An Overview of the Astrophysics Cross Observatory Science Support (ACROSS) Initiative

Christopher J. Roberts

AAAC Meeting

November 19, 2024

Artist's rendering of a supermassive black hole powering an active galactic nucleus. Credit: NASA JPL-Caltech

Agenda & Acknowledgements

- **Motivation & Background**
- **Vision & Mission**
- **System Architecture & Example Implementations**
- **4th TDAMM Workshop Announcement**
- **Closing Remarks**
- **Questions**

ACROSS Core Team:

Physics of the Cosmos Program
Brian Humensky
Chris Roberts

Penn State University
Jamie Kennea

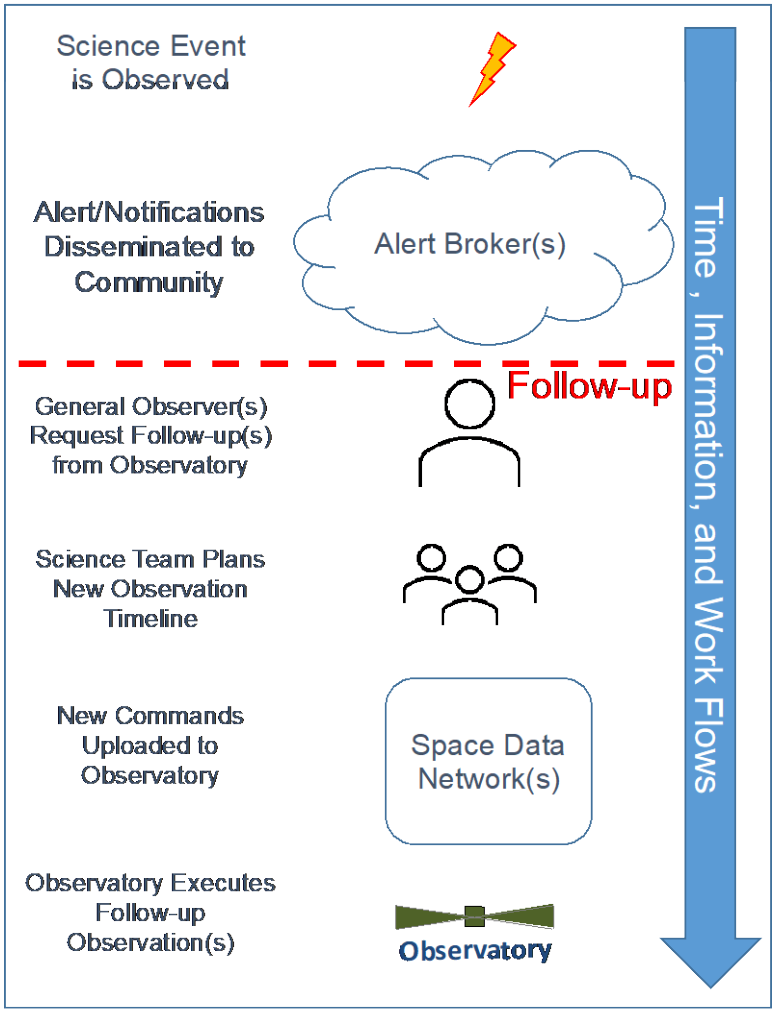
Marshall Space Flight Center
Dan Kocevski, Michelle Hui, Adam Goldstein, Cori Fletcher

Goddard Space Flight Center
Tom Barclay, Nitzan Frock, Christina Hedges, Craig Pellegrino, Tyler Pritchard, Kirill Vorobyev, Sam Wyatt

Motivation

- NASA's competitive mission selection processes deliver an evolving fleet with the required ***diversity*** to push back the frontiers of knowledge.
  - Observational diversity is enhanced when NASA's fleet is used in compliment with ground-based and international observatories
- NASA's mission development and operations funding structures ensure focused and lean science teams, but have ***unintended consequences***.
  - It is difficult for missions to allocate resources for capabilities that are not directly aligned with their primary science cases.
  - Whan a science event of mutual interest occurs, follow-up is often ad-hoc, inefficient, and less scientifically effective than it could be.
- NASA's competitive general observing programs are ***not well suited for some important science cases***.
  - For example, rare events and sources that are rapidly evolving, panchromatic or multimessenger, among others.

General Observing Process (Pointed Mission Follow-up)



Background

- In response to a top priority recommendation of the Astro2020 decadal report, the Physics of the Cosmos (PhysCOS) Program was tasked to:
  1. Organize or support **TDAMM Workshops** at regular intervals,
  2. Conduct a three phase **TDAMM Study** investigating ways to improve coordination within the NASA fleet, with U.S. ground-based observatories, and internationally,
  3. Recommend **implementations** for enabling TDAMM science.

- The Astrophysics Cross-Observatory Science Support initiative is an outcome of the first phase of the TDAMM Study, which identified needs for:
  1. **Software and data systems** to facilitate TDAMM workflows,
  2. A **help desk** to provide subject-matter expertise & facilitate coordination,
  3. A **community grant program** to incentivize scientific innovation

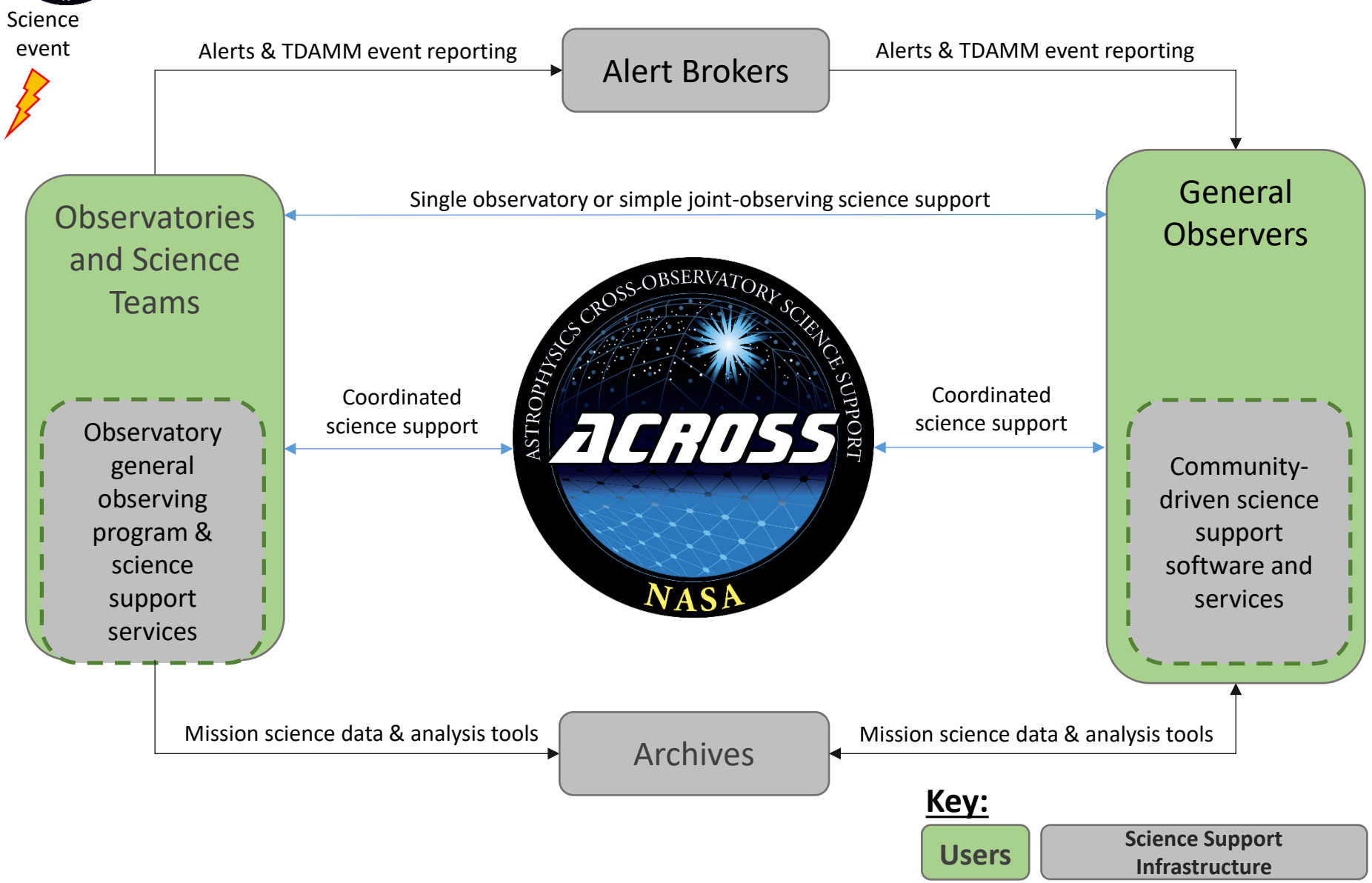
"NASA's astrophysics cross-observatory science support (ACROSS) initiative: enabling time-domain and multimessenger astrophysics," *Frontiers in Astronomy and Space Sciences*, vol. 11, Nov. 2024

Vision & Mission

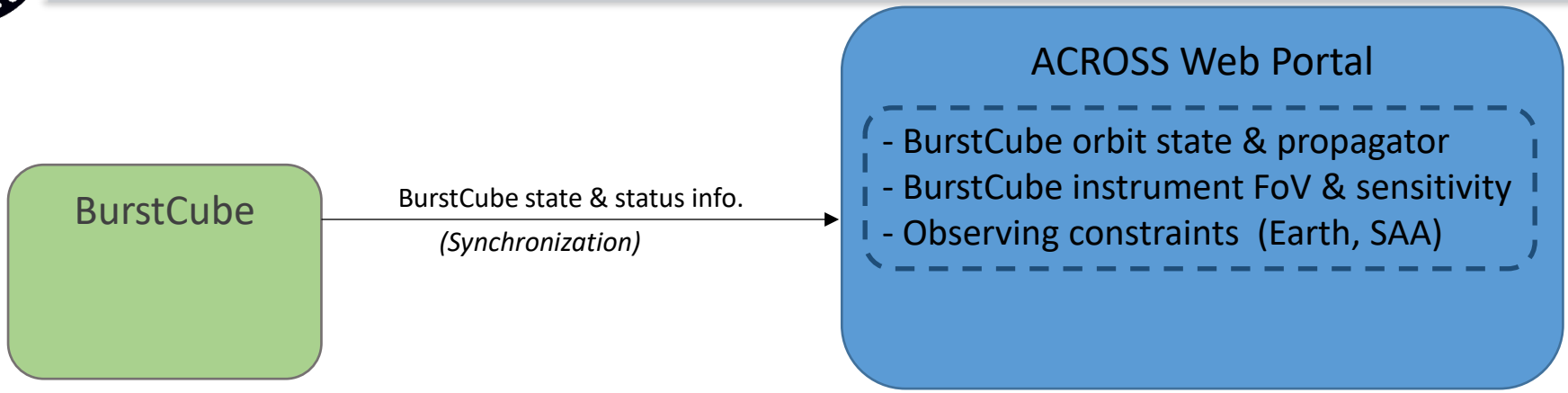
To enable effective TDAMM science cases by providing NASA's fleet-wide coordination infrastructure.

We partner with missions, observers, and science teams across multiple astrophysics domains to maximize the scientific return of NASA's contributions to the diverse, global, and evolving TDAMM ecosystem.

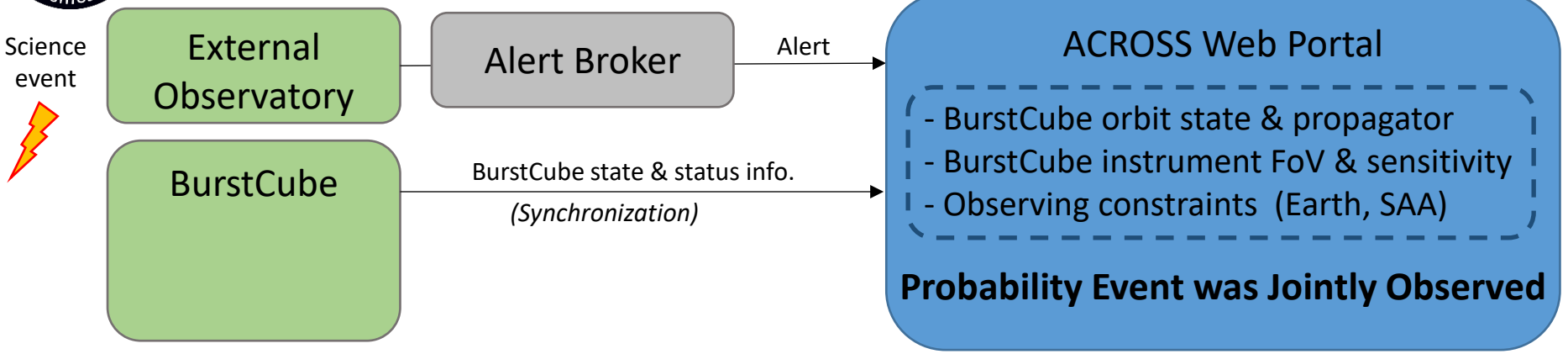
TDAMM Ecosystem Model



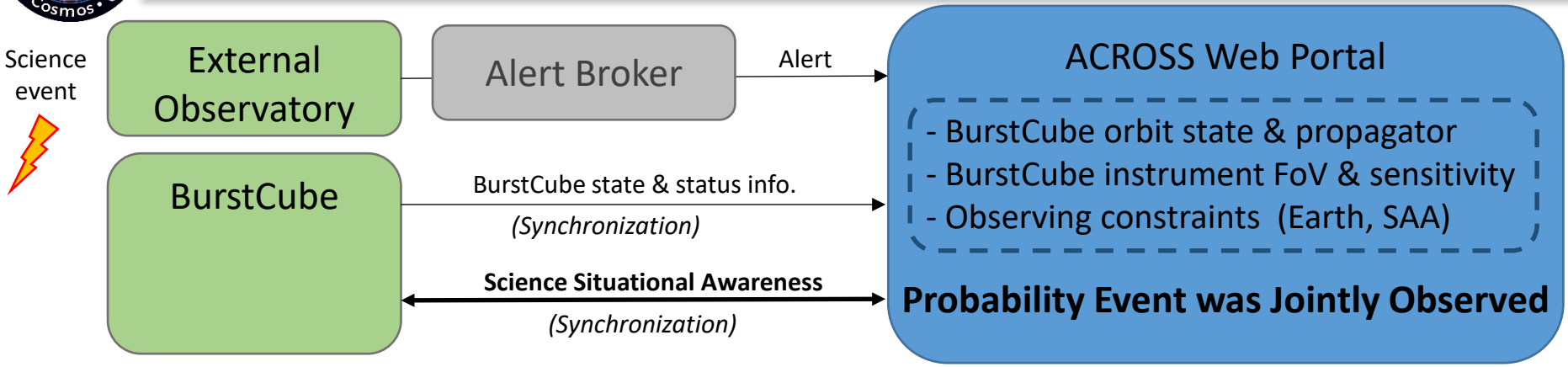
Example Implementation: BurstCube



Example Implementation: BurstCube (1)



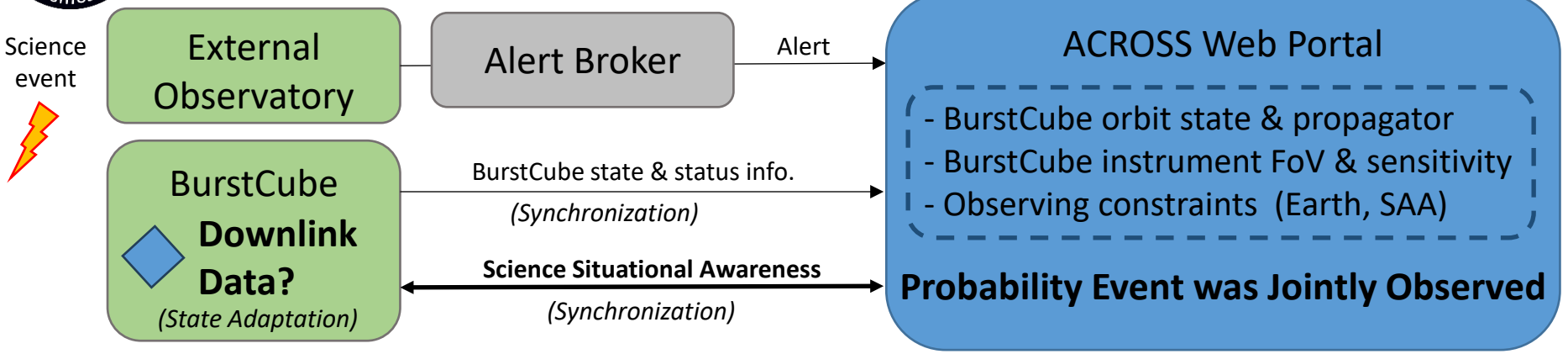
Example Implementation: BurstCube (2)



Example Science Situational Awareness Dashboard

trigger_time	trigger_info	too_info
2024-05-07 04:16:32.362000	Show Trigger Info	Probability inside FOV: 70.86%.
2024-05-07 04:16:32.352000	Show Trigger Info	Probability inside FOV: 25.74%.
2024-05-06 10:20:29.884000	Show Trigger Info	Probability inside FOV: 81.18%.
2024-05-04 13:31:47.236000	Show Trigger Info	Probability inside FOV: 92.41%.

Example Implementation: BurstCube (3)



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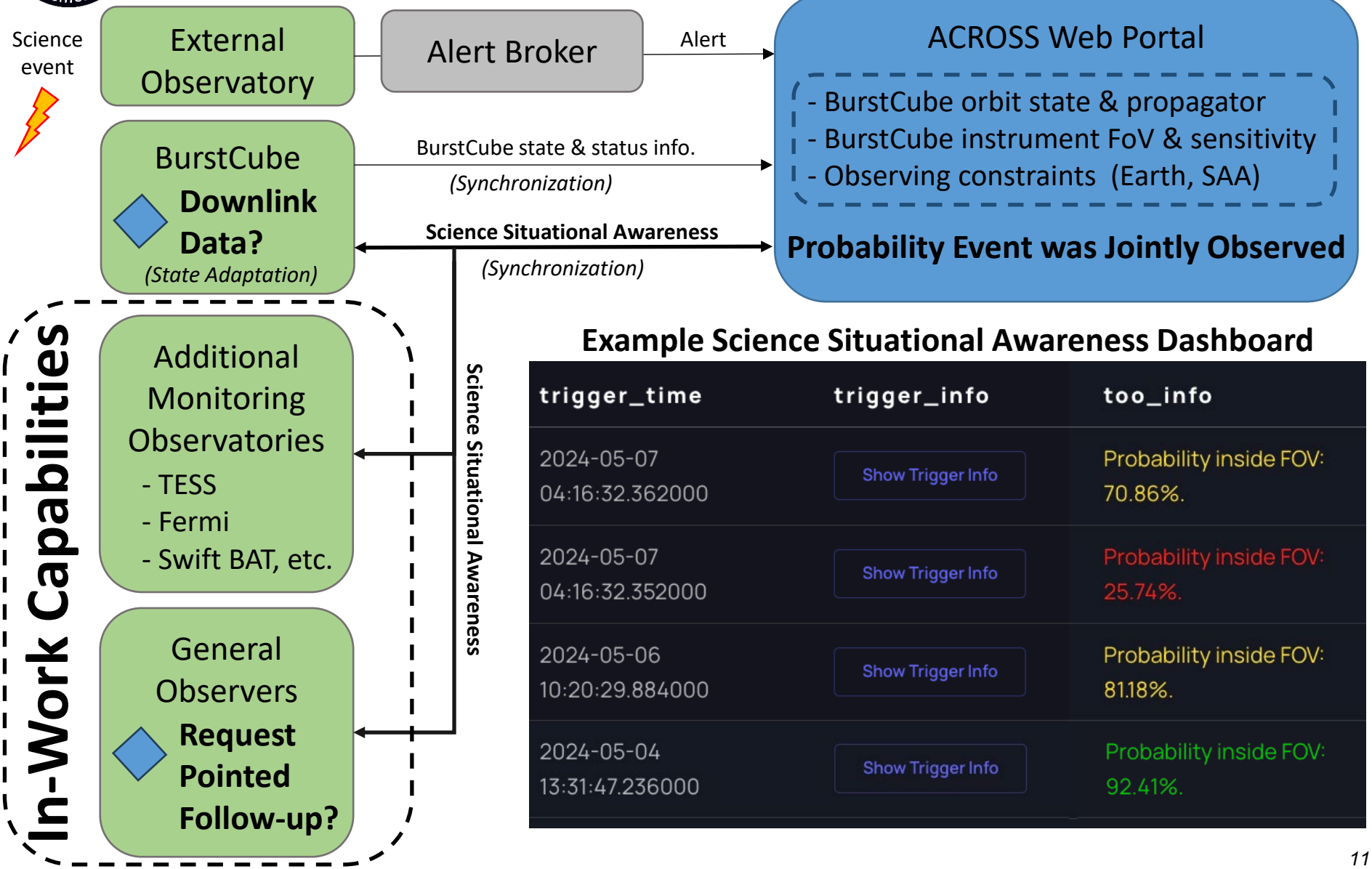
Example Implementation: BurstCube (4)



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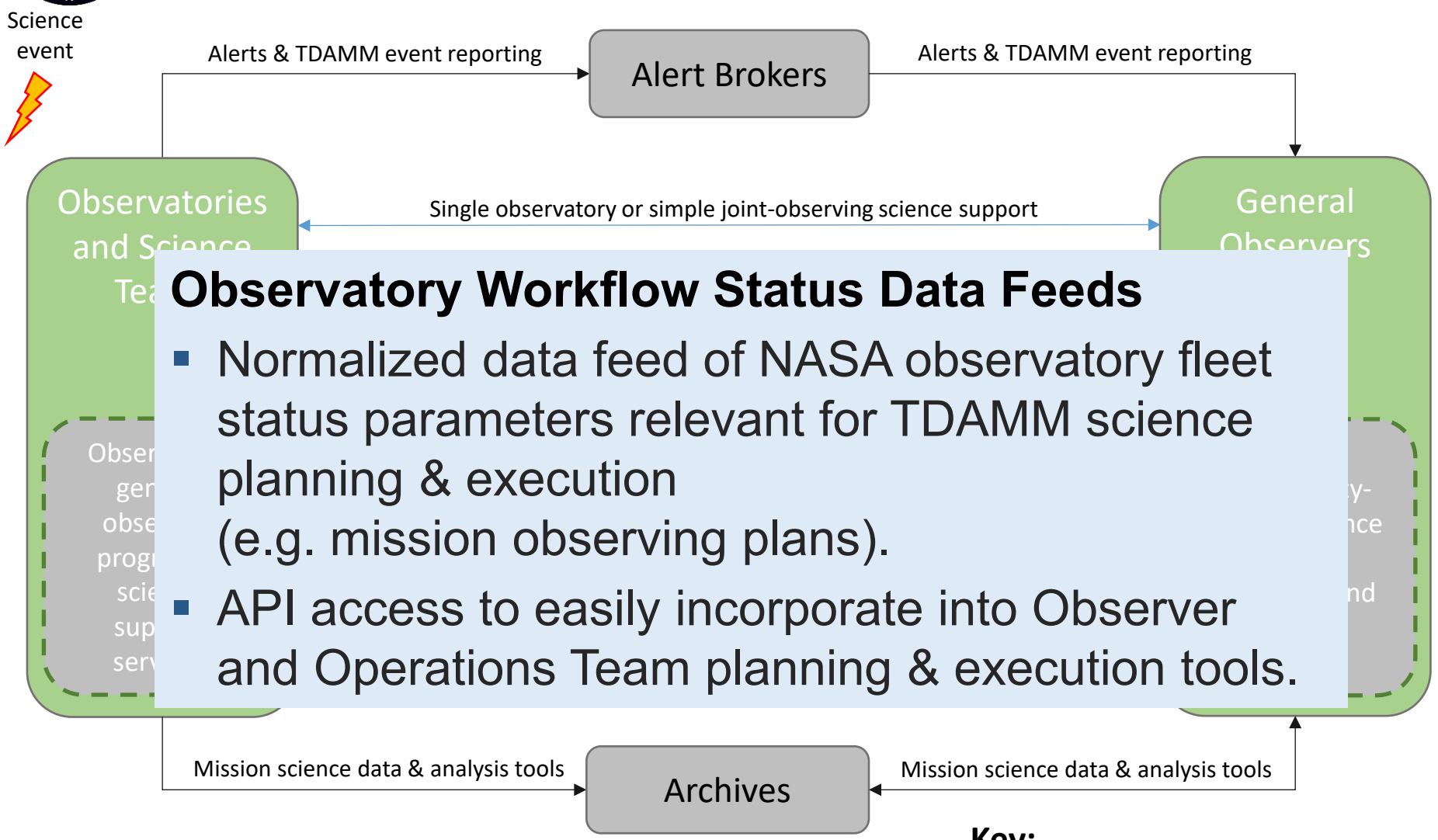
ACROSS Products to Enrich the TDAMM Ecosystem (1/3)



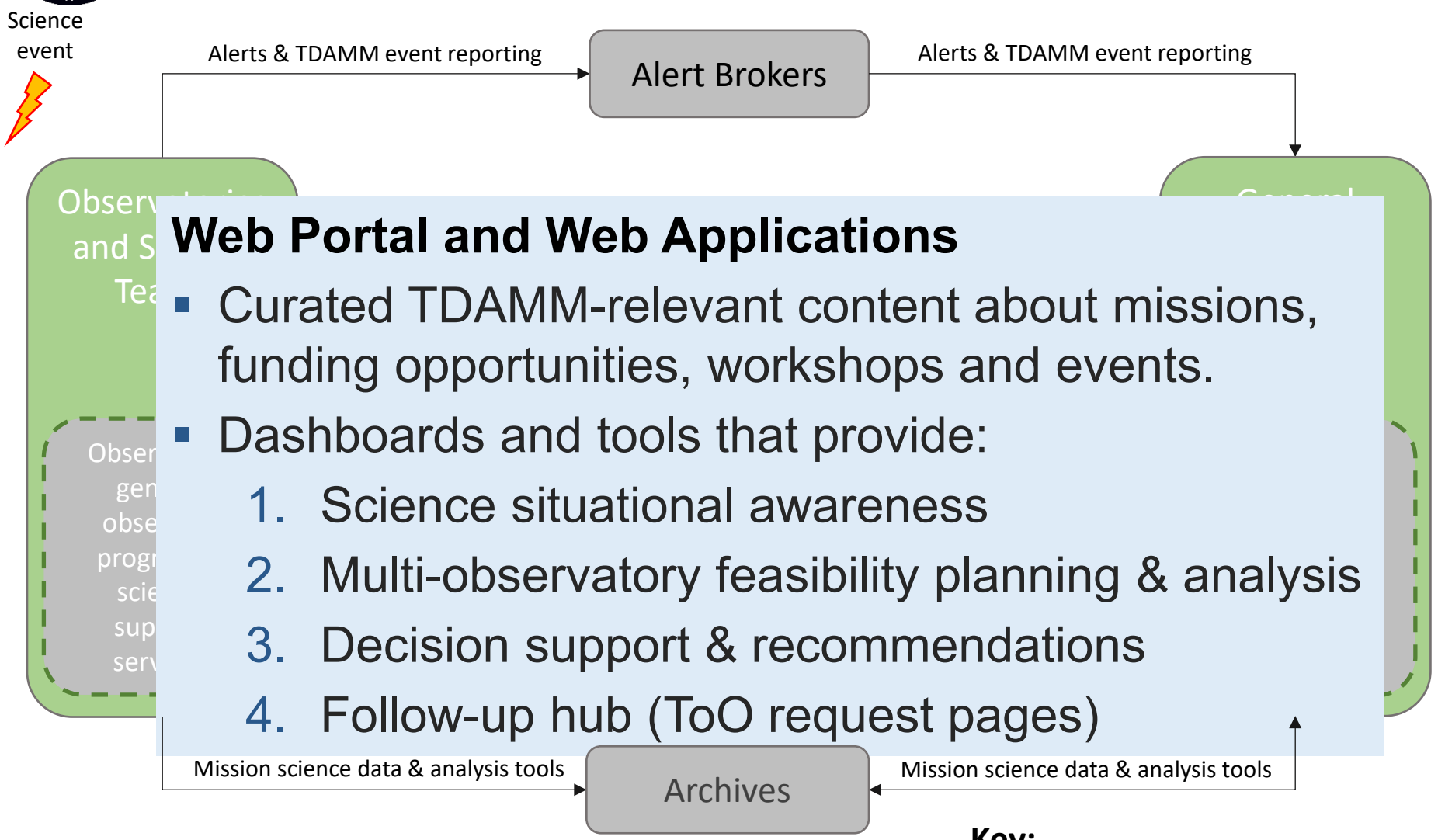
Observatory Workflow Status Data Feeds

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

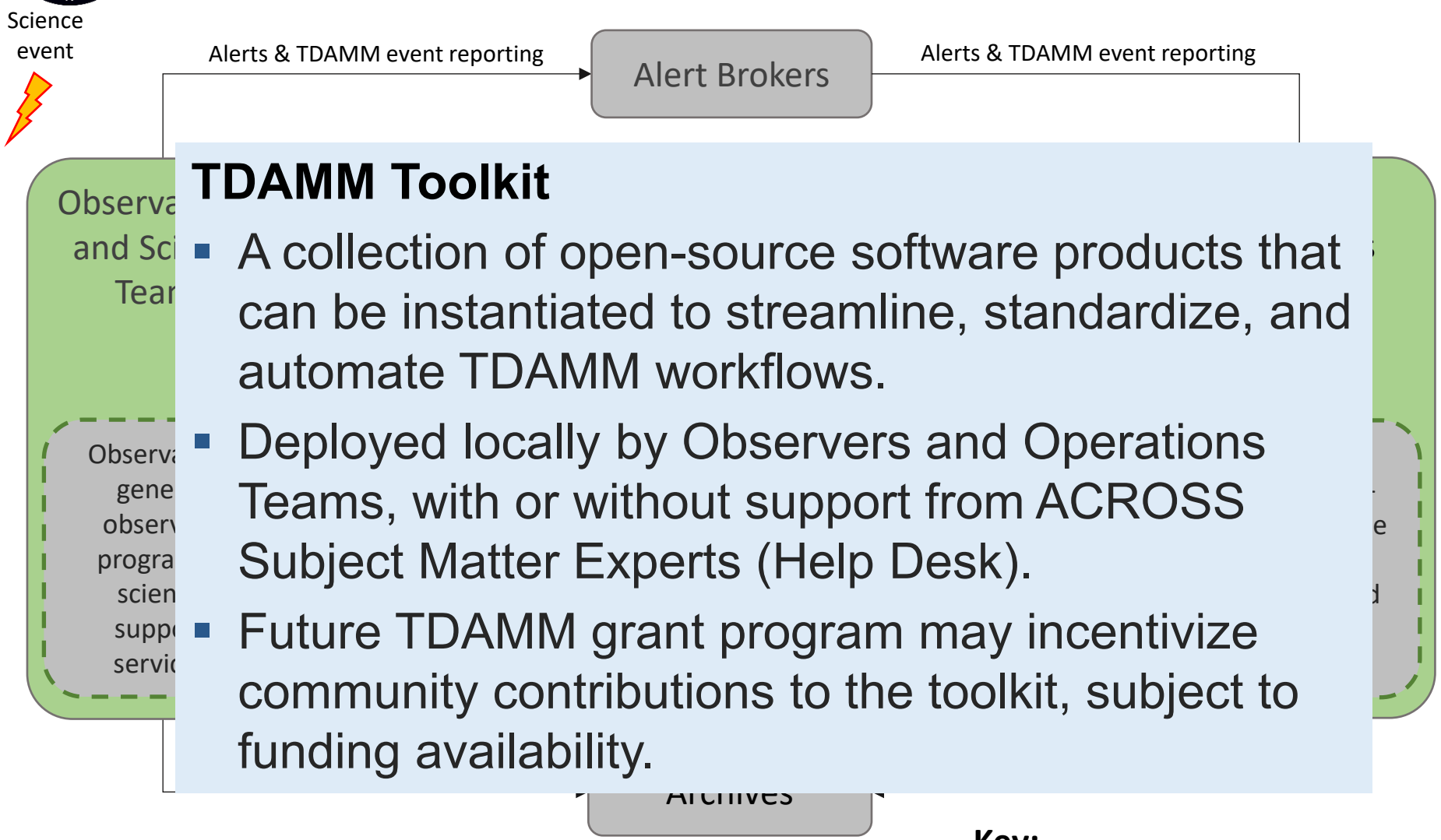
Key:

Users | **Science Support Infrastructure**

ACROSS Products to Enrich the TDAMM Ecosystem (2/3)



ACROSS Products to Enrich the TDAMM Ecosystem (3/3)



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 Subject Matter Experts (Help Desk).
- Future TDAMM grant program may incentivize community contributions to the toolkit, subject to funding availability.

Announcing the 4th TDAMM Workshop

Theme

- Community-defined coordinated observing concepts for rare and important transient events.

Motivation

- Define and prioritize science cases, triggering criteria, and the essential follow-up observations – ground and space – public and private – desired by the community so that observatory science teams can pre-coordinate plans and efficiently execute community-driven observations.

Timeframe:

- ± November 2025: U. of Alabama – Huntsville / USRA.

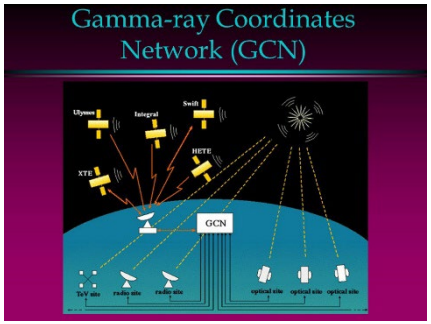
Closing Remarks

My journey from space communications to ACROSS, so far…

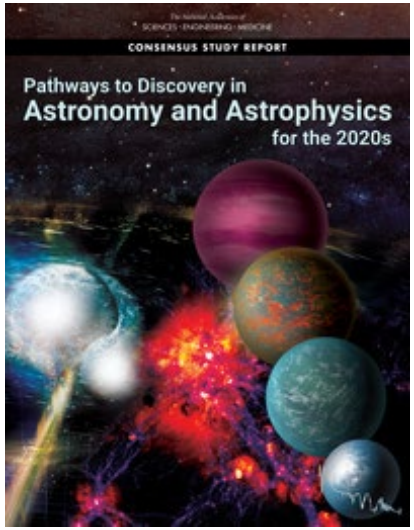
BURSTCUBE

Swift

GW170817



Space Communications Responsive to Events Across Missions (SCREAM)



ASTROPHYSICS CROSS-OBSERVATORY SCIENCE SUPPORT
ACROSS
NASA

We are building coalitions to create virtuous cycles of continuous improvement to expand the frontiers of human understanding.

A. Tohuvavohu *et al.*, "Swiftly Chasing Gravitational Waves across the Sky in Real Time," *Astrophysical Journal Letters*, vol. 975, no. 1, p. L19, Oct. 2024

Questions?

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