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

This letter reports on the IRSA User Panel meeting on January 12, 2016. The members of the panel at this time were Janice Lee (STScI), Mike Person (MIT), Olivier Dore (JPL), Alex Pope (UMass), Naveen Reddy (UCR), and Claudia Scarlata (UMN). Deborah Padgett (GSFC) participated remotely and Aaron Evans (NRAO) was not present. The full day meeting consisted of presentations from Harry Teplitz, Steven Groom, Vandana Desai, Jason Surace, Ranga Charry, Lisa Storie Lombardi & Luisa Rebull on the various activities of IRSA. The meeting was also attended by George Helou, director of IPAC. This report, prepared by the panel, overviews those presentations and makes recommendations on the current activities of IRSA and their priorities.

IRSA is NASA's archive for infrared and sub-mm astrophysics missions, containing fourteen distinct ground-based, airborne, and space-based IR/sub-mm missions. The curated infrared data is the primary repository for an unparalleled decade of infrared space based observations. IRSA implements 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 and NEOWISE surveys and the US archive for the Planck mission. IRSA serves an all-sky database at 22 wavelength from 1.2 microns to 1 cm, including point source photometry in seven bands from 1.2-24 micron. These data contain a spatially complete picture of the stellar, dust and gas components of our galaxy and the extragalactic sky. The all-sky coverage (as well as the extensive coverage of the sky by Spitzer) and broad wavelength coverage will not be surpassed in the foreseeable future.

Since the senior review in 2015, IRSA has undertaken a number of activities. New data from the Spitzer and NEOWISE continue to be archived by IRSA. The final DR3 Planck data will be ingested in 2016. IRSA is also preparing to curate data from SOFIA and the IRTF. In addition to these NASA IR data, IRSA is now the data repository for the visible light, synoptic Palomar Transient Factory data and it will house the archive to the upcoming Zwicky Transient Facility (funded by the NSF and ZTF partners). These data will provide unique multi epoch observations of 3π radians of the sky, expanding IRSA's ability to deliver wide swaths of the sky at multiple wavelengths and enabling new possibilities for time domain work. The current IRSA archive has a size of almost one Petabyte, a significant increase in size over the last year.

The IRSA archive will be an essential resource for observation planning with SOFIA and JWST as well as preparations for the WFIRST mission. In particular, enabling the use of the IRSA archive to develop samples of targets for JWST observations is anticipated to be a key use. Although the detailed design of the observations will be done with tools developed by the STScI

which use the IRSA data, the IRSA interface can be used to efficiently develop programs that require the identification of targets from an all sky database, and the assessment of the targets on the basis of target brightness in the IR, IR background, confusion, etc. Already the addition of the JWST FOV in finder chart is a good step in that direction. Tools to estimate backgrounds and possibly signal to noises should be considered. Providing quick access to data from GAIA would ensure that planning includes state of the art information on parallaxes and proper motions.

IRSA is also developing capabilities that could be of great interest for the planetary science community, in part to support NEOWISE. The moving target tools are quite impressive and make great use of the all sky, multi-epoch database. IRSA should take additional step to raise the visibility of these tools in the planetary science community. This could include booths at DPS meetings, or perhaps a standalone "solar system" button on the IRSA front webpage.

IRSA must continue to make investments in improving the speed, efficiency and reliability of user interactions with the archive. In the last year, IRSA has continued its migration to a new database management software to save money as well as upgraded its Java tool kit. IRSA should continue evaluating its options for future improvements, including moving to the cloud. As the complexity of the user interface increases, IRSA may consider setting up metrics for maintaining the speed of certain interactions, encourage users to quickly report problems with the interface, and perhaps identify users who are willing to test new versions.

Although the focus has been on serving data, maintaining expertise on the Spitzer, WISE, Herschel and PLANCK mission is of great value for the US community. IRSA should consider how to maintain this expertise, while developing new capabilities in a cost constrained environment.

The tutorials and representation of IRSA at the AAS meeting are important for introducing the data and tools to the user community. These will be increasingly important as new features are introduced. Encouraging new users to adopt the IRSA interface as new capabilities are deployed should always be priority. Although not part of the IRSA mission, it should be noted that IRSA is also used for citizen science, outreach and education. For example, the committee has been impressed by NITARP, an IPAC led program to engage high school teachers in research utilizing primarily IRSA data.

One of the key developments in IRSA over the last six years is the deployment of a unified interface for the discovery, display, basic analysis, and retrieval of both image and catalog data from the archive. Given the large size of the database and the expansive angular extent on the sky covered by its holdings, this functionality is essential for most users to efficiently find and utilize the data. The unified design simplifies both the task of accessing the archive and the task of maintaining the archive and developing additional functionality. It also sets the stage for IRSA to further break down the barriers between the different wavelengths by being able to extract and display images covering a wide range of wavelength. T*he panel feels that continuing this evolution should be a major priority of the IRSA.* This evolution should include an SED viewer

displaying the available photometry and spectra for any source in the catalog. In addition, multi-epoch capabilities cloud be developed to efficiently compare images, photometry and spectra obtained at different times, different wavelengths and with different angular resolutions, with the goals of improving matches for moving targets and to study variability at multiple wavelengths. A spectral cube viewer would also be useful given spectral data from Herschel and SOFIA, but the use cases should be carefully examined.

The way in which we use data is changing. Data science approaches to the archive using advanced statistical techniques and machine learning will enable new science. The panel feels that IRSA must aggressively position itself as a leader in deploying the infrastructure to enable such approaches. This includes continuing to participate in NAVO and developing stronger ties to the big data community; such ties could be established by having a representative on the user panel, inviting data scientist to give talks, and participating in and even hosting meetings on data science. Establishing a leadership position in data science applications to astronomical archives could perhaps provide new resources for IRSA. At the same time, given both the constraints of the current staffing and IRSA's other obligations, development of novel capabilities must be approached carefully to ensure that new tools, methodologies and infrastructure meets the needs of the community in this rapidly evolving area.

Sincerely,

Tom Megeath Chair