Planck Help

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NASA Planck Archive (NPA) Quick Start Guide

What is available via this tool? This interface primarily provides an interactive way of exploring Planck images and the most commonly used catalogs. All-sky catalogs are available for each of the 9 frequency ranges (30 - 857 GHz) covered by Planck. These have not been merged into a single multi-wavelength catalog. However, if you are interested in an individual source, you can search for that source in all of the Planck catalogs at once using this tool. Tangent plane projected Planck cutouts at the location of the source are available in this visualization tool. WMAP and IRAS images are also provided for individual sources.

You can also simply download the entire catalogs either via this interface or via the mission page ⧉.

Data releases: The Planck data releases come in three batches, which are (in reverse chronological order): (1) Planck Public Data Release 2 (PR2); (2) Planck Public Data Release 1 (PR1); (3) Planck ERCSC (Early Release Compact Source Catalog) Release. All the catalogs and pointers to documentation can be found linked here ⧉.

Searching: There are three kinds of searches in the NPA. (1) TOI (Time Ordered Information); (2) Browse catalogs (a single frequency at a time, but all positions); (3) cutout visualization (a single position at a time, but all frequencies). See the section on searching for more information.

Time Ordered Information (TOI): TOI consists of the measurements of the sky intensity obtained by the Planck spacecraft as it spun at 1 revolution per minute. Each measurement is tagged by the location on the sky that was pointed to, the time of the observation, and whether or not a Solar System object was within the beam. TOI data are available as of PR2.

The terms *"source lists"* and *"catalogs"* refer to both the single frequency and multi-frequency derived catalogs.

SZ catalogs refer to the Planck Sunyaev-Zel'dovich cluster sample.

PCCS catalogs refer to the Planck Catalog of Compact Sources.

Search Results: The search results can appear in up to a dozen tabs, often with associated images. (See the section on understanding your search results for more information.)

Filtering: Filters, either imposed on your initial search or via your results page, can provide a powerful tool for narrowing down search results to the observations you want.

Visualizing: Visualization is a powerful tool for deciding what data to download.

Downloading Data: Click on the diskette icon to save any catalog you currently have loaded. Alternatively, click on the checkboxes and then click "Prepare Download" to begin packaging your data for download in the background. See the section on Downloads for more information.

For more help, definitions, etc., see the more detailed online help on the left. A set of frequently asked questions (FAQs) is here.

NASA Planck Archive (NPA): Overview

The NASA Planck Archive (NPA) is the final United States repository for all of the data collected by the joint European Space Agency/NASA Cosmic Microwave Background Radiation mission, Planck. Only Planck data that have been released to the public are available via this interface.

The Spacecraft and Instruments

The Planck Telescope, consisting of a 1.5-meter telescope and two science instruments, was launched into an L2 orbit on May 14, 2009, and deactivated in October 2013. Planck performed a detailed study of the cosmic microwave background (CMB). The instruments aboard Planck --- the Low Frequency Instrument (LFI) and High Frequency Instrument (HFI) --- obtained images at wavelengths between 30 and 857 GHz, with spatial resolution ranging from 5 arcminutes at the shortest wavelengths to 33 arcminutes at the longest. More information on Planck can be found at http://planck.caltech.edu/ ⬛ or http://planck.ipac.caltech.edu/ ⬛.

Planck Mission

Mission Milestones include:

- Launch: May 2009
- Start of First All-Sky Survey: August 2009
- End of Nominal Mission: November 2010
- **ERCSC Release**: January 2011
- End of HFI lifetime: January 2012
- **Public Data Release 1**: March 2013
- End of LFI lifetime and spacecraft deactivated: October 2013
- **Public Data Release 2**: February 2015 (updates 8/15, 12/15)

The primary sources of Planck data accessible by the NPA web tool are the Planck ERCSC Release (ER), Planck Public Data Release 1 (PR1), and the Planck Public Data Release 2 (PR2). The ERCSC Release is based on data acquired through 6 June 2010, Public Data Release 1 is based on the Nominal Mission data, and Public Data Release 2 is based on the complete mission data.

Searching, Results, and Filters

The NASA Planck Archive provides several options for searching its holdings. There are basically three kinds of searches in the NPA. (1) TOI (time ordered information); (2) Browse catalogs (single frequency but all positions); (3) cutout visualization (single position but all wavelengths). See the section on searching for more information.

The search results are displayed on the screen in three main regions: (1) upper left: up to a dozen tabs, one each for the nine Planck bands from 30-857 GHz and the remainder for the multifrequency (Cold Cores and/or SZ Cluster) catalogs. (2) upper right: details on the row selected in the tabs; (3) bottom: image cutouts for the row selected in the tabs. See the page on understanding your search results for more information.

Filters, either imposed on your initial search or via your results page, can provide a powerful tool for narrowing search results to the observations you want. For example, you can restrict your search based on source flux density or morphology, or you can restrict the entries in the tabs to be just those objects observed more than, say, three times.

Visualization

After searching the Time Ordered Information (TOI) data, you can combine subsets of the data into a new image. See the Results section for further details. You can explore the image in the same way as you can explore any other image in the NPA. (See the visualization section for more information.)

After searching by "Browse Catalogs" (search by wavelength) or "Cutout Visualization" (search by position), the NPA displays FITS images of a small area around each object. These are shown below the search results table, with the catalog entry highlighted in green and the object centered in the field of view for each wavelength. PR1 and PR2 visualization queries allows the image size to be set between 10 arcminutes and 2.0 degrees. WMAP and IRAS FITS images, where available, may also be shown for each table entry. (The original ERCSC images are JPGs, not FITS, but the WMAP and IRAS images returned for an ERCSC visualization search are indeed FITS files.) See the visualization section for more information.

Downloading Data

If you would like to download catalogs, click on the diskette icon in the upper right of the catalogs tab. It will save the file as an IPAC table file. The entire catalog will be saved if you are in the "browse catalog" kind of search; just the retrieved sources will be saved if you are in the "cutout visualization" kind of search.

If you'd like to download FITS data, click on the checkbox on the upper left side of the corresponding images or to the left of the corresponding row. Next, click "Prepare Download" to begin the packaging and data download process. The data will be made into a downloadable package by a background job, which can notify you via email when it's finished.

See the Downloads section for more specific information on how to select data for download. See the section on the Background Monitor for more information specifically on the background monitor.

User Login

The archive can remember you when you return. See the user registration section for more information.

Basic Features and Functions in the NASA Planck Archive (NPA)

This page is an overview of the basic features and functions of the NASA Planck Archive (NPA); for an even faster overview, see the Quick-Start Guide. Most of this file follows the blue tabs across the top of the Image Service.

| Searches | History | Help | Catalogs | | Background Monitor |

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+Searches -- The basics of searching
+History -- Your search history
+Help -- Getting more help
+Catalogs -- Retrieving and using catalogs
+Background Monitor -- Downloading data and catalogs in the background

Planck Mission

The Planck Telescope observes the entire sky at frequencies ranging from 30 - 857 GHz. The releases of Planck data include:

- all-sky maps;
- a set of source catalogs in each of the wavelength ranges characteristic of Planck's instrument complement;
- a collection of source catalogs, including those based on the multi-band detection of cold cores and SZ clusters;
- TOI information (measurements of the sky intensity as a function of time).

Users have full access to the Planck catalogs through this tool, and the archive enables sorting and selection of columns of data characteristics.

Searches -- The basics of searching

There are basically three ways to search the NPA. (1) *TOI* (time ordered information); this option provides for adding individual measurements of sky intensity together. (2) *Browse catalogs*; since Planck observations cover the entire sky, this option loads the entire catalog by frequency and you can browse through it interactively (e.g., all positions, but one wavelength). (3) *Cutout visualization*; search the multiple frequency data by position (e.g., all wavelengths, but one position). The default when loading the tool is the TOI search; other searches can be accessed from the left hand side of the search window. After a search, you can perform additional searches via clicking on the "Searches" blue tab at top left.

For *TOI searches and Visualization searches*, you enter a position anywhere in the sky. You may enter target names, which will be automatically resolved into coordinates using NED or Simbad. Alternatively, you may enter coordinates directly. These coordinates can be in decimal degrees or in hh:mm:ss dd:mm:ss format. By default, it assumes you are working in J2000 coordinates; you can also specify galactic, ecliptic, or B1950

coordinates as follows:

- '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

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

For the *browse catalog searches*, the simplest initial option is to just ask it to load the catalog at any given frequency. It will then load the catalog for you, enabling you to browse it. You can impose filters from the search page or after the catalog has loaded; see filtering information.

A visualization search (multi-wavelength, positional search) will return the rows of the catalog selected by the input parameters, together with preview images. In the lower portion of the NPA window, images will appear in FITS format: data from Planck (JPEG images only in the ERCSC Release), WMAP, and IRAS will be shown. See the section on visualization for more information on the options within the visualization tabs.

Searching is described in detail in the section on searching, results are discussed in the section on results, and downloading data is discussed in the section on downloads.

You may wish to impose additional filters on your search results; see the section on filtering search results for more information.

History -- Your search history

The History menu option (blue tab at the top of the window, next to "Searches") gives you access to your own search history.

All of the single-position searches that you perform during a given session with the NPA are remembered in the search history panel. A high-level summary of the search is also listed -- what kind of search you performed and which parameters you used.

You can resubmit the search (see buttons at top left of the search history window), remove the search from your history, or save the search as a favorite search to which you can return at a later time/date. However, in order to return to it during a different session, you do need to be logged in when you save the search -- see the user registration section.

(Note that this blue tab is only available after you have performed at least one search.)

You can choose from any of a wide variety of additional catalogs to load and overlay on your visualized data. They can be catalogs from IRSA or your own catalogs from disk. You can also make plots from the catalogs.

For more on catalogs, see the Catalogs section.

# Background Monitor -- Downloading data and catalogs in the background

For information about downloading data (e.g., how to initiate it), please see the Downloads section.

The Background Monitor appears as a blue tab (or button) 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 ("Preparing", etc., e.g.,:
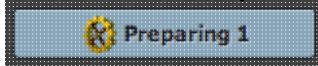
) All data packaging all goes to the Background Monitor; larger catalog requests are also sent to the Background Monitor.

A pop-up window can be called up at any time by clicking the "Background Monitor" tab. You can watch your data or catalog being retrieved. It will update that window when the data are available for download and overlay on your image, providing a link for obtaining the data. It also keeps track of the downloads you have requested during the same session, and indicates with a checkmark those that you have already loaded. Remove them from the list by clicking on the blue 'x'.
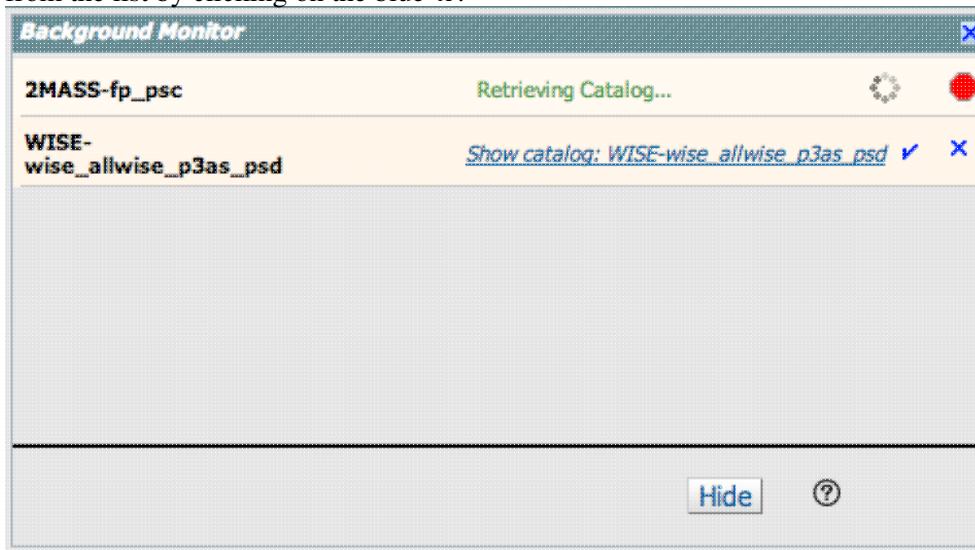
To stop any query mid-way through, click on the little red octagon ("stop sign") that appears next to the query in the Background Monitor pop-up.

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 "Add email" (or "change email") from the lower right of the Background Monitor popup and add (or change) your email during the packaging process.

The Background Monitor will also keep track of catalog downloads for you. The monitor will dynamically update to reflect its status, and will let you know when the catalog is ready to download or display. Open the background monitor and click on the catalog name to load it into a tab of its own. For more on catalogs, see the Catalog section.

Selecting Data to Download

There are basically two ways to download data -- clicking a diskette icon or selecting tickboxes and selecting "Prepare Download."

The diskette icon ( ) can save only the current image (if selected from the image toolbox) or just the current catalog (if selected from the upper right of any catalog window).

If checkboxes appear in the upper left of images or on the far left hand side of a row in a catalog, you can select multiple items for packaging and download; additional data come with this packaged download. After deciding which data to download, click the checkboxes to select specific data files, and then click "Prepare Download" to begin the packaging and downloading process. A pop-up window will appear in order to define exactly what kinds of data you would like to have packaged up. Clicking "Prepare Download" in the pop-up initializes this packaging process.

After you click "Prepare Download", the packaging process moves to the Background Monitor. The background monitor can be called up by simply clicking on the blue tab. You can watch your data being packaged, and when the data are available for download, it will update that panel, providing a link for downloading the packaged data. Your most recent download request appears on the top of the list.

Note that **you** control where the data are saved on your disk through your browser; your browser may be configured to store all downloads in a particular location on your disk. Look for a "Downloads" folder or search for recently modified files.

For more specifics on how to download data, see the Downloads section.

Understanding Your Search Results from the NASA Planck Archive (NPA)

This section is an overview of what exactly is returned by the NASA Planck Archive (NPA) search. It explains some of the terminology the NPA uses and describes some of the common tasks you may want to do. It then discusses the individual tabs on the archive screen, as well as how to further refine search results by using filters.

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+Terminology
+Options Common to Most Search Results
+Table Navigation
+TOI Results
+Images as part of your results
+Details
+Filtering -- Imposing additional filters to get the most out of your search results

Terminology

Search results are displayed in your browser in several sub-windows, sometimes referred to as "panes", like "window panes." Here is an example:

There are three fundamentally different ways to search the NPA, and for two of them, the search results always look more or less like this. There is a list of results on the left, details of the results on the right, and a set of image cutouts on the bottom. TOI searches look fundamentally different, because the nature of those results are so very different.

Options Common to Most Search Results

Dynamic changes

Clicking on things in one pane often changes things in another pane. For example, clicking on a row in the search results pane changes the content of the details tab in the coverage pane, and often changes the set of images in the cutouts pane. When catalogs are overlaid, similar interactivity is available -- clicking on a row in the catalog changes the source color in the source overlays on all of the images, and clicking on a source overlay in any of the images highlights the corresponding row in the catalog.

Images

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 top of the window with a variety of useful items. Much more information about working with images is provided in the Visualization section.

Changing the size of the window or columns

You can resize the boundary between window panes to resize the window pane or individual columns. Click and drag the blue double-sided arrows in the middle of the pane boundary. You can resize columns by dragging the boundary between columns.

Tables

Tables are handled similarly throughout the NPA; see the next section for more details about the icons that appear on the top of a table, and how to navigate through large tables. To sort tables, click on the header of any column. Click it again to sort in reverse order, and click a third time to return to the original view.

Note that, by default, position searches return a table of Planck sources, but the table is **not sorted by distance of a source from the submitted coordinate**. To do that, you must click on the column labeled "dist". The "dist" and the associated "angle" (for Position Angle) columns are appended to the catalog column list so are found at the far right. Scrolling is usually necessary to see these columns.

Table Navigation

In the tabs in the results table (or in any other catalog tab), similar symbols appear:


In the example, the first thing on the left is a "Prepare Download" button. This button may not always appear, depending on what, exactly you are looking at. Clicking on this button starts the packaging process for downloading data.

Next, there is this: . This tells us some important things. In this example, 1256 sources met the search criteria, and the first 50 are being displayed. The black arrows plus the page number allow you to navigate among these 'pages' of 50 sources each. Note that the entire set of results (not just the 50 rows you are currently viewing) can be sorted alphabetically by clicking on any column's name. (Note also that in the plotting and overlay features described elsewhere in this document, all the sources in the catalog are plotted on the images you have, not just the 50 shown in the first page.)

Going from left to right along the top of the catalog tab, the next icon represents a filter: Filters are a *very* powerful way of exploring the catalog data, and as such are summarized in a separate section below. The next icon is -- clicking on this changes the table display into a text display. The icon then changes to --

click this again to return to the default table view.

The next icon is ![save icon] which is "Save" -- this is how you may save the whole catalog (*NOTE: the WHOLE TABLE, not just the rows shown*) to your own local disk. It will save 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. Depending on what table, exactly, you are saving, the the file may be called "GatorQuery.tbl" because, under the hood, the software is talking to the IRSA General Catalog Query Engine ⧉, powered by Gator.

The next option on the top of the catalog tab is this: ![gear icon]. Clicking on this icon brings up options for the table, e.g., how many rows are displayed per page, and which columns are shown. By default, all columns are shown. The default page size is 50 rows. Note that expanding the page size to numbers much greater than 50 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).
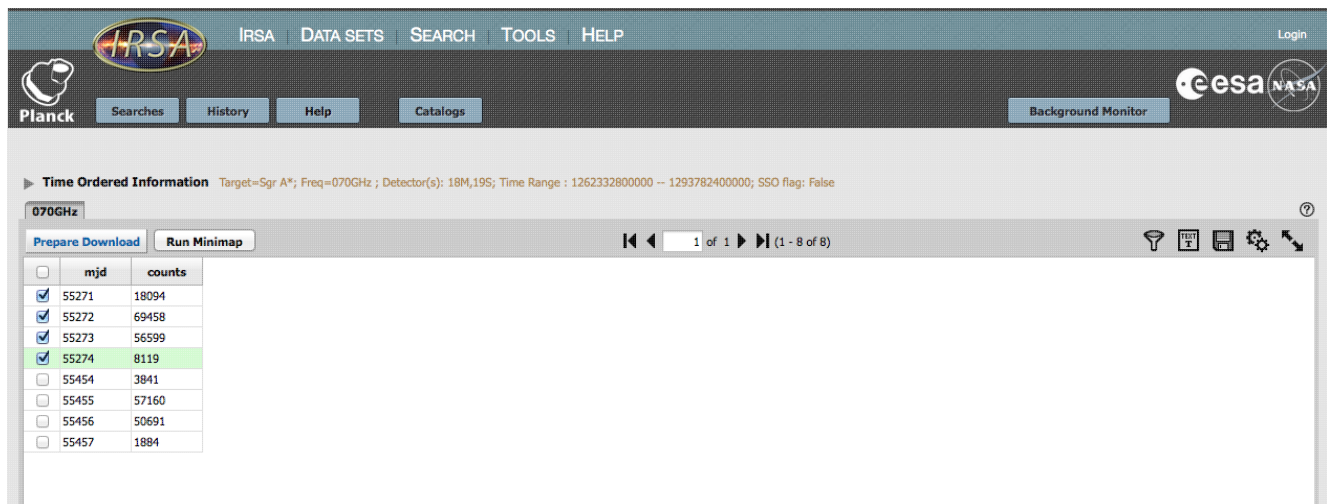
Note also that if you resize columns, and then go and add new columns, the original columns are resized back to their defaults after the new columns are added.

Finally, when your mouse is in the catalog window pane, you may see this as the last option on the top of the catalog tab: ![expand icon]. 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.

TOI results

A TOI search returns a list of the MJDs (modified Julian Dates) during which your source was observed by Planck, along with the number of TOI samples obtained on each day. Because this is the primary search result for a TOI search, the result is one tab per selected frequency with the list of dates and sample counts. Your search criteria are listed above the tabs.

Each MJD's data can be individually selected for download or map generation by clicking on the box to the left of each entry. You can also select all available data by clicking in the box that appears on the column header (above all the checkboxes). In the example here, we've selected the first four contiguous MJDs which are from the same pass. The remaining dates are from the subsequent pass roughly six months later.

For more on downloading the TOI data directly, please see the Download section.

Running Minimap on the TOI data

The other button available on the TOI Search Results page produces an image from the selected TOIs using the Minimap algorithm. Minimap creates a simple sky map from the TOI samples, one in which each weighted TOI signal is assigned to the nearest output pixel, with no interpolation. The pixel value is the unweighted average of the values of all the selected TOI samples for which the detector pointing direction lies within the pixel. It is assumed that offsets due to 1/f noise have already been removed from the TOIs. The map projection is gnomonic, centered on the search direction, and the pixel size is 2 arcmin. Unsampled pixels are marked by a NaN value.

Clicking on this "Run Minimap" button brings up a simple confirmation dialog box listing the rows (starting at 0) that you selected in the MJD list. The only options here are 'OK" to proceed with the image generation or 'Cancel'.
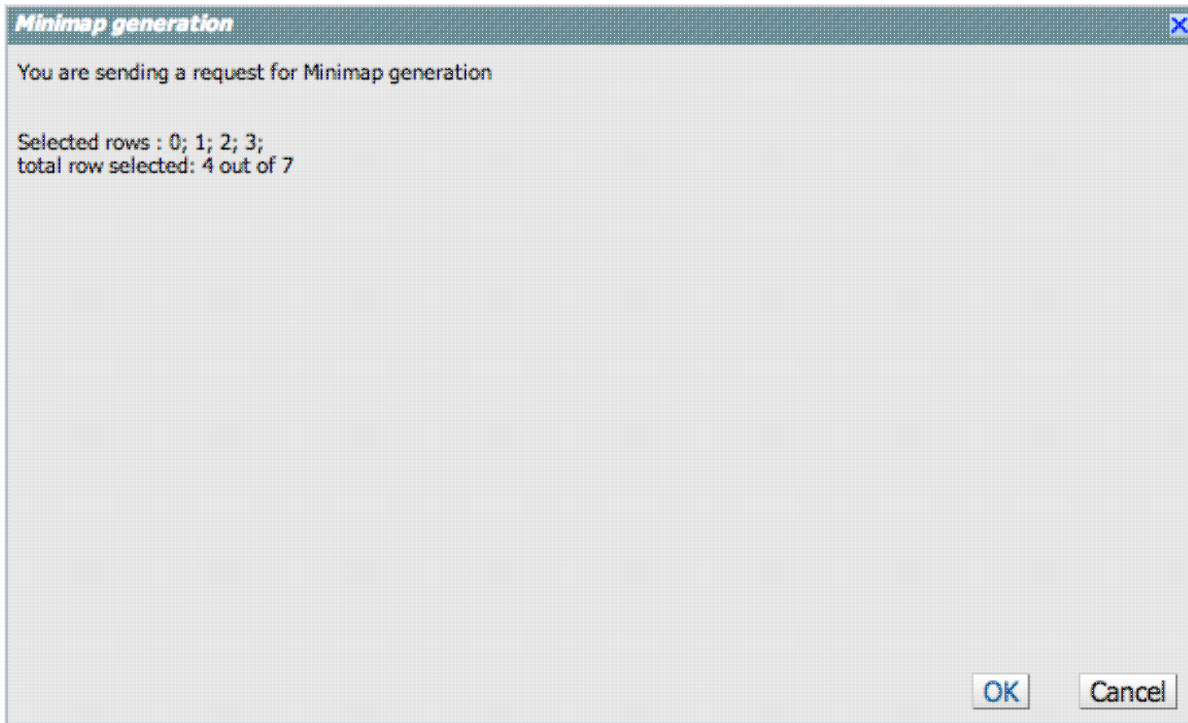
After processing, the resulting Minimap image is displayed in a new tab labeled 'Minimap', which you can interact with like any other image here (see the Visualization section).
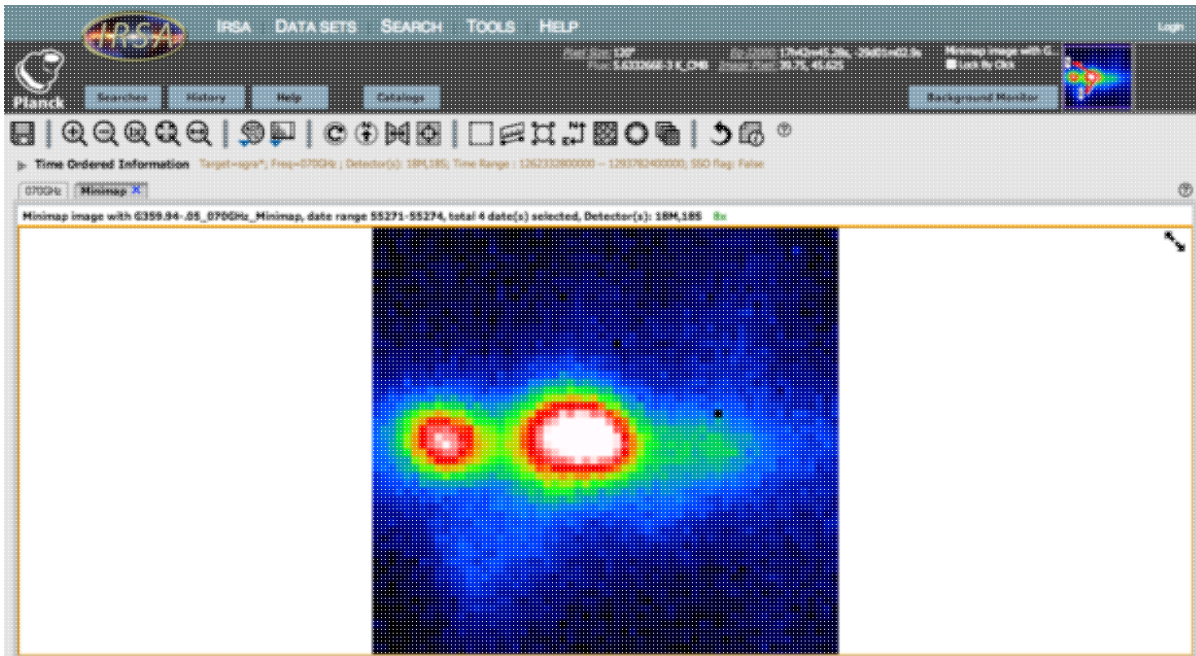
Your original search results are still accessible via a tab that is tagged by the Planck band, in our example '70 GHz'.

During the download dialog, you also have the option of rerunning Minimap again with a different selection of dates. If you do this, then this new map is the one that you will download, i.e., **not** the version displayed in the tab.

Images as part of your results

Once a search by wavelength ("browse catalogs") or by position ("cutout visualization") is complete, the lower portion of the NPA window is populated with three rows of images. The top row consists of Planck images from each frequency band, with frequency increasing from left to right. The next two rows are WMAP and IRAS, respectively. These images contain markers showing the positions of Planck catalog sources from the frequency range selected.

The cutout size is user-selectable betweeen 10 arcminutes and 2 degrees. These cutouts do not have the cosmic microwave background subtracted out. All Planck downloads will come with a set of Planck beams (one per frequency) that correspond to the HEALPIX pixel nearest to the search position.

All the images are FITS images, and can be manipulated using the tools described in the Visualization section. Downloading the images is described in the Downloads section.

(Note: For Early Release-based visualizations, these images appear as a grey background and contain a mosaic of JPEG images for all the Planck sources found within this zone. The mosaics are constructed from maps with a model for the cosmic microwave background subtracted. The individual "postage stamp" Planck JPEGs are each four times the beam FWHM on a side at 33 GHz. However, for each source, data is included only for a region corresponding to four times the beam FWHM at the corresponding frequency. Thus, those regions with data in the postage stamps will vary in size by a factor of 7 between 30 and 857 GHz.)

The Details Pane: Getting More Information on a Row In Your Search Results from the NASA Planck Archive

After you have searched the archive and explored some of the tabs in your search results, you may be interested in understanding the additional information that appears in the Details pane on the right side of your screen when a row in the table (for any tab) is highlighted.

The contents of the Details pane change according to which results tab you have in the foreground and which row you have selected. Here is an example:

From the tab, click on any row (note: no need to select the checkbox on the far left of the row). The row becomes highlighted in green. The details pane on the right side of the window changes accordingly.

The Details tab that appears can contain notes about the selected source. This typically gives association between a Planck source and a source detected in other catalogs, such as WMAP, GB6 or IRAS.

After a positional search, the top portion of your NPA window will, by default, contain tabs for each of the catalogs based on multi-frequency detection algorithms and one for each of the nine Planck frequency ranges in the release. You should make the browser wide enough to see all the different tabs in the result panel. You can also drag the blue triangles on the window pane boundary to adjust the widths of the panels.

Clicking each tab reveals the table of Planck sources for that catalog within the designated search zone. The images displayed in the lower portion of the NPA window will change depending on which source is selected. The selected source is highlighted in green in the table of search results.

You can find the full description of the columns present in the associated documentation:

- The PR2 contents are described in the PR2 Release Documentation ☑. The catalog contents are described in the journal articles linked there.
- The PR1 contents are described in the PR1 Explanatory Supplement ☑. The PCCS catalog contents are listed for the LFI and HFI (except for 857 GHz) bands ☑ and separately for the 857 GHz band ☑. The PR1 SZ Union catalog contents are listed here ☑.
- ERCSC Release catalogs in the ERCSC Explanatory Supplement ☑ You can also find most of the descriptions at 30,44,70 GHz Column Descriptions ☑.

There are some additional columns available:

clon, clat

       RA, DEC in sexigesimal

iras100_bg

       IRAS 100 micron background in MegaJy/sr

dist

       distance in arcsec between the input coordinate and the Planck source

angle

       position angle of separation in degrees East of North

Following the positional search, Planck images of the selected entry in the search results table will be displayed in the lower portion of the NPA window. The entry highlighted in green is centered in each wavelength image field of view. These images and their associated tools are described in the [Visualization](#) section.

Filtering -- Imposing additional filters to get the most out of your search results

In order to quickly sort through what information appears in the results tab and to examine the source you care about, *filters* are a very powerful tool. The filters work the same way whether working on search results from the main window or on catalog search results.

This icon represents a filter: Click on this icon in order to start the process of adding filters. A text entry box appears above each of the current table 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 after typing or click in another box to implement the filter. For fields with a limited set of choices, instead of a text entry box, a filter icon will appear; click on it to select from the available choices. As an example, to show only those sources with declination above a certain value (say, 31 degrees), type "> 31" in the box above the "dec" column. Or, if you have searched on a position and would like to view only the Planck sources with aperture flux densities greater than 1000.0 mJy, enter '> 1000' in the text box that appears above the 'aperflux' column.

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 table pane has changed to remind you that there has been a filter applied, in this case just one filter: . To clear the filters, click on the cancel filters icon (which also appears after you impose filters): .

Note that the filters are logically "AND"ed together -- it will impose this AND that AND this other restriction. You can relatively easily restrict things such that no data are left; if that is the case, you will get "There are no data to display." You can then cancel all the filters at once via the cancel filters icon (), or remove them individually by hand by editing the filter boxes at the top of each column, just as you did to impose the filters.

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 (such as "Bandpass") 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.

Note that each tab has its own, independent filter. If you want to see the objects with more than 3 observations in 30 GHz, 44 GHz, and 857 GHz, you'll need to apply the filter three different times. You can add additional filters to further restrict your list of sources.

For all-sky searches, you can impose filters from the initial search page. By clicking on "Set Column Selections and Filters", you get a popup that fundamentally works the same way:

From this interface, you can pick whether you want fewer columns (short form) or more columns (long form),

and then it presents you with the list of column names.

Near the bottom of the window is where you actually impose filters. Select your column name, your operator, and your value. Once you have these three things configured to your liking, be sure to hit the "<< Add" button to apply it. The box to the left of that button keeps track of all the constraints you apply -- to apply multiple filters, just keep adding filters for each parameter you want to constrain.

It's worth reiterating: applying filters either intially or after a search can result in no sources left -- because the filters are logically "AND"ed together -- it will impose this AND that AND this other restriction. You can relatively easily restrict things such that no data are left.

Searching the NASA Planck Archive (NPA)

There are basically three ways to search the NPA.

1. *TOI* (time ordered information). This option provides for adding individual measurements of sky intensity together.
2. *Browse catalogs*. This loads the entire catalog by frequency and you can browse through it (or filter it) interactively. In other words, this option searches a single wavelength, but all positions.
3. *Cutout visualization*. Search the multiple wavelength data by position. In other words, this option searches a single position, but all wavelengths.

The default when loading the tool is the TOI search; other searches can be accessed from the left hand side of the search window.

You must search each delivery separately; PR2 is the latest and most comprehensive, but PR1 and the ERCSC releases are also available.

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+[Cutout Visualization Search](#) -- Multiple Frequency Search by Position

Time Ordered Information (TOI) Search

TOI data consists of the measurements of the sky intensity obtained by the Planck spacecraft as it spun at 1 revolution per minute. Each measurement is tagged by the location on the sky that was pointed to, the time of the observation, and whether or not a solar system object was within the beam.

Planck TOIs can be selected for download as FITS binary tables and for display. The **TOI Search** page allows you to chose the TOIs you want by location, frequency, specific detectors, and (optionally) by a range of dates.

These TOI have been pre-extracted from the entire-mission [PLA files](#) ⬀. For ease of use, the data have already had offsets and per-detector monopoles applied, and all flagged data removed (except SSO [=Solar System Objects] if selected). Weights, calculated from the RIMO (=Reduced Instrument Model), are supplied in the header for correct combination of multiple detectors.

Here is an example TOI search. The output of this search can be sent to the Minimap tool. Minimap creates a 2D projection of the full map at the specified location, for more details please see [the Results page](#).

This search specifies a 2 degree square field centered on the Galactic Center which is bright and exhibits some structure at these frequencies. The query form requests a single object. We can enter the position or as an object name to be resolved via NED or Simbad. We enter the name of "Sgr A*" which is resolved by NED. We select a 2 degree square field.

The **SSO Flag** selection has two choices, where "SSO" means "Solar System Object." 'F' means we do not want TOI samples in which a bright Solar System object (the planets Mars, Jupiter, Saturn, Uranus, Neptune) was within the detector beam. 'All' means we do allow these data to be included.

The Planck band is specified via the **Select Frequency**. The band selection then populates the list of available detectors at that frequency. We choose '70 GHz' and the 18M and 19S detectors for this example.

In the **Optional Search Constraints** we set the start and end dates to '2010-01-1' and '2010-12-31', respectively, thus choosing only observations in calendar year 2010.

The results of this search continue in the <u>Results section</u>.

Browse Catalog Search -- Single Frequency Search (all-sky)

You may view any of the all-sky Planck catalogs including those based on the multi-frequency detection methods and for each frequency band. Another way of thinking of this is searching a single frequency, but all positions.

To access this search option, selet "Browse Single [...] Catalogs" for your desired release. Because it includes all of the mission data, PR2 is a good place to start if you have never done this before.

The catalogs in each of the data releases can be selected with the drop-down menu from the search page, an example of which is given below as a "callout" in the screen snapshot.

Content filtering on the all-sky catalog columns can be performed from this point in the process by clicking on the "Set Column Selections and Filters" link. This pops up a window in which you can select either the short or the long form for the catalog display (long form has more columns), select the individual columns to be displayed, and set constraints on individual column values (see Filtering for more information).

This search will return the rows of the catalog, selected by the input parameters, together with preview images. The results are displayed with the catalog and FITS cutout images. The table has many columns with positional, photometric, and size information about the source in question. See the section on search results.

Cutout Visualization Search -- Multiple Frequency Search by Position

You may search by position across all of the Planck catalogs. Another way of thinking of this is searching a single position, but across all frequencies.

To access this search option, selet "Multiple Frequency Cutout Visualization [...]" for your desired release. Because it includes all of the mission data, PR2 is a good place to start if you have never done this before.

This is a position search. For this search, you may enter target names, which will be automatically resolved into coordinates using NED or Simbad. Alternatively, you may enter coordinates directly. These coordinates can be in decimal degrees or in hh:mm:ss dd:mm:ss format. By default, it assumes you are working in J2000 coordinates; you can also specify galactic, ecliptic, or B1950 coordinates as follows:

- '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

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

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

After the position, you need to enter the size of the cutouts you want to see. **Caution:** 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.

Next, you need to select which maps you want, and how you want the Planck cutout image to be scaled.

Then, you tell it which catalogs you want it to search, and the search radius for those catalogs. Again, pick your units from the drop-down first, and then enter a number.

Click search to send it searching.

A multi-frequency (position) search will return the rows of the catalog, selected by the input parameters, together with preview images. The results are displayed in tabs, and each of these tabs correspond to the selected catalogs. Each of these tables has many columns with positional, photometric, and size information about the source in question. See the section on search results.

Note that, by default, these searches return a table of Planck sources, but the table is **not sorted by distance of a source from the submitted coordinate**. To do that, you must click on the column labeled "dist". The "dist" and the associated "angle" (for Position Angle) columns are appended to the catalog column list so are found at the far right. Scrolling is usually necessary to see these columns.

Downloading Data from the NASA Planck Archive (NPA)

This page is an overview of how to download data from the the NASA Planck Archive (NPA). There are basically three kinds of searches in the NPA. (1) TOI (Time Ordered Information); (2) Browse catalogs (single wavelength, all positions); (3) cutout visualization (single position, all wavelengths). (See the section on searching for more information on searching.) This page covers downloading data from those three kinds of searches.

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Overview

There are diskette icons (   ) in various places around the NPA. From the image toolbox, clicking on this saves the current image (as FITS, png with overlays, or just the overlays as a ds9 regions file). From a table, it saves the current table as an IPAC table file ⬂, which is basically ASCII.

If there are checkboxes and a "Prepare Download" button available, you can select multiple images or catalog rows using the checkboxes, and then click "Prepare Download" to initiate a download of the selected data plus related files. This packaging process is managed by the Background Monitor.

There are basically three kinds of searches in the NPA. (1) TOI (Time Ordered Information); (2) Browse catalogs (single wavelength, all positions); (3) cutout visualization (single position, all wavelengths). Downloading data is similar but not necessarily exactly the same in all the results, so we describe each separate (with screen snapshots) next.

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

TOIs

After a TOI search, you have the results, which is a list of the MJDs (modified Julian Dates) during which your source was observed by Planck, along with the number of TOI samples obtained on each day.

Each MJD's data can be individually selected for download or map generation by clicking on the box to the left of each entry. You can also select all available data by clicking in the box that appears on the column header (above all the checkboxes).

From this point, you can click on "Prepare Download", which brings up the "download options" box, as shown:

Within this, you can specify whether or not you want to download the search results in FITS binary table format and if you wish the associated Minimap image to be generated and included in the download. The TOIs and images you have requested are accessed and managed by the standard [Background Monitor](#).

If you generate a Minimap interactively, click on the diskette icon () in the image toolbox to save the image as FITS or PNG.

If you generate the Minimap separately, AND select Minimap in the download dialog box with a different selection of dates, then this new map is the one that you will download, i.e., **not** the version displayed in the tab.
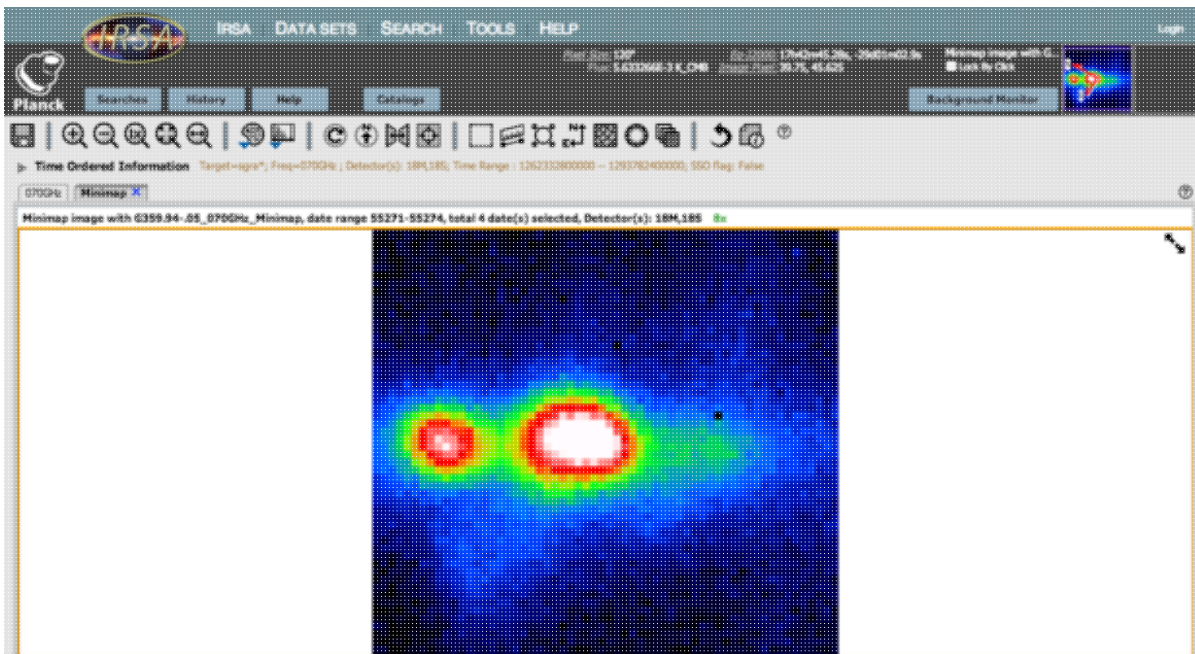
Notes:

- The combination of choosing 'No' for **Download TOI Data** and not selecting **Download TOI Minimap** results in a "No data available for download' Information pop-up window being displayed when you click on **Prepare Download**.
- The download is packaged as a zip file and you can select whether the **Zip File Structure** is 'Flattened (no folders)' or 'Structured (with folders)'.
- You can choose to be notified of the requested data being available via e-mail, which will inform you that when your packaging request has completed, and will include the URL for immediate download.

The FITS file returned from your search and download contains nine columns of data with one row per time-stamped observation. Here are the names and descriptions of each column.

- RA, DEC, GLON, GLAT: detector point direction given in degrees for both Equatorial (J2000) and Galactic coordinates.
- MJD: Planck on-board time (OBT) expressed as modified Julian date.
- SIGNAL: calibrated detector reading in K_CMB (for LFI bands) after removal of offsets.
- SSO: Solar system flag - set to 1 if a bright planet is in the beam.
- PSI: Roll angle in degrees.
- DETECTOR: The name of the detector from which the TOI sample was taken. See the Planck documentaiton for more details.

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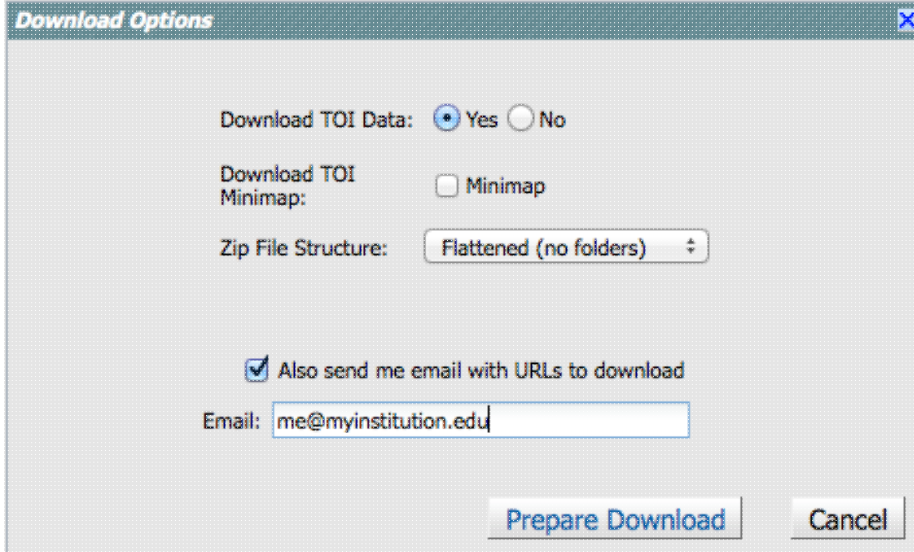
Browse Catalogs

After a "Browse Catalogs" search (search all positions, by wavelength), you have a catalog loaded that has checkboxes on the far left hand side.

To just save the catalog itself, click on the diskette icon (⊞) in the upper right of the table to save the table as an [IPAC table file] ⬀, which is basically ASCII.

To download additional data for each source, click the checkboxes on the far left side of each row to select individual sources, or click the box at the top of the column to download everything. Then click "Prepare Download." You obtain this dialog box:

from which you can select Planck, WMAP, and/or IRAS cutouts to download. (These are the cutouts shown at

the bottom of the search results.) You can choose to be notified of the requested data being available via e-mail, which will inform you that when your packaging request has completed, and will include the URL for immediate download.

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

Cutout Visualizations

After a "Cutout Visualizations" search (search all wavelengths, by position), you can have many tabs loaded, one per selected catalog, with cutouts at the bottom of the search results.

Each of those cutouts has a checkbox in the upper left of the cutout window. Select via those checkboxes which cutouts you wish to download, then click "Prepare Download." You obtain this dialog box:
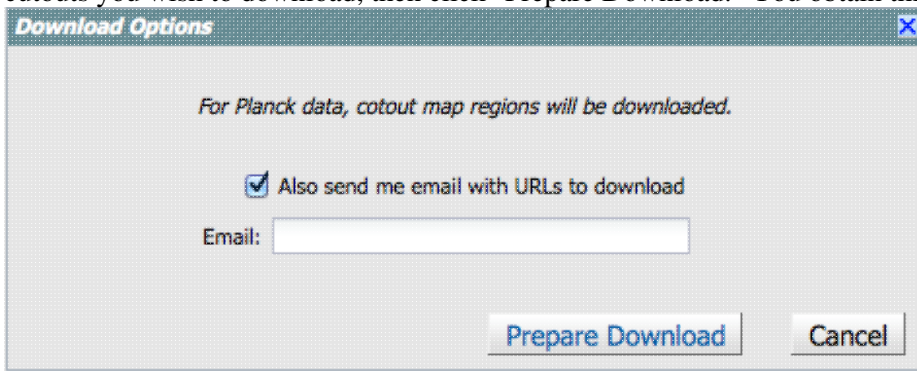
You can choose to be notified of the requested data being available via e-mail, which will inform you that when your packaging request has completed, and will include the URL for immediate download.

The download will contain the FITS files corresponding to your selected images. If only one is selected, the FITS file is downloaded directly; otherwise, the FITS files are combined into a zip file. Note that **you** control where the data are saved on your disk through your browser; your browser may be configured to store all downloads in a particular location on your disk.

To save just the catalog itself returned by the search, click on the diskette icon ( ) in the upper right of the table to save the table as an IPAC table file , which is basically ASCII. Note that you need to click on the diskette catalog in each tab separately.

Additional Catalogs

If you selected additional catalogs to overlay, each catalog will appear in its own tab. To save these catalogs,

click on the diskette icon ( ) in the upper right of the table to save the table as an IPAC table file , which is basically ASCII.

Note that you need to click on the diskette catalog in each tab separately.

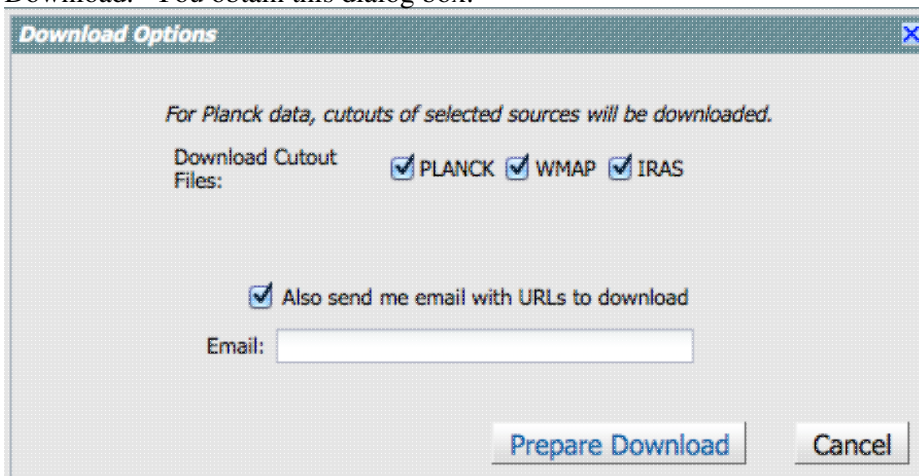Note also that **you** control where the data are saved on your disk through your browser; your browser may be configured to store all downloads in a particular location on your disk.

Background Monitor

The Background Monitor appears as a blue tab (or button) in the upper right of your window to keep track of the data downloads you have requested. Because it appears in the row of blue tabs at the top, more information about how the Background Monitor works is in the Basics section.

Using the Download Scripts

If you download a large amount of data, it may create more than one zip file for you. If it takes longer than a few minutes to package your data, ask the Background Monitor to email you when it completes packaging. Then the NPA will generate a script for you so you can download all of the zip files with a single click.

Links to several versions of the script are included in the notification email. You can choose from wget and curl, and you can choose to have it unzip the zip files at the same time as it downloads.

Generally speaking, the wget script is best for Linux and Unix users. The curl script is best for Mac users, because curl is part of the standard OS distribution; Mac users can also go retrieve and install wget ◻ and then use the wget scripts. For any of the scripts, you can also choose to include an option that unzips the zip files automatically. The files stay on disk here for at least 72 hours, so you have a window of time to download them.

Save the script to a plain text file, and invoke the script. You can copy and paste the script lines individually into your terminal window, or by typing "csh [yourtextfile]" at the prompt. The files will be automatically and sequentially downloaded to your disk, and if you've selected that option, unzipped as well.

For Windows users, download and save the text file of URLs . Then follow the following steps to install the wget script and then download your data:

1. Go to the Windows wget web page ◻
2. Scroll to the Download section and retrieve the wget installation.
3. Install wget and add the binary to your path.
4. Download the text file of URLs
5. At the command prompt: wget --content-disposition -i <file_of_urls_downloaded.txt>

Visualizing data in the NASA Planck Archive (NPA)

Nearly all of the images shown in the NPA are real FITS files, and you can interact with them as such. (The sole exception is the Planck ERCSC images, which really are JPGs. All the other images are really FITS.)

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Visualization Overview

Once a search is complete, the lower portion of the results page (the image display pane) is populated with rows of images. (See the results section for more details.)

Note that nearly all the images that are displayed are FITS files, not JPGs or PNGs, so you can interact with them using the tools described below. (The sole exception is ERCSC images from Planck, which really are JPGs. All the other images are really FITS.)

Basic FITS Viewer

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.

Interactive exploration of 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 top of the window with a variety of useful items. Some information is updated in real time (such as coordinates); some information (such as flux densities) is updated when you stop moving your mouse for a second or two. The image can be interactively investigated in this fashion.
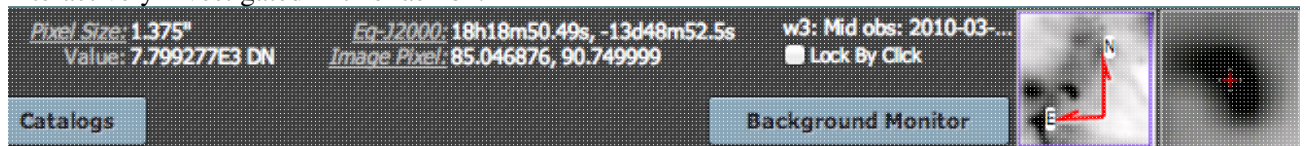
You can make it 'stick' on a particular place on the image -- tick the "Lock by click" box and then click on the image at your desired location.

The orientation of the image is given with a compass rose on the right, next to a zoomed-in view of the image under your cursor. If you can't see all of these two windows, enlarge your browser window slightly.

Finding out more about each image.

Each image indicates the its origin on the top of each image. Some of this information (like the title of the image) is also given in the interactive exploration region described immediately above. This region

also includes additional information about the image (such as the pixel scale and orientation).

Breaking the image out of the pane.
This icon will expand the corresponding visualization window into a larger window covering the results page. There is more on this below.

Visualization Tools -- Image Options

There is a toolbox along the top of the IRSA Viewer window:

from which you can select a variety of options, now described. 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 information is also dynamically updated just to the right of the toolbox itself.

Saving the image.
The diskette icon will allow you to save the current image as a FITS or PNG or Regions file to your local disk. 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.

Saved FITS images will not save the color stretches or overlays; it will just save the underlying FITS image. Saved PNG files WILL include any overlays or annotations you have placed on the image, but will not include the underlying FITS image. Saved regions files will not save the underlying image, but will just save the overlays as a DS9 Regions file. See the DS9 website ⬚ for more information on the syntax of these DS9 region files.

Note that you can save the original or a cropped version of the FITS file; see the select region icon below to crop, and then save the FITS image.

Note also that if you overlay a catalog consisting of tens of thousands of sources, to save bandwidth, what is overlaid on your image at some locations may be a larger symbol representative of several sources at that location; if you save a regions file from the catalog overlay, then you will have fewer sources in the regions file than you have in the full catalog.

Selecting a new image
Depending on what you're looking at, you may or may not have this icon. By selecting this icon, you can change which images are used for each color plane, or for the background.

Zooming in or out.
Clicking on these magnifying glass icons zooms in or out of the image. The readout of how many times you are zoomed appears at the top of the visualization window.

If you click zoom in or out rapidly, a pop-up window appears to allow you to more rapidly select the zoom level you want. Select the desired level, or click on the blue 'x' in the upper right to make the window go away. Here is an example:
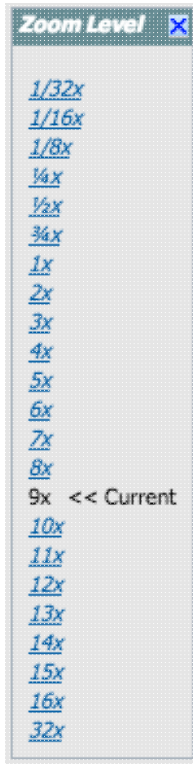
Note that there is a maximum (or minimum) allowed zoom level. A notification will appear when you have reached the maximum (or minimum) allowed zoom level for a given image. To enlarge things more than that, please repeat your search to obtain new images with smaller (or larger) spatial extent.

 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.

 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. 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.

 Changing the color table.

This icon enables you to change the color table of the displayed image. When you click the button, a drop-down menu appears with a wide variety of color table choices.Select your new color table from the options shown:

For the IRAS and WMAP cutouts, by default we use the color table "For false color", 5th from the top in color tables. Here is the detailed explanation of that default color table: Starting with black, fade up in blue to index 68. At index 17 start to fade in green along with the blue. At index 68 continue fading up the green while fading the blue down. At index 102 start fading in red while continuing to fade out blue. Continue to fade up red until index 187 - at this point, green is almost gone and blue is completely gone. At index 204 it is red only. From index 204 fade in both green and blue until all three colors are on full at index 255.

Changing the color table stretch.

This icon enables you to change the color table 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.
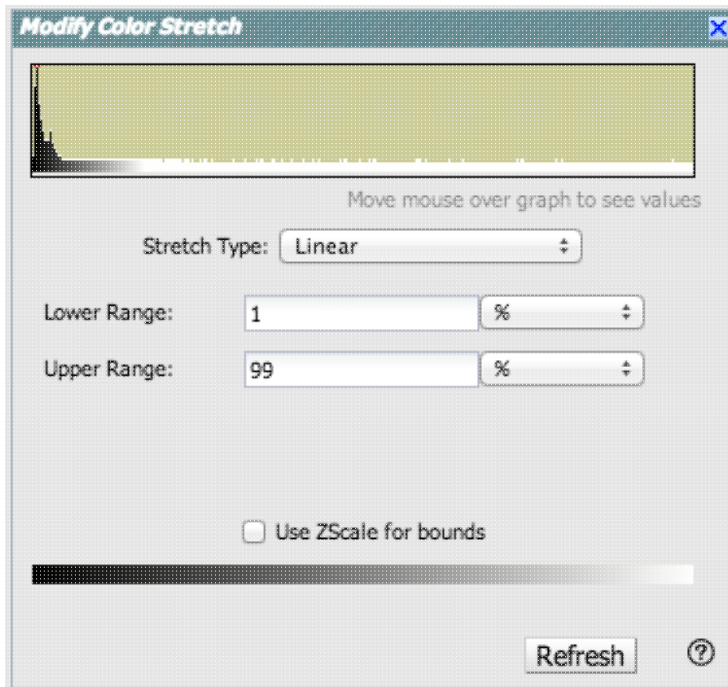
If you pick a color stretch from the pre-defined options, the pop-up window reflects this change. (Ex: pick 'Linear stretch to 99%'. Go back to "color stretch". Note that it has filled out the stretch type and ranges to reflect the current choice. Then -- either with the pop-up window still up or not -- 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.)

Rotating the image to any angle

This feature allows you to rotate the image to any angle of your choice, in degrees. It will rotate the image counter-clockwise (to the left) from the current view, not necessarily the original image. For example, entering "45" in the rotation pop-up and hitting "rotate" will rotate the image 45 degrees counter-clockwise relative to its original orientation. Then selecting the icon again, and entering "180" in the pop-up (followed by hitting "rotate") will rotate the image an additional 180 degrees counter-clockwise. To exit the pop-up without making further changes, hit the blue 'x' in the upper right of the pop-up.

Rotating the image so that North is up.

Images retrieved from FinderChart are commonly already oriented such that North is up, or close to it. However, when interactively investigating images, or in certain situations, 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.

Re-center the image.

Clicking this icon will re-center the image on the center of the last query, or on the center of the image.
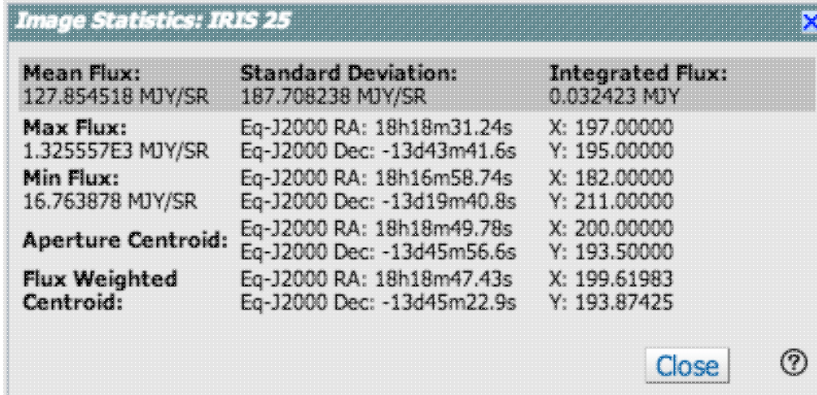
Selecting a region.

When you click this icon, at first, nothing seems to happen. (There is a notice with brief instructions that appears on the lower left of your browser window.) You can now click and drag in the image,

selecting a box on the image. This box can be resized by grabbing and dragging the corners of the box. You can make a new box right away by holding down the shift key and clicking and dragging to select a new box. When you have selected a region of the image, additional icons appear above the image:
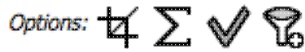
Options: ⊞ Σ ✓ ⏳   These icons will allow you to (from left to right) crop the image to the selected region, obtain statistics on the region, select the catalog sources overlaid on the image within the region, or filter the overlaid catalog down to the enclosed sources. (The last two options will only appear if you have a catalog overlaid.) You can save the cropped FITS image via the save icon (described above). The statistics option results in a pop-up that looks something like this:

Image Statistics: IRIS 25		
Mean Flux: 127.854518 MJY/SR	**Standard Deviation:** 187.708238 MJY/SR	**Integrated Flux:** 0.032423 MJY
Max Flux: 1.325557E3 MJY/SR	Eq-J2000 RA: 18h18m31.24s Eq-J2000 Dec: -13d43m41.6s	X: 197.00000 Y: 195.00000
Min Flux: 16.763878 MJY/SR	Eq-J2000 RA: 18h16m58.74s Eq-J2000 Dec: -13d19m40.8s	X: 182.00000 Y: 211.00000
Aperture Centroid:	Eq-J2000 RA: 18h18m49.78s Eq-J2000 Dec: -13d45m56.6s	X: 200.00000 Y: 193.50000
Flux Weighted Centroid:	Eq-J2000 RA: 18h18m47.43s Eq-J2000 Dec: -13d45m22.9s	X: 199.61983 Y: 193.87425

Close ⑦

Selecting sources highlights them in the catalog list. When you impose a filter, the filters icon changes

above the catalog to indicate that there is a filter applied (in this case just one filter: ⏳①). To clear the

filters, click on the cancel filters icon (which also appears after you impose filters): ⊘ .

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.

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

Add Marker

Add HST footprint

Add JWST/FGS prelim. footprint

Add JWST/MIRI prelim. footprint

Add JWST/NIRCAM prelim. footprint

Add JWST/NIRSPEC prelim. footprint

Add JWST/NIS prelim. footprint

Add JWST prelim. footprint

Add WFIRST prelim. footprint

The first overlay choice (simply called 'marker') is a red circle. Initially, it appears in the center of the
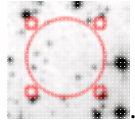
images, and is meant to be moved to wherever you first click in the image. It looks like this: ![circle marker]. The small circles in the four corners are "handles" -- you can grab the handles to resize the circle. You can also drag it to any location in the image. You can change the color of the marker (and add a label to it) 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](#).

Show the directions of North and East

When you click this icon, arrows appear on the image showing which direction is North and which is East.

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).

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 blue 'x' in the upper right of the pop-up.

Viewing/changing the layers on the image.

If you've been following along by trying these various options, you now have an image with a lot of annotations on it. The number that appears in blue over the layers icon tells you at any given time how many layers you have on the currently selected image. If you click this icon, you will get a pop-up window with a list of all the layers you have on top of the image. From the pop-up, you can turn layers off and on, at minimum, but you can often also change exactly what is displayed and what colors get used for it. To add new things, you need to go to other options within the toolbar. Here is an example of a well-populated layers pop-up.
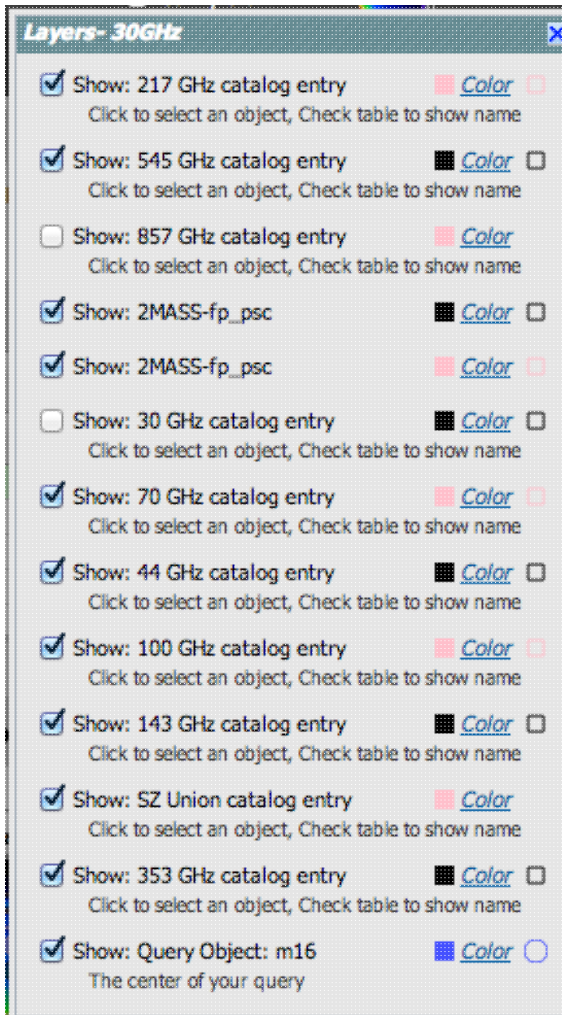
To change colors of a layer, click on the 'colors' link to be taken to a new pop-up from which you can select a new color. To delete a layer, click on 'delete'. Some layers appear do not have that option; to remove that layer, click on the corresponding icon from which you added that feature. To make this pop-up window go away, click on the blue 'x' in the upper right of the pop-up.

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 described above.

Lock/unlock images

For the NPA interface, since you get by default several multi-wavelength views of the same source, this tool has "lock images" turned on by default. In other words, all the images that you have loaded are linked together for zooming, scrolling, etc. You can click on this icon to turn off this linkage among the images, enabling you to zoom/rescale/etc. images on an individual basis. Click it again to re-enable it. This option is discussed in more detail in the WCS section below.
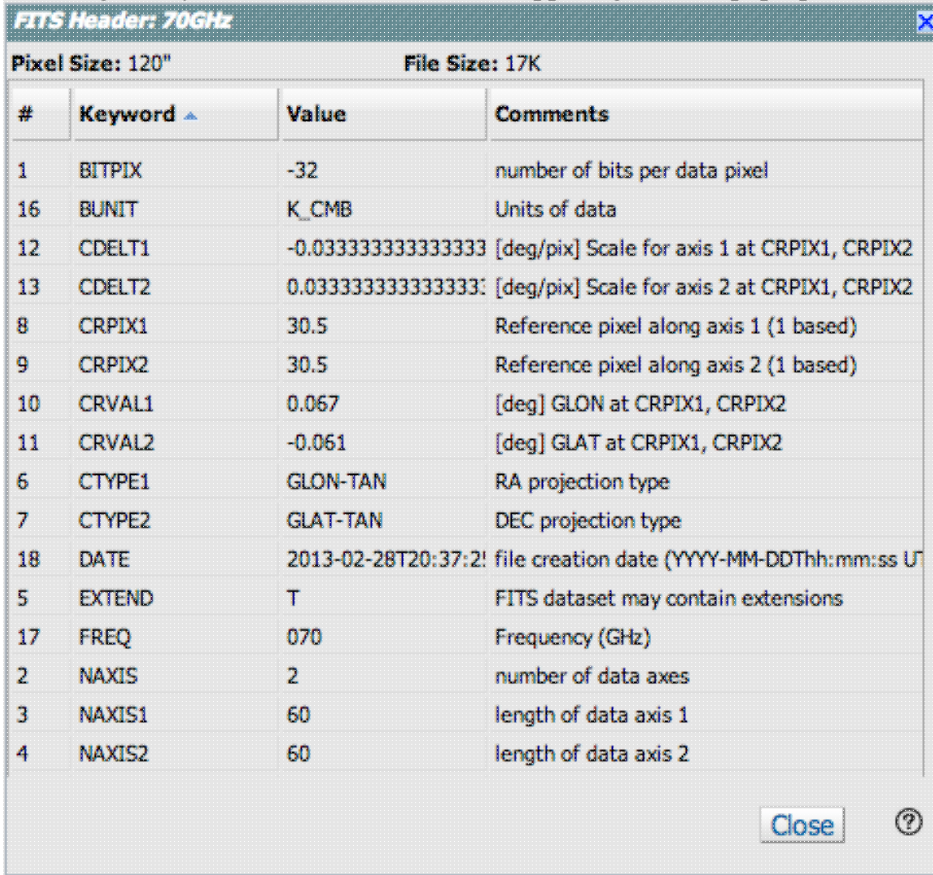
Viewing the FITS header.

This icon will display a pop-up window with the FITS header of the background image. If you click on the columns of the FITS header 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. Here is an example of a sorted FITS header. Note that the first column is the original order of the keywords. To

make it go away, click on the blue 'x' in the upper right of the pop-up.

Getting help.

Clicking on this icon takes you to this help page.

Footprints

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

We now describe these options 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 large circle surrounded by 4 small circles located at the edge of the large circle. 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, and they are in the same color as the marker itself.

From this marker icon drop-down, by default, it comes up with each option as "show". When you select that option, the marker appears in the layers pop-up (described above), from which you can hide/show the marker, or change its color. Note that after you add a marker, the drop-down menu here changes for that marker menu option to be "hide all" in front of that marker menu option. You can add multiple copies of the same marker using the layers pop-up (described generally above). You can also add a label to the marker from the layers pop-up.
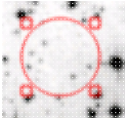
 The first overlay choice (simply called 'marker') is a red circle.

The remaining markers are all footprints from other space-based telescopes: HST, JWST, and Nancy Grace Roman Space Telescope (WFIRST). These footprints are derived from information provided via MAST (see http://gsss.stsci.edu/webservices/footprints/help.html ⬚.) For JWST and Roman in particular, they are pre-launch values.
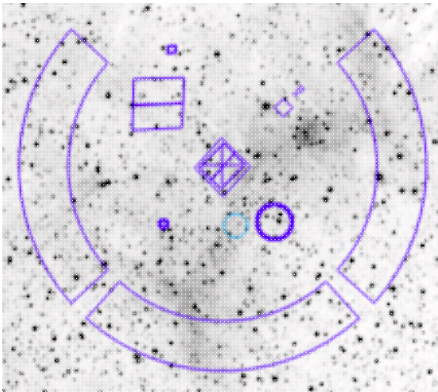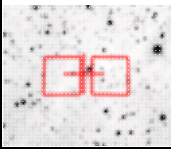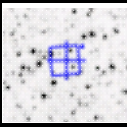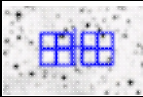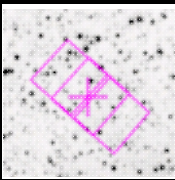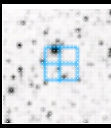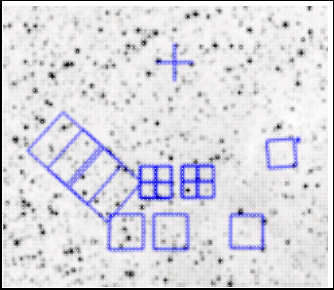
 HST focal plane footprint. Consult the HST documentation ⬚ for specifics on which apertures are which. The footprint can be moved or rotated. Click and drag the center of the footprint. A circle appears with four small circles ("handles") around it. Grab and drag the small circles to rotate it, or drag 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 footprint from the layers pop-up:
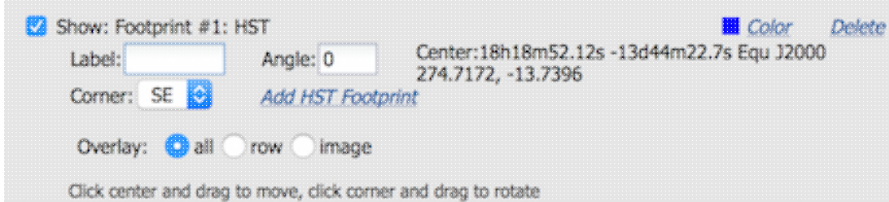
JWST focal plane footprints.

JWST Footprint	Description

JWST Footprint	Description
	JWST FGS Preliminary footprint
	JWST MIRI Preliminary footprint
	JWST NIRCAM Preliminary footprint
	JWST NIRSPEC Preliminary footprint
	JWST NIS Preliminary footprint
	JWST entire Preliminary footprint (cross is boresight)

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 footprints, especially 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, one example of which is given here:
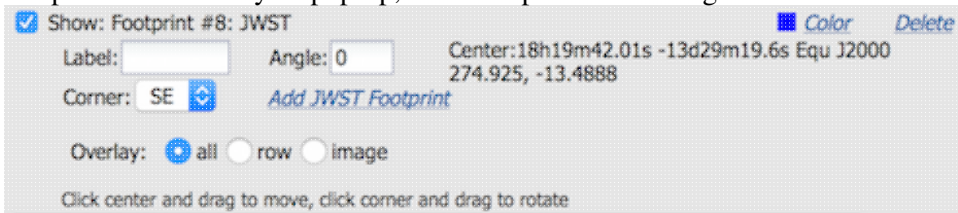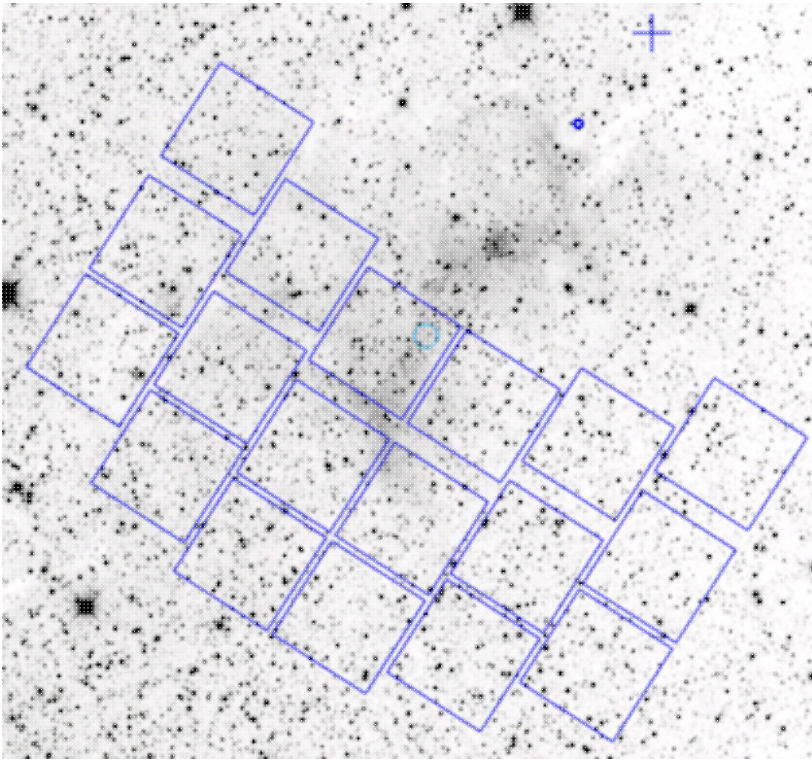
Nancy Grace Roman Space Telescope (WFIRST) focal plane footprint. As above, the footprint can be moved or rotated. Click and drag the boresight (the cross hairs), which appears by default to the upper right of the array of squares. A circle appears, centered on the boresight, with four small circles ("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:
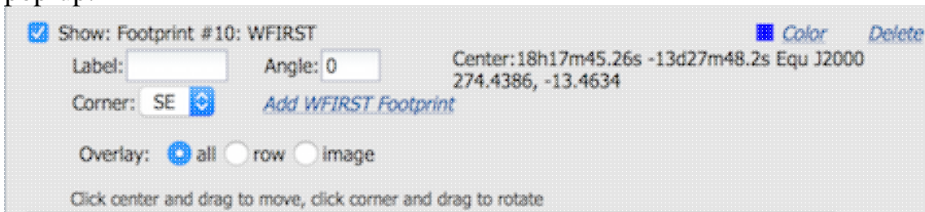
Breaking out of the pane (and going back)

By default in the NPA, the search results are broken up into panes. For some purposes, it is useful to view the images (or the table) as large as possible. On the upper right of either the image pane (or the table pane), there is an expand icon ⬉. Clicking on it will expand the images (or table) into a larger window, with the selected image appearing first. From this view (with the images), you now have some additional options that appear near the top of the new window.
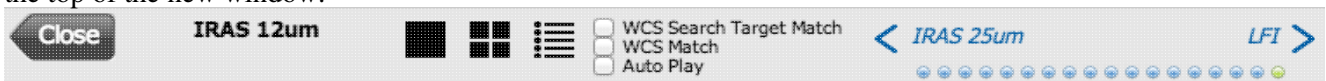
The large "Close" arrow at the left enables you to return back to the pane view. This arrow is always available in these expanded views.

Next, the currently displayed band (sometimes using abbreviations) and magnification factor is shown. Zoom in or out using the visualization toolbox described above.
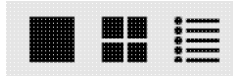
Next, there is a cluster of icons that portray (in icon form) the different views you can have of the images you have loaded. The first icon (the big square) denotes "show one image at a time." The second icon (the cluster of four squares) denotes "show smaller images of all the images I have loaded, but still take up the whole browser window with the set" (as opposed to going back to the window panes). Depending on what you have been doing in your session to this point, you may have more than one image loaded, plus a plot from the catalog. Perhaps you wish to see, e.g., just two of the images tiled? Click on the last, blue "list" icon in this cluster to bring up a pop-up window:
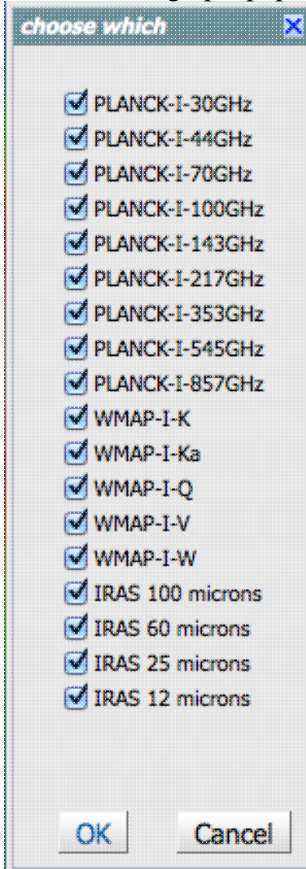
This popup window lists all of the images you have loaded, and if you uncheck the corresponding box, that image, while it is still loaded, will not be shown if you, say, scroll through the images, or look at them in tiled mode. **Note that** the images are in the order in which they were loaded into the tool, not in wavelength (or frequency) order.

To remove an image (or catalog or plot) entirely, click on the small blue 'x' in the upper right of the image in the tiled view, or on the small blue 'x' in the corner of the image (or catalog) tab in the window pane view.

The next portion of the window has some WCS (world coordinate system)-related options that will be discussed below.

Finally, on the right hand side, the arrows, labels, and green/blue dots (which only appear when you are viewing one image at a time) allow you to navigate through your set of images. The green dot inamongst the blue dots indicates where you are in the sequence of images, and the arrows and labels indicate which image is before or

after the currently viewed image. Click on the arrows or the dots to move around in the sequence.

World Coordinate System (WCS) Alignment

Locking/Unlocking images and the default window pane view
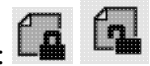
Near the right hand side of the image toolbar, there is an icon that looks like either of the following:
When you have images loaded into the NPA tool, they are probably of the same portion of sky. This icon reflects the current status of the images. Click on the unlocked icon to change it to unlock the images (whereupon the icon changes, so you can then click on the unlocked icon to unlock the images). When the images are locked together, if you make changes to one of the images, such as zooming in or changing the color table, the changes are made to all of the images shown. If you don't want this to happen, if you want to make changes to just one image at a time all by itself, unlock the images. Click it again to lock the images again.

Default Atlas tile view

Whenever viewing Atlas tiles (or pieces thereof), North is always up. (When viewing individual exposures, however, North may not be up.) You may want the WCS options we are describing here in order to align them. Read on!

Expanded view

In the expanded view ("broken out of the pane"), you have up to three checkboxes that may appear as viable
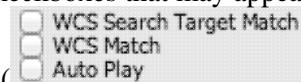
options: "WCS Search Target Match", "WCS Match", and "Auto Play." ( ) However, since the default Atlas tile view has North up, these WCS options may only make sense (e.g., seem to affect the displayed images in any sensible way) in certain circumstances.

WCS Search Target Match
> This box is available whether you are looking in single frame or tiled frame view. Clicking on this box will align all of the displayed images to be centered on the target on which you searched (inertial or moving, indicated by the blue circle), with north up, and zoomed such that the images fit in the available window, and aligned so that each image has the same angular scale. In essence, this is a one-click way of doing the following: ensuring the images are locked via the "lock" icon, clicking on the "rotate North up" icon, clicking on the "zoom to fit" icon, and clicking on the "center on search target." This is particularly useful if you are looking for changes between multiple images of the same target, or following a moving target as it moves across multiple images.

WCS Match
> This box is available whether you are looking in single frame or tiled frame view. The effects of clicking this box is similar to the prior "WCS Search Target Match" option, except that it aligns each image to the orientation, zoom, etc., of the image you have selected. (In tiled view, an image is selected by clicking on that image, and, once it is selected, the tile is outlined in orange. In single-frame view, the image you are looking at is the selected image.)

Auto Play
> This box is only available in single frame view. This option blinks through all of the images you have loaded (and aligned). You may find that you have 'extra' images loaded, beyond what you wanted to blink. To remove those from the blink sequence, stop the blinking by unchecking the "Auto Play" box, click on the list icon immediately to the left of the checkboxes, which brings up a "Choose which"

pop-up. Uncheck the images you don't want to show, click on "ok", and then go back and check the "Auto Play" box to blink the remaining images. (See above for more details on this process.) Once it loads and blinks through all the images at least once, it holds the images on the screen for 1 second before showing the next image.

Note that the WCS options are "sticky", which means that if you click one, and then unclick it a few seconds later, it doesn't automatically "undo" the changes it made; to "undo" it, you either have to redo your search entirely, or click the "return to defaults" icon in the toolbox.

Note also that, even though these WCS options appear when you are looking at expanded views of the Atlas tiles, their effect seems to be minimal, at least in part because the cutouts of the Atlas tiles, made as per your search constraints, are already north-up and centered on your target.

To remove an image (or catalog) entirely, click on the small blue 'x' in the upper right of the image in the tiled view, or on the small blue 'x' in the corner of the image (or catalog) tab in the window pane view.

NASA Planck Archive (NPA): Catalogs

(Note that catalogs are available via a blue tab that appears at the top of the page only after you have performed at least one search -- you need to have something on which to overlay the catalog before it will let you search.)

You can choose from any of a wide variety of catalogs for overlaying on your [visualized data](#).

Contents of page/chapter:
+[Overview](#)
+[Catalogs from IRSA](#) -- Overlaying catalogs from IRSA
+[Catalogs from disk](#) -- Overlaying your own catalogs
+[Catalogs from VO](#) -- Overlaying catalogs obtained via the VO
+[Columns and Filters](#) -- Interacting with catalogs
+[Plotting catalogs](#)

Catalogs -- Overview

Once you have conducted a search and have some displayed images, you can perform a catalog search, which will (among other things) overplot those catalog sources on all the images shown. Catalogs are available via a blue tab that appears at the top of the page only after you have performed at least one search -- in essence, you need to have something on which to overlay the catalog before it will let you search.

Depending on how, exactly, you searched the NPA, you may already have catalogs returned by your search and overlaid on your images.

By default, it assumes you want to perform a catalog search that covers the same region as your currently selected target, and attempts to pre-fill the form with that region -- but you can choose to change those search criteria. You can choose from any of a number of catalogs, including but not limited to Planck catalogs. You can also upload your own catalogs.

The catalog will be overlaid on the images in the coverage pane as well as all of the channels shown in the image display pane. The highlighted source will change depending on which source is selected in the catalog tab in the results pane. When overlaying the sources from a catalog search, note that *all* the sources are shown.

Catalogs from IRSA
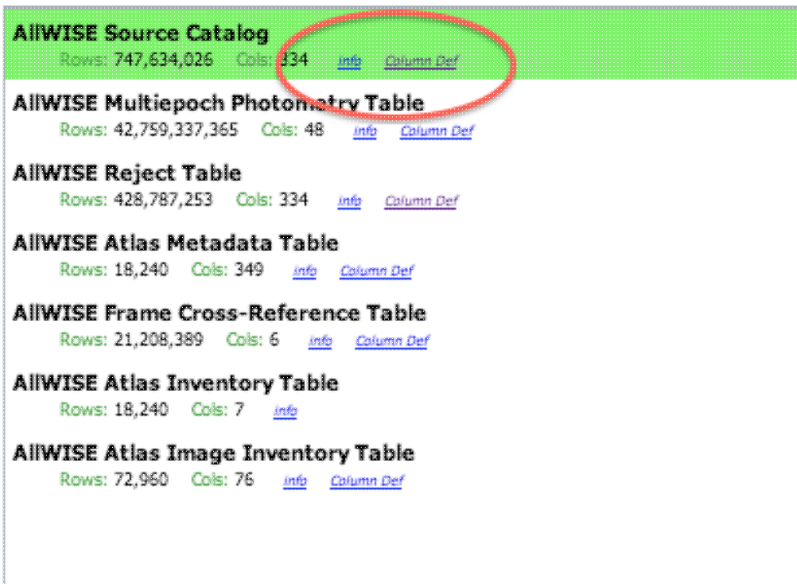
By clicking on the "Catalog" tab (which also looks like a button), a window appears with several options, as follows.

By default, the catalog search page appears with a cone search approximating your prior search. You can customize the search for options beyond a polygon search (e.g., a cone search) by selecting from the "Search Method" drop-down. The entry box immediately to the right of that "Search Method" drop-down changes accordingly, and you can edit the parameters directly. If you choose a 'cone' search, you can also change the target by clicking on "Modify Target" next to the target center that appears. **Caution**: 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.

You then need to specify the catalog you want to search. In order to help it give you a specific list of choices, you need to first tell it the project and category. After you have selected these items, on the right, you can pick the specific catalog . To change catalogs, first select the "project" under which they are housed at IRSA, such as 2MASS, IRAS, WISE, MSX, etc. The options under the "category" and the specific clickable catalog on the right 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 of this link for more information is here:

You can also set restrictions on specific columns by clicking on "Set Column Restrictions" on the left hand side, under the "category" selection drop-down menu. A new window will open up with the available column names in the corresponding catalog, and you can choose what to display, and filter what is returned (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.

Power user tip: By default, this interface may show you fewer columns than are available in the full catalog. By clicking on "Set Column Restrictions" and selecting "long form" from the drop-down at the top of the pop-up window ("Please select long or short form display"), you can access the full range of available columns. In some cases, there are literally hundreds of columns that you can access!

Click on "Search" to initiate the search. It will load the catalog into a tab of its own. The catalog objects will also be overlaid on the images you have loaded. You can obtain a full-screen view of your catalog -- click on the expand icon in the upper right of the window pane when your mouse is in the window: . You can also make an x-y plot from the catalog (for more on the x-y plots, see below). The images and the catalog representations are interlinked -- clicking on a row in the table shows it on the images and vice versa.

To close the catalog search window without searching on a catalog, click on "Close" in the upper left.

On the speed of the catalog results...
    If the catalog search is successful quickly, it will promptly return the results in a tab of its own.

NOTE THAT 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 either spin off to the background monitor (from which you can load it into a tab), or return a tab directly.

Searches that take longer than a few seconds get spun off to the background monitor. If it does spin off to the background monitor, it will dynamically update to reflect its status, and will let you know when the catalog is ready to download or display. A popup appears asking if you want to load the catalog. Either click on the popup or explicitly open the background monitor and click on the catalog name to load it into a tab of its own.

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 millions of rows will take quite a while.

Note that if you overlay a catalog consisting of tens of thousands of sources, to save bandwidth, what is overlaid on your image at some locations may be a larger symbol representative of several sources at that location; if you then save a regions file from the catalog overlay, then you will end up with fewer sources in the regions file than you have in the full catalog.

Loading your own catalogs

By clicking on the blue "Catalogs" tab, you are by default dropped into the interface for searching for catalogs at IRSA. However, you can pick another tab from the top left of the catalogs screen, "Load Catalog", to load your own catalog.

Your catalog needs to be in IPAC table format ⬀, which is a varietal of plain text. IRSA has a table validator ⬀ which may be helpful, or you can download just about any catalog you find through IRSA, and copy that format.

Your table file MUST have RA and Dec values, and unless it is specified, it assumes J2000.

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.

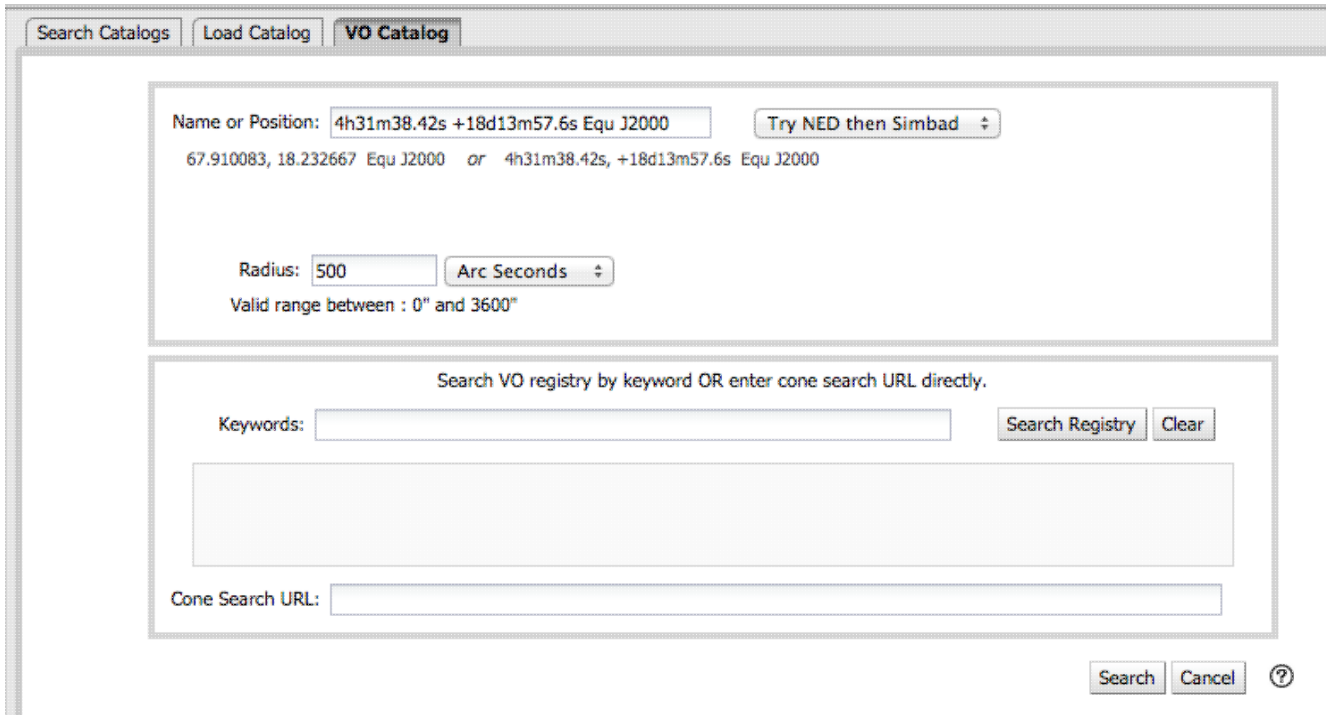Your catalog is then shown (and interacted with) in the same way as the other catalogs described here.

Catalogs from the VO -- Overlaying catalogs obtained via the VO

(VO= Virtual Observatory ⬀.)

By clicking on the blue "Catalogs" tab, you are by default dropped into the interface for searching for catalogs at IRSA. However, you can pick another tab from the top left, "VO Catalog", to search for and load catalogs from the VO.

As for the IRSA catalog search, the tool pre-fills the target position with the coordinates of the target with which you have been working. In this case, you are limited to a cone search, so the next option is the cone search radius. As usual, 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.

If you know your VO URL already, you can jump down to the Cone Search URL box and type or paste your URL into the box and hit search.

More commonly, however, users do not know *a priori* which URL to use. Type your desired keywords into the keywords box and click on "Search Registry". All of the URLs it finds for your keywords within the VO registry service are shown in the box. Locate the one you want to use, and click on "Use" on the far left of the corresponding row. The "Cone Search URL" is populated properly for that catalog. Click on "Search" to initiate the search.

The search results are then shown (and interacted with) in the same way as the other catalogs described here.

Example

Load the tool. Search on IC1396. Go to the catalogs tab. Choose "VO Catalog." It wants the root URL for a cone search. I click on "Find Astronomical Data Resources", which takes me here ⬏. Search on IPHAS. Get this page ⬏. Look for the complete catalog release (not just one associated with one specific study). The name of the catalog goes here ⬏. Hit the [+] to expand it. There is one URL listed there, under "available endpoints

for the standard interface." Copy that URL and paste it into the search form. The IRSA tool will append your coordinates and radius and return you a table.

Tips and Troubleshooting

Note that searching the VO means that you are using resources not specifically housed at IRSA, so servers may be down, or timeouts set, or limits on numbers of returned sources, etc., that are beyond our control. In most cases the solution is to specify as precise a search as possible. Here are the links to VO registries that we are using, just in case you want to do more flexible searches of the registry. The URL you enter into the box in FinderChart, though, must be a Cone Search base URL (not containing RA and Dec parameters, which are inserted into the URL by FinderChart in response to the search parameters you give it).
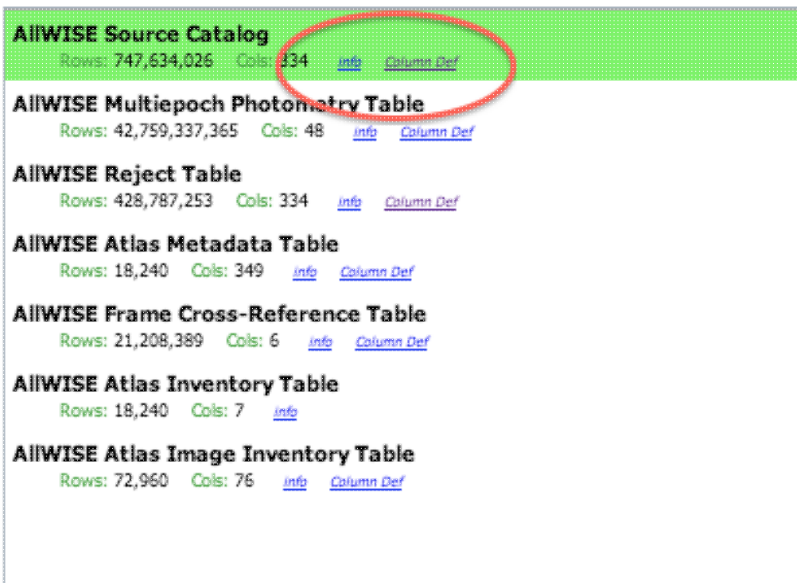
The master list of registries is <u>here</u> ⬚. You can also search the registries directly via that link (as opposed to via the IRSA tools).

Columns and filters -- Interacting with catalogs

After you have loaded a catalog, it appears as an additional tab in the left-hand-side search results pane. Additional catalogs you load appear as additional tabs in this window pane. To see more of the columns, grab the divider between the two window panes and slide it right to widen the pane.

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 the catalog searching popup window, see figure below, or by navigating through the IRSA website.)

The tab (and table) name itself is the name of the catalog file as stored on the system at IRSA; it is a little cryptic, but the first few words should make it clear whether it is WISE, 2MASS, etc. To remove the tab, click on the blue "X".

Immediately below the tab name, there are several icons, just like in in the main search results. See table navigation in the Results section for details on what these icons do. You can also interactively impose filters from plots you make from the catalog - see the next section.

Plotting catalogs

You can plot your catalog after it has loaded. The plots are another view of the catalog; by default, the catalog comes up in 'table' view, and you can swap back and forth between the 'table' and 'plot' view. After you have loaded a catalog, these icons appear in the upper right, just above the image results pane:

The first one is table view, and the second is plot view. The current view is boxed in green. Click on the icon to change views. If you do not see this icon, make sure that a catalog tab is in the foreground of the target list pane. To see more of the catalog while still viewing images, click and drag the slider between the panes to enlarge the plot window pane.

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.

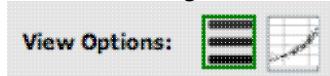The plotting tool, by default, starts with RA and Dec plotted. Note that it does so strictly mathematically correctly -- that is, RA increases to the right (the reverse of astronomical convention). To change what is plotted, click on the gears icon in the upper left of the plot window: . Configuration options then appear to the left of the plot. You can choose a single column to plot against another column -- if you have loaded a WISE catalog, you could plot w1snr vs. w1mpro. You can start typing a column name into the X and Y boxes, and it will help provide you viable options from the column headings. Alternatively, you can click on the "Cols" link to bring up a pop-up window with all the columns for that catalog listed. NOTE THAT you must type in the column name *exactly matching* the column headings as displayed. By default, it echoes the x and y labels and units from the original table, but you can change this by clicking on the triangles below each entry box (e.g., make the label "SNR in WISE-1" rather than the more cryptic column header "w1snr").

You can also do simple mathematical manipulations. For example, if you have loaded a WISE catalog, you can plot w1mpro vs. w1mpro-w4mpro. However, note that as of this version, the axes are from min to max in the strict mathematical definition of the term, so in this example, the fainter W1 objects are at the top of the plot. As a workaround for this, plot -w1mpro vs. w1mpro-w4mpro to get the axes aligned in the way you are expecting such that brighter objects are at the top of the plot.
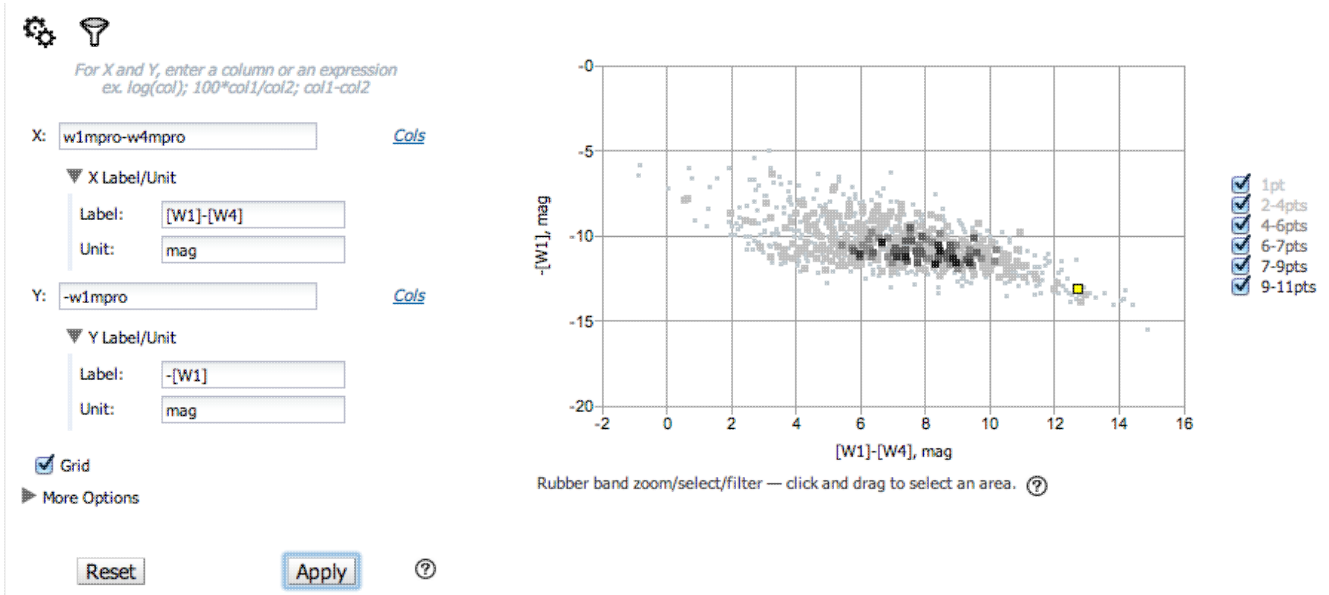
Note that the plot symbols are shades of grey corresponding to how many points are represented at that location in the plot. The lightest shade of grey (and smallest points) represent one point in the plot at that location, and the darkest shades of grey (and the largest points) represent many more points in the plot at that location. Put your mouse over any of the points to find out more about what is represented at that location.

You can add or remove the gridlines via the "Grid" checkbox. If you have zoomed in enough such that there are just black boxes -- one object per point -- you can change the plot style such that the points are connected or unconnected.

You can also **restrict what data are plotted** in any of several different ways. You can set limits based on the "more options" (click on the triangle next to "more options") on the lower left of the plotting window pane, or you can use a rubber band zoom, as follows. Click and drag in a sub-region of the plot. The icons in the upper right of the plot change corresponding to what you can do, in this case to these: . They are, from left to right: zoom in on the region you have selected, select the objects in the catalog, filter the catalog to leave only those objects, or expand the plot to take up the whole browser screen. If you click on the zoom icon, then the plot axes change to encompass just the sources you have selected. If you click on the select icon, then the plot symbols corresponding to your selection change shape and color, the corresponding objects overplotted on the image in the image window pane change color, and (if you change back to the table view of the catalog), the rows (corresponding to those sources) in the catalog are highlighted. If you click on the filter icon, then the catalog view is filtered down, restricted to just those sources you have selected, and the filter notes in the upper left of the plot window (and in the table view of the catalog) change to remind you that you have a filter applied. Only those sources that pass the filter are shown 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 objects.) For more on filters, see the filter section.

If you move your mouse over any of the points, you will get a pop-up telling you the values corresponding to the point under your cursor. 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 view of the catalog. 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.

If you have a very large catalog or many points in a particular location of the plot, the tool will rebin the points in the plot such that displaying the plot is faster. The plot symbols are shades of grey corresponding to how many points are represented at that location in the plot. Put your mouse over any of the points to find out more about what is represented at that location. It will tell you how many catalog rows correspond to that point, and clicking on it will highlight all of the corresponding rows in the table view and the image overlays. In order to have the tool plot one point per row, you need to zoom in or otherwise restrict the data such that there are 'few enough' points represented in the plot. If there is just one point in the plot that needs to be rebinned, all of the points will be a small point.

Want to save a plot to file? At this time, the best way to do that is a screen snapshot. On a Mac, this is accomplished via holding down command, then shift, then 4, then let go and your mouse cursor changes. Hit the space bar to select the window over which your mouse is hovering. Your mouse cursor changes again, and hit the mouse button. A snapshot is then saved to your Desktop, tagged with the date and time.

Once you have made an x-y plot, the plot is then effectively treated as another 'image' in the stack of images you have loaded into the tool. In the Visualization section, it describes various features, including blinking images, and removing images from the blink sequence. If, after you make a plot, you want to blink or tile some of the FITS images, you will need to remove the plot from the image sequence, as described in the Visualization section.

User Registration for the NASA Planck Archive (NPA)

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.

Login

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 Account

Select this option to create a 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.

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.

Frequently Asked Questions (FAQs) about the NASA Planck Archive (NPA)

What does NPA/ER/PR1/PR2/ERCSC/ESZ/ECC/PCCS/TOI mean?

Here are some common definitions.

◊ This is the NASA Planck Archive (NPA).

◊ ER stands for the January 2011 ERCSC Release.

◊ PR1 stands for the March 2013 Public Data Release 1.

◊ PR2 stands for the February 2015 Public Data Release 2.

◊ The ERCSC stands for the Early Release Compact Source Catalog. In addition, there are two source catalogs based on multifrequency detection algorithms which are included with the Planck ERCSC release. These are the Early Release SZ Cluster Catalog (ESZ) and the Early Release Galactic Cold Core catalog (ECC).

◊ The PCCS (Planck Catalog of Compact Sources) is the single-band catalog delivered as part of DR1.

◊ TOI stands for Time Ordered Information, which are the individual detector readings tagged by location on the sky, time and date of observation, and the measured intensity.

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

Sometimes, if there is a network hiccup (e.g., you pick up and move your laptop to a different wireless hub), the NPA can be left in a funny state. Please restart your session by reloading the NPA from scratch: https://irsa.ipac.caltech.edu/applications/planck .

NASA Planck Archive (NPA): Notice to Users -- Privacy Notice

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- The date and time you access our site
- The pages you access (recorded by the text and graphics files that compose that page)
- The Internet address of the website from which you linked directly to our site.

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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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