LAMBDA Users Group Report 2016

Renée Hložek, Ted Bunn, Tom Crawford,
David Chuss, Gary Hinshaw, Jeff McMahon

Abstract

This group of regular users of (and contributors to) to NASA's LAMBDA website was convened with the intention of reviewing and making suggestions for revision to the scope (and potentially content) of the LAMBDA site.

---

1. The LAMBDA mission and reach

LAMBDA is a part of NASA's High Energy Astrophysics Science Archive Research Center (HEASARC). The site provides the community with access to data, software and expertise for cosmic microwave background (CMB) radiation studies over a longer baseline than any individual mission. On the LAMBDA website, LAMBDA's mission statement identifies it as a platform that:

- develops and maintains data archives

- develops and maintains data access and analysis tools

- offers scientific expertise on NASA's CMB missions

- carries out data-intensive processing of vital importance to NASA's CMB community

- conducts education and outreach efforts aimed at the general public.

The committee discussed this mission statement in terms of our experiences and use, and feel that HEASARC might be missing a key user in this scope: the *the early career researcher* (e.g. the junior graduate student. This is someone at a higher level that the general public, who would particularly benefit from access to new software that is being developed for the site.

December 16, 2016

This user already is making use of LAMBDA (through summer schools, or at the instruction of their supervisor) and is a strong base to consider. The Users' Group suggests that **HEASARC redefine the LAMBDA mission statement to include this user group.** To that end, the Users' Group suggests that future iterations of the Group include members at this career stage.

1.1. Recommendations for communication

In addition to the recommendation to change scope, the Users' Group suggested that HEASARC look at **improving its communication about the services and products available on LAMBDA within the community**. For example, most of the committee members did not know about the new software services. If the focus between missions will concentrate on improving software, this will be key to improving and growing the user base. The Users' Group felt that a survey (spread by research supervisors to their students) would not only provide HEASARC with vital information on usership, but also serve to advertise the products and services of LAMBDA more widely. In addition to the recommendation above, the Users' Group was surprised at the following part of the mission statement: "offer scientific expertise on NASA's CMB missions". This role, that LAMBDA staff can assist with technical queries about data quality/characteristics, or provide a reference to a knowledgeable contact, is one which the Users' Group find is under utilised, especially given the time since NASA's space missions. The Users' Group suggests at the least that this part of the charter is communicated in more detail on the main page. This could be highlighted perhaps through short videos on 'How LAMBDA can help you' or similar content.

Finally, the charter item that states that LAMBDA 'carries out data-intensive processing of vital importance to NASA's CMB community' seems less applicable for the times when it serves more as an archive between missions. Given the emphasis towards analysis tools, the Users' Group suggests that this either be combined with the 'analysis tools' section on the charter, or make the language more explicit about the different times when LAMBDA's charge changes.

1.2. Recommendation for the Users' Group

The committee felt that a three-year term was indeed feasible for the Users' Group, but suggested that the terms be staggered to ensure transfer of knowledge between years. This could be initiated by having some users in the group rotate off early or stay for a fourth year. The committee also recommended that the Users' Group include as it members PIs of successful ADAP proposals that utilize relevant microwave background data.

2. Recommendations for data

Initial discussions centered around the possibility of hosting *Planck* data on LAMBDA. In this (and other) instances, LAMBDA should improve communication about these very useful pages.

Given the work on the LAMBDA band power tool, it would be great to have tools which showed the data across multipoles and also to link that to the sky footprint. Software that could potentially be used for something like this would be TopCat.

2.1. Recommendation for expanding data coverage

The Users' Groups discussed hosting additional secondary data (for example 21cm data from a survey like CHIME, or LSST galaxy data once it becomes available). This would prove invaluable for cross-correlation studies, which are arguably where much of the science for future surveys will come from. As such we recommend adding intensity mapping and derived large-scale structure products as a secondary archive objective, as allowed within existing resources. The Users' Group notes that access to these data strengthens the value of the CMB assets considerably. It is also worth noting that neither of these data currently have a 'home', and so LAMBDA can make a significant contribution to the community here. If intensity mapping and large-scale structure (derived products) grow to become primary archive objectives, we recommend support for archive staff with expertise in these areas.

In addition, the question of hosting future, large-scale ground-based CMB data—in particular CMB-S4 and Simons Observatory data—was raised. For several logistical reasons, including the sheer size of the raw data, it is unlikely

that LAMBDA will be the primary host for low-level data products used in ongoing analyses for these projects. A potential role for LAMBDA in this context was seen to be in foreground data and modeling. LAMBDA could provide a common repository for both foreground modeling codes and the data used as inputs to these codes. LAMBDA would provide reference maps used in sky models, and update these (in conjunction with the sky model codes) as new foreground data are available. An ideal outcome would be an interface in the LAMBDA software section with which users could run foreground modeling code and generate output maps over an area of the sky, but even simply having the various codes and input data available in one location would be beneficial.

The Users' Group makes a recommendation **to improve the links to foreground modeling and to connect to templates and higher frequency maps in one location.** Again, ideally this should be more than a repository: it should be a changing/updating interface so that one could query the codes and obtain output maps.

3. Recommendations for software

The HEASARC group defined and explained some of the software tool development that is ongoing for the LAMBDA site. The Users' Group believed that the main software used to date is the hosting of the CAMB code on LAMBDA through an interface (the group did not know about the band power plotter or the survey region plotter before the call). One suggestion would be to add the capability for this to be passed to a series of likelihoods (themselves hosted on LAMBDA) so that a value of a likelihood corresponding to the physical model generated by CAMB could be produced. Rather than only plotting band powers, the tool would also plot theory curves for given parameters, and evaluate the full likelihoods delivered by the experiment teams for that theory curve. The ability to not only see a theoretical model that is generated from a set of cosmological parameters but also to compute the fit of the model to a series of cosmological data would be highly instructive for early-career graduate students.

In order to tap into the newly identified LAMBDA user, the early-career graduate student, the Users' Group recommends **hosting interactive iPython analysis workbooks as a great way to promote learning and the**

use of LAMBDA-hosted data, with tasks and processing power permitted by existing servers and an understanding that significant computational demand would require additional funding. Workbooks in the theme of this recommendation have been produced by Users' Group members Hložek and McMahon for the Atacama Cosmology Telescope. Similar workbooks could be added/hosted on LAMBDA, with the option of running the code (unmodified) on a dedicated server, or downloading the code and making modifications on a local machine. Execution on LAMBDA servers could facilitate broader archive use by avoiding software setup, download and storage overheads. We acknowledge that capabilities for hosted computation are a recent development and require vetting for security. Requesting content from the community to host on LAMBDA could also serve as an interesting way to poll the community on the skills/workbooks that they would find the most useful.

4. Recommendations for appearance/structure

The website in places is difficult to navigate, particularly because there is a lack of redundancy. For example, the 'Tools' section contains much of the necessary software, but there are links on one page to all the tools, rather than relevant links in the additional sections/tabs from other parts of the site. The Users Group recommends **testing for redundancy of the links/tabs on the LAMBDA site**. This will hopefully make it less possible for important software and tools to slip by the eye of the new user.