

The Spitzer Users Panel met for the 20th time at the Spitzer Science Center September 19-20, 2007. This meeting comes at the end of the fourth full year of observatory operations and thus, in addition to operations and observer support, the Spitzer project is actively planning the next phase of SSC operations following the exhaustion of cryogen, including the transition to archive support and archival based research as well as considering the prospects for a productive warm-mission afterlife.

As has become routine, the committee was impressed with the effectiveness and dedication of the SSC staff in nearly every aspect of the SSC's operations and management. The SUP represents the broad base of Spitzer Users and it is a particularly positive testament that, in a community that can be quick to complain, virtually every user polled by the committee prior to this meeting expressed nothing but satisfaction with their interactions with the SSC and with the quality of their data and data analysis tools. Looking beyond the user community, the SUP saw another overwhelming presentation from the Spitzer Public Affairs group underscoring the effective and imaginative connection Spitzer science has with the lay community.

Instrument reports / BCD software

The SUP was impressed with the maturity of basic calibrated data (BCD) pipelines for all three instruments and the fact that current efforts focus on the pursuit of remaining instrumental issues that affect the ultimate precision of the Spitzer data products at the few percent level. Such focus is not nit-picking, but represents essential work to exploit the performance of the observatory in some of its highest profile scientific applications, for example detecting and characterizing emission from extra-solar planets. IRAC, for example, now enjoys 1% photometric repeatability and reports absolute photometry at the 3% level. The error budget is now dominated by unique instrumental effects such as the pixel phase effect that biases photometry at the few percent level depending on the sub-pixel centroid of a star image. Muxbleed correction continues to improve to the point where it is difficult to discern this significant image defect in the fully corrected images.

For both MIPS and IRAC the SUP was particularly pleased to see improvement in the characterization and application of the pixel response functions.

MIPS is now achieving photometry at the 2, 5 and 12% level for 24, 70, and 160um respectively and has corrected the bug that was delivering biased flux measurements for bright point and extended sources. The new 160um AOT provides more uniform coverage and a larger FOV

significantly improving 160um photometry and the overall utility of this mode of observation.

The SUP was also pleased to see the effort invested in recovering the performance of the IRS long-low array. Bias and temperature changes have led to a 54% reduction in rouge pixels. Time dependent darks have further improved the cosmetics and calibration of the LL results. At the same time, the introduction of time dependent bias correction for long-high has reduced scalloping and order tilt for that system.

Specific (minor) instrument issues:

IRAC - The FEPS team has noted that there are systematic differences in color ratios (e.g [24]/[8], [4.5][8.0]) that correlate with IRAC frame time. Since the targets have similar spectral types there is a concern that there may be a frame-time dependent calibration error in the IRAC pipeline.

IRS Pickup - The SUP notes that the reported calibration uncertainty for the IRS pickup photometry is 7% (absolute) and would like to know if this precision can be improved.

IRS - The time dependent bias corrections for LH have been effective. Can such corrections be applied to SH as well?

IRS - For the next software release, can IRS provide an accessible library of stellar data assembled in one place with the star placed at a variety of locations along the slit.

MIPS SED - The SUP heard little about the MIPS SED mode at this meeting but is aware of progress being made on processing and characterizing this mode. The SUP hopes for a more detailed report on the SED mode at the next meeting and notes that the current set of data "caveats" pages does not include information about issues with the SED mode.

The SUP encourages the SSC to continue to keep the data caveats pages complete and up to date (This statement is not a criticism that the pages are out of date, but an expression of enthusiasm for the effectiveness of the caveats pages as they have been developed).

Post-BCD tools

In general, the SUP was quite impressed with the state of development of the various post-BCD tools and with the common cross-platform general user interfaces that make these tools particularly accessible and efficient.

Validation of APEX has progressed substantially, with evidence that it is working well with the well-sampled PRF's for MIPS 24um photometry. Aperture photometry is working well in general. APEX PRF-fitting performance with IRAC continues to be poor due to pixel undersampling and asymmetric PRFs. Since APEX is available to users it remains fundamentally important that its shortcomings are well documented and advertised. A caveat about the problems with the IRAC PRF's (not specifically their use in APEX) appears on the postbcd introductory web page (<http://ssc.spitzer.caltech.edu/postbcd/>). No such qualification appears on the descriptive page for the APEX software (<http://ssc.spitzer.caltech.edu/postbcd/apex.html>) despite previous admonitions on this issue in SUP reports. Overall, the SUP looks forward to further characterization of APEX, particularly regarding applications involving the IRAC PRF fitting.

End of cryogenic mission and beyond

With the end of the Spitzer cryogenic era approaching, this meeting emphasized the final cycle of observations (Cycle 5), the Spitzer archive, and the potential for post-cryogenic operation of the observatory. As with previous proposal cycles, Cycle 5 has been well planned and advertised. The SUP, with perspective reinforced by feedback from the community it represents, has no doubt that this Cycle will proceed as smoothly as the previous from proposal all the way through execution. We do expect that, despite the appropriate advertisements, some proposers will be surprised by the procedures necessary to accommodate the uncertain date for cryogen exhaustion and the associated funding issues, etc. No doubt the SSC award letters for successful proposals will be quite explicit about the complexities of this interesting period.

Archive vs. Extended Mission

Heritage Archive planning is underway. The SUP heard presentations about the structuring of this planning process and the results of an (largely) internal review of the group's progress toward defining the design process for the Heritage Archive. The archive review committee includes SUP member John Carpenter as the chair. All evidence is that the consideration of the structure and implementation of the final archive is being well managed by the newly formed Integrated Product Team. The SUP was promised an overview of the archive final processing plan at its next meeting. The SUP will be particularly interested in the issue of whether the planning permits enough time to validate the final pipeline output, or alternatively to understand the mechanism to catch/avoid the introduction of pipeline bugs in this last processing pass through the data.

Advocating for the archive

The Spitzer archive is exceptionally rich in unmined science. Because of the unique wavelength and sensitivity phase space pioneered by Spitzer it is safe to say that this depth may be unparalleled compared with other missions. Being such, the SUP wishes to ensure that there is balanced advocacy for advancing the construction of the archive and the tools to exploit it. More than being "put to bed" the archive represents the fundamental vehicle for advancing high-spatial resolution high-sensitivity infrared science through the JWST era and thus is a true continuation of Spitzer's mission.

The SUP notes that although the funding for the Spitzer archive and a potential Extended Mission are technically separate, they may be co-existing functions of the Spitzer Science Center during the post cryogenic era and could be viewed as competing for support. The SSC has done an aggressive job of characterizing the scientific potential of the post-cryogenic mission, compiling a compelling and extensive community-developed set of science use cases. The archive, of course, has been viewed as an integral part of the Spitzer mission since its inception, to the extent that its importance is unquestioned....but, on the other hand, could it be in light of a rigorous advocacy for the warm mission? In contrast to the warm mission, the specific science cases for continued aggressive support and exploitation of the archive have been implicit. The SUP is concerned that the extensive work to justify the warm mission could eclipse or diminish the apparent priority of the archive and archival research. The SUP urges the SSC to develop a justification for future archive support and exploitation that balances the stunning case made for an Extended Mission.

Source extraction for the archive

The dialog between the SUP and the SSC regarding the role of source extraction in the SSC data products continued at this meeting, now focusing specifically on the potential for populating the Spitzer archive with source extractions. The SUP continues to stress that having source extractions, even if limited to high SNR, high reliability sources, greatly enhances the utility of the archive, particularly in NVO-like applications. Th SUP was pleased to hear that further characterization of the APEX source extractor has begun to yield greater confidence in the effectiveness of this tool and has begun to demonstrate its potential suitability for use populating the archive with source extractions. The need for a software tool will further drive the development and validation of APEX. The SUP does note, however, that there are many existing

source extraction packages with extensive documented performance that might equally fulfill the specific need for a high-SNR source list.

Assessment is underway to determine the practicality, scope, and FTE cost of delivering a characterized extracted source component for the final Spitzer archive. The SUP was encouraged by this level of response and ongoing activity and with the presentation of a well-considered timeline for resolving these issues. Rather than suggest specific further action, the SUP looks forward to hearing the results of this SSC assessment of the practicality and desirability of source extraction at its next meeting.

Warm mission

The SSC has done an superlative job of developing advocacy and planning for a warm IRAC mission following the exhaustion of cryogen. As representatives of the user community, the SUP remains enthusiastic and hopeful that this advocacy can be translated to concrete agency support for the program (carefully balanced, as discussed above, with the primary need to support archiving and archival science).

- The exact timing of an agency decision to support the warm mission may be relatively coincident with exhaustion of cryogen. Should that decision be delayed, it is all the more important that specific high-impact observations be carried out as soon as feasible. These observations should present a vivid demonstration of potential warm science and reinforce the feasibility of the general warm mission science case. The SUP is eager to hear plans for developing this early warm-mission demonstration science.
- Most all of the warm mission planning has focused on a limited number of projects of large scope, specifically because the streamlined SSC of the warm era is not equipped to manage vast numbers of GO programs. At the same time, the SUP is concerned that there will be some compelling scientific opportunities that require modest observing requests. The SUP hopes that SSC can maintain a mechanism to support a modest number of, for example, 50 hour warm mission proposals.
- There is the possibility that some support from the GTO teams will be required in the warm era, possibly years after the main mission GTO funding has ended (for example to characterize some quirky warm behavior of the arrays). The SUP recommends that SSC consider keeping some funds in reserve for such an eventuality.

User support and documentation

As noted at the outset, there is a remarkably uniform sense of user satisfaction with the SSC across the Spitzer observing community. The data workshops continue to be well attended and well received. The SSC web pages continue to improve in navigability and content. In particular, the instrument data reduction "cookbook" pages are excellent. Some users, however, would like to review printed versions of such documents and have requested that printable .pdf versions of the html pages be made available where feasible.