FinderChart Help

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Finder Chart: Overview

Finder Chart is a searching and visualization tool that allows cross-comparison of images from various surveys of different wavelengths and different epochs. Data can be downloaded in any of a variety of formats, either singly or in bulk. Catalogs from any of a variety of sources are also available.

This tool provides access to data sets from the Two Micron All Sky Survey (2MASS), the Wide-field Infrared Explorer (WISE) AllWISE all-sky survey, the InfraRed Astronomy Satellite (IRAS) all-sky survey, AKARI Far Infrared Surveyor (FIS), the Digitized Sky Surveys (DSS) (both First and Second Generation), and the Sloan Digital Sky Survey (SDSS). Please note that the DSS and SDSS data do not reside at IRSA, so the successful retrieval of DSS and SDSS data depends on the operation of the DSS and SDSS services, located at other institutions.

Besides this online help (also available as a PDF), there are also Finder Chart video tutorials, available at the IRSA YouTube channel. There is a playlist that collects together all of the Finder Chart videos. Also see the list of "micro-tutorials" relevant for more than one tool, and the list of tutorials using more than one tool.

This service makes use of components of Montage, funded by the National Aeronautics and Space Administration's Earth Science Technology Office, Computational Technologies Project, under Cooperative Agreement Number NCC5-626 between NASA and the California Institute of Technology.

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Surveys, Wavelengths, and Sky Coverage

DSS

The Digitized Sky Survey (DSS) is a digitization of the photographic sky survey plates from the Palomar and UK Schmidt telescopes. DSS images have pixels between 1 and 1.7 arcsec and use three broad-band filters covering roughly 3950 Angstroms to 9000 Angstroms. None of the underlying datasets are all-sky; the DSS "surveys" are actually composites of multiple image sets taken at different times using different instruments. The date for the specific retrieved image appears with the image in Finder Chart. For more detailed information on filters, dates, and coverage, see the DSS webpage at STScI.

image	band	approx. wavelength range
DSS1B	Bj	3950 - 5400 Angstroms
DSS1R	R	6125 - 6475 Angstroms
DSS2B	Bj	3950 - 5400 Angstroms
DSS2R	R	6300 - 6900 Angstroms
DSS2IR	I	6950 - 9000 Angstroms

SDSS

The Sloan Digital Sky Survey (SDSS) is not an all-sky survey, but covers more than a quarter of the sky in five optical filters, at about 1.5 arcsecond resolution. The date that the image was obtained is included in Finder Chart. For more detailed information on filters, dates, and coverage, see the SDSS webpage. The version of SDSS image data that is being used here is DR7.

Band	Approximate central wavelength
u	2910 Angstroms
g	4810 Angstroms
r	6230 Angstroms
i	7640 Angstroms
z	9060 Angstroms

2MASS

The Two-Micron All-Sky Survey (2MASS) is an all-sky survey. 2MASS images have about 1 arcsecond resolution and were obtained in three broadband filters: J, H, and K_s (K-short). The date that the image was obtained is included in Finder Chart. For more detailed information about filters, dates, and coverage, see the 2MASS web page at IRSA (and references linked therein) or the 2MASS webpage.

Band	Approximate central wavelength
J	1.235 microns
H	1.662 microns
Ks	2.159 microns

WISE

Widefield Infrared Survey Explorer (WISE) is a spacecraft that conducted an all-sky survey. WISE mapped the sky in four bands (3.4, 4.6, 12, and 22 microns) with an angular resolution of about 6.1, 6.4, 6.5, and 12.0 arcseconds in the four bands, respectively. For more detailed information about filters, dates, and coverage, see the WISE webpage at IRSA and references linked therein. **IMPORTANT NOTES**: The dates for these images as shown in Finder Chart are the average date of the coadded frames from the AllWISE data release. Remember that these images are coadds from individual frames taken at different times. Near the ecliptic poles, these images may span several months. The average date is also included in the FITS header. Note also that there are rather a lot of WISE-1 and -2 data taken after the AllWISE data release that are not included in the AllWISE data products.

Band	Approximate central wavelength
W1	3.4 microns
W2	4.6 microns
W3	12 microns
W4	22 microns

SEIP

The Spitzer Space Telescope was a spacecraft that was a pointed mission, not an all-sky survey. However, much of the most popular regions of the sky have Spitzer data. The Spitzer Enhanced Imaging Products (SEIP) combined all of the data taken during the cryogenic era, made mosaics, and extracted a source list. There are SEIP products for IRAC (3.6, 4.5, 5.8, 8 microns) and MIPS-24 (24 microns). For more detailed information about filters, dates, and coverage, see the Spitzer webpage at IRSA and references linked therein. **IMPORTANT NOTES**: The dates for these images are not shown in Finder Chart; these images are coadds from individual frames taken at different times, possibly over years. The average date is included in the FITS header. Also, please note that the post-cryo mission was more than twice as long as the cryo-era mission, so there are rather a lot of IRAC-1 and -2 data that are not part of SEIP.

Band	Approximate central wavelength
IRAC-1	3.6 microns
IRAC-2	4.5 microns
IRAC-3	5.8 microns
IRAC-4	8 microns
MIPS-1	24 microns

AKARI

AKARI was a Japanese satellite that conducted an all-sky survey at several bands between 1.8 and 180 microns. FIS was the long wavelength instrument, with bands between 65 and 180 microns. For more detailed information about filters, dates, and coverage, see the AKARI webpage at IRSA and references linked therein. **IMPORTANT NOTE**: The dates for these images are not shown in Finder Chart because these images are coadds from individual frames taken at different times. Near the ecliptic poles, these images may span several months. The average date is included in the FITS header.

Band	Approximate central wavelength
N60, or flux65	60 microns
WIDE-S, or flux90	90 microns
WIDE-L, or flux140	140 microns
N160, or flux160	160 microns

IRAS

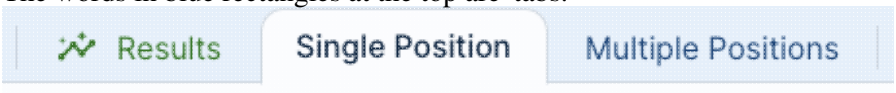
The InfraRed Astronomy Satellite (IRAS) was a satellite that flew in 1983 and conducted an all-sky survey in 12, 25, 60, and 100 microns. The angular resolution of the instrument varied between about 0.5 arcmin at 12 microns to about 2 arcmin at 100 microns. The original images have been reprocessed into the IRAS Sky Survey Atlas (ISSA) and IRIS (Improved Reprocessing of the IRAS Survey). For more detailed information about filters and coverage, see the IRAS webpage at IRSA or the IRAS documentation. For specific information on IRIS, see the IRIS webpage at IRSA.

Band	Approximate central wavelength
IRAS-1	12 microns
IRAS-2	25 microns

IRAS-3	60 microns
IRAS-4	100 microns

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). It also can allow you to change the appearance (dark or light mode) (see below).

When you have results loaded into Finder Chart, 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 

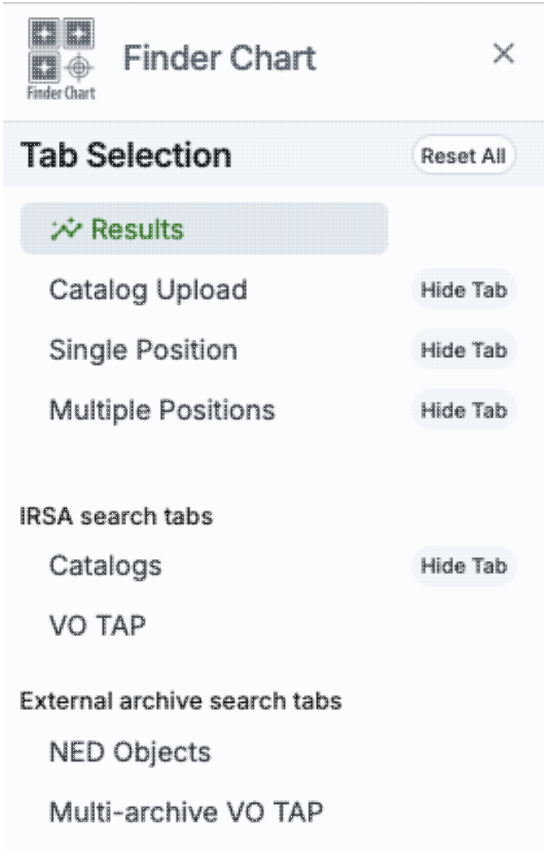
The only mechanism for searching in Finder Chart is searching by position. One can submit a single target ("single position") or a list of targets ("multiple positions"). (More on searching.)

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.

You can use this side menu to add (or remove) blue tabs from the top of your Finder Chart interface. By default, Results, Single Position (a searching option), and Multiple Position (another searching option) are shown.



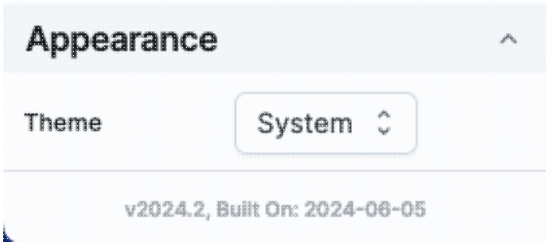
Under "IRSA search tabs," Catalogs and VO TAP search IRSA holdings.

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. Finder Chart can remember you when you return. 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 Finder Chart 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 Finder Chart are listed here. If you think you have found a bug, before reporting it, please check this list, and read this online Finder Chart 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.)

Finder Chart: Searching

This section is an overview of how to search in Finder Chart.

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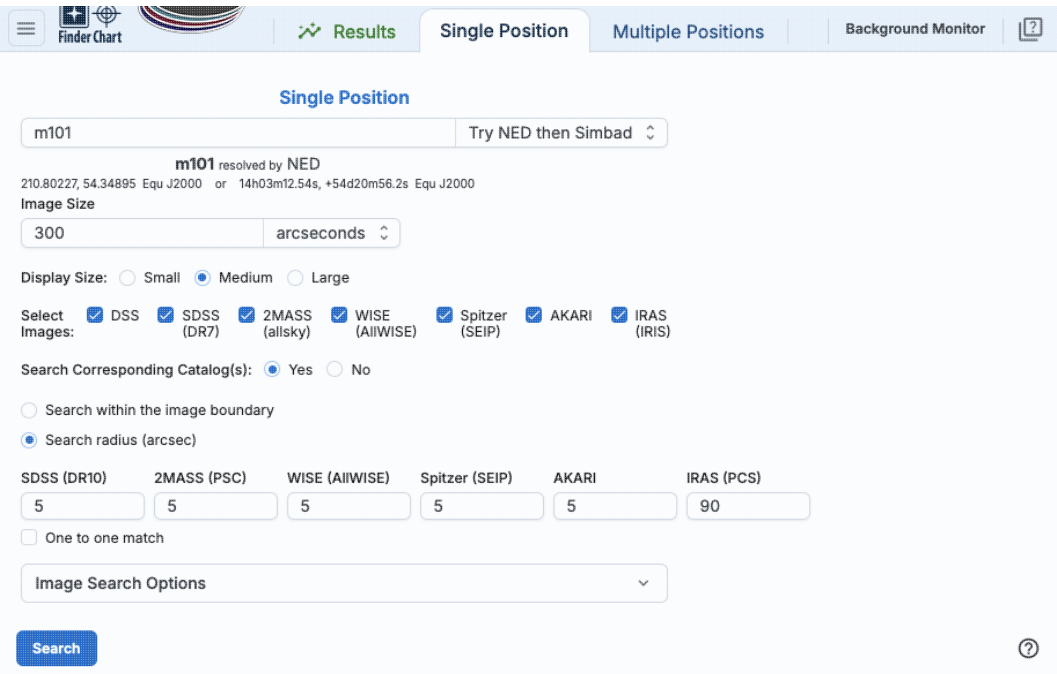
Searching (by position, on a single target)

Searching in Finder Chart is straightforward -- search by position for a cone search.



Coordinates or Object Name.

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

- ◊ '46.53, -0.251 gal' means 46.53, -0.251 degrees in galactic coordinates
- ◊ '12.7, +4.3 ecl' means 12.7, +4.3 degrees in ecliptic coordinates
- ◊ '19h17m 11d58m b1950' means 19h17m 11d58m in B1950 coordinates
- ◊ a source name like 'J140320.67+542028.6' is parsed as 14h03m20.67s +54d20m28.6s.
- ◊ a source name like 'G102.0360+59.7715' is parsed as 102.0360 +59.7715 in galactic coordinates

Examples are given below the text entry box before you start typing in the box.

As you are completing a valid coordinate entry, Finder Chart 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.

Image Size.

After the position entry information, you can specify the image size you want to retrieve; the default is 300 arcseconds. You may enter the radius in arcseconds, arcminutes, or degrees; just change the drop-down option accordingly.

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; Finder Chart will tell you if you request something too big (> 1 degree) or too small (< 1 arcsec).

Display Size.

The "Display Size" indicates whether you want small, medium, or large thumbnails. This feature is useful if you are working on a small laptop screen vs. a large desktop monitor. "Small" thumbnails are 128 screen pixels across, "medium" thumbnails are 192 screen pixels across, and "large" thumbnails are 256 screen pixels across. The angular width (on a side) of each of the thumbnails will be what you have requested above.

Select Images.

Next, you can select which image sets you would like to retrieve. The choices are DSS, SDSS (data release, DR, 7), 2MASS (the all-sky catalog and images), WISE (the AllWISE images and catalog), SEIP (reprocessing of the cryo Spitzer data), AKARI (FIS only), and IRAS (the IRIS catalog and images). By default, it searches for all available bands for each of the surveys you select. You can select only particular bands; see "image search options" below, or see the Overview section for a list of available surveys and bands.

Search Corresponding Catalog(s).

You can ask it to search the catalogs corresponding to those images for SDSS, 2MASS, WISE, SEIP, AKARI, and/or IRAS.

If you have set "Search Corresponding Catalog(s)" to "yes", then you will have an additional set of lines appear that correspond to options for searching the catalogs. You can ask it to find all the sources in the corresponding catalogs within the image boundary (could be over a large region, depending on your image size), or just within a certain search radius. If you select "search radius", additional boxes appear for each survey you have selected that specifies the search radius to use (in arcseconds) for each survey. Default values for IRAS are much larger than the default values of the other surveys because of the difference in spatial resolution.

There is an additional option, "One to One Match." This is a powerful option -- when this option is selected, it will find just the closest source to your position within your selected search radius, and *only* that closest source.

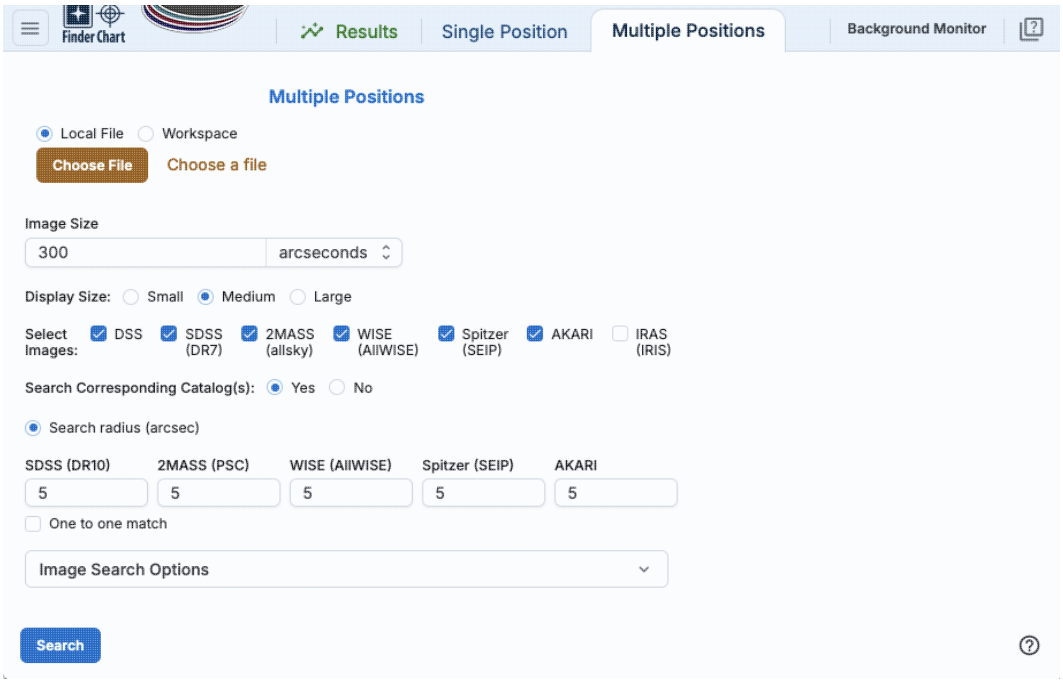
Image Search Options.

Under "Image Search Options" (click on the disclosure triangle on the right to reveal these options), you can turn on or off individual channels within the image search -- for example, if you just want the DSS2 images, or just the WISE-4 image.

To search this way again after completing a search, click on the blue "Single Position" tab at the top.

Searching on multiple targets -- Batch mode

The position search can also be executed in "batch mode" for a list of objects given in a file -- select the "Multiple Positions" 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 your search, your input table will appear as part of your results. If you wish to have a name (not just coordinates and row number) displayed for each of your objects, add a column to your input file called "objname" that contains the name of the object. (NB: that name should just be letters and numbers -- no parentheses or brackets, etc.)

One to One Match: On the search screen, if you select "Search Corresponding Catalog(s)", and then go to "Catalog Search Options", there is an additional option called "One to One Match." This is a very powerful option, particularly for a list of targets. When this option is selected, it will find just the closest source to your position within your selected search radius, and *only* that closest source. The resultant catalog has one line per input source; if no counterpart is found, then the corresponding line indicates that no source was found.

Results

Results are described in detail in another section.

The Visualization section has much more information about interacting with images.

The Tables section has much more information about interacting with tables in general. The Catalogs section has much more information about searching for IRSA catalogs. You can do many other searches as well.

When you load a table, you get an x-y plot displayed as well. See the Plots section for lots more information.

Finder Chart: Results

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Introduction

After searching, Finder Chart presents to you its results in up to four panes. If you did a search on a single target, without catalogs, you have just one pane containing all the images you requested. If you did a search on a single target with catalogs, you have three panes -- images on top, catalog(s) in the lower left, and plot(s) of the catalog(s) in the lower right. If you did a search on multiple targets, you have your list of targets in the upper left, the images on the upper right, the resulting catalog(s) in the lower left, and plot(s) of the catalog(s) in the lower right.

This is an example Finder Chart results screen, which we now discuss.

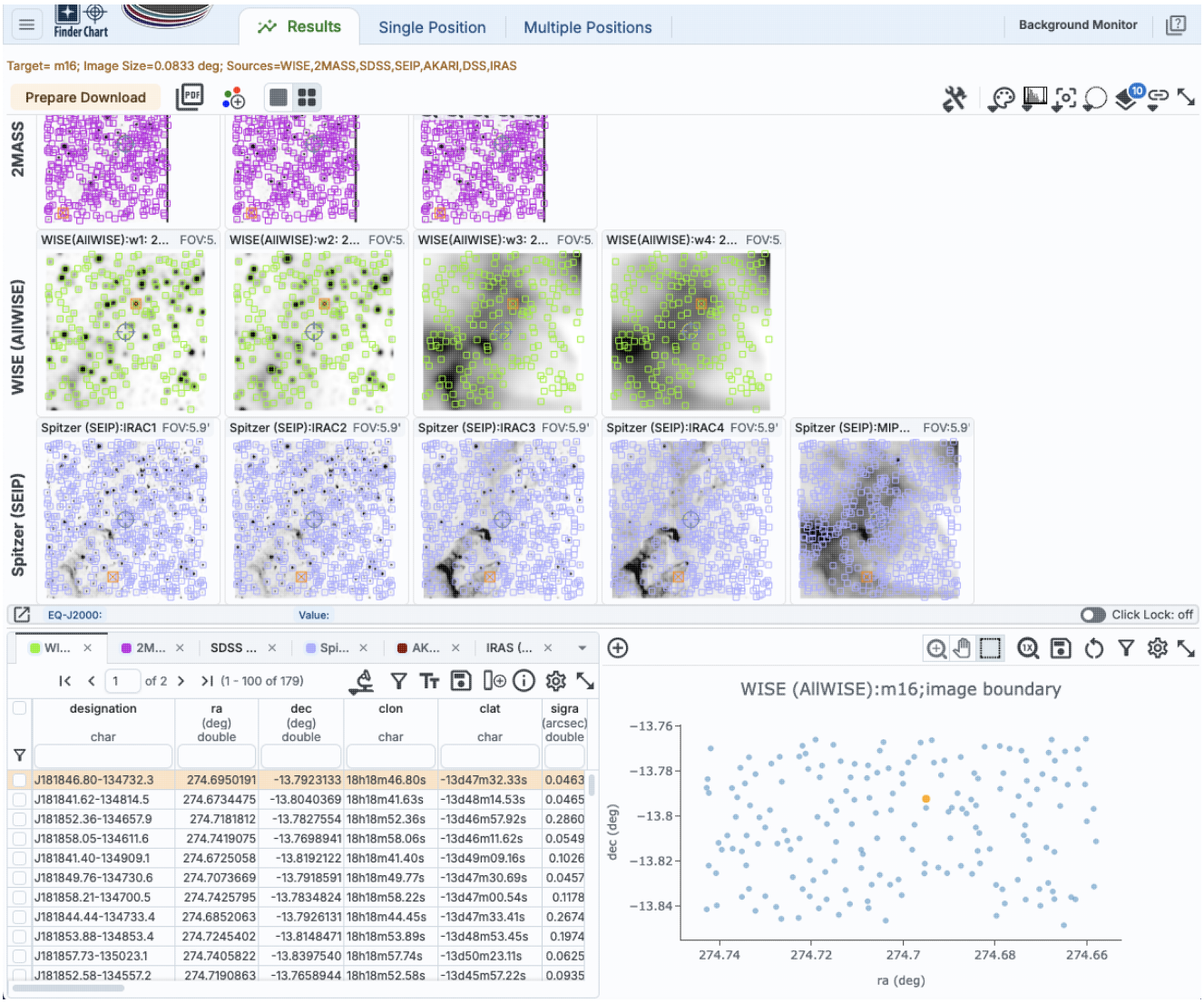


Image Pane

The upper pane, by default, contains all the images matching your search criteria. If you chose to retrieve catalogs at the same time, the catalog is overlaid on the corresponding images -- that is, the 2MASS catalog appears on the 2MASS images, the WISE catalog appears on the WISE images, etc.

Tips and Troubleshooting

- If you opted to have catalogs returned, even over a small radius, those catalogs are overlaid on the images...even if it doesn't look like it. If you have a relatively isolated, bright star, all the catalogs will return a source at the same location, so all the catalogs will be overlaid on the same bright star in each image. The example above is for catalogs searching "within the image boundary."
- The color swatches at the top of the tables correspond to the colors used in the overlays. Go here for more information.
- If you have a lot of sources in your retrieved catalogs (more than ~1000), your catalog may be rendered hierarchically -- go here for more information.

Along the top of the images, there are several notations.

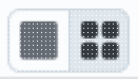
Target= m16; Image Size=0.0833 deg; Sources=WISE,2MASS,SDSS,SEIP,AKARI,DSS,IRAS

Your search is summarized succinctly at the top.

Prepare Download The "Prepare Download" button initiates the data download process.

 The "PDF" button is another kind of data download, where it makes a PDF of the search results.

 This icon adds a 3-color image at the end of each row, where the constituents of the image come from that row.

 This icon controls whether you view one image at a time (left icon) or many images at once (right icon).

All of the basic visualization tools are available to interact with the images.

Tips and Troubleshooting When the 2MASS survey was concluded and final tiles generated, internet (and computers) were much slower, and as a result, the final image tiles are small. Therefore, when you request 2MASS images, you may very well run into edges of tiles, as in the screenshot above where the 2MASS data appear to 'end' on the right hand side before the WISE or Spitzer data do. There really are 2MASS data over essentially the entire sky, and the tool is doing the best it can to get you the best possible tile given the position and size you requested, but you may very well run into an edge of a tile. If you really need a larger contiguous fraction of sky from 2MASS, try the IRSA Viewer tool, and use the "6 degree" (not 6x, but 6 degree) 2MASS images.

Table Pane

All the tables in this tool allow you to filter, sort, manipulate, hide or add columns, etc.

If you opted to have catalogs returned, the lower left pane is a table with tabs for all of the catalogs meeting your search criteria; the catalogs are also overlaid on the images. If you pick a different row in a catalog of search results, that target is highlighted on the images.

If you did a multi-target search, the upper left pane is a table of your input target list, with all the same capabilities as other tables in this tool. If you pick a different row in a search target list, the images update to reflect that search target choice.

Plot Pane

By default, the tool also gives you an x-y plot. It appears on the lower right. By default, it is a plot of the RA and Dec from the corresponding retrieved catalog. If you did a search on an individual stellar target and asked it to only get you a catalog for sources within a small (default) search radius of your target, this is likely a fairly boring plot, as it probably contains only one target.

However, if you choose to retrieve catalogs over the whole image, or you search for more catalogs, the plots are more interesting even in their default ra/dec state. You can make more sophisticated plots in this tab.

Downloading Data

Downloading is covered in separate section.

Finder Chart: Visualization

The images meeting your search criteria are shown as the primary results of the search, sorted by survey. The circle-with-crosshairs (a reticle) overlaid by default is the search position you submitted. See the Tables section for more on table manipulation, and see the Catalogs section for more on catalogs.

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.

Critical to many of the functions described in this visualization section is the concept of the "selected image." Finder Chart can return up to 34 images of the same patch of sky. Look at the array of images returned by a search. One (you may have to look for it) is "selected" -- it is outlined in brown. Click on a different image, and that image becomes outlined in brown as the selected image. By default, the Finder Chart images are locked together, so quite often what you do to one image is done to all the images. But certain other behaviors described here are still customized to each individual image. **In order to affect a given image, you must select it.**

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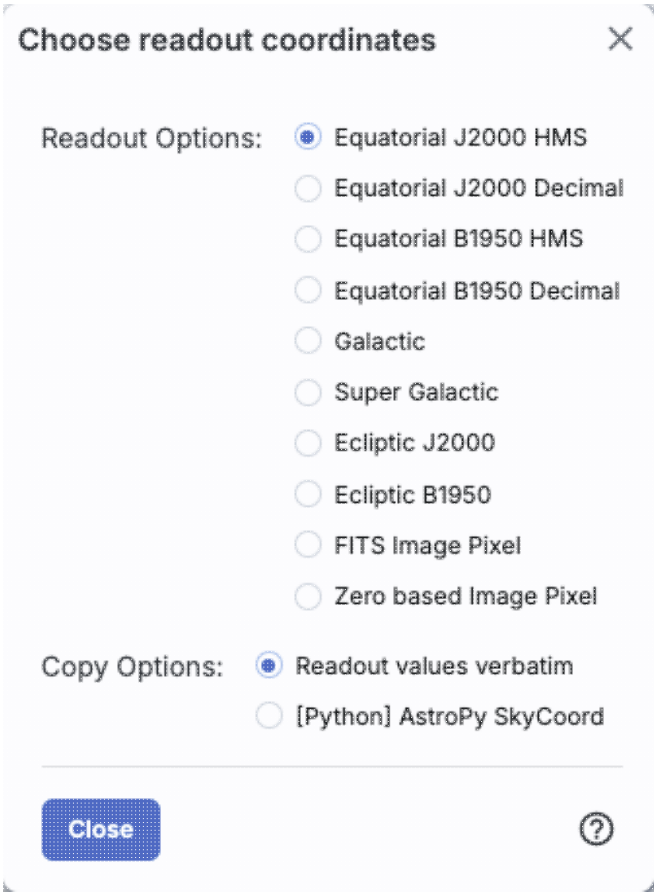
FITS Viewer

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.

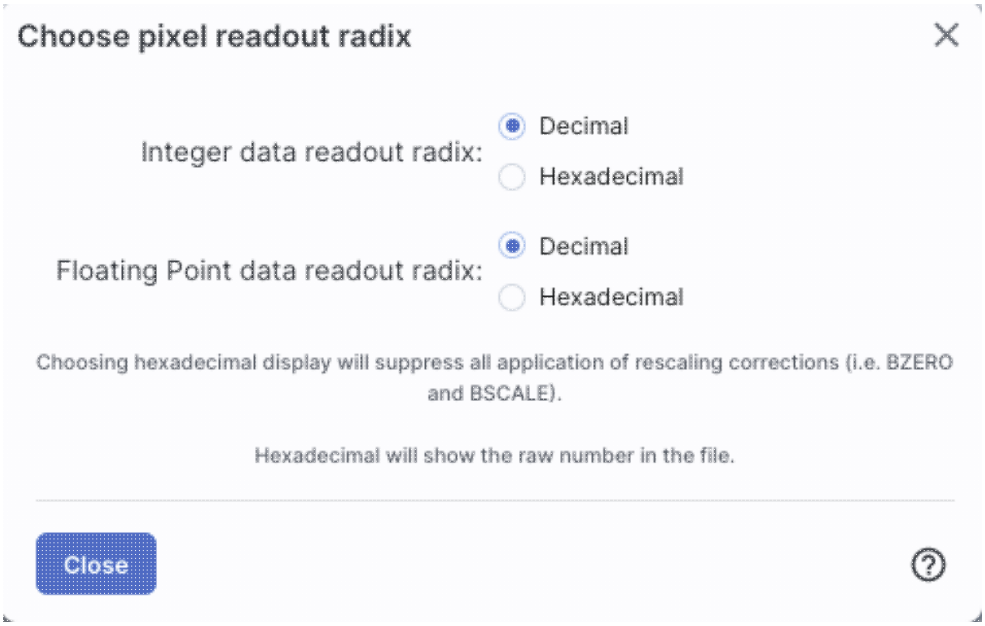
You can change the units of what is being read out, in terms of coordinates or pixel values.



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).



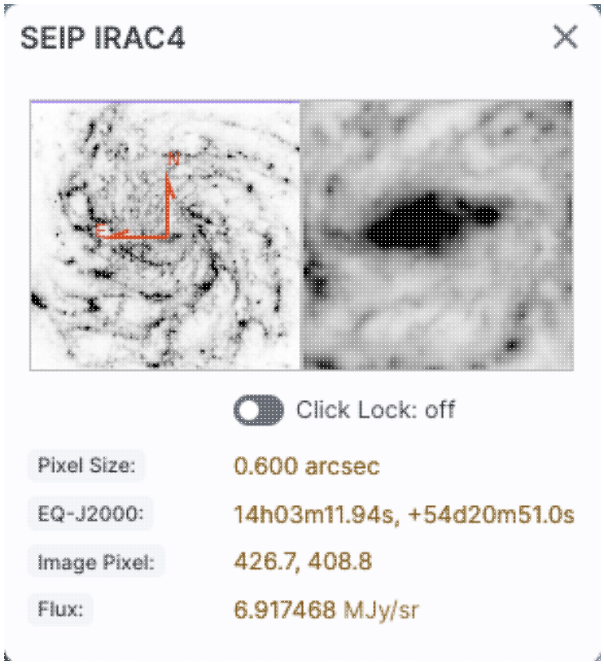
Click on the label of the readout, "Flux" in the tiny snippet of a screenshot example above, and you get this pop-up, from which you can choose the pixel readout from among:

- 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. 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, 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.

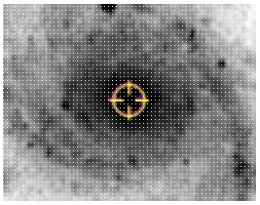


You can make the cursor 'stick' on a particular place on the image -- flip the "Click Lock: off" switch to "on" (either in the pop-up or in the lower right of the image window), and then click on the image at your desired location. When this is clicked, small "clipboards" appear near the position readout.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

Image Information

The results are grouped by survey. The upper left of the loaded image tells you basic things about the image you are viewing: the survey origin (instrument, channel) and, where possible, the date of observation. (Some images are coadds from individual frames taken at different times, up to months or even years, so a single date may be misleading. Investigate the FITS header of the image using one of the other buttons below to obtain the average date suggested by the producer of the FITS files.)

Example of image label. Note that it contains information about the survey, band, date obtained, and current field of view ("FOV").



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

Breaking Out of the Pane (and Going Back)

Panes: If you have both images and catalogs loaded into Finder Chart, the screen is broken up into panes - one for images, one for catalogs, and one for plots from the catalog. If you have more than one image loaded in, the image pane is 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.

Special case of images only: If you have only images loaded in, then the images are taking up all of your browser window, and it is already, by default, in this expanded mode. There's no 'close' arrow in the upper left since there is nothing else loaded in. You can, however, view one image at a time -- see next section on image navigation.

Image Navigation

Single or Tiled Images

When you have many images loaded in, you can have icons like this:  that portray (in icon form) the different views you can have of the images you have loaded. 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. Whether the images (tiled or not) take up all the space or not depends on whether you are viewing in panes or in the full-screen mode (see immediately above on Breaking out of the pane).

Paging through single image views

If you have many images loaded in and click on the single big square to view one image at a time, you are provided with navigation aids in the top of the images window, like this:

The arrows allow you to scroll through your list of images, sorted as originally shown in the search results.

Scrolling through multi-image views

When you have several images loaded in and click on the cluster of four squares to view them all at once, chances are very good that you will not be able to see all the images without scrolling. You can use your mouse to scroll through the collection of images. If you are on a Mac, your scrollbar may be hidden until you try to scroll.

Tips and Troubleshooting: 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

The image toolbox is always present as a row of tools associated with the images you have loaded. 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.

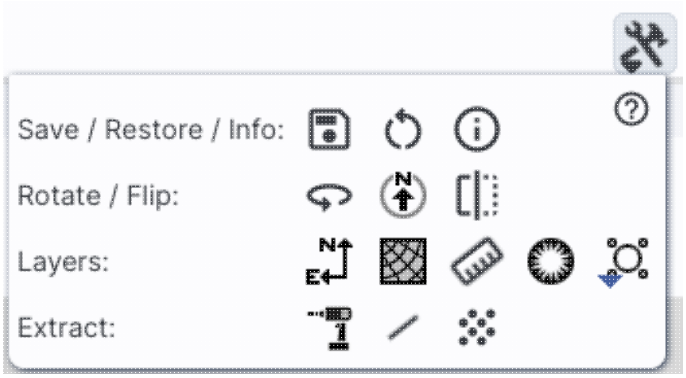
This is the image toolbox when you have clicked on a FITS image you have loaded:

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

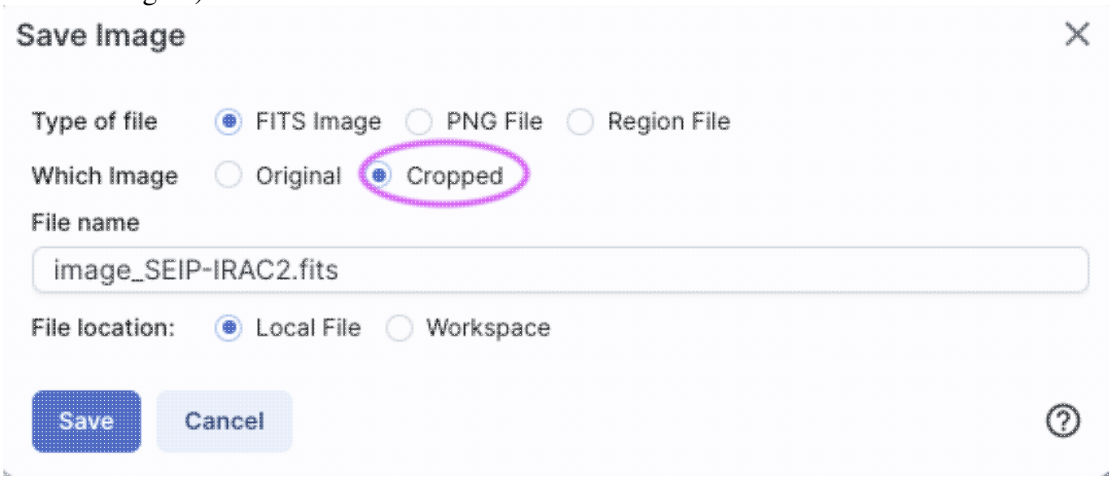
Saving the image

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.

You can save images as FITS, PNG, or regions files to your local disk. Saved FITS images will not save the color stretches or overlays; it will just save the underlying FITS image. Saved PNG

files WILL include the image as shown with 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).



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**.

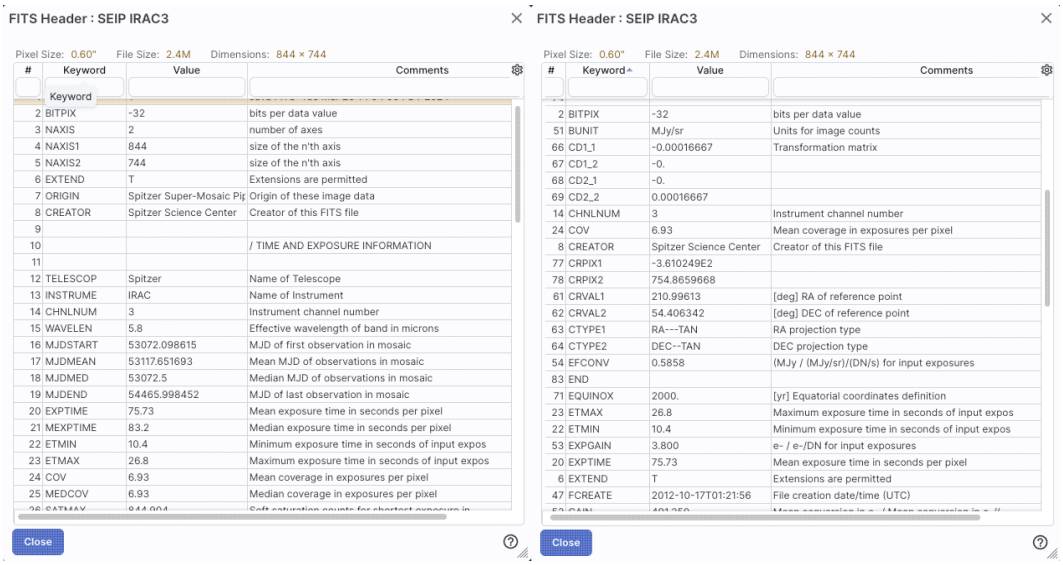
The saved PNG is the same size as it is on your screen. If you want a big version, make the desired image big on your screen (view one-at-a-time; see here) before saving the PNG.

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 the FITS header. This is shown as a Firefly table like all the other tables in this tool, so it is 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.



Rotating the image so that North is up

Images retrieved in Finder Chart are already oriented such that North is up. However, when interactively investigating images, you could find yourself in a situation where North is not necessarily up. 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).

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.)

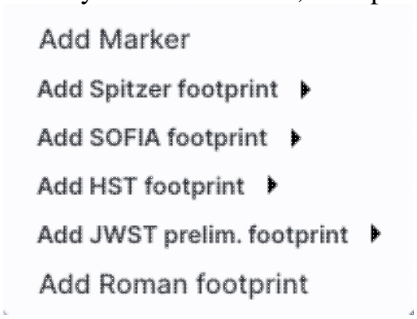
Read in a DS9 Regions file

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 Finder Chart.) 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.

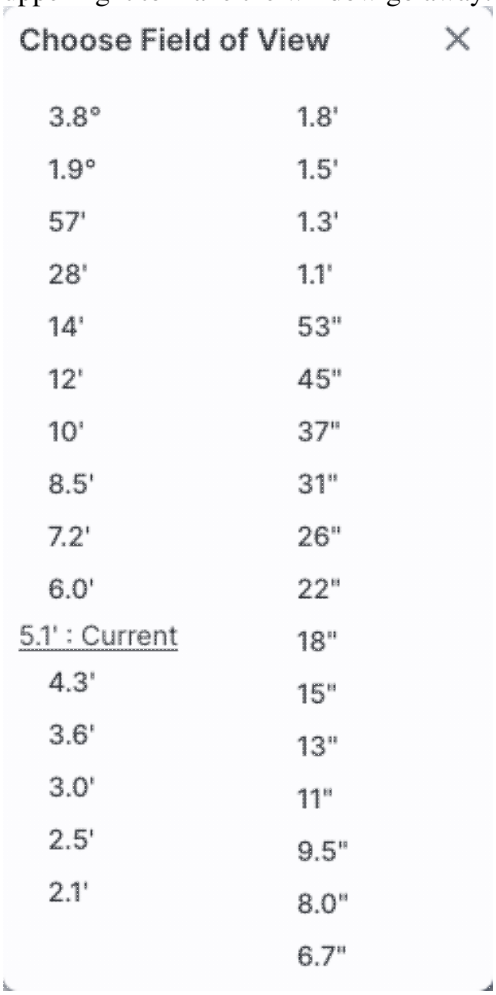
Zoom

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. 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.

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.

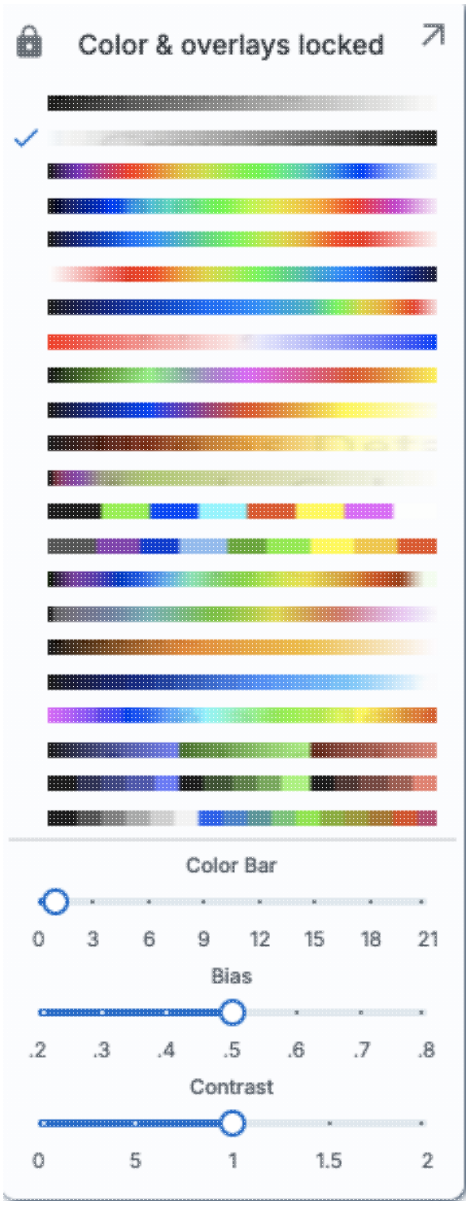
Zooming to a 1-to-1 size

Clicking this icon will zoom the image such that one pixel in the image is one pixel on your screen.

Color table drop down

This icon enables you to change the color table of the displayed image. 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.

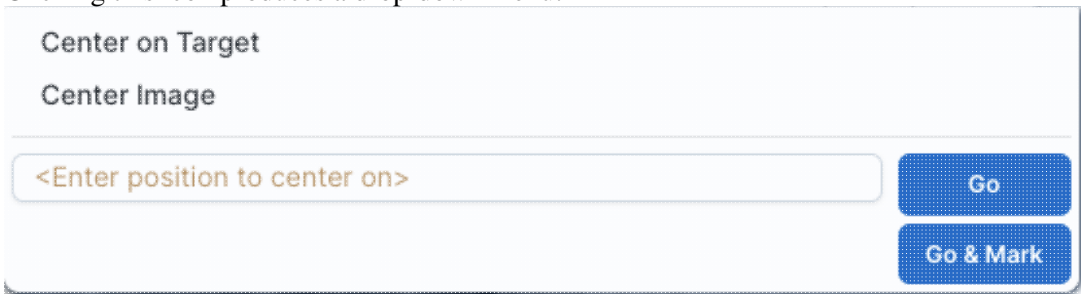


Color stretch drop down

This icon enables you to change the color stretch of the displayed image. 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:



The nature of this Finder Chart tool is that you have small region(s) of sky centered on your target(s) as specified in your search. But, it could be that you are zoomed into a different part of the image and want

the tool to center on the target, or the image, or on coordinates that you enter here. This menu is how you do that.

Selecting a region drop down

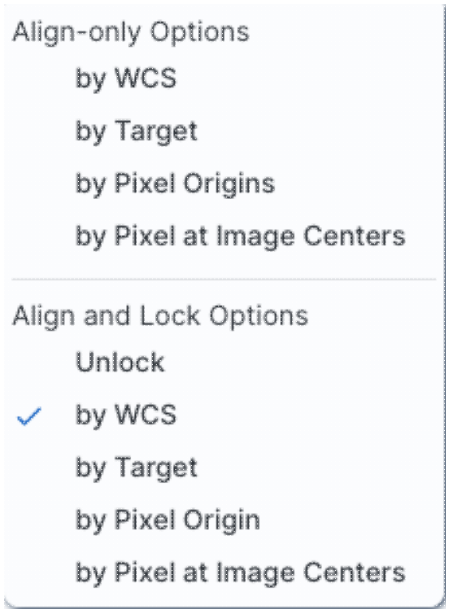
When you click this icon, you can select a region of the image for further actions. Because this is complicated, for much more information, please see below.

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

This "lock images" icon appears locked initially for Finder Chart; the second icon is what it looks like when unlocked. The main purpose of this icon is to lock all the images you have loaded for zooming, scrolling, etc. You can specify how it locks and for how long. Clicking it produces this drop-down menu:



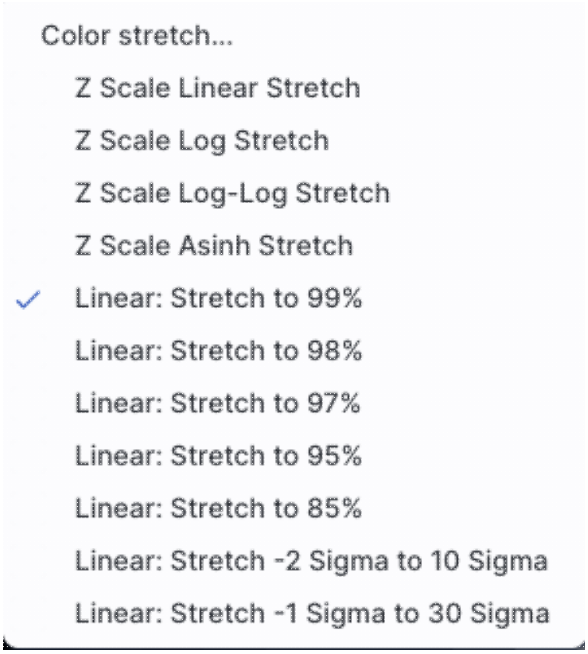
The first set of options aligns the images only once, temporarily; the second set of options makes the alignment persist ("lock") when you move the images (that is, when you move one, they all move). By default in Finder Chart, all the images are aligned and locked by WCS. You can align by the images' 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.

Getting help

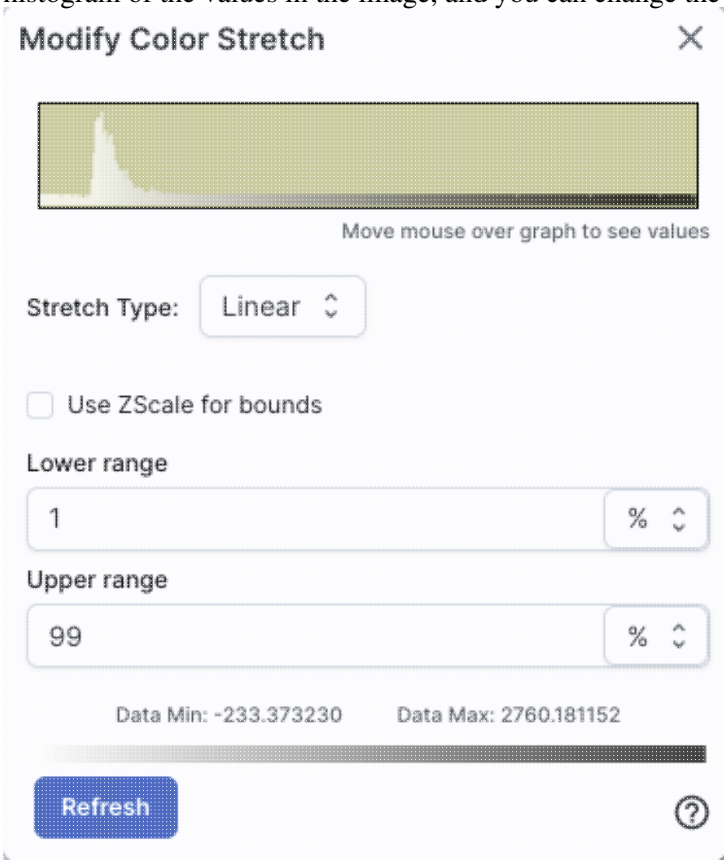
Clicking on this icon, whereever it appears, takes you to this help page.

Color Stretches

This icon enables you to change the color stretch of the displayed image. When you click the button, a drop-down menu appears with a variety of choices. 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.

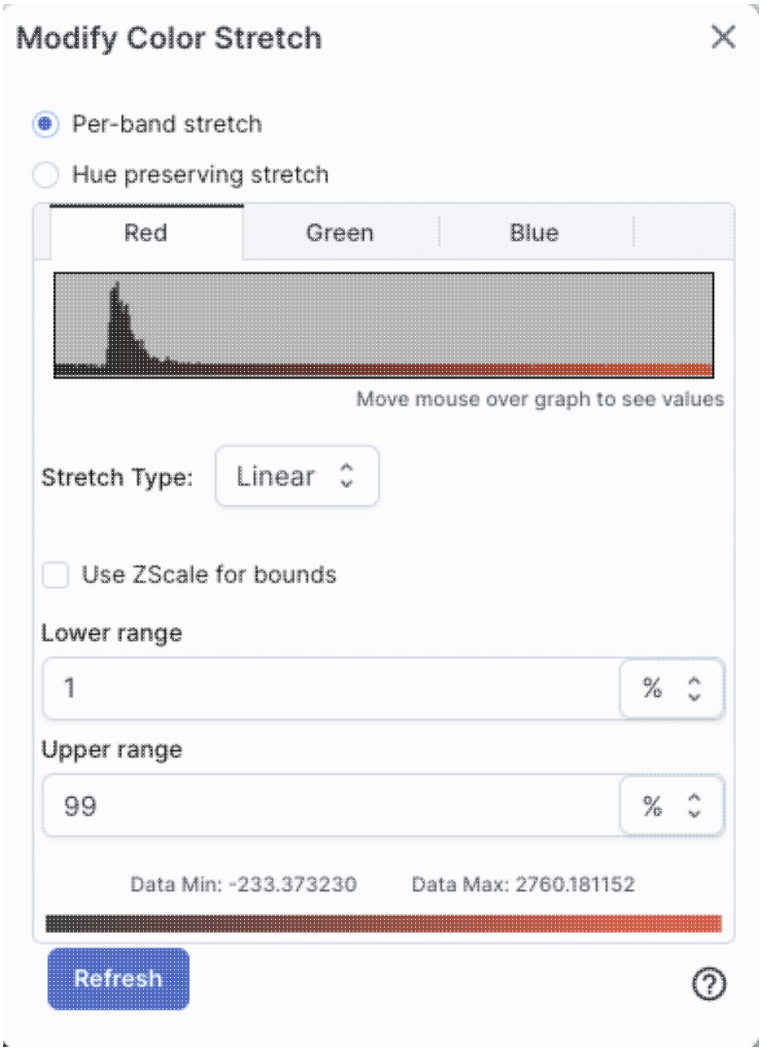


If you pick a color stretch from the pre-defined options, the pop-up window reflects this change. If you change the color stretch in the pop-up window, the drop-down menu changes correspondingly.

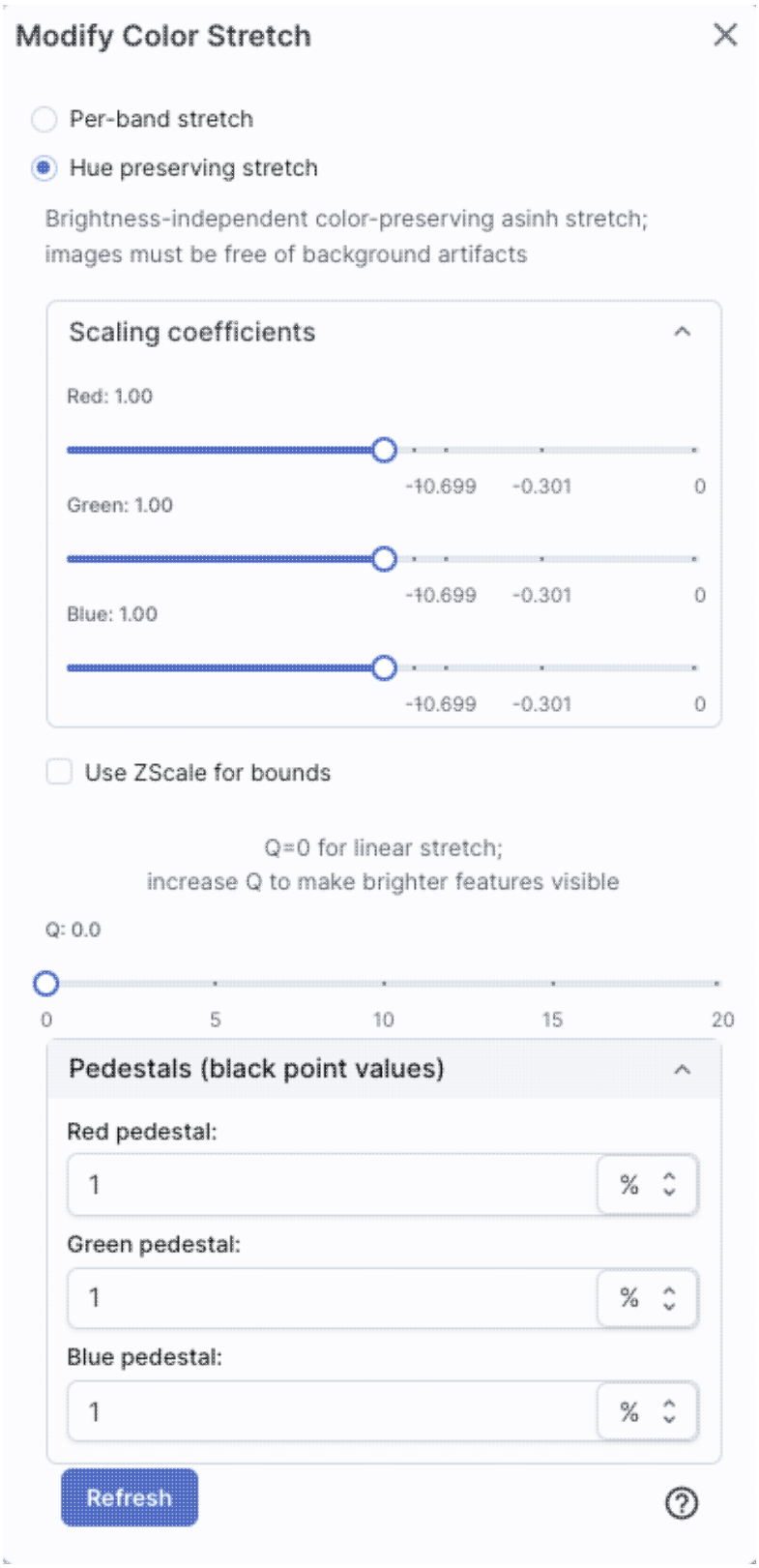
Example: Display the pop-up for color stretch. From the main drop-down, pick 'Linear stretch to 99%'. Go back to the color stretch pop-up. Note that it has filled out the stretch type and ranges to reflect the current choice. Then -- either with the pop-up window still up or not -- go back and pick a 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.

If you have a 3-color image, you can change the stretch in each color plane separately; select the tab at the top accordingly for red, green, or blue. By default, it stretches each band independently, and you can set the parameters in the stretch pop-up accordingly.



As described in Lupton et al. (2004), a different algorithm may be useful for creating 3-band color images. Select "Hue preserving stretch" to invoke this option. This stretch should be a brightness-independent color-preserving asinh stretch, though in practical terms, it seems to work best for optical images.



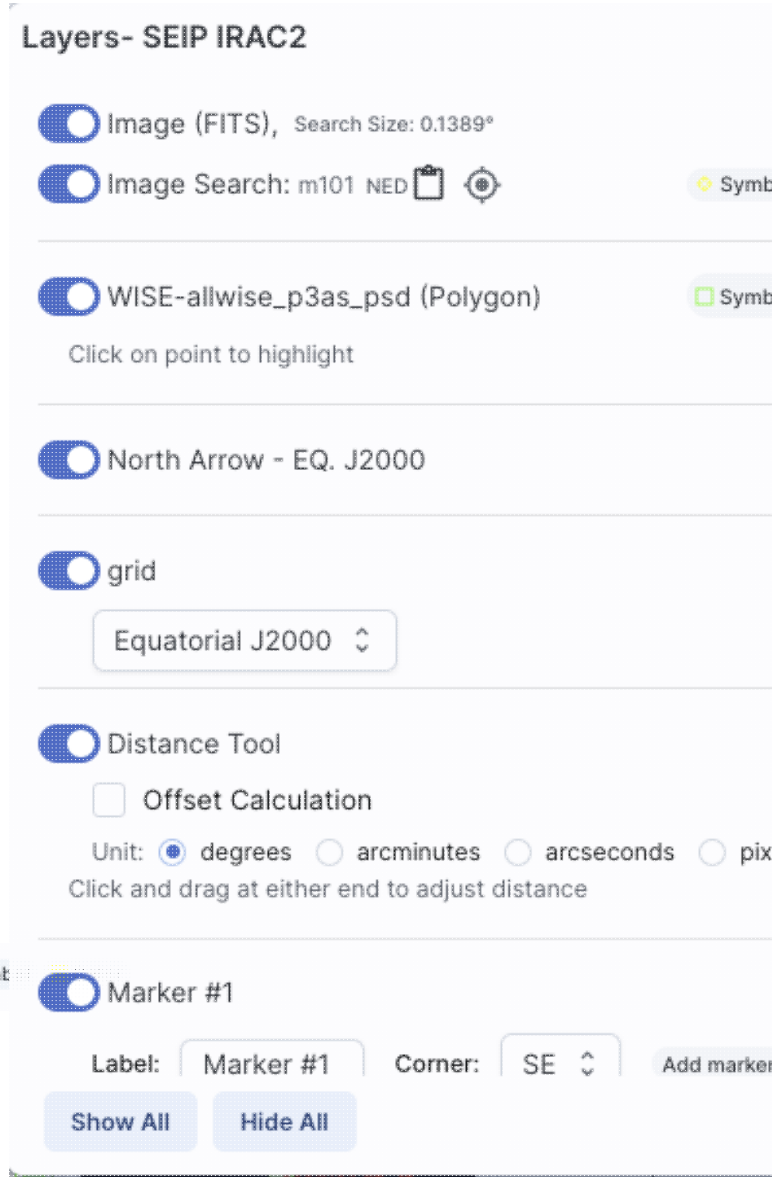
It may be useful to scale individual channels; sliders allow you to do so. The Q parameter has another slider. For a linear stretch, Q=0; increase Q to change what features are emphasized. Pedestal values can also be set to allow the level assigned to "black" to change.

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. 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). From this pop-up, you can:



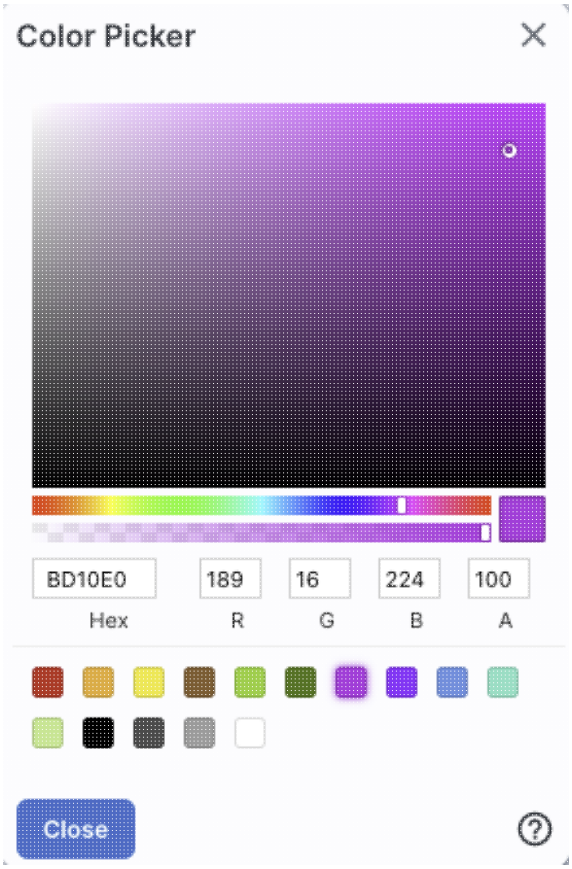
- turn layers off and on (click on the switch on the left of the corresponding row);
- remove layers entirely (click on the 'x' on the right of the corresponding row);
- change colors of overlays (see below);
- change symbol shapes and sizes (for overlaid catalogs), including hierarchical catalog settings;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

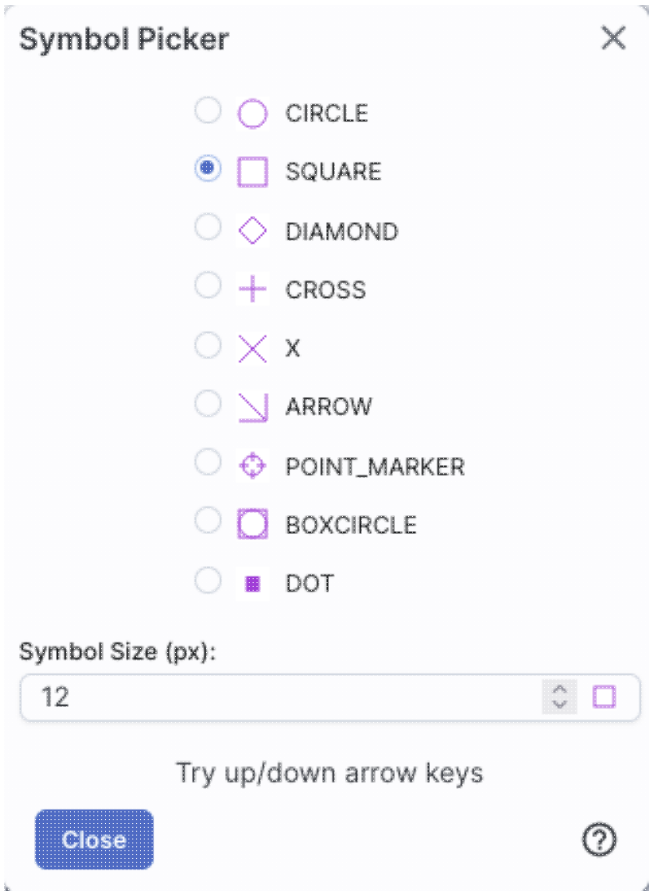
Note the target description:


This reminds you of the target on which you searched -- here, it was M101, where the coordinates were resolved by NED (as opposed to Simbad). 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.

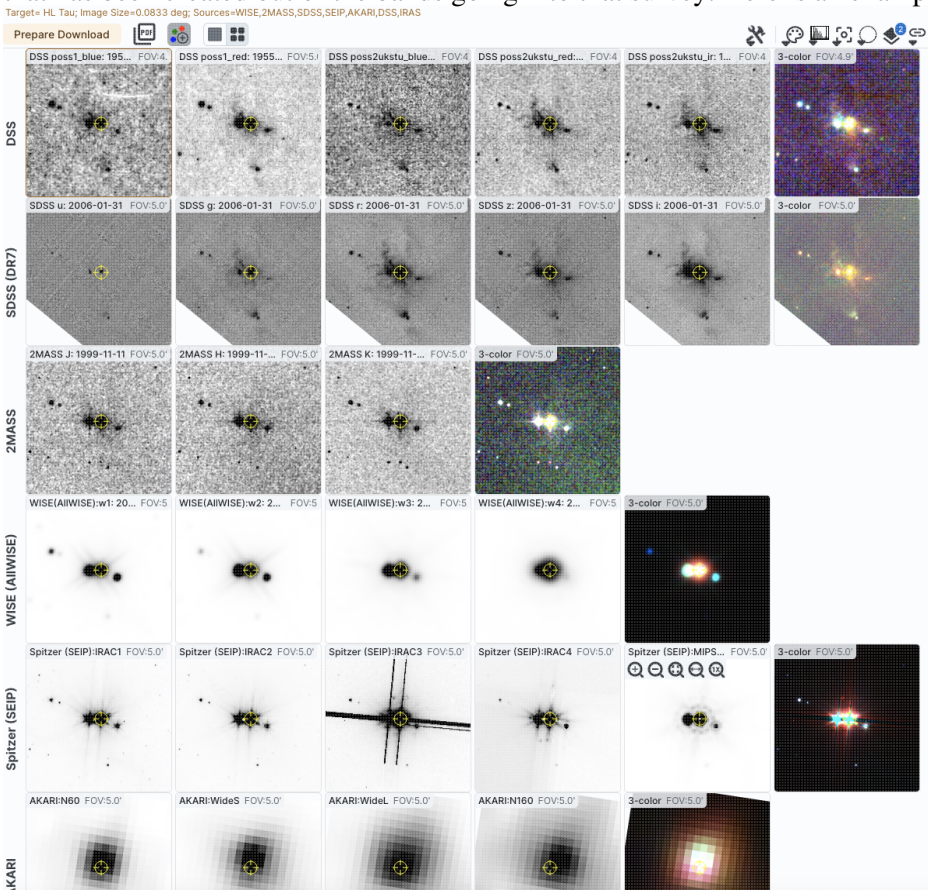


For catalogs or the search target, you can also select the symbol shape and size. To adjust the size, type in the symbol size in pixels or use the up/down arrow keys to change the size by one pixel at a time. Your choices are implemented as soon as you select them. Click 'Close' to close the window,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

3-color images

In Finder Chart, a default search results in images in many bands of the same region of the sky. It can be useful to create 3-color images from these multi-color bands.

The images window pane consists of rows of images grouped by survey. Near the top of the images window pane, you can find this icon:  . If you click on this icon, at the end of each row, a 3-color image appears that has been created out of the bands going into that survey. Here is an example for HL Tau:



At the end of each set of survey images is a new, 3-color image. This image has been automatically generated with pre-selected bands as the color planes:

survey	red	green	blue
DSS	DSS 2 IR	DSS 1 red	DSS 1 Blue
SDSS	z	g	u
2MASS	K	H	J
WISE	W4	W2	W1
Spitzer/SEIP	I3	I2	I1
AKARI	WideL (140 um)	WideS (90 um)	n60 (65 um)
IRAS	IRAS-100	IRAS-25	IRAS-12

The "3-color" button is "sticky" in that if you turn it on, and then do another search, the new search will automatically make 3-color images.

Tips and Troubleshooting:

- To save the color PNGs, you can do either of the following: (1) Click on the image to select it (make it outlined in brown). Go to the image toolbar, click on the tools icon, and find the diskette icon. Select "png" for the file type to save, and click 'save.' (This follows what is described here.) (2) Click on the "prepare download" button in the far upper left of the images window pane. Click on "include PNG color images" in the download options pop-up. (This follows what is described here.)

Extraction Tools

Several tools allow you to extract information from images or image planes (you are unlikely to encounter image planes in Finder Chart).

-  -- 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 (which you are very unlikely to encounter in Finder Chart), the line moves across pixels in a plane, and the points extracts points from a plane.

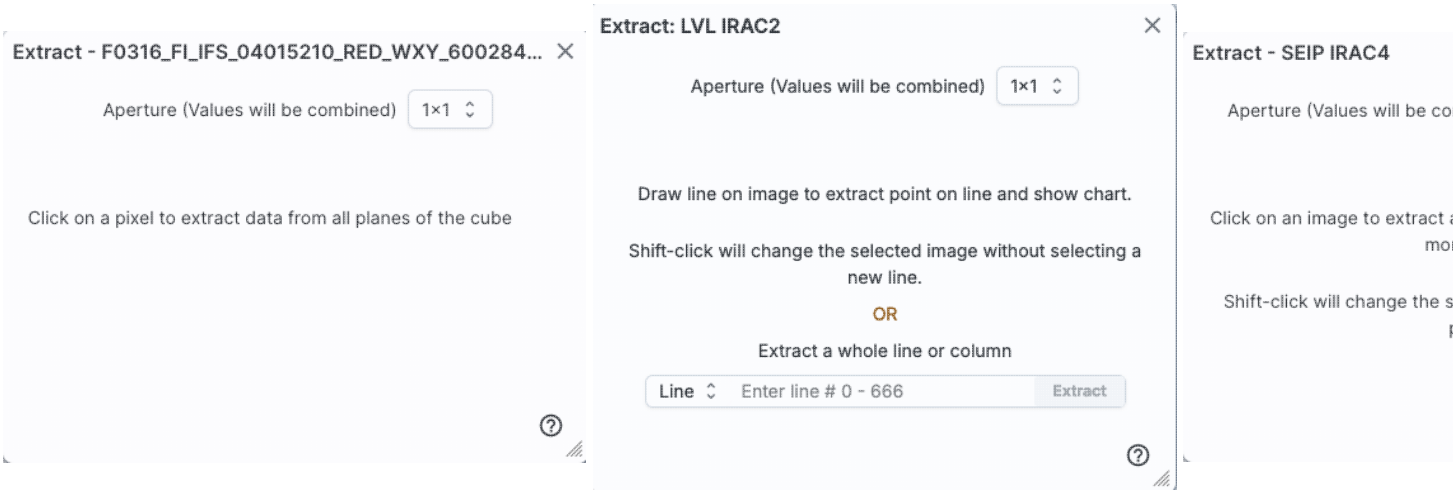
Here, we cover the basic approach, with specifics of each tool integrated as we go along.

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.

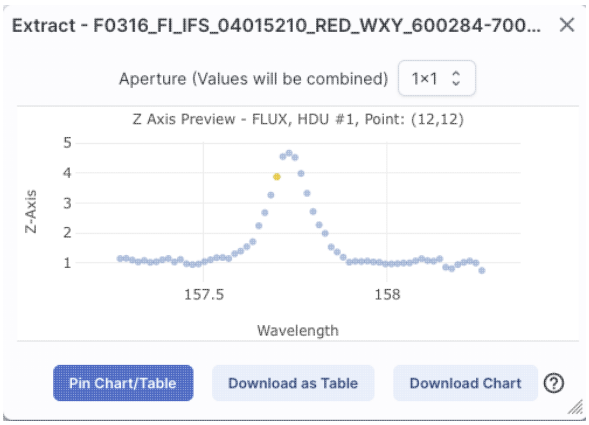
For the drill: for the line: and for the points:



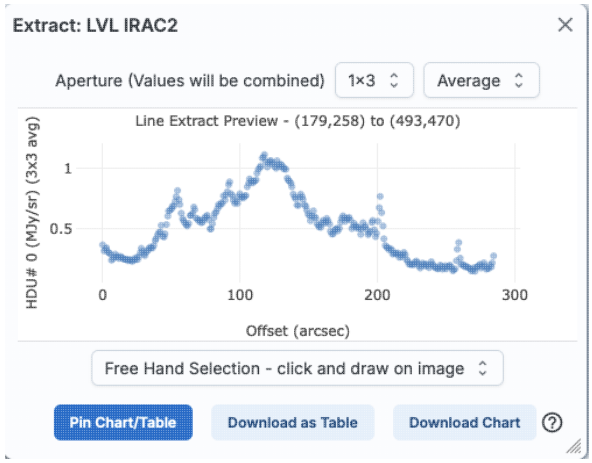
Set aperture. In all three cases, the top center of the extract pop-up window has a drop-down from which you can select the aperture value. For the drill and points, you can choose, in pixels, 1x1, 3x3, 5x5, or 7x7. Values can be summed or averaged. For the line, it's a little different. The apertures 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.

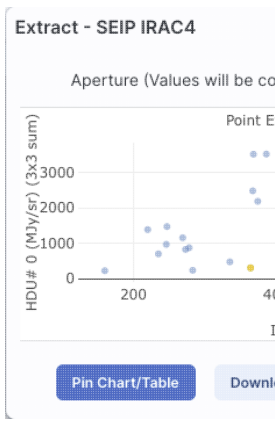
For the drill:



for the line:



and for the points:

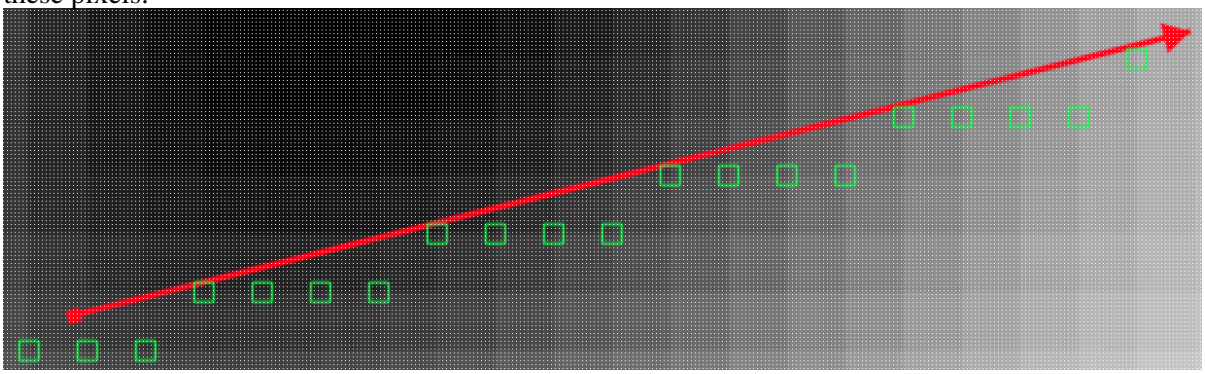


In each of these cases, it does the best that it can to label the axes accordingly. The cube that is used for the drill example here follows the spectral data model so that it is recognized as a spectrum, and it plots against wavelength. The line extraction is a 1x3 average and plots the offset in arcseconds 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.

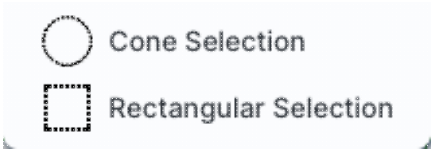
End extraction mode. 

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.

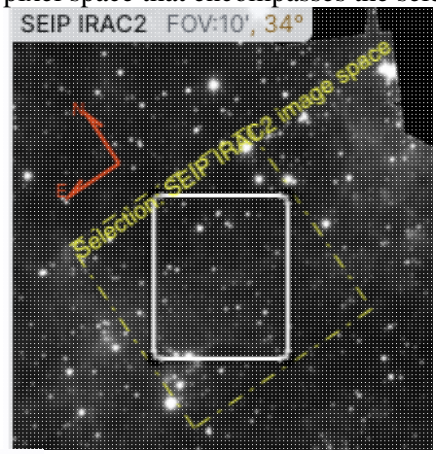
When you have selected a region of the image, additional icons appear above the image, and exactly which icons you see is a function of whether or not you have a catalog overlaid:

 These icons allow you to do several things:

 *Crop the image*

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*

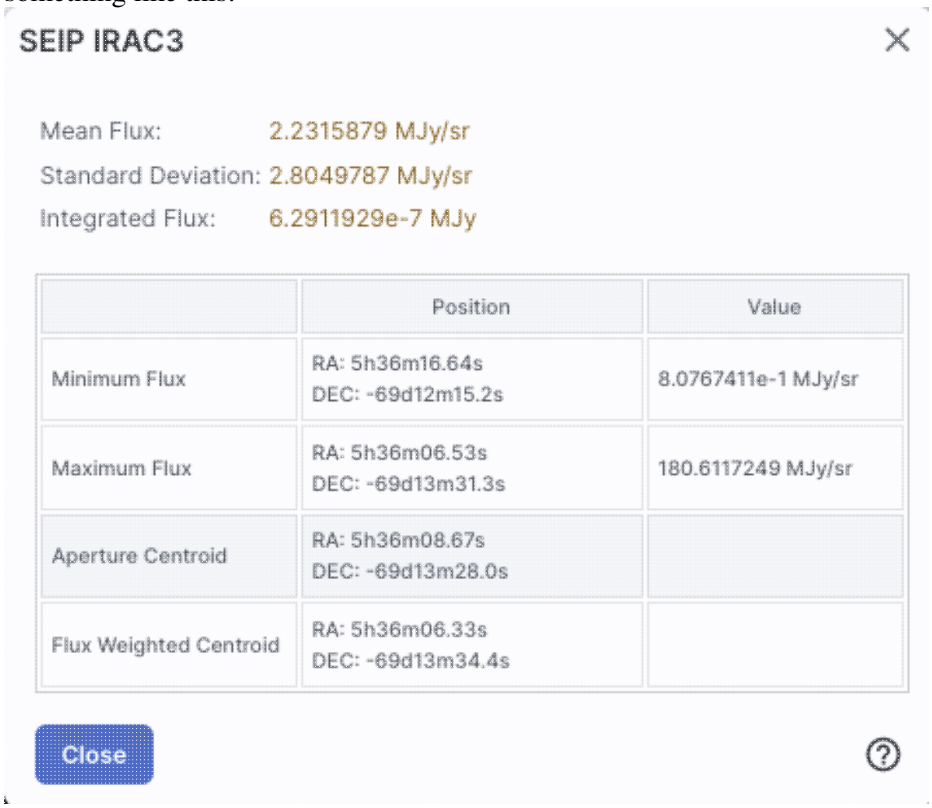
(Only if a catalog is overlaid) Filter the overlaid catalog down to the sources within the enclosed area. When you choose to impose a filter via this selection mechanism; the filters icon changes above the catalog to indicate that there is a filter applied (). To clear the filters, click on the cancel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

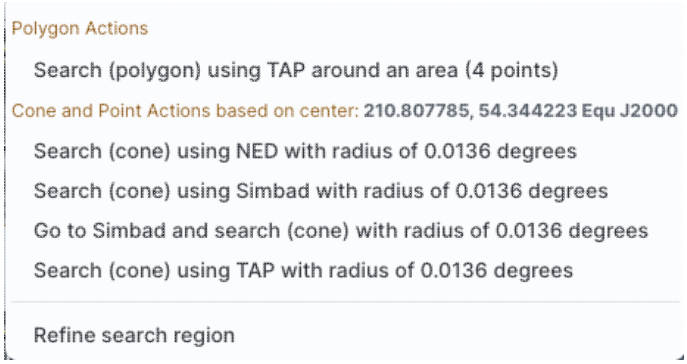

Obtain statistics
Obtain statistics from the image on the region. The statistics option results in a pop-up that looks something like this:



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

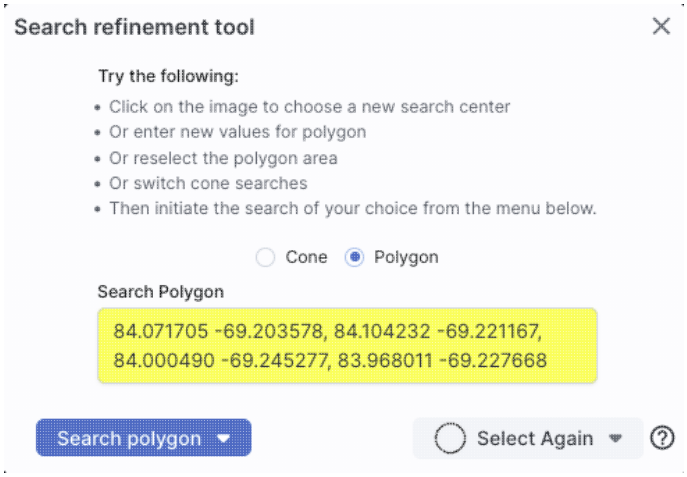
This tool implements a new search, an "action", on the region you have selected. It results in this drop-down (right). where this example is based on a region centered on 210.807785m 54.344223, J2000 decimal degrees, over a 4-cornered polygon. (You can also use the region tool to define a cone; this 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).

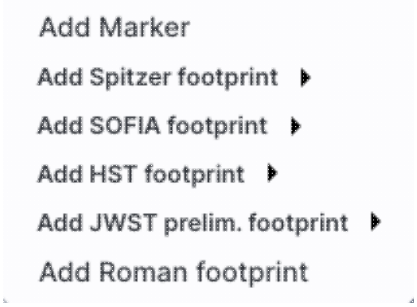
When you are working with the selection tool, this: End Select appears next to the image toolbar to remind you that you are in that mode. If you are refinifng positions for a search, it will be End Search Marker. Either way, when you are done with the selection tool, if your other actions don't turn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

Tips and Troubleshooting

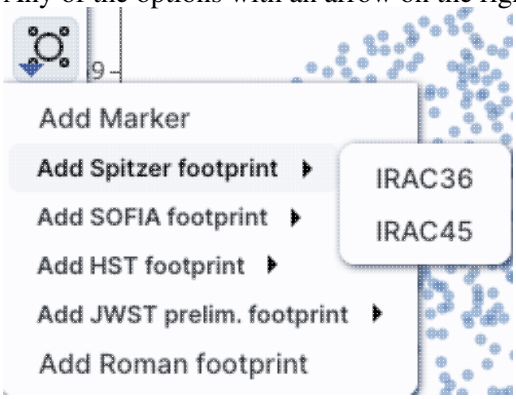
- The "region selection" tool also appears in the slightly different context of interactive target refinement in several other places in this tool, where it works in a a very similar fashion.

Footprints

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



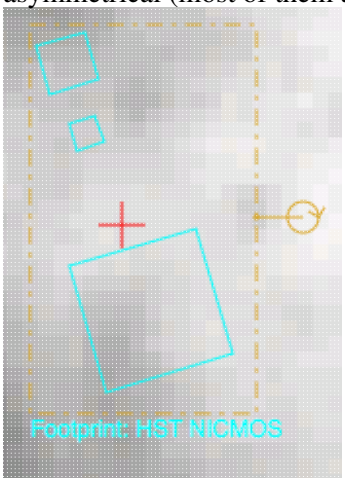
Any of the options with an arrow on the right can expand to additional subsidiary choices, e.g.,:



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:



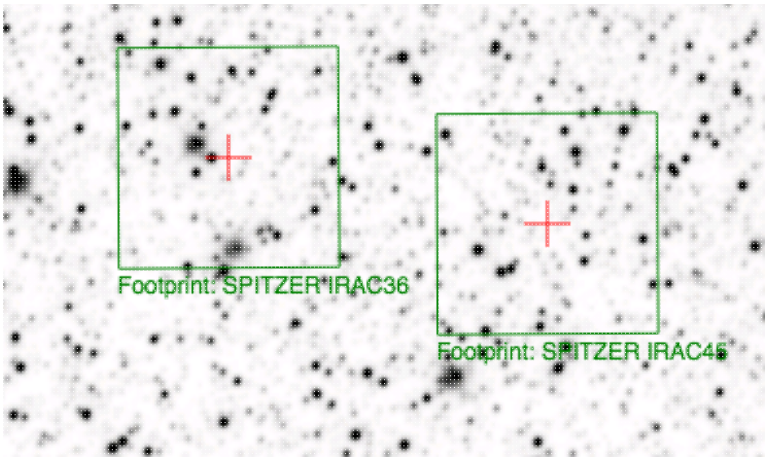
These so-called "handles" allow you to resize and/or rotate the marker, depending on the nature of the marker. These handles only appear when the marker is selected as active; if you wait a few seconds, they vanish.

Tips and Troubleshooting

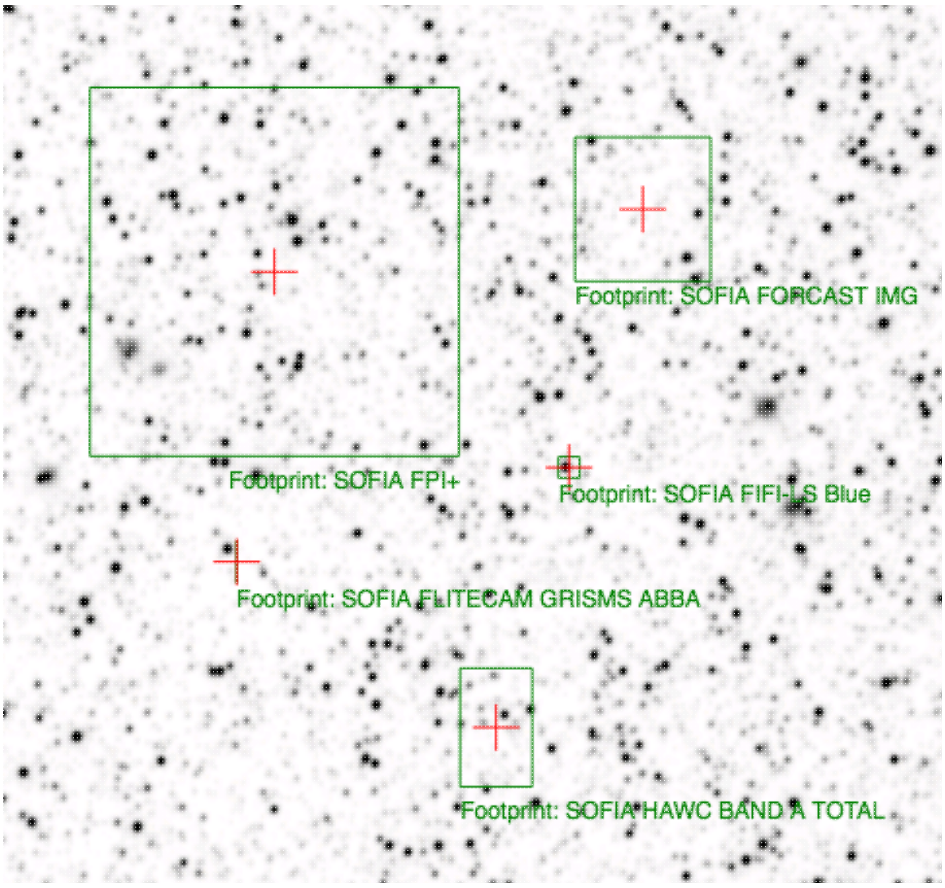
- Some of these footprints are *large*. If you have a small image, some of these footprints will be larger than your image. Zoom out to see it, or find a larger image to use. If you overlay, say, a Nancy Grace Roman Space Telescope (formerly WFIRST) footprint on a 2MASS Atlas FITS image, you may need 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.



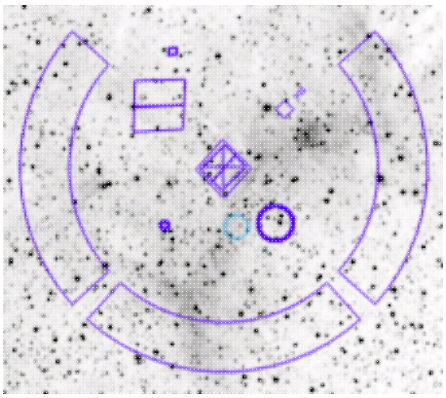
Spitzer/IRAC 3.6 and 4.5 micron footprints. These two footprints are placed separately from each other. The footprint can be moved or rotated. Click and drag the center of the footprint. A circle appears with four small circles ("handles") around it. Grab and drag the small circles to rotate it, or drag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



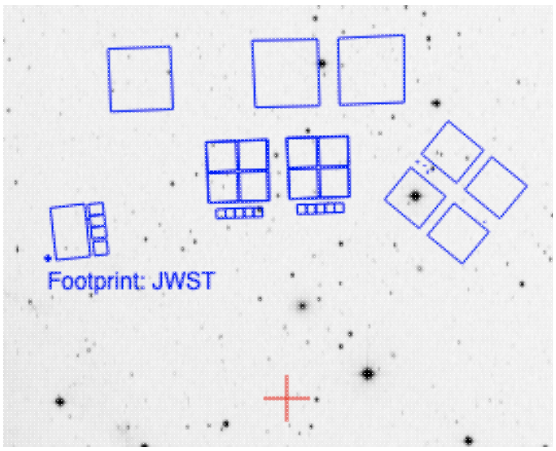
SOFIA footprints. Several different SOFIA footprints are available; the graphic here shows a selection of them. The available footprints (all of which are placed separately) are:

- 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

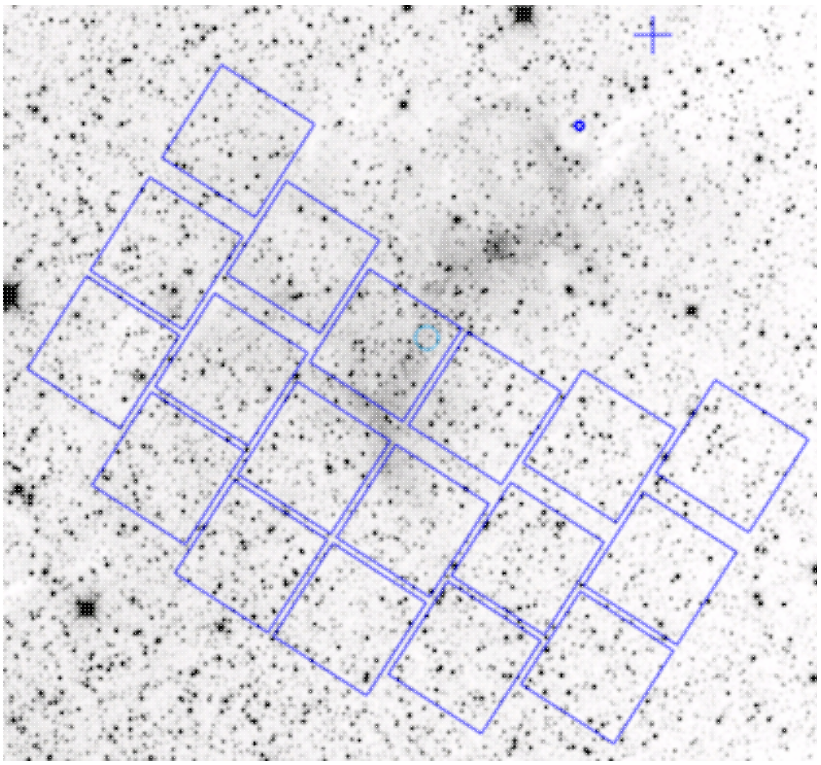
Change the color, delete, or add more copies of the SOFIA footprints from the layers pop-up.



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.

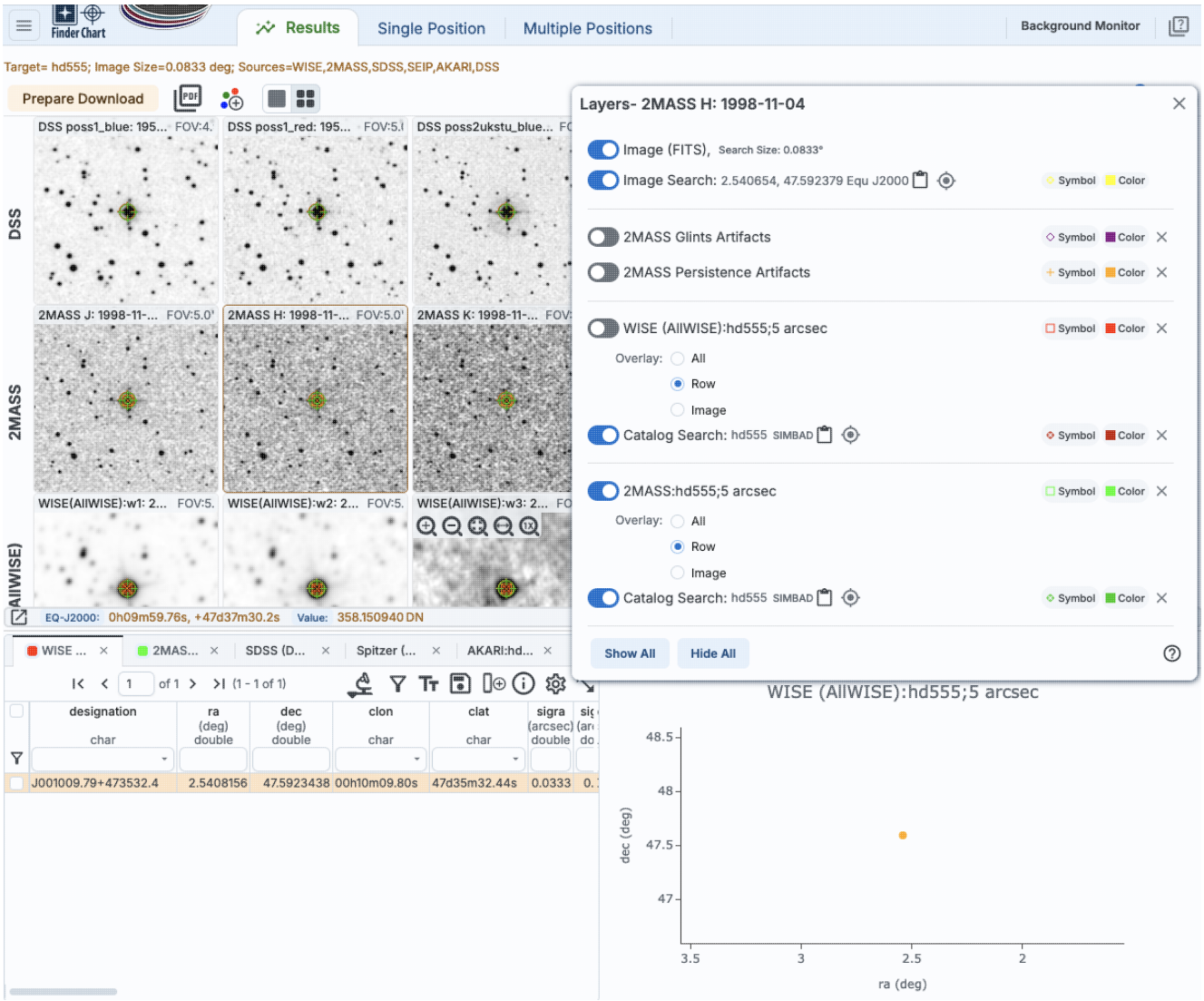


Nancy Grace Roman Space Telescope focal plane footprint. As above, the footprint can be moved or rotated. Click and drag the boresight (the cross hairs), which appears by default to the upper right of the array of squares. A circle appears, centered on the boresight, with four small circles ("handles") 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.

Examples of Catalogs and Layers

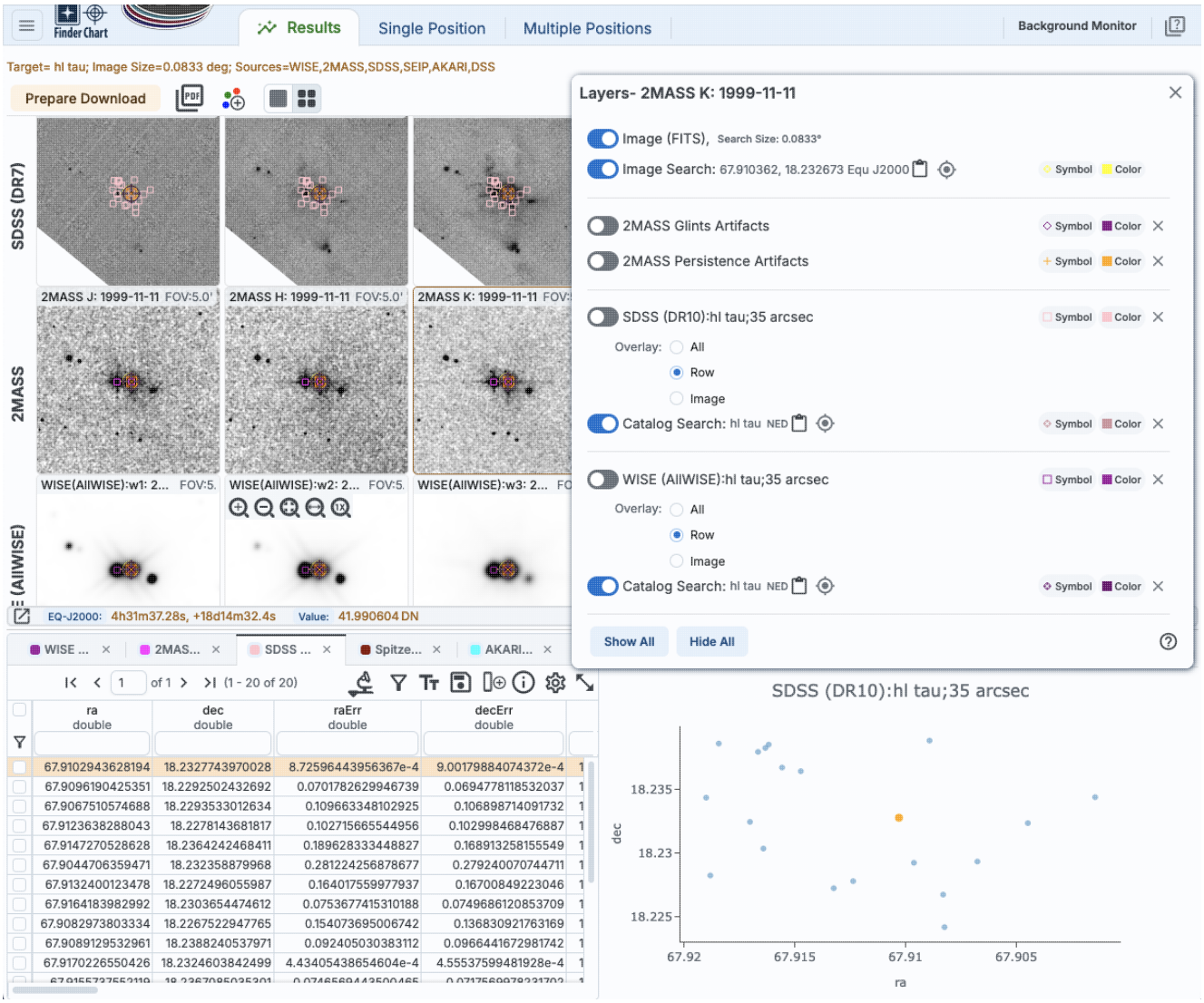
When you search on targets in Finder Chart, sometimes the results can be confusing. If you search on catalogs from the search results page, then Finder Chart will overlay these catalogs on your images as additional layers, but sometimes these layers may not be immediately obvious, or they may be so overwhelming as to block your view of the image entirely. In order to see the layers on any given image, you can click on the layers icon () in the image toolbox (described above). Here are three quick examples demonstrating the issues at play.

HD 555 is a relatively isolated bright star. If you do a single target search on "HD 555" with everything set as defaults (300 arcsecond images, all images but IRAS, yes search corresponding catalogs, within a 5 arcsecond search radius), it will do exactly as you ask, and return this:



Each catalog has one point at this location, and no other points within 5 arcseconds. So, it looks like the search might have failed, because especially at this scale, all the catalogs have a point at the same location, right on top of the bright star (HD 555) and each other, and no catalog has additional sources that 'stand out' in comparison to that bright star. (And, the plots look super boring too.) Moreover, DSS doesn't have a corresponding catalog, so there are no catalogs on that row of images. If you go to the layers icon (shown in the screen shot above), you can see that all the catalogs that you requested are there. Note, though, that the catalog is overlaid on the corresponding images -- that is, the 2MASS catalog appears on the 2MASS images, the WISE catalog appears on the WISE images, etc. You can change that via the layers pop-up -- you can turn the WISE catalog on for the 2MASS or DSS images, etc. In that fashion, you can, for example, easily see whether the WISE catalog has counterparts to an object seen in the 2MASS images, etc.

HL Tau is a bright binary star. If you do a single target search on "HL Tau" using search on "HD 555" with everything set nearly as defaults (300 arcsecond images, all images but IRAS, yes search corresponding catalogs, within a 35 arcsecond search radius), it will return this:



Now it is much more obvious that the catalogs are returning different sources for each row. SDSS has returned a 'halo' of (apparent) sources here, and both 2MASS and WISE have resolved the binary. Once again, the catalogs are all there, and you can control which catalogs appear on which row via the layers pop-up.

If you search on M101, and this time ask it to return 300 arcsecond images, nearly all images (except IRAS), yes search corresponding catalogs, and now search within the image boundary, you get this:

You can see that Spitzer/SEIP has detected so many sources that the image itself is now difficult to see, whereas 2MASS has detected far fewer sources, and WISE is somewhere in between those two extremes. You can use the layers pop-up to toggle off and temporarily hide the catalog overlay, or change the color/size of the points to make the background image easier to see.

See both the Tables section and the Catalogs section for much more information on tables and catalogs in general.

Tips and Troubleshooting:

- If you want to overlay a source list on all the images retrieved from a multi-target search, don't overlay it as a regions file; regions files will only be shown on the currently selected target's images. Overlay your source list as another catalog on its own, and then those sources will appear in each image for each target.
- If you leave the layers pop-up window open while you click on different images to select them, you can see the contents of the pop-up layers window change to reflect the layers (and options) present in that selected image.
- If you can't figure out whether or not an object that you can see by eye in, say, 2MASS, has been detected by WISE, click on a 2MASS image, go click on the layers icon to bring up the layers pop-up

window, and turn on the WISE catalog for the 2MASS images. Then you can easily see (modulo any proper motion) whether or not WISE detected the 2MASS source.

- If you can't really see the image through the sources from a given catalog, but you still want to see the points from the catalog, go click on the layers icon to bring up the layers pop-up window, and change the size/shape of the points to make them less prominent.

Finder Chart: Tables

All of the tables in Finder Chart (whether they are catalogs, or a list of the targets on which you searched, or the contents of a FITS header) are interactive tables, and they have the same basic properties, discussed in this section. The specific broad case of catalogs is in another section.

Contents of page/chapter:

Table Header

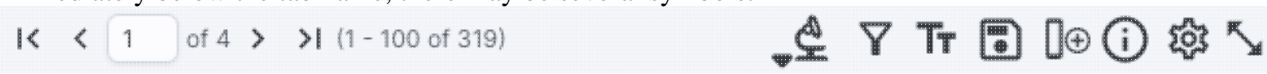
These interactive tables -- called Firefly tables, after the software that is running here -- all have the same functionality, regardless of the contents of the table. If it looks like this sort of table, you can work with it whether it is a catalog, an image header, a list of targets, etc.

If you have loaded a table 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, you may be able to click on the "X" on the tab. In Finder Chart, several catalogs can be searched from the front page, and the name in the tab reflects the origin of that catalog.

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

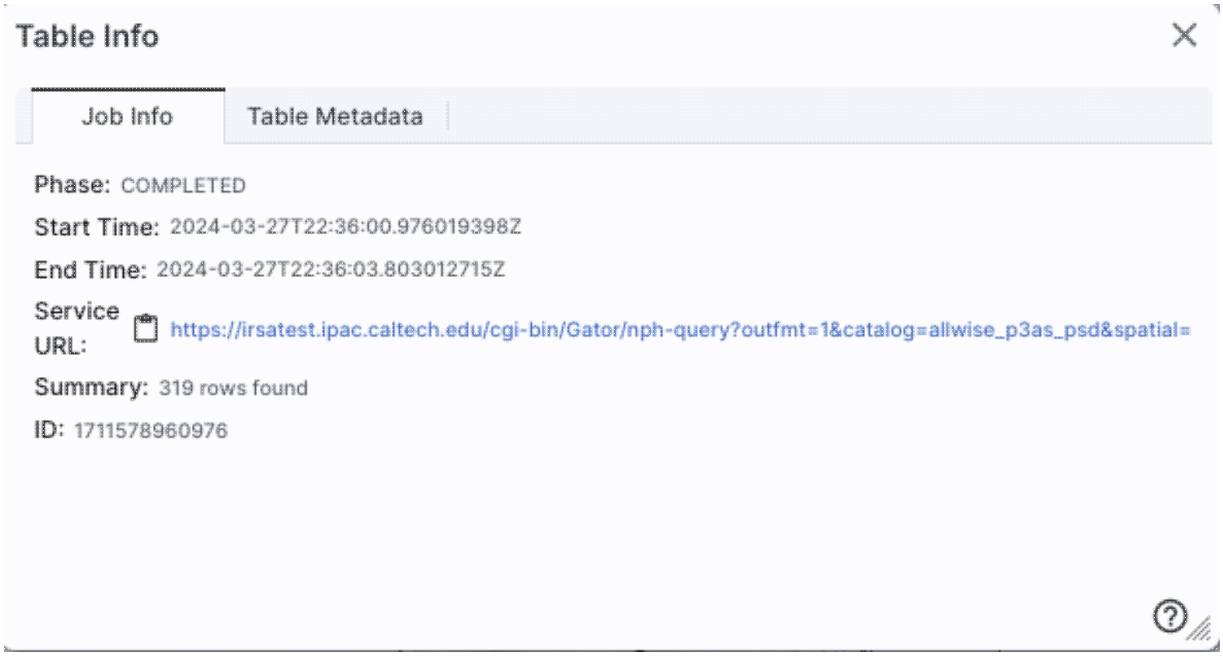
This is how you can save the table. It has a separate section below.


Add a column

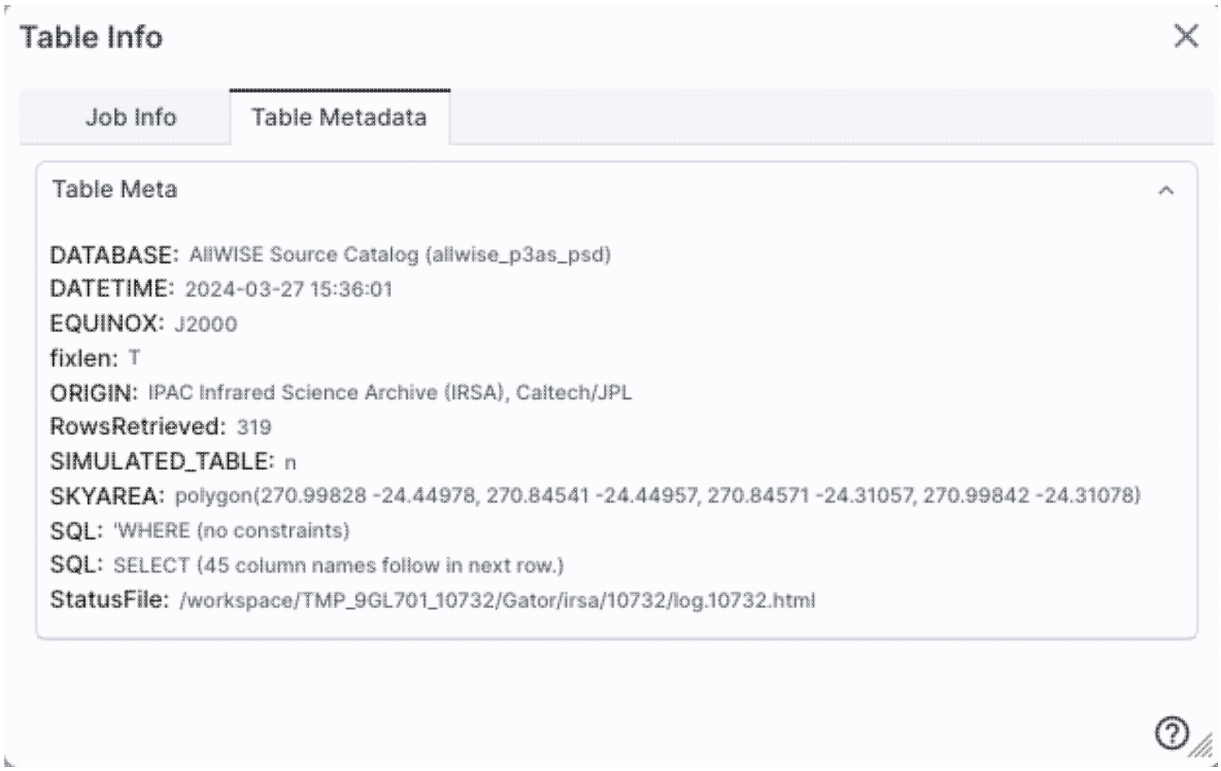
This icon adds a new column to the table. This has a separate section below.


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:



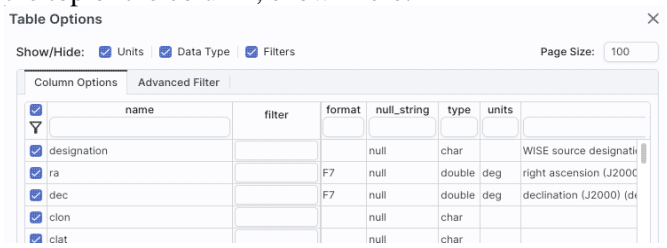
where the information about this table includes information about the query that produced it.

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.

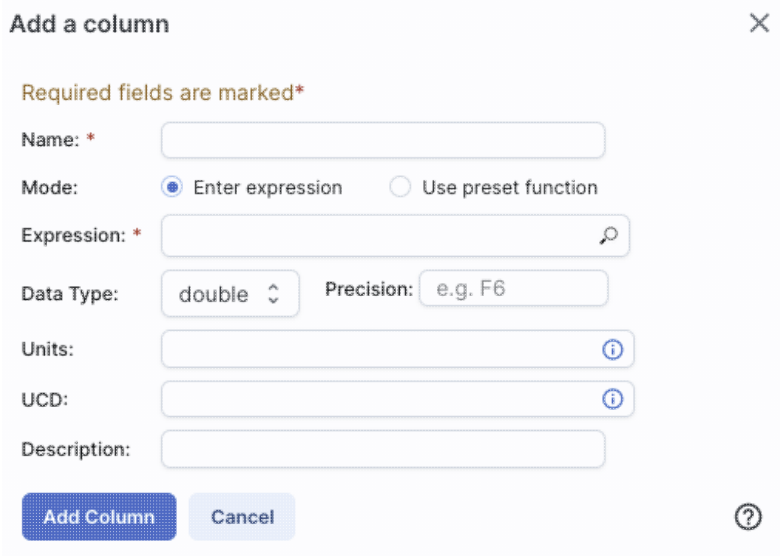
It could be that, when you do a multi-position search on catalogs, you have an option for "one-to-one matching". If that is selected, the line (and only one line) of output is included for each line of input. It chooses the closest source within the radius you specify, or if there is no match, it adds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

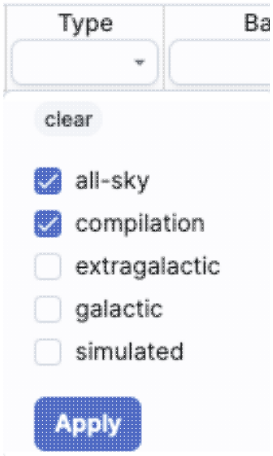
Tips and Troubleshooting

- 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 !=

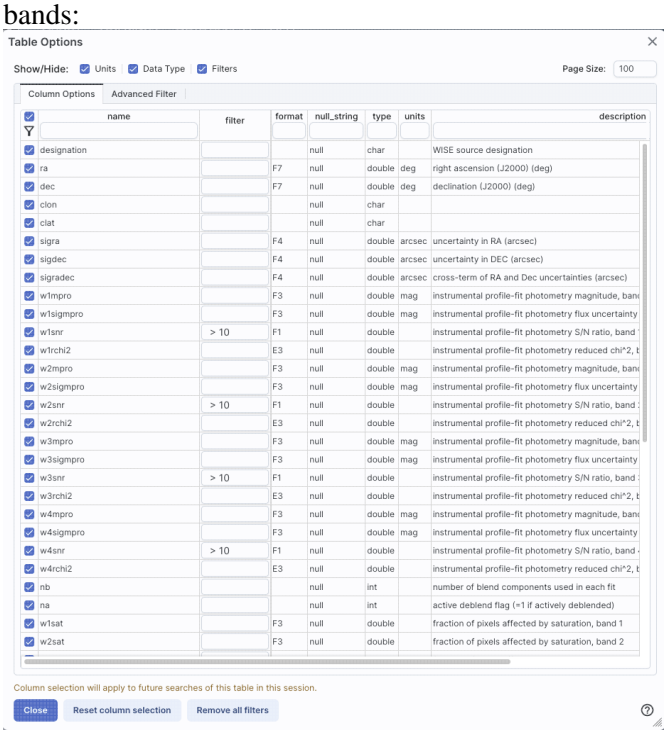
Examples:

- 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.

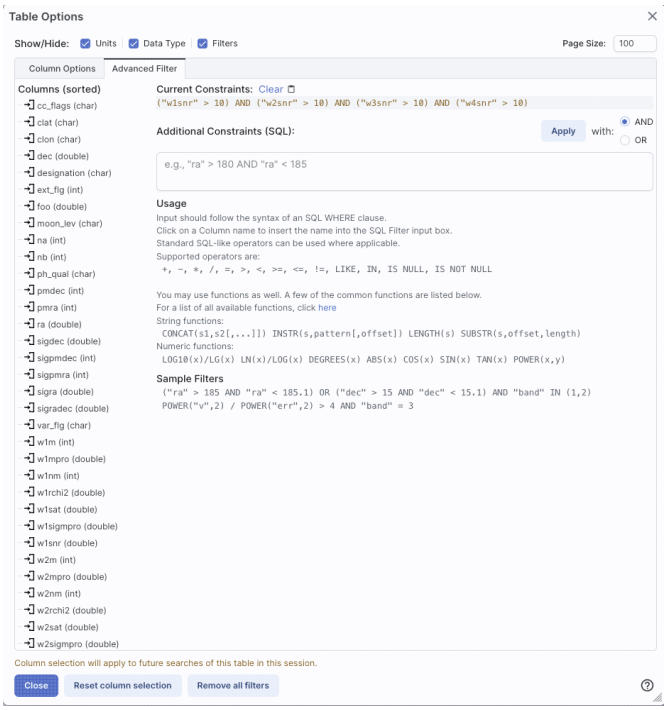
You may also be able to select rows one at a time via the far left column and then filter that down. Example: Retrieve a catalog of any sort. Select rows by ticking the box on the far left, say, every other row out of the first 12. Click on the filter icon on the top of the column. The filter is imposed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

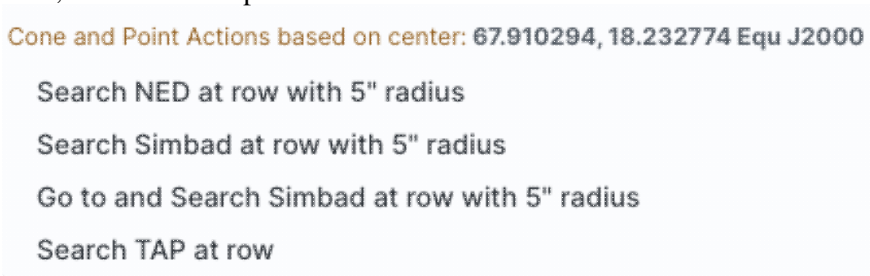
Tips and Troubleshooting

- 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:



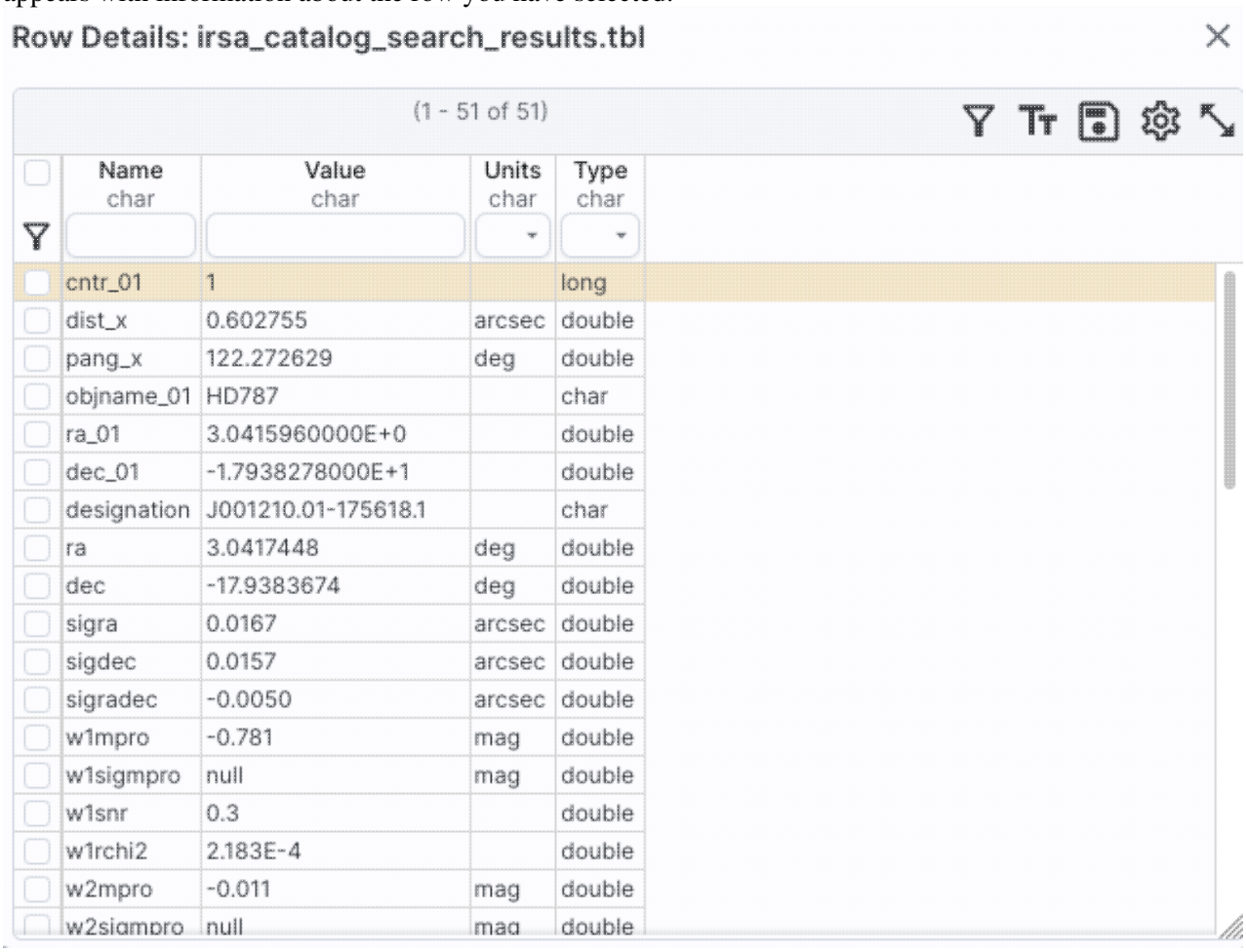
For this example, the selected row is 67.910294, 18.232774 in J2000 decimal degrees. From this drop-down, you can:

- 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:



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.

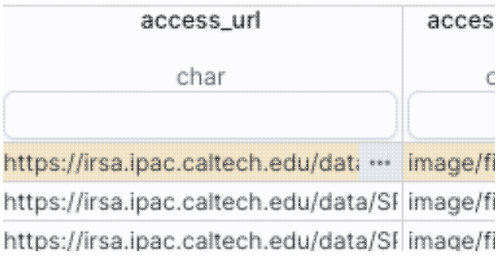
Tips and Troubleshooting

- 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.*

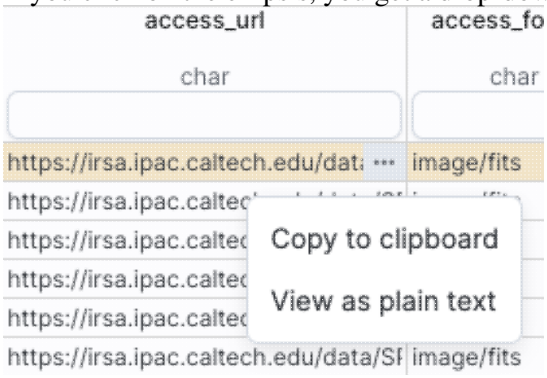
- Because you can sort/filter the data in the property sheet, you can restrict what values are shown. Those filters are respected as you page through your main table.
- When changing rows in the main table, the property sheet scrolls to preserve the visibility of whatever row in the details tab is highlighted. 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.

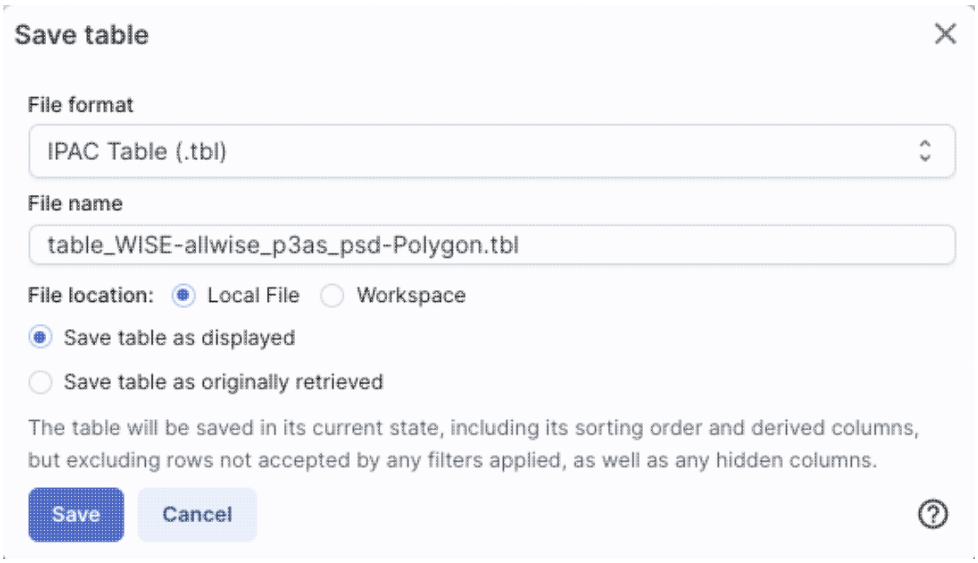
If you view it in a pop-up window, it will attempt to format it in a readable fashion:

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.

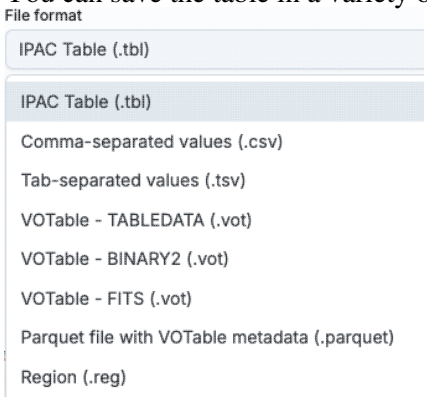
You obtain this pop-up:



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

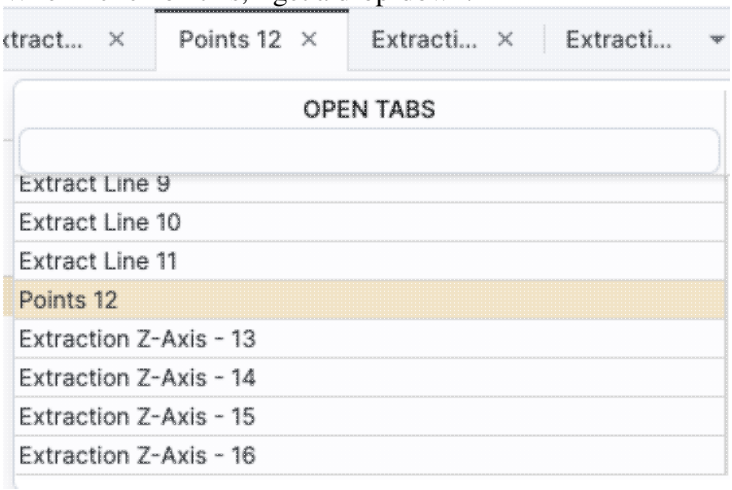
retrieved."

Table Navigation

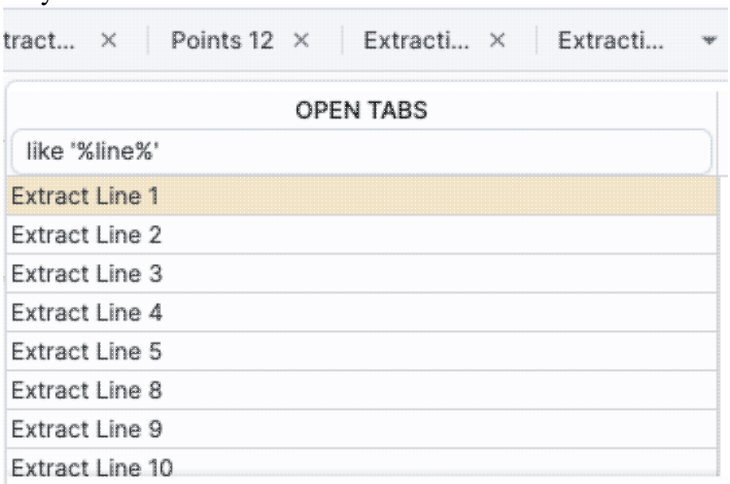
At any time, you can move among tables by just clicking on the tab name. But, with the ability to extract data from images comes the ability to rather quickly drown in tables. There is a way to navigate among a lot of table tabs that have accumulated.

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.

Finder Chart: 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

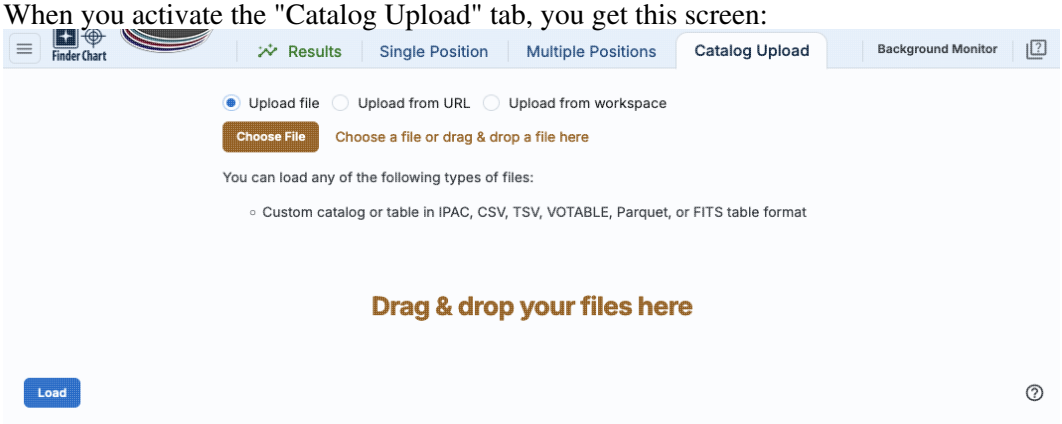
There are several different ways to get catalogs into Finder Chart. You can retrieve them via your initial search, or via any of several blue tabs at the top of the page after your intial search.

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. Finder Chart will only let you load tables, however.

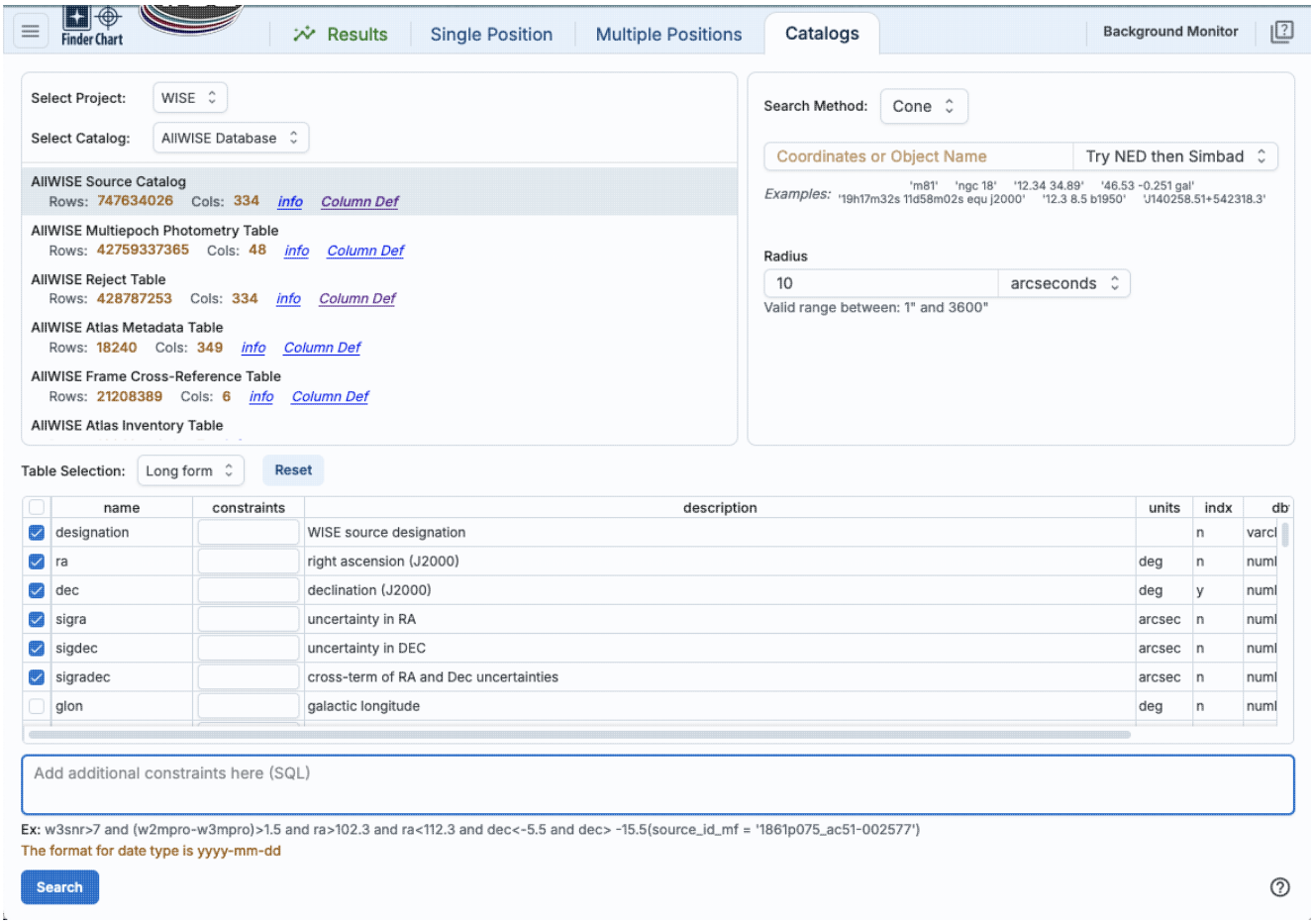
Nearly every file you load will result in a preview of the file you have uploaded. The tables are then shown and, if catalogs, interacted with in the same way as the other catalogs described here.

Tips and Troubleshooting

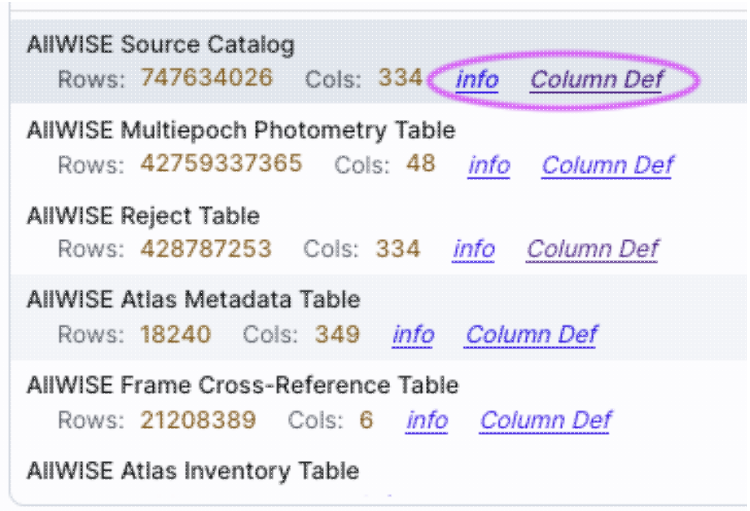
- If you would like to have your catalog overlaid on an image, it needs to have RA and Dec columns. If the tool doesn't seem to recognize your RA and Dec columns, check your formatting, or try headers of "ra" instead of "RA" and "dec" instead of "DEC" or "Dec". If you have columns like "_RA2000" and "_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



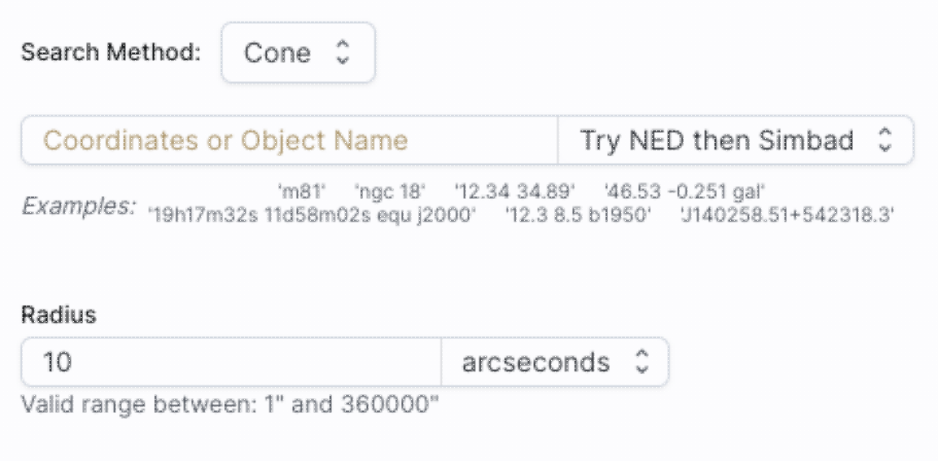
The upper left quadrant of this window is where you specify which catalog you want to search. To change catalogs, first select the "project" under which they are housed at IRSA, such as 2MASS, IRAS, WISE, MSX, etc. The available choices underneath that change according to the project you have selected. 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.

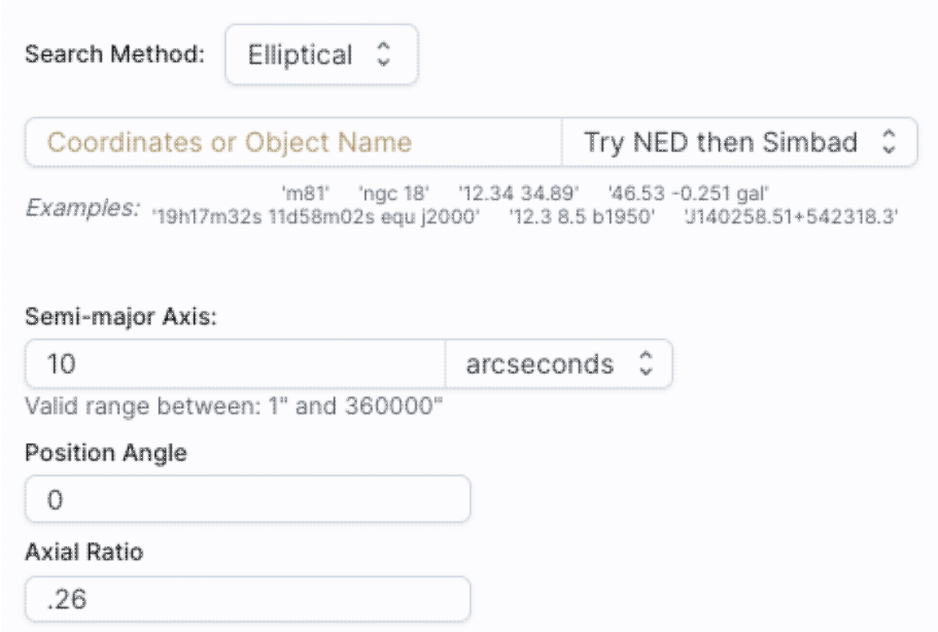
Tips and Troubleshooting: Pick your units from the drop-down first, and then enter a number; if you enter a number and then select from the drop-down, it will convert your number from the old units to the new units. There are both upper and lower limits to your search radius; it will tell you if you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

Cone search:



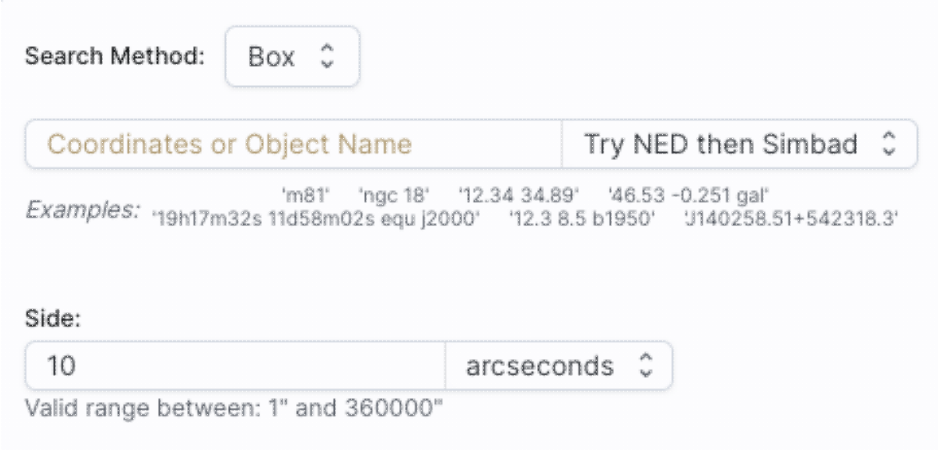
You can put in a position, but sometimes it attempts to guess a position, based on prior searches. You specify the cone radius; the default is 10 arcsec.

Elliptical search:



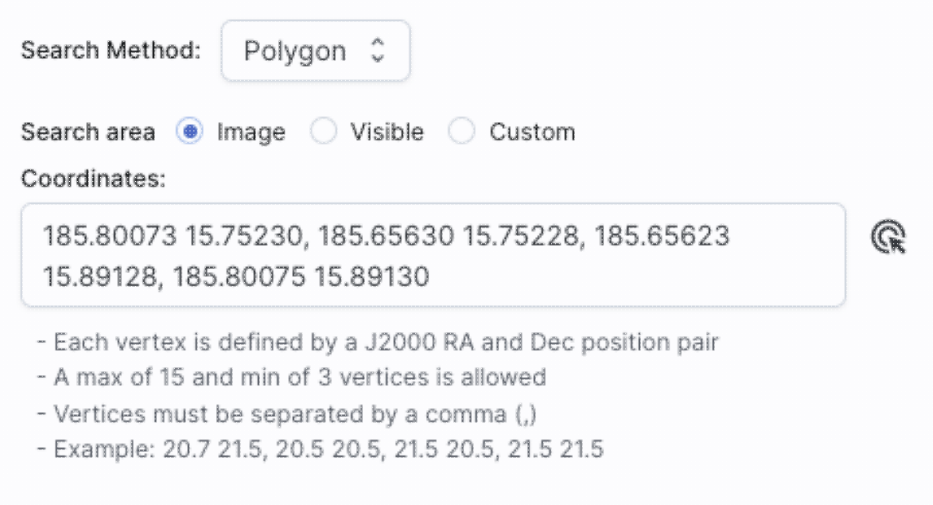
You can put in a position, but sometimes it attempts to guess a position, based on prior searches. You specify the search ellipse's semi-major axis, position ratio, and axial ratio. Defaults are as shown.

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.

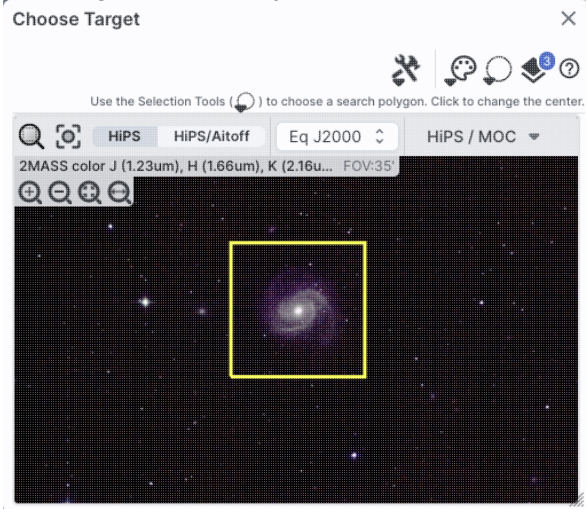
Polygon search:



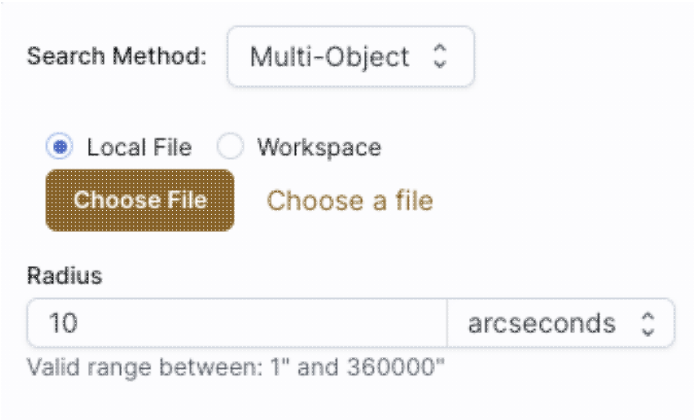
For this, note that it no longer has a single target location. It will sometimes try to pre-fill the vertices of the position it thinks you want, based on prior searches. If you have images loaded, it will give you choices based on the current image -- you can select whether you want the catalog request 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:



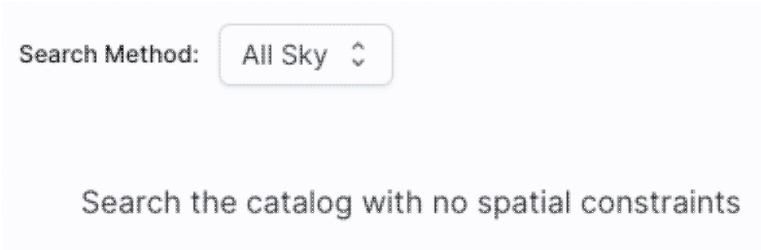
For a multi-object search, it can't guess what position you want. You need to upload a file (from your disk or the IRSA Workspace) in IPAC table format, which is a varietal of plain text. (IRSA has a table validator which may be helpful.) Note that you also have to specify the radius over which to search 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.
- When you load a catalog, even if it is a catalog of the same sort you have already loaded, it will be overlaid on all the images you have loaded. For example, if you search on M101 for all the images, and ask it at the time of your search to also search the catalogs, you'll get the 2MASS catalog on the 2MASS images, the AllWISE catalog on the AllWISE images, etc. If you then use the Catalogs tab to search the AllWISE catalog again, this second search of the AllWISE catalog will be overlaid on all of the retrieved images.

Hierarchical Catalog Display

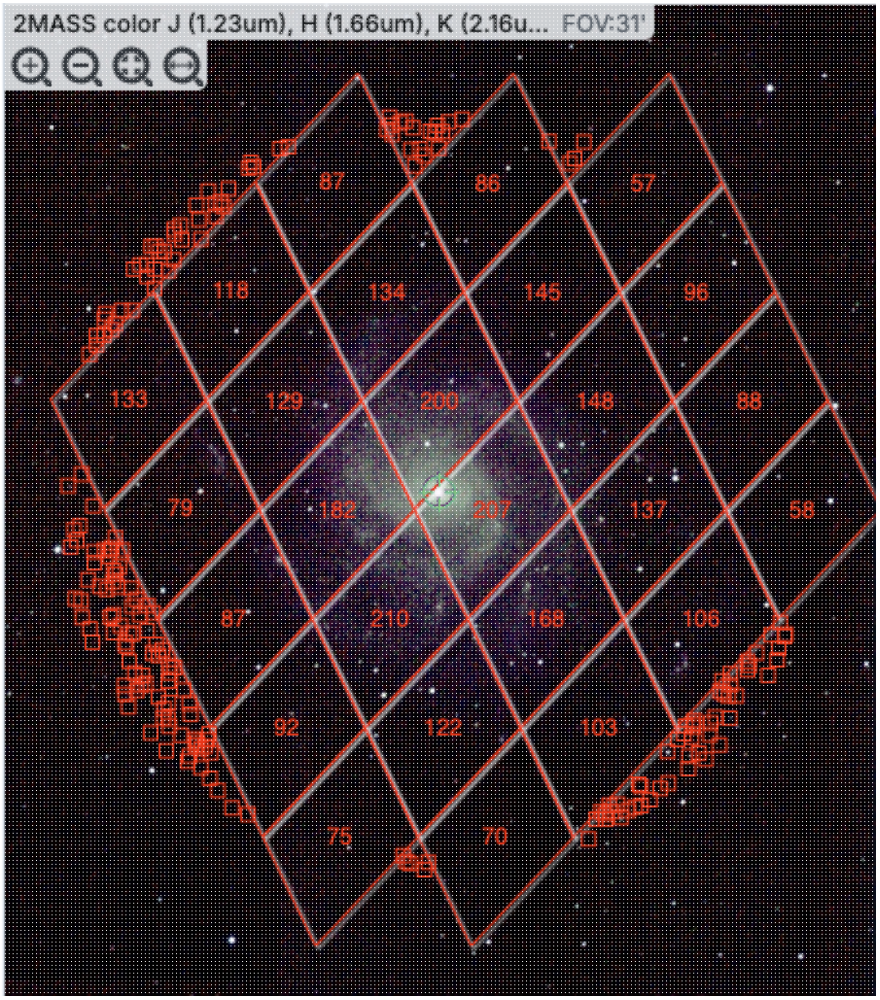
If one has a large catalog loaded into the tool overlaid on top of lots of images the possibility exists that the computer or the network could be overwhelmed trying to render all the points on all the images. Historically we dealt with this by "thinning out" the catalog and not showing all the points.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

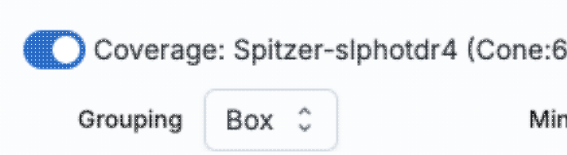
For catalogs below about 1000 points, the tool will show the individual points on the image.

For catalogs above that threshold, the tool will bin up the catalogs based on HEALPix pixels (which are equal-area tesselations of the sky). In summary, the sky is broken up into sections, and the tool will show you symbols with a number indicating the number of sources in that section. Then, when you zoom in, it will dynamically adapt to show you smaller and smaller sections until it shows you all the individual sources.

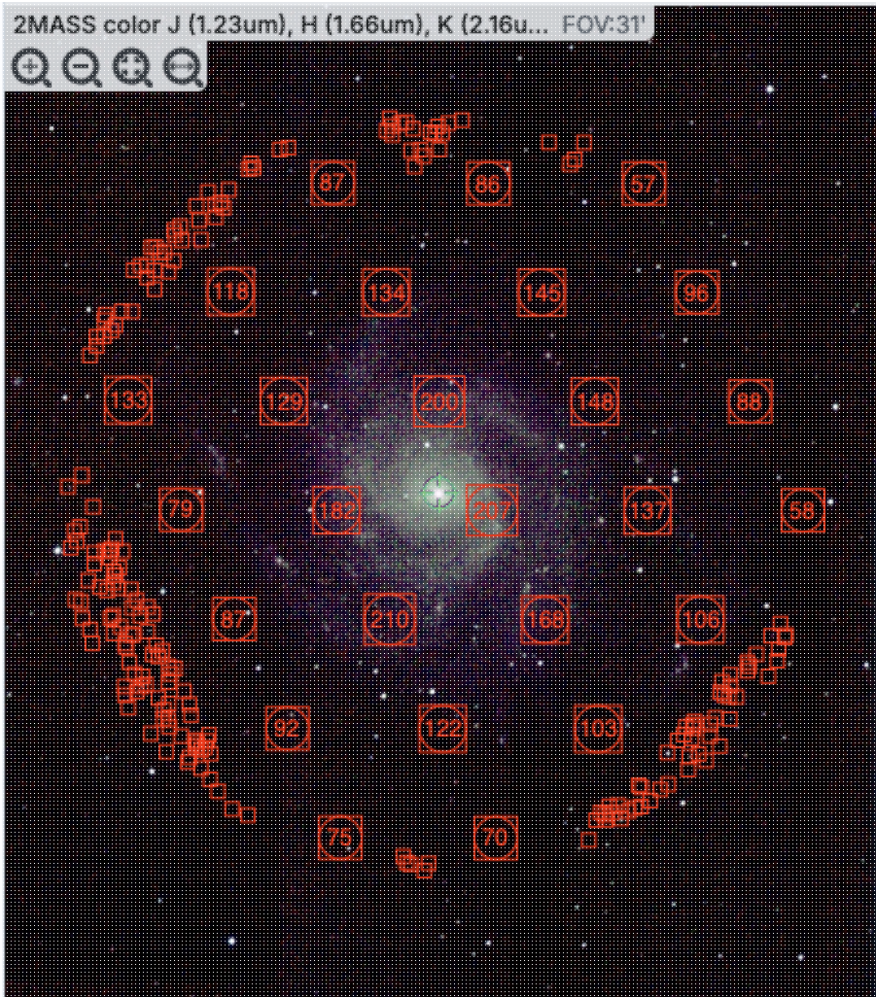
From the layers icon ( see visualization chapter), you can bring up many display options. Below are examples of what is displayed, the options seen in the layers, and additional options. The same catalog and zoom level and minimum group size are used for each view. The "Min Group" option here is 50, 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.

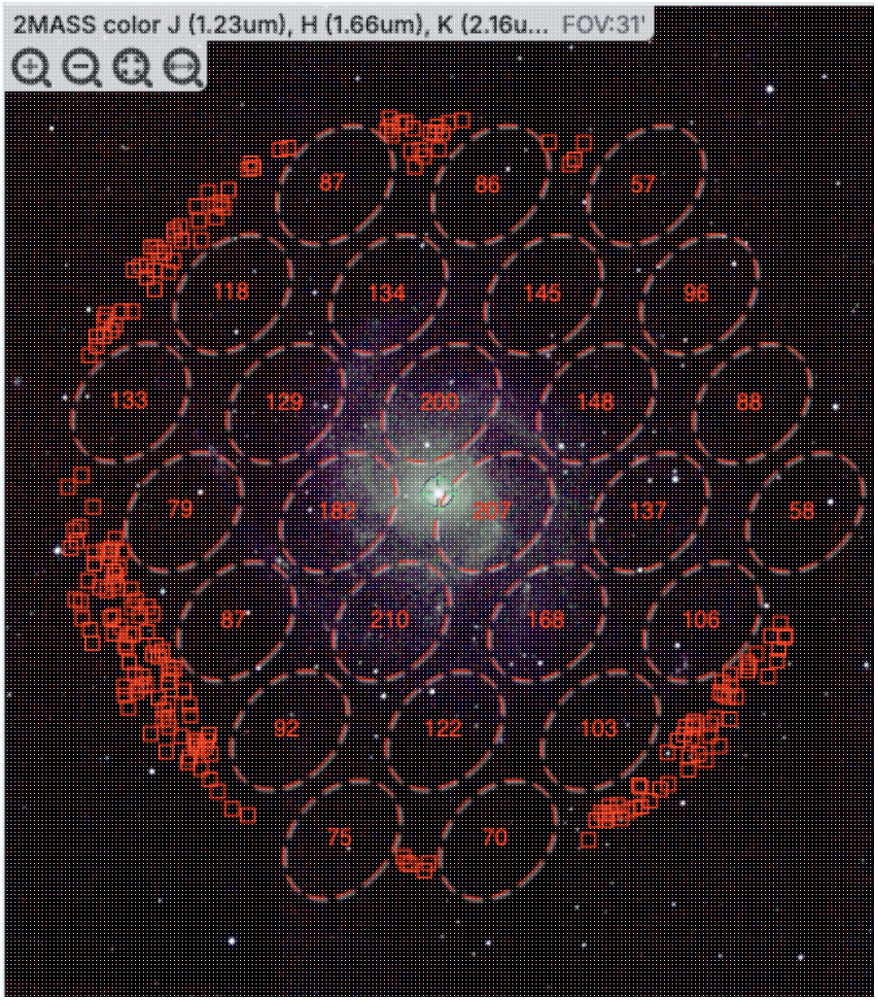


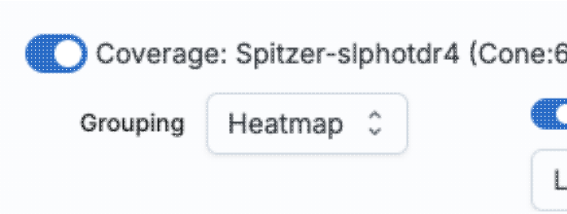


In this view, the 'cells' are shown by circles encl
sizes are the same as in the prior screenshot, but
obvious to new users.

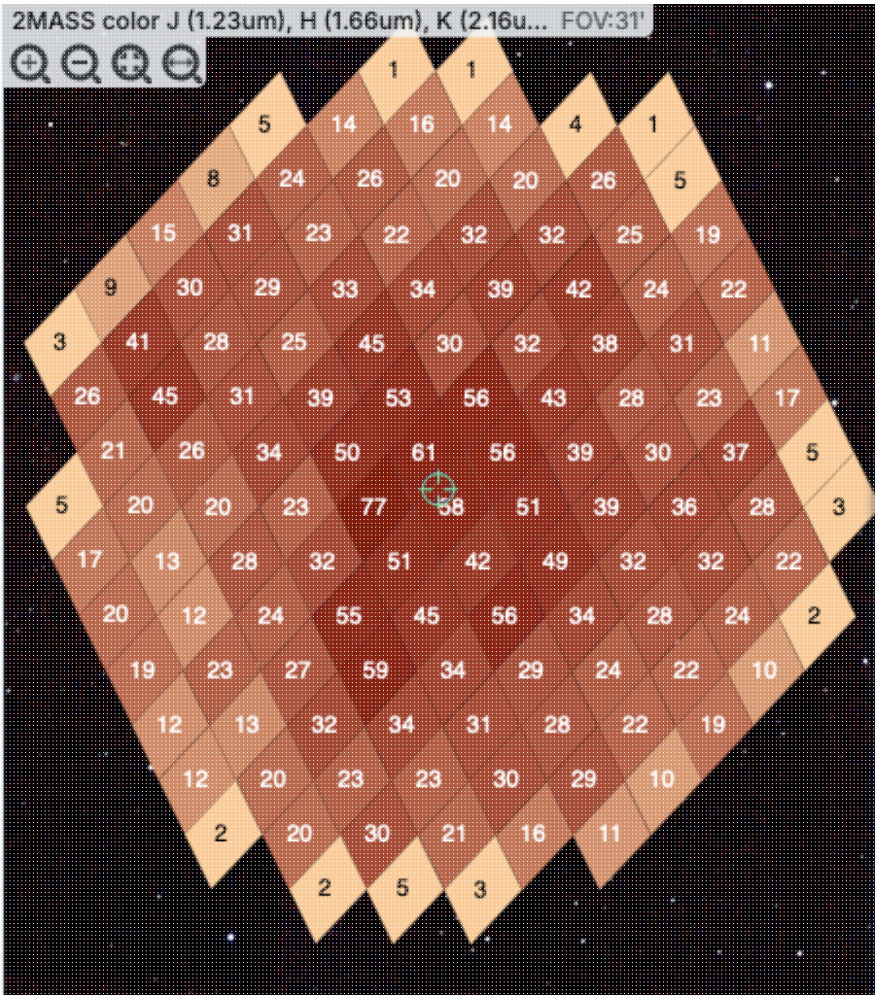


In this view, the 'cells' are shown by ellipses sho
cell sizes are the same as in the prior screenshot,
less obvious to new users. It may be more obvio
groups of points.



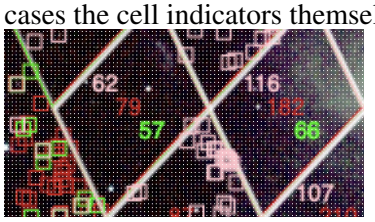


Finally, in this view, the 'cells' are again shown a
color of the cells corresponds to the number of s
"Linear", "Linear Compressed", or "Log Stretch
the color range by changing the color using the
which you can also change the transparency. Thi
how many sources are in each cell, but makes it
though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

Finder Chart: Other Searches

There are several other searches you can add to Finder Chart 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.

Finder Chart can help you interactively create ADQL which then you can copy and use in your own code elsewhere.

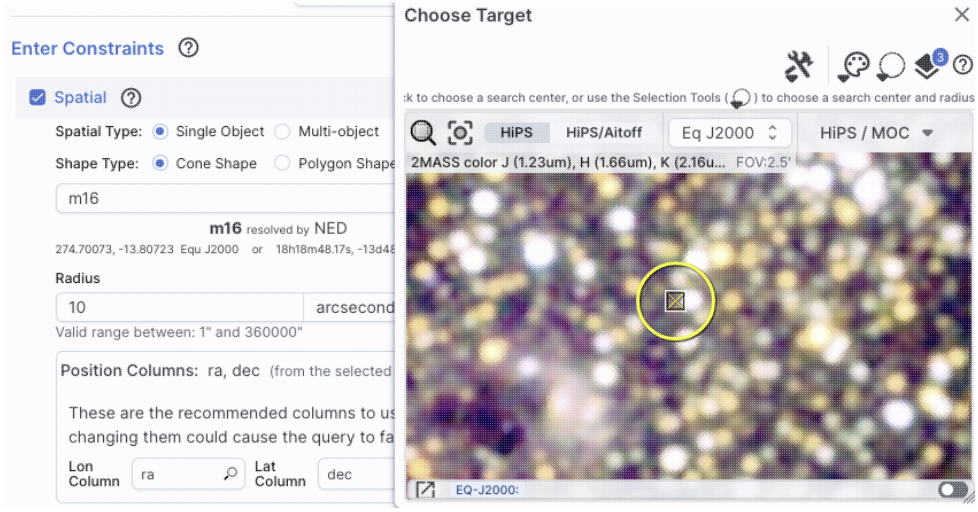
By using TAP and ObsTAP queries, you can use IRSA services to talk to other archives that also comply with these standards, world-wide.

The first part of this section talks about interactive target refinement and some constraints that are common to more than one of the searches discussed here, and then specifics of particular searches follow after that.

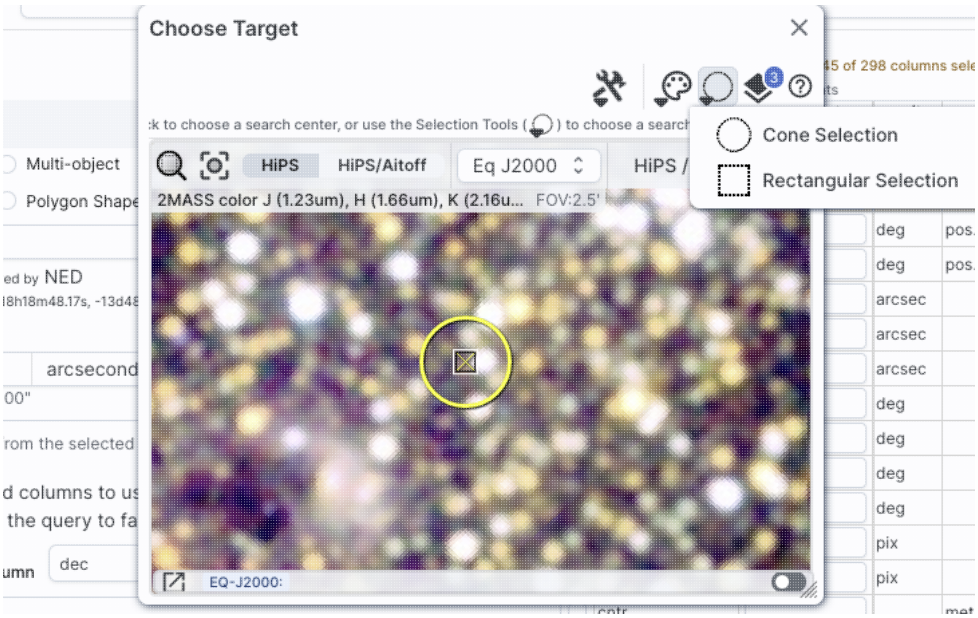
Interactive Target Refinement

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:



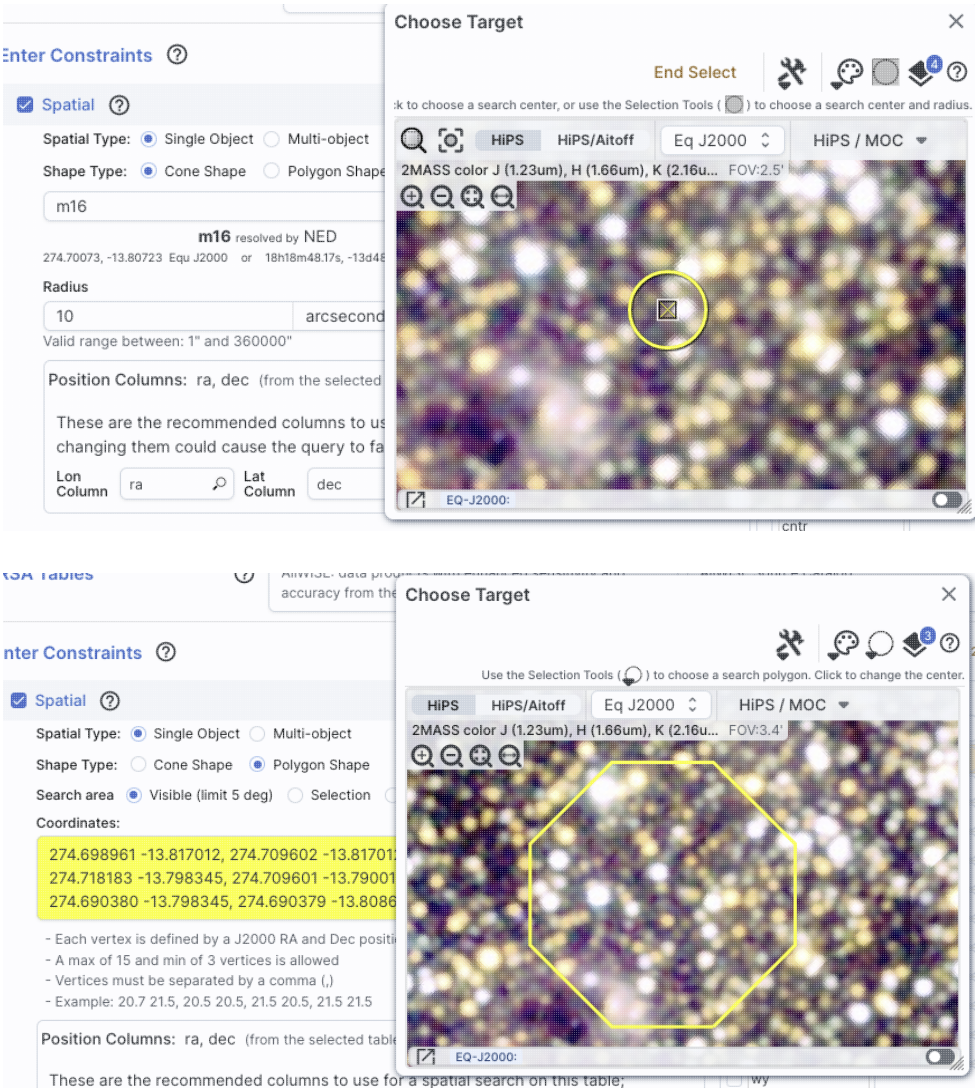
If you have entered a target already, the window arrives already centered on the target. If not, it is centered on the galactic center, zoomed out. If you have entered a cone search radius already, then the circle drawn on the image is that cone size. You can manipulate this image with the same basic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

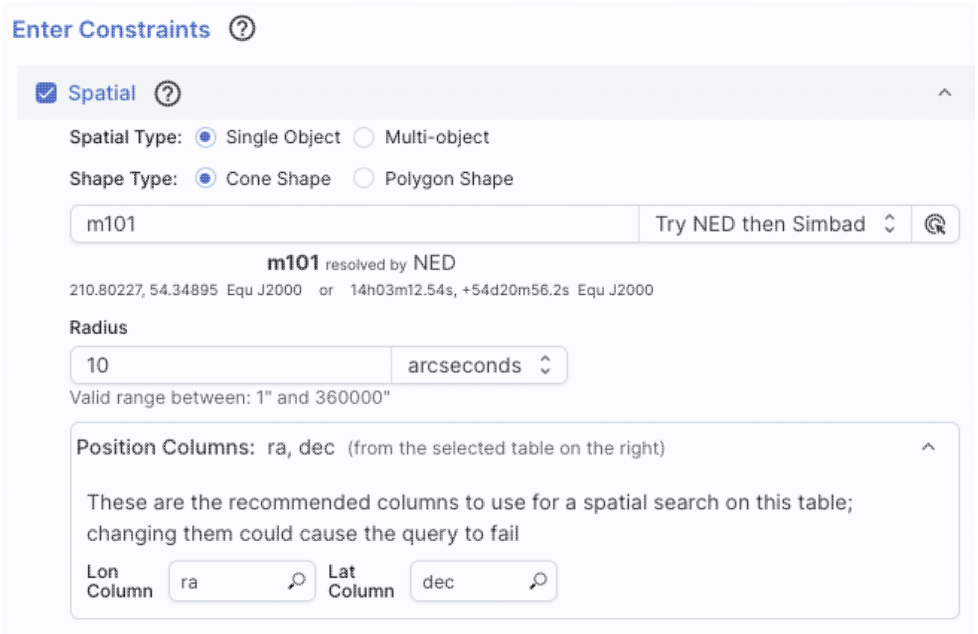
When you are done with this pop-up window, click on the 'x' in the upper right of the window. Then you can continue with whatever you were doing before you started to refine your target parameters.

VO TAP Searches: More information about constraints

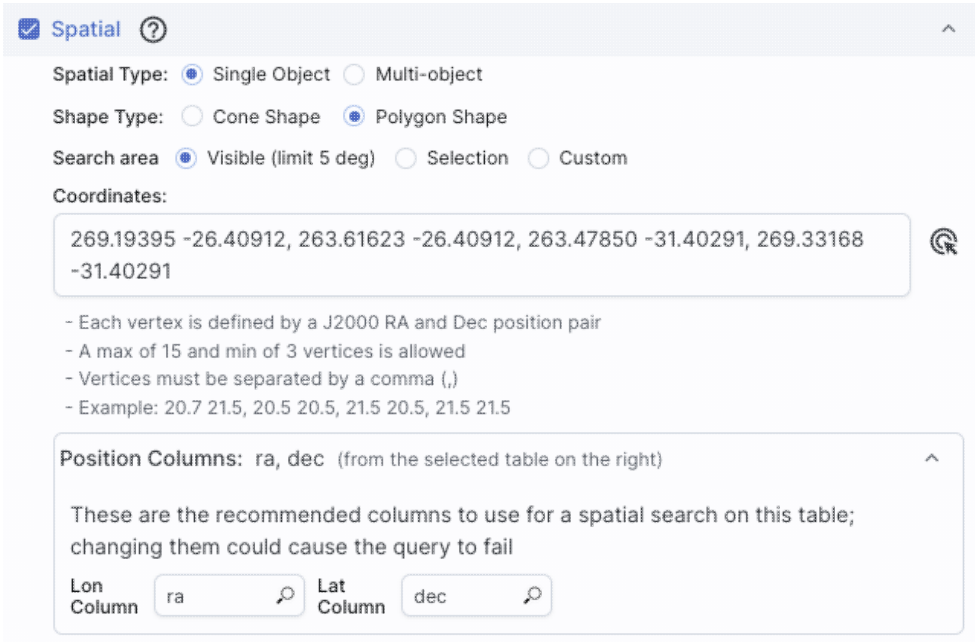
You can have several different ways of constraining your search depending on the options you have selected before the "Enter Constraints" section, and the options depend on what kind of service is available at the TAP service you have selected. If the options do not appear initially, click on the downward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



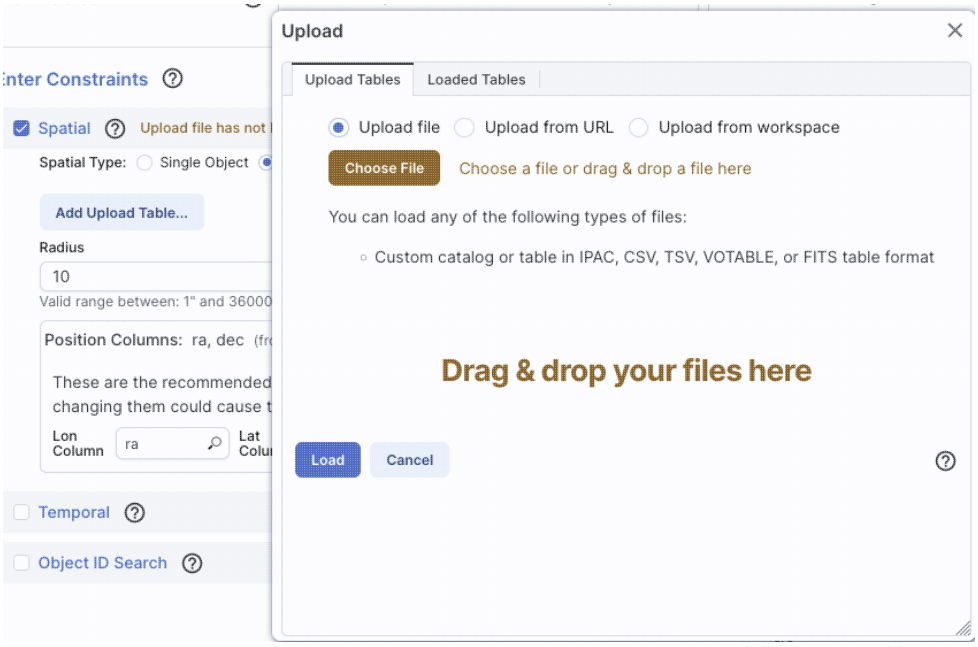
This is what it looks like when you do a **single target cone search**; note that you have the same name resolution options as in any other search here.



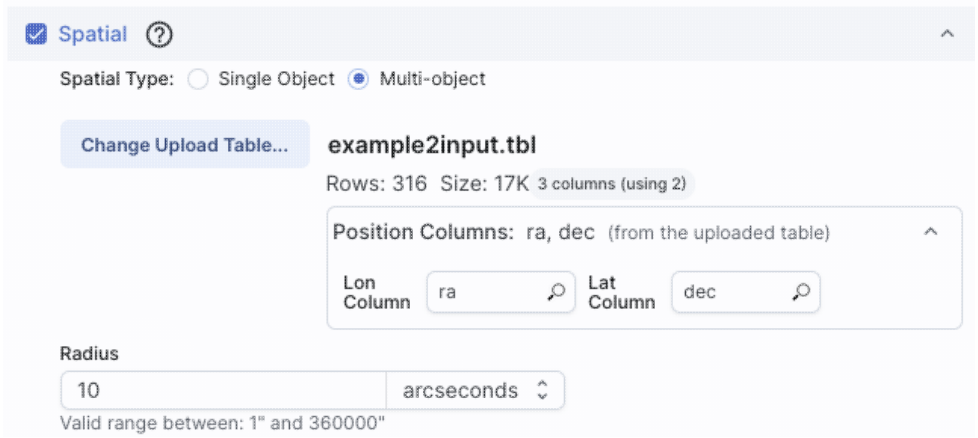
And, this is what it looks like when you do a **single target polygon search**. The search areas here (visible, selection, and custom) are the same as when you do a polygon search on catalog -- that is, you can select whether you want the catalog request to match the entire area of the image you have 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.

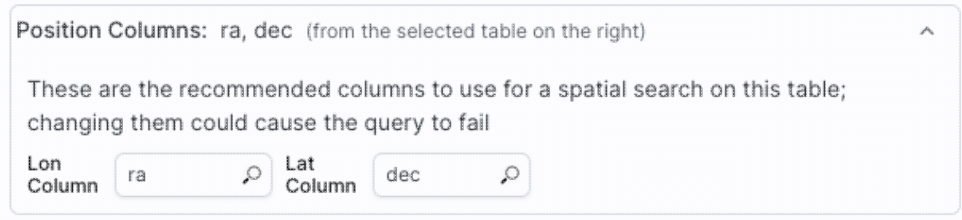


If you want to perform a **multi-target search**, click on "multi-object", which automatically brings up this pop-up, from which you can load a table from disk ("Upload tables" tab) or select one of the tables you have already loaded into the tool (click on the "Loaded tables" tab). Your uploaded catalog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

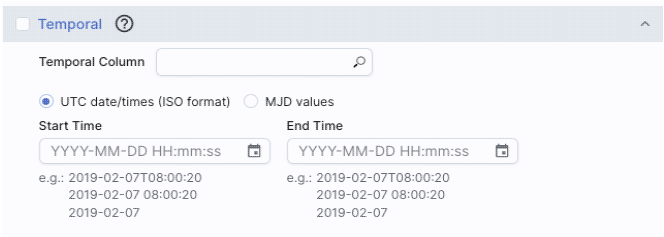


Regardless of what configuration you use, the last thing to check is which columns the tool has assumed are the position columns in the catalog to be matched to your position, region, or list of positions. Again, it attempts to make an educated guess as to the right columns, but if it guesses wrong, 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.

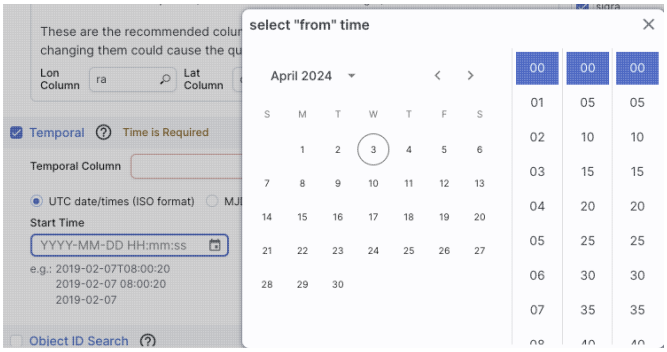
Enter Constraints: Temporal

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.

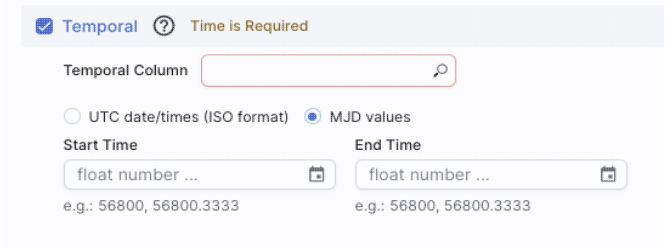
This is what the panel looks like initially, where you specify the column in the catalog you are searching with the time and then the dates. If you don't remember what the column is in the catalog, click on the magnifying glass to get a pop-up with a list of all of the columns.



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 catalog 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.

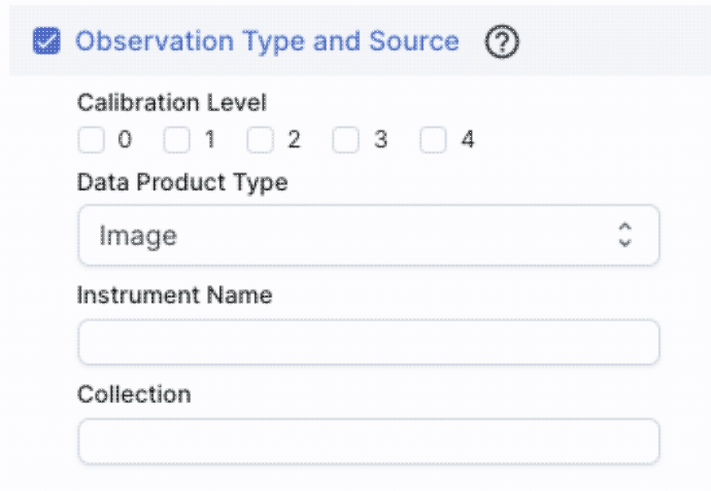
◊ If the catalog to which you are matching is not indexed by the name column you are using, the search may take a long time.

◊ 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.

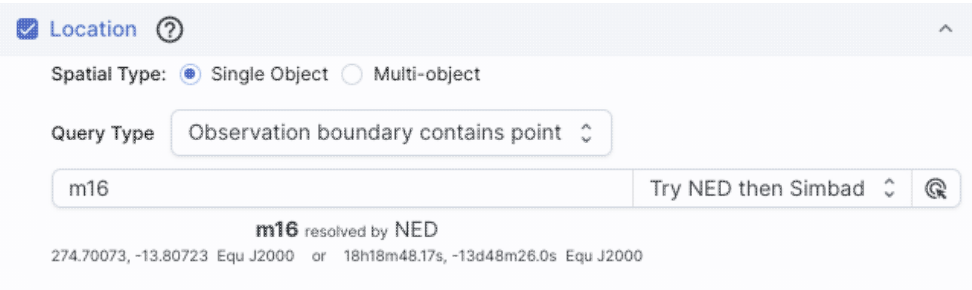
Enter Constraints: Observation Type and Source



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

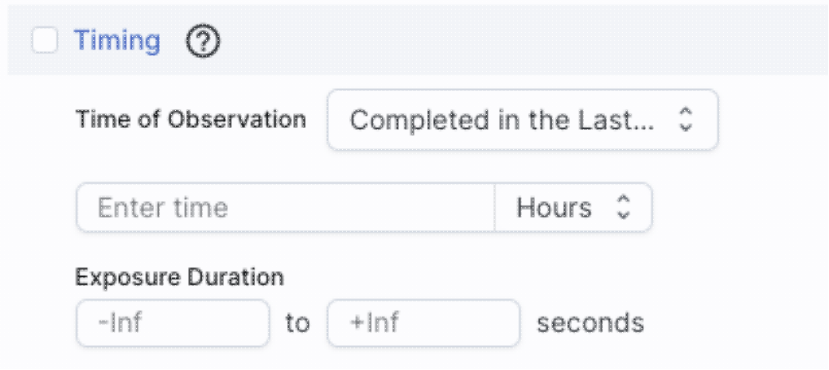


This panel provides a way to constrain the location of your search. Here, it is a single object search, which works just like it does above, including the interactive target refinement via the bullsye icon. You can also upload a list of targets by selecting "multi-object" -- it brings up the same pop-up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

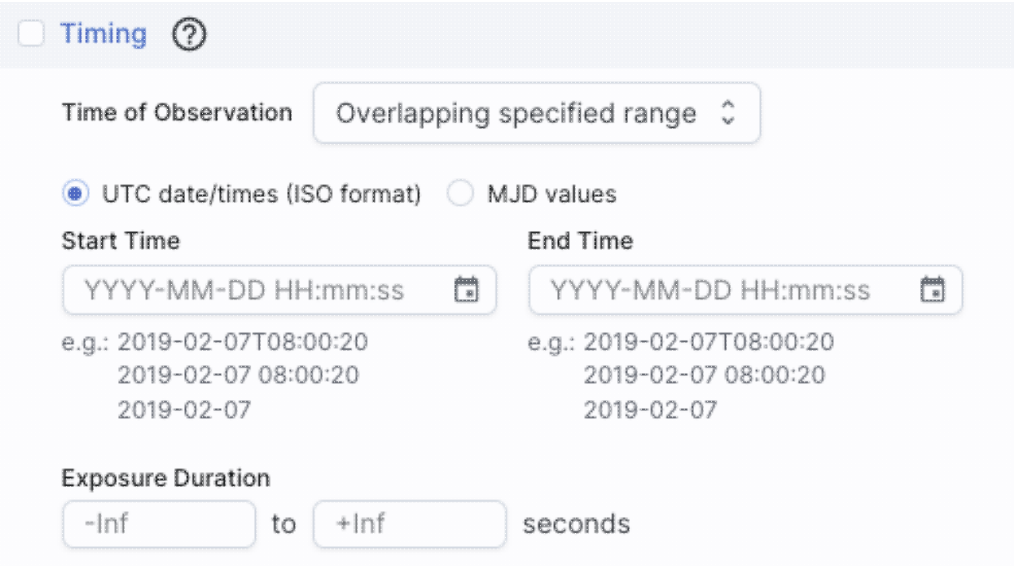
select one of the tables you have already loaded into the tool (click on the "Loaded tables" tab). Your uploaded catalog has to follow all the same rules as normal catalogs from disk.

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

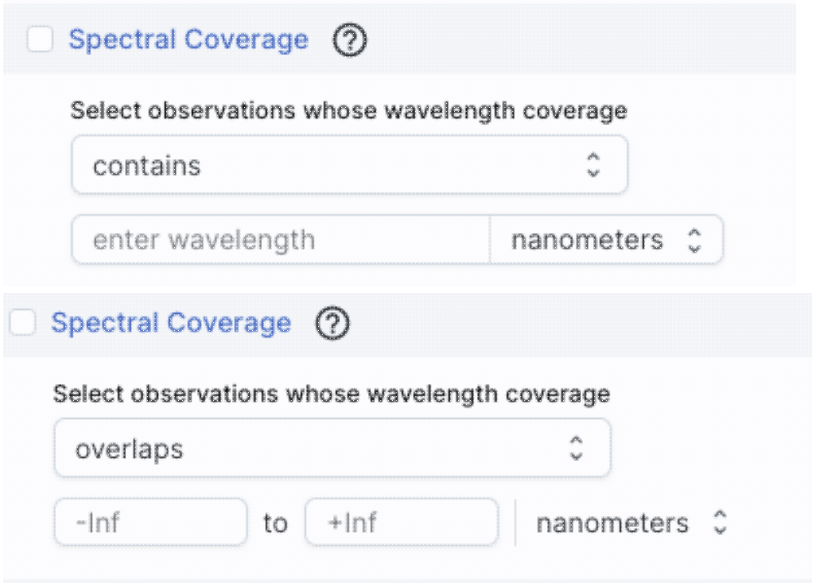


This panel provides a way to constrain the observation time of your search. This is the default option, where you want data completed in the last x hours (or other unit of time).



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



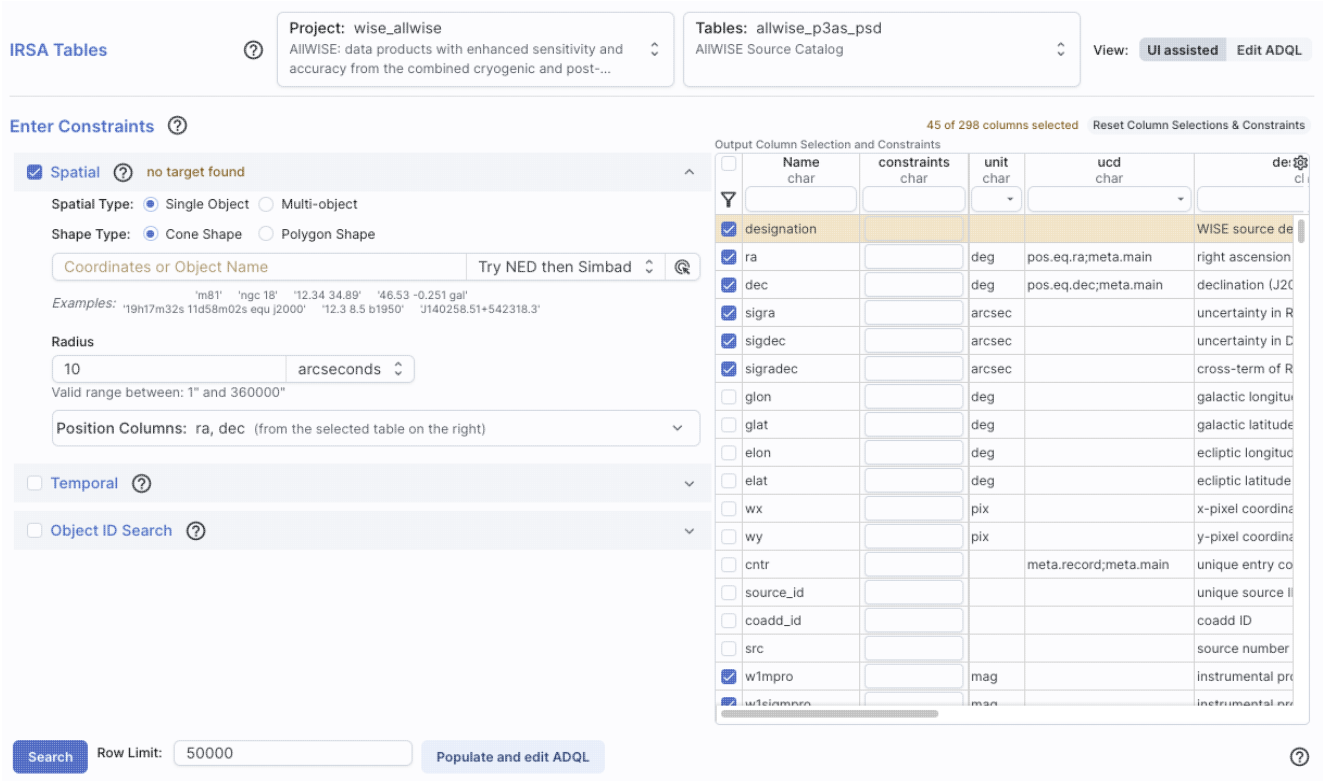
This panel provides a way to constrain the spectral coverage of your search. This is the default option, where you want data containing a given wavelength.

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.)

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



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.

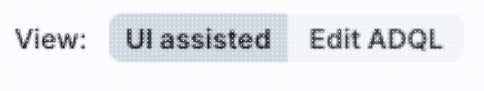
Then **Enter Constraints**: On the **left**, you can impose a variety of constraints. In addition to selecting the tickbox indicating that you wish to impose a particular kind of constraints, you need to specify which columns should be used for those constraints. More information on these constraints 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.
- 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.

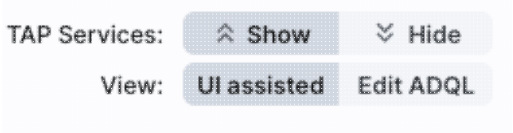
The result of an IRSA TAP search is a catalog that can be interacted with like any other catalog in this tool.

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:

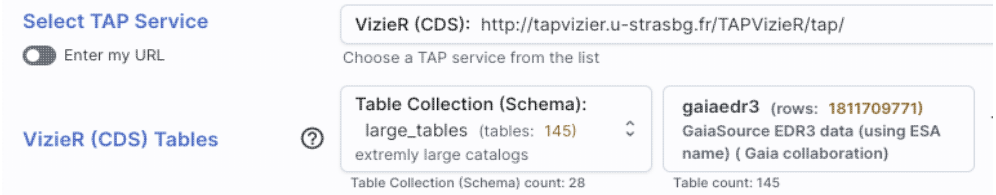
At the top, you now have a choice of which TAP service you want to use, and it defaults to IRSA's. You can select your favorite from the list, or use the toggle on the left to enter your own custom URL. If you want to hide this top row after setting it (to, say, regain screen real estate), look for this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



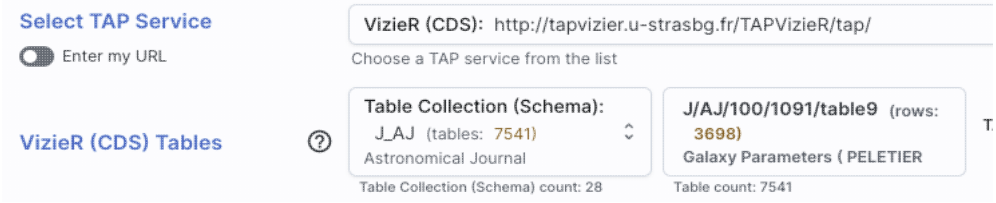
the "TAP Services:" button (show/hide) will reveal or conceal this top row.

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).

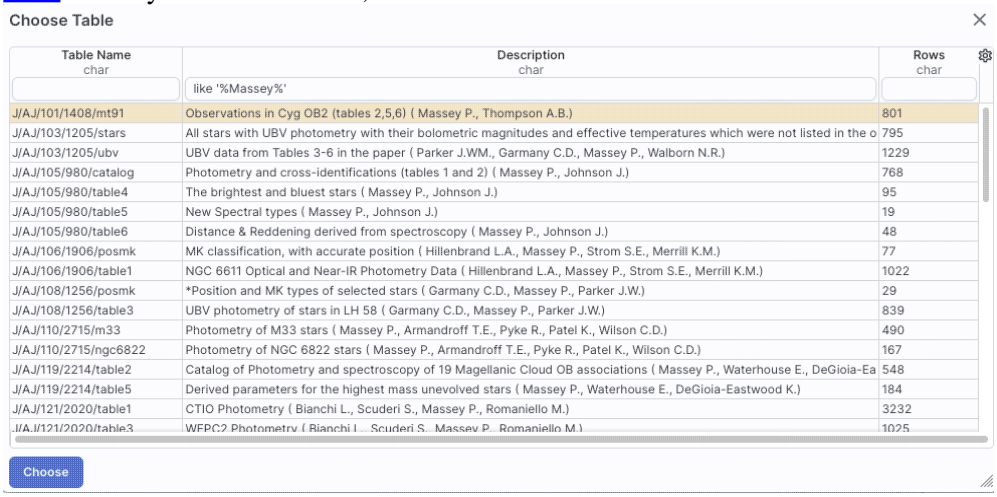
For VizieR's services in particular, because there are so many tables, the tool will give you a slightly different interface under the "Tables" section of the window. Here is the default Vizier choices as of this writing:



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:



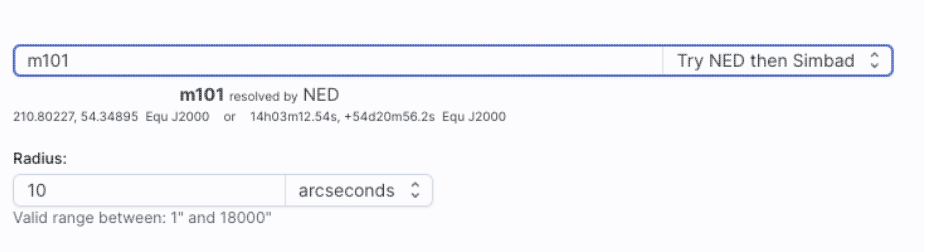
which makes it trivially easy to find tables in which you are interested, such as those associated with papers by Massey, as shown. Select the table that you want to search, and then continue to specify the rest of your search, just as described above in the IRSA VO TAP Search screen discussion.

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.

ObsCore Search

An ObsCore search is technically a subcategory of a TAP search, but it is a special subcategory in that it can return images, spectra, catalogs, and more, or even links to services. As such, it is covered here in a wholly different section than the General TAP section above.

To launch an ObsCore search, you need to find a server that supports an ObsTAP search, and flip the corresponding toggle on the left, for example:

The "UI Assisted"/"Edit ADQL" switch at the top right works just like it does above -- use the UI to construct a query or dive right into the ADQL yourself.

Then in the remaining part of the screen, impose the constraints you want -- see the constraints section above.

At the bottom of the screen, you can "Populate and edit ADQL" if you want to work with the ADQL directly, or just search straight away after setting your search parameters.

Doing this kind of search in Finder Chart will yield a table that is a list of the observations that it found consistent with the search parameters. This table is like any other table in this tool, so it can be sorted, filtered, etc. This kind of search is fairly hobbled in this tool; you may find it far more satisfying to do this kind of search in the IRSA Viewer tool, specifically because it yields much more than just a row in a catalog; it can give you images, spectra, and more.

Finder Chart: Plots

Plots (sometimes called charts) can be made from Tables. Plotting is covered in this section, and plots are made automatically in Finder Chart when catalogs are loaded. 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.

Contents of page/chapter:

Default Plot

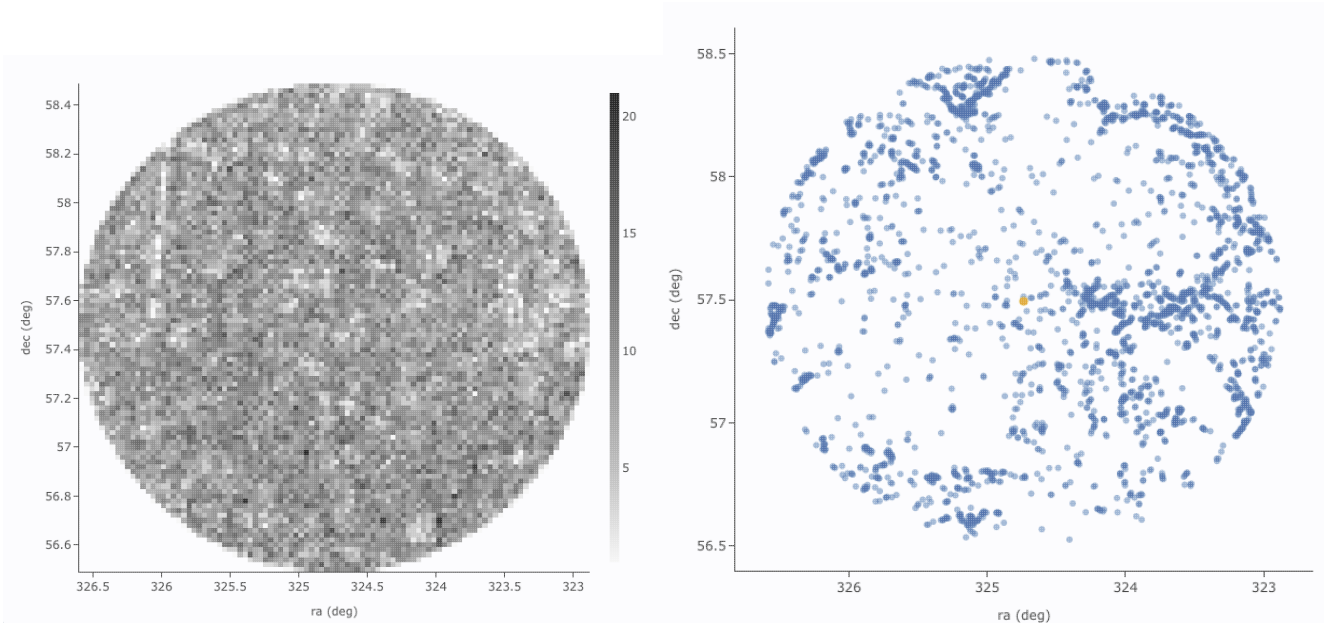
By default, after a catalog has loaded, a plot appears in the browser window.

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

The plotting tool, by default, starts with RA and Dec plotted if it can find RA and Dec in the corresponding table. Note that it does so following astronomical convention -- RA increases to the left. If the catalog does not have RA and Dec, it plots the first two numerical columns it finds.

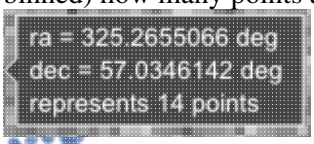
Plot format: a first look

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, or 'decimated' -- 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. In the context of this tool, this is called a **heatmap**. 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, 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 right of the plot window has a row of icons:  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.

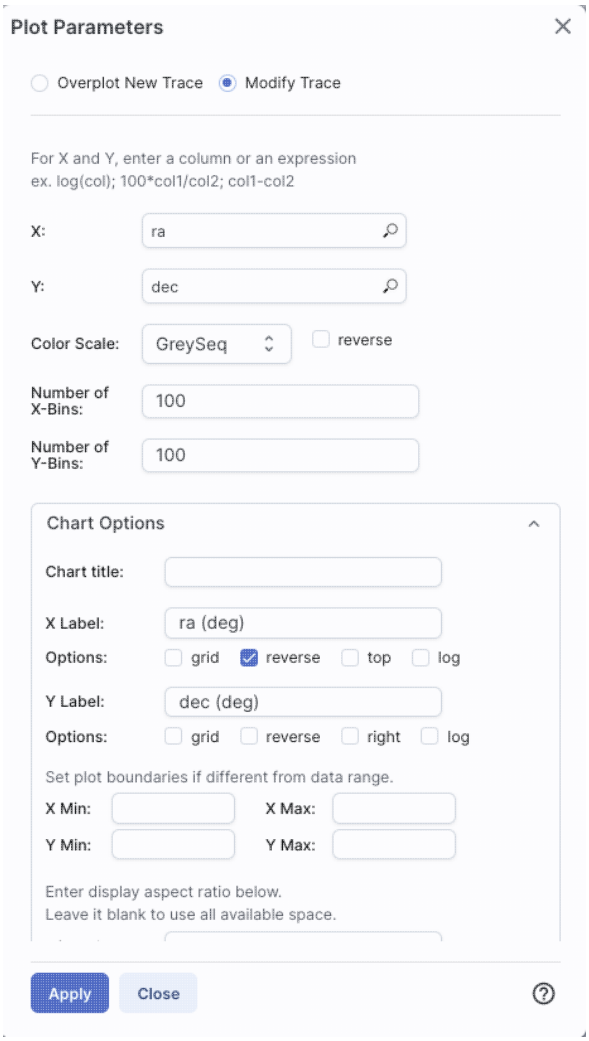
Help
This icon may not appear, but if it does, it is a context-sensitive help marker, which should bring you to this online help.

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

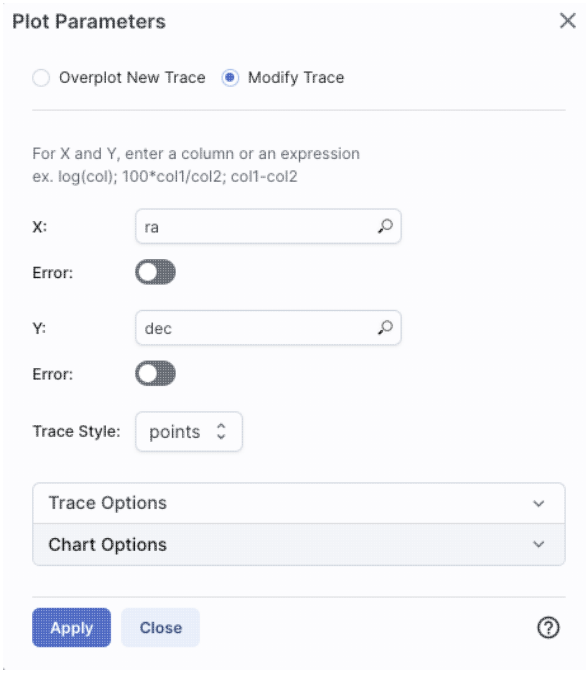
If you move your mouse over any of the points in the plot, you will get a pop-up telling you the values corresponding to the point under your cursor. For scatter plots, if you click on any of the points, the object(s) corresponding to that point will be highlighted in the overlays in the images shown, 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.

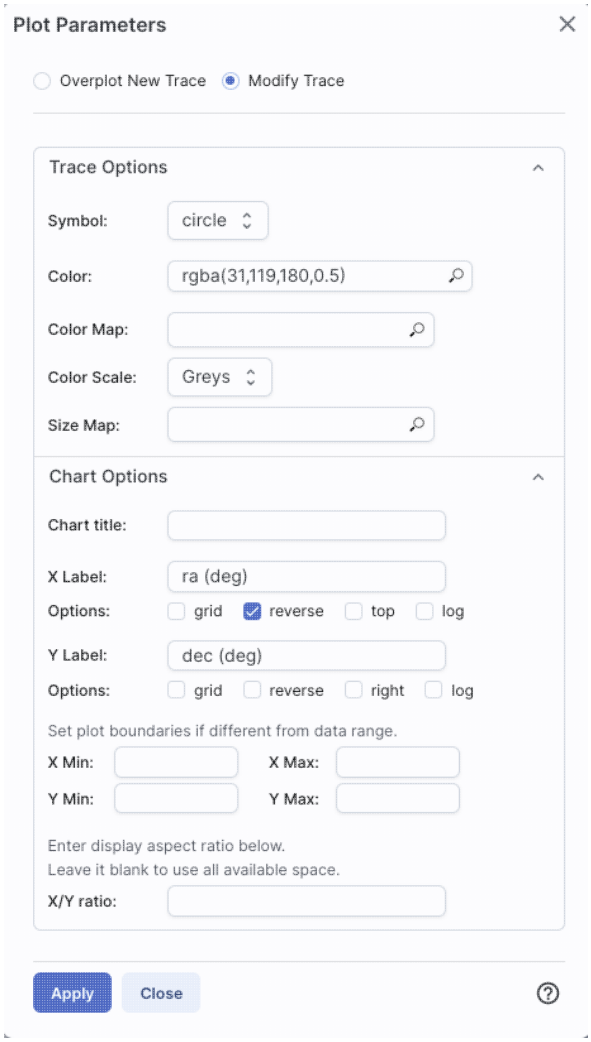
Changing What is Plotted

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. decimated, 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 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.

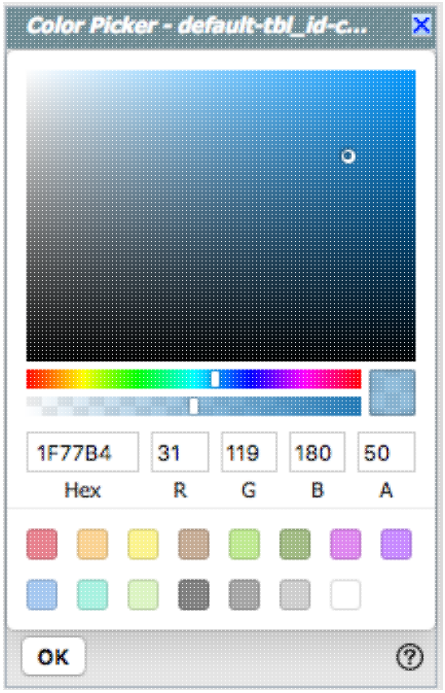
Options found only in plots showing individual points

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:



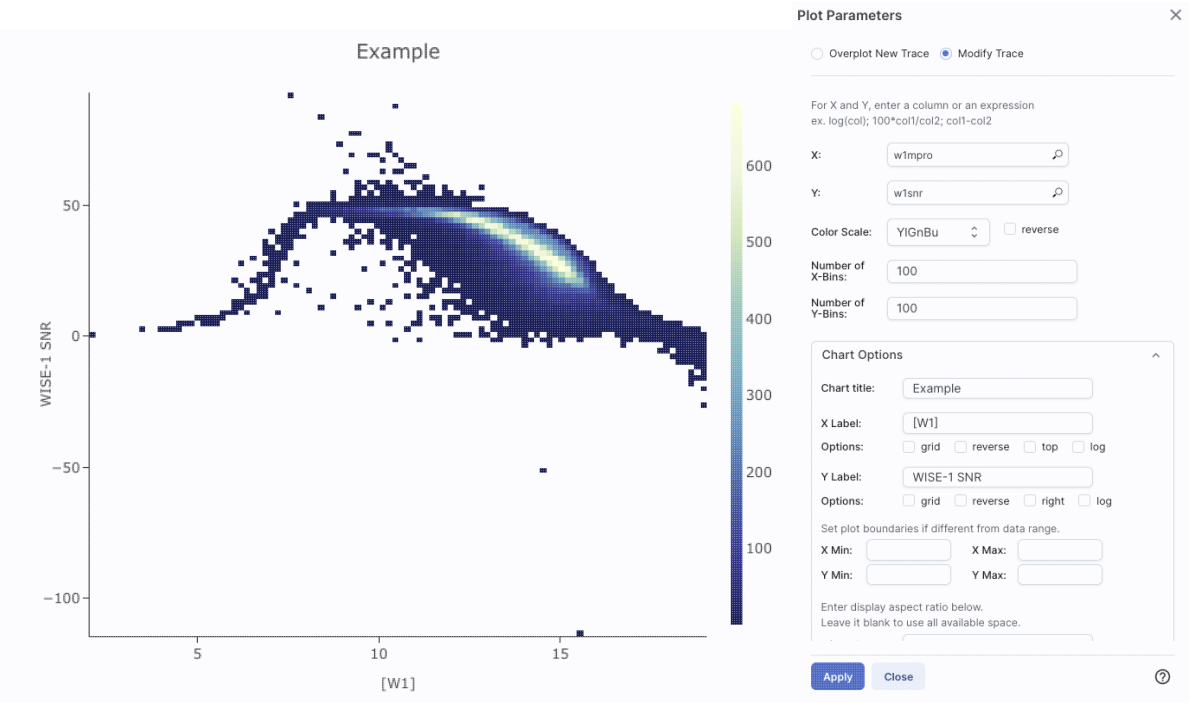
From here, you can click on your desired color in the top colorful box. Immediately below that box, you can change the color and saturation of the top box so that you can select from a different range of colors. Below that, you can enter numerical hex codes or RGBA values (where the value for RGB is 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.

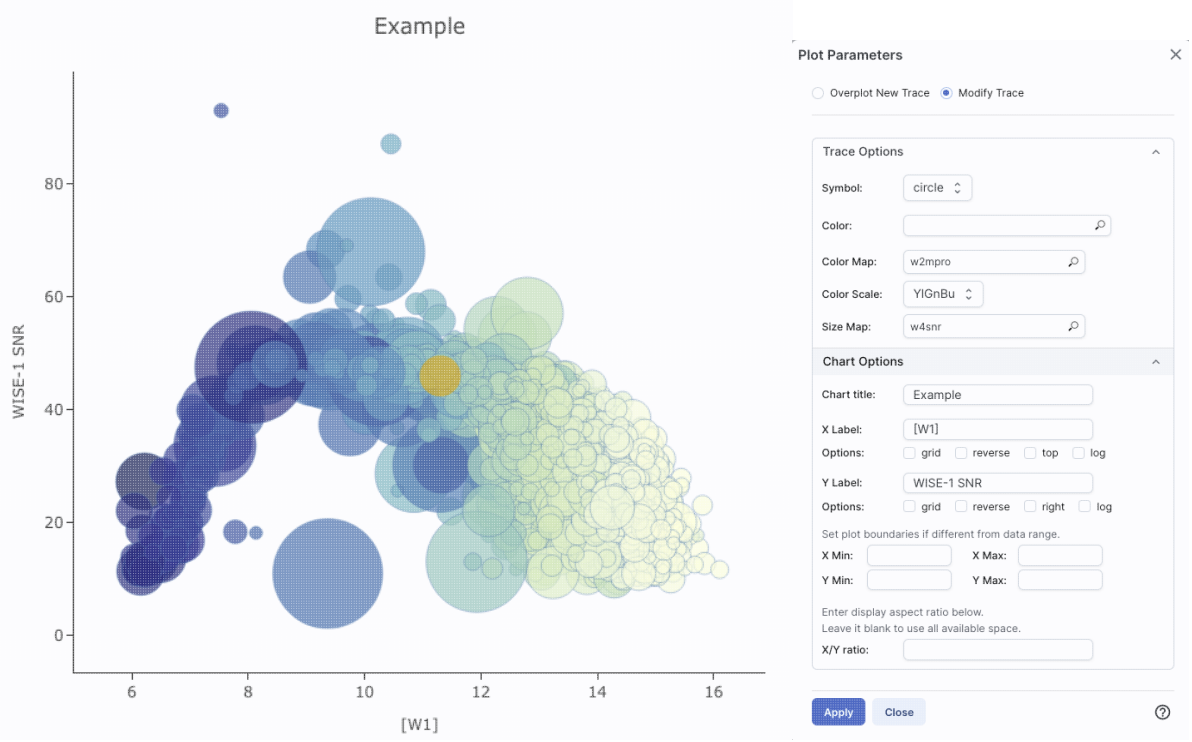
◊ Choose the **color map**. By default, all of the points are the same color, but darker where there are more points. You can change this such that the color scale of the points is tied to a column value, such as w1snr (WISE-1 signal-to-noise ratio) in a WISE catalog. If you select this option, you can 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:



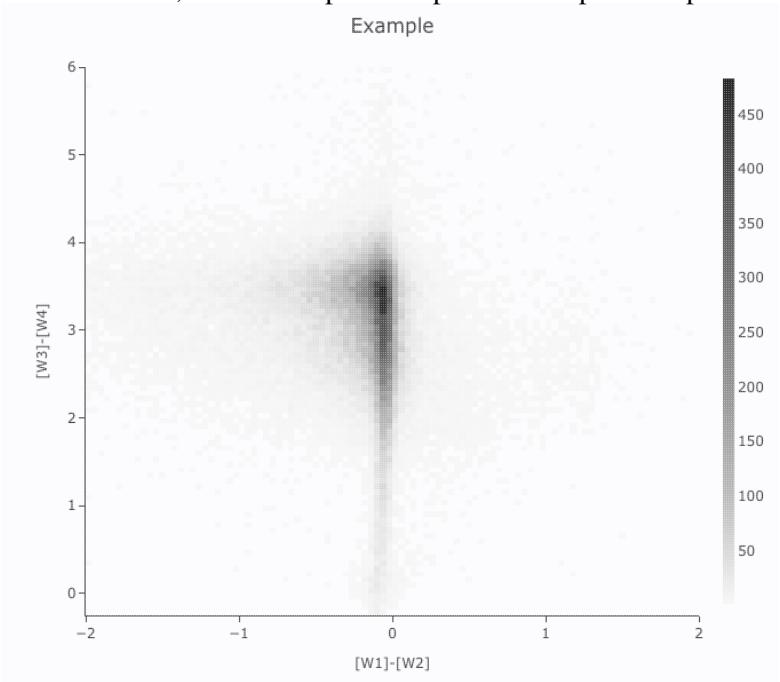
Example: Load either a smaller WISE catalog, or the same large WISE catalog, but filter it down such that w1snr, w2snr, and w3snr are all greater than 10, which limits the number of points to be <5,000. Plot w1snr vs. w1mpro. It shows the points individually. Change the labels. Change the point color 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:

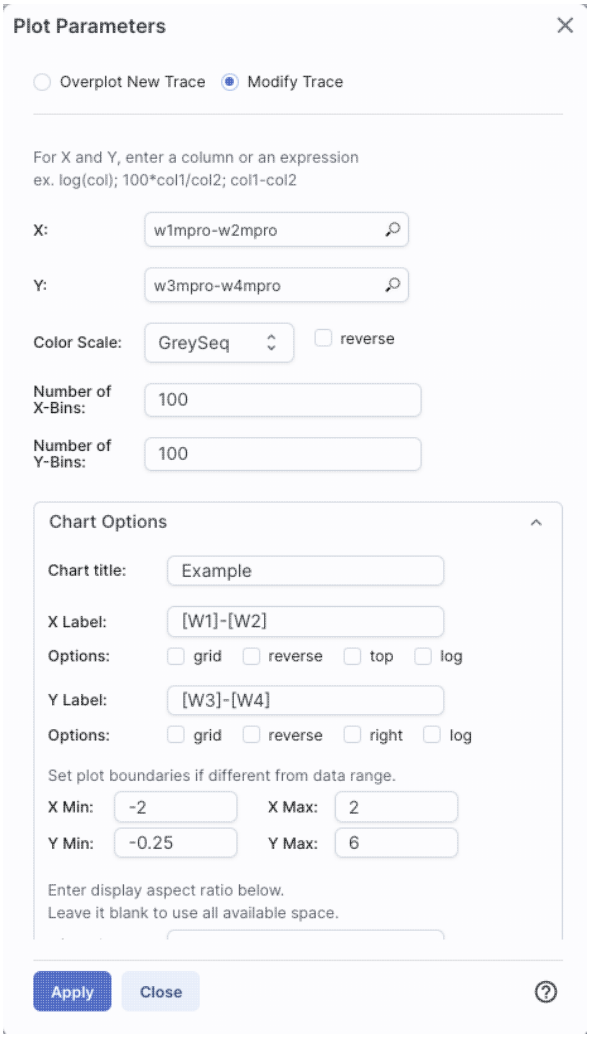


Plotting Manipulated Columns

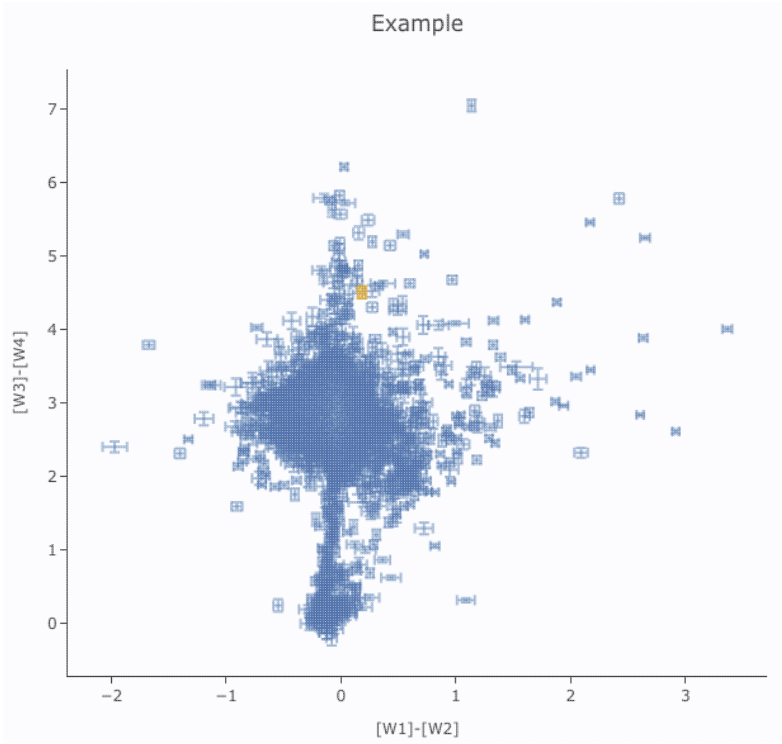
You can choose a single column to plot against another column, as above. However, you can also do simple mathematical manipulations.

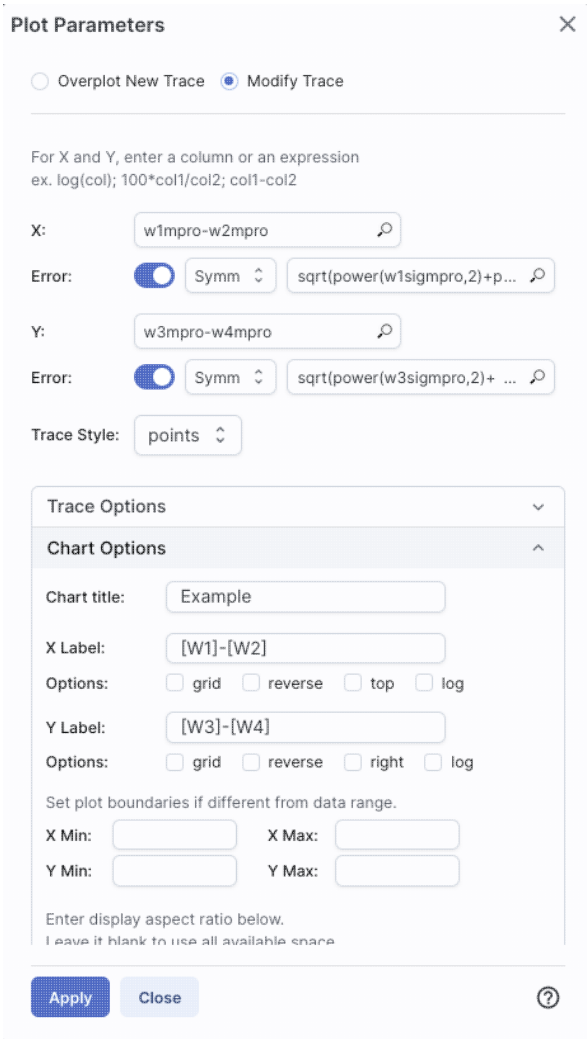
For example, if you have loaded a WISE catalog, you can plot [W1]-[W2] vs. [W3]-[W4]. In terms of the names of the columns in the database, this is w1mpro-w2mpro vs. w3mpro-w4mpro.





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).

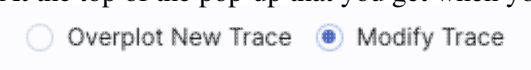
However, and perhaps more powerfully, you can set limits from the plot itself using a rubber band zoom. Click on the select icon in the plot  Then, click and drag in a sub-region of the plot. New icons appear:  If you click on the funnel icon, only those data points that pass the filter are shown in 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.

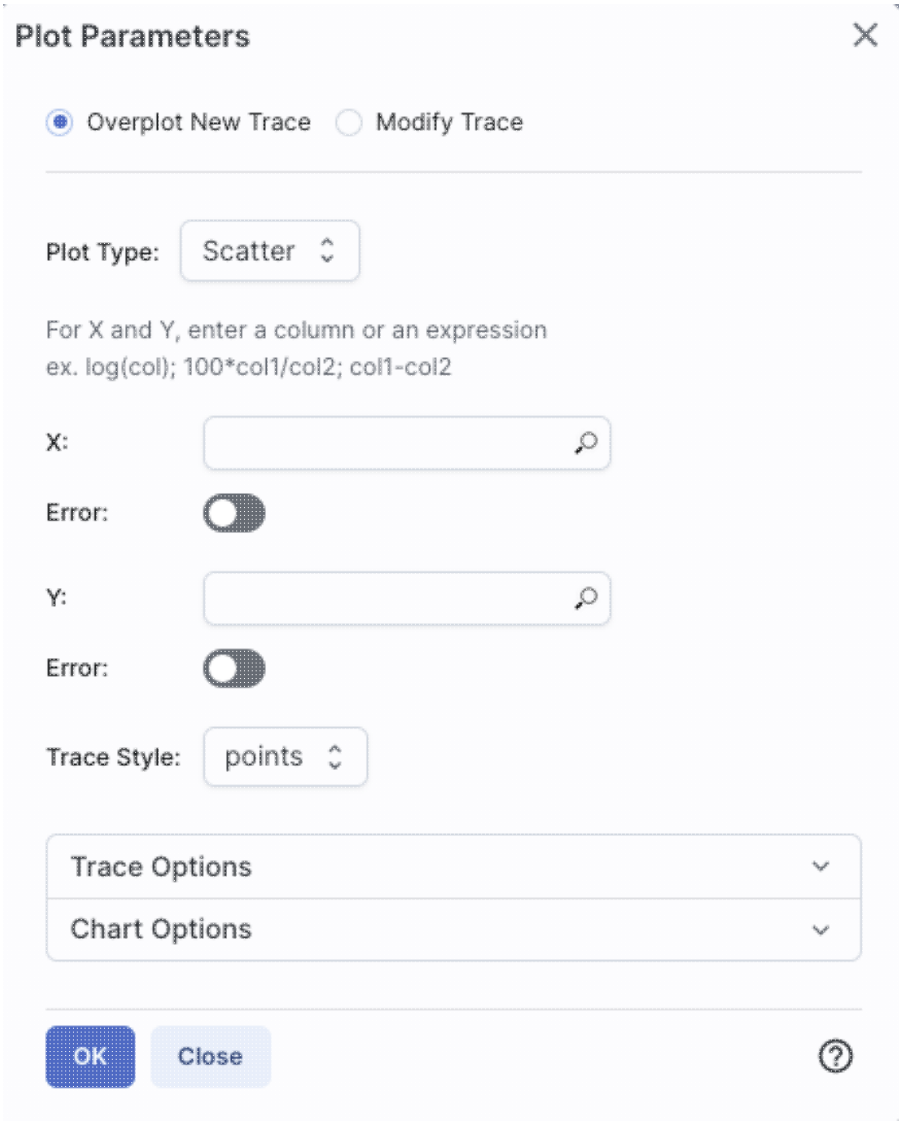
Overplotting

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.

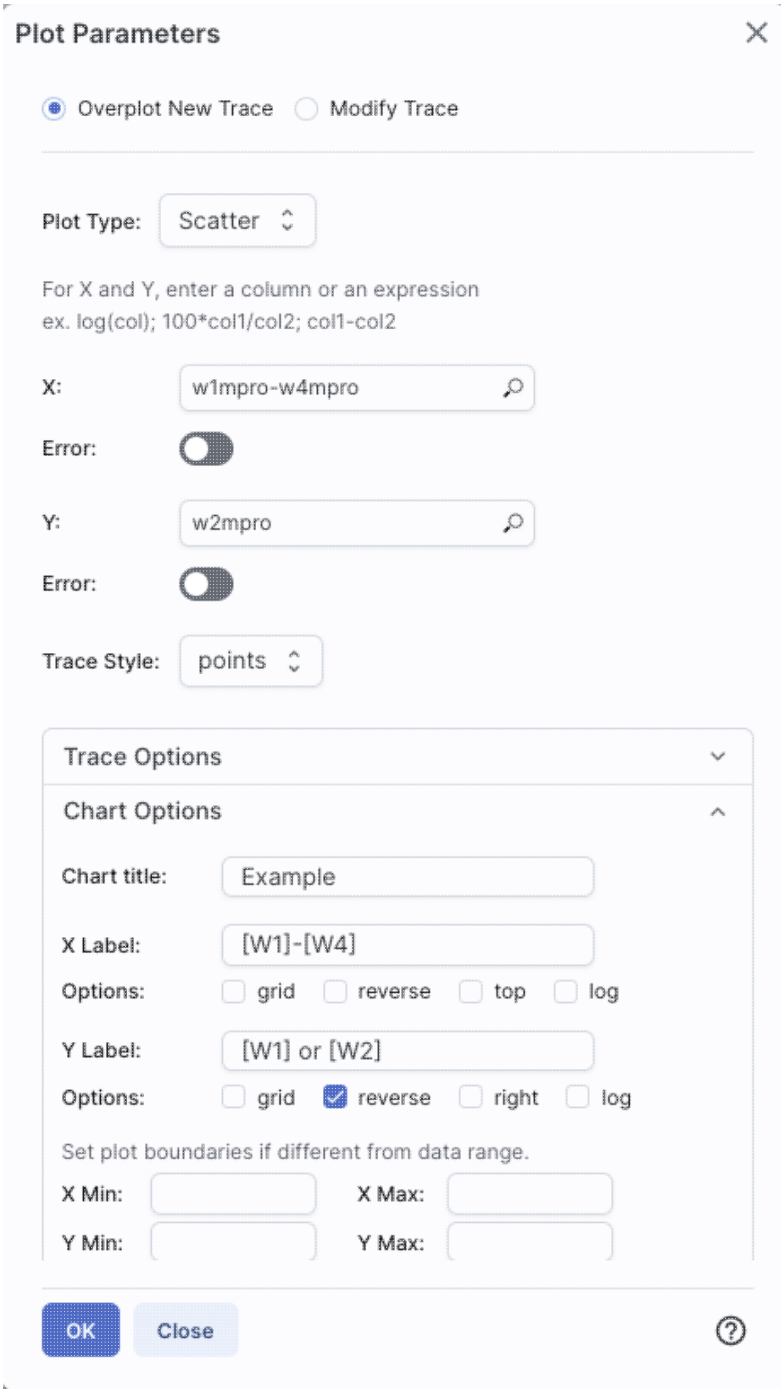
When you select "Overplot New Trace," you get a new interface that is very similar to the original interface where you selected what to plot:



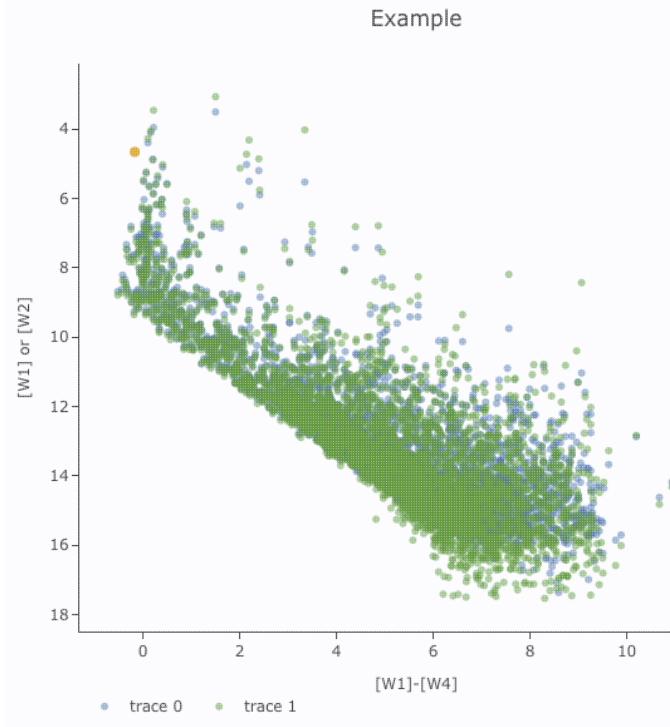
As before, you need to :

- 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.

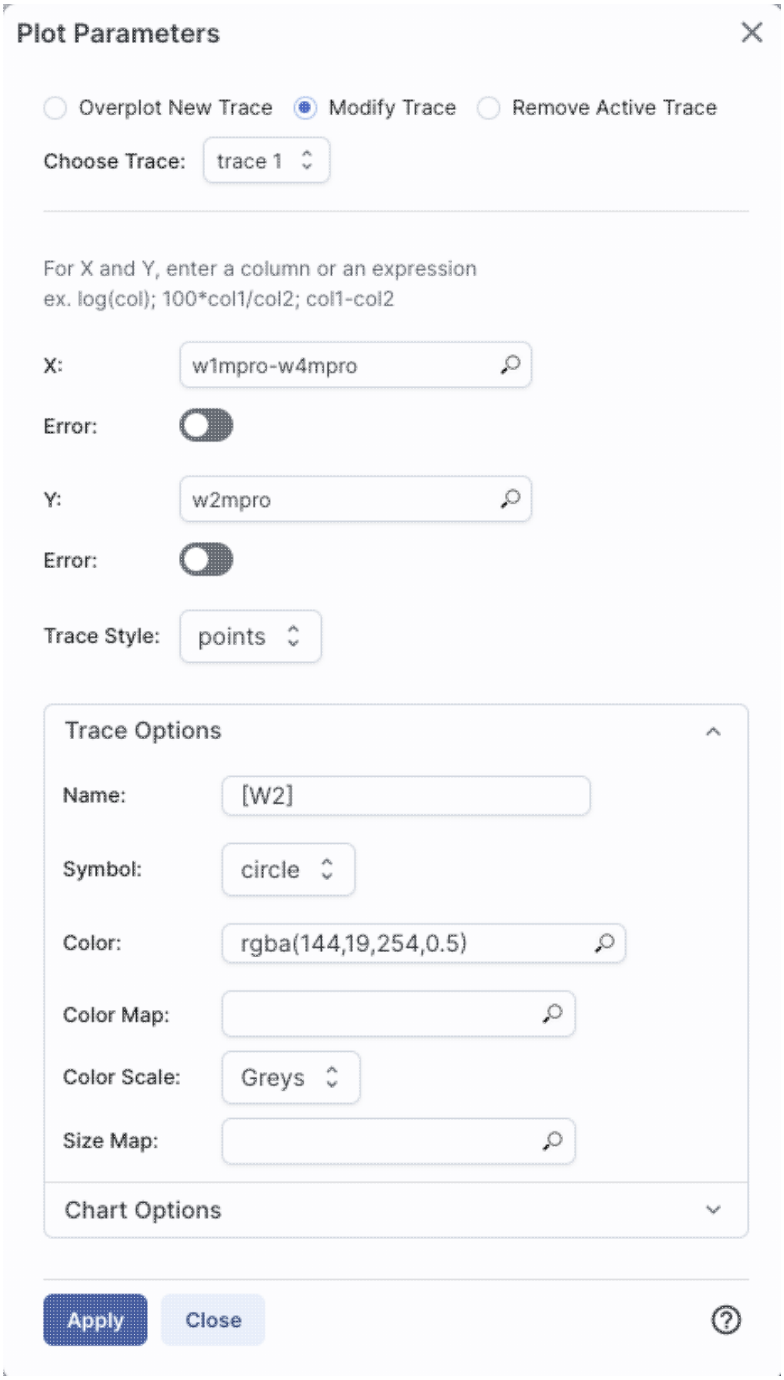
The best way to explain how to use this feature is probab
example. We have a plot of [W1] vs. [W1-W4] from abo
add on top of it a plot of [W2] vs. [W1-W4]. Click on the
bring up the pop-up. Select "Overplot New Trace." Enter
"w1mpro-w4mpro" for x and "w2mpro" for y. Expand "C
Options." Note that it has 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



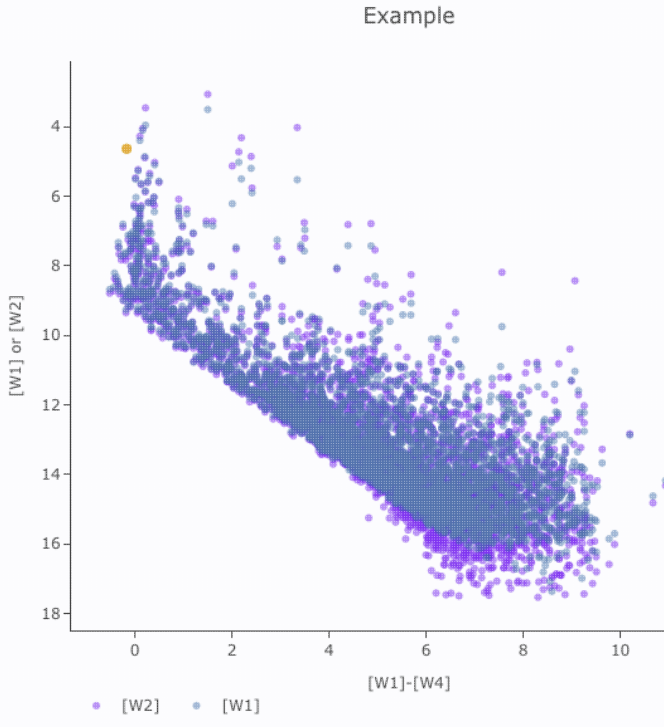
window right before clicking "ok", and the resultant plot



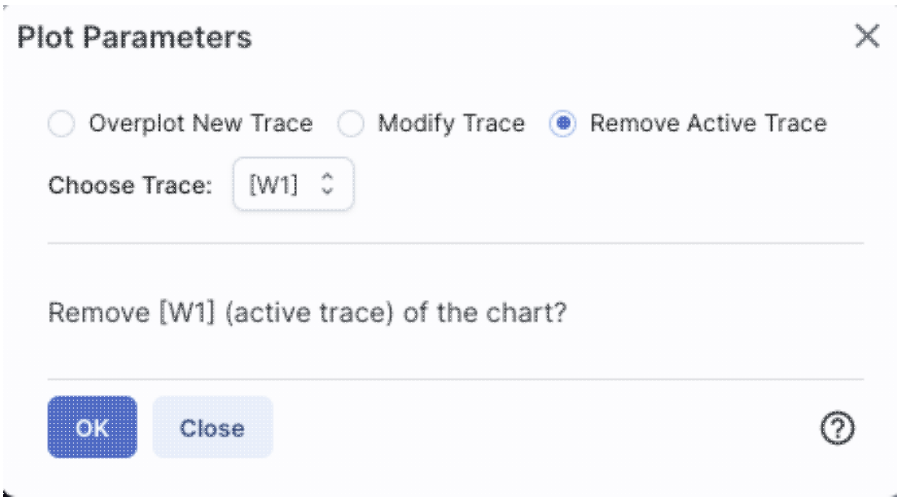
After you add the overplot, if you click on the gears agai
that the choices at the top of the window have changed. Y
add another overplotted trace, modify a trace, or remove
trace. Each trace that you add is a new 'layer' on the plot.
drop-down menu near the top of the window controls wh
is 'active' 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:

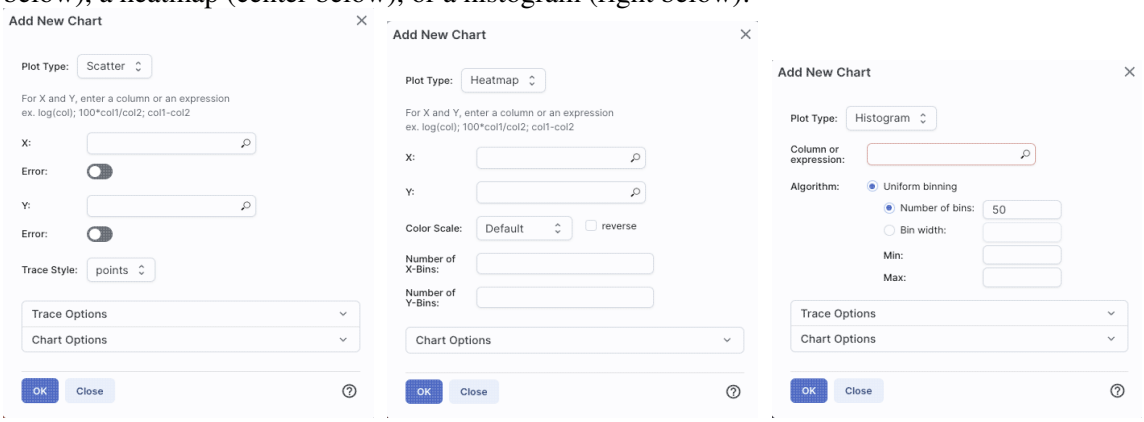


Tips and Troubleshooting

- 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.

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. There is a maximum of 5,000 points for scatter plots.

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.
- The tool will refuse to make a scatter plot for catalogs with >5,000 points.
- To remove a plot, click on the 'x' in the upper right corner of the plot.

Example of catalog plots #1: Catalog pulled after initial search

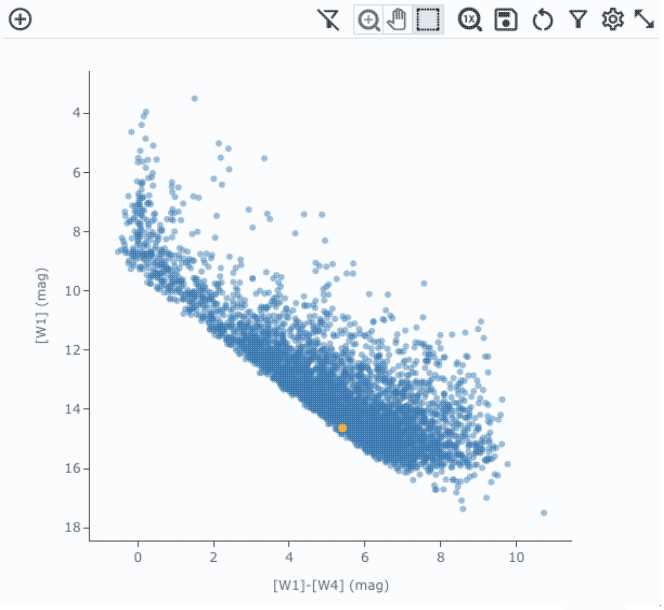
Example: Plotting [W1] vs. [W1]-[W4] in a star-forming region

For this example, we are trying to find young stars in a star-forming region. We are searching in the WISE AllWISE catalog. Stars without circumstellar dust should be at a variety of W1 brightnesses, but all have [W1]-[W4]~0. Background galaxies should be faint and red. Stars with circumstellar dust (e.g., young stars) should be bright and red. Here, we will make a plot, identify a bright and red object in the plot, and find where it is in the WISE images.

1. Launch the Finder Chart tool. Search on IC1396. Simbad's interpretation of the coordinates are fine. Select image size of 1 degree (pick the units first, then enter the number). Display size of Medium is fine. Select just DSS and WISE. Now, at this point, we could click on "Yes" for "Search Corresponding Catalog(s)", then tell it to "search within the image boundary." But we want to be mindful of the numbers of sources it is likely to find over an image in the catalog (spoiler alert: a LOT). At this point, we are only interested in the WISE catalog. So, let's set "Search Corresponding Catalog(s)" to "No." Click "Search." Wait for it to come back with the results.
2. Now, let's search just for the WISE catalog in this region. Click on the blue "hamburger" in the upper left () to open the side menu, and pick "Catalogs" to bring forward the tab that enables you to search IRSA's catalogs. Select Project=WISE. Select the AllWISE Database, and the AllWISE Source Catalog. By default, it is set for the same target but not the same region as our original search, so we want to change that. Leave the target coordinates as they appear. Change the search method to "polygon." Ensure the "Search area" is set to "image" so that it matches the image request you have already made. Click "Search."
3. You may have to wait a bit for the catalog to be returned, because there are ~20,000 sources.
4. Now the catalog is overplotted on the images in the top half of the window, plotted as an x-y plot in the lower right, and loaded as a table on the lower left. Note that the plot is a greyscale plot, which means that the plot shows a binned "heatmap" where darker colors mean more points. Note too that this decimation means that all ~20,000 sources are **NOT** overplotted on the images but a representational

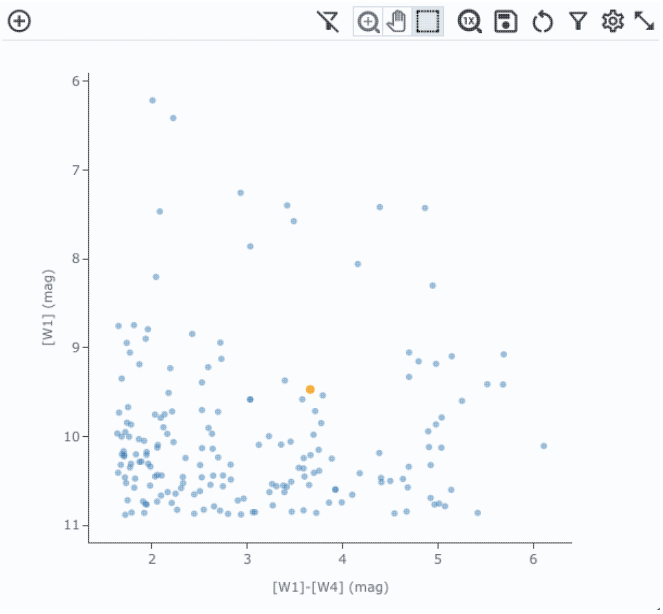
subset are overplotted. Only the first 100 are shown in the catalog, though all are loaded, and you can page through the list, 100 at a time. Note that selecting a source in the image makes its corresponding row in the catalog change color. It doesn't highlight in the plot, because there are too many points in the plot to be shown individually.

5. Filter down the catalog to only have detections. If you don't already have boxes at the top of each column, in the upper right of the catalog, click on the funnel icon to add filter boxes to the top of each column. In this catalog, limits have null errors. To limit the catalog to just those with detections, in the top of the "w1sigmpro" (WISE-1 profile fittted magnitude error) column, type ">0" (without the quotes). Repeat for w2sigmpro, w3sigmpro, and w4sigmpro. After this process, you should have ~4,000 sources, enough fewer that the plot now has individual blue points (it is no longer a heatmap). Now the individual sources are also **all** shown on the images.
6. The plot is an RA/Dec plot by default. Let's make a color-magnitude diagram instead. Click on the gears icon in the upper right of the plot window to change what is plotted.
7. Ensure "Modify Trace" is selected in the pop-up window. Enter in the x box: w1mpro-w4mpro. This is WISE-1 profile-fitted measurement in magnitudes minus WISE-4 profile-fitted measurement in magnitudes,or [W1]-[W4].
8. Enter in the y box: w1mpro. This is the [W1] mag.
9. Click on the triangle next to "Chart Options", and enter "[W1]-[W4] (mag)" for the x-label, and "[W1] (mag)" for the y-label. Tick the box for "reverse" for the y-axis to make the brighter objects appear at the top of the plot.
10. Click "Apply" and then "Close"
11. Obtain this plot. The points are shown as blue circles. Where they overlap, the blue appears darker.

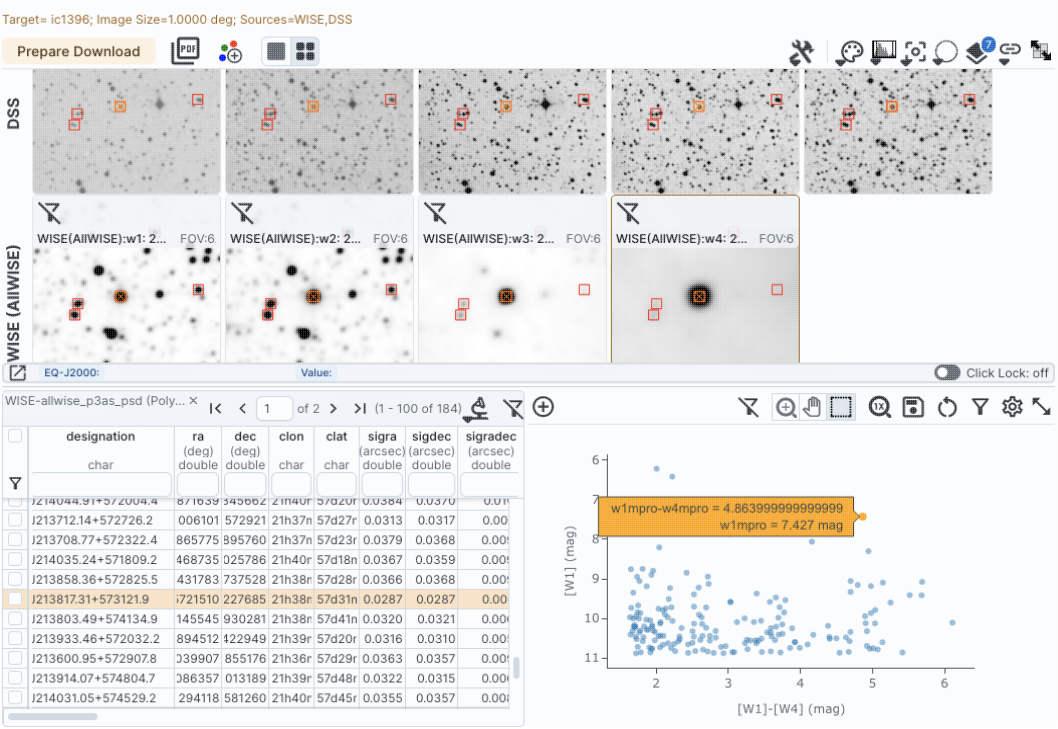


.

12. Ensure that the select icon is "active" in the plot ( ). Click and drag from corner given approximately by (2,6) to (7,11).
13. The icons in the upper right change after you do this, and we want to filter on this region. Click on the filter icon. This filters the table and the image overlays as well as the plot.
14. After this filtering, you should have about 100-200 points left in the catalog. The scatter plot after the filtering looks something like this:



15. We want to find an (astrophysically) bright and red object in the plot, catalog, and images. Find one of the the brightest, reddest sources near [W1]-[W4]~4.5 in the plot. Click on that point. It is highlighted in the overlays on top of the images (though it may be hard to distinguish), and it is highlighted in the catalog (though you may need to scroll slightly in the catalog to find the highlighted line). If you have been following closely, it should be J213817.31+573121.9 or J213808.44+572647.6. To make the images slew to center this position, copy the position (either from here or the table). Find the the recenter icon () in the image toolbar, and paste this position into the "Center On" box, and click "Go."

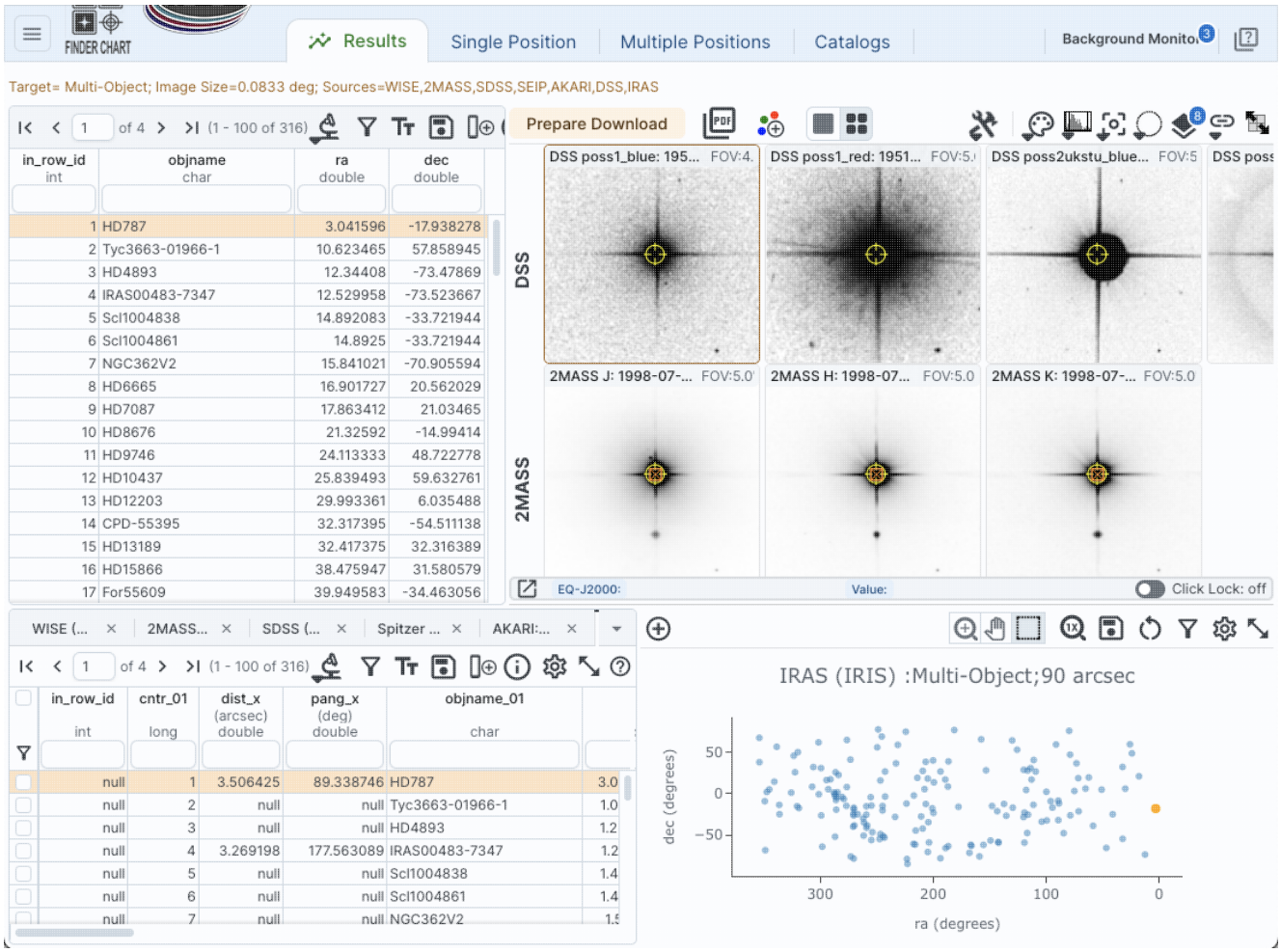


Example of catalog plots #2: Catalogs pulled during initial search (using one-to-one matching)

Example: Searching all over the sky for objects with SDSS, 2MASS, and WISE data, and plotting [W1] vs. [W1]-[W4]

This example provides an opportunity to explore images and catalogs (including 1-to-1 matching, which can be powerful but may be confusing). This example does not walk through every source in detail, but sources can be found in this list where proper motions are high (such that 1-to-1 matching doesn't work well), and/or coordinates are bad, and/or the sources are not point sources, and where the WISE measurements have to be pulled out of the reject catalog.

1. I have a target list containing 316 targets, which I have prepared in IPAC table format, of some objects claimed to be rapidly rotating K giants. They are all over the sky. Some are claimed to have IR excesses, and I want to see if they have WISE excesses, as well as look at the WISE images for them, just as these folks did; see also this page. Some of the coordinates are good to within an arcsecond, and some are very poor coordinates. Many of the sources are very bright (some saturated). Download that IPAC table file to your disk.
2. Launch the Finder Chart tool. Select "multiple positions". Click on "choose file" and locate the IPAC table file with the targets that you just downloaded. The default image size, and display size are fine. We are interested in these targets in all possible images here, including IRAS. Select all the surveys. Set "Search Corresponding Catalog(s)" to yes. "Search radius" is the only catalog option now, because we are using multiple targets. Leave the default search radii for each catalog. Click on the box for "One to one Match". This will make one line in each output catalog for each line in the input catalog, and it will take the source in each catalog closest to the input position within the search radius tolerance. Click "Search."
3. It takes a bit to load in all the images and catalogs. When it loads, it looks like this:



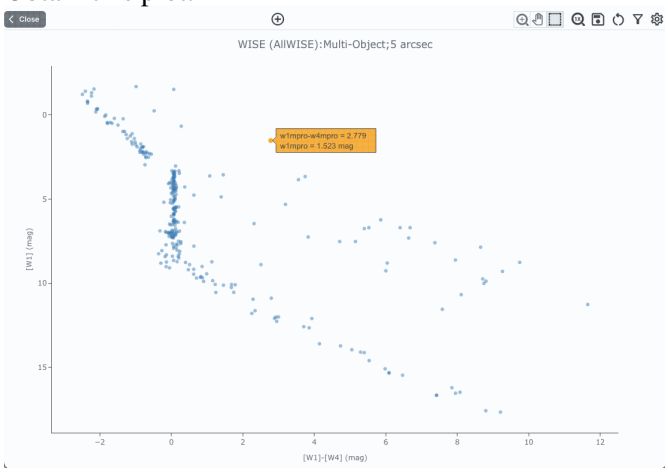
in_row_id int	objname char	ra double	dec double
1	HD787	3.041596	-17.938278
2	Tyc3663-01966-1	10.623465	57.858945
3	HD4893	12.34408	-73.47869
4	IRAS00483-7347	12.529958	-73.523667
5	Scl1004838	14.892083	-33.721944
6	Scl1004861	14.8925	-33.721944
7	NGC362V2	15.841021	-70.905594
8	HD6665	16.901727	20.562029
9	HD7087	17.863412	21.03465
10	HD8676	21.32592	-14.99414
11	HD9746	24.113333	48.722778
12	HD10437	25.839493	59.632761
13	HD12203	29.993361	6.035488
14	CPD-55395	32.317395	-54.511138
15	HD13189	32.417375	32.316389
16	HD15866	38.475947	31.580579
17	For55609	39.949583	-34.463056

in_row_id int	cntr_01 long	dist_x (arcsec) double	pang_x (deg) double	objname_01 char
null	1	3.506425	89.338746	HD787
null	2	null	null	Tyc3663-01966-1
null	3	null	null	HD4893
null	4	3.269198	177.563089	IRAS00483-7347
null	5	null	null	Scl1004838
null	6	null	null	Scl1004861
null	7	null	null	NGC362V2

Things to note: The upper left pane has the list of targets, the upper right pane has the images, the bottom left pane has the returned catalogs, and the bottom right pane has plots of the catalogs. The orange row in the list of targets is the target whose images are shown on the right. No data were found for SDSS or SEIP for this target, but at least it doesn't take up any screen area. (There are other targets in the list for which there are SDSS and/or SEIP data.) There are 6 catalogs loaded in the bottom window pane. The catalog that is on top in the screen shot above is that from IRAS. We asked it for one-to-one matching within 90 arcseconds for IRAS. Out of the targets shown, it found a match for target 1 ("cntr_01" column), and it is within 3.5 arcseconds ("dist_x" column). The catalogs are overlaid in a survey-by-survey fashion -- the 2MASS catalog is overlaid on the 2MASS images, and the WISE catalog is overlaid on the WISE images, but because we asked for just one source per catalog, and because they are nicely coincident with the target position, it does not LOOK like the catalogs are overlaid... but they are!

4. These targets are ones for which we would like to know if there are any IR excesses. Click on the WISE catalog tab in the catalog window pane. If the plot is too small to read, either grab and drag the boundary between panes, or click on the plot's expand arrows ( ).
5. Now we have a full-screen view of the plot, but it's just a plot of RA and Dec. Click on the gear icon in the upper right of the plot window.
6. Enter in the x box: w1mpro-w4mpro. This is WISE-1 profile-fitted measurement in magnitudes minus WISE-4 profile-fitted measurement in magnitudes, or [W1]-[W4].
7. Enter in the y box: w1mpro

8. Click on the arrow next to "Chart Options" and enter "[W1]-[W4] (mag)" for the X label. Enter "[W1] (mag)" for the Y label. Tick the box on 'reverse' for the Y axis to make the brighter objects at the top.
9. If you want, check the "grid" box for both axes.
10. Click "Apply" and then "Close".
11. Obtain this plot:



Note that each one of the points as shown is a small blue dot, so each point represents one line in the catalog (the data are not binned). The things brighter than [W1]~3 are likely saturated, given the structure seen in this plot. There are some bright red things, and some faint red things.

12. Locate the bright red thing near [W1]-[W4]~3, [W1]~2. Click on it. Close the expanded plot view if you're in that view. Find the highlighted object in the list, which corresponds to this bright red object. It is number 241.
13. Go up to the target list on the left. If the filter boxes are not yet on the top of each column, click on the filter icon to reveal the filter boxes. Locate the "in_row_id" column. Type in that filter box "=241" and hit return.
14. The target list is now filtered down to just be target #241, and the images change accordingly. Go and inspect the images in all bands. This sure looks like a point source!
15. Go back to the WISE plot. Click on the expand arrows if you need to. Locate the reddest source there. Click on it. Close the expanded plot view if you need to. This red object is object 269 in the list.
16. Go up to the target list on the left. Locate the "in_row_id" column and change the filter box to be "=269" and hit return. Look at the images. There does not seem to be a point source there at POSS or 2MASS bands, but there is a source with a very steeply rising SED through the WISE bands; it looks like it might even be there in IRAS. We conclude that this is probably not a K giant.
17. It is useful in general to look at each set of images in concert with the catalogs. In the interest of space, we do not work through each of these ~300 sources, but this target list provides a great example of some of the things to look for. In this list of targets, at least one source has substantial proper motion, such that the automatic catalog 1-to-1 matching is not going to work well enough to find the true match across catalogs, and you have to do a separate search via the catalogs tab to find its true measurement at the other bands. Three sources have WISE measurements that do not appear in the AllWISE catalog, but erroneously instead in the catalog of WISE rejects -- that, too, you can search via the 'catalogs' tab. Many of these sources appear in other catalogs housed at IRSA, such as the AKARI IRC catalog (the AKARI FIS catalog is what is returned automatically). Many of these sources really are saturated (as you can see in the plot above), and checking the images helps assess the degree of saturation. Several of the sources are point sources for IRAS but not for WISE. Several of the IRAS point source positions are likely physically associated with but not well-matched to the positions of the brightest source seen in the WISE images, meaning that 1-to-1 matching fails because human judgement is required to make the match. There are other irregularities as well. We encourage you to explore. (The journal article that came out of this work has long discussions of individual targets if you want to learn more about them.)

18. Saving the catalogs: For each of the catalogs, click on the diskette icon and save it to disk. Because each catalog has 316 data rows exactly, merging these lists together is straightforward. (Note that the catalogs might have different lengths of header information, however!)
19. Saving the images: To save the FITS images to disk, click on "Prepare Download" in the upper left of the image window pane. From the pop-up, select "all targets", FITS, "separate by object". Click "prepare download" and wait until it is done to download it. Unzip it, and you have the images sorted by target name to browse offline. You can also save png images or PDF files (both of which include stretches and overlays as you customized interactively).

Finder Chart: Downloading Data

Contents of page/chapter:

Introduction

There are a few different ways to download the search results. You can download one item at a time (one image or one table), one object at a time (all images), or all of the images at once (even for a batch search for a list of targets). The Background Monitor helps keep track of downloads placed in the background.

Note that **you** control where any files are saved on your disk through your browser; your browser may be configured to store all downloads in a particular location on your disk.

Individual Images

If you want to save an individual image, click on the image you want to save so that it has the brown highlighted box around it. The diskette icon () in the image toolbar is within the tools drop-down (), and that will allow you to save that currently selected image as a FITS file (or other formats, including saving just the overlays).

Tables

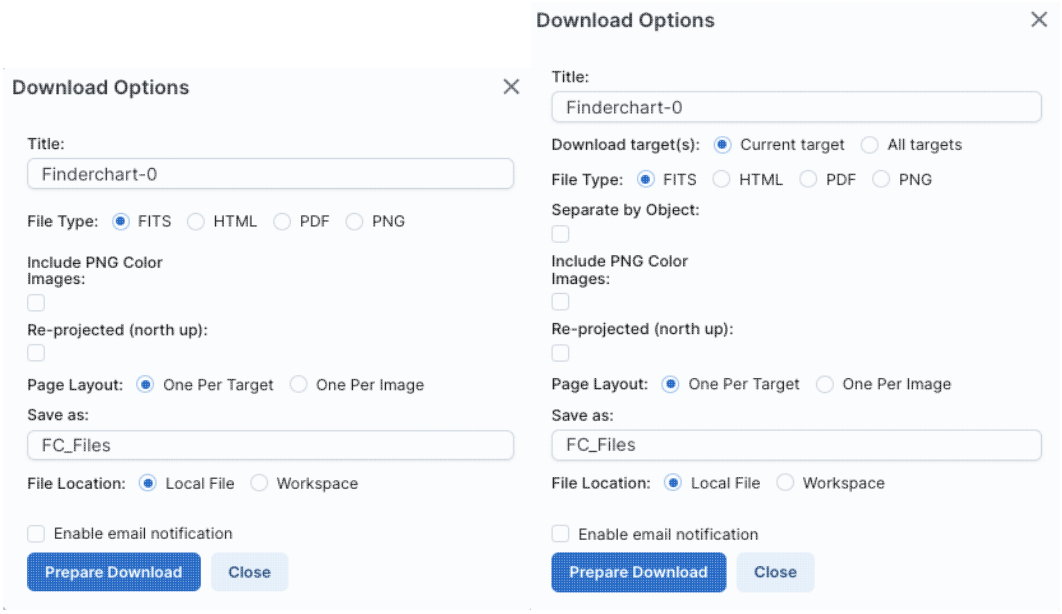
On the upper right of any table shown in the tool, there is a diskette option:  . Click on this icon to save the table; you have a variety of choices of file format.

Plots

On the upper right of any plot shown in the tool, there is a diskette option:  . Click on this icon to save the plot. The plot will be saved to your disk as a png file.

Prepare Download

The "Prepare Download" button brings up this pop-up -- the left one is what you get for a single target search, and the right one is what you get for a multi-target search:



In the download pop-up, there are several options.

Title

This is a string by which your packaged data will be known in the background monitor list. This has the greatest utility when you are setting up several downloads, and need to keep track of which ones are done and which are not. This is **NOT** what is going to be the filename of the saved data.

Current target/All targets

If you searched for multiple targets, the first row asks if you would like the data for just the current target, or for all the targets on which you searched. If you searched on only one target, this row does not appear, because it assumes you want the one target on which you searched.

File type: FITS, HTML, PDF, PNG

You can select FITS files, HTML (plus associated) files, PDF files, or PNG files.

- ◊ The FITS files that are packaged for your download are the original FITS files delivered by the respective archive, which may or may not be north-up, and all surveys do not have the same pixel size. Also note that any overlays you have added will not be included in the FITS download, though artifacts will be included as IPAC table files.
- ◊ PNG files, by contrast, will include the stretch and overlays as shown in the interface. You can save the color PNGs as well; see below.
- ◊ HTML format includes PNGs of all the images, with the stretch and overlay as shown in the interface.
- ◊ PDF files also include the stretch and overlays plus additional notations such as target location and survey. For PDF files, the search parameters appear on the top of the PDF page. If you searched on multiple targets, you may wish to include an 'objname' column in your input file -- then your RA/Dec as well as your object name will appear. (NB: that "objname" name should just be letters and numbers -- no parentheses or brackets, etc.) Please note that the PDF files take time to generate, and the maximum number of sources per PDF file is 50. If you have requested data for more than 50 objects, it will generate more than one PDF file. Also note that, while it asks you whether or not you want one object per PDF page, if you have selected too many image sets, it will not fit one object per PDF page.

Separate by Object

If you searched for multiple targets, you can choose to have the files separated into subdirectories for each of your targets, or all in one directory (a flat file structure). This option does not appear when

downloading data from only one target.

Include PNG Color Images

You can choose to save the color images as well as the single-color-plane images. This option only makes sense (and therefore only appears) in the context of HTML or PNG files.It is particularly powerful for saving color images, automatically generated, for all your batch search targets at once.

Reprojected (north up).

You can choose to have the images reprojected. Selecting this option rotates all the images to strictly north-up (many images may already be north-up by default, or close to it), preserving flux, and resamples the images to all be the same pixel size, 0.36 arcsec. **Do not select this option cavalierly**, because it can take a very long time, especially for big images. (It is a non-linear process in that an image that is twice as big takes more than twice as long to reproject.) It is using Montage (specifically the library mProjectPP) on IPAC's servers to do this reprojection; please see the Montage documentation for more details on what, exactly, it is doing. To reproject the images on your own (selecting your own pixel size, for example), download the original images, and then download, install, and use the Montage software, which is is freely available for a variety of platforms.

Page Layout

This option controls how the HTML or PDF pages are generated -- one per target, or one per image set (all images from a given survey). This option only makes sense in the context of HTML or PDF pages, because it is only in these cases where there is a page to lay out in the first place. However, note that if you pick all possible image sets to include, it will end up being more than one PDF page. Select fewer image sets to enforce fitting on one page.

Save as:

This is where you put in the filename you wish the packaged file to have when downloaded.

File Location

You can save the file to your local disk (wherever your browser is configured to save files), or to the IRSA Workspace.

Enable email notification

You have an option to provide an email address to which it will send an email when the packaging is done. Select the tickbox and then a place for your email will appear. (Within the same Finder Chart session, Finder Chart remembers what you have entered before, but when initiating a new Finder Chart session, you will have to re-enter this information.) This is useful if you are generating PDFs or color PNGs -- anything that takes longer than a few seconds to a few minutes.

After setting your preferences for all of that, click "Prepare Download" in the pop-up window, and it will go do it! Send the download to the background by clicking on "Send to background." If you select this, it will spin off this packaging process to the background monitor.

This packaging process could be virtually instantaneous, or it could take some time, depending on how much data you asked for. You can watch it in the background monitor. If your packaging is taking longer than expected, you can add an email address mid-stream, and it will email you when it is done.

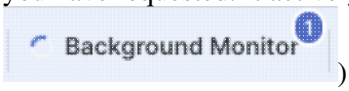
PDF Button

The "PDF" button is an icon at the top of the images window pane. It is a shortcut to saving the current target as a PDF -- that is, it hs equivalent to Prepare Download, then under download options, file type "PDF", with all the other defaults.

Tips and Troubleshooting: Note that if you pick all possible image sets to include, it will end up being more than one PDF page. Select fewer image sets to enforce fitting on one page.

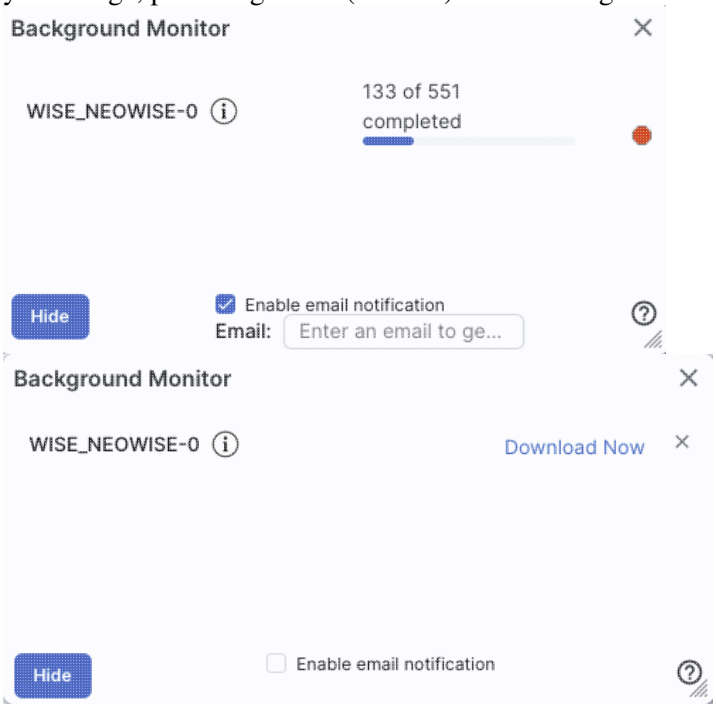
Background Monitor

The Background Monitor appears as blue text 

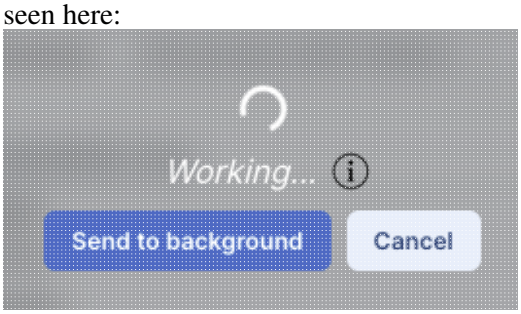
in the upper right of your window to keep track of the data downloads you have requested. It actively changes to reflect what it is doing (e.g., this is preparing a download or catalog: 

) Larger catalog requests can be sent to the Background Monitor.

A pop-up window can be called up at any time by clicking the "Background Monitor" tab. You can watch your data being retrieved. It will update that window when the data are available for download and/or overlay on your image, providing a link (or links) for obtaining the data. Remove them from the list by clicking on the 'x'.



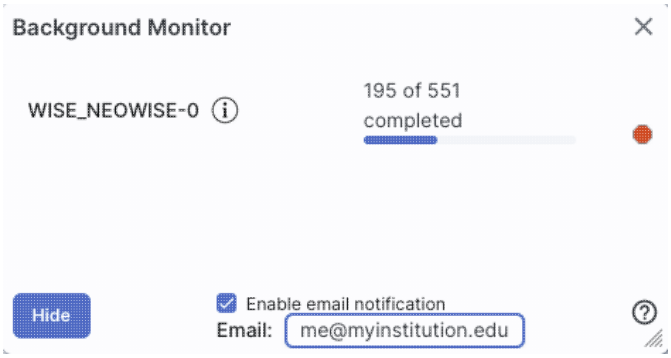
If you have made, say, a large catalog request and don't want the pending catalog request to occupy screen space while it loads, you can click on the button marked "send to background" to reclaim your screen space, seen here:



When the background monitor finishes, however, you will have to actively tell it to display results; it doesn't do it automatically if you have sent it to the background. You can ask it to send you email when it is ready by clicking on the "enable email notification" and giving it an email address.

To stop any query mid-way through, click on the little red octagon ("stop sign") that appears next to the query in the Background Monitor pop-up.

If you forgot to put in your email at the beginning, or if the packaging is taking longer than you expected, you can click on "Enable email notification" from the bottom of the Background Monitor popup and add your email during the packaging process.



If you are having technical difficulties, click on the circle with an "i" in it to get additional information, like this:

In this case, the job is executing, at the time as given, with a job id as shown.

Acknowledgments

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

This service you are using now, the Finder Chart Service, has DOI 10.26131/IRSA540. The individual data sets have their own DOIs; see the mission pages linked below.

The standard IRSA acknowledgment is:

> This research has made use of the NASA/ IPAC Infrared Science Archive, which is operated by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

The standard POSS/DSS acknowledgmet is:

> The Digitized Sky Survey was produced at the Space Telescope Science Institute under U.S. Government grant NAG W-2166. The images of these surveys are based on photographic data

obtained using the Oschin Schmidt Telescope on Palomar Mountain and the UK Schmidt Telescope. The plates were processed into the present compressed digital form with the permission of these institutions."

The standard SDSS acknowledgment is:

Funding for SDSS-III has been provided by the Alfred P. Sloan Foundation, the Participating Institutions, the National Science Foundation, and the U.S. Department of Energy Office of Science. The SDSS-III web site is http://www.sdss3.org/. SDSS-III is managed by the Astrophysical Research Consortium for the Participating Institutions of the SDSS-III Collaboration including the University of Arizona, the Brazilian Participation Group, Brookhaven National Laboratory, University of Cambridge, Carnegie Mellon University, University of Florida, the French Participation Group, the German Participation Group, Harvard University, the Instituto de Astrofisica de Canarias, the Michigan State/Notre Dame/JINA Participation Group, Johns Hopkins University, Lawrence Berkeley National Laboratory, Max Planck Institute for Astrophysics, Max Planck Institute for Extraterrestrial Physics, New Mexico State University, New York University, Ohio State University, Pennsylvania State University, University of Portsmouth, Princeton University, the Spanish Participation Group, University of Tokyo, University of Utah, Vanderbilt University, University of Virginia, University of Washington, and Yale University.

The standard 2MASS acknowledgment is:

This publication makes use of data products from the Two Micron All Sky Survey, which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation.

The standard Spitzer acknowledgment is:

This work is based on observations made with the Spitzer Space Telescope, which is operated by the Jet Propulsion Laboratory, California Institute of Technology under a contract with NASA.

The standard WISE acknowledgment is:

This publication makes use of data products from the Wide-field Infrared Survey Explorer, which is a joint project of the University of California, Los Angeles, and the Jet Propulsion Laboratory/California Institute of Technology, funded by the National Aeronautics and Space Administration.

There does not seem to be a standard IRAS acknowledgment. The canonical IRAS reference is Neugebauer et al. 1984. You may wish to include this in the acknowledgements:

The Infrared Astronomical Satellite (IRAS) was a joint project of the US, UK and the Netherlands.

The standard AKARI acknowledgment is:

This research is based on observations with AKARI, a JAXA project with the participation of ESA.

Finder Chart: API and URL Construction

Contents of page/chapter:

Introduction

There are four ways to interact with Finder Chart in an automatic or semi-automatic fashion.

Batch searching
: You can upload a list of up to 1000 sources to Finder Chart from the search screen, and then bundle up the results to download all at once in any of a variety of formats. More information on that is in the Basics of Searching section. This option is best if you don't want to write code to search and parse the results, and/or if you have at most a few thousand sources.

API (application programming interface) for links in a file (mode=prog, the default)
: An API, or application programming interface, enables programs to interact with IRSA's holdings, search for data, and download it. You can request a file with links to the results, e.g., https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?locstr=146.22351+22.88512&subsetsize=1.0&repro Currently this file is in XML format. You will need to write code to parse the XML yourself.

API to download the images or visualizations directly (mode=getImage)
: You can get FITS images, PNG's, or a PDF overview directly, e.g., for FITS images: https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?mode=getImage&RA=146.22351&DEC=22.88512

API to launch the web page (mode=getResult)
: You can launch a new browser window with images centered on the target, e.g., M101: https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?mode=getResult&locstr=m101

NOTE 1: If multiple positions are desired, care should be exercised when using the Finder Chart API's. Test first with a small subset. It is a good idea to put some 'wait' steps between requests. If an undue load on IRSA's servers is detected (a real-life example being more than 70,000 requests over 10 hours, an average of 2 per second), the jobs may be killed and the IP address may be blocked. If you suspect this has occured, please contact the IRSA Help Desk .

NOTE 2: Want to construct a URL automatically? Basically, you need interact with the API to launch a FinderChart session; see below.

API: Introduction

The Finder Chart service can be accessed via an HTTP/GET program interface (basically a really long URL) where the request is a set of *parameter=value* pairs, separated by ampersands (&). What is returned by default is an XML file containing metadata and URL links to download products with the related ancillary files. Below, we describe these input parameters and the columns returned.

Many of the interactive features inherent in the web interface, e.g., the visualization tools, are not available via the API.

The **base URL** for this service is https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?

The **input parameters** are specified by *parameter=value* pairs, separated by ampersands (&). For example, "locstr=m101" specifies the search center of the subset images. A URL that just specifies this location and nothing else looks like https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?locstring=m101 This query does not specify either the sizes of the images or the survey names, so the default values of all the rest of the parameters are used. If the value contains any spaces or special characters, these need to be URL-encoded. Here are examples for XML output sent to a local file. In this mode, the minimum requirement is "locstr" (or "RA" and "DEC"). See the next section for a discussion of "reproject".

```
curl --output out.xml "https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?locst

wget --output-document=out.xml "https://irsa.ipac.caltech.edu/applications/finderchart/servlet/
```

Things to notice: It is https, not http. The URL is enclosed within quotes. The output is saved in out.xml, but if you have errors in your query, the file out.xml may not actually be xml but instead be html. It is the simplest query, only specifying a target, and the rest the parameters fall back to the defaults. You can use curl instead of wget.

API Input Parameters

The input parameters are entered as standard HTTP "parameter=value" pairs in HTTP/GET syntax. In this syntax, the parameter name is followed by an equals sign which is then followed by a value. These pairs are separated from each other by ampersand (&) characters. No extra spaces are allowed, and if the value needs to contain any spaces or special characters that might cause ambiguities, these spaces have to be encoded as shown in any URL reference. In the rest of this section, we list the parameters. For examples, see later sections below.

Note that if you want to download PNG files via the API, there is currently no way to change the default stretch via the API.

Parameter	Values	Default	Description
locstr *(either locstr or an RA/DEC pair is required)*	A set of sky coordinates or an object name resolvable via NED or SIMBAD.	none	If an object name, it is resolved into coordinates using NED and, if that fails, SIMBAD. For coordnates, both decimal degree and sexagesimal coordinates are supported. Any spaces or special characters must be URL-encoded (see, e.g., this site for more information). The following are examples of acceptable name/coordinate formats (human-readable version in parentheses): • m83 • NGC%207479 (= NGC 7479) • 2MASXJ23045666%2B1219223 (= 2MASXJ23045666+1219223) • 23h04m56.63s%2B12d19m22.7s%20Equ%20J2000 (= 23h04m56.63s 12d19m22.7s Equ J2000) • 22h57m57.5s%20%2B26d09m00.09s%20Equatorial%20B1950 (= 22h57m57.5s +26d09m00.09s Equatorial B1950)

Parameter	Values	Default	Description
			• 17h44m34s%20%2D27d59m13s (= 17h44m34s -27d59m13s) • 00h42m44.3s%20%2B41d16m08s%20b1950 (= 00h42m44.3s +41d16m08s b1950) • 00:42:44.3%20%2D41:16:08 (= 00:42:44.3 -41:16:08) • 34.5565%2054.2321%20gal (= 34.5565 54.2321 gal) • 34.5565%20%2D54.2321%20gal (= 34.5565 -54.2321 gal) • 34.5565%2B54.2321%20gal (= 34.5565+54.2321 gal) • 34.%20+54.%20ecl (= 34. +54. ecl) • 34.%20%2D+54.%20ecl (= 34. -54. ecl)
mode	prog, getImage, getResult	prog	Specifies the output: "prog" (default) gives a file in XML format, "getImage" retrieves images given by the "file_type" parameter, "getResult" spawns a Finder Chart in a browser.
subsetsize	a decimal number	5.0	Specifies the cutout size of the retrieved images in arcmin. It should be between 0.1 and 60.0 arcmin.
reproject	true or false	false	Specifies whether to reproject to equatorial J2000 with North up. This needs to be requested for FITS images of DSS, SDSS, IRAS, and AKARI. All others will already be in this form. It is set in the XML output calls to make sure the individual FITS links get the call to reproject, and it is set here in most of the getImage calls to allow easy swapping in of FITS.
survey	DSS, SDSS, 2MASS, WISE, SEIP, AKARI, IRAS	DSS, SDSS, 2MASS, WISE, IRAS	Specifies the survey dataset(s) to be retrieved. ("IRIS" can be used instead of "IRAS" for the same image set.) It can be one dataset (e.g. "survey=SDSS") or multiple datasets (e.g. "survey=SDSS,DSS,SEIP"). It defaults to the five datasets at left. IRAS is not very informative at this spatial scale and will be removed from the default in the future.
file_type *used in conjunction with "mode=getImage"*	fits, png, pdf	fits	Specifies the desired output of a specific query. FITS, PNG, and PDF are the same options as when you select "Download" in the interactive GUI. The PDF option results in a single PDF file. Note that this does not work for mode=getResult.
grid	true or false	false	Specifies whether or not a grid should be added to the PNG images. Note that this does not work for mode=getResult.
marker	true or false	false	Specifies whether or not a location marker should be added to the PNG images. Note that this does not work for mode=getResult.
marker_color	Basic color names in lowercase or HEX value	red	Specifies the color of the marker. 'marker' option must be set to true. Color name may be one of black, aqua, blue, cyan, fuchsia, gray, green, lime, magenta, maroon, navy, olive, orange, pink, purple, red, silver, teal, white, or yellow. Note that this does not work for mode=getResult.
marker_size	integer	4	Specifies the size of the circle marker, in px. 'marker' option must be set to true. Size must be greater than 0. The overlay symbol is a circle whose diameter is 2 times the marker_size in px. Note that this does not work for mode=getResult.

API Input Examples

The following examples can be run by clicking their links; examples 1 through 8 produce valid results while 9 and 10 are examples of the error conditions. Number 11 shows the launching of a web page. All of them should have this prepended:

```
https://irsa.ipac.caltech.edu/applications/finderchart/servlet/
```

1. **api?locstr=m101&reproject=true**
   Retrieves XML file containing links to images for the area centered on object "m101" (where the resolved coordinates come from NED) with default image size of 5.0 arcmin.

2. **api?locstr=m101&survey=2mass&reproject=true**
   Retrieves XML file containing links to 2MASS images for the area centered on object "m101" (where the resolved coordinates come from NED) with the default image size of 5.0 arcmin.
3. **api?locstr=210.77805%20+54.32714&subsetsize=4.0&reproject=true**
   Retrieves XML file containing links to images for the area centered on object at coordinates "210.77805 +54.32714" (14h03m06.73175s +54d19m37.7082s) and with image size of 4.0 arcmin.

4. **api?locstr=m101&survey=2mass,dss&reproject=true**
   Retrieves xml file containing links to 2MASS and DSS images for the area centered on object "m101" with the default image size of 5.0 arcmin.
5. **api?locstr=m101&survey=2mass&mode=getImage&reproject=true**
   Retrieves a zipfile of 2MASS images for the area centered on object "m101" and with default image size of 5.0 arcmin.
6. **api?locstr=m101&survey=2mass&grid=true&marker=true&mode=getImage&reproject=true**
   Retrieves a zipfile of 2MASS images for the area centered on object "m101" with default image size of 5.0 arcmin and draws both grid and input location marker on the PNG images.
7. **api?mode=getImage&file_type=pdf&subsetsize=5&survey=DSS,SDSS,2MASS,IRIS,WISE,SEIP,AKARI&lo**
   This requests the PDF file output for the given position, which includes 5 arcminute images from all 7 surveys.
8. **api?locstr=m101&marker_color=yellow&marker=true&marker_size=20&mode=getImage&file_type=pdf&**
   Retrieves PDF for the area centered on object "m101" with default image size of 5.0 arcmin, with a large yellow marker overlaid.
9. **api?locstr=xxx**
   The input location of this query is unresolvable, it produces the error condition: "Coordinate [xxx] lookup error: Invalid object name."
10. **api?locstr=m101&subsetsize=62.0**
    The input search radius of this query is larger than 60.0 arcmin. It produces the error condition: "subsetsize is not between .1 and 60 arcmin."
11. **api?mode=getResult&locstr=m101**
    Pasting this into a new browser window launches a Finder Chart session with images of M101 loaded

API Output Parameters (in XML)

The **output** in the default mode (saved in out.xml in the commands above) is an XML document containing the URL of the corresponding interactive Finder Chart search results, and the URLs that point to the individual retrieved FITS images and the corresponding PNG images (both small and large).

Browsers vary in how they treat XML tables, so if you click on any of the example API links below, your

browser may have trouble rendering it, or will render only pieces of the embedded text. You may need to save the contents of the link to a file. You may also be able to use an option like "View Page Source" to see the result.

The returned XML "inventory" contains a results HTML page which includes the rotated and scaled PNG images from the retrieved images so they are all same size and orientation for being useful as a Finder Chart. In addition, it contains the URLs of the retrieved FITS images, the scaled PNG images used in the HTML page, and the PNG images in the original size. It also contains the 2MASS glint and persistent artifacts tables if the 2MASS survey is queried.

Once you have parsed the URLs out of the XML, you can retrieve the results using wget or curl. In order to do this, you should enclose the URL in quotes, and tell it what to do with the output. Here are some explicit examples of using quotes around URLs for wget or curl:

```
wget --output-document=file.pdf "https://irsa.ipac.caltech.edu/applications/finderchart/servlet

curl --output file.pdf "https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?mode
```

Here are all of the XML tag names that can occur. Examples of returned queries are below.

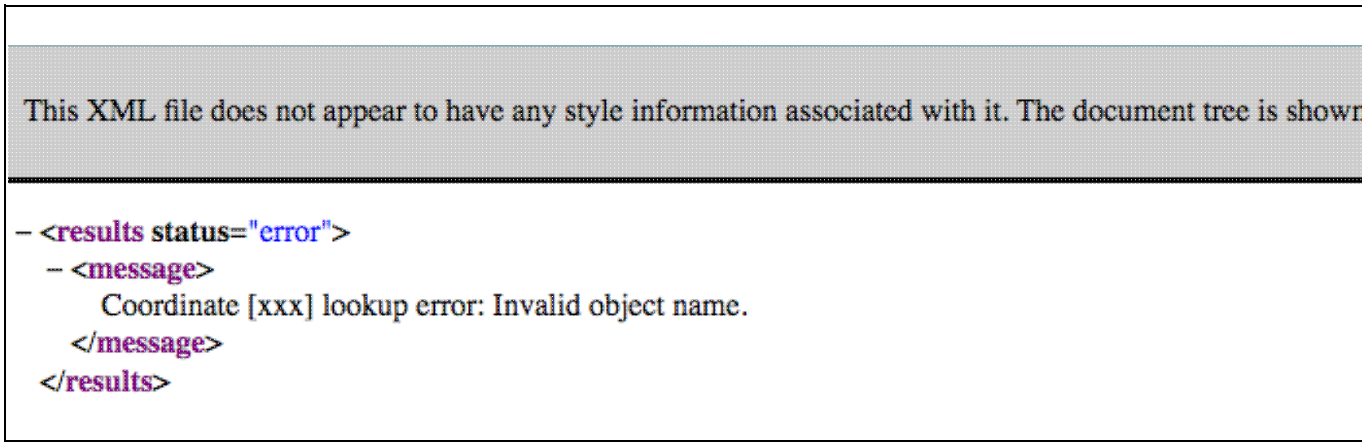
Tag name	Description
finderchart	The top tag of the XML file which contains a variable "status" indicating whether the query is successful; "ok" for successul query and "error" otherwise.
message	The error message when the query status is "error".
input	A section tag which contains several input parameter sub-tags.
locstr	Input objname or coordinate (examples above).
surveys	Surveys included in the query.
subsetsize	Image subset size in arcmin.
grid	A "true" or "false".
marker	A "true" or "false".
result	A section tag which contains sub-tags of all the results including the search coordinate (in equatorial, galactic, and ecliptic), the URL links to the retrieved FITS images, the PNG images, and the 2MASS glint and persistent artifact tables when the 2MASS survey is requested.
datatag	The datatag contains the parameters of the query which allows the same query to be reproduced at a later time. Please consult the datatag instruction document on how to rerun the query.
equCoord	The input location in the equatorial coordinate system and sexigesimal format.
galCoord	The input location in the galactic coordinate system.
eclCoord	The input location in the ecliptic coordinate system.
totalimages	The total number of images retrieved.
htmlfile	The URL of the HTML file that contains the finder chart results.
pdffile	The URL of the PDF file that contains the finder chart results.
image	This is a sub-tag of the "result" tag, but it is a section tag that contains the sub-tags of an image's information and URLs.
colorimage	This is a sub-tag of the "result" tag.
surveyname	

Tag name	Description
	The survey name of the retrieved image: SDSS, DSS, 2MASS, WISE, SEIP, AKARI, or IRAS. ("IRIS" can be used instead of "IRAS" for the same image set.)
band	The band name of the retrieved image. By default, all bands are returned.
obsdate	The observation date extracted from the retrieved FITS image.
fitsurl	The URL of the retrieved FITS image.
jpgurl	The URL of the PNG image which is the same resolution as the FITS image. (Note that the name of the tag incldues 'jpg' but it returns PNGs.)
shrunkjpgurl	The URL of the shrunken PNG image. (Note that the name of the tag includes 'jpg' but it returns PNGs.)
artifact	The sub-tag of the result, one for each survey.
arturl	The URL to get the artifacts for the survey.

API Output Examples

Any of the input example links above will yield output, and if you click on them right now, your browser will attempt to render the retrieved results. Output that is XML (examples 1-10 above) may throw your browser a curve ball. Choose "View Source" within your browser to see everything that is returned. Output that is a zip file or pdf file (example 11) should be easily handled by your browser; as noted above, when using wget or curl, you should specify how it should save the results.

Here is a screen shot of the error message from example 9 above:



And the first part of the XML output from example 2:

```
−<finderchart status="ok">
  −<input>
      <locstr>m101</locstr>
      <surveys>2MASS</surveys>
      <subsetsize>5</subsetsize>
      <reproject>true</reproject>
    </input>
  −<result>
      <datatag/>
      <equCoord>210.80227;54.34895;EQ_J2000</equCoord>
      <galCoord>102.03732337663382;59.771380823715184;GALACTIC</galCoord>
      <eclCoord>174.3654119353654;59.79726608917241;EC_J2000</eclCoord>
      <totalimages>3</totalimages>
    −<htmlfile>
        https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?reproject=true&mode=getResult&UserTargetWorldPt=210.80227;54.34895;EQ_J2000&
        subsize=0.083333336&survey=2MASS
      </htmlfile>
    −<pdffile>
        https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?mode=getImage&file_type=pdf&subsetsize=5&reproject=true&locstr=m101&survey=2MASS
      </pdffile>
    −<image>
        <surveyname>2MASS</surveyname>
        <band>J</band>
        <obsdate>1999-02-14</obsdate>
      −<fitsurl>
          https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?mode=getImage&RA=210.80227&DEC=54.34895&subsetsize=5.0&thumbnail_size=medium&
          survey=2mass&reproject=true&twomass_bands=j&type=fitsurl
        </fitsurl>
      −<jpgurl>
          https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?mode=getImage&RA=210.80227&DEC=54.34895&subsetsize=5.0&thumbnail_size=large&
          survey=2mass&reproject=true&twomass_bands=j&type=jpgurl
        </jpgurl>
      −<shrunkjpgurl>
          https://irsa.ipac.caltech.edu/applications/finderchart/servlet/api?mode=getImage&RA=210.80227&DEC=54.34895&subsetsize=5.0&thumbnail_size=small&
          survey=2mass&reproject=true&twomass_bands=j&type=shrunkjpgurl
        </shrunkjpgurl>
      </image>
    −<image>
```


with additional image tags (not shown) for other images returned.

Finder Chart: User Registration for the IRSA Archives

There is one user registration for all IRSA applications, but data access, preferences, search history, data tagging, etc., are all unique to each archive.

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

Finder Chart does not access proprietary data, so there is no strong motivation to register in order to use Finder Chart.

On the other hand, ***if you are trying to gain access to your proprietary data in a particular archive (other than Finder Chart), you will need to log in*** so that the system grants you access to your data. Not all archives served by IRSA have proprietary data. If you got email from an archive's Help Desk about account information, you may already have an account; else you can set up an account (see below). Once you have set up an account, please send us an email at the IRSA Help Desk and we'll tie your new account to your proprietary data.

Log In

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

Finder Chart: FAQs

Do you have any tutorial videos?

Yes. The IRSA YouTube channel has several tutorials that are relevant to the Finder Chart service -- see the Finder Chart 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.

I have a bunch of targets and I want to get all the images for these targets. Can I do this?

You can give it a list of sources, up to 1000 sources, and it will go away and think about it and load them all into the browser. You can customize the stretch, color table, etc. You can then ask it to prepare the download for you, and when it's done, if you want, mail you a list of URLs to download the data.

Is there a way to interact with Finder Chart from the command line or a script?

Yes. There are three approaches that might meet your needs.

1. You can give it a list of sources, up to 1000 sources, and it will go away and think about it and load them all into the browser. You can then ask it to prepare the download and when it's done, if you want, mail you a list of URLs to download the data.
2. You can construct a URL that, when loaded, results in the interactive web-based user interface, with files pre-loaded.
3. You can use the application programming interface (API) to obtain the files you want.

How come some of the 2MASS images are not "whole images", like it's trying to center on my target but half the image is missing as if it's going off the edge of an image?

It is actually running off the edges of the relatively small images we have in the main 2MASS image archive. When the 2MASS survey was concluded and final tiles generated, internet (and computers) were much slower), and as a result, the final image tiles are small. Therefore, when you request 2MASS images, you may very well run into edges of tiles, as in the screenshot above where the 2MASS data appear to 'end' on the right hand side before the WISE or Spitzer data do. There really are 2MASS data over essentially the entire sky, and the tool is doing the best it can to get you the best possible tile given the position and size you requested, but you may very well run into an edge of a tile. If you really need a larger contiguous fraction of sky from 2MASS, try the IRSA Viewer tool, and use the "6 degree" (not 6x, but 6 degree) 2MASS images.

I've retrieved a catalog. What are all these columns?

The columns that are returned are exactly those that are stored in the archive for that catalog. Each catalog is different. Please check the project's documentation for each catalog separately, all of which are available at IRSA. Some of the more commonly used ones are:

- 2MASS
- WISE
- IRAS

I've created a nice image within the FITS viewer, and I have the stretch and overlays exactly the way that I want them. How do I save this?

Click on the diskette icon and tell it to save the PNG file. If you just save the FITS file, you will lose the overlays, and if you just save the overlays (as a ds9 region file), you will lose the underlying image.

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.

How do I get more help?

The "Help" blue tab leads you into this online help, as does "Finder Chart Help" from under the "Help" in the IRSA menu on the top of the Finder Chart page. You can also download a PDF version of this manual; look at the top of the help window.

You can submit questions to the IRSA Help Desk.

Found a bug? The known bugs and issues in this version of Finder Chart are listed here. If you think you have found a bug, before reporting it, please check this list, and read this online Finder Chart 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.)

Finder Chart: Notice to Users -- Privacy Notice

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The website also collects and stores information about your search options, such as

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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
- Plus, additional preferences that may be developed in the future, such as those tied to the visualization options.

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