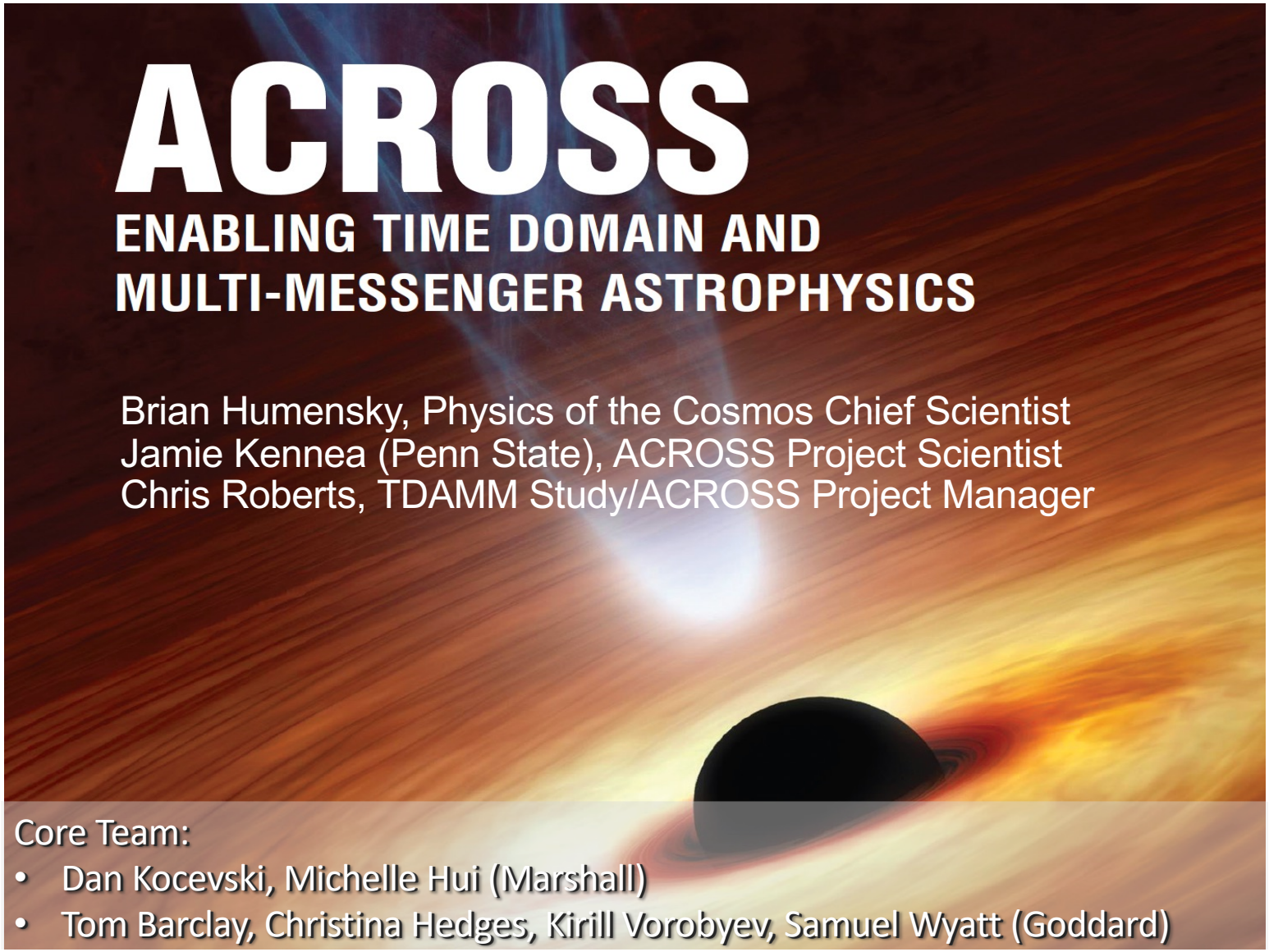
ACROSS

ENABLING TIME DOMAIN AND MULTI-MESSENGER ASTROPHYSICS

Brian Humensky, Physics of the Cosmos Chief Scientist
Jamie Kennea (Penn State), ACROSS Project Scientist
Chris Roberts, TDAMM Study/ACROSS Project Manager



Core Team:

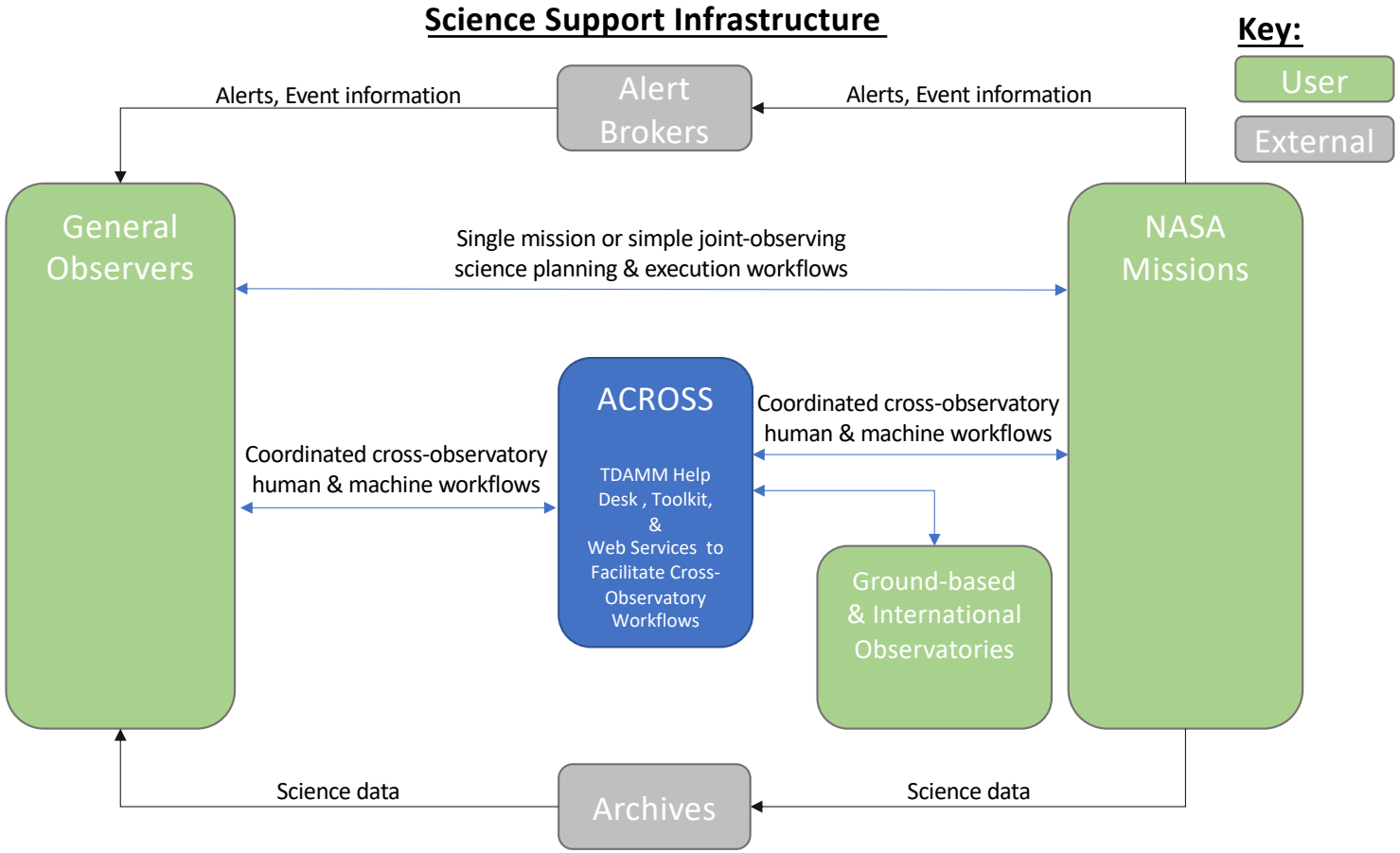
- Dan Kocevski, Michelle Hui (Marshall)
- Tom Barclay, Christina Hedges, Kirill Vorobyev, Samuel Wyatt (Goddard)

Background

- **The PhysCOS Time-Domain and Multi-Messenger (TDAMM) Initiative responds to a top-priority of the Astro2020 decadal report recommendation and has been tasked with:**
  1. Organizing or supporting **TDAMM workshops**,
  2. Conducting a three-year **TDAMM Study** investigating policy, processes and technical coordination mechanisms to enable TDAMM science,
  3. Recommending one or more potential implementations for a General Observer Facility for TDAMM science.
- **The Astrophysics Cross-Observatory Science Support (ACROSS) pilot project is an outcome of the first year of the TDAMM study, which identified needs for:**
  1. Software & data systems to facilitate TDAMM science workflows,
  2. TDAMM help desk to provide expertise & facilitate coordination, and
  3. TDAMM community grant program to incentivize scientific innovation.

The objective of the pilot phase is to put ACROSS on a path to becoming a center of excellence for enabling TDAMM science.

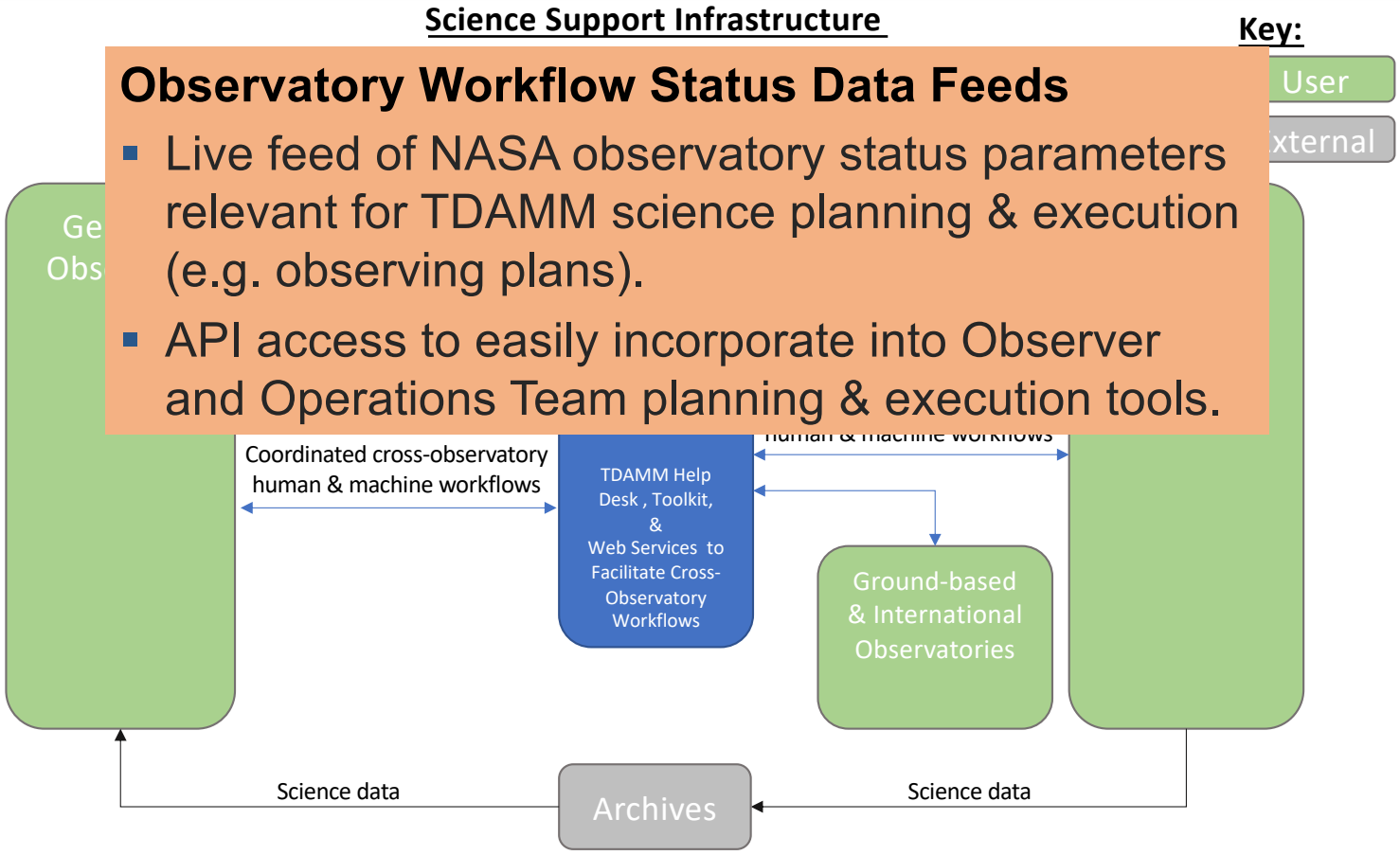
High-Level Architecture: Future-State Context Diagram



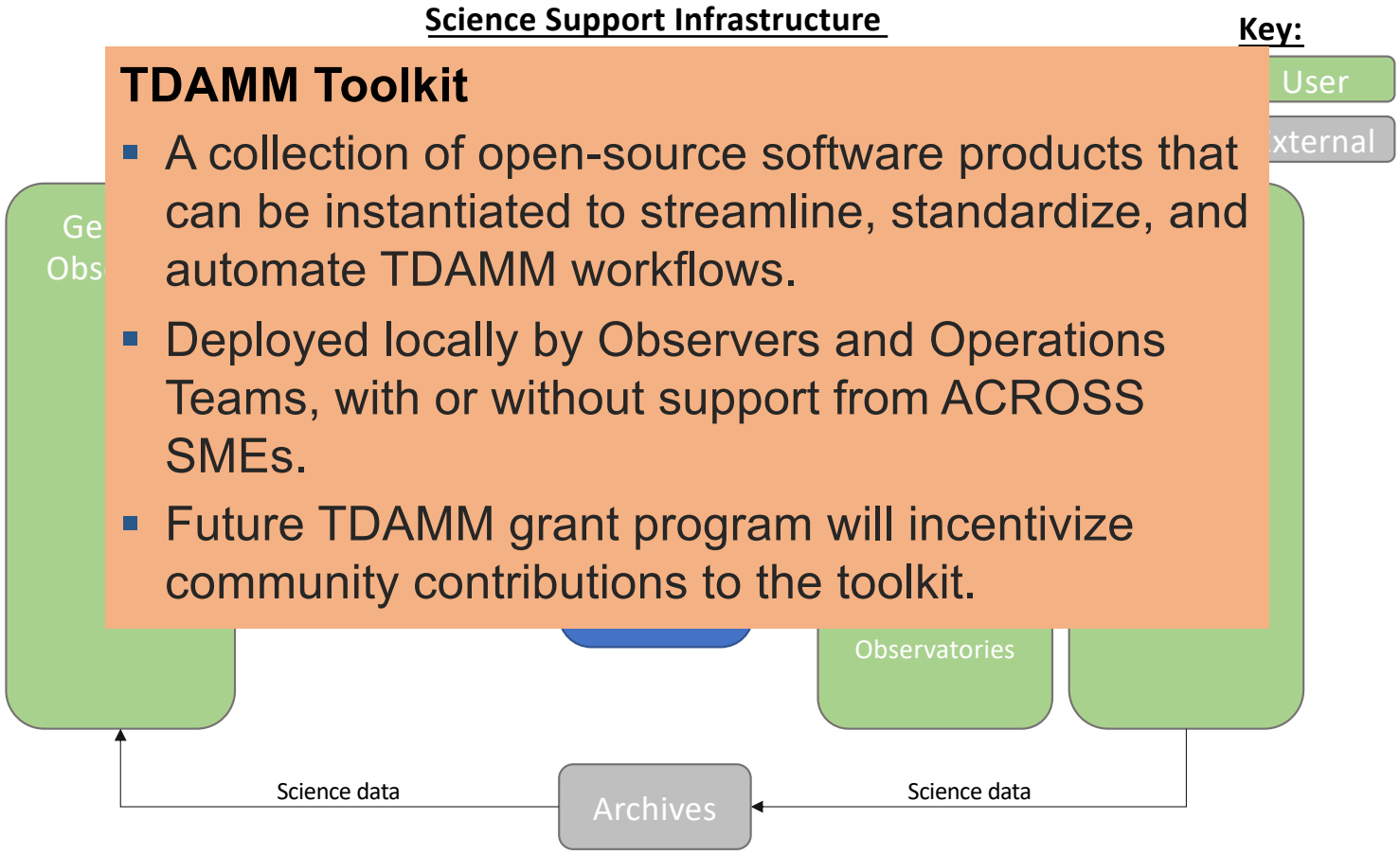
High-Level Architecture: Future State Context Diagram

Observatory Workflow Status Data Feeds

- Live feed of NASA observatory status parameters relevant for TDAMM science planning & execution (e.g. observing plans).
- API access to easily incorporate into Observer and Operations Team planning & execution tools.



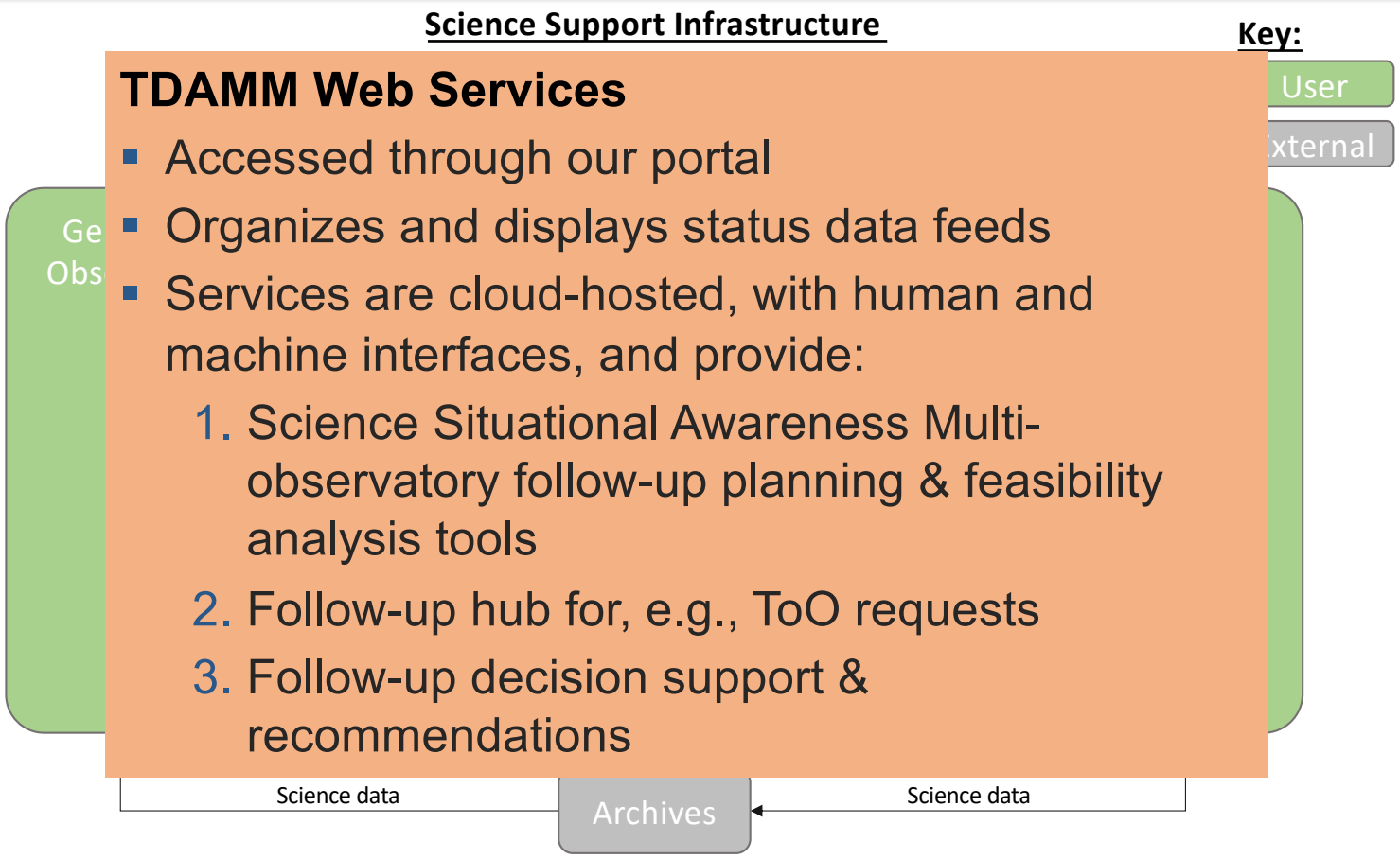
High-Level Architecture: Future State Context Diagram



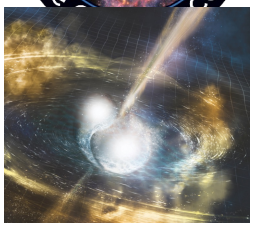
TDAMM Toolkit

- A collection of open-source software products that can be instantiated to streamline, standardize, and automate TDAMM workflows.
- Deployed locally by Observers and Operations Teams, with or without support from ACROSS SMEs.
- Future TDAMM grant program will incentivize community contributions to the toolkit.

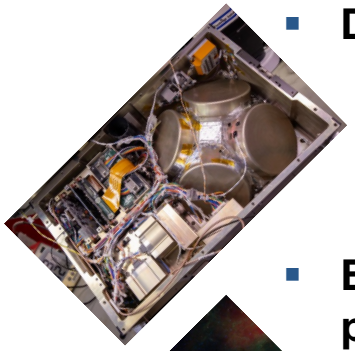
High-Level Architecture: Future State Context Diagram



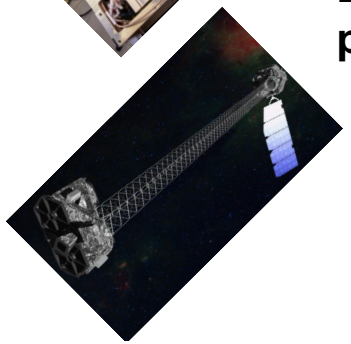
Highlighted Recent Accomplishments



- **Pre-coordinated gravitational-wave follow-up plans among current NASA X-ray missions and XMM-Newton during the LVK O4 runs.**
  - Established an O4-follow-up Slack channel for rapid science team coordination.
  - Demonstrates a value-added function provided by an ACROSS TDAMM Help Desk.



- **Developed a Minimum Viable Product TDAMM web service for BurstCube**
  - Supports reprioritization and downlinking of priority science event data.
  - Serves as a pathfinder for how ACROSS manages and implements value-added interfaces with in-development mission science teams and systems.



- **Established interfaces to receive NuSTAR near-future/recent-past observing plans**
  - Fills a gap in science situational awareness for both observers and science teams.
  - Serves as a pathfinder for how ACROSS manages and implements value-added interfaces with current NASA mission science teams and systems.

Study Year 2: Coordinating with U.S. Ground Assets

- **Objectives:**
  1. Assess the landscape of infrastructure efforts among the ground-based community.
  2. Understand what information from the NASA fleet needs to be exposed to the ground-based community and vice versa.
  3. Discuss what tools, platforms, or services can be shared or co-developed between NASA and the ground-based community.
- **Tasks & Status:**
  - Participated in the NOIRLab-hosted Windows on the Universe: Establishing the Infrastructure for a Collaborative Multi-messenger Ecosystem workshop and white paper.
    - Using the white paper recommendations to inform the TDAMM GO Program design.
  - Meeting with developers of widely used ground observatory software infrastructure tools (TOM Toolkit, SkyPortal, YSE PSE, AEON) to understand workflows, options for interfacing ACROSS data streams and web services.
  - Meeting with observers to survey user experience of coordinating observing campaigns between ground and space assets.
  - Holding monthly meetings with the ACROSS Advisory Group to provide status and receive feedback.

TDAMM Community Grant Program & Current Status

- **Subject to funding availability and suitable mechanism, Phase I study identified opportunities for community grants in 3 areas,**
  1. Development of tools and observing modes that enable new TDAMM science cases.
  2. Funding unplanned TDAMM-related observations made by smaller missions (analogous to flagship DDT opportunities).
  3. An overarching TDAMM science call for proposals designed to streamline or fill the gaps between existing joint observing calls, remove the risk of double jeopardy, and explicitly support observing programs which require coordination between two or more observatories.
- **National Science Foundation's recent Windows on the Universe Workshop and White Paper validated our Phase I study findings**
  - NSF recently released an infrastructure grant program "Multi-Messenger Coordination for Windows on the Universe."
- **We will continue definition and refinement of the grant program design, in consultation with stakeholders, Missions and Program Scientists for other NASA Grant programs, targeting 2026 call.**

Summary

- **ACROSS was developed as a result of the 1st year of the TDAMM study, with a goal of partnering with observers and science teams to provide services and infrastructure that enable the full potential of time domain and multi-messenger (TDAMM) science**
- **The study continues, to understand how this coordination can extend to ground-based and international observatories**
- **What we're developing:**
  - TDAMM Toolkit & API sharing observatory state and status information, observing plans, observability constraints, and target of opportunity (ToO) request pages
  - Web Portal: links to tools, ToO requests, funding opportunities, conferences, and Events of Interest pages
  - TDAMM Research Announcement: Initial call targeted for 2026, subject to availability of funds
  - Community support: help desk, documentation, tutorials, and workshops