

2022 MAST Users Group (MUG) Report

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Introduction

The MAST Users Group (MUG) met virtually in 2022 to receive updates from the MAST team. This report summarizes the findings and recommendations of the MUG following these presentations and further discussion amongst MUG members.

The state of MAST is strong. MAST leadership has a well-defined, well-communicated vision, and its team of developers and scientists is producing world-class tools for the astronomical community. The MUG was extremely grateful to receive the reports by the team, and applauds them for their hard, impactful work.

The MUG wishes to highlight that throughout the presentations, and over the recent years, there has been a consistent dedication to inclusive innovation at MAST. This inclusivity and commitment to accessibility shines through in initiatives like Hello Universe, the TIKE, sonification, and diverse forms of documentation to appeal to different users. Accessibility is a bedrock principle in the new search interfaces that have been presented, and the MUG remains both impressed and appreciative of these efforts and of the deeper principles upon which they rest. NASA missions that have data served by MAST have higher impact and reach because they are served by a MAST which is well led, well managed, and well positioned to serve future data of increasing volume and complexity.

In the remaining report, we respond to most presentations we received, and do so in order of the presentations.

Moving Targets

The MUG was presented with an update on the progress of moving object target tools at MAST, and discussed the evolution of the tools since the last MUG meeting. The MUG was presented with two options under consideration: working towards implementing a moving object search for a single mission; or investigating technology to search across a larger number of data sets. The MUG felt that it did not have representative enough experience in planetary astronomy (there was only one planetary astronomer on the MUG), and as such cannot make a strong

recommendation in either case. The MUG felt that the MAST team should establish a temporary working group of Solar System researchers to provide detailed feedback on MAST's development plans for the moving object search tool. Planetary astronomy is a wide field with differing needs for the various small body populations, planets, and satellites. A lack of feedback beyond the MUG could slow or hurt development and future adoption of this tool.

RECOMMENDATION: *The MUG recommends that MAST explore additional ways to interface with the planetary astronomy community, such as a workshop, to tap into an experience beyond what the MUG has, given the diversity of science and archival needs in the planetary community*

Nevertheless, the MUG continues to endorse MAST's efforts to expand their capabilities in moving object search to better serve the planetary community.

FINDING: *The MUG is glad to see continued improvement in the development of a robust moving object search.*

FINDING: *The MUG is pleased to see JWST observations included in the moving target pre-match search as a test case.*

The MUG also notes that significant work is underway at the Rubin Observatory, and advises that MAST may want to connect with the Rubin Solar System processing team at UW for additional insight.

High Level Science Products (HLSPs)

An update was presented to the MUG on HLSPs at MAST. Overall, the MUG remains impressed and pleased with the amount of consideration HLSPs are given at MAST. The MUG noted that scaling HLSPs to higher volume data, especially with Roman, may require certain limitations on the content or size of the HLSPs to remain usable, and manageable from a resource perspective at MAST and in the community.

FINDING: *HLSPs in the large data volume era may not be manageable or usable without significant curation.*

RECOMMENDATION: *MAST should explore what limitations may be needed in future large data volume HLSPs with a nod towards the onset of Roman operations.*

With these larger volume considerations in mind, the MUG felt it was important that the community be well informed on HLSP creation and promotion, and that the community ensure that HLSPs are usable, and not duplicative with parts of existing HLSPs. MAST should consider modifying the HLSP ingestion process reasonably limit the size of an HLSP so that the HLSP creators thing carefully about information compression, redundancy, and useability.

Furthermore, the MUG felt that HLSP PIs could provide more documentation and use examples to improve useability of HLSPs, again with a nod towards future *Roman* possibilities

RECOMMENDATION: *MAST should explore requiring further documentation from HLSP PIs to include interactive, user-centered tutorials for HLSP usage (e.g. example data visualization and analysis notebooks)*

In terms of community engagement, the MUG felt that a community engagement plan may be an effective tool in HLSP creation, and may help broaden HLSP scope (e.g. more cross-mission HLSPs, HLSP PIs from non-R1 institutions, etc.). Such a plan may help the community to better help itself utilize these great data products.

RECOMMENDATION: *If resources allow, MAST should develop a community engagement plan for HLSPs, and make more transparent where responsibilities lie for community promotion of HLSPs*

FIMS-SPEAR

The MUG was presented with a prototype ingest from a small mission, FIMS-SPEAR. Overall the MUG was extremely impressed with the prototype example, and is excited to see further small mission support within MAST, especially with the increase in such missions in the NASA portfolio. In addition to FIMS-SPEAR, the MUG was presented with aspects of a draft policy for small mission support. The MUG applauds these efforts. The MUGs only concern was with resources at MAST available for ingestion, and the expectations of missions with regards to either providing resources to MAST or to be intentional at the onset and prepare the data to meet MAST standards prior to ingestion.

FINDING: *The draft policy for smaller mission support in MAST is supported by the MUG*

RECOMMENDATION: *MAST, in conjunction with NASA, should provide as precise a definition as possible to delineate between what small missions are expected to contribute as opposed to what MAST will contribute without additional resources. Guidelines about MAST ingestion of small mission data opportunities should be added to the mission solicitation documentation.*

Modernized Search Interface

The MUG received an update on the ongoing search interface work at MAST and notes the permanent redirect from HST Classic search in late 2022. The new interface was extremely well received by the MUG, and it sets the new standard for accessibility in astronomical data search. The autocomplete, descriptive text, and favoriting features were of particular note.

FINDING: *The MUG applauds MAST for the new search interface, and notes in particular the focus on accessibility by the interface development team. The MUG strongly supports the new interface being the default landing page.*

As the interface becomes the default for the community, the MUG recognizes that even a radically improved interface can miss things that the community might see that the developers do not. The MUG felt that a discussion with ADS might be helpful, given their experiences with a significant interface change.

RECOMMENDATION: *The MUG recommends that MAST continue to incorporate lessons learned from other major interface changes in the community, particularly ADS.*

Greenplum

The MUG was presented with MAST's efforts to react to the evolution in data volumes and query sizes that can negatively impact user experience via slowed query results and on accessibility. These efforts are of significant importance to the community, but the work is fundamentally a back-end infrastructure issue, and a highly technical one at that. The MUG felt that it could not offer much in the way of a response other than to encourage MAST to continue these efforts with their focus on user experience in the high data volume age.

FINDING: *The MUG supports the Greenplum efforts and other efforts to significantly increase the speed of search result return.*

FINDING: *The MUG, as currently constituted, does not have the deep technical knowledge needed to make significant recommendations on infrastructure development initiatives like Greenplum.*

Cloud Services

The MUG was presented with an update on cloud services at MAST, which has been a point of concern for the committee in prior years (as we are sure it was to MAST as well). A long-term contract has been arrived at, which the MUG applauds. The MUG carries remaining concerns about larger cloud policies within NASA SMD and how they might impact MAST in the future. The MUG recognizes that the landscape is changing, and that data policies including cloud policies, are often driven by policy considerations that do not have specific science cases or entire fields of science for that matter, in mind. As such, the MUG may not be the correct body to weigh in on cloud policy at MAST beyond how it impacts the user experience. The MUG also recognizes that there must be balance between access to platforms within the cloud and security concerns.

FINDING: *The MUG applauds MAST for arriving at a ten-year contract for cloud services, which will alleviate many of the previous MUG concerns about the cloud such as uncertain pricing models.*

FINDING: *Cloud support for MAST and other archives within the NASA ecosystem is evolving at both the policy and implementation levels, and the MUG expresses concern that NASA SMD cloud policy may impact MAST cloud services, and eventually user experience, without careful and deliberate consultation.*

Hello Universe

The MUG received a briefing on the Hello Universe project, an online facility and repository for tutorials at the intersection of astronomy, machine learning, statistics, and data analysis. The resources consist primarily of explainers, data, and downloadable jupyter notebooks, dually hosted by STScI and github. The initial public release took place at the June 2022 AAS Meeting. The MUG felt that Hello Universe addresses many of the needs of novice users. It is clearly designed and written, and it is concise, makes it easy for people to jump and start using. It provides introductory material at the intersection of multiple topics and therefore allows for people to see the diversity of applications and tools. There is extraordinary potential for growth in multiple spaces: training for mid-/late-career scientists, student education, public engagement, more tutorials and data sets. Given the immense potential of the project, the MUG would like to have more in the community see it and to have the pedagogical value of the project enhanced. The MUG also notes the great potential for the project to build educational and research connections to minority serving institutions.

FINDING: *The MUG applauds the efforts made by Hello Universe to date and sees immense potential in the future for the initiative.*

RECOMMENDATION: *The MUG recommends that MAST raise more community awareness of Hello Universe, and encourage more input from users.*

RECOMMENDATION: *The MUG recommends exploring collaboration with educators to enhance the pedagogical value of Hello Universe.*

TESS

The MUG received a report on MASTs continuing efforts to serve TESS data, including some cloud-based hosting. The MUG notes that as highlighted in the Astrophysics Senior Review, cloud services will be important for a future extended mission(s) of TESS, and that MAST is appropriately giving consideration to these and other issues.

FINDING: *MAST has provided excellent support for TESS and is planning appropriately for the notional MAST needs if the mission enters a third extended mission cycle.*

The TIKE

As presented to the MUG, the Timeseries Integrated Knowledge Engine (TIKE) aims to increase the accessibility of MAST data and software with a powerful, freely-accessible all-inclusive platform for data acquisition and analysis. It is powered by a JupyterHub platform hosted by AWS, in the same region as MAST's public datasets. TIKE currently connects to datasets from TESS, Kepler, and K2, with plans to expand in the future. The MUG found that a major strength of the TIKE platform is its well-produced set of tutorials, which are provided in the easily navigable format of a JupyterBook. Each notebook within the JupyterBook also has its own table of contents, making them easily searchable.

The TIKE team plans to offer classes on TESS data science, specifically targeting the following audiences: small colleges, new grad students/postdocs, and summer interns. They will also be advertising the platform through workshops and presentations at conferences (AAS, AAPT, etc.,). The MUG applauds the efforts to be accessible and inclusive, and advises that user use statistics may further inform these efforts.

FINDING: *The MUG is excited to see continued development and expansion of the TIKE platform*

RECOMMENDATION: *The MUG recommends that MAST obtain statistics on user use (who and what for) for TIKE to guide future development*

RECOMMENDATION: *The MUG recommends continued and expanded support for TIKE tutorials*

Tutorials and Documentation

The MUG was presented with the ongoing efforts to provide better documentation and tutorials to the community. MAST has been making great strides in these efforts, embracing modern technologies and methods, lowering the barrier for the community to obtain and use data from MAST. A recent example is JWST: a new, complicated flagship mission with data products unlike any served by MAST before. The use of multiple forms of media (videos, notebooks, more standard written documentation) appeals to different modes of learning in the community. The 'MAST as a library' concept was well received by the MUG, and the MUG advises MAST to develop it further and formulate an outreach plan to inform the community of the availability of these resources.

FINDING: *The MUG applauds the MAST team for their multi-pronged approach to documentation and tutorials, and highlights the successful rollout of user documentation and help resources with the first release of JWST data to the astronomical community*

RECOMMENDATION: *The MUG encourages the MAST team to continue developing the "MAST as a library" concept with a coherent set of branding across the various methods used to provide support to users.*

RECOMMENDATION: *The MUG recommends that a communication/outreach plan be developed to introduce and repeatedly inform the user community about these resources.*

JWST

With the successful launch and onset of Cycle 1 observations, the MUG was presented with MAST's approach to serving JWST data. JWST is unlike any mission before it for MAST, with a single target generating up to thousands of files, making the traditional 'download basket' concept less viable. How to present the data, and how to access it in a reasonable timeframe are unique challenges, and significant attention has been paid by MAST on how to educate the community to interact with JWST data.

FINDING: *The MUG applauds MAST's efforts to successfully host and serve JWST data throughout commissioning, the initial public data release, and throughout the first year of operations. The MUG commends the strong user support, including MAST documentation, API tutorials, and the JWebbinar materials.*

RECOMMENDATION: *Given the complex nature of the JWST data products (large data volume, large numbers of files, and continuous data re-processing), the MUG recommends additional training for the community, particularly in the use of the APIs*

RECOMMENDATION: *The MUG recommends that MAST proceed with the medium-term plans as laid out by the JWST MAST group, particularly the improved API scripts and notebooks and additional webinars.*

Looking forward, the MUG advises that MAST survey users frequently on how JWST data is presented given the volume of results for a single observation. The JWST data pipelines have not yet matured to the level of other mission counterparts, so data and how it is served via MAST is likely to change. The MUG looks forward to continued updates on MAST's JWST efforts.

General Considerations

MAST as an archive is clearly dedicated to increasing diversity in its user base. The MUG applauds these efforts, and hopes they continue. The MUG felt that a better understanding of where users are interacting with MAST is warranted to inform future efforts.

FINDING: Demographic data exists, such as the nature and location of the institution, to measure the grasp of MAST data

RECOMMENDATION: MAST should use demographic information to inform community outreach efforts, particularly at non-R1 institutions