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

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

Agenda & Acknowledgements

- **Background**
- **Vision & Mission**
- **Capability Development Focus Areas**
- **Status & Schedule**
- **4th TDAMM Workshop**
- **Q&A**

ACROSS Core Team:

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Background

- **In response to the U.S. National Academies of Science Astro2020 decadal report recommendation on Time-Domain and Multimessenger (TDAMM) Astrophysics, NASA's Physics of the Cosmos (PhysCos) Program was tasked to:**
  - Conduct a study investigating ways to improve coordination within the NASA fleet, with U.S. ground-based observatories, and internationally.
  - Recommend implementation options for enabling TDAMM science.
- **The Astrophysics Cross-Observatory Science Support (ACROSS) pilot is an outcome of the PhysCos TDAMM study**
  - Enables a "whole-of-fleet" approach to TDAMM by providing organizational, workforce, and technical infrastructure.
  - Involves NASA's operating missions and those in development.
  - Enriches and supports the broader TDAMM ecosystem.

"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 Statement

To provide NASA's fleet-wide coordination infrastructure and enrich the global TDAMM ecosystem.

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

How will ACROSS achieve its mission?

1. Science Feasibility Tools

2. Modern Target of Opportunity Resources

3. TDAMM Web Portal

4. Community Engagement and Innovation Program

The ACROSS capability development focus areas enable NASA's "whole-of-fleet" approach to TDAMM within the context of the global TDAMM ecosystem

1. Science Feasibility Tools

Science Feasibility Tools	Capabilities
Standardized Data Interfaces for Pointed and Wide-Field Instrument State/Status Information	• Long and short-term observing plans • Target visibility & observability • Constraints on planning / scheduling feasibility • Mission target histories
Value-added Applications for Wide-Field Instruments	• Whether an event-of-interest was coincidentally detected. • When was a source last within the Field of View? • When will a source next be within the Field of View?
Ground Observatories	• Analogous capabilities as above and/or Interoperability with externally developed services

ACROSS Science Feasibility Tools will be available as open-source software on GitHub and deployed as web applications

2. Modern Target-of-Opportunity (ToO) Resources

ToO Resources	Capabilities
ToO Application Programming Interface (API)	• A context-aware ToO submission API for all participating missions / observatories • Interoperability with externally developed services
ToO Web Application	• Front-end web interface for users to interact with the ToO API. • ToO submission history by mission and user • Incorporates cross-observatory science feasibility tools and provides follow-up decision support within the context of the global/ecosystem state and status
ToO Toolkit	• An open-source python software toolkit to assist in the programmatic planning and execution of ToO requests

ACROSS ToO Resources will be available as open-source software on GitHub and deployed as web applications

3. TDAMM Web Portal

Web Portal	Capabilities
Information Content	• TDAMM relevant information about NASA missions, funding opportunities, conferences & workshops. • Links to mission and external tools & resources
Dynamic Content	• Application Programming Interface and Front-end web interface for users to interact with the Science Feasibility Tools and ToO Resources
Help Desk	• Access to subject-matter-experts to assist in coordinating “ACROSS” multiple observatories • Access to report bugs or make contributions to our open-source software (via GitHub)

The ACROSS TDAMM web portal will provide a single point of entry for TDAMM community support

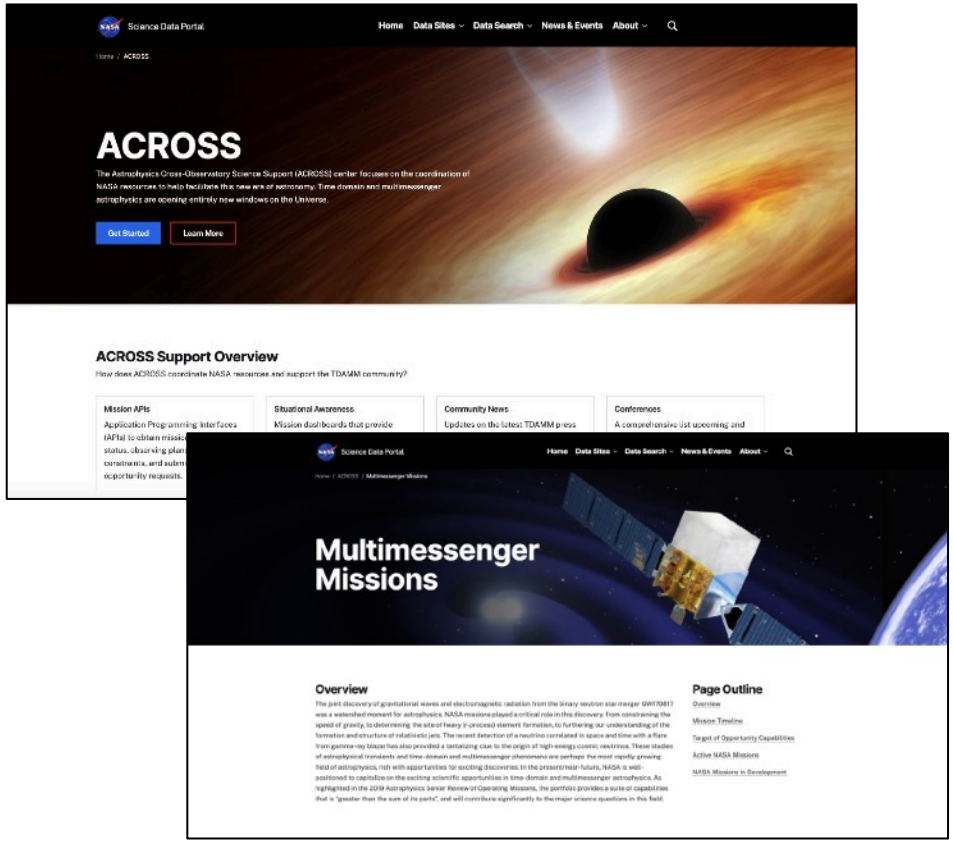
4. Community Engagement and Innovation Program

Community Support	Capabilities
TDAMM Workshops	• Organize and support TDAMM workshops • Facilitate definition and explore implementation options for enabling community science cases • Tutorials and training on ACROSS tools
Funding Opportunities	• Several concepts for incentivizing community engagement and innovation are under active development • All concepts are subject to funding availability
ACROSS participation in external / community-led initiatives	• Access and engagement to obtain community feedback. • Access and engagement to ensure cross-organization process and technical interoperability and to coordinate capability development roadmaps

ACROSS is a community resource and will adapt to respond to community priorities!

Status

- We have implemented an agile software development process in GitHub
- We are actively working through NASA's open-source software release process
- We anticipate launching our web portal and opening our GitHub to coincide with the 4th TDAMM workshop in October 2025

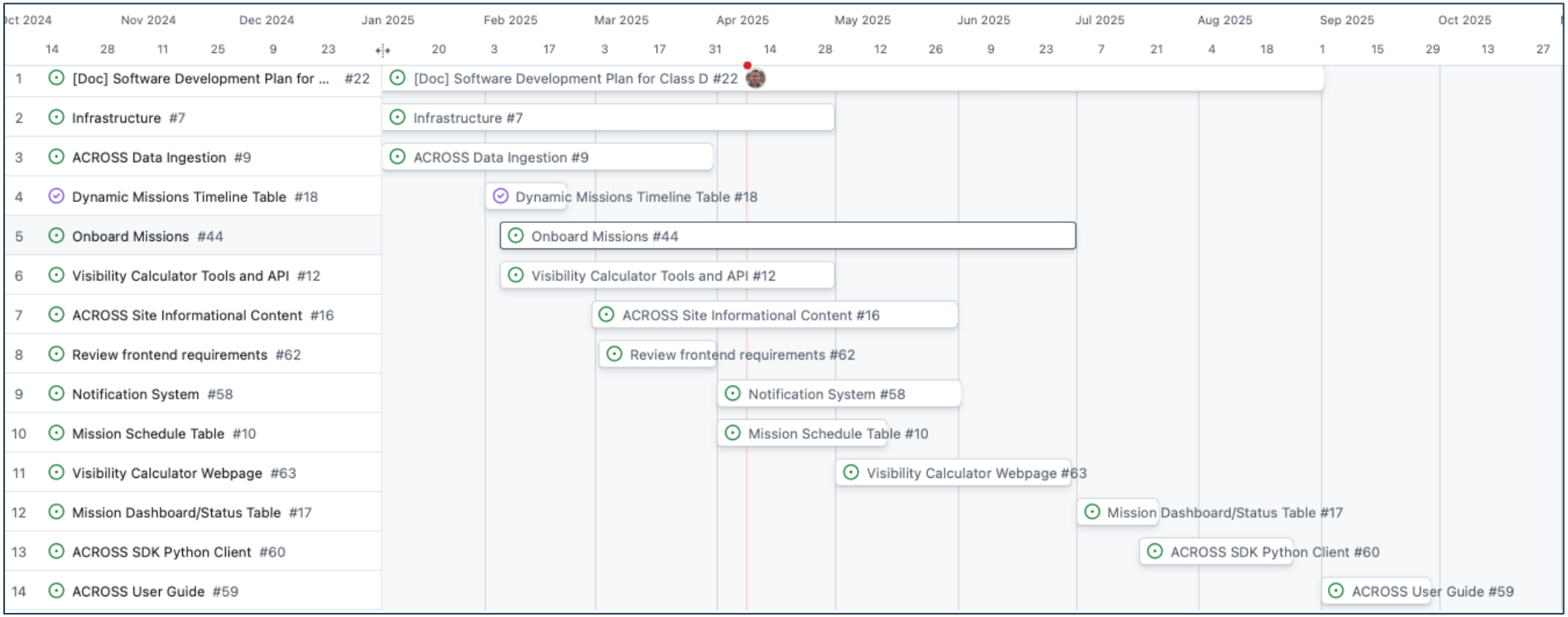


ACROSS Web Portal Structure & Page Layouts

We will be hosted as a Science Mission Directorate Interdisciplinary Site
science.data.nasa.gov/TBD

Technical Development Schedule

- **Our Initial Operating Capability includes information content and a data interface for observing plans of several missions**



We are on track to deliver an Initial Operating Capability by October 2025

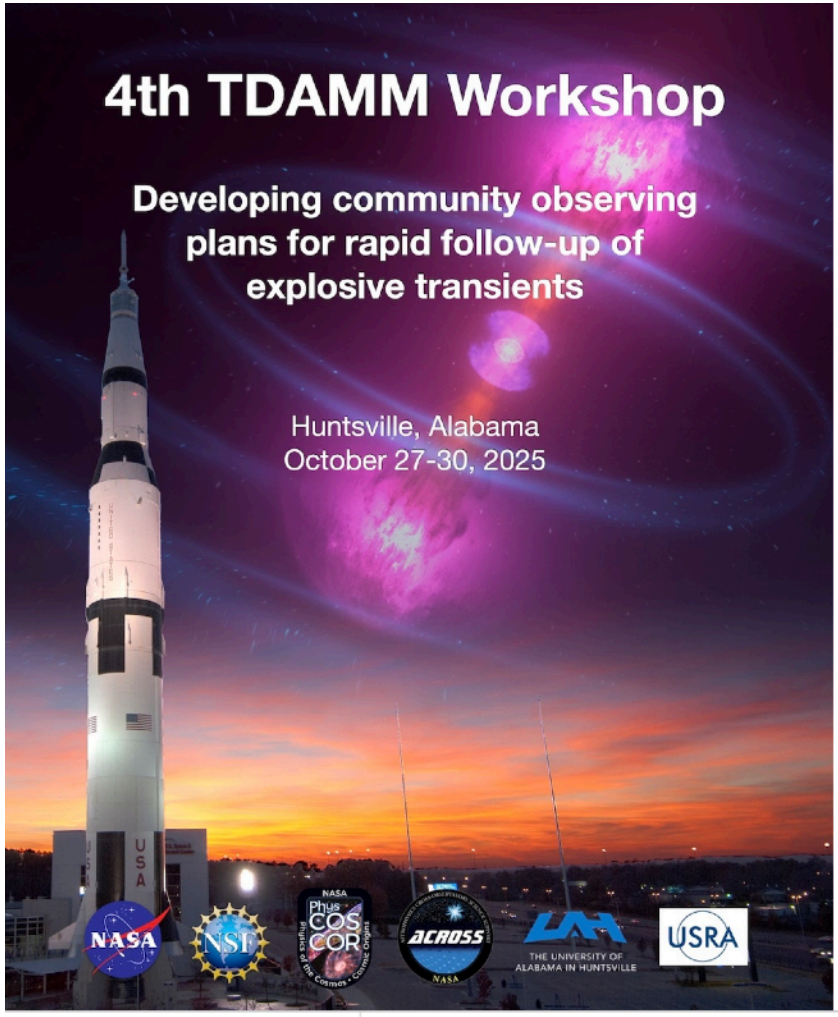
4th TDAMM Workshop

- **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.



Q&A

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Bonus Slides

- **Discussion of Burst-Cube ToO Architecture**

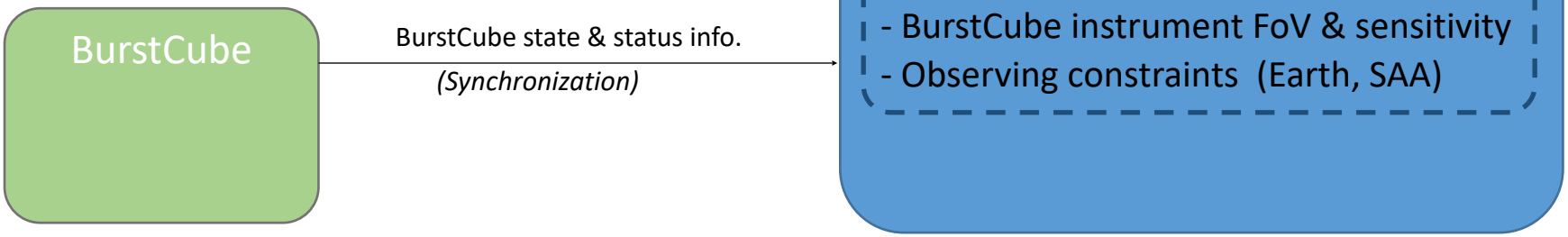
Example Implementation: BurstCube

- BurstCube was a NASA cubesat mission that launched from the International Space Station in 2024.

- Objective: Detect, localize and characterize short gamma-ray bursts and provide rapid alerts to ground observatories for follow-up observations

- ACROSS developed a “Minimum Viable Product” to increase the science return of BurstCube, right-size its software development process, and demonstrate the ACROSS value proposition

Example Implementation: BurstCube



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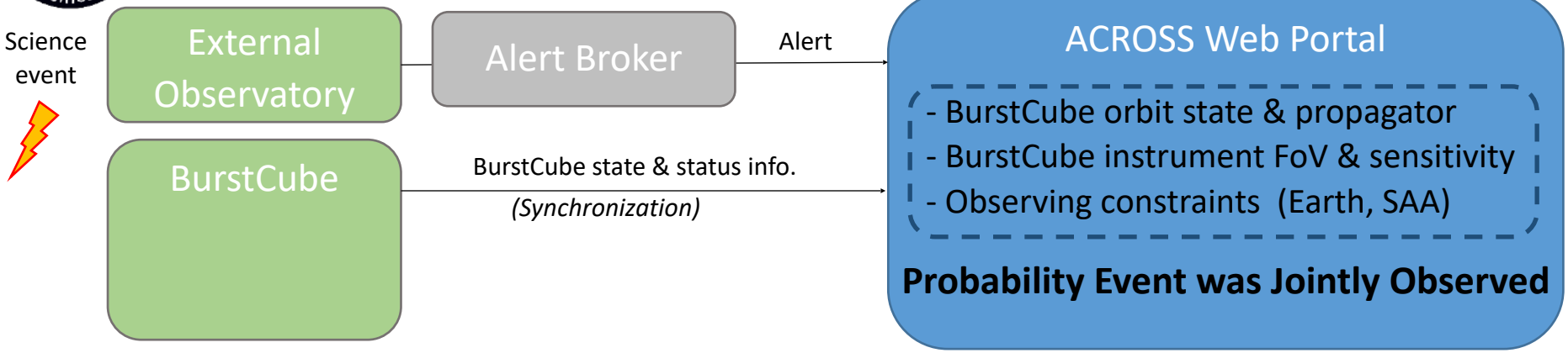

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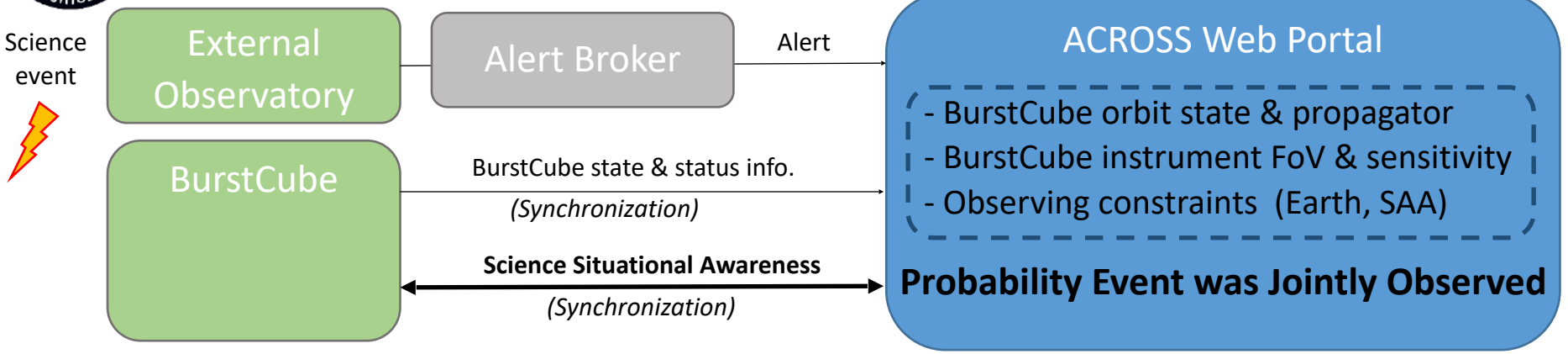

Example Science Situational Awareness Dashboard

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%.

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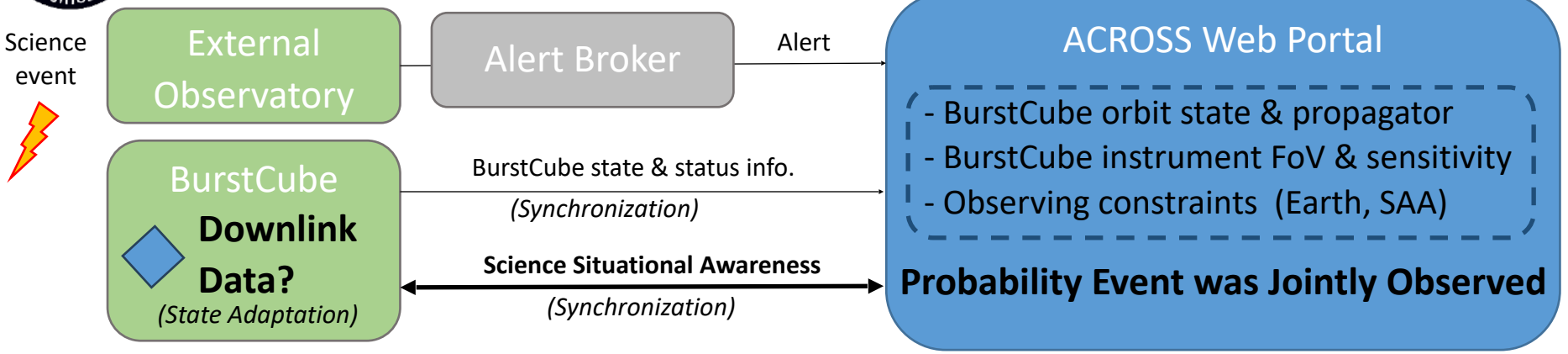

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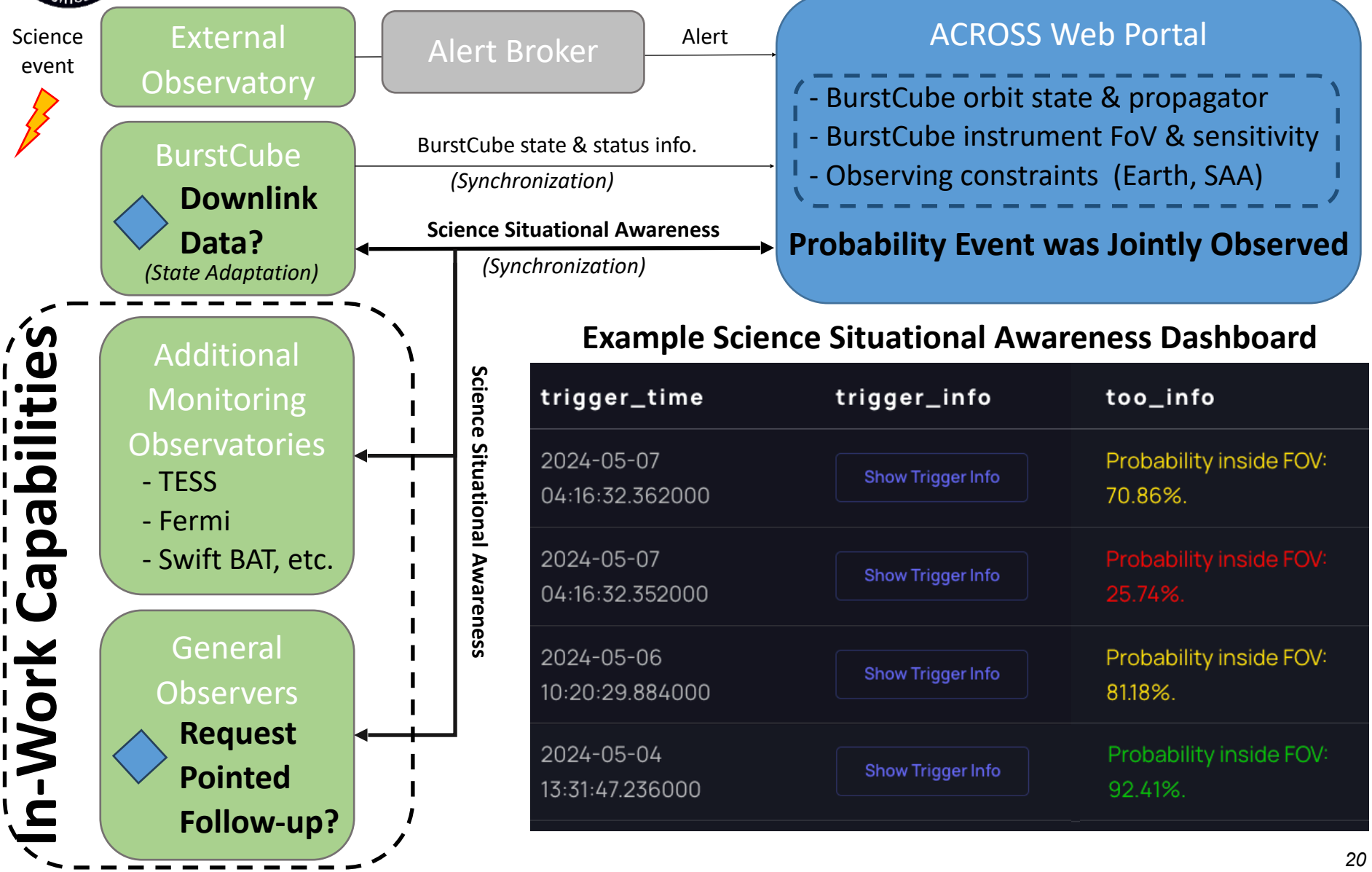

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