

Dr. Harry Teplitz (IRSA lead)
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Dear Harry and George,

This letter contains the report of the IRSA User Panel meeting on December 9, 2013. The members who attended and contributed to this report were Mark Dickinson (NOAO), Aaron Evans (Virginia), Oliver P. Doré (JPL), Robert Jedike (Hawaii), Stellar Kafka (CIW), Tom Megeath (Toledo) and Sachin Shenoy (ARC). Claudia Scarlata (UMN) and Deboray Padgett (Goddard) participated remotely. Janice Lee (STScI) was not present. The full day meeting consisted of presentations from Harry Teplitz, Steven Groom, Vandana Desai, Trey Roby, Perigrinne McGhee, Lisa Storie Lombardi & Luisa Rebull. The meeting was also attended by George Helou, director of IPAC. The various activities of IRSA were overviewed at this meeting.

IRSA is NASA's primary archive for infrared and sub-mm astrophysics missions. Currently, twelve distinct ground-based, airborne, and space-based IR/sub-mm missions are curated by IRSA. This archive is unique in two ways. First, it contains the infrared data from an unparalleled decade of infrared space based observations with Spitzer, WISE and Planck. IRSA manages the Spitzer Heritage Archive for the Spitzer space telescope, one of NASA's four great observatories, and it currently maintains much of the technical expertise from that mission. It is also the data archive for the WISE survey and the US archive for the Planck mission. Second, the IRSA archive holds an unparalleled all-sky database spanning 22 wavelength from 1.2 microns to 1 cm, including point source photometry in seven bands from 1.2-24 micron. These data provide a spatially complete picture of the stellar, dust and gas components of our galaxy and the extragalactic sky. The importance of the archives maintained by IRSA is demonstrated by download rates which typically exceeded 10 TB per month in 2013, with a maximum 40 TB in one month.

The IRSA holdings impact almost every area of astrophysics, from studies of exoplanets and planet formation, stellar astrophysics and brown dwarfs, galactic and extragalactic star formation, and surveys of the high-Z universe. The archives also provides a key resource for other NASA missions, such as Chandra and HST, and will play an essential role in planning and interpreting observations from future NASA missions including JWST, EUCLID and WFIRST, as well as observations with ALMA and other ground based observatories. The data contained in the archives managed by IRSA will not be exceeded and replaced in the foreseeable future: the IR data cannot be obtained from ground based telescopes and there are no current plans for space observatories that can match the combination of wide field coverage, sensitivity and wavelength coverage achieved by Spitzer, WISE or Planck. Maintaining IRSA and the scientific technical expertise of its staff is necessary to provide the astronomical community continual access to these data, to facilitate new discoveries both by deploying improved data products and by

improving tools for accessing and utilizing these data, and more generally, to fully exploit the enormous quantity of data returned from NASA's infrared and sub-millimeter astrophysics missions.

Currently, IRSA is undertaking a number of activities with its modest staff. New data from the Spitzer, NEOWISE and Planck mission are being archived by IRSA. This activity continues with new data from the Spitzer Warm mission, and the upcoming releases of the NEOWISE and Planck data. The current IRSA archive has a size of one Petabyte, a significant increase in size over the last year.

IRSA also continues the development of a unified software interface for displaying images and photometry which is now deployed for Spitzer, and Planck. This now includes the capability to interactively select sources in the Spitzer and WISE images based on their photometric properties and overlay their positions on the images. This is a powerful capability and the panel was highly impressed.

IRSA is involved in the creation and/or deployment of new products from existing data in the archive. The Spitzer Enhanced Imaging Products, which provide the community with supermosaics and point source catalogs of Spitzer data combined from multiple observations and programs, has now been released to the community through IRSA. The recently released ALLWISE database, created by combining all the individual epochs of WISE data, provides the community significantly more sensitive all sky data, multi-epoch photometry and proper motions; with applications to studying distant galaxies, nearby stars, and time variable young stellar objects. These data products significantly add to the value of the archive and open up new potential for discovery.

Another activity is participating in the Virtual Observatory. With the close out of the VAO in 2014, NASA has directed its data centers to cooperate in maintaining of the minimum VO infrastructure. A partnership of IRSA, MAST and HEASARC, have submitted a proposal describing the basic activities to sustain the VO with a clear division of institutional roles and responsibilities among the three NASA archives. Among the activities expected for IRSA is to support a liaison between NASA archives and the International Virtual Observatory Alliance (IVOA) and to ensure that the IRSA archives are compatible with IVOA protocols.

Upgrading hardware and software is a continual effort for IRSA. One of the primary ongoing activities is the ongoing migration of the database to a new database management software to save money by taking advantage of a CALTECH site license.

The panel is highly impressed by the ability of IRSA to balance the above activities and make significant progress considering the modest size of its staff. The holdings and capabilities of IRSA continue to improve. The one year delay of the senior review for NASA's data archives has provided IRSA an opportunity to refine their interface, deploy new capabilities and achieve an excellent grade. For the upcoming year, we make the following recommendations.

- Expanding the areal coverage of image products is valuable, particularly since the boundaries of the data tiles can be a major inconvenience when dealing with survey data. The release of larger 2MASS mosaics will be a great benefit. Although it made sense to delay this in favor of deploying the AllWISE data, these mosaics should still be on the list of products to be delivered in the near term.
- IRSA's capabilities for viewing, serving out, and enhancing the Planck data are of great value. They should be widely advertised, as the capabilities are superior to what is available at ESA. Real time generation of maps from Planck's Time Ordered Information data with HIREs will be a unique capability with the potential to significantly enhance studies of galactic objects with Planck. IRSA should also make contingency plans for the eventuality that the Planck consortium does not deliver the final products on schedule.
- The panel recommends that IRSA improve their interface to the archive by reducing the number of clicks, time and overall effort needed to get to the data, particularly for users with standard, relatively small requests. The current interface is complex, with many routes and options for getting to the data which can be daunting for less experienced users desiring a quick result. The new IRSA front page (which has not yet been deployed) appears to be an impressive step forward in this regard, providing a quick entry to the data of a particular mission without first having to find the name of the mission on a side bar or having to enter the coordinates of a particular target in the data discovery interface. The mission specific icons would make it easy for advanced users to find the extensive catalog and image data that IRSA has archived for each mission, but it is important to include icons which provide a quick and efficient path to cross mission data for users who have simple requests. For example, there could be icons for quickly obtaining images spanning the wavelength range of the IRSA holdings for a modest (< 1 deg.) region of the sky (much like the results of FC2), obtaining photometry of the same modest region of the sky from 2MASS, WISE and maybe Spitzer, or quickly viewing all the data on a single source, such as images, SEDs from photometry and spectra, photometric variability and/or proper motions.
- The continued improvement of tools to find, access, and examine data across multiple missions should remain a high priority. This requires IRSA to break down the barriers between images, spectra, photometry and SEDs, and plots of quantities derived from these data, so that the user can seamlessly exploit all of these data modalities in exploring rich data sets. The Universal Interface (UI) described during the panel meeting appears to be a powerful approach to achieving these goals. It has the ability to work across missions, as well as ancillary data from user contributed data, to select data on the basis of photometry as well as spatial coordinates. It allows the user to tailor data queries to complex, multi-wavelength archives to discover new data and new objects. It also appears that the UI is a major step towards facilitating the analysis of big data without downloading it from the archive. It is the panel's recommendation that the UI be a high priority so that a demonstration version is working by the Senior Review. As the UI grows in sophistication and complexity, it may be worthwhile to

develop specific use cases to guide the development. Linkages to the Herschel archive should be pursued, as these would allow users to access far-IR data with an angular resolution comparable to the Spitzer and WISE data within the UI.

- Continuing to expand the user base should be a priority. It has been a past recommendation that IRSA aggressively advertise new capabilities and track usage, and this year IRSA has shown an aggressive campaign to inform users of new capabilities. While new holdings such as ALLWISE are bringing new users, IRSA needs to retain those users and to find ways to continually promote and advertise the rapidly improving IRSA tools, which in the past may have been underutilized. The deployment of the new front page should draw in new users. IRSA should consider using the popular quick-look queries on VizieR as a benchmark to ensure that new users continue to use the archive. The panel also suggests that the roll out of the front page be preceded with extensive testing, perhaps by identifying a community of testers.
- Public outreach is important. The committee is impressed by NITARP, an IPAC led program to engage high school teachers in research utilizing primarily IRSA data. We endorse IRSA's participation in this program as long as there is adequate funding.

The above list is not in order of priority. The panel feels that the highest priorities should be given to the delivery of new data products from Spitzer, WISE, NEOWISE and Planck, the deployment of the new front page (and more generally, a more efficient, simplified access to the data), and the development of the UI.

Sincerely,

Tom Megeath Chair