save icon. Be sure to save the cropped FITS image (see annotated figure). This feature is not available for HiPS images.



Note that if you overlay a large catalog on an image, then turn around and save a regions file from the catalog overlay, the full catalog may not be saved to the regions file. If you have >5,000 sources, it's entirely likely that not every source will be overlaid on the image (because of hierarchical catalogs display), and thus will not be in the regions file. If you want to save your entire catalog as a regions file, **save the catalog from the table pane**.

The saved PNG is the same size as it is on your screen. If you want a big version, make the desired image big on your screen (view one-at-a-time; see here) before saving the PNG.

You can't save HiPS images from within this tool. To download your own copy, you will have to track down the original source of the image.

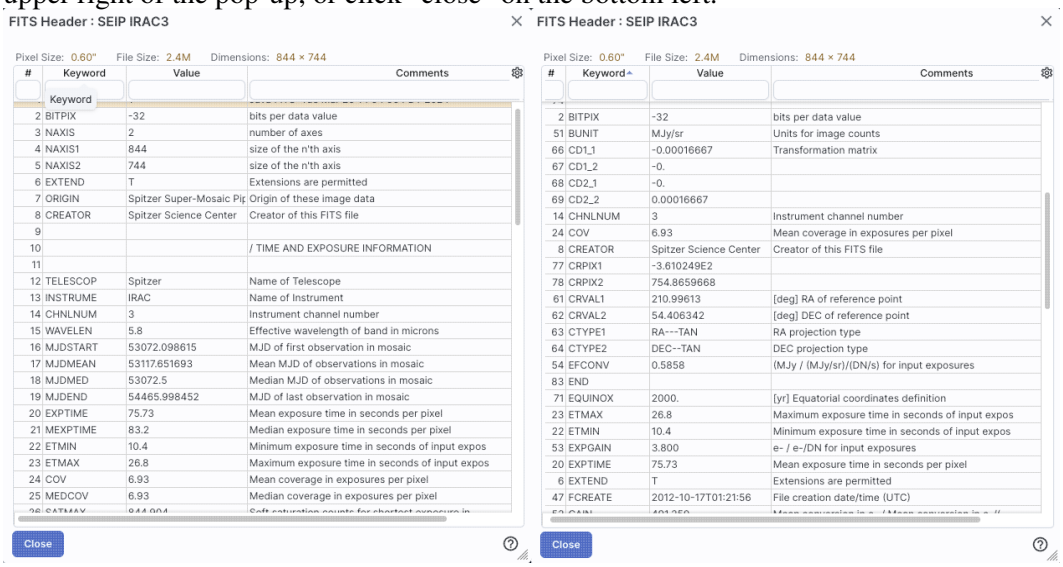
Restoring everything to the defaults

If you've played around a lot with the image, you may want to undo everything you've done. Click this button to restore everything to their original default values. Some layers may persist; remove them via the layers icon.

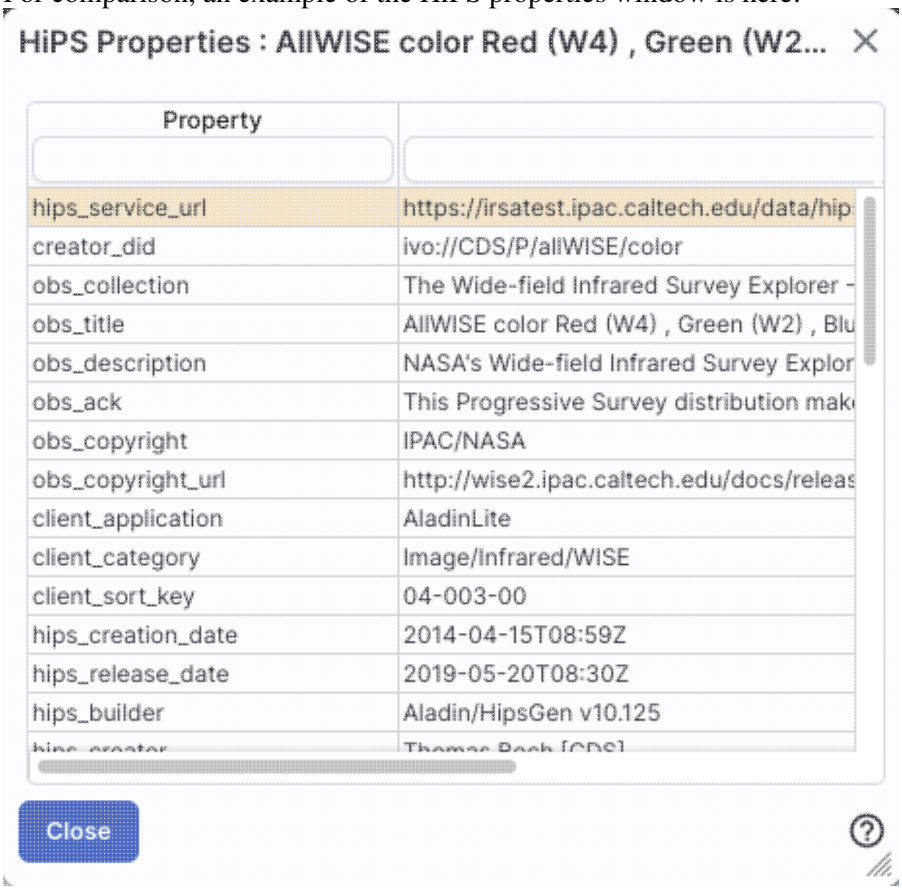
Viewing the image header

This icon displays a pop-up window with information about the image. If a FITS image is selected, it will show the FITS header of the image; if a HiPS image is selected, it will show the HiPS properties of the image. These are Firefly tables like all the other tables in this tool, so they are sortable and filterable, etc. If you click on the columns in the pop-up, it will sort the keywords alphabetically by that column. This is useful for finding individual keywords in

particularly densely populated FITS headers. Click the header again to sort in reverse-alphabetical order, and a third time to return to the default order. Below are examples of an original and sorted FITS header. To make this window go away, click on the 'x' in the upper right of the pop-up, or click "close" on the bottom left.



For comparison, an example of the HiPS properties window is here:



Rotating the image so that North is up

Images retrieved from the Spitzer Heritage Archive are frequently North-up/East-left, so this

icon is of little use. Clicking this icon will orient the selected image so that North is up.

Flipping the image on the y-axis
Clicking on this icon flips the image on the y-axis. (This option is only available for FITS, not HiPS, images.)

Add a compass rose
When you click this icon, arrows appear on the image showing which direction is North and which is East. Clicking on this icon a second time removes this compass rose. (You can also remove this layer via the layers icon, described below.)

Add a coordinate grid
Click on this icon to overlay a coordinate grid on the image. Click it again to remove it. Customize the units of the grid (to, e.g., Galactic coordinates) via the "layers" icon (described below).(Also see information on HiPS grid in the WCS section.)

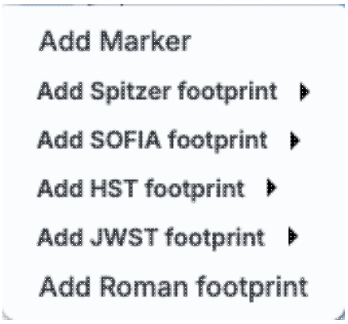
Measuring a distance
When you click this icon, at first, nothing seems to happen. However, you can now click and drag to draw a line on the image, and the length of the line is displayed (in the middle of the line). The units for the measured distance (and the color of the overlay) can be changed from the "layers" icon (described below). You can calculate the difference in RA and Dec separately via the layers icon as well; find the layer associated with the distance measurement and tick the "offset calculation" box. When it displays the offset calculation, it will give you the angle in degrees in one corner, and the length of the line segment in the RA and Dec directions, in the units you have specified. When you are done with the distance tool, you can click on the

that appears next to the image toolbar, or click on this icon a second time to remove the distance tool. (You can also remove this layer via the layers icon.)

Read in a DS9 Regions file
When you click this icon, you get a pop-up window from which you can read in a DS9 regions file from your local disk. See the DS9 website for more information on the syntax of these DS9 region files. The supported regions are text, circle, box, polygon, line, and annulus. To make this window go away without doing anything, click on the 'x' in the upper right of the pop-up.

Tips and Troubleshooting: If you overlay a list of sources you created in ds9 regions format from your disk, it will only be overlaid on the current image, not all of the images you have loaded. If you want to have it overlaid on all the images you have loaded, create a catalog from your source list and overlay it as a catalog. Then it will appear on all of the images you have loaded, provided that the positions overlap on the sky.

Put a marker on the image
When you click this icon, a drop-down menu appears with several possible options:



The first overlay choice (simply called 'marker') is a red circle. Initially, it appears in the center of the images, and is meant to be moved to wherever you first click in the image. It looks like this:

. The dash-dot line around it means that it is 'active', so you can move (click and drag the marker) or resize it (click and drag the dash-dot boundary). You can change the color of the marker (and change the label) via the "layers" icon (described below). You can also remove this layer via the layers icon. There are several additional options in the drop-down, enough that they have their own section below.

Drill down through the image

If your FITS image has multiple planes or HDUs, especially if each plane or HDU represents a different wavelength, it can be useful to "drill" down through the image cube at a given position on the sky. (You are unlikely to find this kind of file in the ZTF archive.) This tool allows you to do just that. When activated, this tool extracts the data at the place your mouse clicks down through the cube. For more information on saving the information, see the extraction section below.

Draw a line in the image

When this tool is activated, you can draw a line in your FITS image with your mouse, and it will extract for you the pixel values along that line. If you have more than one image loaded and visible, you can shift-click in another image to see the same line in another image. For more information on saving the information, see the extraction section below.

Make points in the image

When this tool is activated, you can click in your FITS image with your mouse, and it will extract for you the pixel values at the location of your click, creating a catalog for you as you click. If you have more than one image loaded and visible, you can shift-click in another image to extract points from another image. For more information on saving the information, see the extraction section below.

Zoom

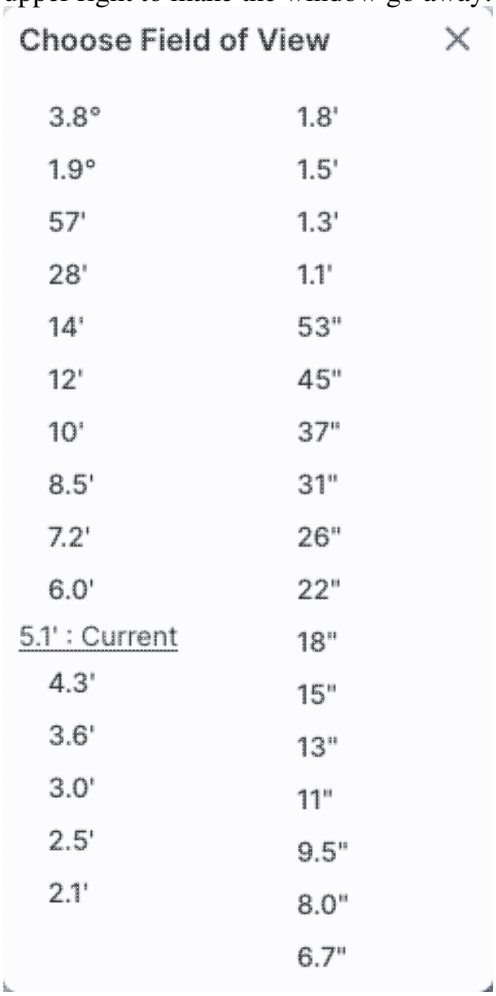
When your mouse is in an image, these options appear in the upper left of the image.

Zooming in or out

Clicking on these magnifying glass icons zooms in or out of the image. The readout of the net effect of your zooming on the displayed field of view (FOV) appears at the top left of each image.

If you click zoom in or out rapidly, a pop-up window appears to allow you to more rapidly select the zoom level (field of view) you want. Select the desired level, or click on the 'x' in the

upper right to make the window go away. Here is an example:



You can alternatively zoom using the mouse wheel (or drag forward and backward on a touchpad or magic mouse).

Note that there is a maximum (or minimum) allowed zoom level, and they are different for FITS and HiPS images. A notification will appear when you have reached the maximum (or minimum) allowed zoom level for a given image. To enlarge images more (or less) than that, please repeat your search to obtain new images with smaller (or larger) spatial extent. HiPS images are specifically designed for large areas, so if you need a big area, use HiPS. If you want to zoom in close enough to see individual original pixels, your best choice is FITS.

See also the section on changing coverage images, specifically that on automatic transitions while zooming.

Fit image to screen or fill screen

These two icons are designed to maximize the available space in your browser window. The first one automatically picks a zoom level such that the image entirely fits within the available space (which could be your whole browser window, or just the portion of it where that image is loaded). The second one automatically picks a zoom level such that the image fills as much of the available space as possible (e.g., it is zoomed such that short axis of the window is filled with the image, whether that short axis is left-right or up-down).

By default, the images that are returned are frequently but not always centered on your search target. Clicking on these icons let you see the whole image that is returned, whether or not it is centered on your target.

This is available for both FITS and HiPS images, though note that FITS images retrieved from IRSA using this tool are typically small, and HiPS images cover the sky, so fitting the image to the screen might not be what you want to do.

Note that if spectra are displayed, sometimes the zoom level isn't particularly well behaved, because spectra are intrinsically different than images.

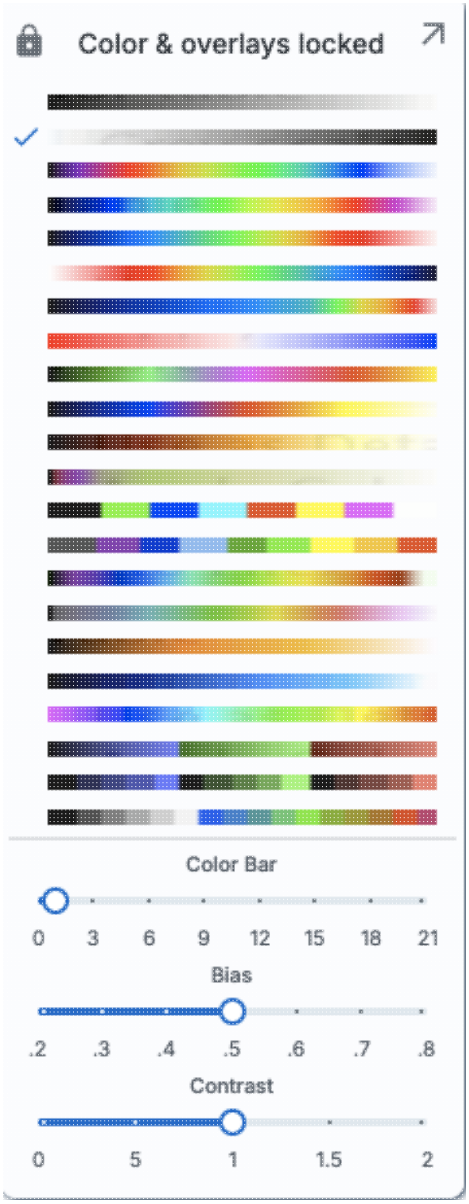
Zooming to a 1-to-1 size

Clicking this icon will zoom the image such that one pixel in the image is one pixel on your screen. This option is only available with FITS images; HiPS images by their nature have pixels of varying sizes, so this button would have no meaning in this case.

Color table drop down

This icon enables you to change the color table of the displayed image. (This option is available for FITS and HiPS images.) When you click the button, a drop-down menu appears.

- The top of the menu either says "Color and overlays locked" or "Color and overlays unlocked" -- by default, all of the (FITS) images that you have loaded are locked together for color and overlays. What that means is if you change the color table (via this menu), then the color table for all the (FITS) images are changed. (Or, if you add a layer to one image, then the layer is added to all the images; see below.) If you don't want this to happen, select "Color and overlays locked" to unlock it. Select the text again to lock it again.
- The arrow in the upper right creates a pop-up window out of this drop-down menu so that you can leave the choices up while settling on the best option.
- The next portion of the menu has a wide variety of color table choices. Select your new color table from the options shown.
- Alternatively, you can use the "color bar" slider to move among the color tables by number. These numbers correspond to the color bar number used in the Python implementation of the Firefly tools.
- Below the color bar slider, there are sliders controlling the bias and contrast. Click or drag the slider to change the image display.



Color stretch drop down

This icon enables you to change the color stretch of the displayed image. (This option is only available for FITS, not HiPS, images.) Because this is complicated, for much more information, please see below.

Re-center the image drop down

Clicking this icon produces a drop-down menu:

By default, "Pan by table row" is turned on (checked), but, depending on how you have loaded your images, or whether you have catalogs loaded, it may not seem to do very much. However, if you have a catalog loaded and are zoomed in on your images, as you scroll through your catalog, the FITS image underneath will move as needed when you have selected an observation in a different part of the sky than was originally shown.

Other choices are to center on the target of the observation, center the image in the window, or center on a target of your choice. For the last of those, you can simply center on that target, or center and leave a marker on the image at that location.

Selecting a region drop down

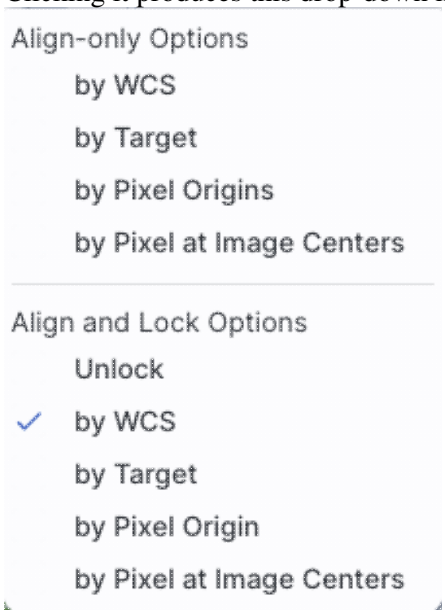
When you click this icon, you can select a region of the image for further actions. Because this is complicated, for much more information, please see below.

Image Layers: Viewing/Changing the Layers on the Image

Every time you add something new to the image, you add a 'layer' to the image. This is complex, so please see below for much more information.

Lock/unlock images

You may have this "lock images" icon appear in your toolbar; it will appear as the first icon if they are locked and the second icon if they are unlocked. The main purpose of this icon is to lock all the images you have loaded for zooming, scrolling, etc. You need to specify how it locks and for how long. Clicking it produces this drop-down menu:



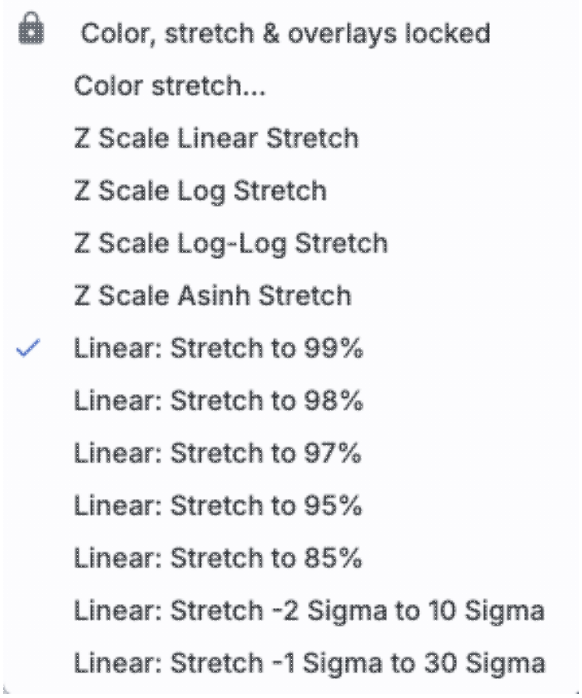
The first set of options aligns the images only once, temporarily; the second set of options makes the

alignment persist ("lock") when you move the images (that is, when you move one, they all move). You can align by the images' WCS (e.g., RA and Dec), by the target, by the pixels according to the origin of the coordinate system in the image header, or by the pixel at the image center. The most common choice is likely the WCS align and lock. This is discussed in more detail in the WCS section.

Getting help
Clicking on this icon takes you to this help page.

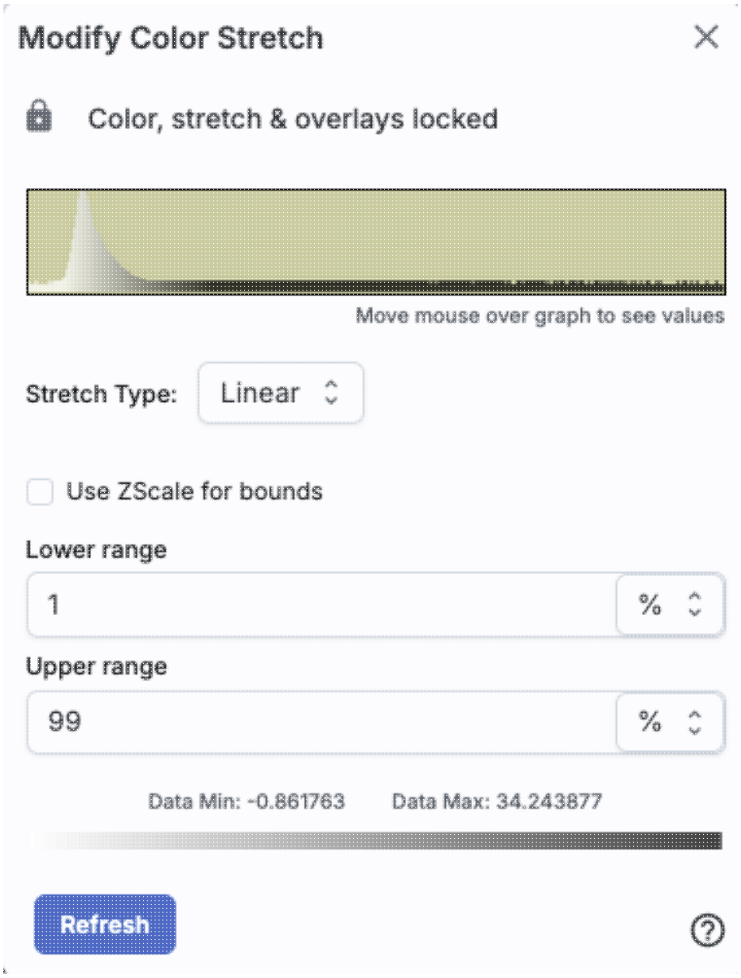
Specific information on Color Stretches

This icon enables you to change the color stretch of the displayed image. (This option is only available for FITS, not HiPS, images.) When you click the button, a drop-down menu appears with a variety of choices.



The top of the menu either says "Color and overlays locked" or "Color and overlays unlocked" -- by default, all of the (FITS) images that you have loaded are locked together for color and overlays. What that means is if you change the color stretch (via this menu), then the color stretch for all the (FITS) images are changed. (Or, if you add a layer to one image, or change the color table of one image, then the change is made to all the images; see other sections of this chapter.) If you don't want this to happen, select "Color and overlays locked" to unlock it. Select the text again to lock it again.

Below that, you can choose from a set of pre-selected options. If you pick the first one, "color stretch", you can customize the stretch. A pop-up window appears with a histogram of the values in the image, and you can change the stretch type and range.



If you pick a color stretch from the pre-defined options, the pop-up window reflects this change. If you change the color stretch in the pop-up window, the drop-down menu changes correspondingly.

Example: Display the pop-up for color stretch. From the main drop-down, pick 'Linear stretch to 99%'. Go back to the color stretch pop-up. Note that it has filled out the stretch type and ranges to reflect the current choice. Then -- either with the pop-up window still up or not -- go back and pick a different pre-defined stretch from the standard options. Note that the values in the pop-up change to reflect this current choice. From the pop-up, pick a different stretch type -- try "histogram equalization." Select "refresh" to update the images. Go back to the drop-down menu. The last 7 items have changed to be based on histogram equalization, as opposed to the "linear" default.

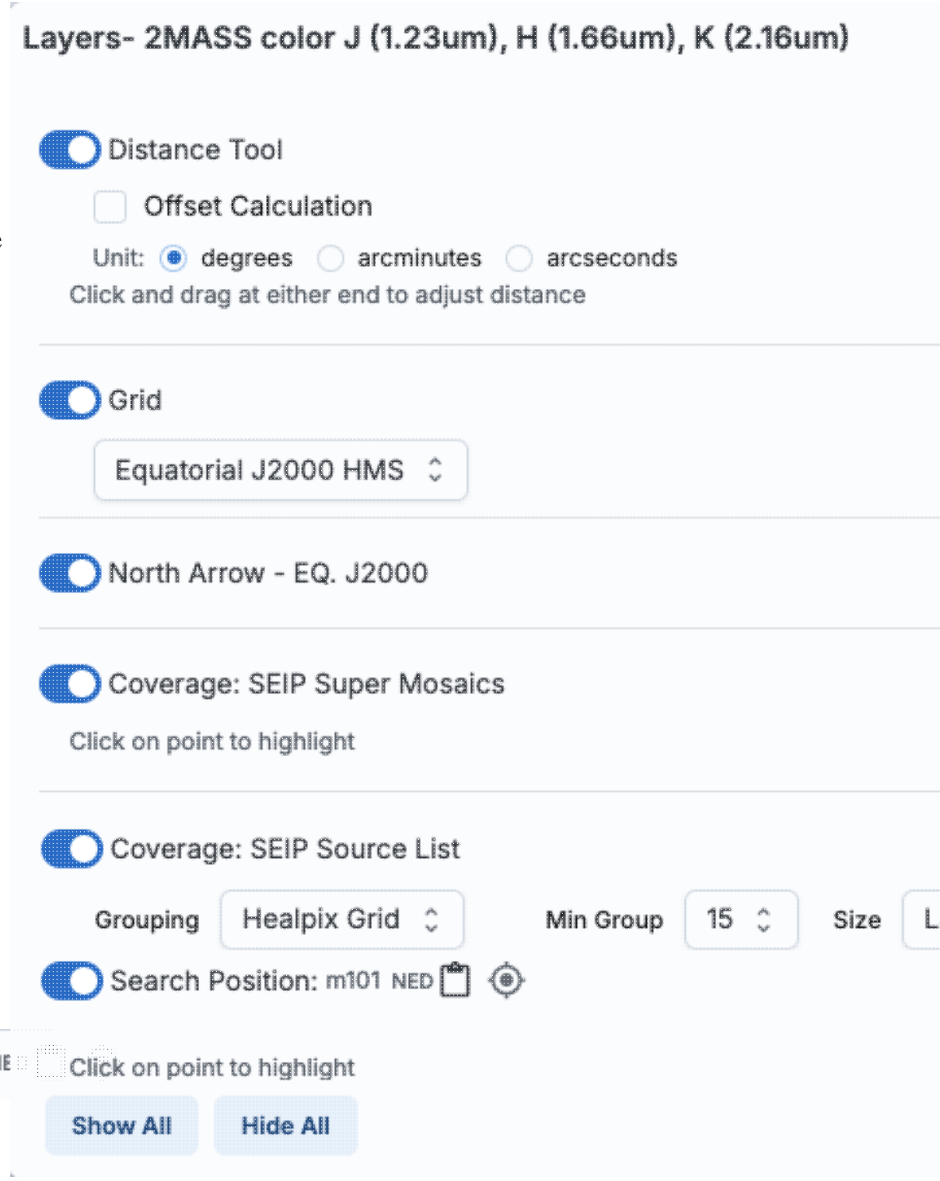
Viewing/changing the layers on the image

Every time you add something new to the image, you add a 'layer' to the image. You can have an image with a lot of annotations on it.

The number that appears circled in blue over the layers icon tells you at any given time how many layers you have on the currently selected image (the image outlined in brown).

If you click this layers icon, you will get a pop-up window with a list of all the layers you have on top of the image. Here (on the right) is an example of a well-populated layers pop-up; in real life, this is scrollable to see several more layers, and you can see the scrollbar here). From this pop-up, you can:

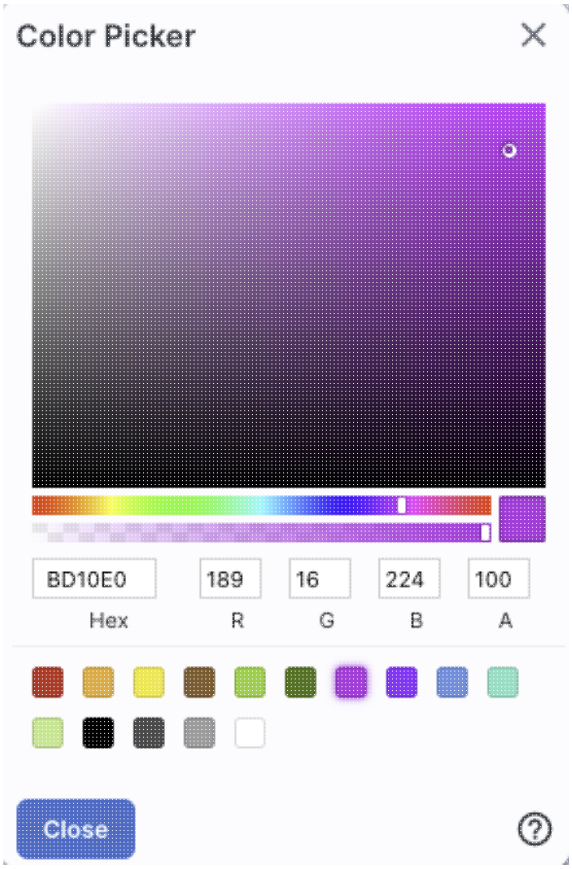
- turn layers off and on (click on the switch on the left of the corresponding row);
- remove layers entirely (click on the 'x' on the right of the corresponding row);
- change colors of overlays (see below);
- change symbol shapes and sizes (for overlaid catalogs), including hierarchical catalog settings;
- change annnotations (for markers);
- or change units (for the coordinate grid or the distance tool).



To add entirely new layers, though, you need to go to other options within the toolbar.

You can "show all" or "hide all" with the buttons on the lower left of the pop-up window. To make this pop-up window go away, click on the 'x' in the upper right of the pop-up.

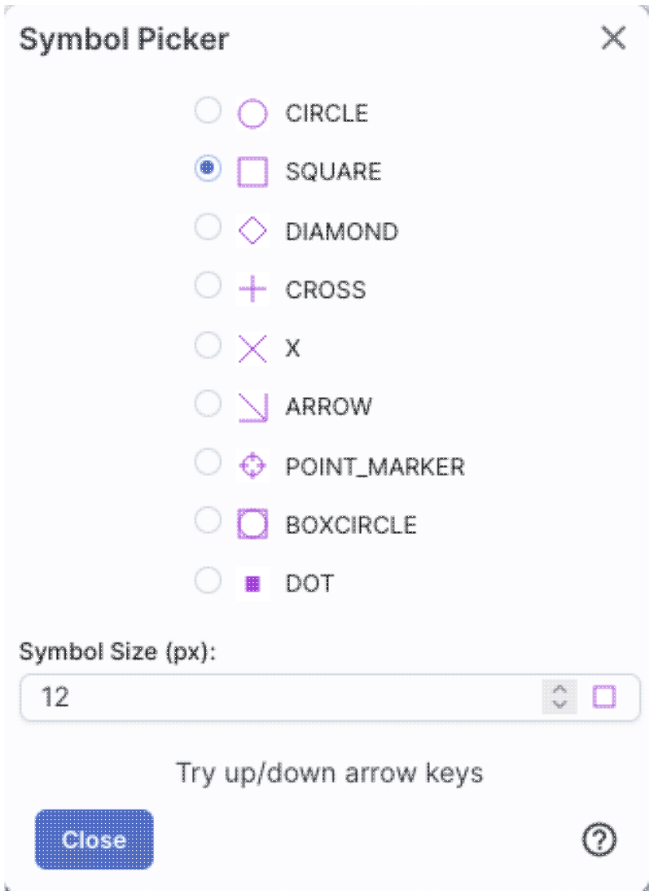
Note the target description:
This reminds you of the target on which you searched -- here, it was M42 in J2000. The first icon in the row is a toggle to show or hide the target. After the target name, the two icons next in that row indicate, respectively, "copy this location to the clipboard" and "center image on this position."



Where it's possible to change colors of a layer, click on the 'colors' link to be taken to a new pop-up from which you can select a new color.

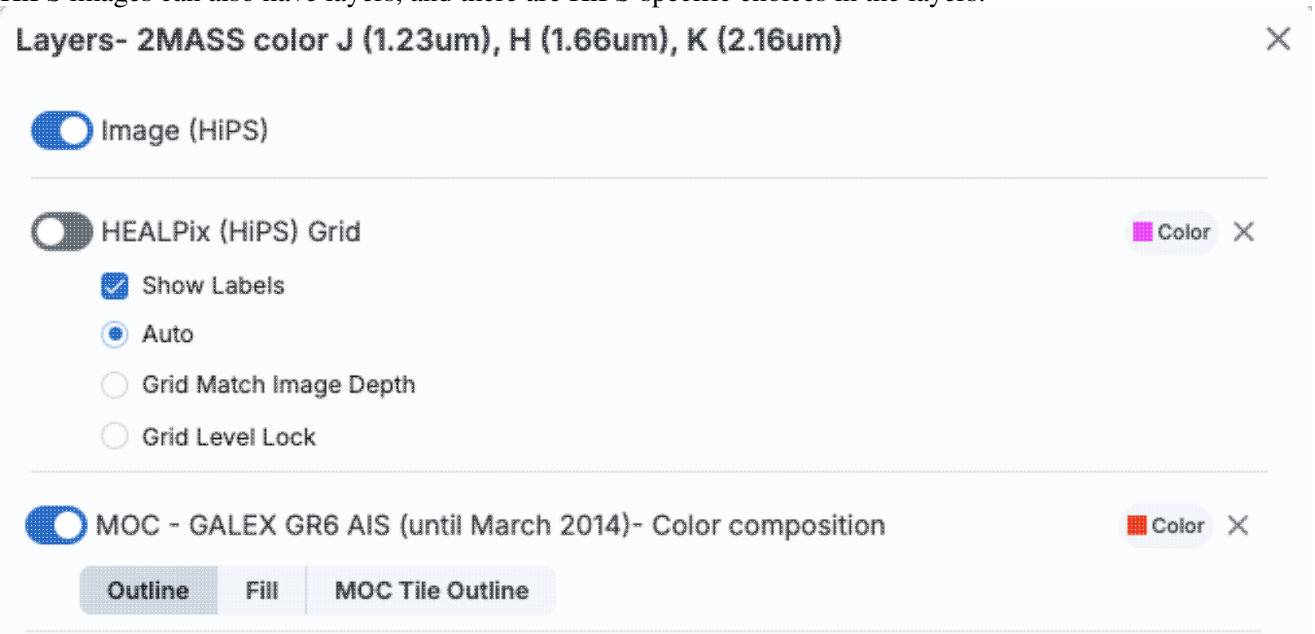
From here, you can click on your desired color in the top colorful box. Immediately below that box, you can change the color and saturation of the top box so that you can select from a different range of colors. Below that, you can enter numerical hex codes or RGBA values (where the value for RGB is between 0 and 255, and A is in units of percent, e.g., 50 = 50%). Finally, you can also select from a pre-defined set of 15 colors by clicking on any of the small boxes. Note that the numerical codes update as you select different colors. Your choices are implemented as soon as you select them. Click 'Close' to close the window, or click 'x' in the upper right.

If you have a catalog loaded into the tool, you can also obtain this pop-up by clicking on the color swatch in the heading of the catalog tab.



For catalogs or the search target, you can also select the symbol shape and size. To adjust the size, type in the symbol size in pixels or use the up/down arrow keys to change the size by one pixel at a time. Your choices are implemented as soon as you select them. Click 'Close' to close the window, or click 'x' in the upper right.

HiPS images can also have layers, and there are HiPS-specific choices in the layers:



HEALPix (HiPS) Grid

To turn on these choices, toggle the switch to the left of "HEALPix (HiPS) Grid". (See images section for more information on HiPS images in general.)

Auto: This option overlays a position grid, with the tile numbers marked in the center of each box. As you continue to zoom in, when smaller tiles are needed, they are drawn, with the new tile numbers marked. You may not zoom beyond HiPS Norder level 14 tiles. The numbers after the "/" is in the "NESTED" (as opposed to RING or NUNIQ) numbering system; see the IVOA standards document for more information.

Grid Match Image Depth: If you select this option, the grid will adjust to a new level when you zoom in and a new level of HiPS image both exists and is used for the display.

Grid Level Lock: Selecting this option yields an additional numerical drop-down menu. The higher number you pick, the smaller the grid boxes are that are drawn. When this option is selected, the boxes stay the same size regardless of how zoomed-in on the image you are.

HiPS MOC

To turn on these choices, toggle the switch to the left of "MOC".

A MOC tells you via a simple boolean yes/no, is there sky coverage from this data set in this region. The choices here are:

- ◊ Outline - an attempt to outline the entire region covered by the data; it still sometimes struggles near the edges of coverage, so zoom in to get a better sense of the coverage edges.
- ◊ Fill - filled regions, where you can control the opacity of the overlay by going to the color picker; you control the opacity by changing the number above the "A".
- ◊ MOC Tile Outline - individual tile outlines, where the tiles are set by the MOC tiles themselves (as opposed to tiles created by the mosaic tiles that make up the data set).

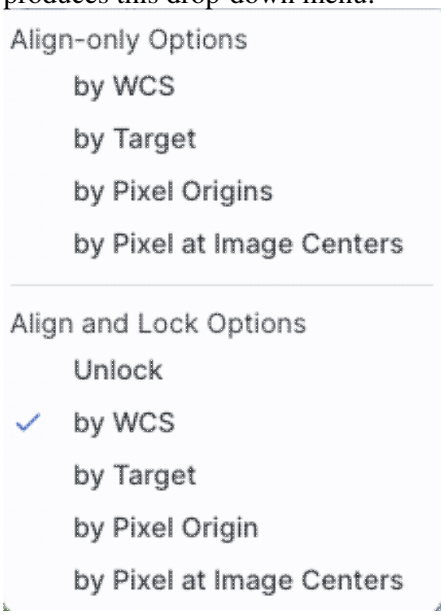
Tips and Troubleshooting:

- The entire concept of a MOC is built upon the "tiles" that are inherent to the HiPS concept. As a result, those tiles are imprinted on how the MOC is rendered, especially near edges or corners of coverage. Strange behavior may result; you can always zoom in to get a better sense of the coverage. For authoritative information, download the actual data for the region you are concerned about.
- For the "fill" option for a MOC, depending on how you display a MOC, you may see two shades of color in the MOC. It is important to note, though, that the information it is displaying does not include depth of coverage, merely boolean "is there data there or not." Why is it displaying shading? Well, it's rounding. For example, a given WISE MOC might be generated at order 13. At this order, there are 805,306,368 HEALPixels on the sky, and they are about 26 arcseconds across. When zoomed out far, there is no point in trying to show each of these pixels, so the application "rounds up" the MOC to an order in which there are roughly 100-200 displayed HEALPixel polygons horizontally across the image. When it does this, it flags the rounded up polygons with the paler color. So the boundaries of a coverage region in the MOC all get a paler color. If you zoom in far enough on a MOC, the two-tone colors go away.
- You might be here in the documentation looking for more information on hierarchical catalog settings; this is also related to HEALPix.

World Coordinate System (WCS) Alignment

As described above, there is a way to lock/unlock images to each other  for position matching. This section describes the image locking in more detail.

When aligning images, you can specify how the images align and for how long. Clicking the lock images icon produces this drop-down menu:



The first set of options aligns the images only once; the second set of options makes the alignment persist ("lock") when you move (zoom, etc.) the images.

You can align by the images' WCS (world coordinate system, e.g., RA and Dec), by the target (align by target on the screen, regardless of position in the sky), by the pixels according to the origin of the coordinate system in

the image header, or by the pixel at the image center. The most common choice is likely the WCS align and lock.

Note that aligning by WCS puts North up, and aligned so that each image has the same angular scale.

Tips and Troubleshooting

- When you have both FITS and HiPS images loaded (as you should when you run the SHA tool, because the coverage image is a HiPS image), if you select a HiPS image to be active when you select "lock by WCS", the HIPS will not lock to the FITS image unless the image is either J2000 or galactic north up. If you want the HiPS image to align to the FITS image, select the FITS image first and then select "lock by WCS"

Extraction Tools

Several tools allow you to extract information from images or image planes, but only for FITS (not HiPS) files. Within the Spitzer Archive tool, it is relatively unlikely that you will encounter data for which the drill can be used.

-  -- Extract down through image planes
-  -- Extract a line from the image
-  -- Extract points from the image

All three of these follow the same basic structure --

1. Intitiate extraction mode
2. Set aperture
3. Try extraction; repeat if desired
4. Pin (retain) extraction if desired
5. Download (as table or chart) if desired
6. Repeat if desired
7. Click on "end extraction" to finish the process.

The drill pokes down through multiple planes, the line moves across pixels in a plane, and the points extracts points from a plane.

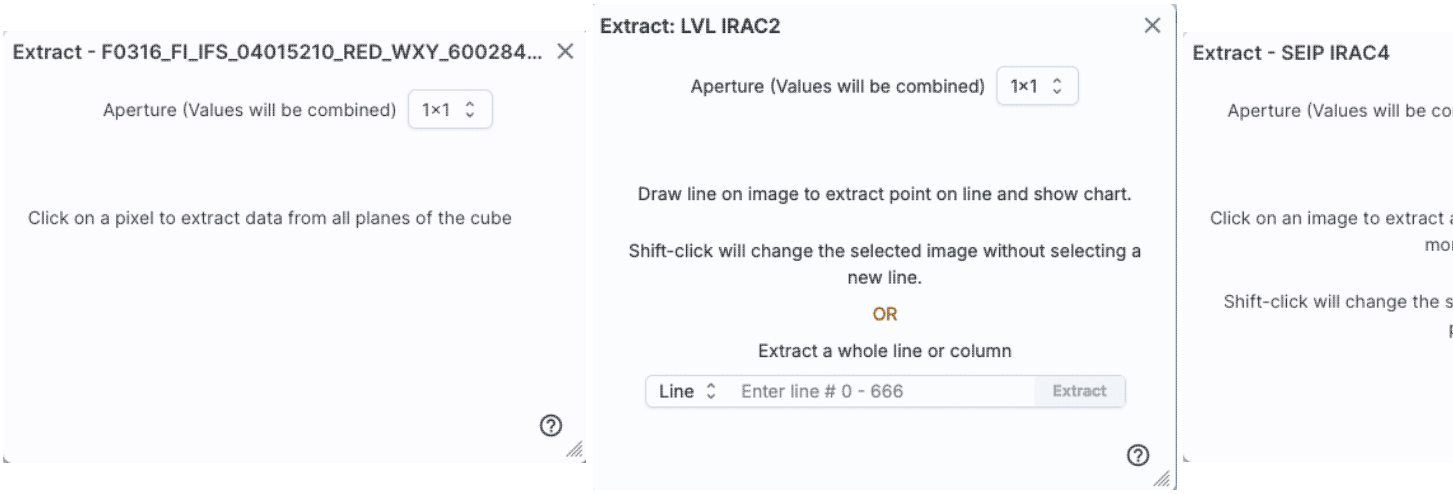
Here, we cover the basic approach, with specifics of each tool integrated as we go along.

Intitiate extraction mode. When you click on one of these icons, you enter into the extraction mode. Text appears next to the image toolbar to remind you that you are in this mode: 

When you are done, to end this mode, click on this "end extraction."

When starting out, the pop-up window that you get depends on the tool you pick.

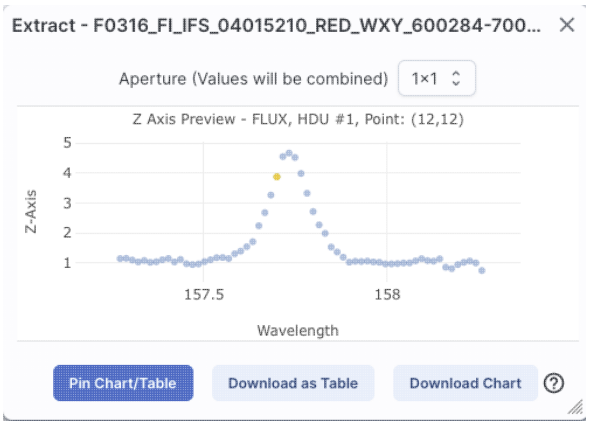
For the drill: for the line: and for the points:



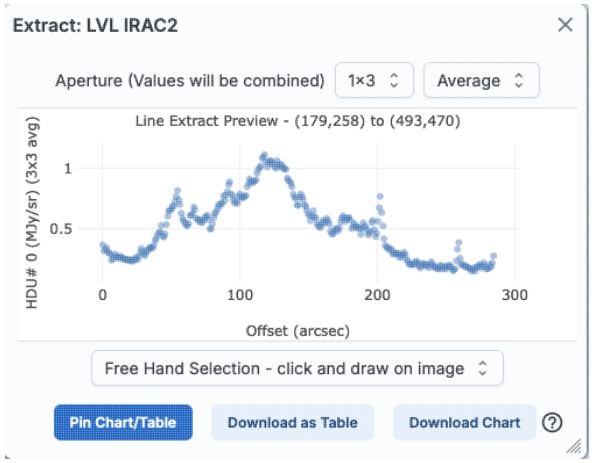
Set aperture. In all three cases, the top center of the extract pop-up window has a drop-down from which you can select the aperture value. For the drill and points, you can choose, in pixels, 1x1, 3x3, 5x5, or 7x7. Values can be summed or averaged. For the line, it's a little different. The apertures are 1x1, 1x3, 1x5, or 1x7, and you control whether the points are summed or averaged. You can have it extract along a line that you draw with your mouse on the image (useful for examining brightness profiles, e.g., across spiral arms of a galaxy), or you can have it extract an entire line or column of the image that you specify (useful in the cases where the 'image' is a file where the first row is an extracted spectrum, the second row is the error, the third row is a mask, etc.).

Try extraction. From this point, you can click on your image, or click and drag for the line tool. The pop-up then contains a plot of your extraction.

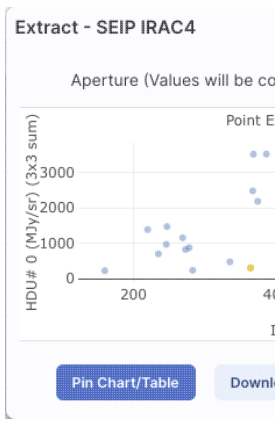
For the drill:



for the line:



and for the points:

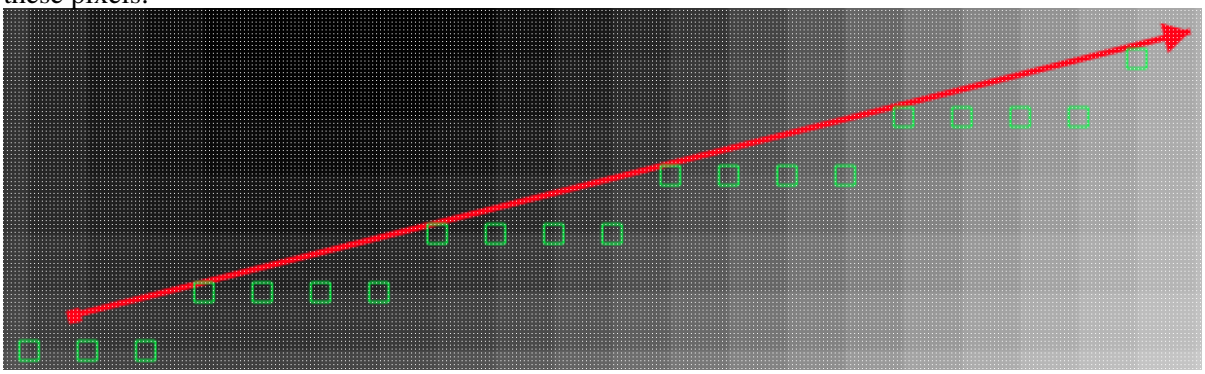


In each of these cases, it does the best that it can to label the axes accordingly. The cube that is used for the drill example here follows the spectral data model so that it is recognized as a spectrum, and it plots against wavelength. The line extraction is a 1x3 average and plots the offset in arcseconds from the initial mouse click, given the WCS information in the header of the image. The point extraction is a 3x3 sum, and plotted in image x coordinates, but can be changed to show image y coordinates.

Note that for the line, if you have more than one image loaded and visible, you can shift-click on a new image to see the same line on a new image. Similarly, for the points, you can shift-click to change images without extracting points. For the line extraction, if you want to change at this point to extraction along a line or column, use the drop-down menu at the bottom of the pop-up (shown here as "free hand selection").

Pin extraction. Once you have an extraction that you like, you can retain the extraction for further analysis. "*Pin chart/table*" extracts the information as a table, just like any of the other tables in this tool, with an accompanying plot. You can then manipulate the table/plot just like any other table or plot in this tool. If the tool recognizes the extraction as a spectrum, you may have additional capabilities.

Once you pin or save your extraction, the tool leaves a "footprint" of your extraction on the image so that you can remember what the extraction was. **NOTE THAT it is not interpolating** across fractional pixels here. It is averaging if you have asked it to average, but particularly if your pixels are large, if you draw a line that is diagonally across pixels, it will be immediately obvious that it's not interpolating. This line gets rendered as these pixels:



The point appears on the image at the lower left corner of the relevant pixel.

You can pin as many different extractions as you want. Each one will result in new tabs with the corresponding table at the bottom of the screen. There are navigation aids within the tables section that may help.

Download extraction. You can download the extraction as a table or plot without pinning it. *Download as Table* saves the table to your local disk with all the same options as a regular table. *Download Chart* saves the plot as shown, as a png file.

After pinning an extraction, you also have the extraction appearing as a table in the tables section of your window and as a plot in the plots section of your window. As with any table in this tool, you can save the table by clicking on the diskette icon in the table. You can choose from a variety of formats; see the tables chapter for more information. Similarly, as with any plot in this tool, you can save the plot by clicking on the diskette icon in the plot. See the plots chapter for more information.

Repeat extraction. As long as the extraction pop-up is still open, you can continue to click points or draw lines to make additional extractions.

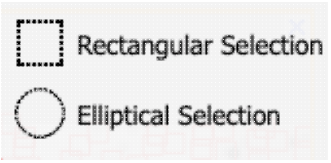
End extraction mode. 

When you are done, to end the extraction, click on "end extraction" to end the extraction. Alternatively, just click on the 'x' in the upper right corner of the extraction pop-up.

Region Selection

 When you click this icon, you can select a region of the image, from which then you can do a whole host of things to the image and to the catalog you may have overlaid upon it.

First, from the drop-down, you are given a choice of a rectangular selection or an elliptical selection:



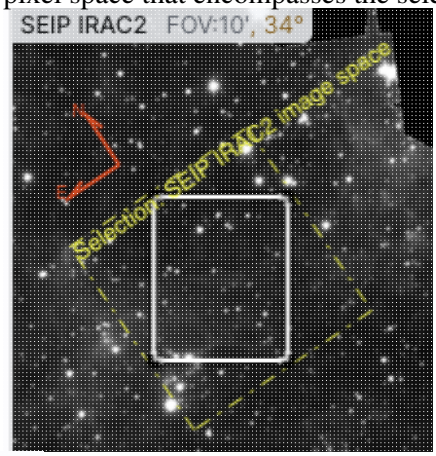
After you make that choice, you can click and drag in the image, selecting a box or a circle on the image. For the circle, your click is the center of the circle and the drag is the radius of the circle; for the box, your first click is one corner of the rectangle, and the drag is the opposite corner of the rectangle. This region can be resized by grabbing and dragging the corners of the box or the pixels delineating the corners of a box around your code. If you need to move the image underneath, you can hold the shift key and click and drag.

When you have selected a region of the image, additional icons appear above the image, and exactly which icons you see is a function of whether you are working on a FITS or HiPS image, and whether or not you have a catalog overlaid:  These icons allow you to do several things:

 *Crop the image*

(FITS only) Crop the image to the selected region. Then you can save the cropped FITS image via the save icon described above.

Note that, if you have a rotated FITS image such that a crop would have to bisect pixels, it will show you the region that encompasses your selection. If you crop at that point, then, it will crop in image space (such that pixels are not bisected). See the figure below -- in the original image, north is up. This has been rotated 45 degrees. The selected region is in white. The yellow dash-dot line is the crop in pixel space that encompasses the selected region.



 *Select sources* (and *cancel selection*)

(Only if a catalog is overlaid) Select the catalog sources overlaid on the image within the region. Selecting highlights the sources in the list and plot with a different color row or symbol. Once there are selections made, the second icon appears to give you an option to cancel the selection.

 *Filter sources*

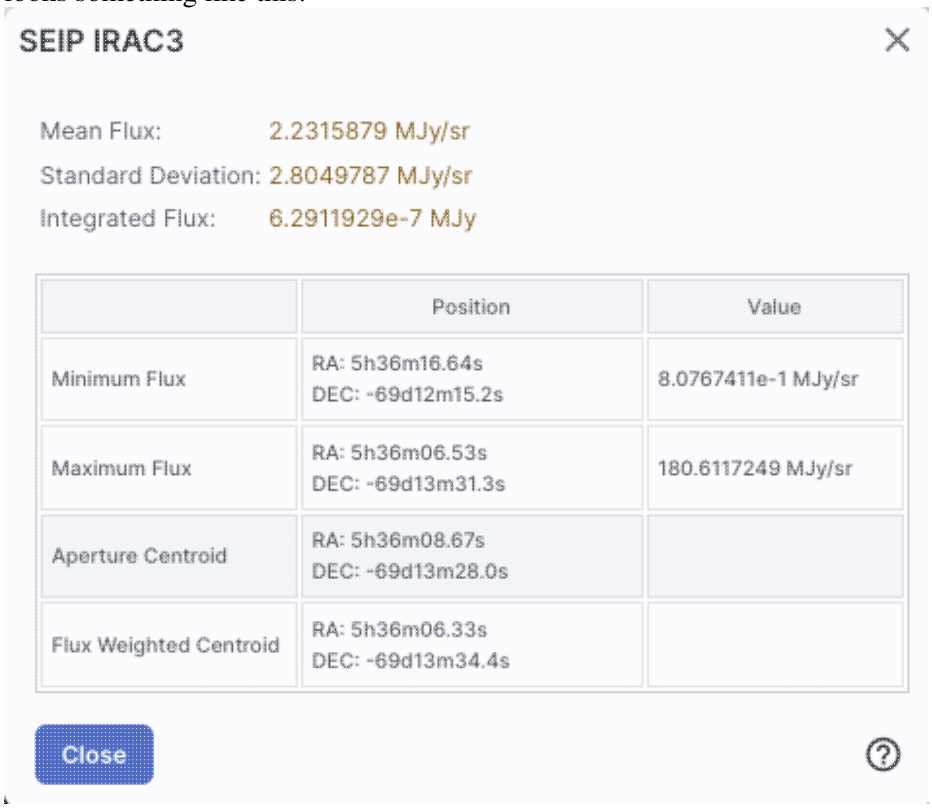
(Only if a catalog is overlaid) Filter the overlaid catalog down to the sources within the enclosed area. When you choose to impose a filter via this selection mechanism; the filters icon changes above the catalog to indicate that there is a filter applied (). To clear the filters, click on the cancel filters icon (which also appears after you impose filters):  . There is much more on filters in the Tables

section.

Zoom the image
Zoom the image to fit the selected area into your field of view.

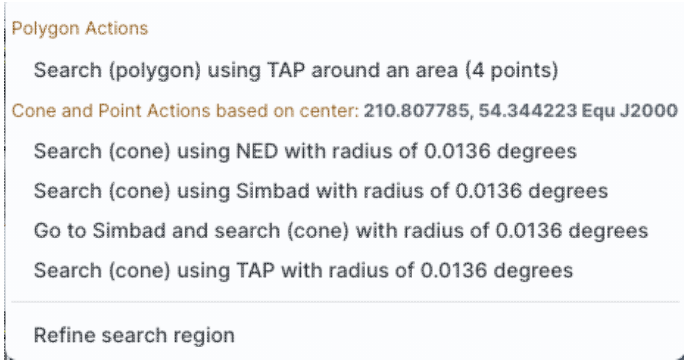
Recenter the image
Recenter the image on the selected area.

Obtain statistics
(FITS only) Obtain statistics from the image on the region. The statistics option results in a pop-up that looks something like this:



Note that it calculates the location of the minimum and maximum fluxes, and the aperture and flux-weighted centroids; the flux values given are in the same units as the FITS file. If you put your mouse over the row of the table in the pop-up, that location appears as an 'x' on the image.

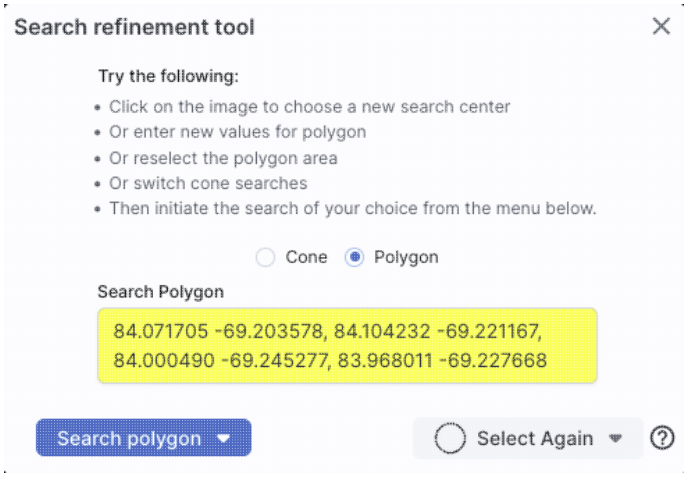
Search
This tool implements a new search, an "action", on the region you have selected. It results in this drop-down (right). where this example is based on a region centered on 84.036131, -69.224431, J2000 decimal degrees, over a 4-cornered polygon. (You can also use the region tool to define a cone; this example happends to be a rectangle.) From this drop-down, you can launch:



- A TAP polygon search over this region (more information about TAP searches)

- ◊ A NED cone search at this position with a radius attempting to correspond to this polygon (more information about NED searches); results loaded into this tool.
- ◊ A Simbad cone search at this position with a radius attempting to correspond to this polygon; results loaded into this tool.
- ◊ A Simbad cone search at this position with a radius attempting to correspond to this polygon, but launch another browser window or tab at Simbad with the results.
- ◊ A TAP cone search at this position with a radius attempting to correspond to this polygon (more information about TAP searches); results loaded into this tool.
- ◊ Refine the search region.

The last option brings up another pop-up window (similar to this) that allows you to refine the search region iteratively by choosing a cone or polygon, setting the center, and setting the cone size or polygon vertices.



From here, you can change the kind of search, refine the positions, launch searches from your refined position (blue button on lower left), and select from the image again (drop-down on the lower right).

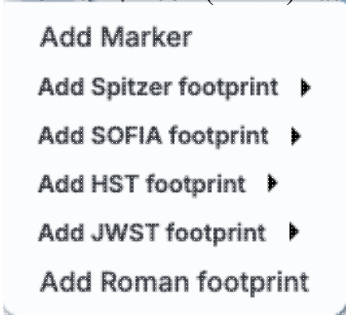
When you are working with the selection tool, this: End Select appears next to the image toolbar to remind you that you are in that mode. If you are refinifng positions for a search, it will be End Search Marker. Either way, when you are done with the selection tool, if your other actions don't turn off the selection tool, click on that text to turn it off.

Tips and Troubleshooting

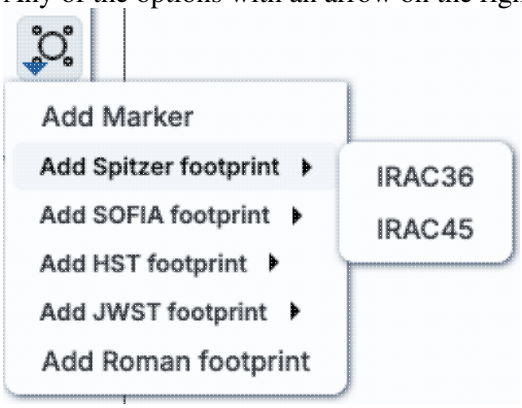
- The "region selection" tool also appears in the slightly different context of interactive target refinement in several other places in this tool, where it works in a a very similar fashion.

Footprints

The marker icon () has a drop-down menu with several possible options:



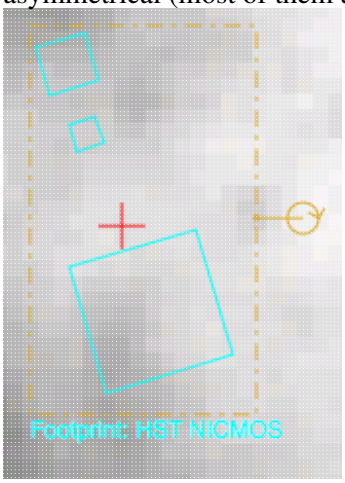
Any of the options with an arrow on the right can expand to additional subsidiary choices, e.g.,:



We now describe these various footprints here.

For each of these choices, the markers appear initially in the center of the loaded images. The first mouse click you make in any of the images will move the marker to that location.

Each of these marker choices, when overlaid and/or selected as 'active', has a dot-dash square around it. If it is asymmetrical (most of them are), it has an additional "appendage" and a red plus at the center of the footprint:



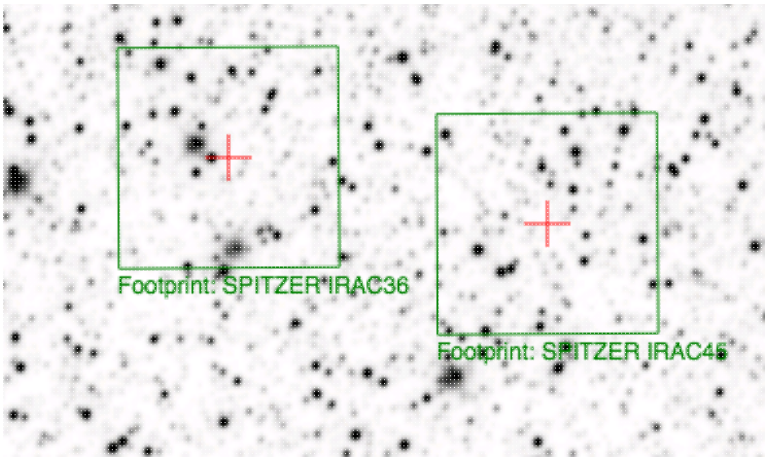
These so-called "handles" allow you to resize and/or rotate the marker, depending on the nature of the marker. These handles only appear when the marker is selected as active; if you wait a few seconds, they vanish.

Tips and Troubleshooting

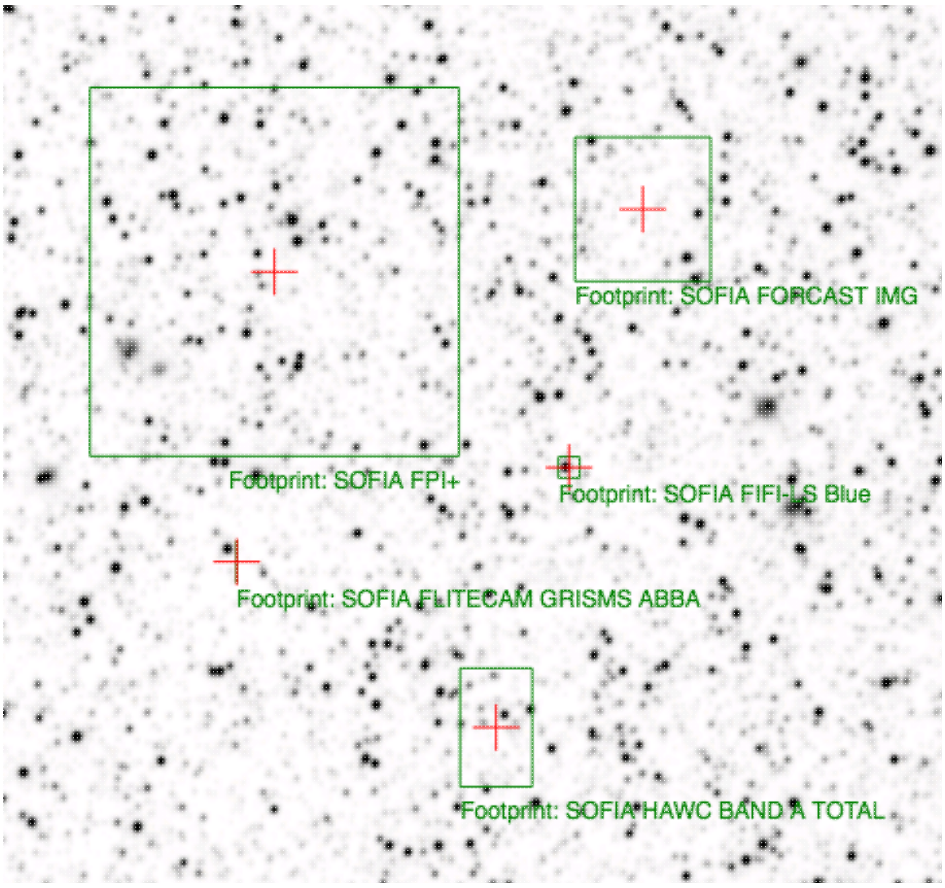
- Some of these footprints are *large*. If you have a small image, some of these footprints will be larger than your image. Zoom out to see it, or find a larger image to use. If you overlay, say, a Nancy Grace Roman Space Telescope (formerly WFIRST) footprint on a 2MASS Atlas FITS image, you may need to zoom out a considerable amount before you can see the Roman footprint. You will see the center indicator of the marker before you will see the Roman footprint itself.
- You can add multiple copies of the same marker using the layers pop-up (described generally above). From the layers pop-up, there is a link right under the 'angle' option that says "Add another [marker type]" -- click on that to get an additional marker of the same type. You can also add a label to the marker from the layers pop-up, or change its color.
- If you have many footprints on the same image, you may have trouble grabbing and moving footprints lower in the stack of layers on the image. For example, overlay footprint 1, then footprint 2, and you might have a hard time grabbing and rotating footprint 1 after footprint 2 has been added. The only workaround here is to use the layers pop-up (described generally above) to temporarily hide footprint 2, then move footprint 1, then restore footprint 2.
- If you have images of very different resolutions loaded (e.g., IRAS and really anything else), sometimes it struggles to render the marker on each image. You may need to place markers on one image at a time. (Unclick the "lock color & overlays" option to place markers one image at a time.)

The first overlay choice (simply called 'marker') is a red circle.

The remaining markers are all footprints from various telescopes: Spitzer, SOFIA, HST, JWST, and Roman. HST, JWST and Roman are derived from information provided via MAST (see http://gsss.stsci.edu/webservices/footprints/help.html .) For Roman in particular, they are pre-launch values.



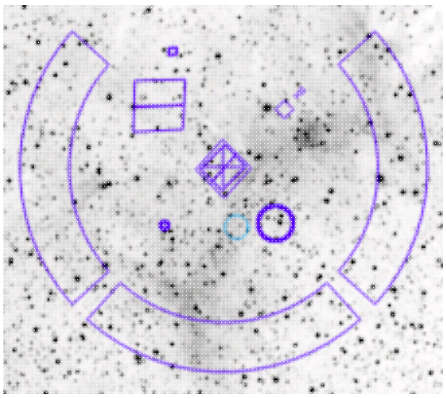
Spitzer/IRAC 3.6 and 4.5 micron footprints. These two footprints are placed separately from each other. The footprint can be moved or rotated. Click and drag the center of the footprint. A circle appears with four small circles ("handles") around it. Grab and drag the small circles to rotate it, or drag the big circle to move it. Change the color, delete, or add more copies of the IRAC footprints from the layers pop-up.



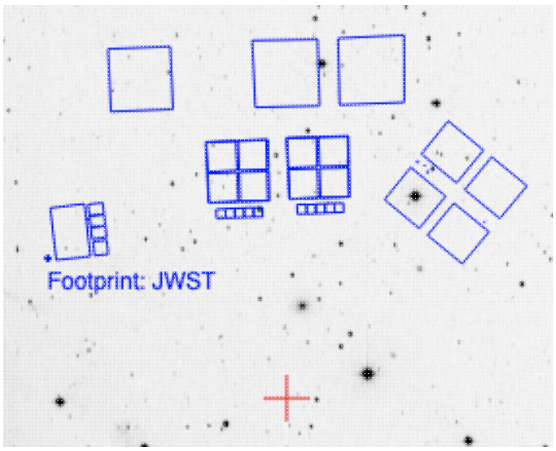
SOFIA footprints. Several different SOFIA footprints are available; the graphic here shows a selection of them. The available footprints (all of which are placed separately) are:

- FIFI-LS
  - Blue (50-120 microns)
  - Red (110-200 microns)
- FLITECAM
  - Imaging
  - Grism ABBA
  - Grism AB
- FORCAST
  - Imaging
  - Grism a
  - Grism b
- FPI+
- HAWC+
  - 53 microns (Band A), Total Intensity
  - 53 microns (Band A), Polarization
  - 89 microns (Band C), Total Intensity
  - 89 microns (Band C), Polarization
  - 154 microns (Band D), Total Intensity
  - 154 microns (Band D), Polarization
  - 214 microns (Band E), Total Intensity
  - 214 microns (Band E), Polarization

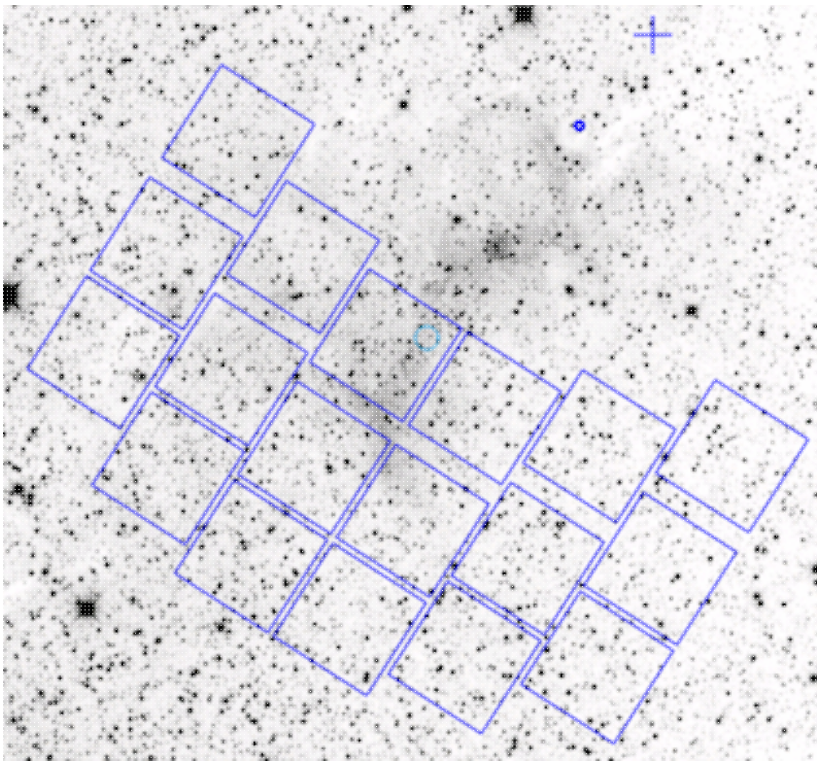
Change the color, delete, or add more copies of the SOFIA footprints from the layers pop-up.



HST footprints. You can overlay the whole focal plane footprint, shown here, or individual instrument footprints (NICMOS, WFPC2, ACS/WFC, ACS/HRC, ACS/SBC, WFC3/UVIS, and WFC3/IR). Consult the HST documentation for specifics on which apertures are which. The footprint can be moved or rotated. Click and drag the center of the footprint. A circle appears with four small circles ("handles") around it. Grab and drag the small circles to rotate it, or drag the big circle to move it. **Note that** if you overlay the footprint on a very small image, nothing will appear to have happened. You need at least a 45 arcmin image to comfortably see the footprint. Change the color, delete, or add more copies of the HST footprints from the layers pop-up.



JWST footprints. You can overlay the whole focal plane footprint, shown here, or individual instrument footprints (FGS, MIRI, NIRCAM, NIS, and NIRSPEC). **Note that** if you overlay the footprint on a very small image, nothing will appear to have happened. You need at least a 30 arcmin image to comfortably see the entire JWST focal plane. Please consult the JWST documentation for details about the footprints. In all cases, if the footprint is 'active', a circle near the middle of the footprint will appear with four small circles ("handles") around it. Grab and drag the small circles to rotate it, or drag the big circle to move it. Change the color, delete, or add more copies of the footprints from the layers pop-up.



Nancy Grace Roman Space Telescope focal plane footprint. As above, the footprint can be moved or rotated. Click and drag the boresight (the cross hairs), which appears by default to the upper right of the array of squares. A circle appears, centered on the boresight, with four small circles ("handles") around it. Grab and drag the small circles to rotate it, or drag the big circle to move it. **Note that** if you overlay the footprint on a very small image, nothing will appear to have happened. You need at least a 60 arcmin image to comfortably see the footprint, and even then you will probably have to click and drag to see the entire footprint. Consult the Roman documentation for specifics on the apertures. Change the color, delete, or add more copies of the Roman footprint from the layers pop-up.

Spitzer Heritage Archive: Tables

All of the tables in the Spitzer Heritage Archive (whether they are catalogs, or spectra, or the contents of a FITS or HiPS header, or a list of results) are interactive tables, and they have the same basic properties, discussed in this section. The specific broad cases of catalogs and spectra are in other sections.

Contents of page/chapter:

Table Header

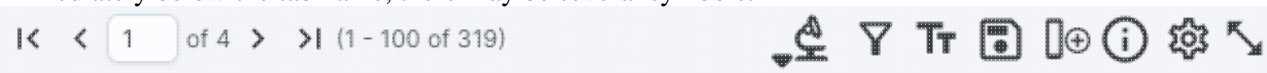
These interactive tables -- called Firefly tables, after the software that is running here -- all have the same functionality, regardless of the contents of the table. If it looks like this sort of table, you can work with it whether it is a catalog, an image header, a list of images, etc.

If you have loaded a catalog into a tab and it doesn't take up the whole screen, to see more of the window, grab the divider between the window panes and slide it up/down or over as needed, or use the expand arrow icon ( ) to enlarge the window pane to take up the whole window.

The table is shown exactly as it has been provided to the tool, with all columns as defined by the creator of the table. To understand what each column is, please see the documentation associated with that catalog or table.

The tab (and table) name itself likely indicates its origin. To remove the tab, it is likely that you can click on the "X" on the tab.

Immediately below the tab name, there may be several symbols:



which we now describe, going from left to right along the top of the tab.

Table navigation
The first thing to notice is that (typically) only the first 100 rows of the retrieved catalog (or table) are displayed in the table. In the example here, there are 319 sources that were retrieved as a result of the search, grouped into 4 'pages.' The left/right black arrows plus the page number allow you to navigate among these 'pages' of 100 sources each. Note that the entire set of results (not just the 100 rows you are currently viewing) can be sorted by clicking on any column's name.


Table Actions: Searches
This drop-down has choices to launch new searches, and as such, it has a separate section below.

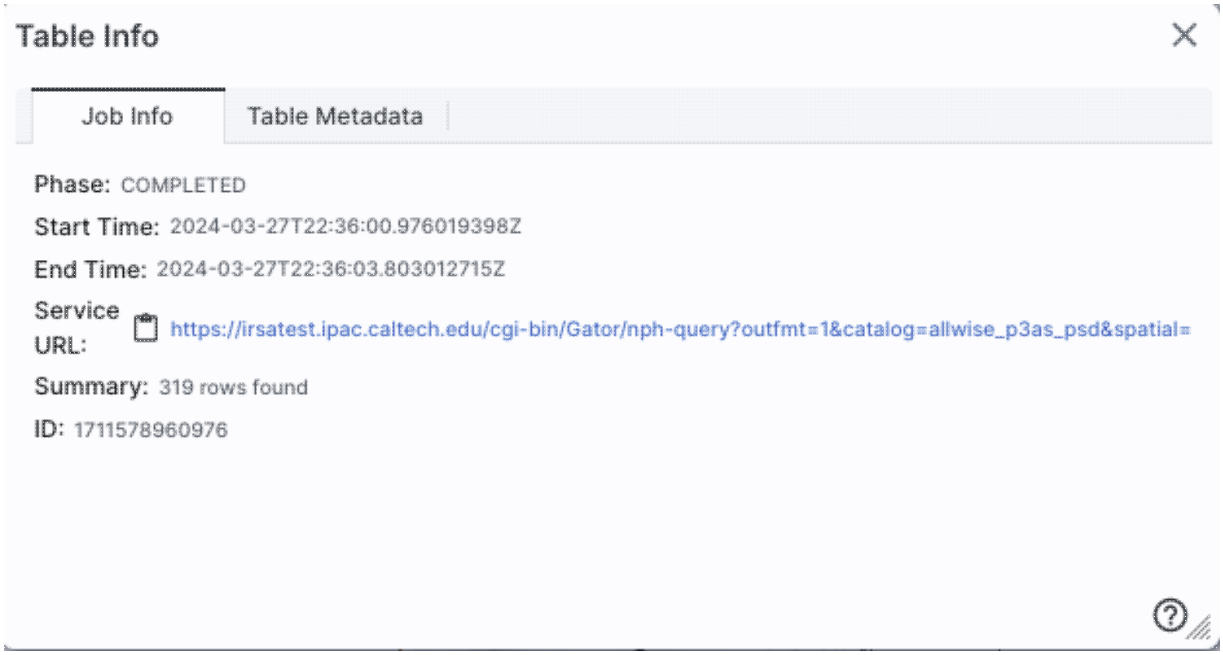
Filter
Filters are complex and powerful enough that they are covered in a separate section below.

Table as text
Clicking on this changes the table display into a fixed-width text display. The icon then changes to click this again to return to the default table view.

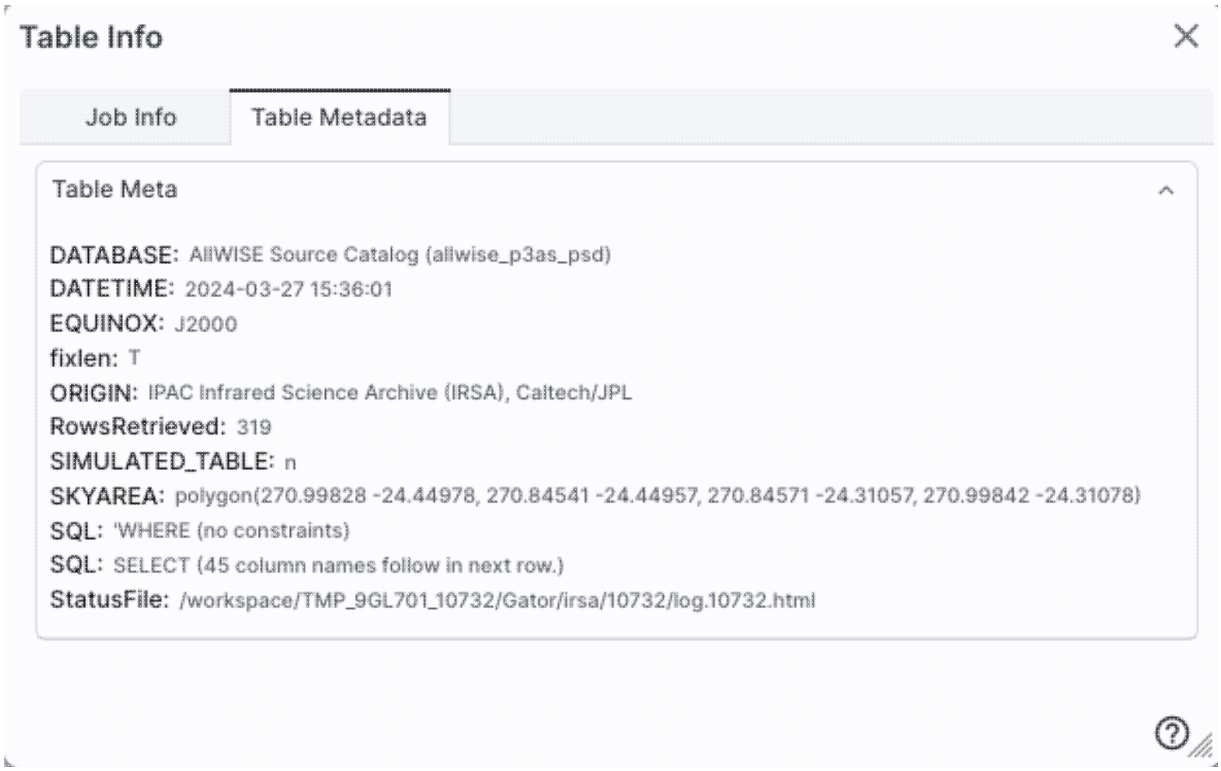
Save table
This is how you can save the table. It has a separate section below.

Add a column
This icon adds a new column to the table. This has a separate section below.

Info link
You may or may not see this icon. This is an "information" button and, if it exists, it may provide additional information about the table. It could have information about the job that was used to retrieve it:



where the direct link to the job is given there (and can be copied by clicking on the clipboard, ready to be pasted into a helpdesk query, for example), with a job id as shown. It could also just have information about the table metadata:



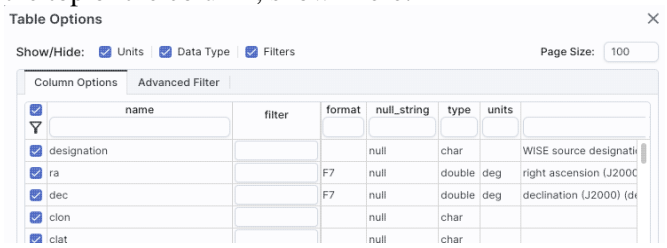
where the information about this table includes information about the query that produced it.

Row details

You may or may not see this icon. This is how you get more information about the currently-selected row. It has a separate section below.

Table options

Clicking on this icon brings up options for the table, e.g., how many rows are displayed per page, which columns are shown, metadata about each column if available, whether units and data types are shown at the top of the column, shown here:



By default, it is often but not always the case that all columns are shown. To show or hide columns, select the tickbox in each given row. The default page size is 100 rows. Note that expanding the page size to numbers much greater than 100 may result in a substantial performance degradation (e.g., your browser will appear to freeze or not appear to be doing anything while it manages and renders the large table). See the Filters section below for more things to do from the table options pop-up.

Expand

Clicking on this expands the catalog window pane to take up the entire browser window. To return to the prior view, click on "Close" in the upper left.

Help

The last option on the top of the catalog tab may be a context-sensitive help marker, which should bring you to this online help.

Table Columns

Depending on what you did to display a table, the columns that are shown may be in easily-human-readable form, or may reflect column names used within the individual catalog. Please consult the detailed documentation associated with your specific table if the headers are not clear to you.

The table is shown exactly as it appears in the corresponding database (or as it appeared on your disk), with all columns as defined for that catalog. To understand what each column is, please see the documentation associated with that catalog. (For IRSA catalogs, this documentation is available via navigating through the IRSA website.)

Clicking on the column names sorts the table by that column; clicking once sorts in ascending order, clicking a second time sorts in descending order, and clicking a third time returns the table to the original order. Small arrows appear next to the column names to remind you if the column is sorted in ascending or descending order. When you do a single-position search on catalogs, depending on how you do it, it could be that two new columns are appended to the end of the catalog as it is returned to you. These columns are:

- dist - the distance between the source in question and the location you specified
- angle - the position angle between the target position you requested and the object it found (degrees E of N)

When you do a multi-position search on catalogs, you could have three new columns prepended to the catalog as it is returned to you. These columns are :

- cntr_01 - the target position you requested
- dist_x - the distance between the target position you requested and the object it found
- pang_x - the position angle between the target position you requested and the object it found (degrees E of N)

These additional columns can help you assess if the target it found is the target that should be matched to the position you requested.

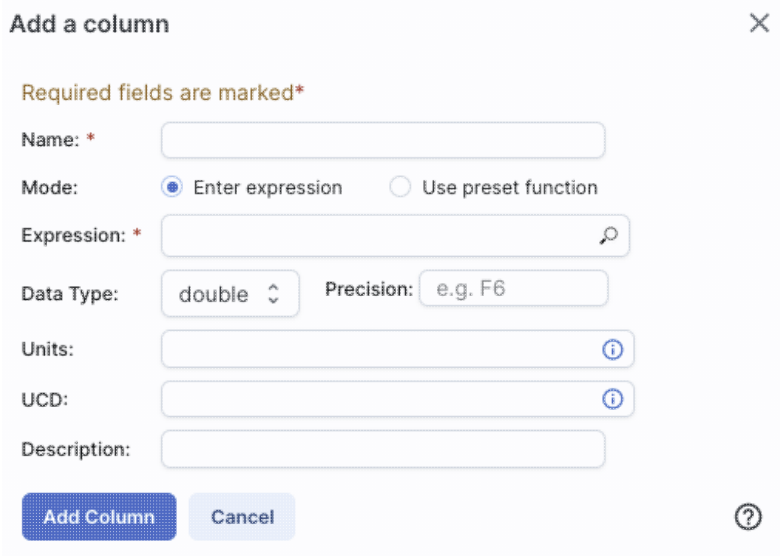
It could be that, when you do a multi-position search on catalogs, you have an option for "one-to-one matching". If that is selected, the line (and only one line) of output is included for each line of input. It chooses the closest source within the radius you specify, or if there is no match, it adds a line indicating no match.

Tips and Troubleshooting

- You can hide or display columns; click on the gears () to get to the table options, and tick the box corresponding to the row you want to hide or show.
- If you are constructing and loading your own catalog where you don't specify the formatting, the tool tries to guess the formatting of the column based on the first row's values. Therefore, if you have a value in the first row that happens to be a string like "null" where the rest of the column isn't like that, or happens to have only one decimal place where the rest of the column has 2 or more, it will guess incorrectly and format the other rows just like the first one. Try editing your catalog file to put the most general case as the first row.

Adding Columns

This icon  allows you to add a new column to your catalog. When you click on it, it brings up this pop-up window:



This window asks for:

- *Name* of the column (required) -- it cannot have special characters like a minus sign or a percent symbol; you can only use letters, numbers, and underscores.
- *Mode* "Enter expression" or "Use preset function" -- options shown here correspond to "Enter expression" options; the preset function options are included in the last bullet here.
- *Expression* (required) -- using basic SQL operators, you can manipulate columns to create the new column. (See more on this below.)
- *Data Type* -- specify if your new column is a double precision floating point ("double"), a long integer ("long"), or a string ("char").
- *Precision* -- if you have selected "double" for data type, select how many decimal places your new column should display. For example, if you want the numbers to display as 1.23, enter "F2".
- *Units* -- specify the units of your new column. For more information, see IVOA documentation
- *UCD*, or unified content descriptor -- for VO compliance, add this for your new column. For more information, see IVOA documentation
- *Description* -- add a description for your new column.
- *Select a preset* -- if you select "Use preset function", you can choose (a) "set filtered rows to 'true' and the rest to 'false'", (b) "set selected rows to 'true' and the rest to 'false'", or (c) "number rows in current sort order". These options are useful for tagging items you have selected in myriad ways (from plots, images, complicated filters), or ordered in complicated ways. For example, if you have constructed a complicated filter, then you can create a column that is true for the selected rows; if you cancel the complicated filter, you can then easily recreate the complicated filter by simply filtering on your newly created column.

In order to construct the expression for your new column, your input should follow the syntax of an SQL expression. If you click on the magnifying glass next to the form input, you get a pop-up window that can help you construct an expression; click "apply" to apply the expression.

You need to use the column names exactly as they appear in your catalog. Supported operators are: +, -, *, /, =, >, <, >=, <=, !=, LIKE, IN, IS NULL, IS NOT NULL. You may use functions as well; for a list of all available

functions, see here. Some examples include:

- "w3mpro" - "w4mpro"
- sqrt(power("w3sigmpro",2) + power("w4sigmpro",2))
- ("ra"-82.0158188)*cos(radians("dec"))
- "phot_g_mean_mag"-(5*log10(1000/"parallax") - 5)

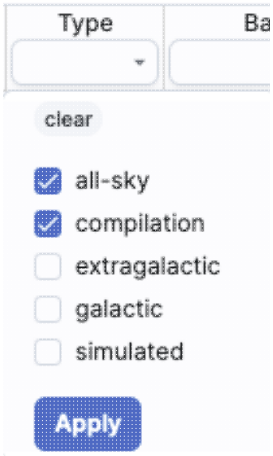
Tips and Troubleshooting

- When you create a new column that is calculated from other columns, it is created statically. That is, it is not dynamically updated like a spreadsheet, but calculated once and left alone after that.
- When you create a new column, the header of the new column is red to let you know that the column is not present in the original catalog.
- When you save the catalog, the header of the saved catalog indicates that you have added a column. When you load the catalog back into the tool, the header of the new column is still red.
- You can edit or delete columns after you have created them; click on the gears ( ) to get to the table options, and then click on the edit icon to bring up a dialog box to edit or delete the column.
- You can hide columns; click on the gears ( ) to get to the table options, and tick the box corresponding to the row you want to hide or show.
- If you create a new column that turns a floating point column into an integer with the "FLOOR()" function, you need to be sure to set the resulting column type to "long". For example, if you have data covering several days or years, and you have a column that is a floating-point MJD, you can convert it into an integer, e.g., via FLOOR(mjd) for days or FLOOR(mjd/365.24) for years, then you can use the drop-down filter menu for the new column to quickly compare different time ranges. But, the new column must be an integer (e.g., "long") in order for this to work properly.
- If you need to, say, take the square root of a column that occasionally has a negative number, and you want it to attempt to handle this in a physically reasonable manner, you can construct expressions like this for a column named 'col' that has some positive and some negative numbers:
  if("col">=0,sqrt("col"),-sqrt(-"col"))

Table Filters

Filters are a *very* powerful way of exploring the table full of search results. Click on this icon in order to start the process of adding filters. A text entry box appears above each of the current catalog columns, with a small version of the filter icon corresponding to that row on the far left. You can type operators and values in these boxes -- hit return or tab after typing or click in another box to implement the filter.

Example: From a catalog, show only those sources with declination above a certain value (say, 31 degrees), type "> 31" in the box at the top of the "dec" column. Or, if you have retrieved a WISE catalog and would like to only view the objects with a W1 (3.4 micron) profile-fitted magnitude less than 6 magnitudes, in the box at the top of the 'w1mpro' column, type "< 6" in the form.



For columns (fields) with a limited set of choices, on the right edge of the text entry box, an arrow appears; click on it to get a drop-down from which you can select the available choices. To implement the filter, make the choices, and click "Apply" when you are done. Click "clear" in the top of the drop-down menu to remove that filter.

After you impose a filter, then the number of rows in the table is restricted according to the rules you have specified, and the "filters" icon on the top right of the catalog pane has changed to remind you that there has been a filter applied, in this case four filters:  . To clear the filters, click on the cancel filters icon (which also appears after you impose filters):  .

Filters can be used in combination. Note that the filters between columns are logically "AND"ed together, but filters within the same column can be logically "AND"ed or "OR"ed together; examples are below.

The available logical operators are :

- = which means 'equal to' (exactly!), e.g., the parameter on which you are querying (the column headers as shown) is exactly equal to this value you are specifying.
- > which means 'greater than'
- < which mean 'less than'
- != which means 'not equal to' (exactly!)
- >= which means 'greater than or equal to'
- <= which means 'less than or equal to'
- IN which means 'included within this list', e.g., the parameter on which you are querying is included within the list you are specifying (if the column filter is free-form text, type "value1,value2" and it will give you rows that have value1 or value2).
- LIKE which means 'resembles the text that is entered', e.g., the text resembles the text that you type in the box.
- IS which effectively is the same as =
- IS NOT which effectively is the same as !=

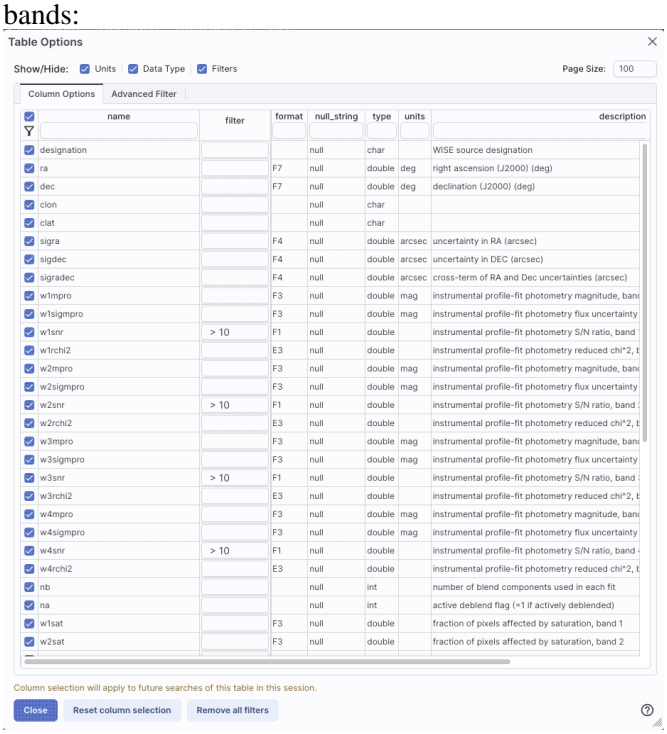
Examples:

- Retain rows for which a certain parameter is not an empty string: !="
- Retain rows for which a certain parameter is not NULL and is larger than 1.234: > 1.234 and IS NOT NULL
- Retain rows that have values between -0.5 and 1.25: > -05 and < 1.25
- Retain rows with a parameter greater than one value or exactly not equal to another value: > 12345 or != 3000
- Retain rows with a parameter equal to one of the values in a list: IN a,b,c,d

You can also interactively impose filters from plots from a catalog. Moreover, all the same operators that are available for making plots can be applied in filters. In both cases, see the plots section for more information.

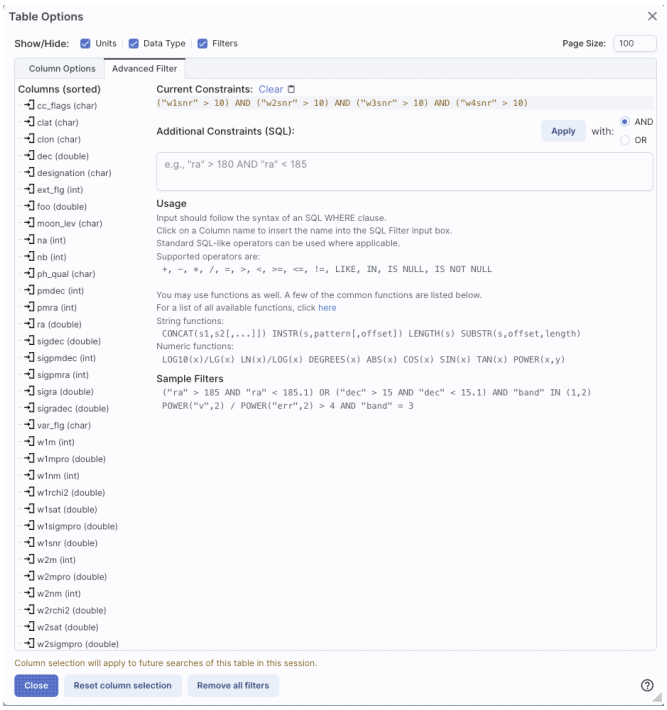
You may also be able to select rows one at a time via the far left column and then filter that down. Example: Retrieve a catalog of any sort. Select rows by ticking the box on the far left, say, every other row out of the first 12. Click on the filter icon on the top of the column. The filter is imposed to only include the 6 rows you selected.

If you click on the table options icon ( ), you get a pop-up that includes a place to filter columns. Here is an example of the table columns for a WISE catalog that has been filtered to just have SNR>10 for each of the four bands:



You can type in constraints in the filter box in much the same way as you can from the catalog itself; note that the column description is included here, which may make this way of setting filters more useful when working with a new (to you) catalog.

The second tab is the advanced filter interface:



Here, the columns are listed alphabetically on the left, the constraints you have imposed are in the "current constraints" box, and you can apply additional SQL constraints via the free-form text box. Hints for syntax are given below the entry box. This window can be resized such that you can see the whole set of hints and imposed filters. Note that in this interface, column headers must be enclosed within double quotes.

Cancelling filters

After you impose a filter, then the "filters" icon on the top right of the catalog pane has changed to remind you that there has been a filter applied, in this case just one filter:  To clear all the filters at once, click on the cancel filters icon (which also appears after you impose filters):  .

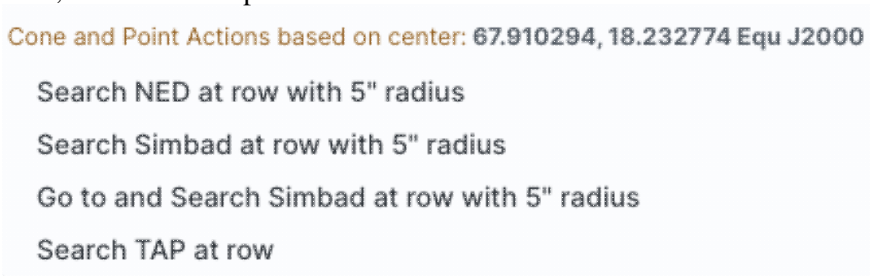
Tips and Troubleshooting

- If you impose logically inconsistent restrictions such as "exposure_time > 160" and "exposure_time < 100" (">160;<100" in the filter box for a column called "exposure_time"), no data will result, because no data are (can be) both less than 160 seconds long and greater than 100 seconds long at the same time. However, "exposure_time > 160 or < 100" works just fine (">160 or <100" in the filter box for the column "exposure-time").
- If you impose nonsensical filters (like using a letter where a number should be, like "w1snr < f") then it will let you know that something has gone really wrong, and let you go back to fix it.
- However, a filter like "ph_qual < f" could be valid -- if the column with which you are working is a string, then a string is a valid filter. It is case-insensitive. For the ph_qual column in the 2MASS catalog, the values are always three letters, such as AAA or ABA or CUU. A filter like "ph_qual < f" will operate as if you have alphabetized the list. Any string that starts with A comes before F and so will be retained. If you do "ph_qual < BBB" then AAA will be left in, but so will "BAU", because alphabetically, BAU precedes BBB.
- If you impose filters from a plot, it can manifest as several filters on the catalog, e.g., one for each side of the square you have drawn on the plot. If you want to remove, say, just one of the four filters (rather than all of them by cancelling all filters), you can do so from the table options pop-up.

- If you want to copy all of the "current constraints", even if the entire field is not visible to you, you can click on the clipboard icon to copy the entire string, and then paste it into another field or application to see what it is.
- If you are choosing filters from a list of terms, cancelling those filters might not work the way it cavalierly seems like it should. If a down arrow appears next to the filter box, then a list of options you can select is available. Tick the boxes you want, and click "Apply" to apply the filter. Now, if you want to change the filter, click the down arrow, select different options, and click "Apply" again to re-impose the new filter. To remove the filter, you have to treat it like you would when applying a modified second filter -- unselect the choices, or hit 'clear', and **then hit Apply again**. If you deselect the choices and then click elsewhere in the window without hitting clear, your actions are interpreted as 'cancel without doing anything' as opposed to 'impose the new filter I just set' (which is 'cancel all filters'). When you are resetting the filter to be 'select nothing', it is treating that as a new filter setting, so you need to set up that filter and click 'Apply' in order for it to understand.
- If you impose filters from a plot, image, or table, you can cancel them from a plot, image, or table. That is, if you impose filters from a plot, and different additional filters from the image, when you click the 'cancel filters' icon from the table, *all* the filters are canceled at once. If you have filters imposed from multiple places, clicking on 'cancel filters' doesn't cancel just the filters imposed from that place; it cancels all of them. If you want to be able to reconstruct a complicated set of filters, though, you can add a column to your table that is one of the preset functions -- set it to true if the row is filtered. Then you can cancel all your filters at any time but you can easily recover the filtered data by filtering on that one new column.

Table Actions

 This icon implements a new search, an 'action', on the currently selected row of the table. When you click on it, it reveals a drop-down:



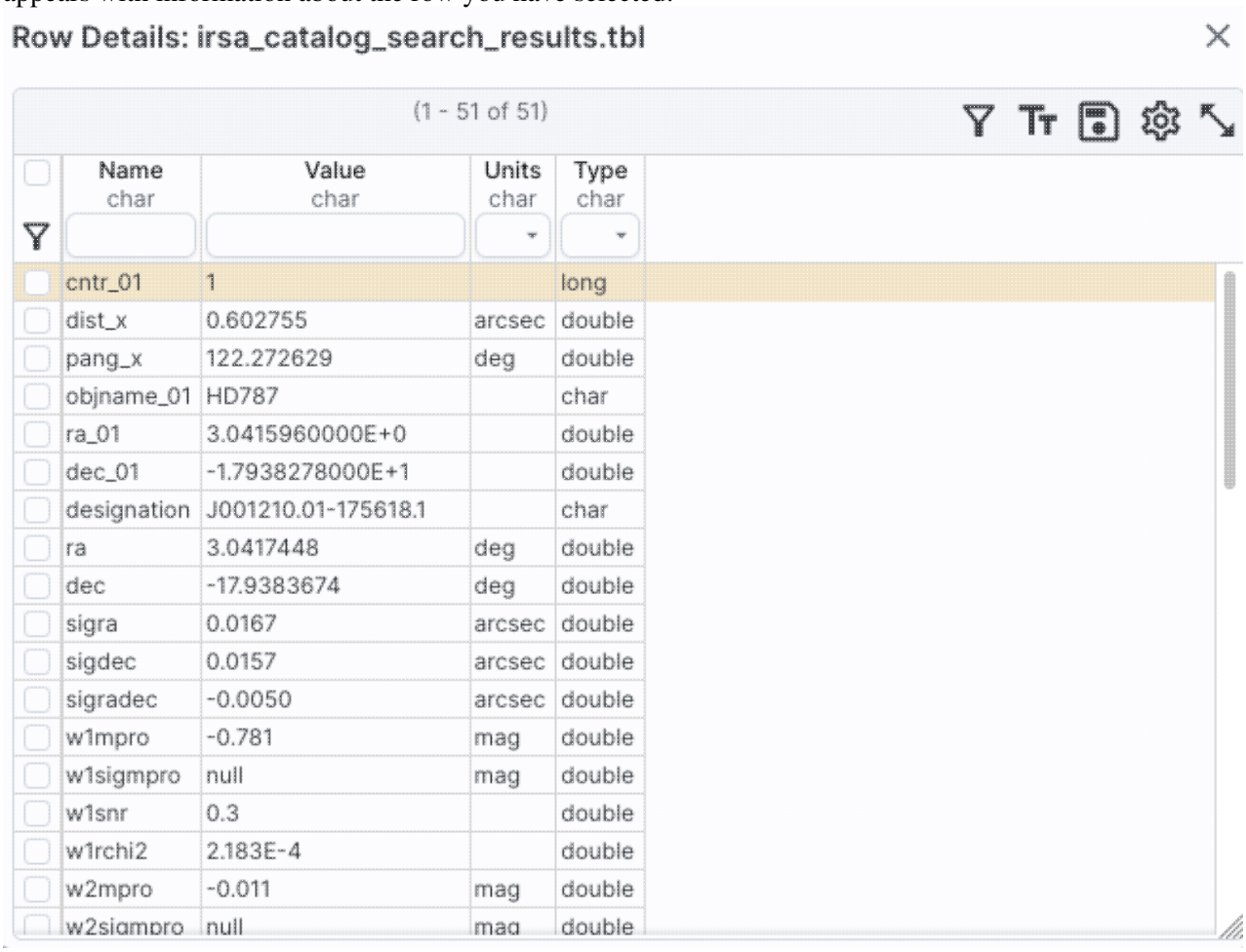
For this example, the selected row is 67.910294, 18.232774 in J2000 decimal degrees. From this drop-down, you can:

- Launch a NED search at this position with a 5 arcsecond radius (more information about NED searches)
- Launch a Simbad search at this position with a 5 arcsecond radius, and put the results in a table here in the tool
- Launch a Simbad search at this position with a 5 arcsecond radius, but start another browser window or tab at Simbad with the results
- Launch a TAP cone search at this position (more information about TAP searches)

Any of these searches (except the search that launches another browser window with the Simbad results) places the search results into this same tool.

Row Details

 This icon is not always available. When it is available, when you click on it, a new pop-up window appears with information about the row you have selected:



In some tools, this content appears as additional tab elsewhere in the tool (not in the table pane, but often viewable at the same time as the table itself), as an additional tab called "Details."

In either incarnation, this information is sometimes called a "property sheet."

This table consists of each of the columns of the retrieved catalog with additional information about each field where available. (Not every catalog may have this information available.) For additional information, please consult the full documentation that accompanies the catalog.

Note that if you leave the pop-up or tab open as you select different rows in your main table (or catalog), it is dynamically updated.

Tips and Troubleshooting

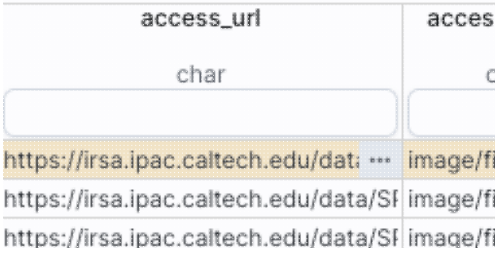
- The property sheet is a more expanded, vertical view of the information shown in a row of a catalog, along with documentation of the catalog columns. If you think of the main table (catalog) view as a single row that you have to scroll left and right to see in its entirety, this view is sort of an orthogonal

view, where you have all of the same contents of that row but shown as its own table, with the full header description, if available, and you can scroll up and down to see the entire contents (as opposed to left-right). *This is sometimes a more user-friendly way to view any given row.*

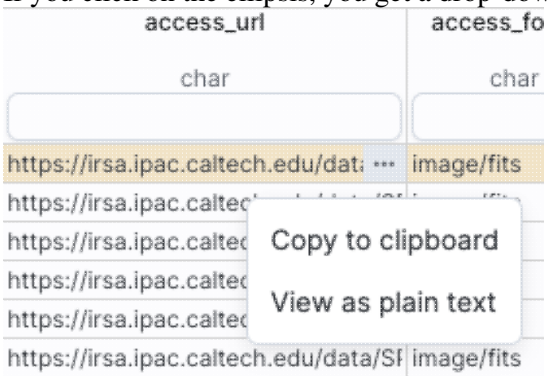
- Because you can sort/filter the data in the property sheet, you can restrict what values are shown. Those filters are respected as you page through your main table.
- When changing rows in the main table, the property sheet scrolls to preserve the visibility of whatever row in the details tab is highlighted. If you scroll down in the property sheet *without changing the highlight*, when you change rows in the main table, because the first row in any table is always highlighted by default, the property sheet will scroll back to the top.

Table Cells

Some cell values may be too long for the cell space. If that is the case, an ellipsis ("...") will appear in the cell as you mouse over it:



If you click on the ellipsis, you get a drop-down menu:



from which you can choose to copy the cell value or view it in a pop-up window.

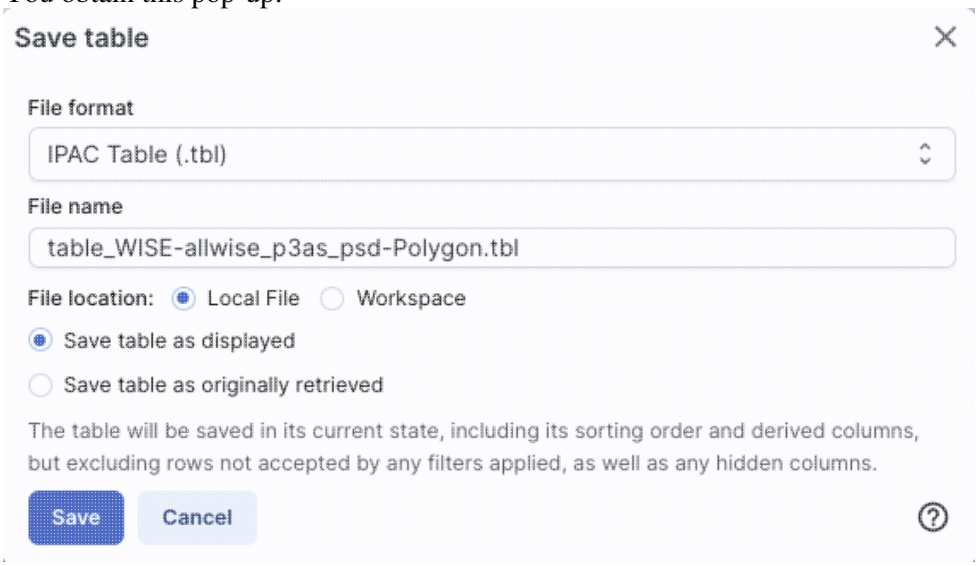
If you view it in a pop-up window, it will attempt to format it in a readable fashion:

which, for most cells, will be functionally indistinguishable from no special formatting. It will only matter for very complicated cells.

Saving Tables

Click on the diskette icon ( ), if available, to save the table.

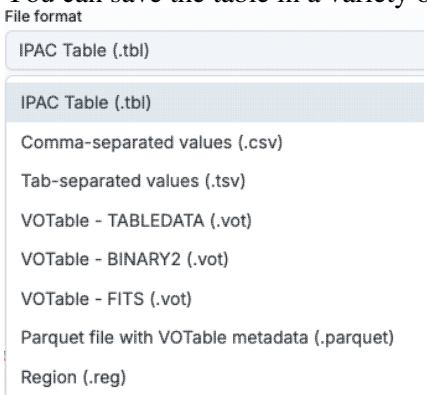
You obtain this pop-up:



You have several choices to make. In order, they are:

File format

You can save the table in a variety of formats:



It defaults to saving it as an IPAC table file, which is basically ASCII text with headers explaining the type of data in each column, separated by vertical bars.

Other formats include comma-separated values (csv, suitable for, e.g., Excel), tab-separated values (tsv), and three different versions of VO tables. You can save the file in parquet file format, which is a highly efficient, compressed, column-oriented format for tabular data that has been adopted by many recent wide area survey projects. You can also save the file in DS9 Regions file format. The advantage of saving it here as a regions file (as opposed to from the visualization) is that this way, the entire catalog is guaranteed to be saved.

File name

The tool tries to make a guess at a sensible filename. Feel free to change it to something that makes sense to you.

File location

You may save your file to a local file (on your disk) or, if you are logged in, in the IRSA Workspace.

Modifications to the table

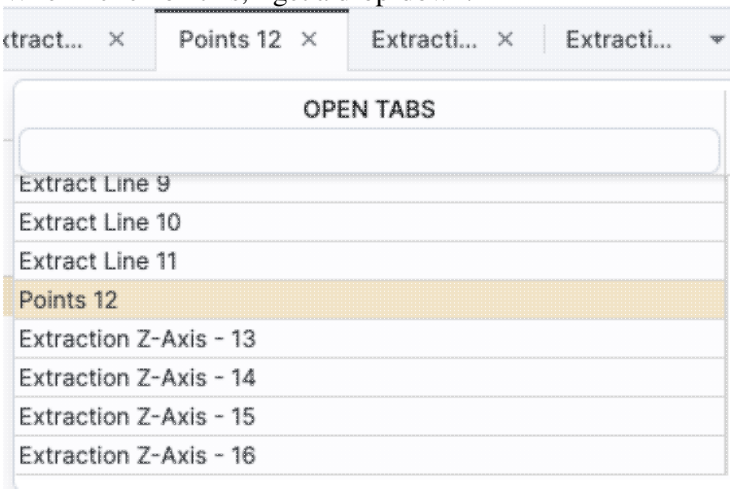
Depending on what you have been doing to the table at this point, you may have filtered or added columns. If you want to save the table as it is currently displayed, with all filters as imposed and any columns hidden, and any added columns as shown, select "Save table as displayed." If you want to save the original table, with all rows and the original columns intact, choose "Save table as originally retrieved."

Table Navigation

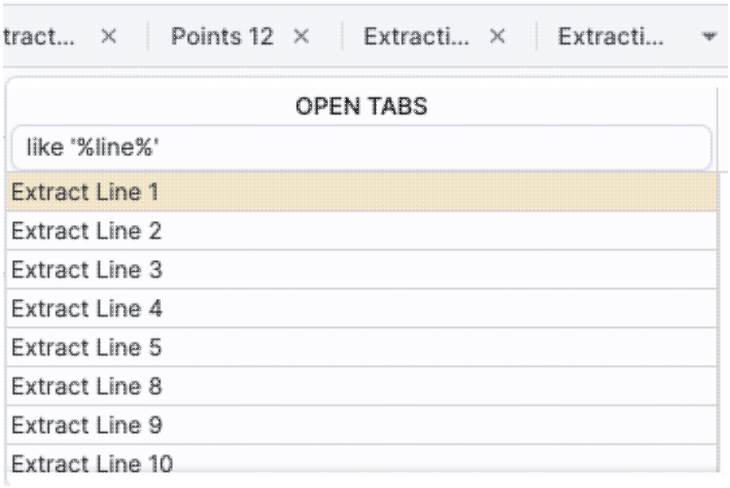
At any time, you can move among tables by just clicking on the tab name. But, with the ability to extract data from images comes the ability to rather quickly drown in tables. There is a way to navigate among a lot of table tabs that have accumulated.

This is probably best explained via an example. Here, I have tabs showing that I have extracted several lines, drills, and points from my images:

On the far right of the collection of tabs, at the top right of the table pane, I have a downward pointing arrow. When I click on this, I get a drop-down:



This drop-down shows that the tab marked "Points 12" is in the foreground (it is shaded yellow) and this drop-down has a filter box at the top. That filter box at the top works just like the filters discussed above, so if I want to find the tabs with the extracted lines, I can type "line" in the box, and it will filter down the list, leaving only those tabs with "line" in the name:



Then, from there, I can select the tab I want to bring to the foreground. (When I select a tab to bring to the foreground, that tab is also in the foreground for plotting.)

In this fashion, I can navigate easily among many tabs that are open at the same time, even if I have so many tabs that their headers are not completely shown.

Spitzer Heritage Archive: Catalogs

Catalogs are a special case of tables; the basic functionality of tables is covered in the Tables section. You can choose from any of a wide variety of catalogs to load for overlaying on your visualized data. Plotting catalogs is covered in the Plots section.

Contents of page/chapter:

Introduction

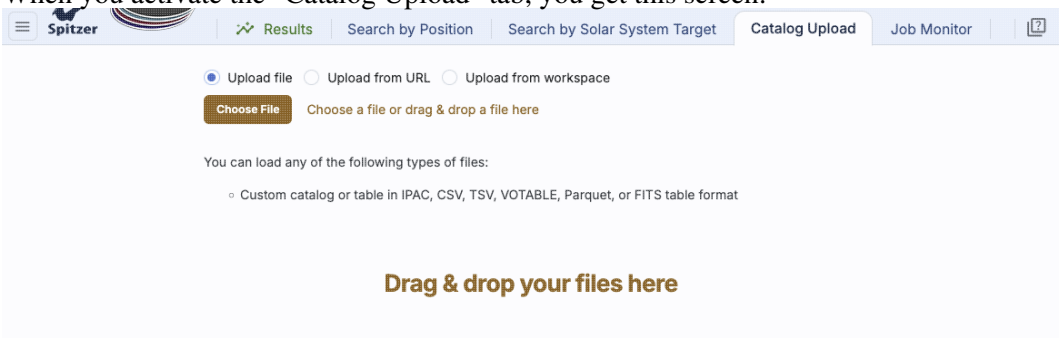
There are several different ways to get catalogs into the Spitzer Heritage Archive. You can retrieve them via any of several blue tabs at the top of the page after your initial search.

This chapter focuses on the most local and straightforward of a few of those additional blue tabs.

When you click on the "hamburger" in the upper left  , it pulls open a "drawer" from the left hand side which enables you to add or remove tabs from the row of blue tabs on the top of your window. You can add (or remove) "Catalog Upload", and also, under "IRSA search tabs," "Catalogs." The other catalog searches acessible from the "drawer" are covered in another chapter.

Catalog Upload

When you activate the "Catalog Upload" tab, you get this screen:



You may upload a file from disk (you can use the system browser to identify the file, or drag-and-drop them into this window), from the web via a URL, or from the IRSA Workspace. Click "Load" in the lower left to actually load the file.

The file can be in any of a number of formats, which we now briefly describe.

IPAC table format (*.tbl)

IPAC table format is plain text with a particular formatting. IRSA has a table reformatting and validation service which may be helpful, or you can download just about any catalog you find through IRSA, and mimic that format.

If you want it recognized as a catalog, your table file MUST have RA and Dec values, and unless it is specified, it assumes J2000. (See also "tips and troubleshooting", below.)

You can add a "SYMBOL" parameter to change the shape (X, SQUARE, CROSS, EMP_CROSS, DIAMOND, DOT) of catalog marks, e.g.:

```
\SYMBOL = X
```

You can add a "DEFAULT_COLOR" parameter to assign a CSS color name or a HEX value to catalog marks, e.g., either of these two:

```
\DEFAULT_COLOR = lightcyan
\DEFAULT_COLOR = #00FF00
```

You can find the CSS color code or the CSS color HEX values online.

Comma-separated values (CSV) format (*.csv)

CSV format is often accepted by spreadsheet programs, and most spreadsheet programs can output CSV. It is plain text, with values for each column separated by commas.

Tab-separated values (TSV) format (*.tsv)

TSV format is sometimes accepted (or generated) by spreadsheet programs, and sometimes in tabular data downloaded from journal articles from the 90s. It is plain text, with values for each column separated by tab characters.

VOTable (*.vot)

Virtual Observatory (VO) tables are a special case of XML tables. (All VO Tables are XML but not all XML are VO Tables.) It is a format developed by the International Virtual Observatory Alliance (more information here). XML tables initially look to the human eye like it might be HTML, but they are easier to parse with code. There are packages in astropy that handle VO Tables.

Parquet (*.parquet)

Parquet file format is a highly efficient, compressed, column-oriented format for tabular data that has been adopted by many recent wide area survey projects. It can enable faster searching for large tables. There are packages in astropy that handle parquet files.

FITS files (*.fits)

FITS tables can be loaded into this tool. Note that this tool is flexible enough to handle multiple header data units (HDUs), so that you can upload a FITS file that has both images and tables. The ZTF Image Service will only let you load tables, however.

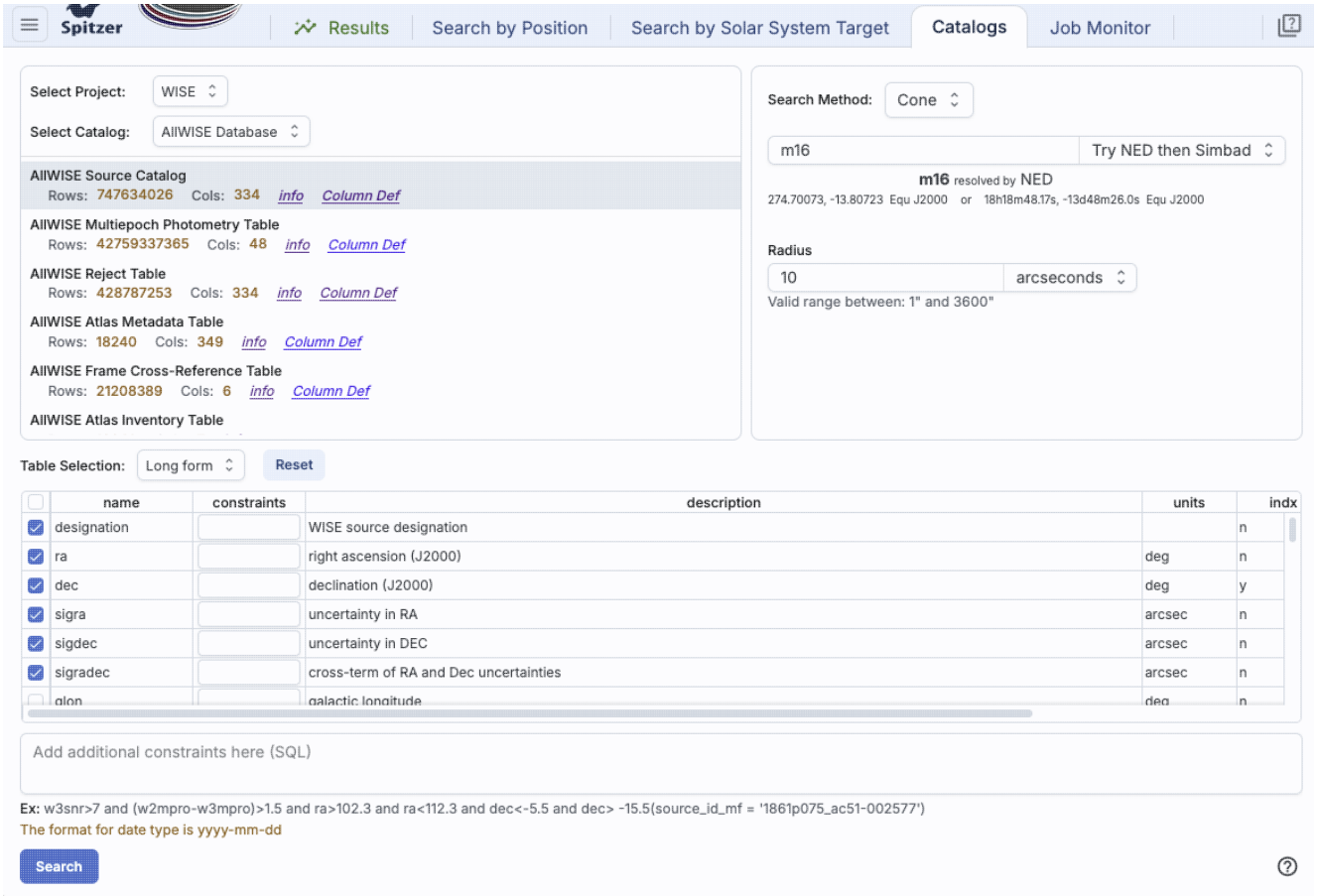
Nearly every file you load will result in a preview of the file you have uploaded. The tables are then shown and, if catalogs, interacted with in the same way as the other catalogs described here.

Tips and Troubleshooting

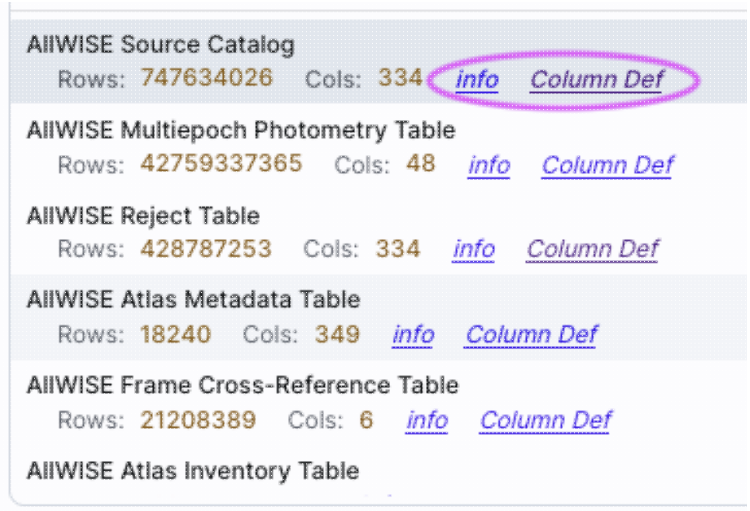
- If you would like to have your catalog overlaid on an image, it needs to have RA and Dec columns. If the tool doesn't seem to recognize your RA and Dec columns, check your formatting, or try headers of "ra" instead of "RA" and "dec" instead of "DEC" or "Dec". If you have columns like "_RA2000" and "_DE2000", it's going to be confused.
- Unless specified, the tool assumes any coordinates you give it are J2000.

- If there are no discernible positions in the uploaded file, it will still let you plot columns from the file after you've loaded it; it just can't overlay things on images in that case.
- This interface looks a lot like the file upload window that is available in other tools such as IRSA Viewer, but if you try to upload things that aren't catalogs here, it will give you an error.

IRSA Catalogs -- Searching for catalogs at IRSA



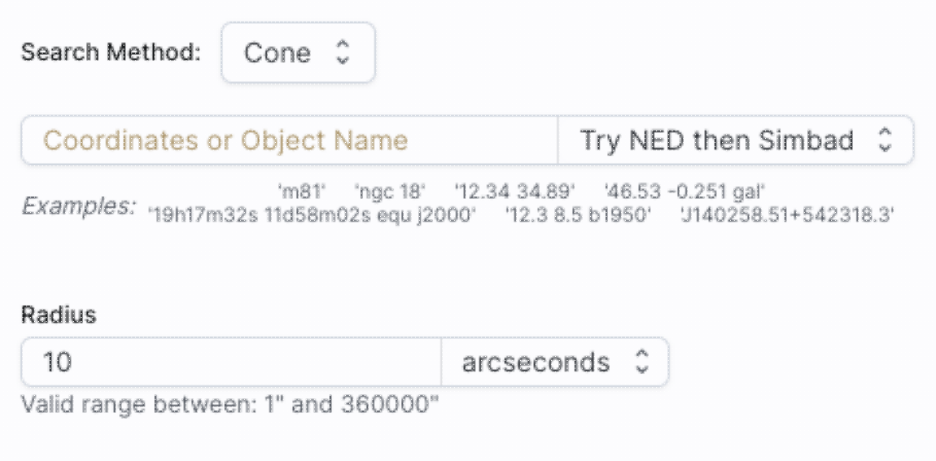
The upper left quadrant of this window is where you specify which catalog you want to search. To change catalogs, first select the "project" under which they are housed at IRSA, such as 2MASS, IRAS, WISE, MSX, etc. The available choices underneath that change according to the project you have selected. A short description is provided for each of the catalogs, with links for more information (including definitions of the sometimes cryptic column names); an example is here:



The upper right quadrant of this window is where you specify the target (the position is sometimes pre-filled with its best guess as to what you want) and the search method (cone, elliptical, box, polygon, multi-object, all-sky), and the parameters that go with that search method (e.g., the radius of the cone). The parameters for each of these searches change dynamically as you select search options, which we describe next.

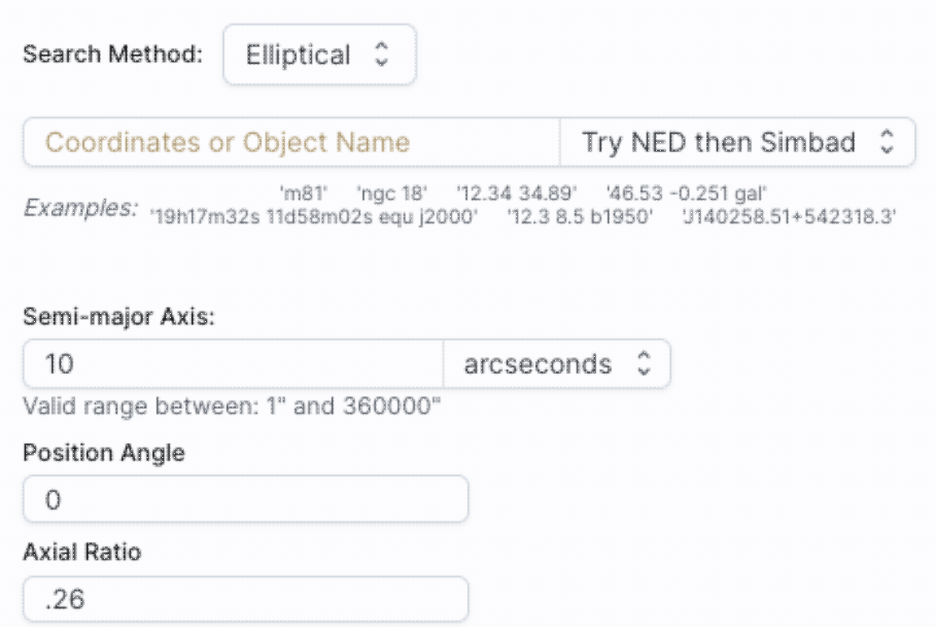
Tips and Troubleshooting: Pick your units from the drop-down first, and then enter a number; if you enter a number and then select from the drop-down, it will convert your number from the old units to the new units. There are both upper and lower limits to your search radius; it will tell you if you request something too big or too small. Note that these limits are catalog-dependent.

Cone search:



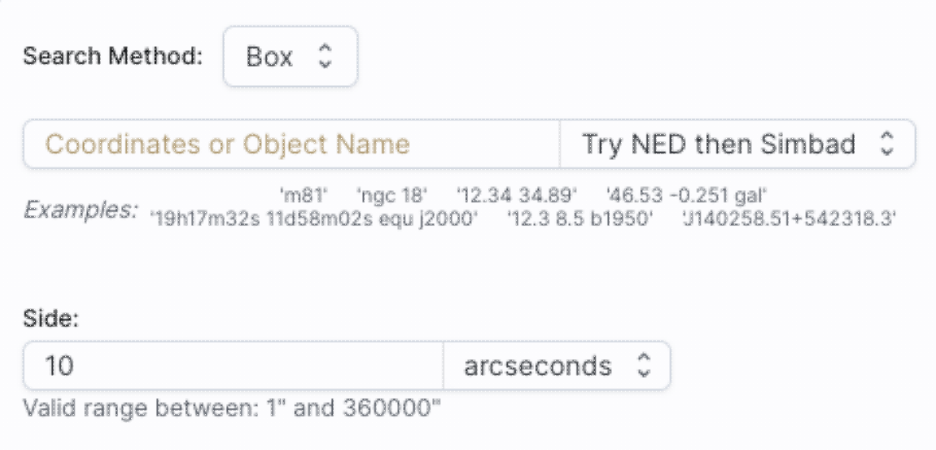
You can put in a position, but sometimes it attempts to guess a position, based on prior searches. You specify the cone radius; the default is 10 arcsec.

Elliptical search:



You can put in a position, but sometimes it attempts to guess a position, based on prior searches. You specify the search ellipse's semi-major axis, position ratio, and axial ratio. Defaults are as shown.

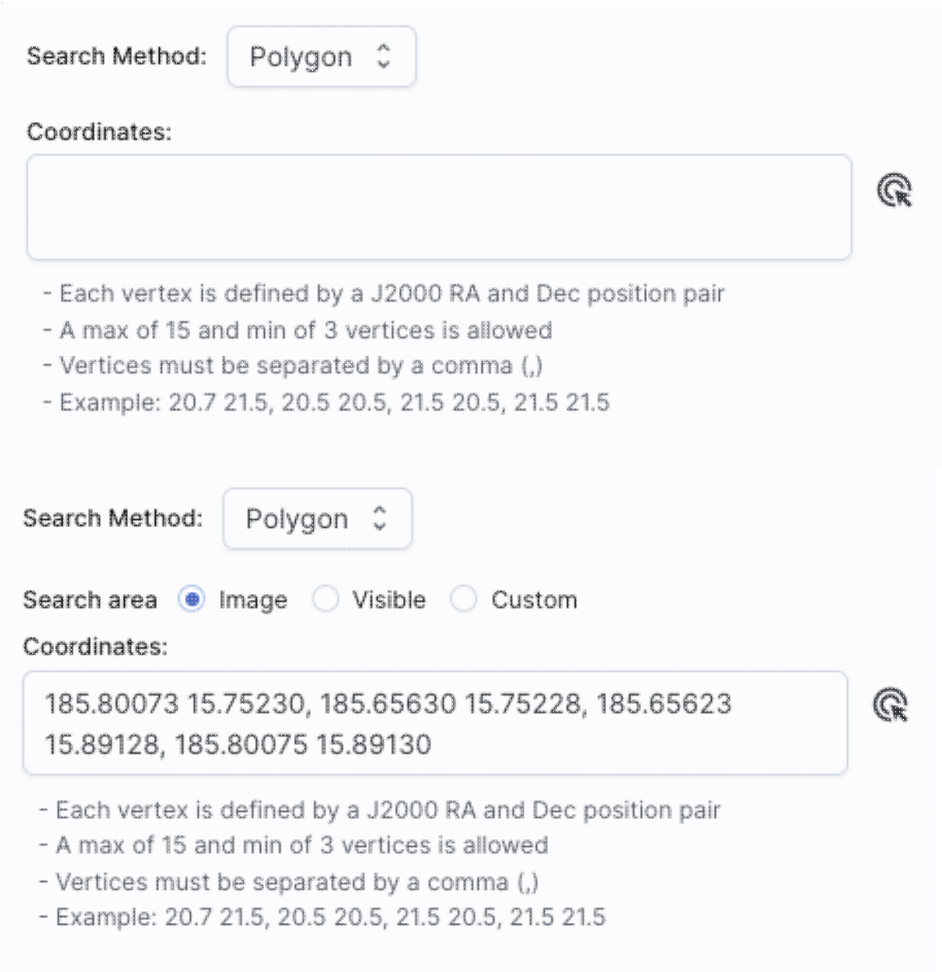
Box search:



You can put in a position, but sometimes it attempts to guess a position, based on prior searches. You specify the box's length on a side; default is as shown.

Tips and Troubleshooting: If you enter coordinates in non-equatorial units (e.g., Galactic or ecliptic), the search is still carried out in equatorial coordinates (RA and Dec).

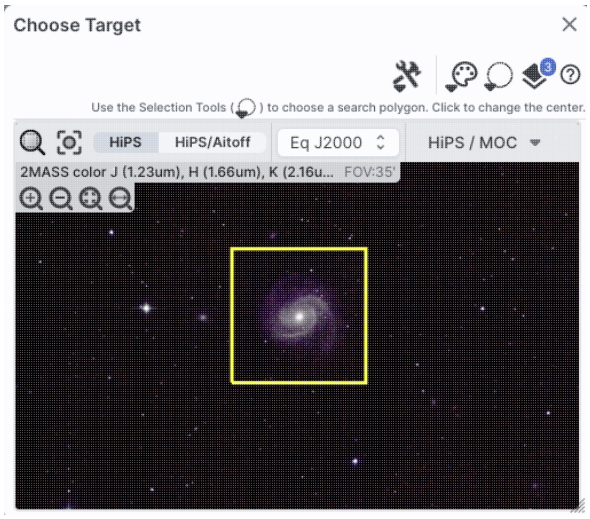
Polygon search:



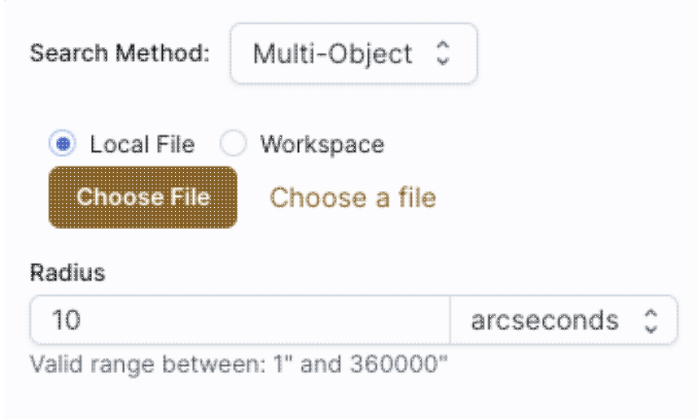
For this, note that it no longer has a single target location. It will sometimes try to pre-fill the vertices of the position it thinks you want, based on prior searches. If you have images loaded, it will give you choices based on the current image -- you can select whether you want the catalog request to match the entire area of the image you have selected ("image"), or just the portion of the image you can see in the current view ("visible"), or your own ("custom") area. (However, note that if you have selected a HiPS image before searching, you are limited to a maximum of 5 degrees.) The list of vertices in the coordinates box are in decimal RA and Dec in degrees. You must enter at least 3 and at most 15 vertices, separated by a comma. Note that, for overlaying catalogs on HiPS images, you cannot select "image", because HiPS images are generally very, very large, so this would result in too many points being returned. There is a maximum of 5 degrees imposed on catalog searches to match HiPS images.

If you select a rectangular region of your image and then select a polygon catalog search, you will have a fourth radio button above, "selection", which matches the corners of your selected image region.

If you select the "bullseye" icon on the right ( ), you get a pop-up with a way to interactively select your target; this works just like this interactive target refinement (go there for more details) :



Multi-Object search:



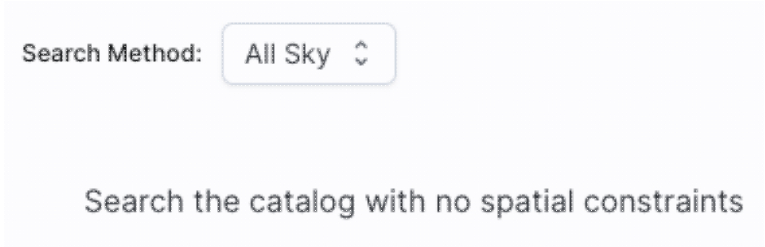
For a multi-object search, it can't guess what position you want. You need to upload a file (from your disk or the IRSA Workspace) in IPAC table format, which is a varietal of plain text. (IRSA has a table validator which may be helpful.) Note that you also have to specify the radius over which to search for each of the targets in your list.

When you do a multi-position search on catalogs, three new columns are added to the catalog as it is returned to you. These columns are :

- ◊ cntr_01 - the target position you requested
- ◊ dist_x - the distance between the target position you requested and the object it found
- ◊ pang_x - the position angle between the target position you requested and the object it found

These additional columns can help you assess if the target(s) it found is the target that should be matched to the position you requested.

All-sky search:



Because this is an all-sky search, it does not have a single target entry box. In order to constrain this search, you need to impose constraints on the bottom of the screen (see below).

The bottom of this window allows you to set restrictions on specific columns. It gives you a list of all the available column names in the corresponding catalog. (Most catalogs have identical "standard" and "long form" selections, but some have more columns available in "long form".) From here, you can choose what to display (tickboxes on the left), and filter what is returned ("constraints" column). For example, only return objects with values in column y that are greater than x. If you add more than one restriction, they are combined logically using an "AND" operators; be careful, because you can thus restrict data such that none of the catalog meets your criteria.

Click on "Search" to initiate the search. It will load the catalog into a tab of its own. The objects will also be overlaid on any images you have loaded, and a default x-y plot will be shown. (For more on the x-y plots, see Plots section.) All of these representations are interlinked -- clicking on a row in the table shows it on the image and in the plot, and clicking on an object in the image shows it in the table and in the plot, and clicking on an object in the plot shows it in the table and on the image.

To close the catalog search window without searching for a catalog, click on "Cancel".

Tips and Troubleshooting

- If the catalog search is successful quickly, it will promptly return the results in a tab of its own.
- The search may take a long time to return, especially if you have asked for a large catalog, and you may think that nothing has happened, but be patient and eventually it will return a tab.
- Use large search radii with caution! Be sure you understand how many sources you are likely to retrieve. Searches that retrieve more rows will take longer. Searches that retrieve tens of thousands of rows will take quite a while.
- If you want to impose additional constraints on the catalog during your initial search, you can do so in the lower half of the screen (e.g., SNR > n in some band, or an SQL command), you can place constraints at this point. However, be advised that it is easy to combine constraints such that no sources are retrieved!
- If you overlay a large catalog, the tool will show cells with a number enclosed indicating the number of sources in that region. As you zoom in closer and closer, the tool will adjust those bins to smaller and smaller cells until it shows you individual sources. Go here for more information!
- If you overlay a large catalog, then turn around and save a regions file from the catalog overlay, then the entire catalog may not be saved. To get a large catalog saved as a regions file, save it from the table.
- By default, it may show you fewer columns than are available in the full catalog. By selecting "long form" (above the list of columns), you can access the full range of available columns. In some cases, there are literally hundreds of columns that you can access!

The search results are then shown in a Firefly table and you can interact with it.

Interacting with Catalogs

When you load a catalog, the tool may create a table, a plot, and/or, if your catalog has position information (e.g., RA and Dec), it overlays the catalog on an image. All three of these ways of displaying the catalog are interlinked and interactive.

Catalogs are a special case of tables; the basic functionality of tables is covered in the Tables section. You can sort and filter the table.

Plots are also covered in a different section. You can make scatter plots, heat maps, and histograms. You can plot columns from your catalog, including simple mathematical manipulations of catalog columns.

If the catalog has positions included, the catalog will also be overlaid on the loaded image(s). The Visualization section includes information about that. Each catalog that you load is overlaid on the image using different, customizable symbols and colors.

When you have catalogs loaded into the tool, the header of the catalogs has the name of the catalog and a color swatch:

This color swatch corresponds to the symbol color that is used in the image overlays. You can change the color by clicking on the color swatch in the header, or by navigating to the layers in the image pane. See the color picker section of the visualization chapter for more information.

Tips and Troubleshooting

- Large catalogs will be displayed hierarchically! See next section.
- If you save the overlays from an image as a regions file, you may not get your complete catalog, especially if it is a large catalog (see next section!). However, you can save the full contents of a single catalog as a regions file using the "save" (diskette) icon in the table toolbar, instead of the image toobar.
- The "color swatches" may not appear immediately. To make loading faster, sometimes the colors don't load until they are actually needed. If you are in a situation where no images are visible, then no color swatches may appear until you ask the tool to show you an image (like the coverage image), and then the color swatches will appear.

Hierarchical Catalog Display

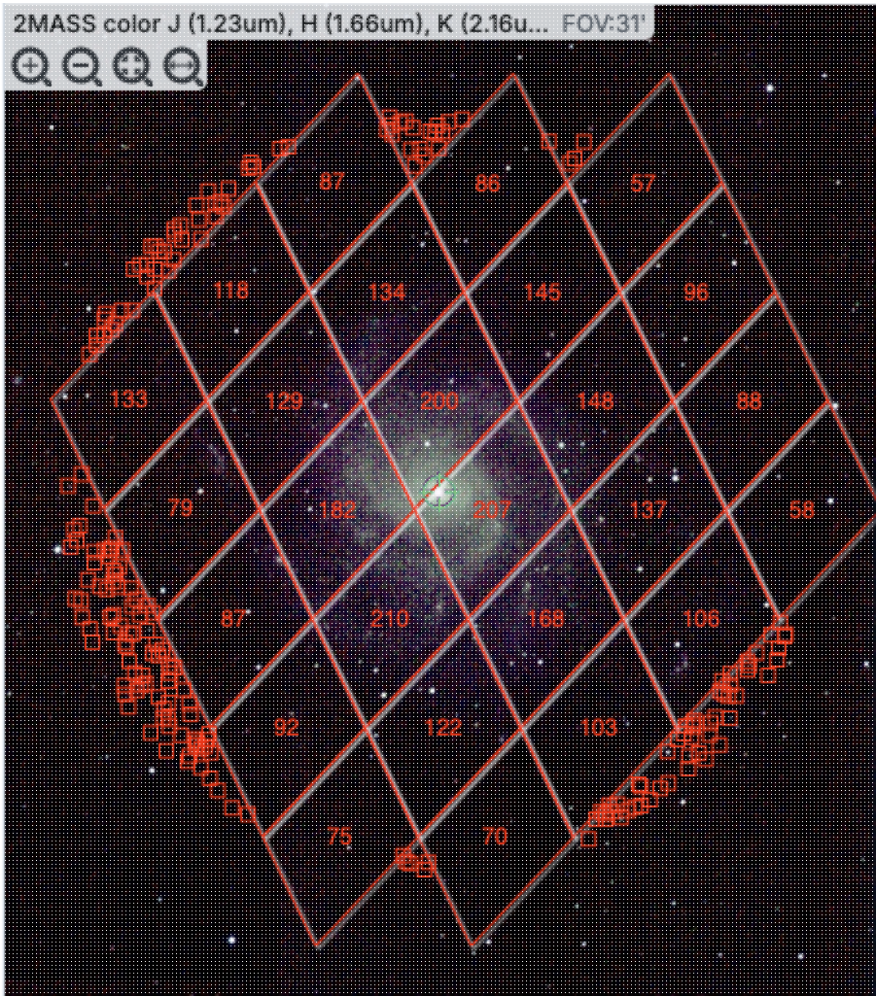
If you have a large catalog loaded into the tool overlaid on top of lots of images, the possibility exists that the computer or the network could be overwhelmed trying to render all the points on all the images. Historically we dealt with this by "thinning out" the catalog and not showing all the points. However, there is a better solution, which is now employed here!

For catalogs below about 1000 points, the tool will show the individual points on the image.

For catalogs above that threshold, the tool will bin up the catalogs based on HEALPix pixels (see HiPS section here for more links). In summary, the sky is broken up into sections, and the tool will show symbols with a number indicating the number of sources in that region. Then, when you zoom in, it will dynamically adapt to show you smaller and smaller cells until it shows you all the individual sources.

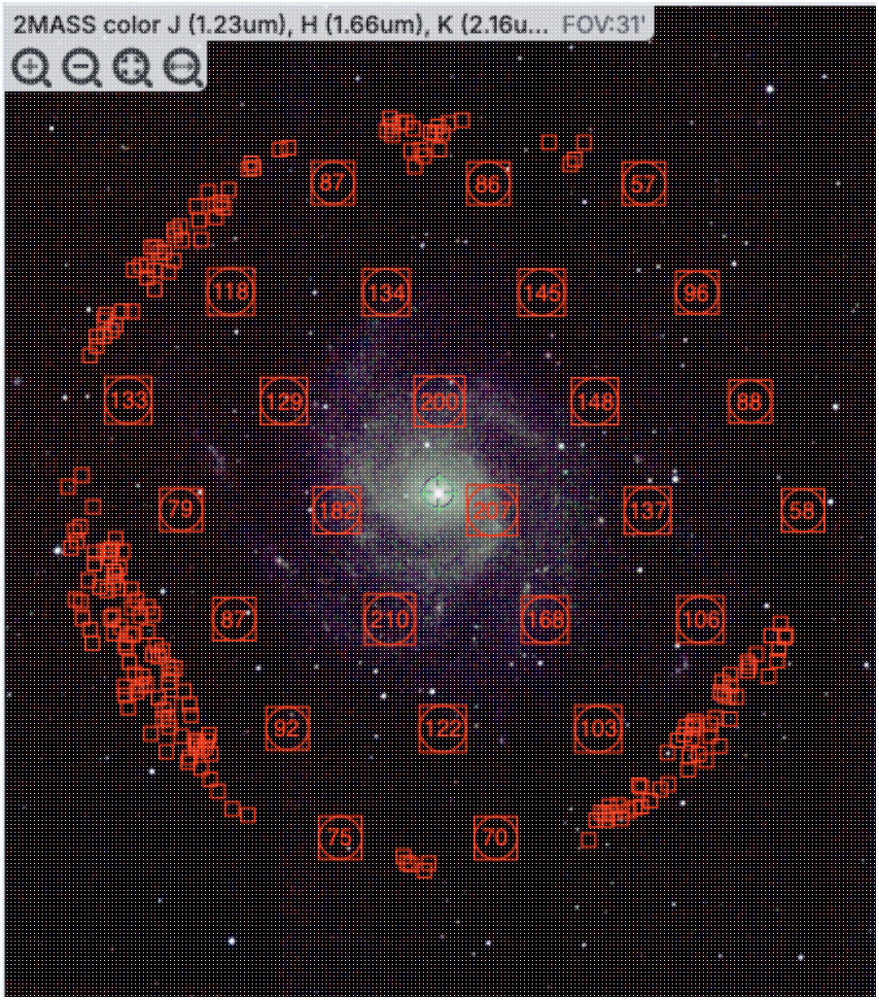
From the layers icon (

see visualization chapter), you can bring up many display options. Below are examples of what is displayed, the options seen in the layers, and additional options. The same catalog and zoom level and minimum group size are used for each view. The "Min Group" option here is 50, so if there are cells with fewer than 50 sources, then the individual sources are shown, and if there are more than 50 sources, then the cell is shown with a number inside corresponding to the number of sources from the catalog. (See below for additional information.)

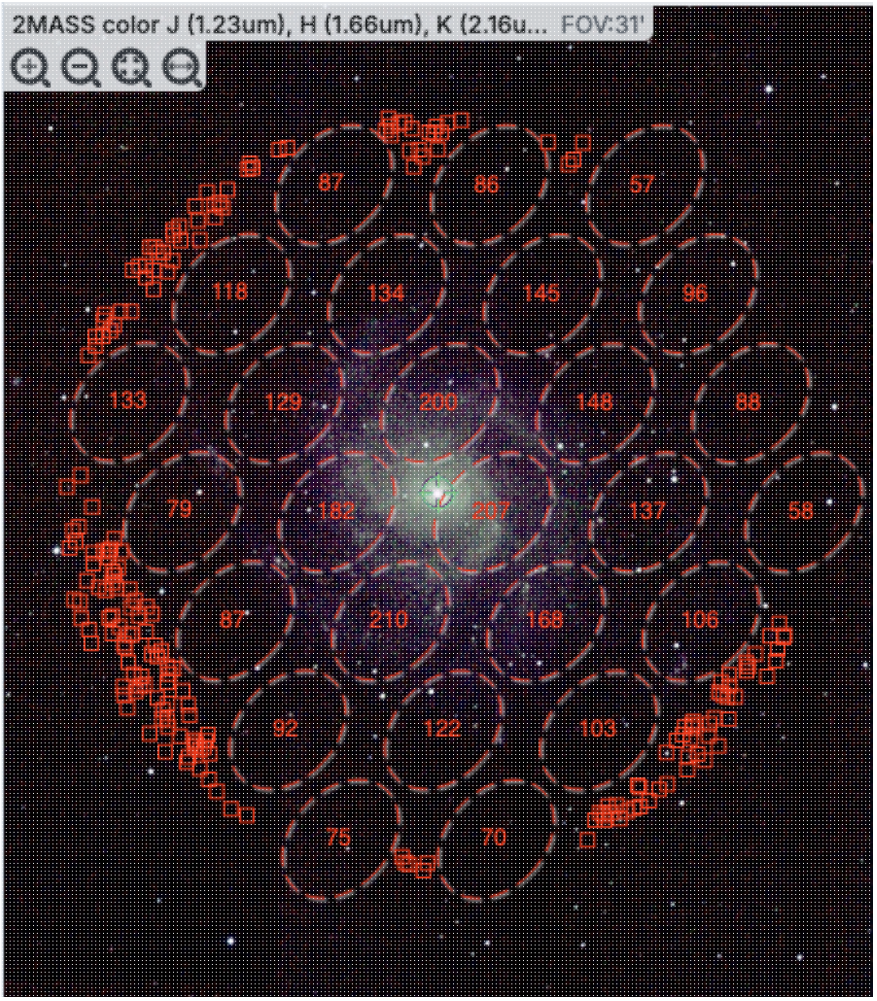


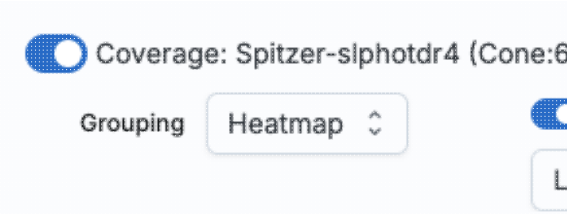
In this view, the 'cells' used are the cells explicit the size of the cells is very clear. In the top row across the top have fewer than 50 sources (so the individual sources are shown), then the next row 57 sources respectively.

In this view, the 'cells' are shown by circles encl sizes are the same as in the prior screenshot, but obvious to new users.

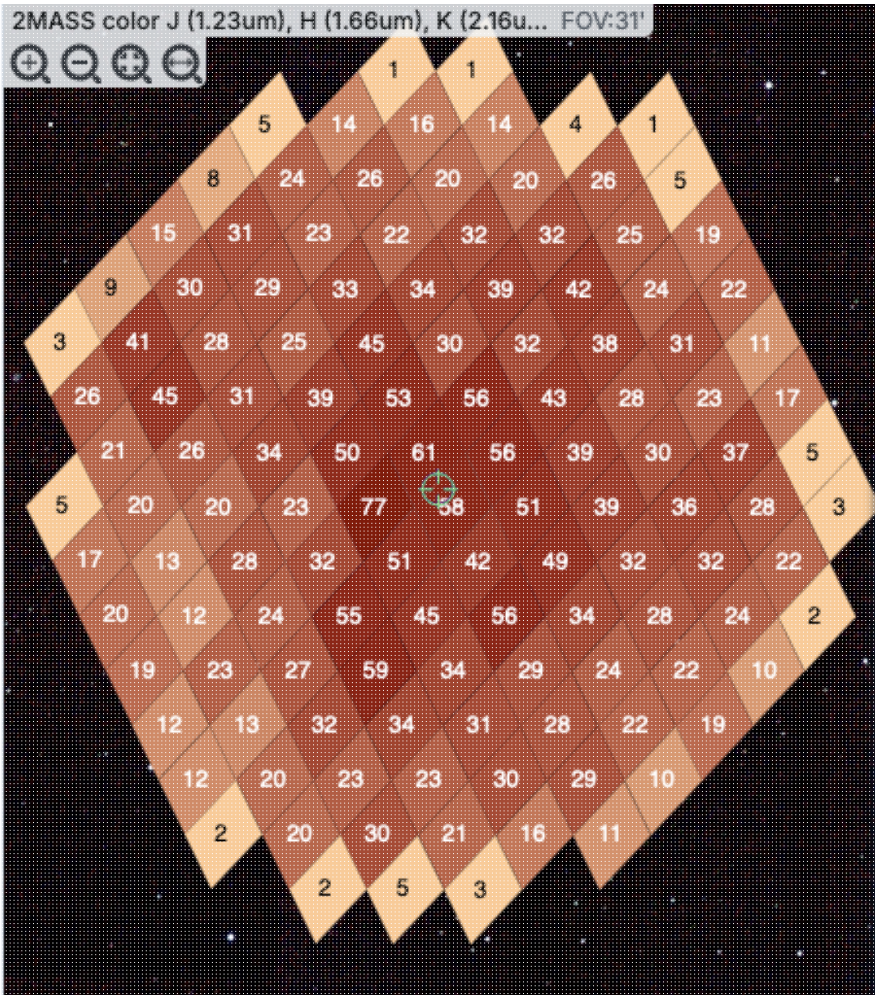


In this view, the 'cells' are shown by ellipses sho
cell sizes are the same as in the prior screenshot,
less obvious to new users. It may be more obvio
groups of points.



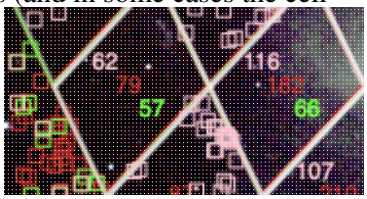


Finally, in this view, the 'cells' are again shown a
color of the cells corresponds to the number of s
"Linear", "Linear Compressed", or "Log Stretch
the color range by changing the color using the
which you can also change the transparency. Thi
how many sources are in each cell, but makes it
though you can change the transparency of this
still can make seeing the image challenging in so



Tips and Troubleshooting

- For all of these renditions, when you zoom in close enough, it will dynamically adapt and show you individual sources when you zoom in. (That is, it no longer decimates the overlaid catalog, which is what it used to do.)
- For all of these renditions, if you click on a cell, it will display all of the sources in the cell. You can click on many cells in a row and it will continue to display all the sources it can until it reaches the point at which it thinks performance will suffer, at which point it will turn some of the points back into cells.
- If you want to have more of your catalog shown as individual sources, pick a smaller "min group" number.
- If you have more than one catalog loaded, the numbers within the cells (and in some cases the cell indicators themselves) will be offset slightly so that you can see them.



- If you have a catalog that includes sources from all over the sky, it very well may just give you box groupings, and may not allow you to change that view until you zoom in.
- If you have cells where only 1/4 of a cell is populated, it automatically renders a smaller cell, so if you have a sparsely populated but still large catalog, the size of the display will always be "small" size cells.

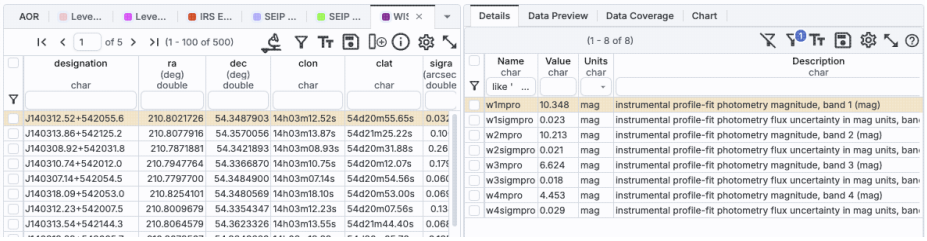
- If you are looking at many footprints from, say, a complex, and long ObsCore search, if you have more than 30,000 footprints, it may not be able to render all of the outlines of all of those images. It may render the centers of all of those images as if it were a catalog, in which case you will encounter these kinds of hierarchical catalog display options.

Details Tab

When you have a table loaded on the left, you will have an additional tab on the right hand side, under the plot, called "Details." This additional tab is sometimes called a "property sheet." This tab is, itself, another Firefly table, and consists of each of the columns of the retrieved catalog with additional information about each field where available. (Not every catalog may have this information available.) This information can be used to learn more about each of the columns in retrieved. For additional information when it is showing details about a catalog, please consult the full documentation that accompanies the catalog.

Tips and Troubleshooting

- The property sheet is a more expanded, vertical view of the information shown in a row of a table or catalog, along with documentation of the catalog columns. Because you can sort/filter the data in the property sheet, you can restrict what values are shown. Those filters are respected as you page through a catalog. So, for example (see screenshot below), you can pull up the property sheet, filter it down to only show the profile-fitted magnitudes and errors by filtering on "mpro", and then step through the values in the catalog and inspecting the brightnesses as shown in the property sheet for each source.
- When changing rows in the main table, the property sheet/details tab scrolls to preserve the visibility of whatever row in the details tab is highlighted. If you scroll down in the property sheet *without changing the highlight*, when you change rows in the main table, because the first row in any table is always highlighted by default, the property sheet will scroll back to the top.



Spitzer Heritage Archive: Data Collections

Contents of page/chapter:

Introduction

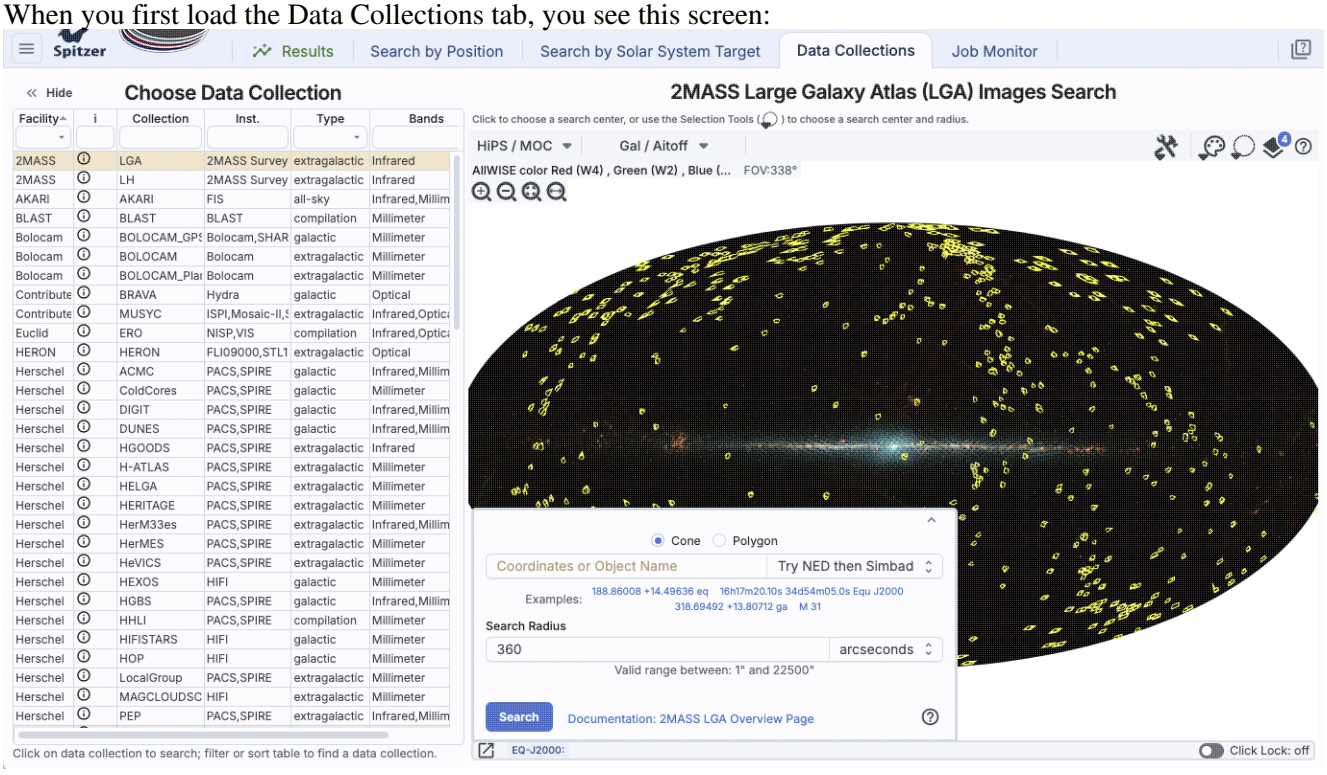
The Data Collections tab is one of the searches you can add to your SHA session by using the side menu to add to the tabs at the top. (It is also essentially the same as the separate, standalone Data Collection Explorer tool!) The information we cover here is for the Data Collections tab within the SHA.

There are many Spitzer-relevant data deliveries at IRSA, and this tab is a way to get access to them in the same tool where you can find the original data.

In order to learn more about any enhanced data product, the particular values that are returned, how the data were reduced, its strengths and weaknesses, etc., please see the documentation corresponding to the products.

Searching

When you first load the Data Collections tab, you see this screen:

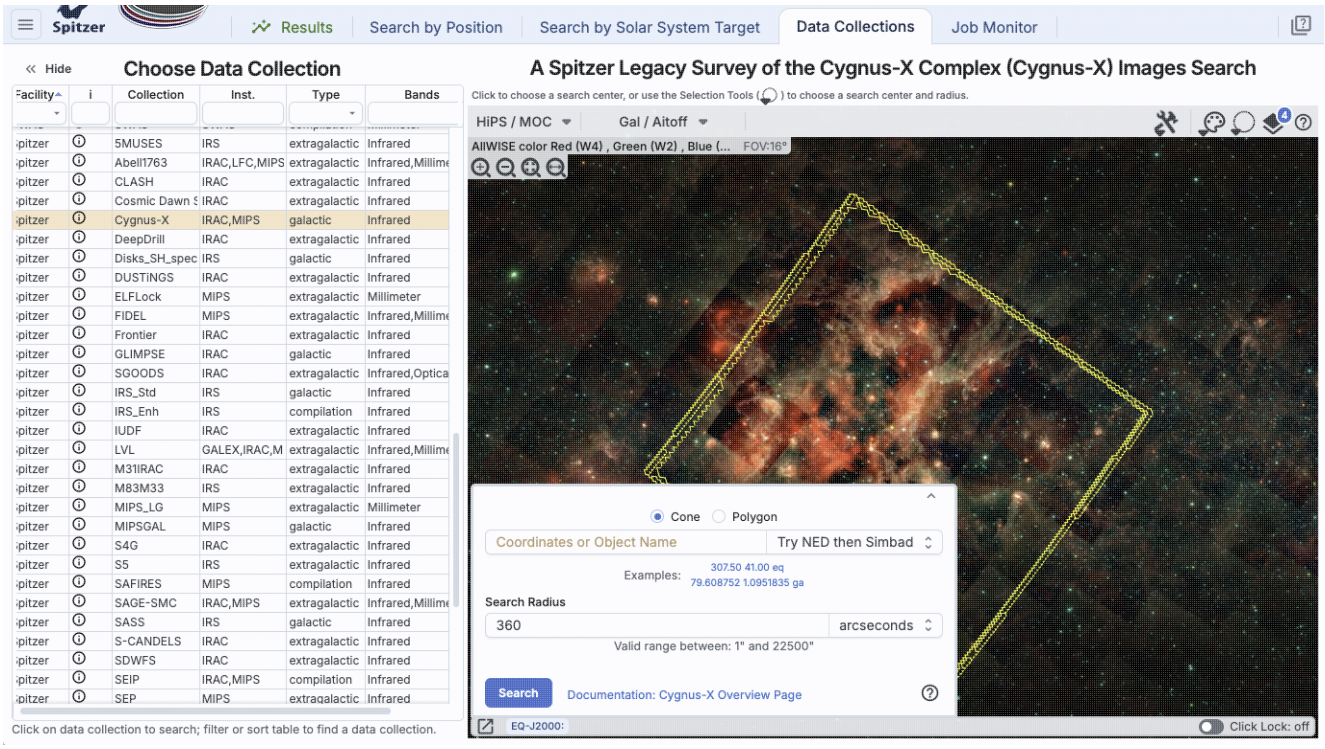


On the left, you see a table entitled, "Choose Data Collection." This table is like any other table here in that it is searchable, sortable, filterable, etc. Each row here corresponds to a data set that is currently available within this

tool.

If you select a row in this table by clicking on it, then the contents of the image on the right changes in response. If the dataset is all-sky (like AKARI or IRAS/ISSA), then no polygons appear on the right. If the dataset covers just portions of the sky, then the polygons on the right indicate the sky coverage of the dataset. In the example above, the 2MASS LGA is selected on the left, and the small, yellow polygons on the right show the footprints of the individual images that make up the LGA survey.

The reason this search option is available in SHA is because there are a lot of Spitzer data sets available via this tool. Filter down the "Facility" column to be just "Spitzer" to see just the Spitzer-related data deliveries, as shown here:



Tips and Troubleshooting:

- The HiPS image as well as the MOC are customized to each data set, so it may take a few seconds to update. For some data sets with many small footprints (e.g., z0MGS), it may take longer to render the MOC than others.
- If you know exactly what you want, you don't have to wait for the MOC to render before you search -- just type in your target and 'Search'!
- If no MOC is shown on the HiPS image, the data set is all-sky (or there is a bug!)... if it is an all-sky data set, it should say "Covers whole sky" in the title of the search portion of the screen on the right.
- The i with a circle ( ) in the table is a link to more information about the data collection. You can also click on the "Documentation..." link in the search box on the right.
- The image on the right is a HiPS image which has the MOC for the data set overlaid. As described in the discussion of the layers icon, specifically that on the HiPS MOC, you can change how the MOC is rendered; here it is attempting to draw the MOC as outlines, and its accuracy will be improved the closer you zoom in.

- If you want more screen 'real estate' to work with, click on "<< Hide" in the upper left to collapse the Data Collection table and maximize the space with the image and survey overlay.
- The search box can be collapsed (click on the 'disclosure arrow' in the upper right of the search box), or made translucent (click anywhere off the search box/on the image). If you put in some search information and then collapse the search box, a summary of the information you have entered is still shown when the box is collapsed.
- You can filterdown the table on the left using all the same filtering capabilities as elsewhere in tables here, so you can filter down the table to be just Spitzer, or just Spitzer and MIPS, or Spitzer and extragalactic, etc.

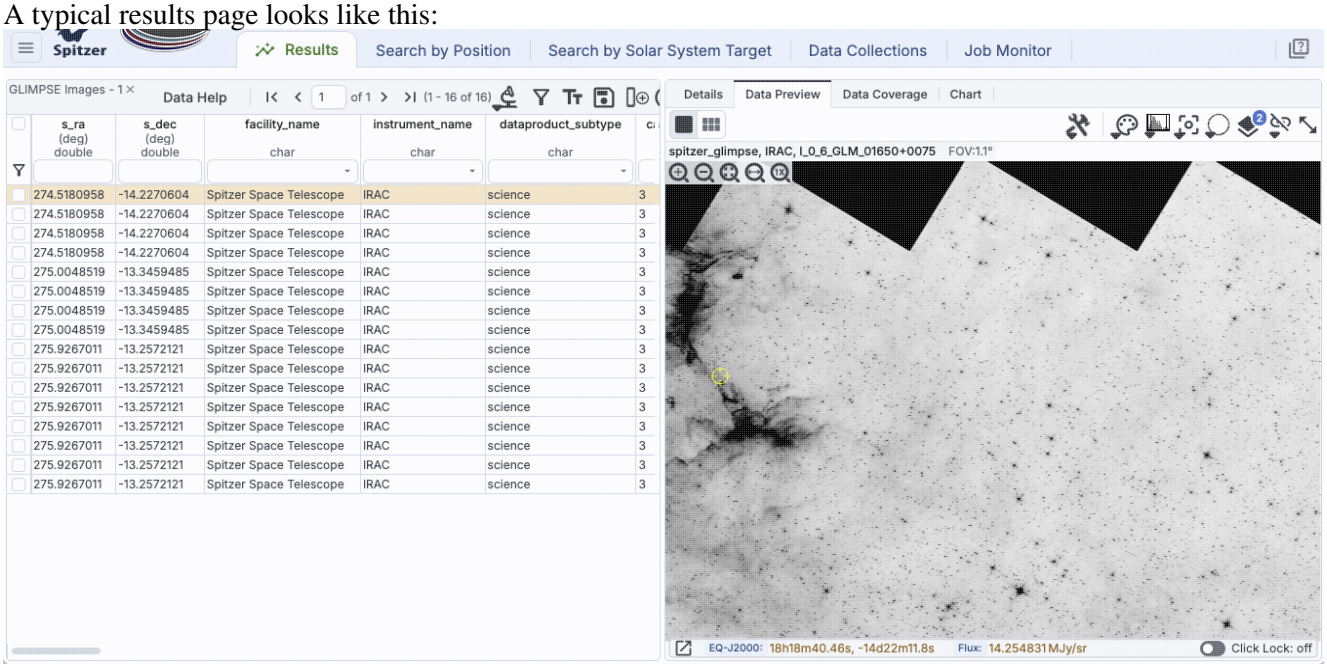
You can navigate around on the image on the right just like you can on any other image here -- pan, zoom, etc.

To select a target, you can type in a name and have NED or Simbad resolve it into coordinates, type in coordinates in any of a variety of units, or click on the image to select a target based on your mouse position. This is just like entering a target anywhere else in the tool, or interactive target refinement elsewhere in the tool.

Enter a search radius, and click "Search" to start the search.

Results

A typical results page looks like this:



The table on the left is a list of the observations that it found consistent with the specified search. This table is searchable and sortable just like all the other tables here. The "Data Help" button at the top left of the data table will take you to more information about the data set. The image (or plot in some sitautions) in the upper left is a preview of the selected row in the table.

The plot on the right is often initially relatively uninteresting, because it has just the positions of the data products it has retrieved. It's a plot like any other in this tool, so you can make it plot other things.

Tips and Troubleshooting:

- The coverage image, which is by default on the right, under the window showing data product previews, will show polygons corresponding to the data products' coverage. However, if there are too many polygons to manage, the tool may fall back to showing just the positions of the data products it has retrieved. (Whether that is the central point or the lower left corner of the image depends on the data product itself.)

Downloading Data

Here, you have a Prepare Download button, so select the data as described on the Download page, and click that button.

In order to learn more about any enhanced data product, the particular values that are returned, how the data were reduced, its strengths and weaknesses, etc., please see the documentation corresponding to the products.

Spitzer Heritage Archive: Other Searches

There are several other searches you can add to the Spitzer Heritage Archive using the side menu to add to the tabs at the top. This chapter covers the more complex of these choices. The VO searches retrieve some sort of tables, many of which are catalogs. For the results of any of these searches, if the tool recognizes positions in a catalog, it will overlay the catalog on images and make plots.

Contents of page/chapter:

Introduction & Terminology

There is a lot of terminology in this chapter to understand.

- VO = Virtual Observatory
- TAP = table access protocol. TAP services enable complex queries of tables using ADQL.
- ADQL = astronomical data. query language
- ObsCore = core components of Observation Data Model
- Data model = A standard logical structure for a type of dataset; more flexible and general than a data format.
- ObsTAP = TAP service that serves ObsCore tables

There are myriad places on the web to learn more about TAP queries and ADQL, as well as all the rest of the VO standards and protocols. We just provide a brief overview here in the context of this tool.

The Spitzer Heritage Archive can help you interactively create ADQL which then you can copy and use in your own code elsewhere.

By using TAP and ObsTAP queries, you can use IRSA services to talk to other archives that also comply with these standards, world-wide.

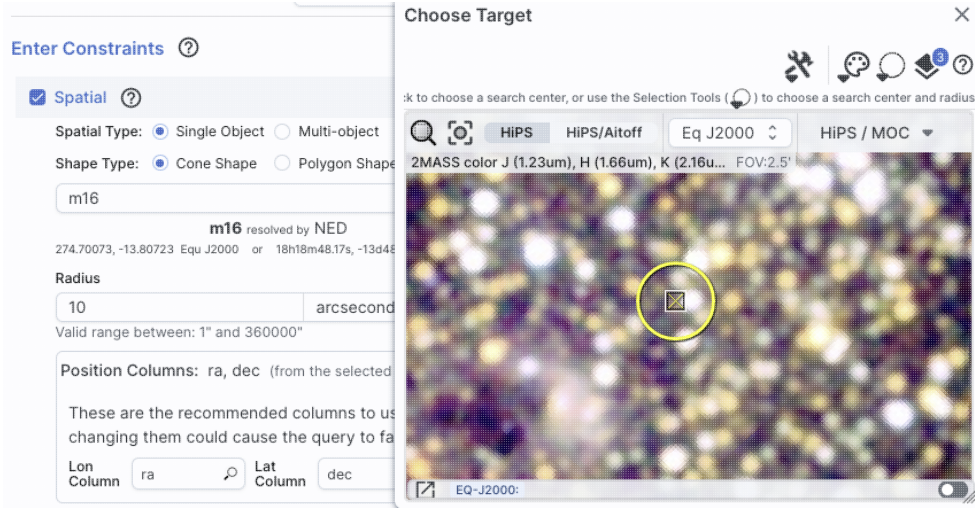
The first several parts of this section talk more generally about interactive target refinement and constraints that are common to more than one of the searches discussed here. Specifics of particular searches follow after that.

Data Collections is another tab and possible search, but it has its own help page.

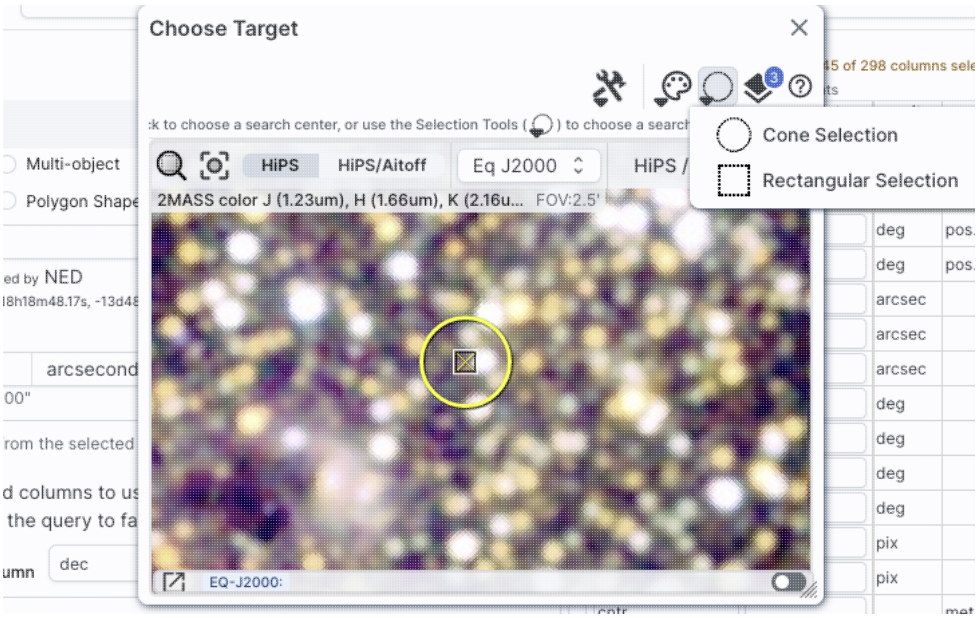
Interactive Target Refinement

Whenever you see this icon  in IRSA tools, you can click on it to bring up a window to **interactively refine your target selection via clicking on a HiPS map**. Here, we are using a TAP search to demonstrate this process, but you can find this kind of target refinement in several places in IRSA tools.

When you click on the icon  you bring up a window:



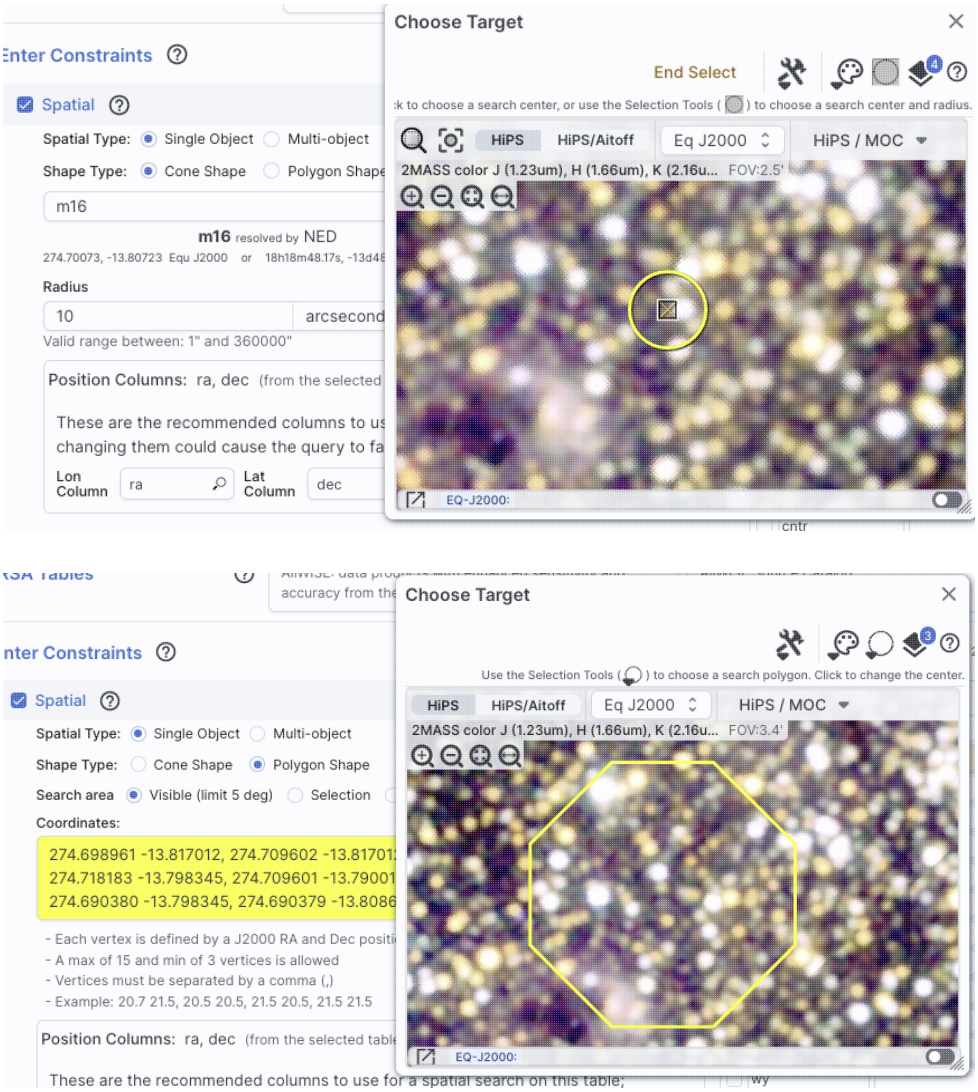
If you have entered a target already, the window arrives already centered on the target. If not, it is centered on the galactic center, zoomed out. If you have entered a cone search radius already, then the circle drawn on the image is that cone size. You can manipulate this image with the same basic tools as in the visualization tools.



To change the search region interactively, choose the selection tools and draw a shape on the image.

Note that if you have selected a cone search on the left, no matter what you select on the right, it will give you a cone search. If you change the cone position or radius in the yellow boxes after you change the selection, it will update the region in the image.

If you want to quit out of the selection without changing, click on "end selection" (the brown text near the top of the image).



If you select polygon on the left, and you use the selection tool for "cone selection" on the right, you will get a spherical polygon (a polygon where the line segments are on a sphere).

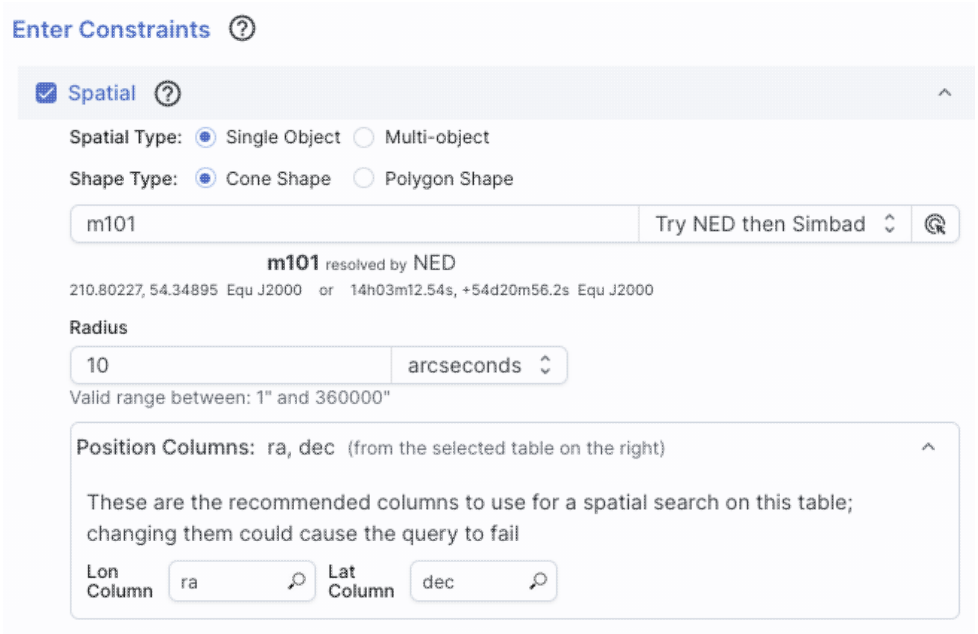
When you are done with this pop-up window, click on the 'x' in the upper right of the window. Then you can continue with whatever you were doing before you started to refine your target parameters.

VO TAP Searches: More information about constraints

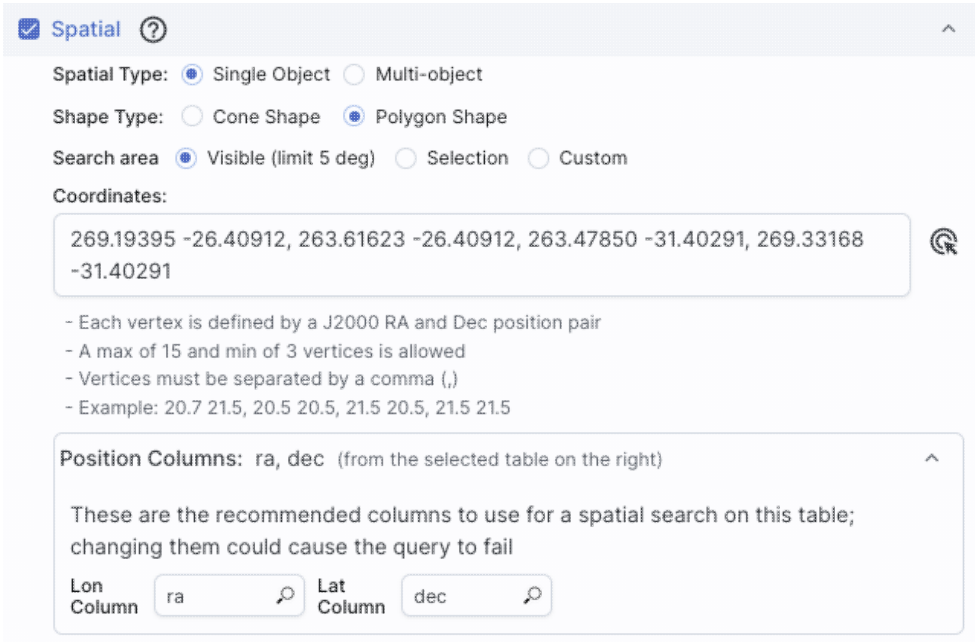
You can have several different ways of constraining your search depending on the options you have selected before the "Enter Constraints" section, and the options depend on what kind of service is available at the TAP service you have selected. If the options do not appear initially, click on the downward arrow to "unfold" the options.

Enter Constraints: Spatial

This part of the interface allows you to specify the details of a spatial search. You need to specify both what kind of search you want to do and which columns of the catalog are to be used for coordinates.



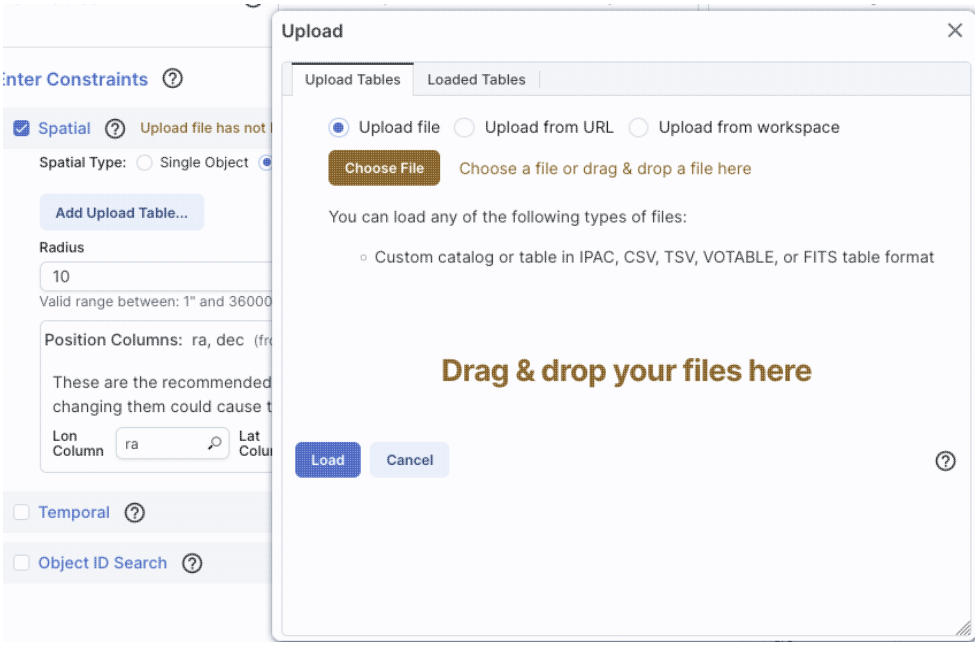
This is what it looks like when you do a **single target cone search**; note that you have the same name resolution options as in any other search here.



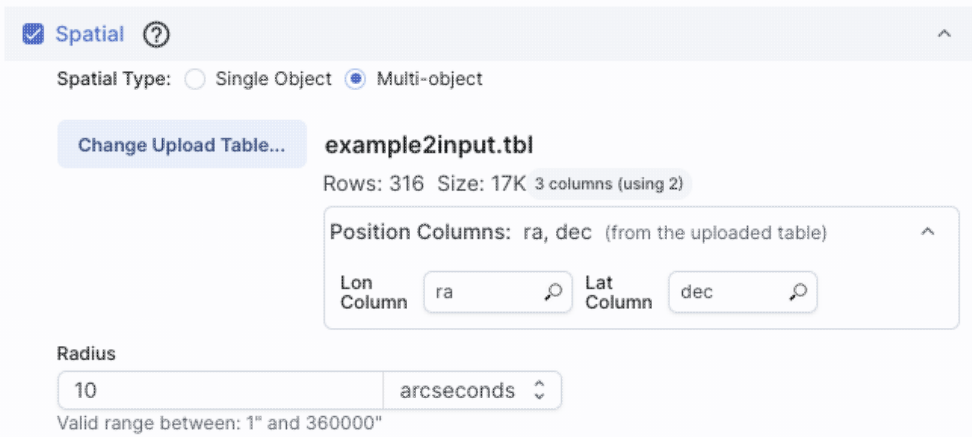
And, this is what it looks like when you do a **single target polygon search**. The search areas here (visible, selection, and custom) are the same as when you do a polygon search on catalog -- that is, you can select whether you want the catalog request to match the entire area of the image you have selected ("image"), or just the portion of the image you can see in the current view ("visible"), or your own ("custom") area. The list of vertices in the coordinates box are in decimal RA and Dec in degrees. You must enter at least 3 and at most 15

vertices, separated by a comma.

You can also click on this icon to interactively refine your search position.

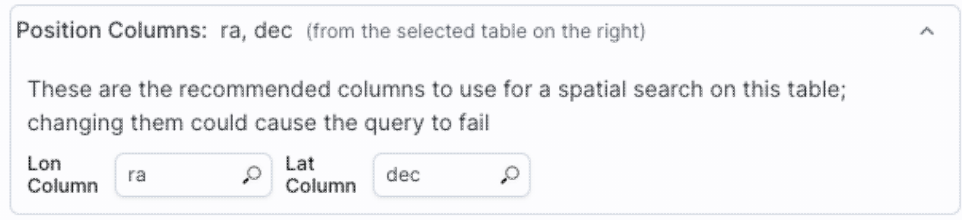


If you want to perform a **multi-target search**, click on "multi-object", which automatically brings up this pop-up, from which you can load a table from disk ("Upload tables" tab) or select one of the tables you have already loaded into the tool (click on the "Loaded tables" tab). Your uploaded catalog has to follow all the same rules as normal catalogs from disk.



After you find your file with your listed positions and upload it, the tool attempts to guess which two columns are the position columns. In this example, it has (correctly) guessed that the position columns are "ra" and "dec". If it guesses wrong, or can't figure it out, you can help it along by clicking

on the down-arrow to 'expand' that part of the panel and selecting the two coordinate columns to use.

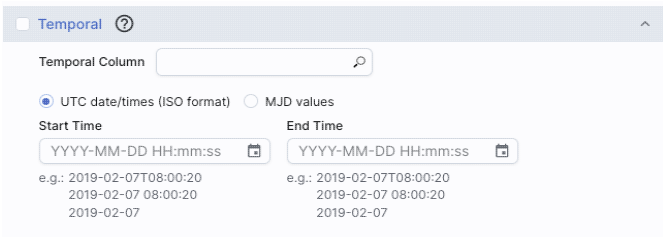


Regardless of what configuration you use, the last thing to check is which columns the tool has assumed are the position columns in the catalog to be matched to your position, region, or list of positions. Again, it attempts to make an educated guess as to the right columns, but if it guesses wrong, you can help it along by clicking on the down-arrow to 'expand' that part of the panel and selecting the two coordinate columns to use.

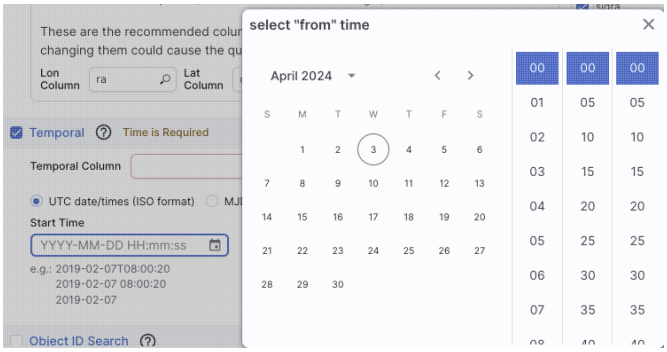
Enter Constraints: Temporal

This part of the interface allows you to specify which column of the catalog is to be used for timing, and allows you to constrain the date in two different systems.

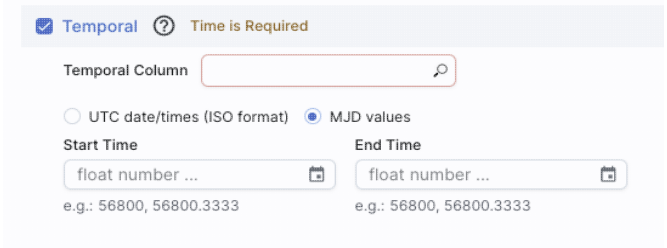
This is what the panel looks like initially, where you specify the column in the catalog you are searching with the time and then the dates. If you don't remember what the column is in the catalog, click on the magnifying glass to get a pop-up with a list of all of the columns.



For the dates and times, if you click on the calendar icon at the far right of the entry box, you get a pop-up from which you can specify the date and time, shown here.



If you would like to work in MJD instead of ISO dates, select the "MJD" radio button. Note that it echoes below the box what it thinks you've entered in two different systems (UTC and MJD) to verify what you have entered.



Enter Constraints: Object ID

This part of the interface allows you to match object IDs.

This is what the panel looks like initially:

This is what the panel looks like after you have selected your uploaded list of IDs (in this case, a file called "gaiaids.tbl", which consists of an IPAC table file that is just the list of Gaia IDs, in a column called "gaiaid"), and it is being matched against the Gaia DR3 main catalog, where the relevant field is "source_id".

Tips and Troubleshooting

◊ The names have to match exactly, so in the case of this example, since the Gaia column source_id is a long, the IPAC table file must also cast the Gaia ID as a long.

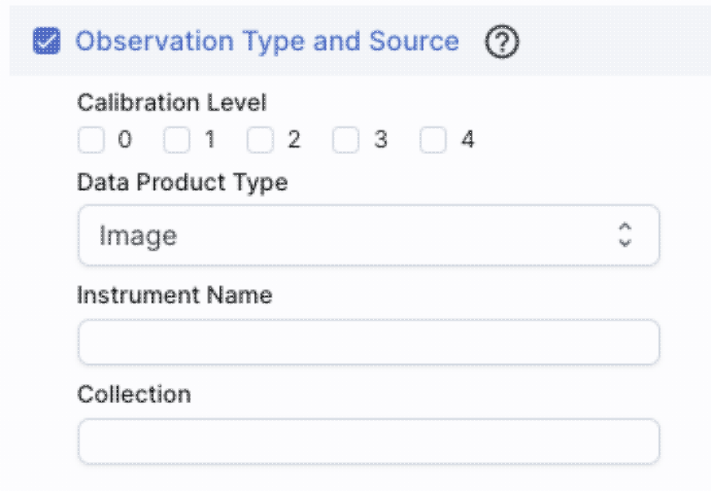
◊ If the catalog to which you are matching is not indexed by the name column you are using, the search may take a long time.

◊ If you are doing, say, an object ID search, you need to turn off the position search, otherwise it doesn't understand what you want it to do.

VO ObsCore Searches: More information about constraints

These are several additional ways of constraining your search depending on the options you have selected before the "Enter Constraints" section. These options appear if you have configured an ObsCore search from a Multi-archive VO TAP search. If all of these options do not appear initially, click on the downward disclosure arrow to "unfold" the options.

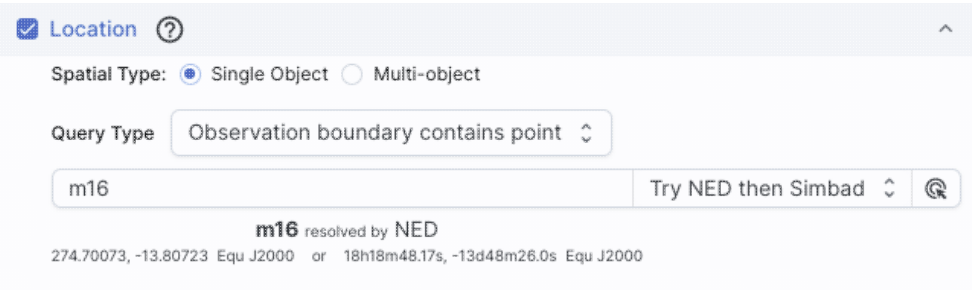
Enter Constraints: Observation Type and Source



This panel provides a way to constrain the:

◊ *Calibration level* - 0 is the least processed and 4 is the most processed, and not all instruments provide all levels
◊ *Data product type* - image, cube, spectrum, SED, time series, visibility, event, measurement, or none specified. You can select more than one of these at a time by using a right mouse click.
◊ *Instrument name* - must match exactly, wild cards not accepted
◊ *Collection* - must match exactly, wild cards not accepted

Enter Constraints: Location

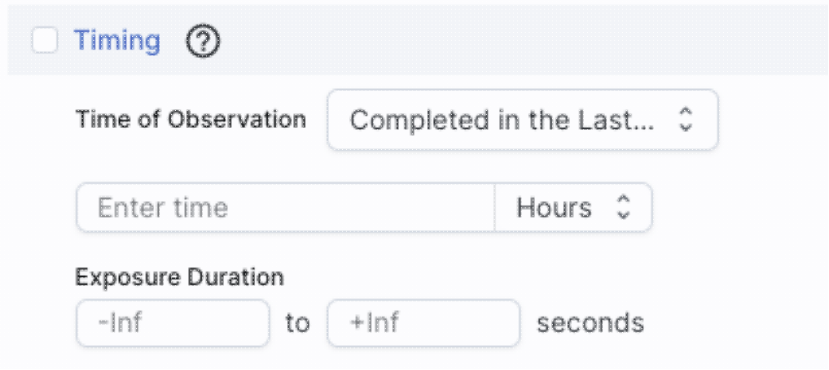


This panel provides a way to constrain the location of your search. Here, it is a single object search, which works just like it does above, including the interactive target refinement via the bullsye icon. You can also upload a list of targets by selecting "multi-object" -- it brings up the same pop-up as above, from which you can load a table from disk ("Upload tables" tab) or

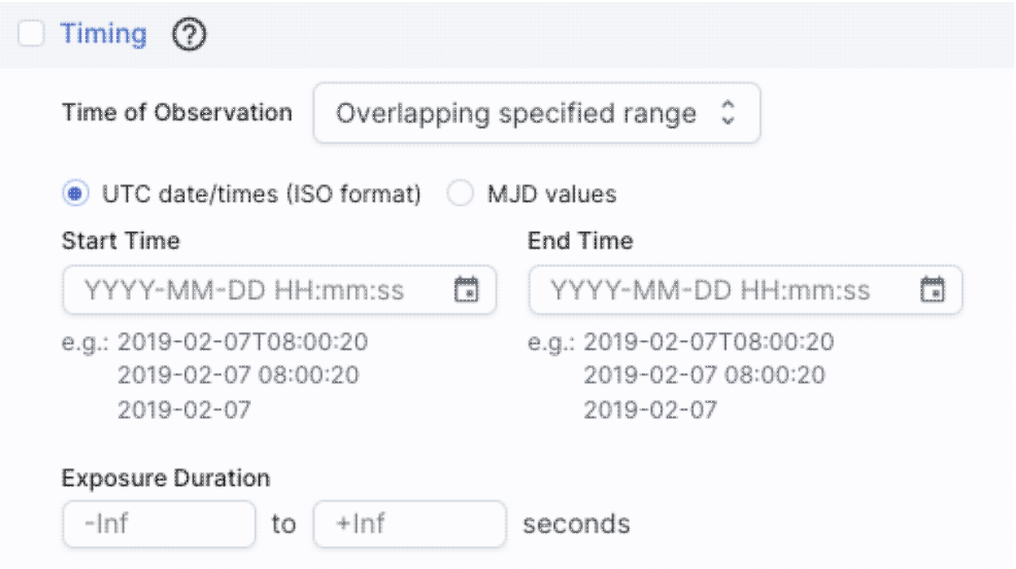
select one of the tables you have already loaded into the tool (click on the "Loaded tables" tab). Your uploaded catalog has to follow all the same rules as normal catalogs from disk.

You can specify via the drop-down the type of your query: "observation boundary contains point", "observation boundary contains shape", "observation boundary is contained by shape", "observation boundary intersects shape", and "central point (s_ra, s_dec) is contained by shape." The latter refers to the columns "s_ra" and "s_dec" in the ObsTAP table.

Enter Constraints: Timing

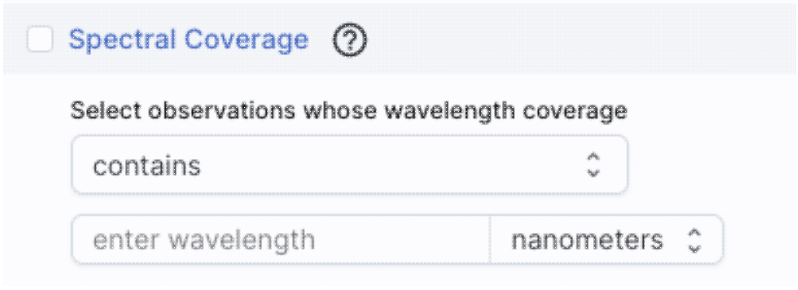


This panel provides a way to constrain the observation time of your search. This is the default option, where you want data completed in the last x hours (or other unit of time).

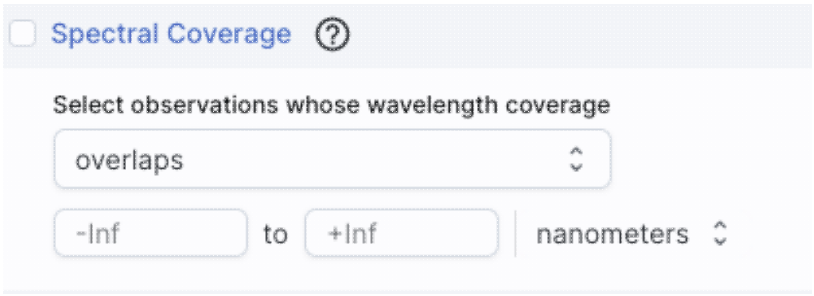


This is the alternate option, where you want data overlapping a specified date range, where you can specify UTC or MJD times.

Enter Constraints: Spectral Coverage



This panel provides a way to constrain the spectral coverage of your search. This is the default option, where you want data containing a given wavelength.

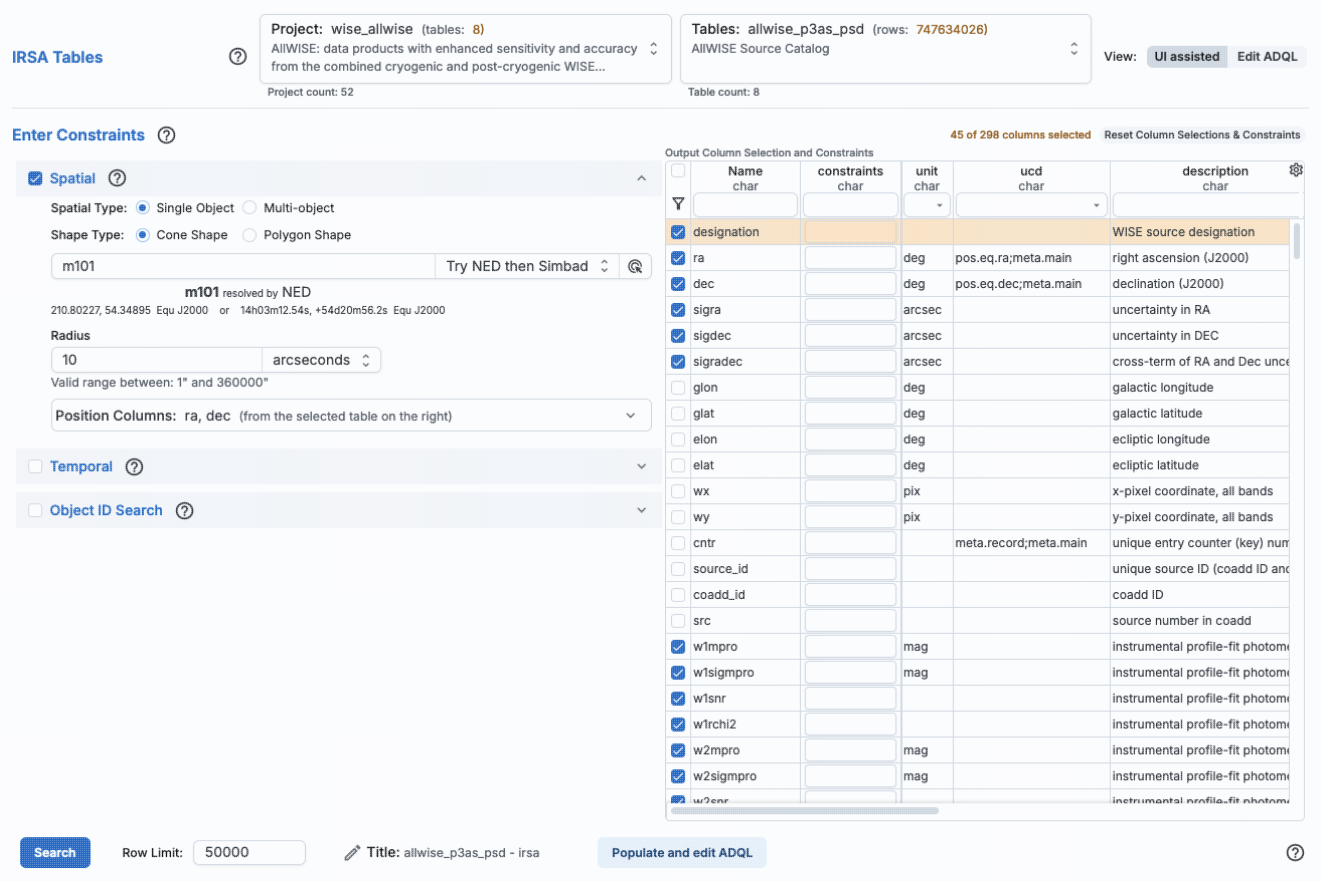


This is the alternate option, where you want data overlapping a specified wavelength range.

IRSA VO TAP Search

To see this tab as a choice on the top, you may need to select it from the side menu. (You may also find yourself having landed here from a Multi-archive VO TAP search, in which case you need to go there for more information.)

This is what the IRSA VO TAP search screen looks like:



Just do it: a quick start

Select Table: It comes up ready to search on *IRSA Tables*. You first need to select the "project" (sometimes called "Table Collection" or "Schema" in other contexts). Then, having selected that, the drop-down menu on the right changes to reflect the tables available under that schema.

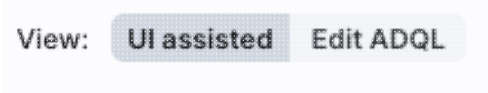
Then **Enter Constraints**: On the **left**, you can impose a variety of constraints. In addition to selecting the tickbox indicating that you wish to impose a particular kind of constraints, you need to specify which columns should be used for those constraints. More information on these constraints is above. On the **right** is a list of the columns in the selected table, with tickboxes to indicate which columns will be returned. You can also set constraints on the columns from here, following the same filter rules as for any tables here. Above this section of the screen, there is an indication of which columns are selected (e.g., 45 of 298 columns). You can reset the column selection via the button here as well.

Then to **actually do it**, click "Search."

Getting more out of it: Taking advantage of additional options

Selecting a Query Type

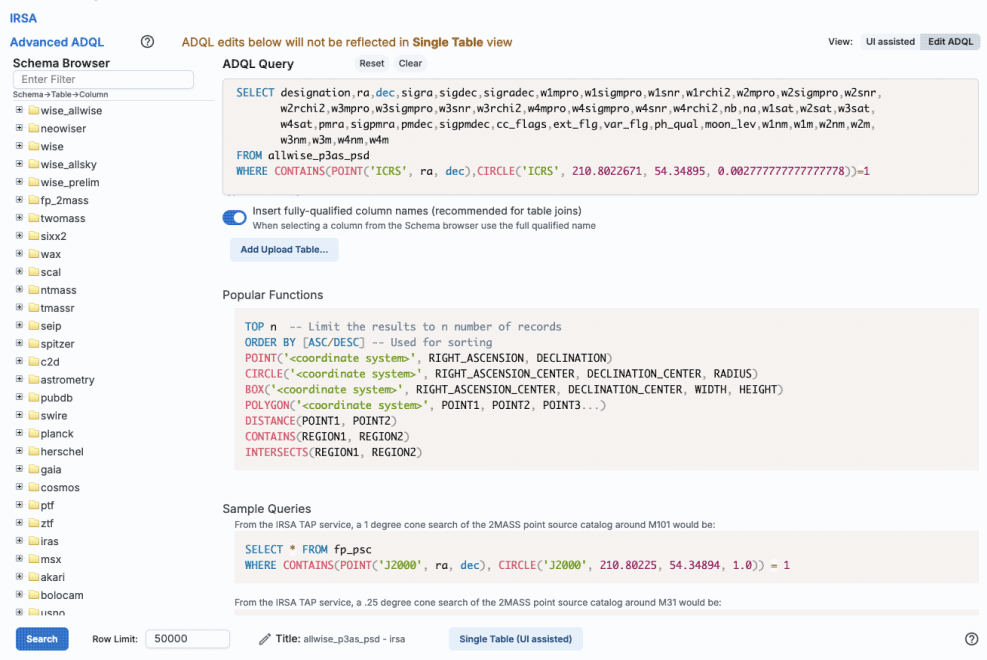
On the far right of the top row, there is a slider or button:



By default, it is set to "UI-assisted", as opposed to "Edit ADQL". Especially when starting out, UI-assisted is easier. By using the UI assisted" option, you can select pre-defined options and have the interface construct the query in ADQL. Alternatively, if you are already fluent in ADQL, you can select the second option, "Edit ADQL", to construct even more complex queries.

After populating the search parameters using the UI, you can click the button on the bottom, "Populate and edit ADQL" -- this takes the parameters you have entered, creates the ADQL, and launches the "Edit ADQL (advanced)" interface.

Advanced ADQL



You can get to this screen by selecting "Edit ADQL (advanced)" in step two, or by clicking on "Populate and edit ADQL" after filling out the UI.

You can select the schema from the left side of the screen. Each of the schemas can expand into viable tables and then columns within each table via clicking on the "+" to the left of the folder icon. Click on a column name to have it appear at the location of your cursor in the ADQL query box on the right. If you have the tickbox checked on the right that says "Insert fully-qualified column names", clicking on the column name inserts fully-qualified column names at your cursor location in the box.

You can type the ADQL directly into the box. If you configured a search on the "UI assisted" page, this box is already pre-filled with the ADQL version of your search, and you can proceed to edit it further.

Examples of useful functions and queries are given on the lower right of this window; you may need to scroll down.

Tips and Troubleshooting

- All the drop-downs near the top are roughly searchable. This is very useful if you are trying to find a particular table or service that you can't quite recall. Click in the drop-down area, type the first letter of what you are looking for, and it will jump to the first instance of a string starting with that letter. Hit that letter again, and it goes to the second instance of a string starting with that letter.
- Not every table available via this interface even has RA/Dec or, if it does, it may not be searchable via positions. If you have selected a table that doesn't have positions, it will not yield results if you try to search by position.
- If none of the columns are selected, then the tool behaves as if you have selected all of the columns.

- There is a maximum number of returned rows at the bottom. If you are anticipating more than this number of rows, increase this number!
- If you arrive at the advanced ADQL page from the "Populate and edit ADQL" button, this is a one-way trip -- any changes you make to the ADQL here are NOT transmitted automatically back to the "UI Assisted" query page.

If you choose to use the GUI, you can work within it to set the constraints you desire at the bottom of the screen; see VO TAP: More About Constraints for all of the information about setting constraints.

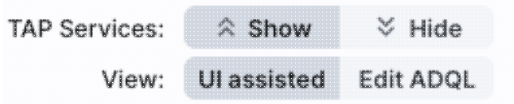
The result of an IRSA TAP search is a catalog that can be interacted with like any other catalog in this tool.

Multi-archive VO TAP Search

To see this tab as a choice on the top, you may need to select it from the side menu. Or, you may land in this tab from a table action.

When you first go to this tab, you will see this near the top of your screen:

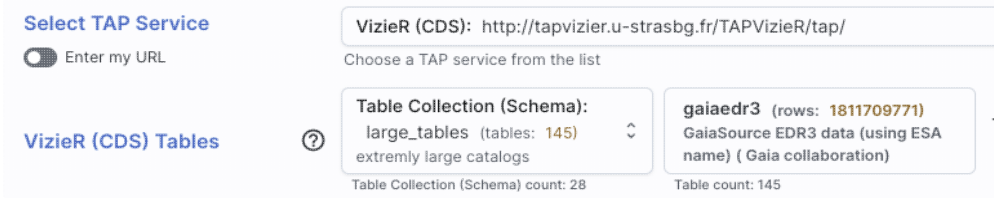
At the top, you now have a choice of which TAP service you want to use, and it defaults to IRSA's. You can select your favorite from the list, or use the toggle on the left to enter your own custom URL. If you want to hide this top row after setting it (to, say, regain screen real estate), look for this on the far right:



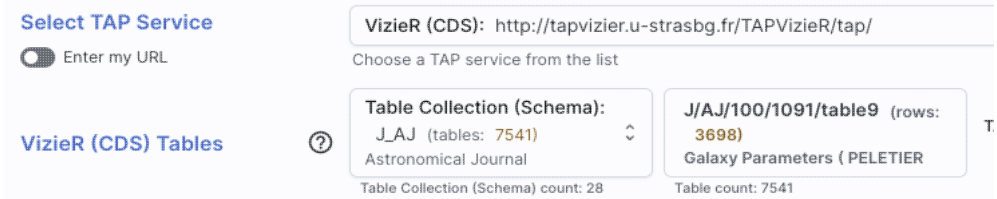
the "TAP Services:" button (show/hide) will reveal or conceal this top row.

The rest of this search screen is basically identical to that which you get from the IRSA VO TAP Search screen, even if you pick a TAP service other than IRSA's (with a few exceptions, including if it's ObsCore; see below).

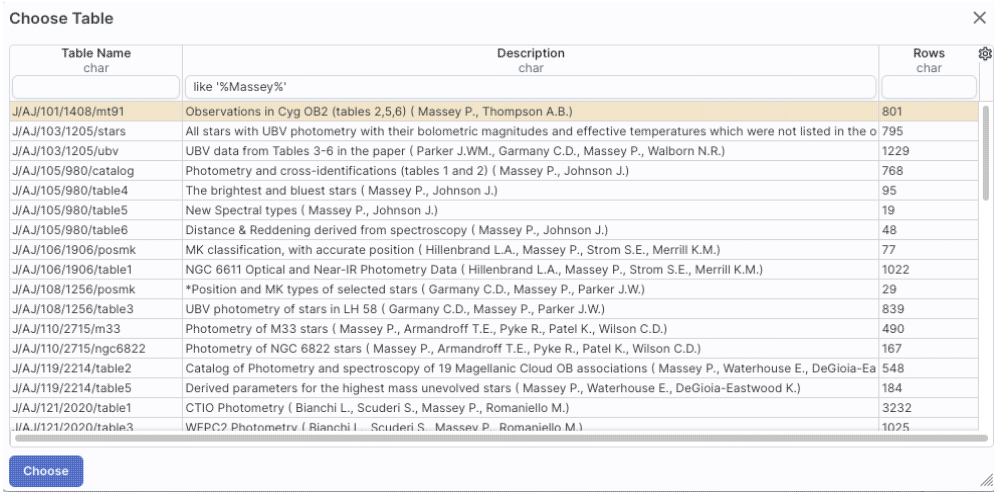
For VizieR's services in particular, because there are so many tables, the tool will give you a slightly different interface under the "Tables" section of the window. Here is the default Vizier choices as of this writing:



Note that it tells you how many tables and rows are available. Switching to tables associated with journal articles, far more tables are available:



Now, if you click on the second tier menu (J/AJ/100/1091/table9), you get a pop-up, which is another Firefly table like any other in this tool, so it's searchable and sortable:



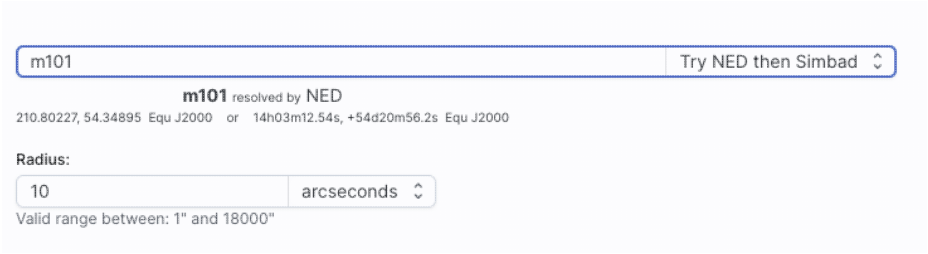
which makes it trivially easy to find tables in which you are interested, such as those associated with papers by Massey, as shown. Select the table that you want to search, and then continue to specify the rest of your search, just as described above in the IRSA VO TAP Search screen discussion.

The result of any VO TAP search is a catalog that can be interacted with like any other catalog in this tool.

NED Objects -- Searching for NED objects

(NED= NASA Extragalactic Database.)

To see this tab as a choice on the top, you may need to select it from the side menu.



As for the other catalog searches, the tool may pre-fill the target position with its best guess of the coordinates of the target with which you have been working. You can use an object name in place of coordinates. Note that although NED is used for name resolution, the actual search is then performed using coordinates, as opposed to name. In this case, you are limited to a cone search, so the next option is the cone search radius. Pick your units from the drop-down first, and then enter a number; if you enter a number and then select from the drop-down, it will convert your number from the old units to the new units. There are both upper and lower limits to your search radius; it will tell you if you request something too big or too small.

From the NED results, you have one-click access to the fully detailed information from NED on any object returned from such a search. The search results will generally include a column "Details", though you may have to scroll to the right to see it. Clicking on a link in this column takes you directly to the full NED information display for the selected object in a new window.

The result of any NED search is a table that behaves like any other table in this tool.

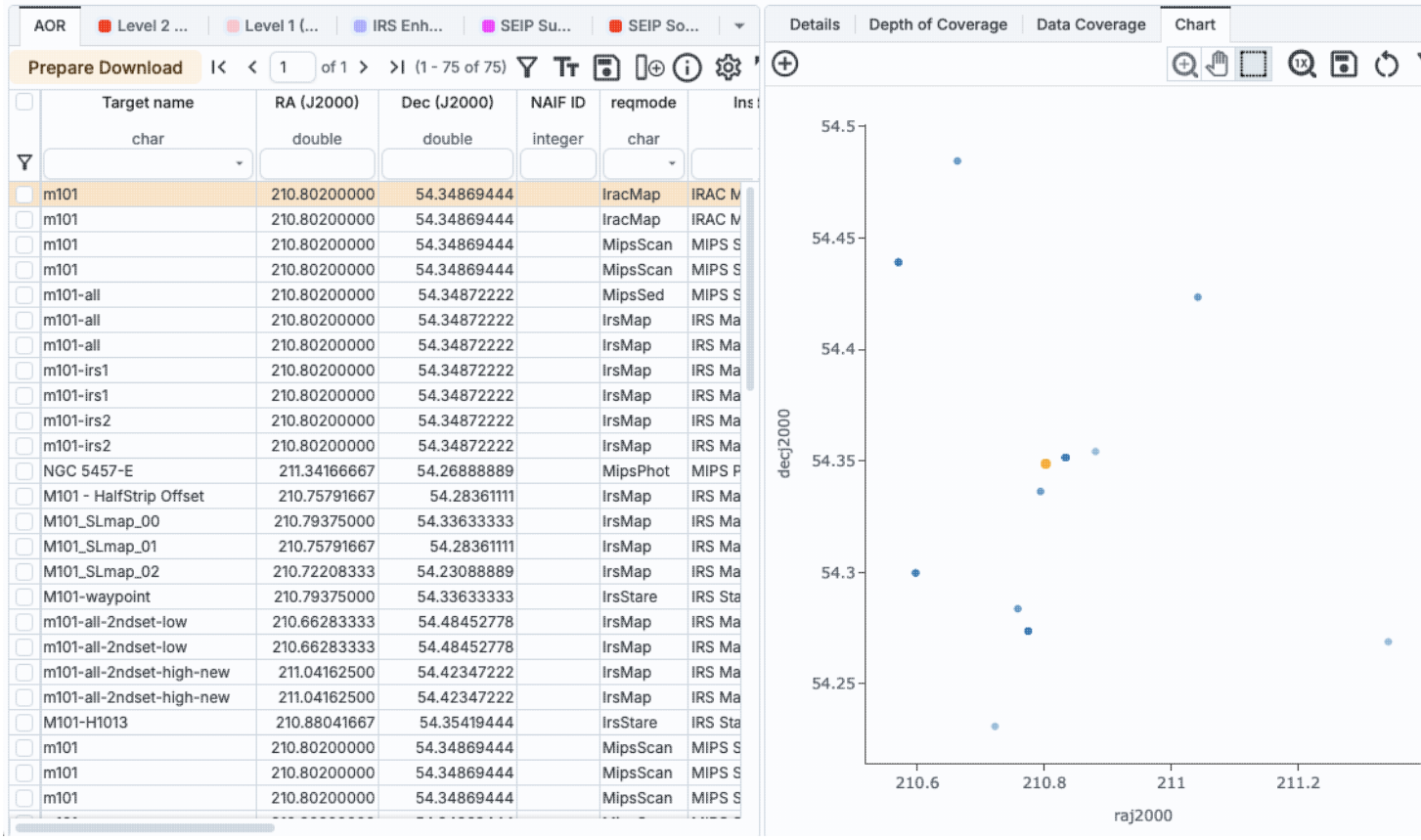
Spitzer Heritage Archive: Plots

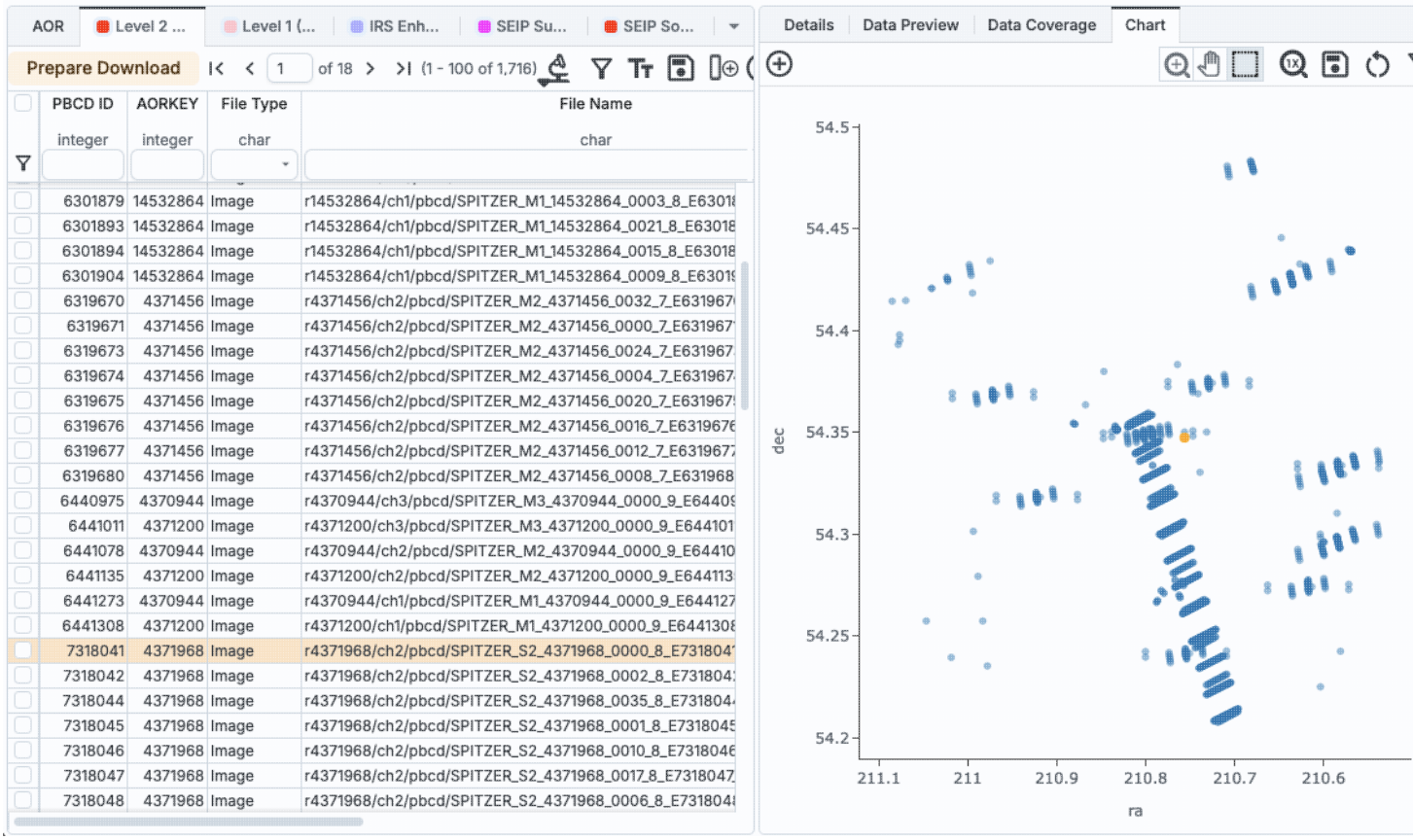
Plots (sometimes called charts) are made from Tables, and, more commonly (or usefully) from Catalogs. Plotting is covered in this section. The Tables section discusses tables more generally, and the specific case of loading catalogs is in another section. If your table has RA and Dec in it, the Visualization section covers how the catalog can be overlaid on images. If your plot is a spectrum, the Spectra section also covers that.

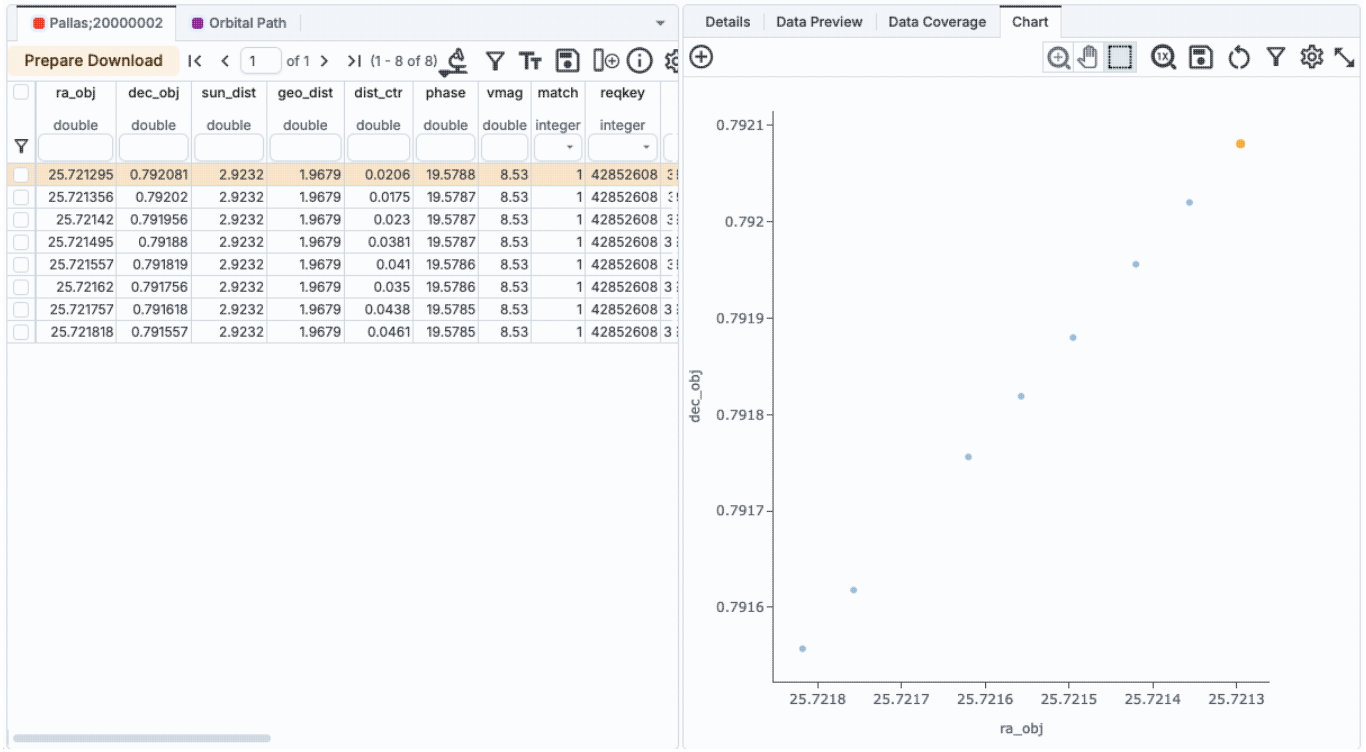
Contents of page/chapter:

Default Plot

When doing a position search for a fixed target, the default plot is often somewhat less than useful -- it grabs the positions from the list of observations, which is just the coordinates of the reference pixel (the CRVAL 1 and 2) of the retrieved images (see first screenshot below). If you have constrained your search results to only return the most centered image, this is an even more phenomenally uninteresting plot, because it has a single point. If you do a search on a moving target, the default plot is the RA and Dec of the object that it finds with data, so moderately more interesting (see second screenshot below).


AOR
Level 2 ...
Level 1 (...
IRS Enh...
SEIP Su...
SEIP So...
Prepare Download
1
of 1
(1 - 75 of 75)
Target name
char
RA (J2000)
double
Dec (J2000)
double
NAIF ID
integer
reqmode
char
m101 210.80200000 54.34869444 IracMap
m101-all 210.80200000 54.34872222 MipsSed
m101-all 210.80200000 54.34872222 IrsMap
m101-irs1 210.80200000 54.34872222 IrsMap
m101-irs2 210.80200000 54.34872222 IrsMap
NGC 5457-E 211.34166667 54.26888889 MipsPhot
M101 - HalfStrip Offset 210.75791667 54.28361111 IrsMap
M101_SLmap_00 210.79375000 54.33633333 IrsMap
M101_SLmap_01 210.75791667 54.28361111 IrsMap
M101_SLmap_02 210.72208333 54.23088889 IrsMap
M101-waypoint 210.79375000 54.33633333 IrsStare
m101-all-2ndset-low 210.66283333 54.48452778 IrsMap
m101-all-2ndset-high-new 211.04162500 54.42347222 IrsMap
M101-H1013 210.88041667 54.35419444 IrsStare
Details
Depth of Coverage
Data Coverage
Chart
decj2000
raj2000
54.5
54.45
54.4
54.35
54.3
54.25
210.6
210.8
211
211.2


AOR
Level 2 ...
Level 1 (...
IRS Enh...
SEIP Su...
SEIP So...
Prepare Download
1
of 18
(1 - 100 of 1,716)
PBCD ID
integer
AORKEY
integer
File Type
char
File Name
char
6301879 14532864 Image r14532864/ch1/pbcd/SPITZER_M1_14532864_0003_8_E63018
6301893 14532864 Image r14532864/ch1/pbcd/SPITZER_M1_14532864_0021_8_E63018
6301894 14532864 Image r14532864/ch1/pbcd/SPITZER_M1_14532864_0015_8_E63018
6301904 14532864 Image r14532864/ch1/pbcd/SPITZER_M1_14532864_0009_8_E63019
6319670 4371456 Image r4371456/ch2/pbcd/SPITZER_M2_4371456_0032_7_E631967
6319671 4371456 Image r4371456/ch2/pbcd/SPITZER_M2_4371456_0000_7_E631967
6319673 4371456 Image r4371456/ch2/pbcd/SPITZER_M2_4371456_0024_7_E631967
6319674 4371456 Image r4371456/ch2/pbcd/SPITZER_M2_4371456_0004_7_E631967
6319675 4371456 Image r4371456/ch2/pbcd/SPITZER_M2_4371456_0020_7_E631967
6319676 4371456 Image r4371456/ch2/pbcd/SPITZER_M2_4371456_0016_7_E631967
6319677 4371456 Image r4371456/ch2/pbcd/SPITZER_M2_4371456_0012_7_E631967
6319680 4371456 Image r4371456/ch2/pbcd/SPITZER_M2_4371456_0008_7_E631968
6440975 4370944 Image r4370944/ch3/pbcd/SPITZER_M3_4370944_0000_9_E64409
6441011 4371200 Image r4371200/ch3/pbcd/SPITZER_M3_4371200_0000_9_E644101
6441078 4370944 Image r4370944/ch2/pbcd/SPITZER_M2_4370944_0000_9_E64410
6441135 4371200 Image r4371200/ch2/pbcd/SPITZER_M2_4371200_0000_9_E644113
6441273 4370944 Image r4370944/ch1/pbcd/SPITZER_M1_4370944_0000_9_E644127
6441308 4371200 Image r4371200/ch1/pbcd/SPITZER_M1_4371200_0000_9_E6441308
7318041 4371968 Image r4371968/ch2/pbcd/SPITZER_S2_4371968_0000_8_E731804
7318042 4371968 Image r4371968/ch2/pbcd/SPITZER_S2_4371968_0002_8_E731804
7318044 4371968 Image r4371968/ch2/pbcd/SPITZER_S2_4371968_0035_8_E731804
7318045 4371968 Image r4371968/ch2/pbcd/SPITZER_S2_4371968_0001_8_E731804
7318046 4371968 Image r4371968/ch2/pbcd/SPITZER_S2_4371968_0010_8_E731804
7318047 4371968 Image r4371968/ch2/pbcd/SPITZER_S2_4371968_0017_8_E731804
7318048 4371968 Image r4371968/ch2/pbcd/SPITZER_S2_4371968_0006_8_E731804
Details
Data Preview
Data Coverage
Chart
dec
ra
54.5
54.45
54.4
54.35
54.3
54.25
54.2
211.1
211
210.9
210.8
210.7
210.6



Positio
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You can change what is plotted (see below) but plots of image metadata may not be what is most desirable.

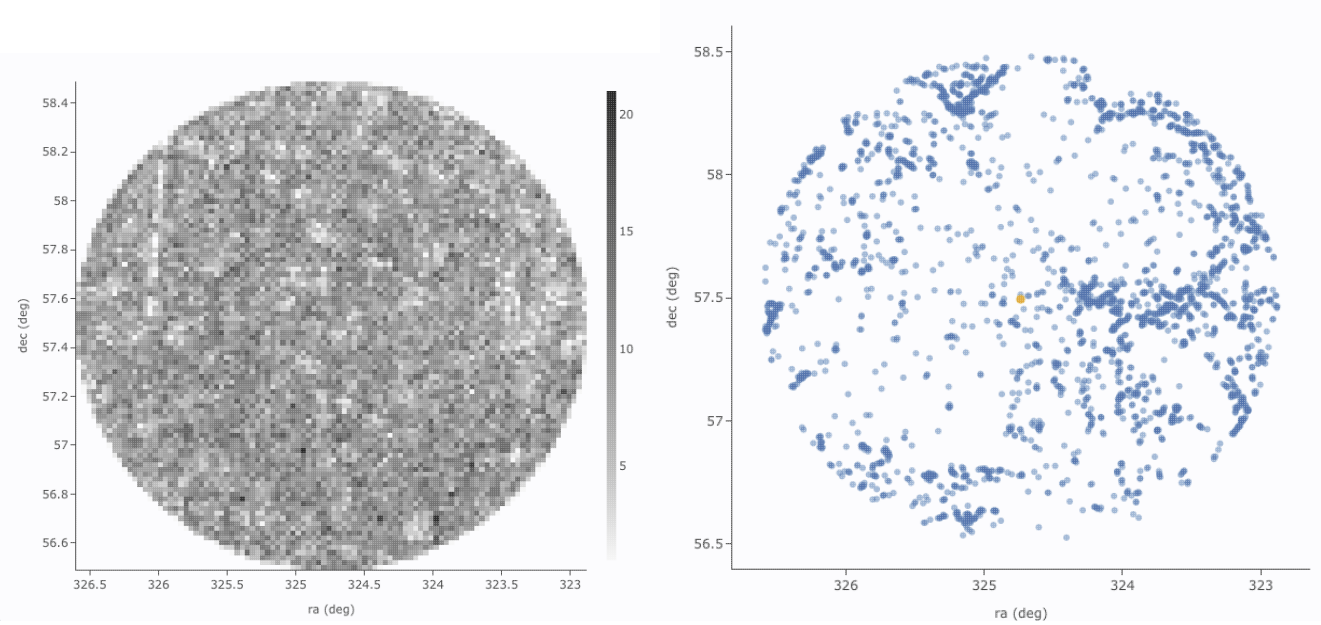
Try loading in a catalog and keep reading! The default plot for a catalog will also be RA and Dec.

Note that all of these RA/Dec plots follow astronomical convention -- RA increases to the left.

To obtain a full-screen view of your plot, click on the expand icon in the upper right of the window pane:  . To return to the prior view, click the "Close" arrow in the upper left.

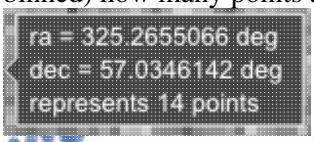
Plot format: A First Look

If you have loaded a catalog with many (> 5,000) points, you may have an RA/Dec plot that looks something like the one on the left here. If you have loaded a catalog with few (< 5,000) points, you will have an RA/Dec plot that looks more like the one on the right here.



The difference between them is that, for larger catalogs (left), the plot is binned -- more points are encompassed in a black tile and fewer points are encompassed in a white tile. In the context of this tool, this is called a **heatmap**. The shades of grey correspond to how many points are encompassed in each 'cell', with the density scale given on the right hand side of the plot. For smaller catalogs (right), each individual point is shown as a blue dot. In the context of this tool, this is called a **scatter plot**. Note that even when individual points are shown, where the points overlap, the color is darker.

In either case, letting your mouse hover over a point tells you the values of the point under your cursor, and (if binned) how many points are represented:



for binned plots, and

for just one point.

Clicking (in an unbinned plot) highlights that point, and it stays highlighted, though you must keep your mouse on the point in order to see the information about it.

The reason the tool makes a heatmap for large catalogs is to more fairly represent the point density -- and to make the plotting faster. In these cases, though, it will not give you the option to overplot errors (see below). If you have a heatmap and want a scatter plot *by default*, you need to filter or otherwise restrict the catalog to have fewer points (see below). You can change the bin size and shading via the plot options pop-up (more on this below).

Plot Navigation

The top of the plot window has a row of icons something like this:


which we now describe.

Add new plot

You may or may not have this icon. Clicking on this icon adds a new plot. This has a separate section below.

Plot mode

This trio of icons controls the plot interaction 'mode'. By default, you are in 'selection' mode, as seen here -- the last icon is darker, like a pushed-in button. To activate the other modes, click on the other icons, and they become darker or "pushed in."

Zoom mode

When this mode is active, when you click and drag in the plot, the plot is zoomed to the region you have selected. Even when this mode isn't active, you can also zoom using your scroll feature on your mouse. To return to the original view, click on  .

Pan mode

When this mode is active, when you click and drag in the plot, it moves around in response to where you drag. To return to the original view, click on  .

Select mode

When this mode is active, when you click and drag in the plot, you are given additional options at the top of the plot :  The checkmark means "select" and the funnel means "filter." The difference is that filtering (temporarily) limits what is shown in the plot, catalog, and image (see general information on filters), and selecting just highlights the points enclosed within your selection. To cancel either one, click on cancel filters  or cancel selection  .

Re-scale plot

Return to the view that optimizes the range of x and y to show the currently displayed points.

Tips and Troubleshooting: Did you accidently zoom in the plot with your magic mouse or touchpad? Click on this icon to reset the plot.

Save plot

Save the plot. It will save as a png file, wherever your browser is configured to save files. The saved png is the same size as it is on your screen. If you want a big version, make the desired plot big on your screen (expand the view to take up as much space as possible) before saving the png.

Undo

Restore everything to the defaults. If you've played a lot with the plot, you may want to undo everything you've done. Click this icon to restore everything back to the defaults.

Filter from plot

Pull up interactive filters. This button brings up filters for the displayed catalog in an interface like all the other tables here, except you don't see the values in the catalog themselves; you can enter filters here in the same way you can everywhere else in this tool (see general information on filters).

Configure plot

Click on this icon to change what is plotted (much more on this below).

Expand plot

Click on this icon to make the plot take up the whole browser window. To return to the prior view, click the "Close" arrow in the upper left.

Help
This icon may not appear, but if it does, it is a context-sensitive help marker, which should bring you to this online help.

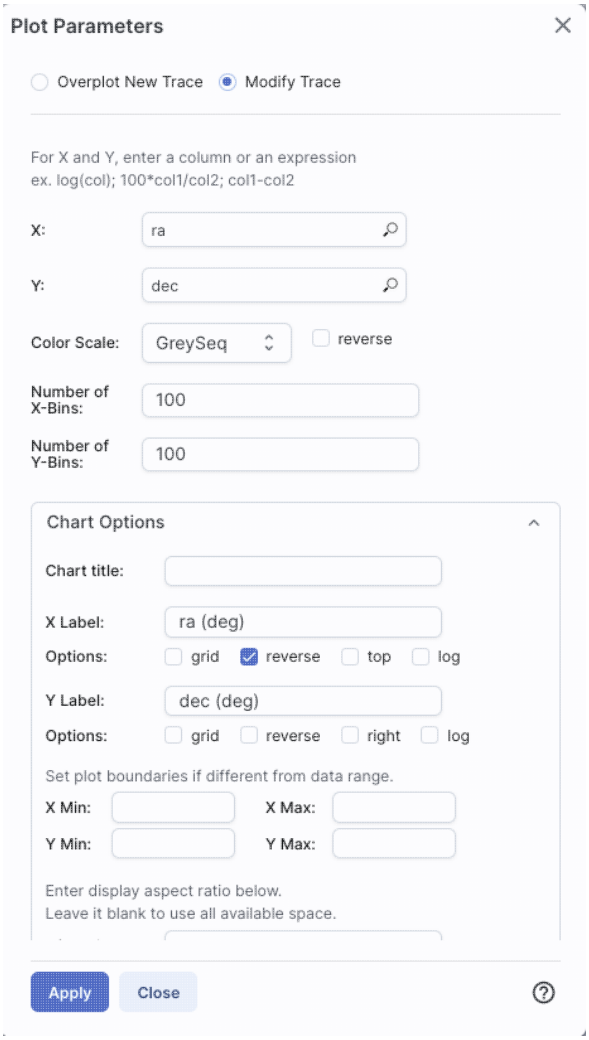
Plot Linking: Plots are linked to catalog and image(s)

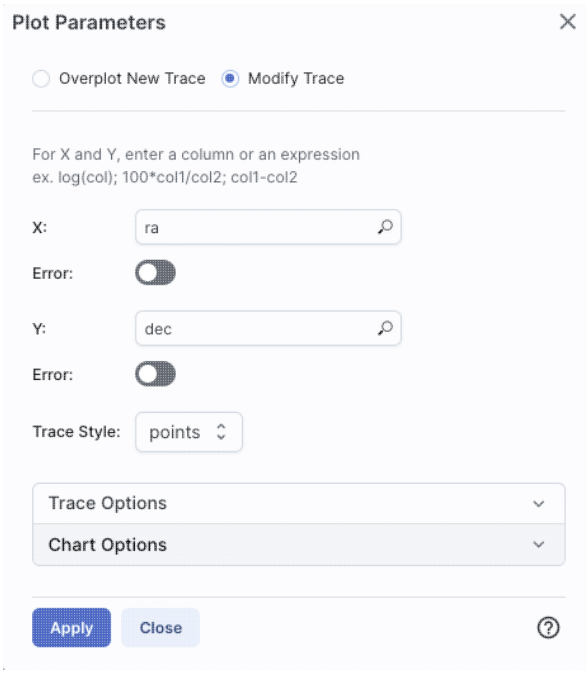
If you move your mouse over any of the points in the plot, you will get a pop-up telling you the values corresponding to the point under your cursor. For scatter plots, if you click on any of the points, the object(s) corresponding to that point will be highlighted in the overlays in the images shown, and highlighted in the catalog table. This works the other way too -- click on a row in the catalog, or an object in the images, and the object will be highlighted in the plot or the catalog or the image.

Changing What is Plotted

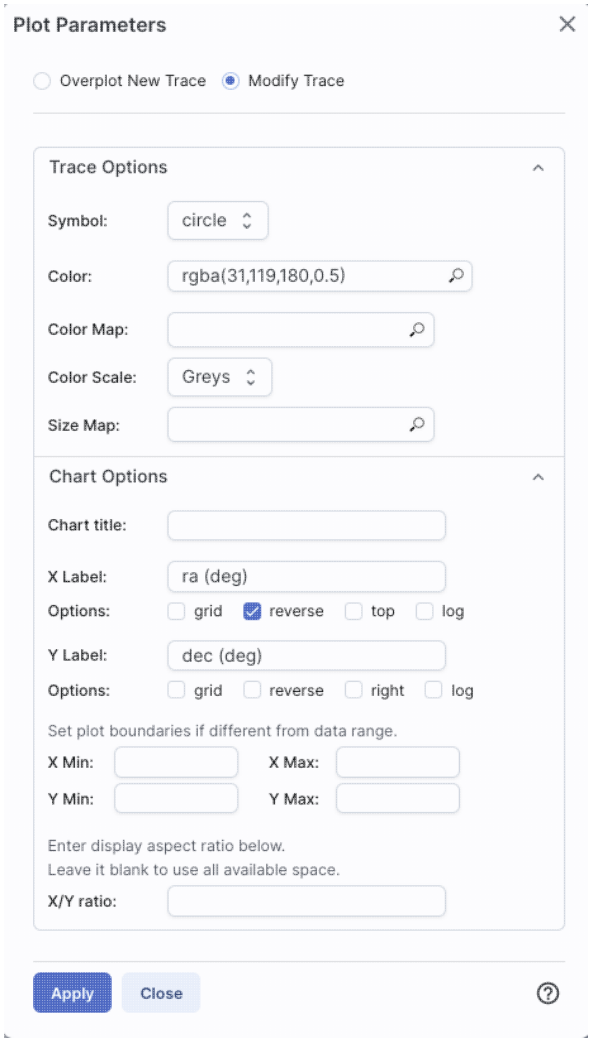
To change what is plotted, click on the gear icon in the upper right of the plot window pane: . Configuration options then appear; the options are a little different depending on whether the points are binned or not. This section describes how to change what is plotted, i.e., the "Modify Trace" option at the top of both of these pop-ups. The overplotting option (and, for that matter, adding plots) are covered in more detail below.

This is the configuration window for a binned (a.k.a. heatmap and/or greyscale) plot. By default, the "chart options" may be hidden; to reveal them, click on the name "Chart Options" or the disclosure arrow on the right. To hide them again, click on the disclosure arrow on the right.





The configuration window for a plot that shows individual points, once fully extended, is much longer (and scrollable), and so is shown here in two parts. Both the "Trace Options" and "Chart Options" may be hidden by



default; to reveal them, click on the name or the disclosure arrow on the right. To hide them again, click on the disclosure arrow on the right.

Options found in both kinds of plots

In either case, you can **specify what should be plotted on each axis**. The magnifying glass is a link that brings up a table that lists all of the available columns in the catalog. Alternatively, you can just start typing, and viable options appear below the box. Whatever you put in the box must match the column name as shown in the catalog *exactly*.

Click on the black triangle to reveal additional options.

In both of the examples above, RA is plotted on the x-axis. It has pulled the column name for the label; in this table, the column is "ra" rather than "RA", and it is case-sensitive. It has copied over the units ("deg") from the catalog, and plotted the x-axis increasing to the left as per astronomical convention. You can change what column is plotted, and whether or not errors are shown. Under "**Chart Options**", you can specify:

◊ title of the plot;
◊ labels on the x and y-axis;
◊ whether or not there is a grid shown;
◊ whether or not the axis is reversed (as for ra in the examples above);
◊ whether the x-axis is on the top or bottom and the y-axis is on the left or right;
◊ whether or not the axis is logarithmic;

- ◊ the maximum and minimum values of the plot range;
- ◊ the aspect ratio of the plot (e.g., square or rectangular).

By default, the boundaries of the plot are set to encompass the full data range. Here you can change the boundaries to specific numbers. (This can also be set via filtering from the plot; see below.)

You can enter **simple mathematical relations** in these boxes too, such as (for a WISE catalog) "w1mpro-w4mpro" to put [W1]-[W4] on one axis. Supported operators:

- ◊ +,-,*,/
- ◊ abs(x), acos(x), asin(x), atan(x), atan2(x), ceil(x), cos(x), exp(x), floor(x), lg(x), ln(x), log10(x), log(x), power(x,y), round(x), sin(x), sqrt(x), tan(x)
- ◊ degree(x) and radians(x) are also supported -- these are the same functions as in ADQL and convert radians to degrees or degrees to radians. For small astrometric offsets, you could make a scatterplot of dec2-dec1 vs. (ra2-ra1)*cos(radians(dec1)) instead of typing cos(dec1*pi()/180). (NB: pi() is also a supported function you can use, instead of typing 3.14159.)
- ◊ Non-alphanumeric column names (e.g., those with - or + or similar characters) should be quoted in expressions.

Click "Apply" to apply, and "Close" to return to the plot without making changes. (For the latter, you can also click the 'x' in the upper right.)

Options found only in binned plots

(Plots are binned by default if there are > 5,000 points in the catalog.) From the pop-up, you can control the color table that is used (greyscale is the default; there are many other choices in the drop-down menu), as well as the number of bins in the x and y directions. The default value for the number of bins is 100 in both directions.

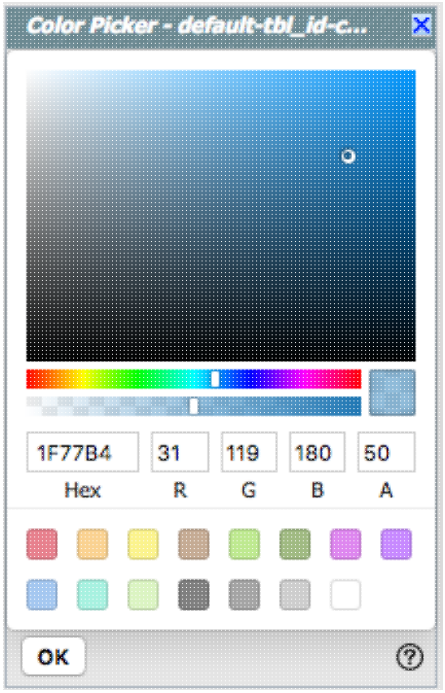
Options found only in plots showing individual points

You can add errors. Toggle the error switch, and then additional choices appear. From there, you can select symmetric or asymmetric errors, and then you can specify an error as either an existing column in the catalog, or calculated from a column in the catalog.

Under "**Trace Style**," you can control whether the points are shown as individual points, connected points, or just lines connecting the points.

Under **Trace Options**, you have many choices.

- ◊ Choose the **symbol type**: circle (default), open circle, square, open square, diamond, open diamond, cross, x, upward-pointing triangle, hexagon, or star.
- ◊ Choose the **color**. By default, the point color is a mid-range blue that is darker where more points. This is specified by the rgba vector shown in the example here (31, 119, 180, 50) where the last number is in units of fraction of 1, so 0.5=50% in this example. Click on the magnifying glass to bring up a color picker window:



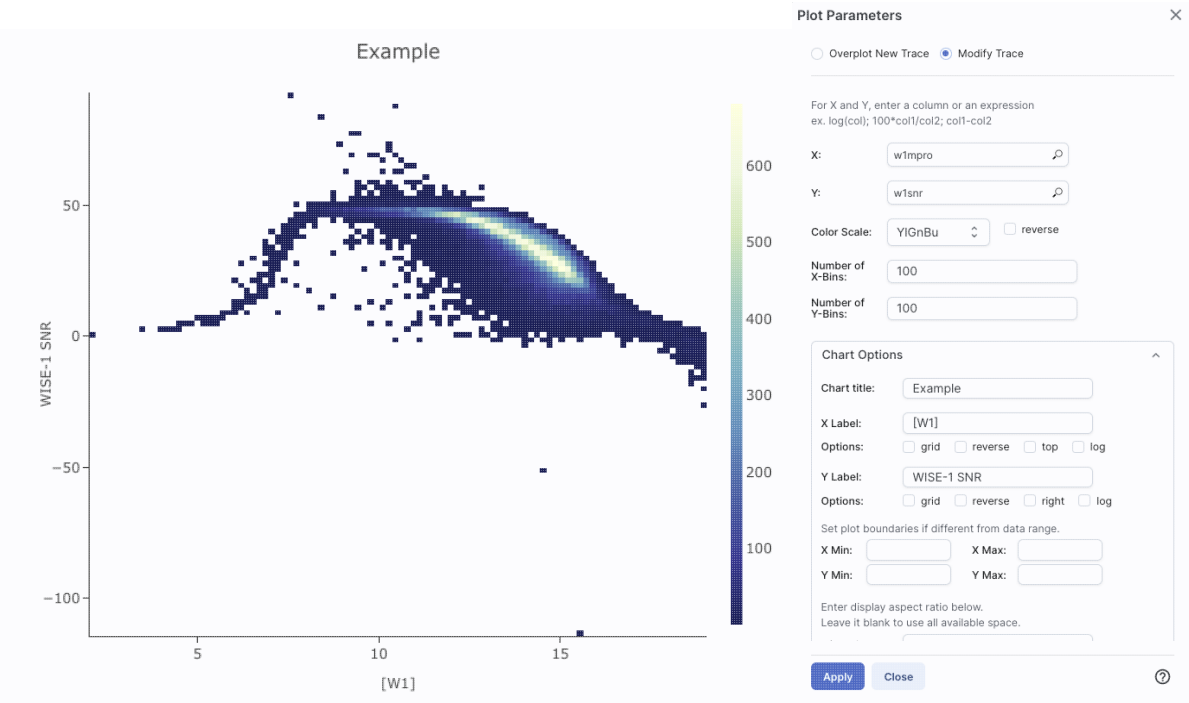
From here, you can click on your desired color in the top colorful box. Immediately below that box, you can change the color and saturation of the top box so that you can select from a different range of colors. Below that, you can enter numerical hex codes or RGBA values (where the value for RGB is between 0 and 255, and A is in units of percent, e.g., 50 = 50%). Finally, you can also select from a pre-defined set of 15 colors by clicking on any of the small boxes. Note that the numerical codes update as you select different colors. Click "OK" to implement your color choice, or click 'x' in the upper right to close the window without changing the color.

Tips and Troubleshooting: Don't like the transparency feature of the points that makes them darker when there are more points? Set the last value of the vector (A) to 1. Don't like the blue? Pick a diferent color entirely. Want the faintest point to be brighter than it is by default? Set the last element of the color vector ("A") to be 0.7 or 0.8.

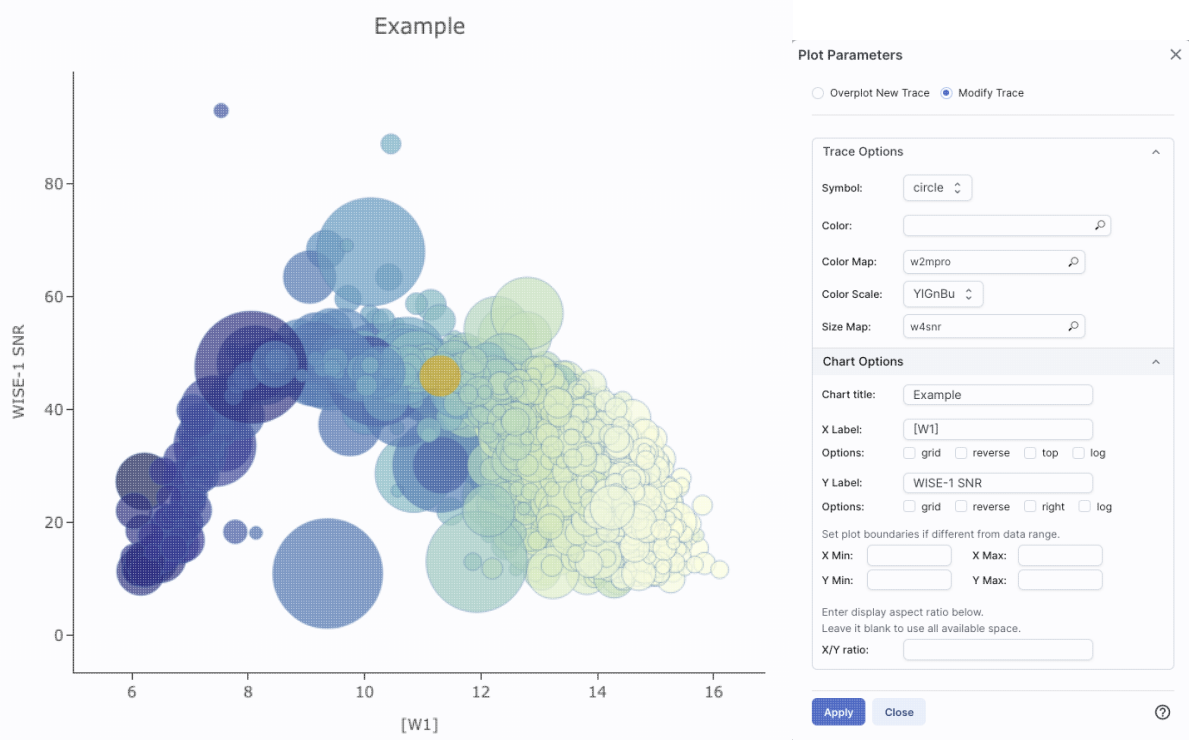
◊ Choose the **color map**. By default, all of the points are the same color, but darker where there are more points. You can change this such that the color scale of the points is tied to a column value, such as w1snr (WISE-1 signal-to-noise ratio) in a WISE catalog. If you select this option, you can also change the color scale to any of many different options (see the drop-down). Simple mathematical relations (as above) are also permitted in this box.

◊ Choose the **size map**. By default, all of the points are the same size. You can change this such that the color scale of the points is tied to a column value, such as w1snr (WISE-1 signal-to-noise ratio) in a WISE catalog. Simple mathematical relations (as above) are also permitted in this box.

Example: Load a large WISE catalog. Plot w1snr (WISE-1 signal-to-noise ratio) vs. w1mpro (WISE-1 profile fitted magnitude). It defaults to a heatmap. Change the labels, making the y-axis label "WISE-1 SNR" rather than the more cryptic column header "w1snr". Change the x-axis label to "[W1]." Change the greyscale to yellow-green-blue ("YlGnBu") to make it easier to see the lowest-populated bins. Depending on your catalog, you may need to adjust the ranges. Obtain this plot:



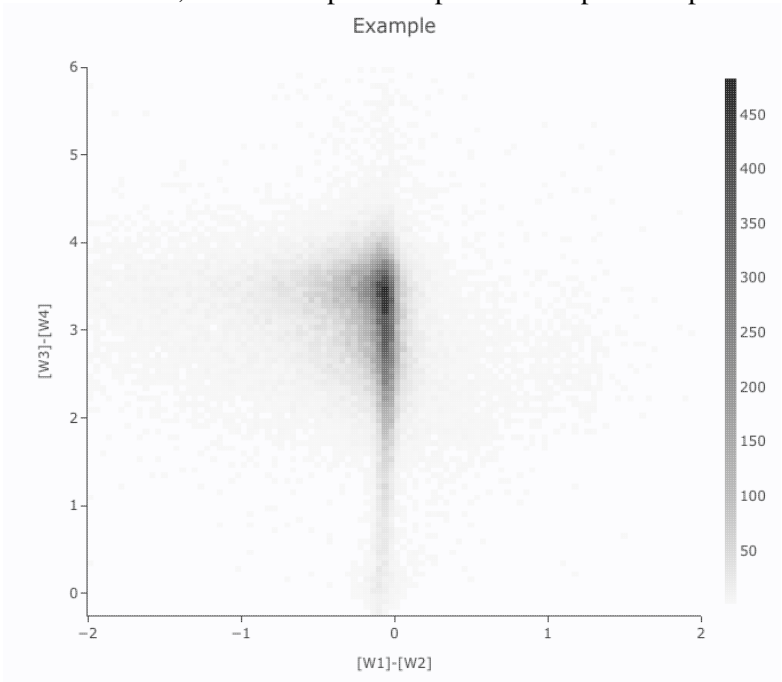
Example: Load either a smaller WISE catalog, or the same large WISE catalog, but filter it down such that w1snr, w2snr, and w3snr are all greater than 10, which limits the number of points to be <5,000. Plot w1snr vs. w1mpro. It shows the points individually. Change the labels. Change the point color map to scale with w2mpro (WISE-2 profile fitted magnitude). Change the point size map to scale with w4snr (WISE-4 signal-to-noise). Obtain this plot:

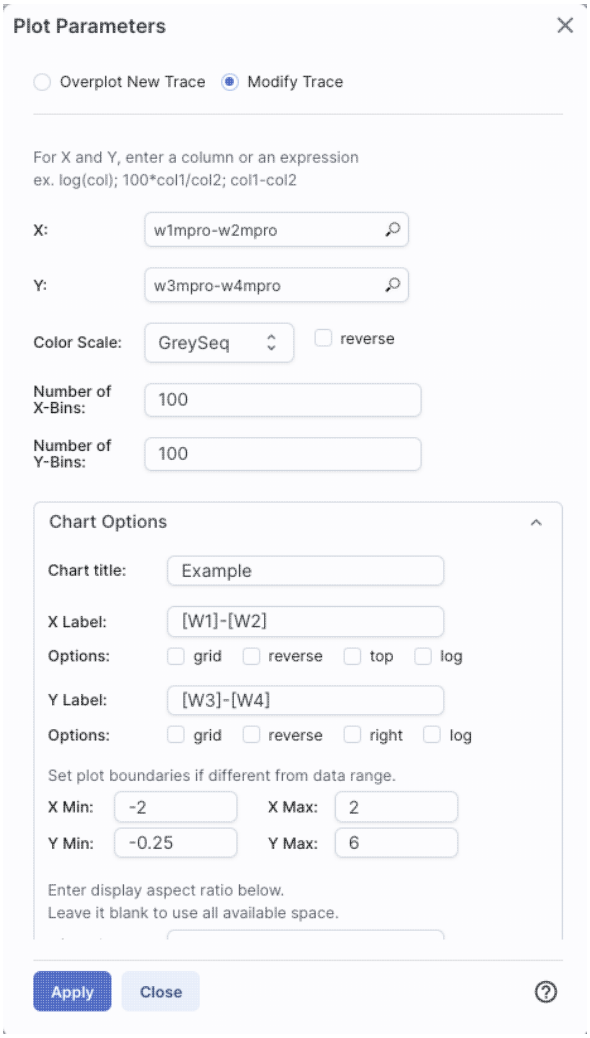


Plotting Manipulated Columns

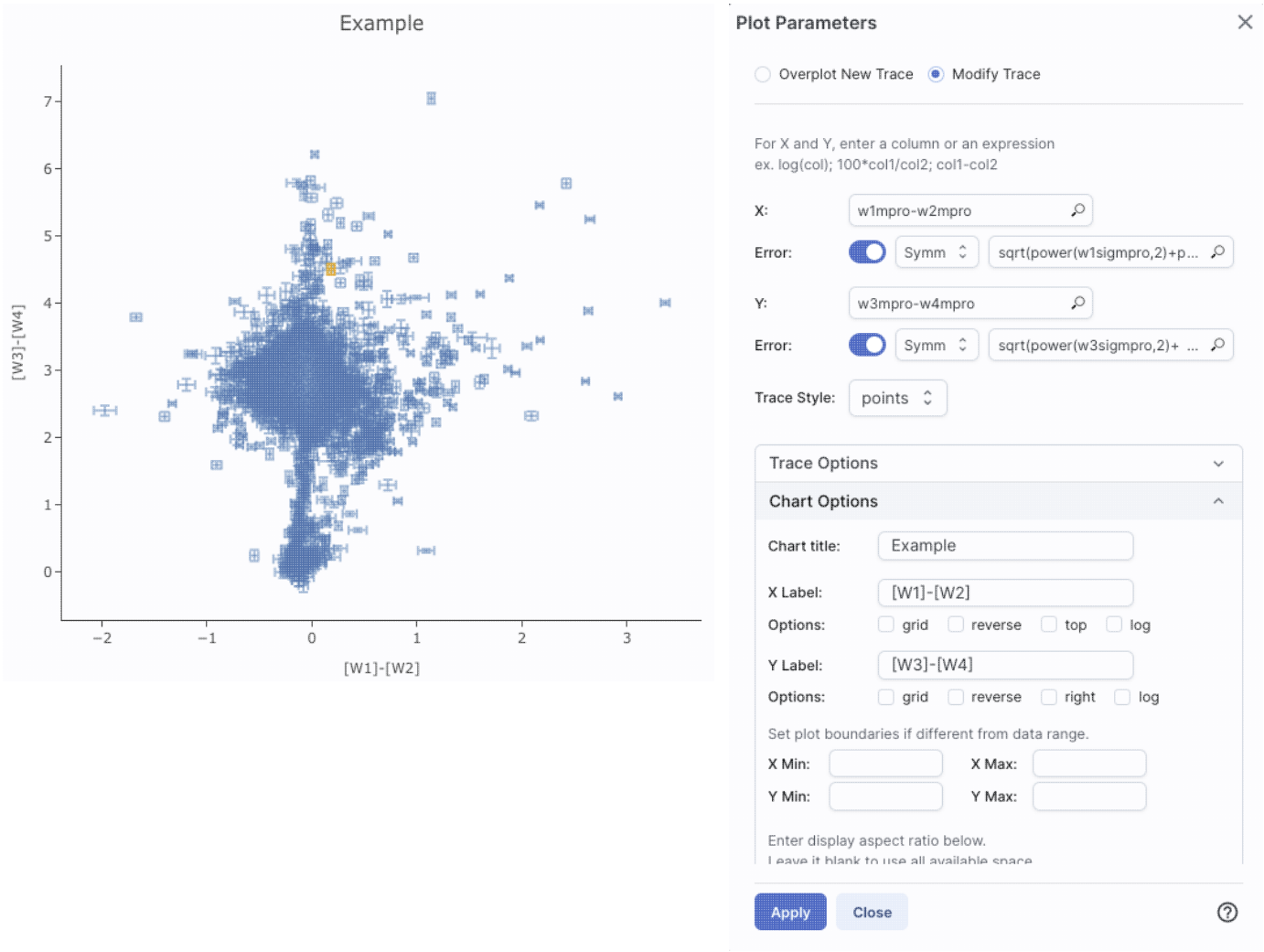
You can choose a single column to plot against another column, as above. However, you can also do simple mathematical manipulations.

For example, if you have loaded a WISE catalog, you can plot [W1]-[W2] vs. [W3]-[W4]. In terms of the names of the columns in the database, this is w1mpro-w2mpro vs. w3mpro-w4mpro.





If you have few enough points that the plot is not binned, you can add errors that you calculate. Here, the expression for the x-axis errors is sqrt(power(w1sigmpro,2)+power(w2sigmpro,2)) and for the y-axis errors, it is sqrt(power(w3sigmpro,2)+power(w4sigmpro,2)) -- that is, the errors for the individual photometric points added in quadrature.

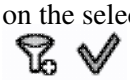


Restricting What is Plotted (from the plot)

You can also restrict what data are plotted in any of several different ways.

You can filter the catalog from the table itself (discussed in another section).

You can set axis limits on the plot itself from the plot options pop-up (discussed above).

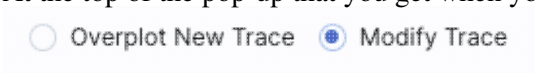
However, and perhaps more powerfully, you can set limits from the plot itself using a rubber band zoom. Click on the select icon in the plot  Then, click and drag in a sub-region of the plot. New icons appear:  If you click on the funnel icon, only those data points that pass the filter are shown in the plot, in the table, and/or overlaid on the image(s). (This is the behavior of 'filter', as opposed to 'select'; the former restricts what is shown, the latter just highlights the points.) For more on filters, see the filtering discussion in the tables section.

Example: Obtain a WISE catalog of a star-forming region, say IC1396. Filter down the catalog to only have detections at all four WISE bands. (Limits have undefined errors, so ask the catalog to filter down such that w1sigmpro>0, w2sigmpro>0, w3sigmpro>0, and w4sigmpro>0). Plot w1mpro-w4mpro on the x-axis, and

w1mpro on the y-axis. Reverse the y-axis to put bright objects at the top. Click and drag in the plot to select the bright and red objects, and filter them down to get a subset of bright and red sources. For clarity, the screenshot here has the sources selected, not filtered.

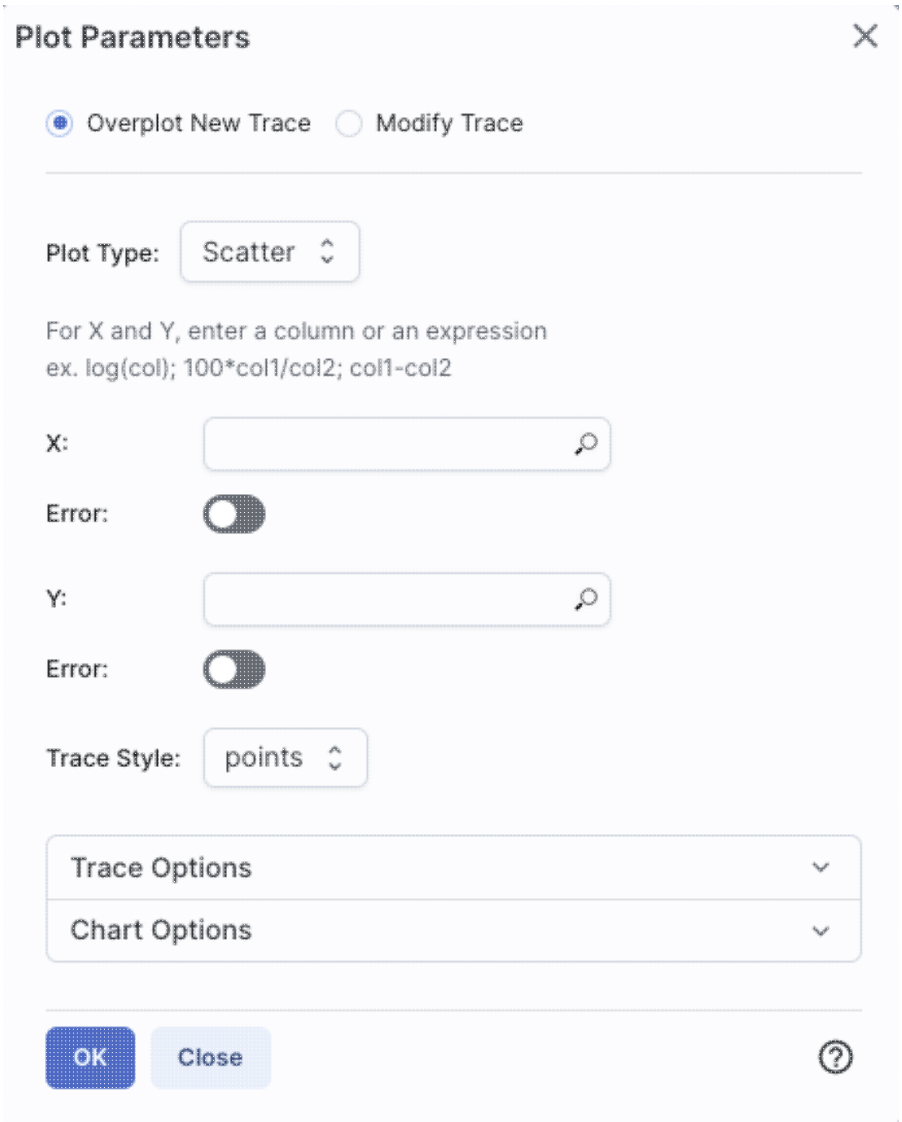
Overplotting

At the top of the pop-up that you get when you click on the gears, you have two radio buttons:



They are "Overplot New Trace" and "Modify Trace." Modifying traces (plots) has been covered above; in this section, we will cover overplotting. This is sometimes called "multi-trace," meaning that more than one thing is plotted.

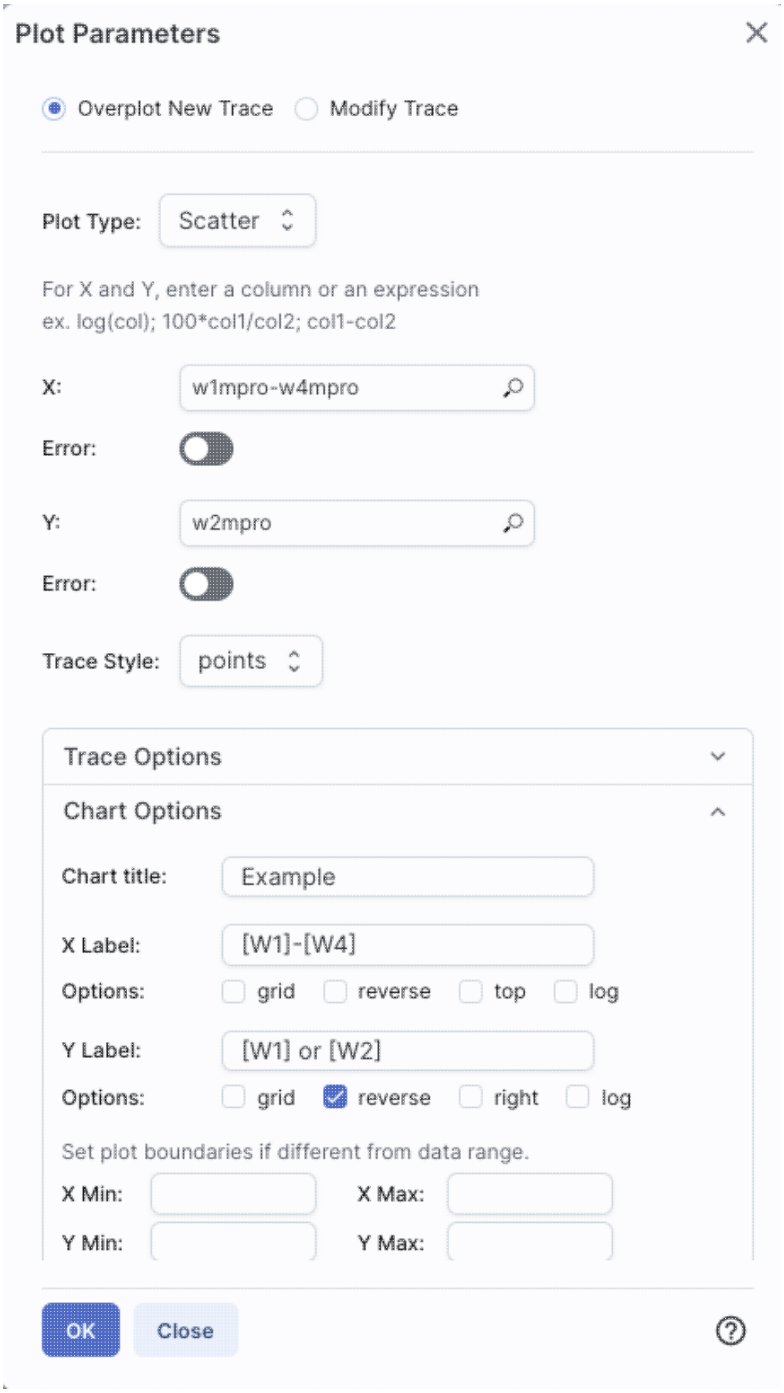
When you select "Overplot New Trace," you get a new interface that is very similar to the original interface where you selected what to plot:



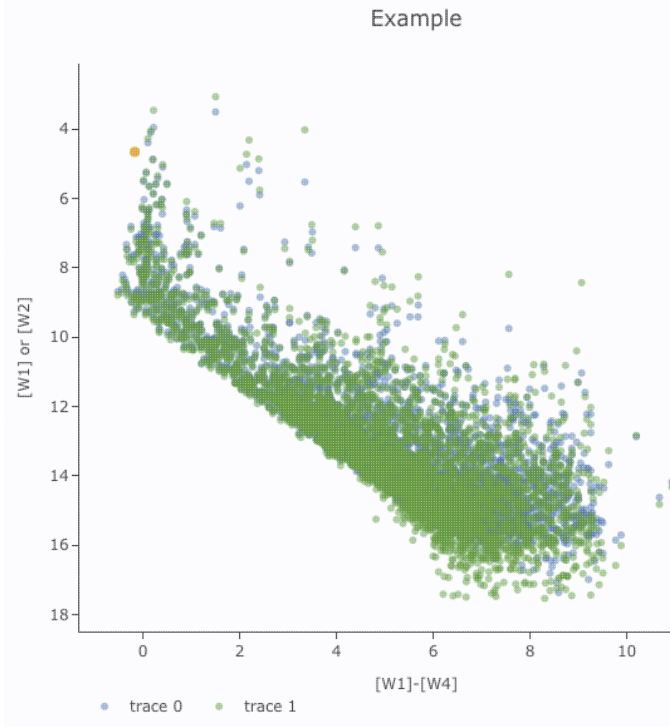
As before, you need to :

- select a plot type (scatter, heatmap, histogram);
- tell it what column(s) (and and manipulations thereof) you want for x, y, and associated errors;
- select the trace style (points, connected points, lines);
- set any additional trace options;
- set any additional chart options.

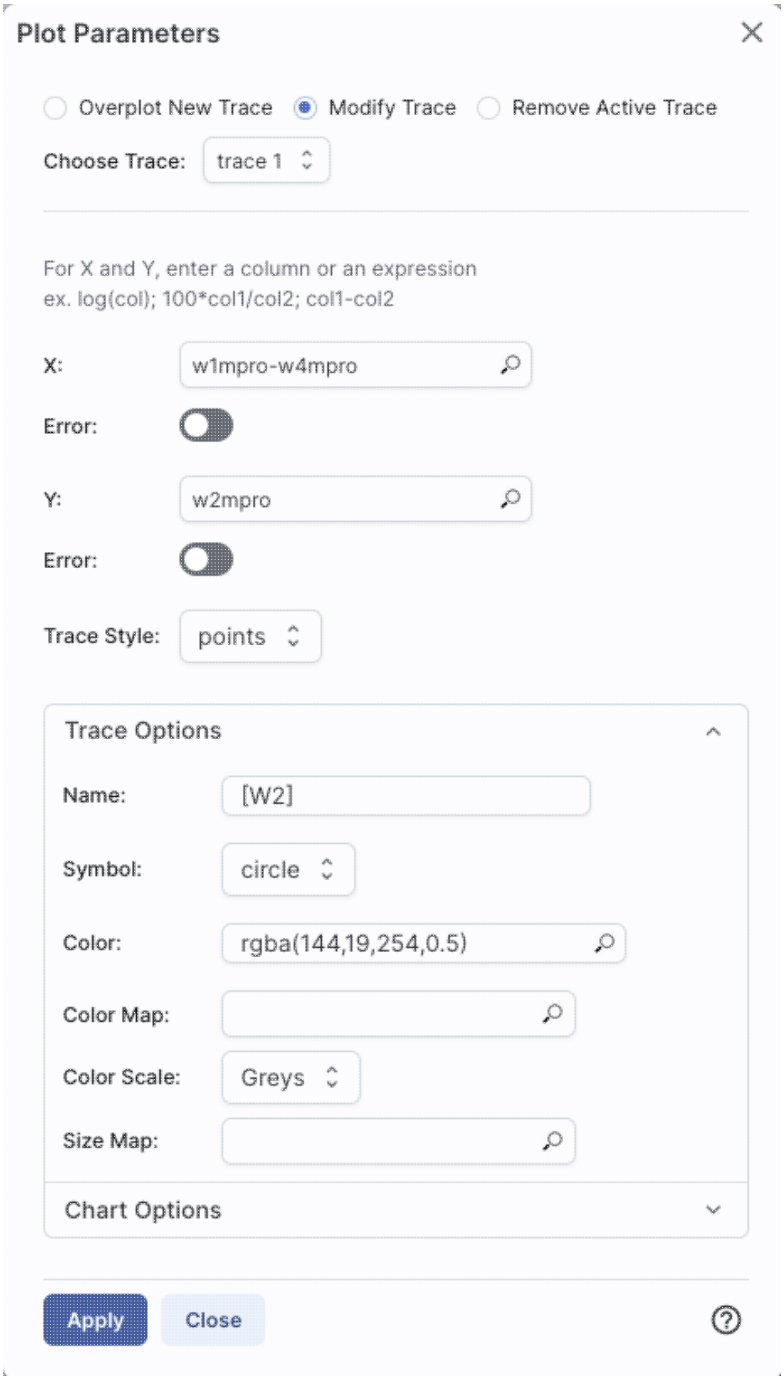
The best way to explain how to use this feature is probab
example. We have a plot of [W1] vs. [W1-W4] from abo
add on top of it a plot of [W2] vs. [W1-W4]. Click on the
bring up the pop-up. Select "Overplot New Trace." Enter
"w1mpro-w4mpro" for x and "w2mpro" for y. Expand "C
Options." Note that it has preserved the overall chart title
before, but has erased the X and Y labels (and lost the re
the y axis) because the overplot could literally be anythin
need not be the same columns or even the same units as
already plotted. Type them in again. Here is the configur



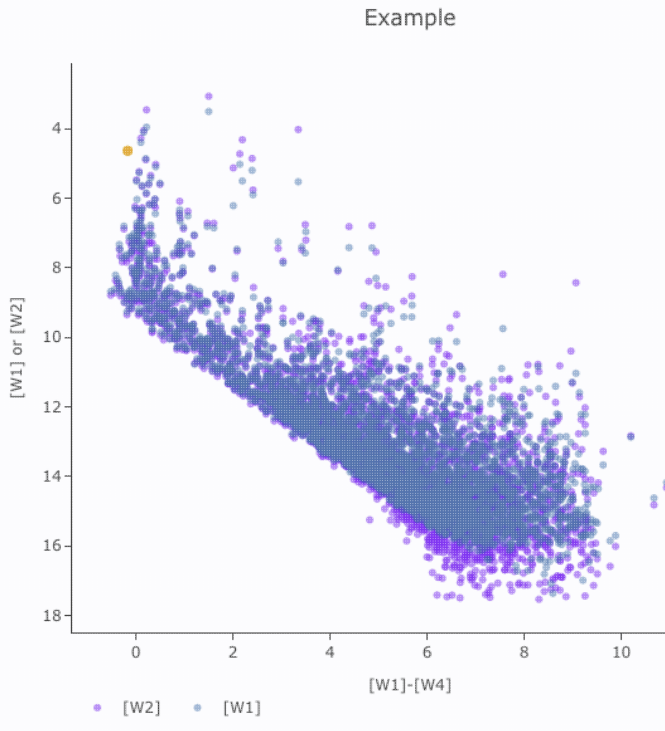
window right before clicking "ok", and the resultant plot



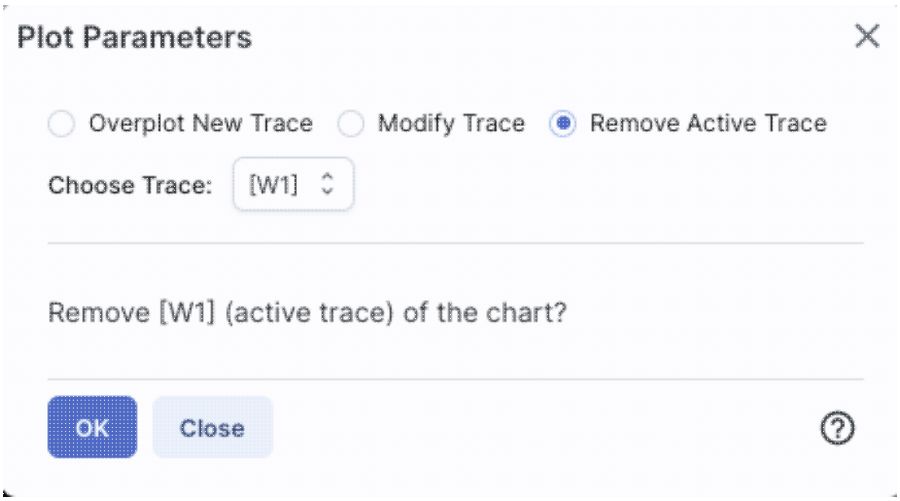
After you add the overplot, if you click on the gears agai
that the choices at the top of the window have changed. Y
add another overplotted trace, modify a trace, or remove
trace. Each trace that you add is a new 'layer' on the plot.
drop-down menu near the top of the window controls wh
is 'active' for setting the x, y, errors, trace style, name, sy
color, etc. there is now a drop-down menu at the top of th
There is a legend on the plot specifying which color corr
to which trace. In this example, the plot above has appea
a blue and green color scheme, which may be too hard to



differentiate. To change the new points' color, click on th
ensure "Modify Trace" is selected, select "trace 1" (as op
"trace 0", the first one you loaded), go down and expand
"Trace Options" and pick a different color. You can also
the legend name from "Trace 1" to, in this case, "[W2]".
"apply" to apply the changes to the plot. Note that once y
change the trace name, the relevant drop-down menus in
pop-up window and the legends on the plot update accor



Note that the pop-up spawned by clicking the gears now has an additional option at the top: "Add New Chart", "Overplot New Trace", "Modify Trace", and "Remove Active Trace." From here, you can modify a trace you have already plotted (as described above), overplot another trace (also as described above), or remove the selected trace:

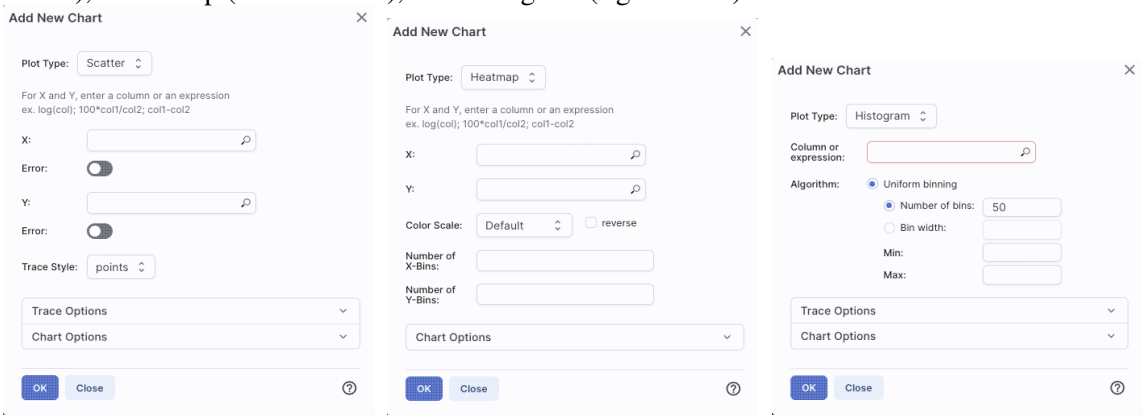


Tips and Troubleshooting

- Right now, the overplotting only works from the same catalog -- that is, you cannot plot [W1] vs. [W1]-[W4] from one catalog and overplot [W1] vs. [W1]-[W4] from another catalog. (We enthusiastically await this capability too.)
- You can easily get yourself into a physically nonsensical situation, say, by overplotting a histogram onto a scatter plot. If you find yourself in a hopeless mess, click on the "undo" icon to reset everything and try again.
- When you have more than one thing (trace) plotted, double click on the legend to bring that trace to the foreground and temporarily hide the other traces.
- You can overplot a scatter plot on top of a heatmap if you really want to!

Adding Plots

Clicking on this icon brings up a dialog from which you can choose to make another scatter plot (left below), a heatmap (center below), or a histogram (right below):



The options for these plots here are very similar to what is described above. You can specify which columns to plot or manipulate and plot, specify labels, etc.

Scatter plots allow you to choose points, connected points, or lines; you can add errors to each point.

Heatmap plots are binned scatter plots; you can choose what color scale and how many bins to use.

Histogram plots allow you to choose how many bins or the bin width. Note that, if you provide a minimum number, the binning starts at the minimum value you provide, and may exceed the maximum you entered in order to fit in a whole bin.

You can change what is plotted after plotting by clicking on the gears, as described above.

You can have many plots up at the same time.

You can view multiple plots all at once or one at a time by clicking on the corresponding icons above the plots (just as when you have multiple images loaded).  The single box means "one at a time", the set of four boxes means "all the plots at once". If you are viewing one at a time and have more than one plot loaded, you will see the ">" and "<" signs (as in the image here), and you can scroll among the plots by clicking on these arrows (just as when you have multiple images loaded).

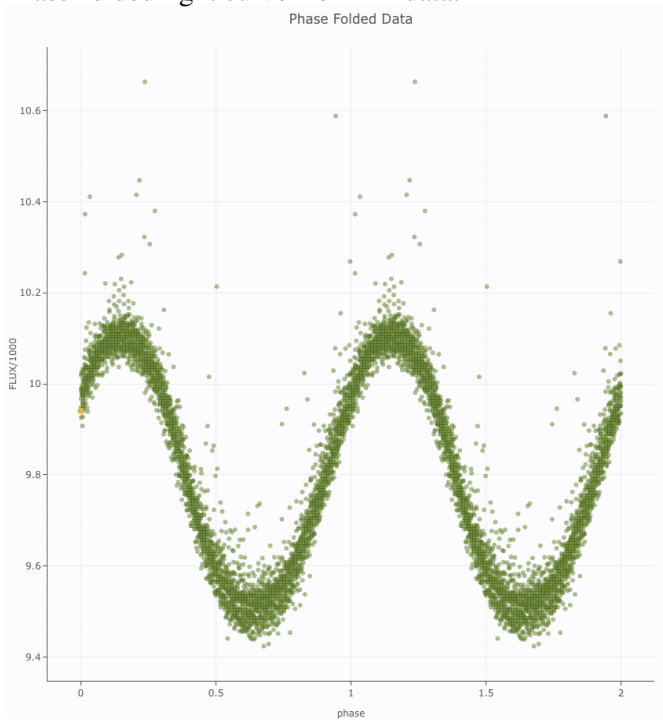
Tips and Troubleshooting

- Note that many plots of a large catalog may make your browser run slowly.
- You can force the tool to make a scatter plot even if you have a catalog of >5,000 points; it just might make your browser slow down. You can even overplot a scatter plot on top of a heatmap if you really want to!
- To remove a plot, click on the 'x' in the upper right corner of the plot.

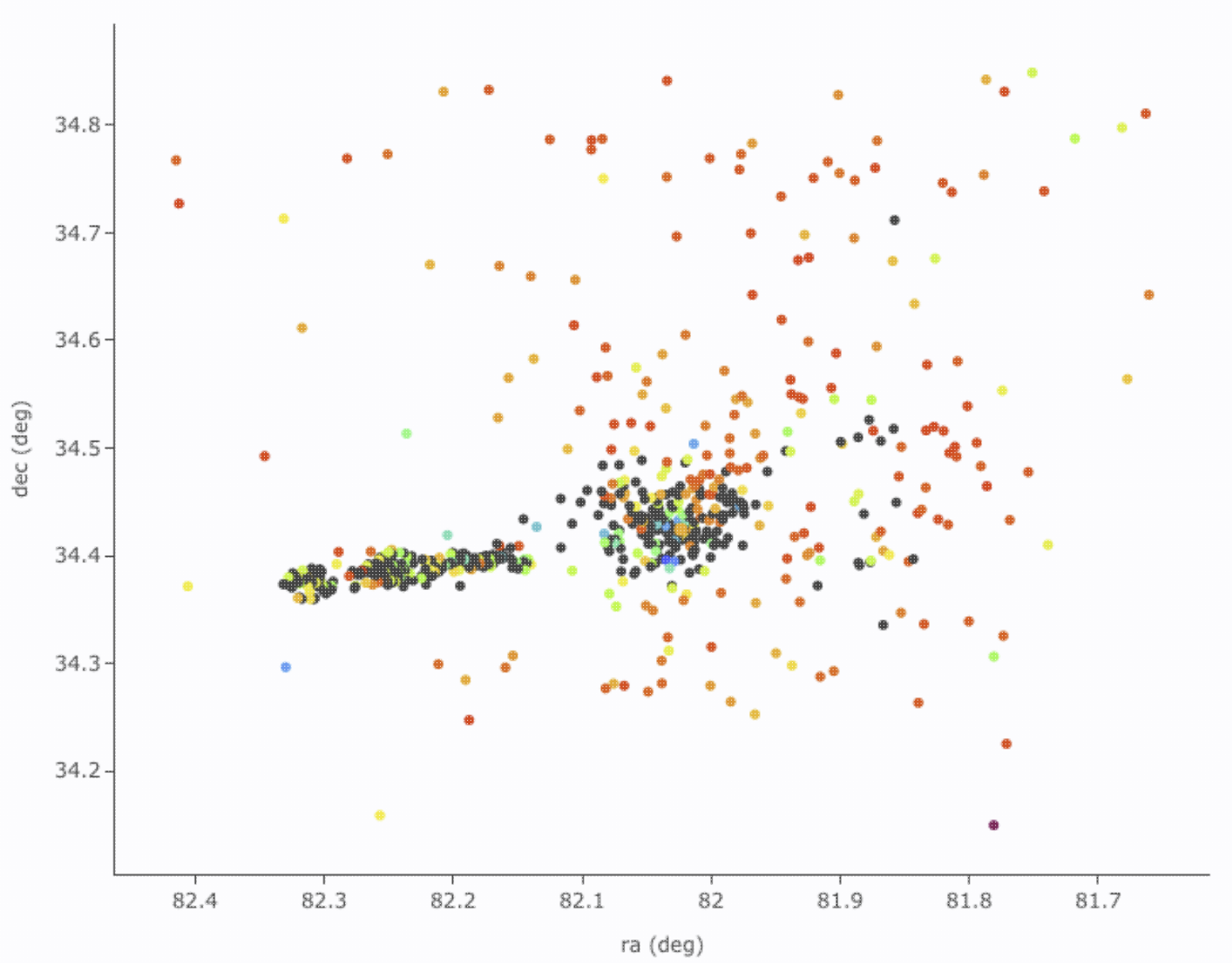
Examples of catalog plots

Here are several examples of plots made with IRSA tools.

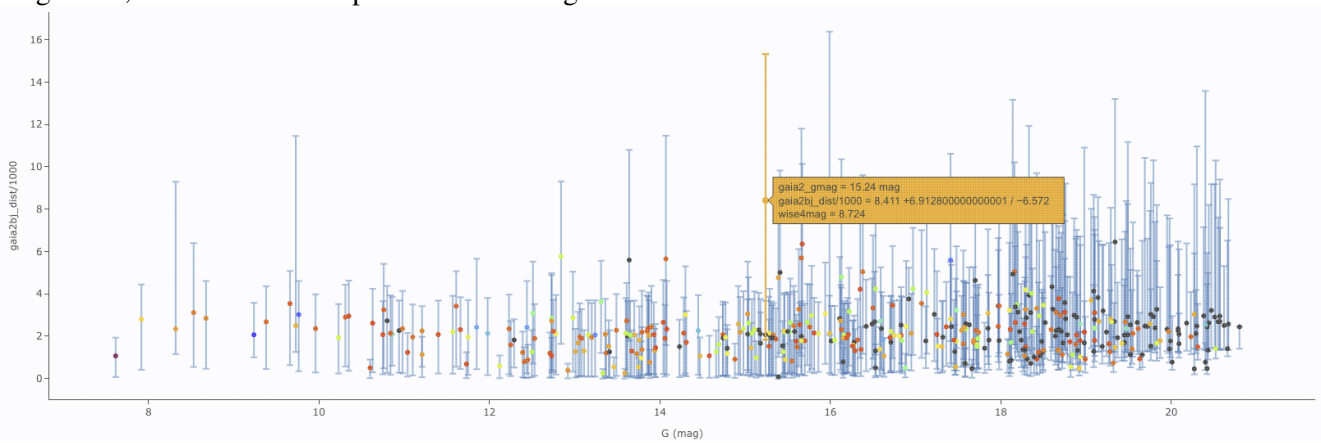
Phase-folded light curve from K2 data:



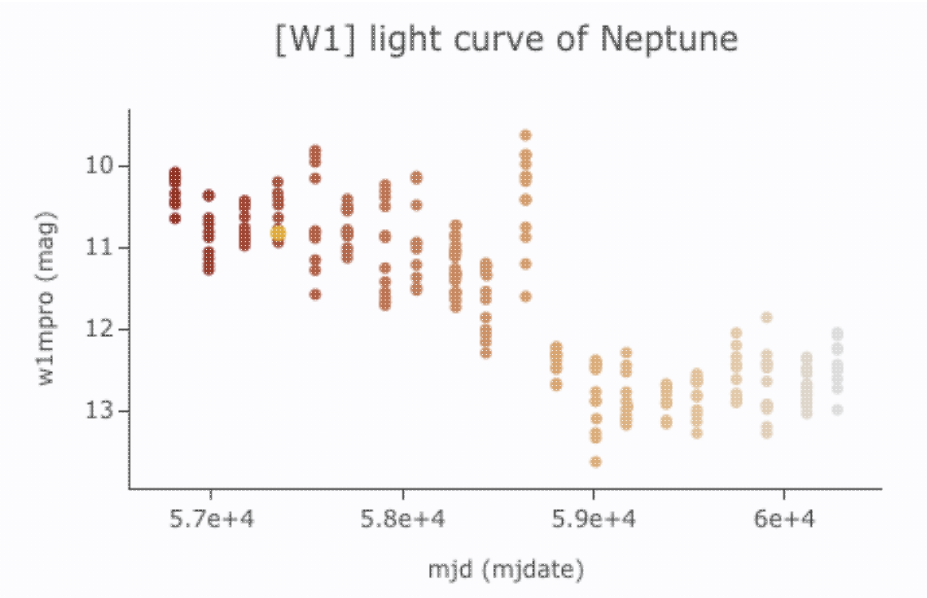
Plot on the sky of stars where the color of the point is scaled to brightness in WISE-4:



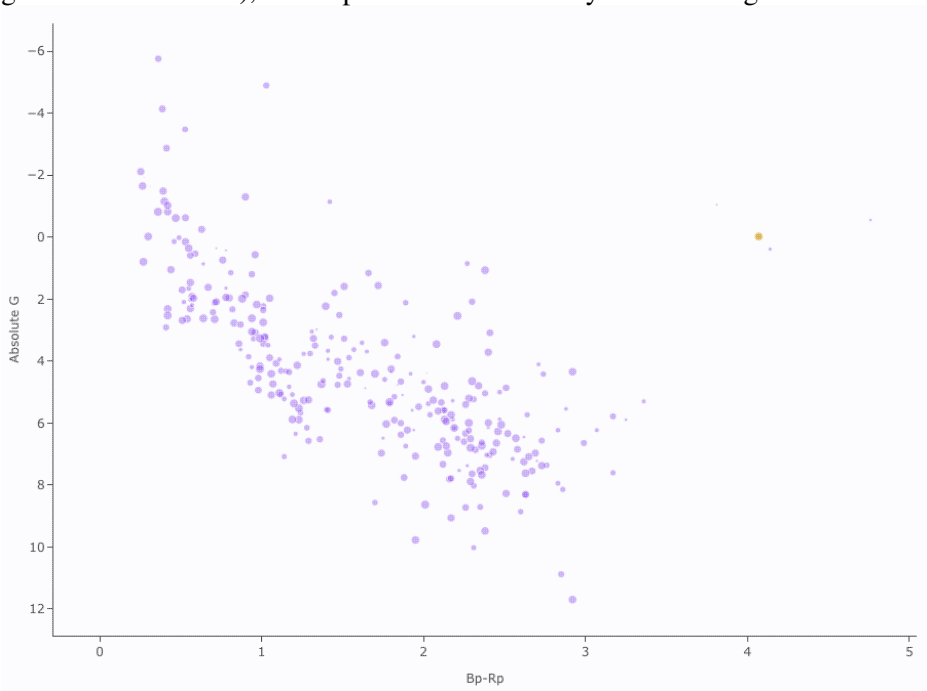
Gaia distance (in kpc, from Bailer-Jones et al. 2018), with asymmetric errors, as a function of Gaia G magnitude, with colors of the point scaled to brightness in WISE-4:



[W1] light curve of Neptune over several years, with colors of the point scaled to heliocentric distance:



Absolute Gaia color-magnitude diagram of candidate members of a star-forming region (note some background giants still in the list), where point size is scaled by WISE-4 brightness:



Spitzer Heritage Archive: Spectra

Visualization of spectra within the Spitzer Heritage Archive use capabilities of Tables, (image) Visualization, and Plots. Generic help on those capabilities can be found in those other sections; since spectra are a special case of plots, this section focuses on spectra specifically found in the Spitzer Heritage Archive.

Contents of page/chapter:

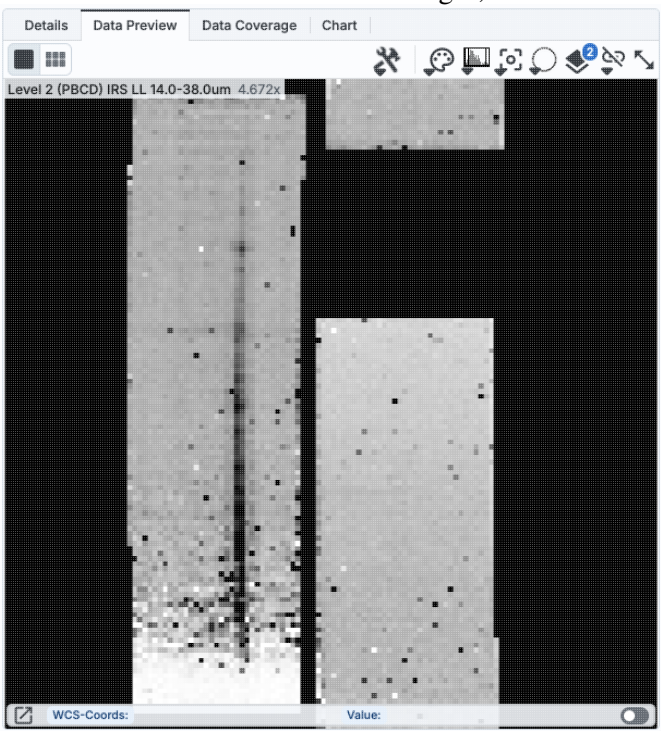
Introduction

Some of the spectral files in the Spitzer Heritage Archive show the spectrum as an image, and for some you are given a choice to view it as as a table or a plot.

To visualize spectra, you must be on the search results page, with an Level 2 (PBCD) or Level 1 (BCD) or IRS Enhanced Product instrument tab in the foreground on the left (not any of the other ones) and have the "Data Preview" tab in the foreground on the right. (And, of course, your search must have returned spectra.)

Images

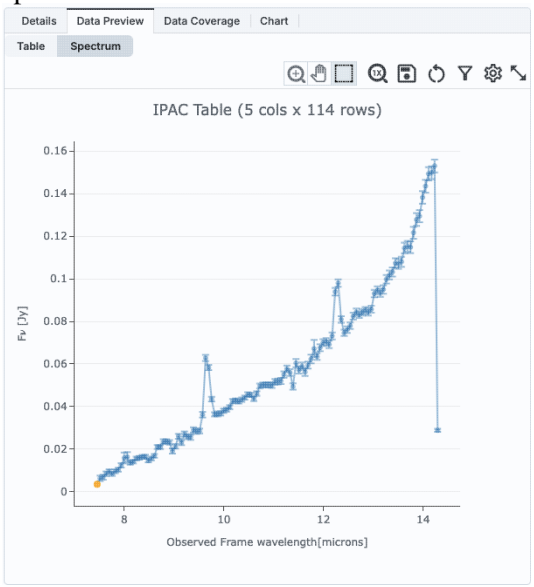
If the data are stored as FITS file images, it will show the image to you, as in this Level 2 IRS LL data product:

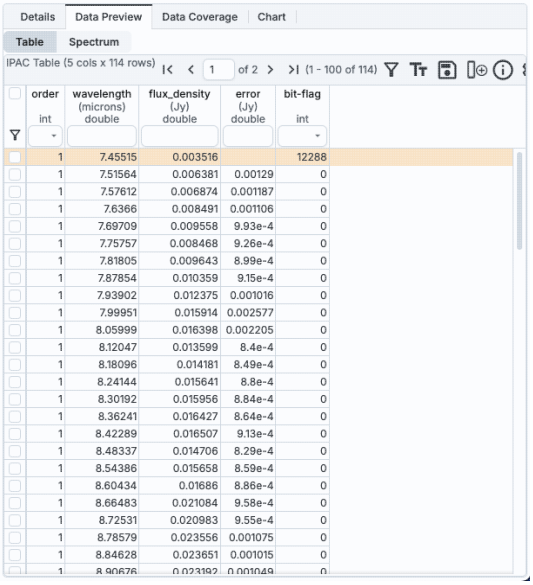


Each of these images can be interacted with as described in the (image) Visualization section. However, zooming has a somewhat different physical meaning in this sort of image than it does for, say, an IRAC image.

Data Tables and Plots

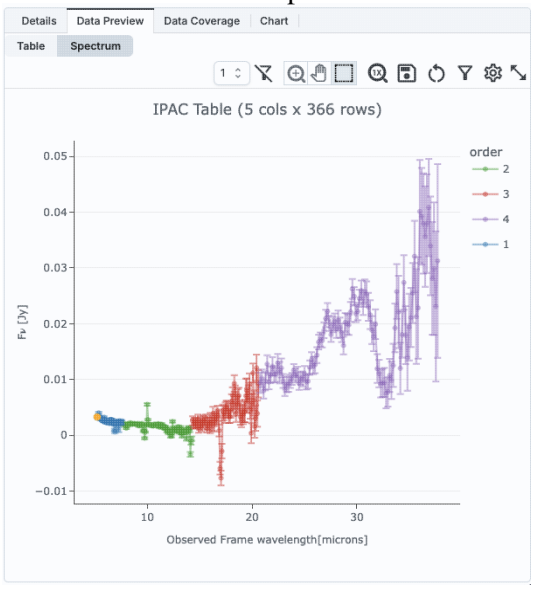
Some data products can be viewed as plots or as tables, as in the case of this IRS Level 2 background-subtracted spectrum.

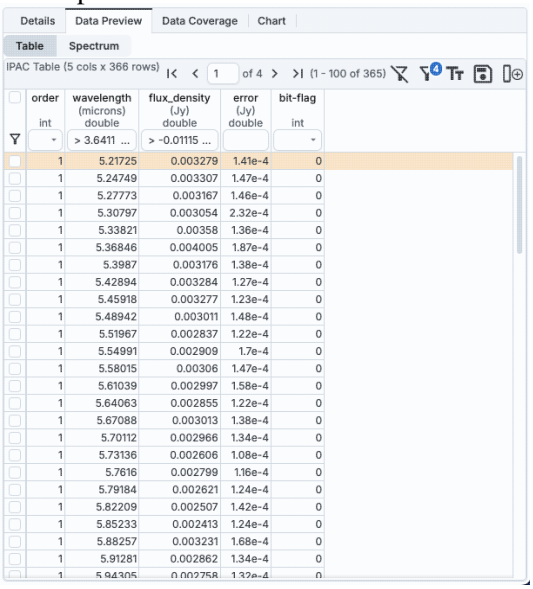




You can toggle between plot and table using the buttons on the top left. Note that the plot is only as smart as the information given to it by the data file -- if the tool doesn't recognize it as a spectrum, or no units are provided in the data table, then it can't understand the units.In this case, it understands the units and even adds error bars.

The IRS Enhanced data products are a little more sophisticated:





The tool is smart enough to understand that there are multiple spectral orders in the file and plots them in the same plot, with different colors, and it gets the units right. It has included error bars here too. In this case, there has been a filter imposed to omit a last point at the reddest wavelength that is apparently an outlier; you can see the filter imposed particularly at the top of the table columns.

These tables can be interacted with as described in the Tables section, and the plots can be interacted with as described in the Plots section.

Redshifting Spectra

When the tool recognizes the wavelength axis, it offers you a choice of redshifting the spectrum. By default, it assumes you want to plot the data as observed:

but if you pick "Rest Frame":

you can enter a redshift, and it shows you how it adjusts the wavelength axis accordingly:

Click 'Apply' to implement these changes in the plot. The axis labels on the plot correspondingly change.

To change back to the data as observed, simply pick "Observed Frame" from the drop-down menu.

Spitzer Heritage Archive: Data Downloads

Contents of page/chapter:

Overview

To save individual things like single tables, images, or plots, look for a diskette icon () in the corresponding pane. Tables, images, and plots can all be saved individually.

To download data, in the simplest case, on the search results page, just click the checkboxes on the far left of each row to pick specific observations to download, and then click the "Prepare Download" button 

to begin the packaging (and downloading) process. A pop-up window will appear in order to define exactly what kinds of data you would like to have packaged up. Clicking "prepare download" in the pop-up initializes this process.

To select *all* of the data you have displayed, click on the checkbox at the top of the column of checkboxes, and all of the rows are automatically clicked (even those on subsequent pages if you have more than one page). Then click "Prepare Download" to initiate the packaging process.

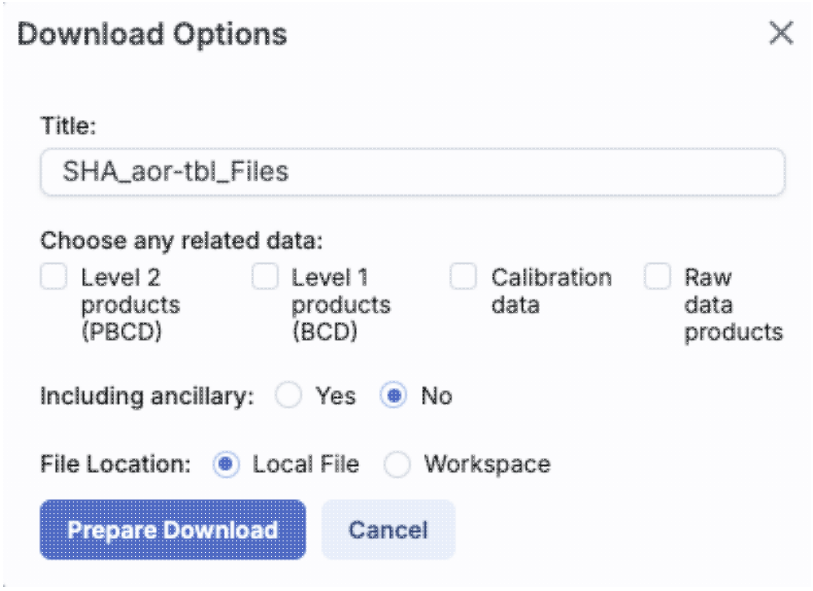
The packaging process spins off into the Job Monitor, which keeps track of its progress and notifies you when the downloads are complete. You can choose to have an email sent to you to let you know when things are ready, even after the packaging process has started.

Tips and Troubleshooting

- **You** control where the file is saved on your disk through your browser; your browser may be configured to store all downloads in a particular location on your disk. Try looking in a "Downloads" directory, or for "recently modified files."
- You need to be logged in to use the IRSA Workspace.

Options for Downloading Data

From the pop-up, you can choose what to download:



(The options may be slightly different, depending on the tab from which you initiate the download.)

The first row is the name by which this packaging job will be known to the Job Monitor as well as what the root filename is for the saved file - change it to whatever you want (time or a description of your search is usually the most helpful).

The second row is an indicator of what kinds of data you want -- the Level 2 (PBCD) data products, the Level 1 (BCD) data products, the calibration data associated with this observation, and/or the raw data products. The Level 2 data are often science-ready, but depending on your science goals, you may need different data products; consult the Spitzer documentation.

The third row controls whether additional ancillary (frequently calibration- or pipeline-related) files are included. Again, consult the Spitzer documentation for more information.

The "File Location" row controls whether the file is saved to your local disk or the IRSA Workspace.

Click "Prepare Download" in the pop-up window, and it will go do it!

If you request relatively little data, the download will happen quickly. If you request a lot of data, you are given a choice to place the job in the Job Monitor.

Tips and Troubleshooting

- Select one row at a time by clicking the tickboxes on the far left of each row. Select all of them at once by selecting the tickbox at the top of that column of tickboxes.
- If you select data products from the AOR, Level 2, Level 1, or even the IRS Enhanced Products tab, the tool is smart enough to be able to trace back all the data products and give you the option to download the constituent products (e.g., from the IRS enhanced tab, you can still immediately download BCD data products that went into that IRS enhanced data product). However, the SEIP Super Mosaics are not quite as clever. You can only download the mosaics (plus optional ancillary materials) from this tool. The traceback information is in the SEIP delivery, but you will have to do that tracing back yourself to find the constituent observations.

- Note that **you** control where the data are saved on your disk through your browser; your browser may be configured to store all downloads in a particular location on your disk.
- To save any SEIP source lists you retrieve, use the diskette icon on the table, not the "prepare download" button.
- You will download zip files. Depending on how, exactly, you unzip your files, your computer may put the contents of each *zipfile* into one directory, rather than, say, the contents of each *observation* into one directory. If you are using a GUI-based method (e.g., click to uncompress), there should be a preferences option to allow you to uncompress subsequent zipfiles into the same root directory. You can also set flags on the command line to put all files from the same observation in the same directory.
- Double-clicking on the saved downloads should uncompress them, and then you should be off and running. However, some Windows users have reported having difficulty unzipping files downloaded from the SOFIA archive using the default application. We recommend using 7-zip.

Deciding what files to download

All users should consult the corresponding Instrument Handbook (available in the Spitzer documentation) for details and for information to consider for your own project.

Most new users probably will want the most highly processed data versions available -- Enhanced Products first, then Level 2 (PBCD) products.

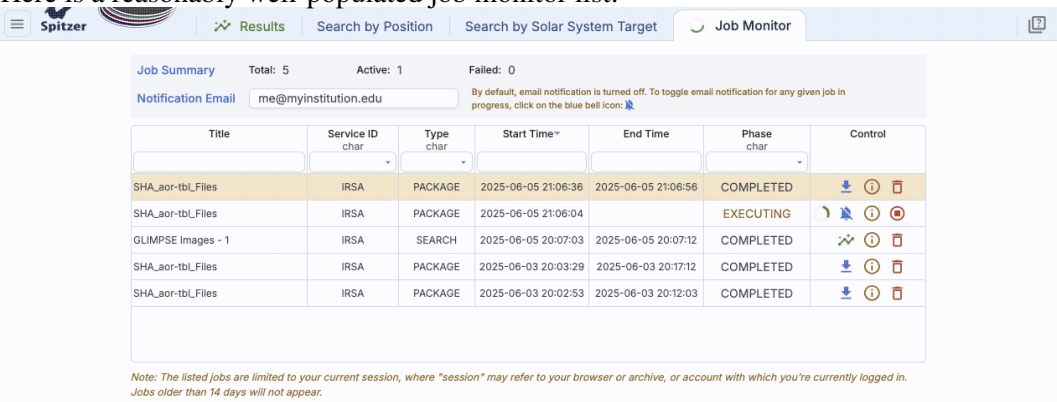
More experienced users, or users wanting more control over the analysis (e.g., wanting highly accurate photometry), will want to download the Level 1 (BCD) data.

Very experienced users may want the Level 0 (raw) data. Choose this option with caution! Note also that some raw data was not included in the generation of the final products. When selecting the 'raw data' download option, *all* of the frames associated with your AORs are downloaded, not just the ones, e.g., within a smaller search radius.

Job Monitor

To explore the Job Monitor, click on the Job Monitor tab at the top of the screen:

Here is a reasonably well-populated job monitor list:



At the top, it summarizes (in this case) that there are 5 jobs, one of which is currently active, and none of which have failed. The email has been filled out, so that email notification can easily be toggled on (or off) with a single click.

Below that, there is a table, like any other table in this tool (with all the associated sorting and filtering cabilities), that lists all of the jobs that have been sent to the Job Monitor in this session, along with basic information like what time (in Universal Time) they were launched. Four of them in this screenshot are data packaging (type = package), one of which is still executing, and one is a search (type = search).

On the far right is a collection of icons. The different icons do different things:

Usually this icon is animated -- the job is executing.


Display the results of this job in the tool -- usually this appears in reference to a catalog search, and the icon matches that in the "Results" tab, which is where the results will appear after you click on this icon.


Notification toggled on -- if an email is provided in the top of the Job Monitor, then email will be sent upon completion (see below).


Notification toggled off -- this is the default state.


Download the results of this job to your disk -- this could be a zip file, a data file (e.g., a FITS file), or a download script, depending on what data you are accessing.


Get more information about this job (see below).


Stop this job.


Discard this job from this list.

Jobs accumulate in the Job Monitor over a given session, which could include more than one browser window accessing the same archive, because it relies on cookies being set. Jobs that are older than 2 weeks will not appear.

Tips and Troubleshooting

- **You** control where the file is saved on your disk through your browser; your browser may be configured to store all downloads in a particular location on your disk. Try looking in a "Downloads" directory, or for "recently modified files."

Sending Email

For large data packaging jobs, you may wish to have the system email you when it is done and ready for downloading.

In order to make this happen, you have to do two things.

1. Enter a valid email at the top of the Job Monitor page. (It should go without saying that if you don't enter a correct email, it can't do anything to fix that.)
2. Tell it that you want it to send you an email for the specific job in question. Click on the blue bell at any time before the job completes to toggle an email being sent to you upon completion.


This means don't send email


This means do send email

The reason it defaults to "don't send email" is so that you avoid spamming yourself - if you make a lot of requests, you most likely don't want it to send you a lot of emails in rapid succession.

If you ask it to email you for a download packaging request, you will be emailed links to obtain a curl or wget script, or a list of URLs that you can feed to your own code to get your data. See the scripts section for more details.

Tips and Troubleshooting

- By default, it will NOT send you email when it is complete, even if you have an email filled out. (This is to avoid accidentally spamming yourself!) Click on the blue bell at any time before the job completes to toggle an email being sent to you upon completion.

Scripts

If you get an email from the Job Monitor, you will get a curl or wget script that you can execute on your computer to download the files you have requested, or you may choose to obtain just a list of URLs that you can feed to your own code to download the data. The scripts are designed to echo to the screen updates on what they are doing, so that you can track the download's progress.

To use these, save the script to a plain text file, and invoke the script. You may need to do something at the commmand line like "chmod +x script.sh" and then "./script.sh" to invoke it. You could also copy and paste the script lines individually into your terminal window.

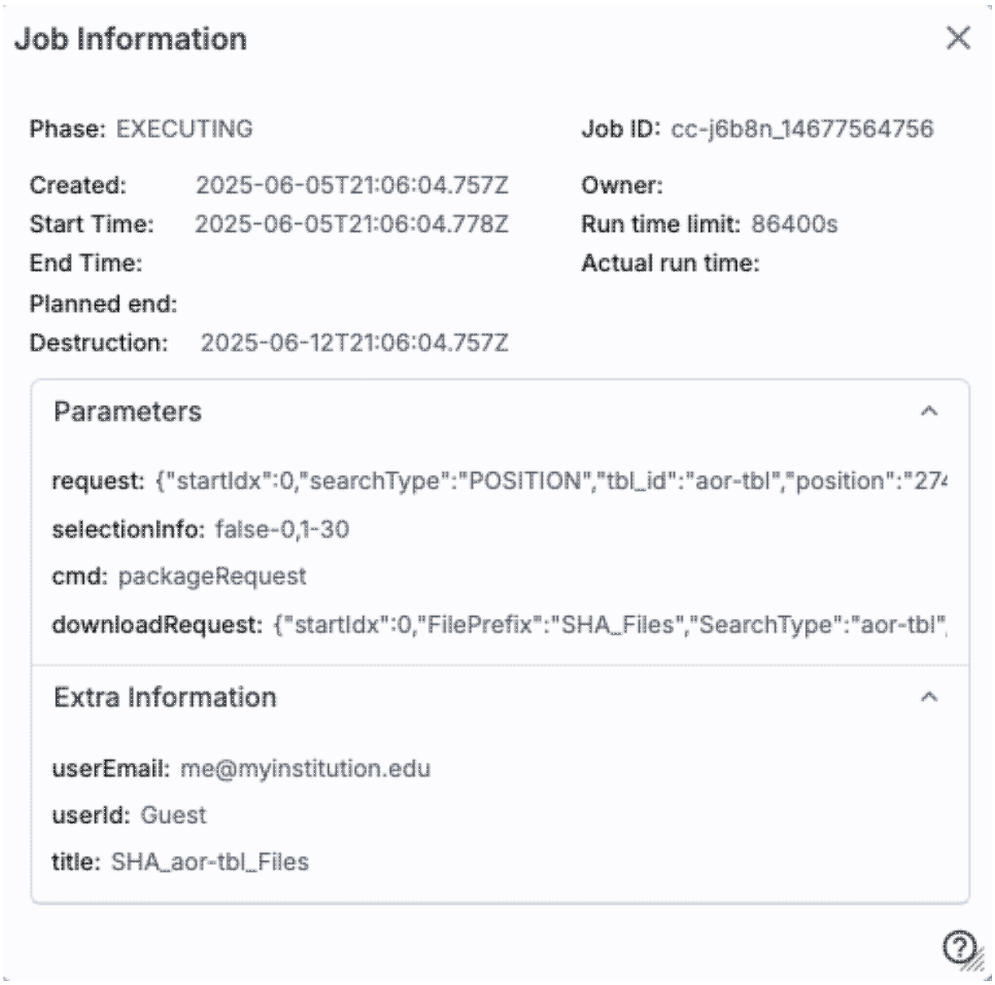
Generally speaking, the wget script is best for Linux and Unix users. The curl script is best for Mac users, because curl is part of the standard OS distribution; Mac users can also go retrieve and install wget and then use the wget scripts.

Double-clicking on the downloaded zip files should uncompress them, and then you should be off and running. However, some Windows users have reported having difficulty unzipping files downloaded from the SOFIA archive using the default application. We recommend using 7-zip.

Depending on how, exactly, you unzip your files, your computer may put the contents of each zipfile into one directory, rather than, say, the contents of each AOR into one directory (which was the original design, and the conceptually most straightforward). If you are using a GUI-based method (e.g., click to uncompress), there should be a preferences option to allow you to uncompress subsequent zipfiles into the same root directory.

Job Information

The information you get when you click on the i-in-a-circle  in the Job Monitor looks something like this:



It specifies things about the query, like when it was submitted and how long it took, but also the job ID (useful for helpdesk tickets), and the parameters you used (which you can copy using the ellipsis, just like for table cells), and also what information you provided -- username if you logged in, email if you provided it, title if you provided it, and the URL that links directly to the job (also useful for helpdesk tickets; to copy it, click on the tiny clipboard icon).

Acknowledging Spitzer and IRSA

Now that you've got your data, you're going to write a great paper. Please consult this page to find the acknowledgments to use for Spitzer.

This service you are using now, the Spitzer Heritage Archive, has DOI 10.26131/IRSA543. Individual data sets that delivered ready-to-use data back to IRSA each have their own DOI; see the page corresponding to each data set to find the DOI and canonical paper to cite.

Note that you can use the \facilities call in AASTeX to acknowledge both IRSA and Spitzer as a facility you used in your journal article.

Spitzer Heritage Archive: API

Contents of page/chapter:

Overall Introduction

There are several ways to interact with the SHA in an automatic or semi-automatic fashion.

The semi-automatic way is to pass a list of sources to the SHA web interface. You can pass a list of up to 1000 sources to the SHA from the search screen. More information on that is in the Searching section. For this, you still need to examine the output of this by hand, but at least you do not have to send targets individually to the server.

An API, or application programming interface, can also be known as a "command-line" interface.

You can write code that constructs a URL that launches an SHA session in a browser, either ready to search, or with search results, or with search results already loaded. That's what the rest of this page covers.

There are other ways to interact via code with all of IRSA's holdings, including the data held in the SHA. All of that documentation is elsewhere at IRSA.

SHA-specific API Examples

Open search panel with Program ID prefilled and default data products selected
/applications/Spitzer/SHA/?api=search&searchoption=PROGRAM&program=30080&execute=false
Search and return an SHA result with the following criteria: Program ID and selected data products
/applications/Spitzer/SHA/?api=search&searchoption=PROGRAM&program=50180&selectProducts=levelAor,lev
Open position search panel with position and search radius filled in and data products selected
/applications/Spitzer/SHA/?api=search&searchoption=POSITION&WorldPt=83.773986;-5.418506;EQ_J2000&sel
Search and return an SHA result for a given position and search radius
/applications/Spitzer/SHA/?api=search&ra=83.7739862708531&dec=-5.41850696034436&sr=350s&searchoption=
Open search panel with AORKEY filled in and data products selected
/applications/Spitzer/SHA/?api=search&searchoption=AORKEY&aorKey=21641216&selectProducts=levelAor,lev
Search and return an SHA result with following criteria: AORKEY and selected data products
/applications/Spitzer/SHA/?api=search&searchoption=AORKEY&aorKey=21641216&selectProducts=levelAor,lev
Open NAIF ID search panel and select some data products
/applications/Spitzer/SHA/?api=search&searchoption=NAIFID&naifId=2003226&selectProducts=levelAor,level2,
Search and return an SHA result with NAIF ID filled in and data products selected
/applications/Spitzer/SHA/?api=search&searchoption=NAIFID&naifId=2003226&selectProducts=levelAor,level2&

SHA-specific API Input Parameters

The input parameters are entered as standard HTTP *parameter=value* pairs. In this syntax, the parameter name is followed by an equals sign (=) which is then followed by a value. No extra spaces are allowed, and if the

value contains any spaces or special characters that might be ambiguous, they have to be encoded formally as in any HTTP or URL reference (more discussion here: http://www.w3schools.com/html/html_entities.asp). As shown above, these pairs are separated from each other by ampersand (&) characters.

WorldPt or ra/dec	coordinates of the search position. worldPt format - lon;lat;Csys - eg: 1.0;2.3;EQ_J2000 or 5;4;GAL ra, dec format - ra=1&dec=2 - always j2000
searchoption	SHA search options: POSITION, PROGRAM, AORKEY, NAIFID
program	Alphanumeric value representing a Program
aorKey	Spitzer Astronomical Observation Request Number (AORKEY)
naifId	Unique number allocated to Solar System Objects (e.g. planets, asteroids, comets, spacecraft) by JPL
selectProducts	SHA data products: levelAor, level2, level1, levelssc, levelSuperMosaics, sourceList. Optional parameter, if not specified, set to default value.
sr	radius of search (optional) sr format options: d or none - degrees, m - arcminutes, s - arcseconds sr=1.1d or sr=1.1 - 1.1 degrees sr=150s - 150 arcseconds sr=22m - 22 arcminutes
execute	true or false - if true, execute the search and show the results

User Registration for the Spitzer Heritage Archive

While you certainly **do not have to register** to search the archive, download data, analyze it, and write a paper, you may wish to register so that the SHA remembers you.

Note that there is a single user account/password combination for all IRSA services, but that data access is unique to each archive.

Log In

The "Login" link is in the far top right of the SHA page.

Select this option to log in if you know your password, or to create a new account.

Create New Account

Find this option by selecting "Sign in" in the far top right of the browser window, and then "Create an account" appears as an option in the lower left of the pop-up window.

Select this option to create a new account.

Forgot your Username or Password

If you do not remember your username or password, select this option to retrieve this lost information.

Find this option by selecting "Sign in" in the far top right of the browser page, and then "forgot your password?" appears as an option below the Login button.

Edit Profile

Find this option by logging in, and then clicking on your account name in the top right of the browser window. Then, select "Edit Profile" to change your password on an existing account.

Change Password

Find this option by logging in, and then clicking on your account name in the top right of the browser window. Then, select "Change Password" to change your password on an existing account.

Update Email

Find this option by logging in, and then clicking on your account name in the top right of the browser window. Then, select "Update Email" to change your email on an existing account.

Frequently Asked Questions (FAQs) about the Spitzer Heritage Archive (SHA)

Interface questions

What does SHA/AOR/IER/BCD/PBCD/Level 1/Level 2 mean?

Here are some common definitions. The archive of Spitzer data is the Spitzer Heritage Archive (SHA). An individual Spitzer observation sequence is an AOR, or Astronomical Observation Request. In certain cases (often calibration or sometimes science observations), you may also see an IER, or Instrument Engineering Request. Either one involves many individual frames. The individual data frames that emerge, calibrated, from the Spitzer pipeline are Level 1, or Basic Calibrated Data, or BCDs. The products that come from combining these individual data frames (such as mosaics of individual pointings) are Level 2, or post-BCD, or PBCD data. Enhanced products come from combining AORs or doing post processing (such as synthetic photometry from spectra or source extraction from images). These can be contributed by the community, or generated by the SSC itself.

Do you have any tutorial videos?

Yes. The IRSA YouTube channel has several tutorials that are relevant to the SHA -- see the Spitzer playlist as well as the set of "micro-tutorials" relevant for more than one archive. The videos are in HD; you may need to manually use the YouTube gear menu to force it to realize this. There is also English closed-captioning available.

How do I download all of the data shown at once?

Click on the checkbox at the top of the column of checkboxes, at the top left of the search results pane. Then click on "prepare download."

How come I can't make a 3-color image from Spitzer data I am exploring interactively?

The visualization tools currently only allow you to create 3-color images that you load from disk or from the web. If you want to create 3-color images using Spitzer data, download the data to disk and then load them from your disk into other IRSA tools with this look and feel, such as IRSA Viewer -- it is easier to create 3-color images there.

I know that there are a lot more files that should come as part of Level 1 (BCD) or Level 2 (PBCD) data. How come I can't see them in the Level 1 or 2 tabs?

Yes, there are a lot more files than what are shown, such as the errors! We decided for clarity that only certain files of primary interest to users would appear for individual examination in the SHA interface, but of course the download includes many more files -- you don't even have to tell it to include ancillary products. The IRAC, IRS, and MIPS Instrument Handbooks list (and define) all of the files that are included in the downloads.

How come it is only showing me mosaic files in the Level 2/PBCD tab? Where are the errors, shorter exposure frames for HDR data, etc?

Only the highest level products are shown in the Level 2/PBCD tab, and for that matter the Level 1/BCD tab. This is designed for you to inspect the data enough to see if you want to download it. If you package up the data for downloading, the most frequently used standard files (errors, coverage, masks, etc.) will come with the download; to ensure you have all the files, select "incuding ancillary" when packaging.

I did a search, left the SHA window up, and now that I've come back to this session, it's in a funny state and does not appear to be responding as it should. Why?

Sometimes, if there is a network hiccup (e.g., you pick up and move your laptop to a different wireless hub), the SHA can be left in a funny state. (In some extreme cases, you will need to not just restart the browser but clear your browser cache.) To avoid losing a search, if you've accomplished a complex search, log in to the SHA and save or tag the search. That way, you can recover it easily with a single click the next time you log in.

Is there a way to interact with the SHA via a computer program? (Is there an application program interface, or API?)

Yes; learn more about it here.

I asked it for just MIPS data, but the SEIP tab is returning IRAC data. What gives?

Many of the 'more options' obtainable for a position search don't apply to enhanced products of any sort. For example, if you ask the SHA to give you just IRAC observations at a particular position, but also ask it to give you IRS Enhanced Products (which are of course completely independent of any IRAC observations), it will return just IRAC observations in the AOR/Level 1/Level 2 tabs, but the IRS Enhanced Products search is independent of the AOR search, and may still return viable results in that tab. Similarly, if you restrict your search to MIPS results but still ask it to give you IRS Enhanced Products and SEIP Super Mosaics, it will give you IRS and IRAC data, respectively, in those tabs, regardless of the MIPS filter you have imposed (that MIPS filter applies just to the AOR/Level 1/Level 2 tabs).

File questions

How long do these zip files stick around on IRSA's disk after they are prepared?

72 hours, sometimes longer if the SHA is not under heavy use.

What do I do with the zip files I get when I download data?

To uncompress the files you have downloaded, type "unzip foo.zip". To uncompress multiple files at once, type "unzip '*.zip'" (the single quotes are important), or "unzip *.zip" -- you just have to escape out the wildcard.

What is the file naming scheme for all these files? Why do I have so many files for a single observation? Which files do I need to download my data?

Each of the instruments (IRAC, IRS, and MIPS) has an Instrument Handbook, which lists and defines each of the files. They also describe instrument artifacts, and give guidance as to how to reduce the data.

Why does my IRAC observation appear to have no post-BCD (Level 2) data?

If the data was taken in IRAC's subarray mode, or for certain IERs (Instrument Engineering Requests), there will be no post-BCD data for the observation. Data in IRAC subarray mode are not processed through the online post-BCD pipeline. The post-BCD pipeline was not designed to work with the three-dimensional data cubes that are the subarray BCDs. When the software was developed it was deemed unlikely that subarray observations would be used for anything other than photometry of single bright objects and mosaics would not be a desired product. As a result, post-BCD products (e.g., mosaics and source lists) are not available from the pipeline. Please see the IRAC Instrument Handbook for more information on dealing with subarray data.

Where are my dmask files?

Pipeline products after S18.5 no longer provide dmasks as they contain misleading and incomplete information. They have been superseded by the information contained in the imask files. The imasks are more robust, include flagging of various artifacts that are not present in dmasks and make full use of the saturation correction made by the pipeline. Please see the IRAC Instrument Handbook (Appendix A) for more information.

Why does my IRAC observation appear to have incorrect header information?

If the data was taken in as IERs (Instrument Engineering Requests), the pipelines will not necessarily run to completion, which means that there may be incorrect values of some header keywords.

Why does my MIPS 24+70 photometry observation appear to have no serendipitous 24 um data?

If the 70 um data was taken in MIPS-70's fine scale mode, no serendipitous 24 um data were obtained during the 70 um observation. Please see the MIPS Instrument Handbook for more information on dealing with these data.

Getting more Help on Using the Spitzer Heritage Archive

More information on Spitzer's cryogenic mission can be found at IRSA's Spitzer site.

You can submit questions to the IRSA Help Desk.

Note that there are also SHA video tutorials, including a quick start and a longer AAS-demo-style overview, available at the IRSA YouTube channel. Look for the playlist that combines all the SHA videos together.

Found a bug? The known bugs and issues in this version of the Spitzer Heritage Archive (SHA) are listed here. If you think you have found a bug, before reporting it, please check this list, and read the online SHA help. It may be a "feature" we already know about. If you have found a new, real bug then please do contact us via the IRSA Help Desk. Please include your operating system version and your browser software and version. If you can, please also include any specific error message you may have gotten. (NB: In our testing, copying shortcuts worked on Windows and Linux; the command-C did not work on Macs, but selecting and clicking the right mouse button did.)

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- Page size (number of rows)
- Which search results (tabs) should be displayed
- Email address, if provided, for email notifications
- Search parameters so that you can resubmit your search via your search history
- Data tags, if you create one
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