# Spitzer Data Access through the NASA/IPAC Infrared Science Archive (IRSA)

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## ABSTRACT

In August 2007, in collaboration with the Spitzer Science Center, IRSA released an interface to the Spitzer Space Telescope post-BCD products. The interface is accessible at http://irsa.ipac.caltech.edu/applications/Spitzer/Spitzer/ and offers coverage maps for all three instruments and their modes. The interface supports queries by position/target, by instrument, and/or by program parameters. It returns spatial coverage and footprint maps, previews of data and metadata, and single file or bulk data download options.

IRSA has also curated and served Spitzer Legacy Enhanced Products and Ancillary data since 2003. Currently, it serves data from eight Legacy projects, and will serve data sets from all the Legacy teams (currently numbering 26).

*Subject headings:* general – infrared data: general – archives: multi-wavelength data: general – Spitzer data: 2MASS: Spitzer Legacy

## 1. Introduction

Based at the Infrared Processing and Analysis Center (IPAC), IRSA is the steward of the scientific data sets, ancillary data products and documentation delivered by NASA's Infrared and Sub-millimeter missions. It currently serves data from 15 major projects and missions, and hosts over 200 source catalogs, 11 million images, and 100,000 spectra. IRSA is a true multi-wavelength archive, with infrared and sub-millimeter data sets from 1.2 um to 2.8 GHz, and ancillary products from X-ray to radio wavelengths.

IRSA leverages the technical knowledge at IPAC to deploy Web-based engines that retrieve the full scientific content of the data sets. In 2007, IRSA's Web pages received over

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12 million hits and 32 TB of data were downloaded from it. IRSA offers technical support to the astronomical community and archive projects, including database management support, validation of the structure and content of data sets, and creation of value-added browse products.

Below we highlight data holdings and services, give details of the IRSA interface to the Spitzer data holdings, and discuss details on two recent upgrades/deliveries to our suite of user tools.

## 2. IRSA Data Holdings and Services

IRSA curates a wide variety of data sets, ranging from the classic IR data of IRAS and 2MASS to the current and evolving Spitzer Space Telescope data sets. Of particular interest of this conference are the ISM-related data sets, listed in Table 1.

Table 1: ISM-Related IRSA Data Sets

| Name of ISM-Related Dataset at IRSA | Acronym of Dataset | Wavelength Range (um) |
|---|---|---|
| Two Micron All Sky Survey (Skrutskie et al. (2006)) | 2MASS | 1.25 - 2.17 |
| 2MASS Large Galaxy Atlas (Jarrett et al. (2003)) | LGA | 1.25 - 2.17 |
| Infrared Astronomical Satellite (Beichman et al. (1988)) | IRAS | 12 - 100 |
| Improved Reprocessing of the IRAS Survey (Miville-Deschenes & Lagache (2006)) | IRIS | 12 - 100 |
| Midcourse Space Experiment (Price et al. (2001)) | MSX | 8 - 21 |
| Spitzer Space Telescope Legacy Data Sets: | | |
| From Molecular Cores to Planet-Forming Disks (Evans et al. (2003)) | C2D | 3 - 160 |
| The Spitzer Infrared Nearby Galaxies Survey (Kennicutt et al. (2003)) | SINGS | 3 - 160 |
| Galactic Legacy Infrared Midplane Survey Extraordinaire (Benjamin et al. (2003)) | GLIMPSE I & II | 3 - 8 |
| Surveying the Agents of a Galaxy's Evolution (Meixner et al. (2006)) | SAGE | 3 - 24 |
| A 24 and 70 Micron Survey of the Inner Galactic Disk with MIPS (Carey et al. (2005)) | MIPSGAL | 24 - 160 |

IRSA deploys simple, Web-based engines that deliver the scientific content of data sets. Some key services at IRSA perform the following tasks: examine anomalies in 2MASS images; get cutouts of image data sets, simple and in bulk; visualize images from 2MASS, SDSS, and DSS in *Finder Chart*; study coverage maps for all catalogs at IRSA, CDS VizieR, and NED with the *NVO Quick Stats* service, hosted by IRSA; get inventories of holdings and perform general catalog queries in real time; interact with maps of the 100 um sky to study intensity, extinction, and dust temperature; and perform on-request image mosaics of 2MASS, SDSS,

and DSS (discussed in Section 5). IRSA also seamlessly accesses remote archives and data sets, including NED, MAST, SDSS, MSC, HEASARC, and CDS VizieR.

## 3. IRSA's User Interface to the Spitzer Archive

In August 2007, in collaboration with the Spitzer Science Center, IRSA released an interface[1] to the Spitzer Space Telescope post-BCD products. The User Interface offers coverage maps for all three instruments and their modes. The interface supports queries by position/target, by instrument, and/or by program parameters. The user can perform a spatial search or a moving target search, or they can upload a table of coordinates for a multiple-target query.

The search returns spatial coverage and footprint maps (see Figure 1), previews of data and metadata (see Figure 2), and single file or bulk data download options (using wget and curl). IRSA is in the process of adding abstracts associated for each Astronomy Observation Request (AOR) to be available on the search results page.

## 4. Montage Mosaic Engine

Montage is a toolkit for assembling FITS images into custom mosaics. IRSA has made available on-request mosaics[2] of 2MASS, SDSS and DSS data sets, using Montage[3]. The key features are of Montage and the on-request mosacking service are: (1) accuracy - preserves spatial and calibration fidelity of input images; (2) portability - runs on all common Linux/Unix platforms; (3) scalability - runs on desktops, clusters, and computational grids; (4) availability - open source code and user documentation available for download; (5) generality - supports all World Cooddinate System (WCS) projections and common coordinate systems (6) flaxibility - independent modules for analyzing geometry of images on the sky, reprojecting images, rectifying background emission, and co-adding images; (7) convenience - tools for managing and manipulating large image files.

Montage is heavily used in research. Three Spitzer Space Telescope Legacy teams

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[1]The interface is accessible at **http://irsa.ipac.caltech.edu/applications/Spitzer/Spitzer/**.

[2]The Montage on-request mosaics of 2MASS, SDSS, and DSS can be found at **http://hachi.ipac.caltech.edu:8080/montage**

[3]The Montage Wed Page can be found at **http://montage.ipac.caltech.edu**

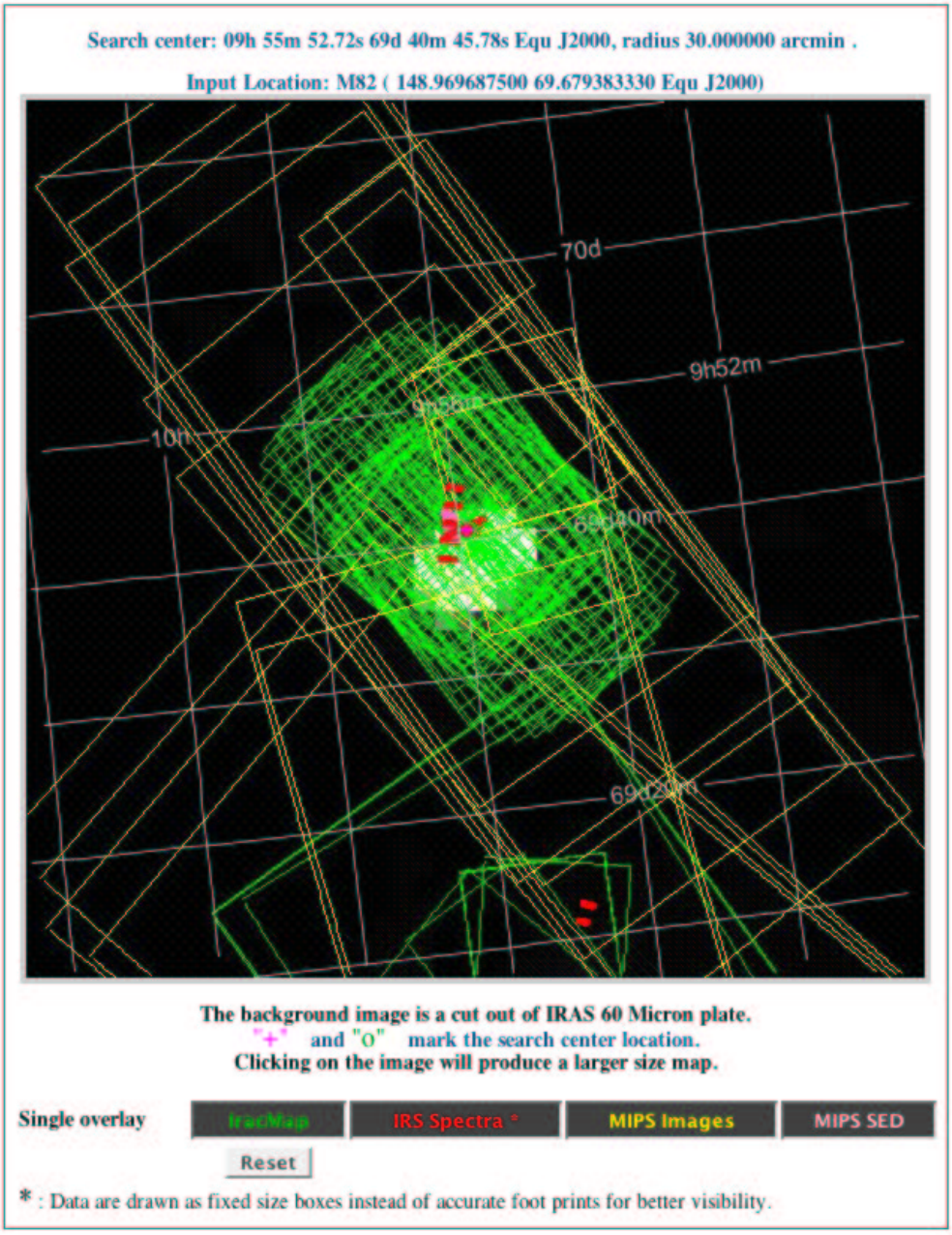
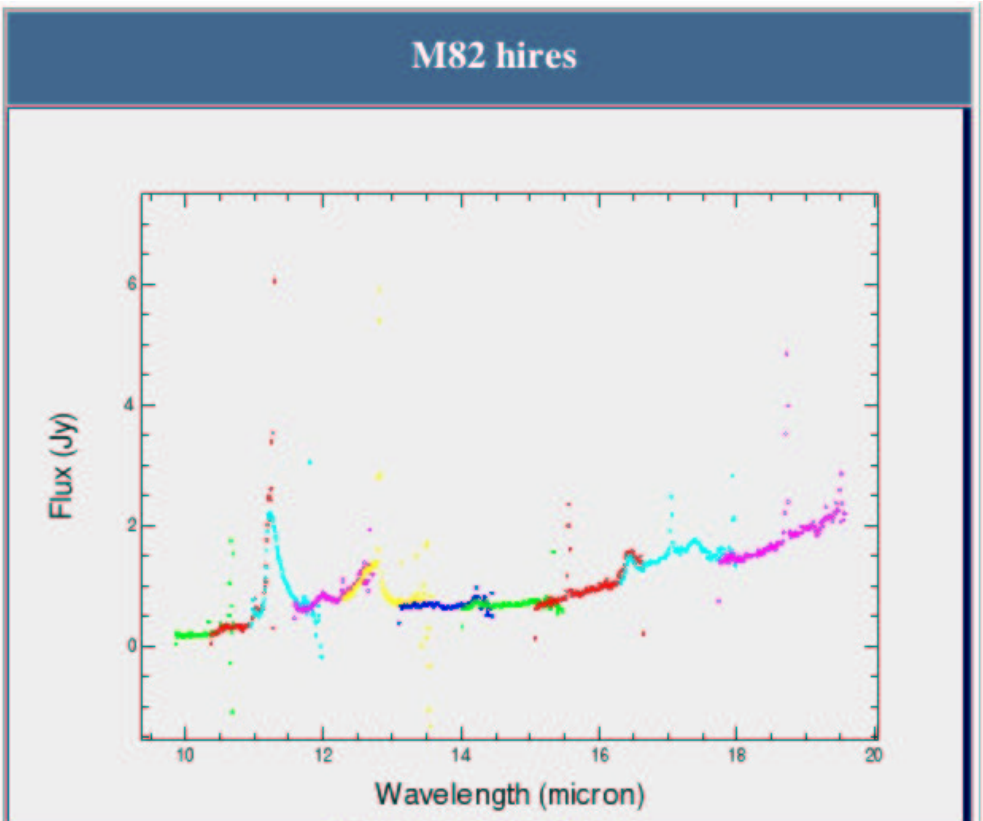



Fig. 1.— Search Results for M82 - observation footprints of various instruments




| | |
|---|---|
| **Program:** | Spectroscopic Study of Star Formation in Interacting Galaxies |
| **Observer:** | James R. Houck |
| **Request Key:** | 3840512 |
| **Object:** | M82 hires |
| **AOR Label:** | IRSM-e-brb-iagal015 |
| **Instrument:** | IRSX |
| **Channel:** | 1 (Short Wavelength / High Resolution) |
| **AOT Type:** | IrsMap |
| **Slit Location:** | 9h 55m 52.88 69d 40m 34.6s Equ J2000 -> (148.970335, 69.676289) |
| **Slit Position Angle:** | 21.78 |
| **Observation Date:** | 2007-02-04T04:00:19 |
| **File:** | SPITZER_S1_3840512_0000_6_E2744856_tune |
| **Software Version:** | S15.3.0 |

Fig. 2.— Search Results for M82 - preview of spectrum data and header information

(GLIMPSE, SWIRE, and SAGE), and the INT Photometric H$\alpha$ Survey of the Northern Galactic Plane (IPHAS) have integrated Montage into their pipelines to produce science products for delivery to the community. Montage is also used in developing on-line services. The NVO Quick Stats Service uses sky geometry tools in Montage to create on-the-fly sky coverage maps for catalogs in IRSA, NED, and CDS VizieR.

Quality assurance was enhanced by the use of Montage for the Spitzer GLIMPSE Legacy project. They constructed mosaics of MSX and 2MASS images to support quality checking of Spitzer Infrared Array Camera (IRAC) images. Montage is also used is education and public outreach. Visitors to the Adler Planetarium, in Chicago, IL, may navigate 2MASS and IRAS skymaps created with Monage at a Quicktime Virtual Reality exhibit, *Explore our Sky at Different Wavelengths*.

## 5. IRSA's IRAS Scan Processing and Integration Tool (Scanpi)

IRSA modernized its IRAS Scan Processing and Integration Tool, Scanpi (v6.0), in September, 2007. The service performs one-dimensional scan averaging of the IRAS raw survey data with various weighting schemes. Enhancements in the upgraded version are as follows.

Fitting and display parameter ranges have been expanded to add more flexibility to the fitting and viewing of results. Plotting is now done in color for ease of visualization, especially with multiple overplots. Scans are now visualized on background IRAS Sky Survey Atlas (ISSA) and Digital Sky Survey (DSS) images, in color, with scan directions marked at the start by the scan number. Figure 3 displays an example of the scan tracks of IRAS 03419+6756 (aka IC 342).

Improved logic has been added for template fitting; groups of scans in forward and reverse directions are counted to keep track of dominant direction in order to tie that direction to the template direction, instead of using a general average-direction template. SIGMA is now being calculated as the square root of the variance. (Classic Scanpi uses the "goodness" of the coadd background fit.) All intermediate files associated with the individual scans and coadded scans are now vailable for every step of processing. Finally, the user has an option to plot all intermediate calculations in an extensive and thorough summary for ease of understanding each processing step.

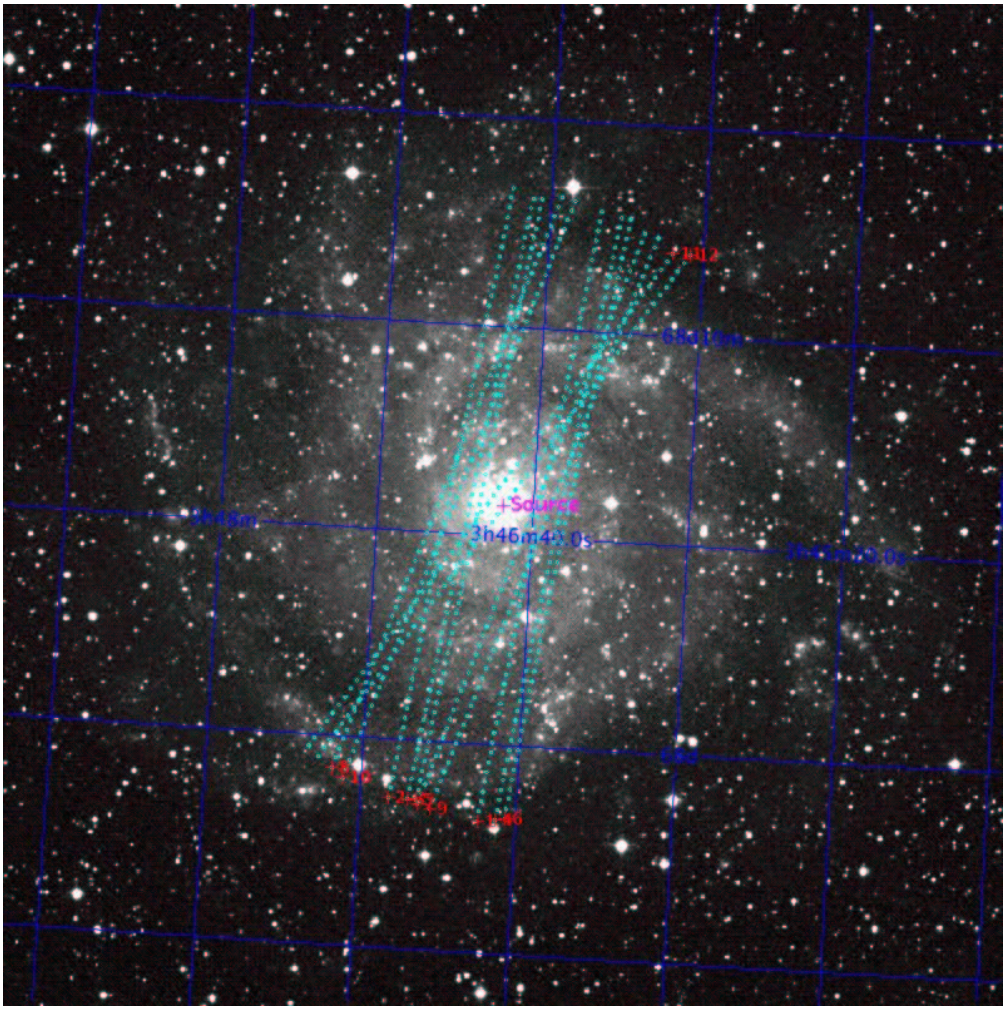



Fig. 3.— Scanpi Scan Tracks of IRAS 03419+6756 (aka IC 342), using DSS background image

## 6. Summary

IRSA now encompasses 15 major projects and missions, millions of images, billions of catalog entries, over a hundred thousand spectra, all in a range of wavelengths that span the cosmos, from X-ray to radio. IRSA offers services to data providers, including validation of data sets, generation of value added browse products, advice on technival documenation, and deployment of query engines that meet customer specifications. There are over 1000 references of IRSA services in peer-reviewed literature. If you use IRSA in your research, please include the following acknowledgement in your paper:

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

Please include also in your paper acknowledgements requested by individual missions and data providers.

## 7. Acknowledgements

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