PennState
Eberly College of Science

SWIFT, ACROSS AND VO

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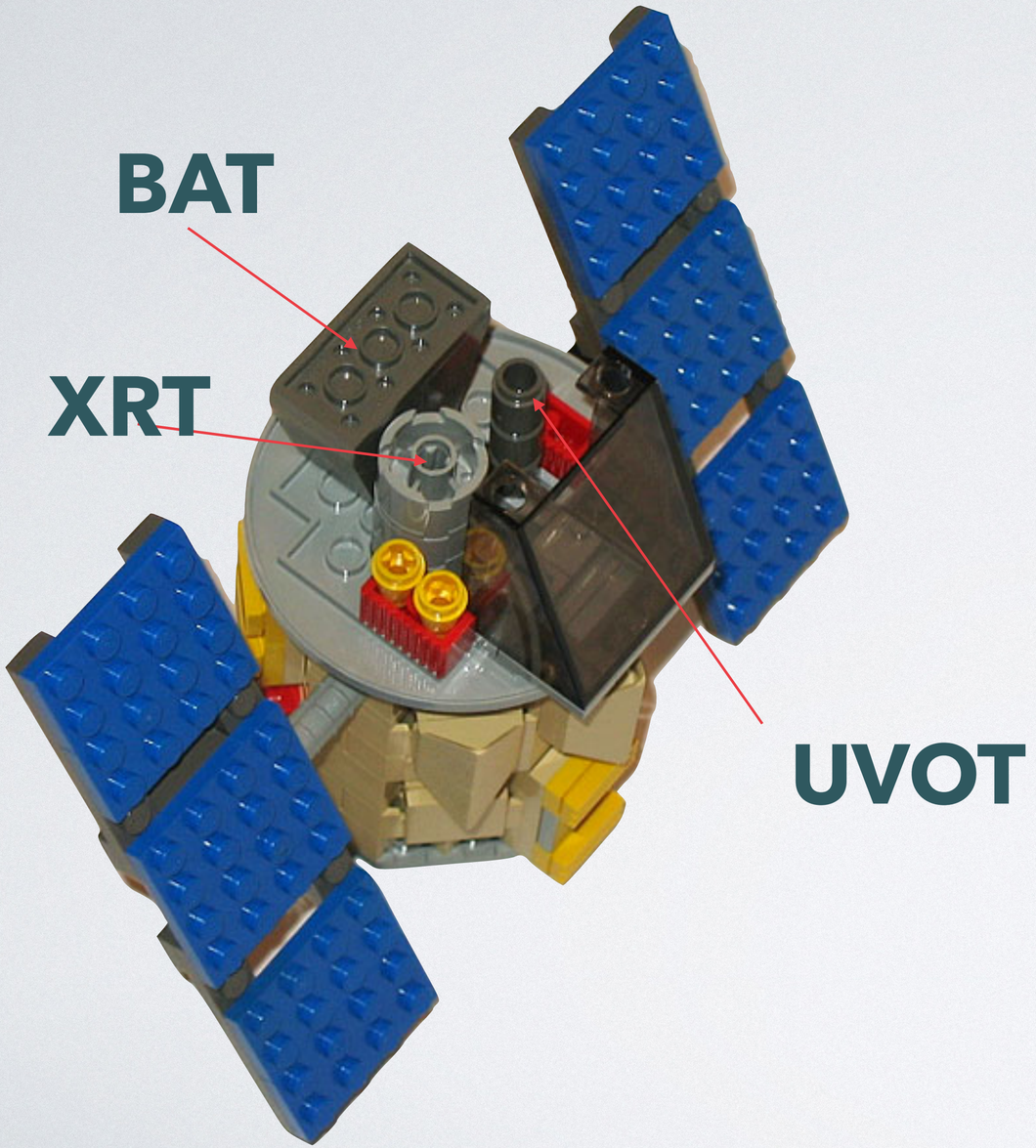
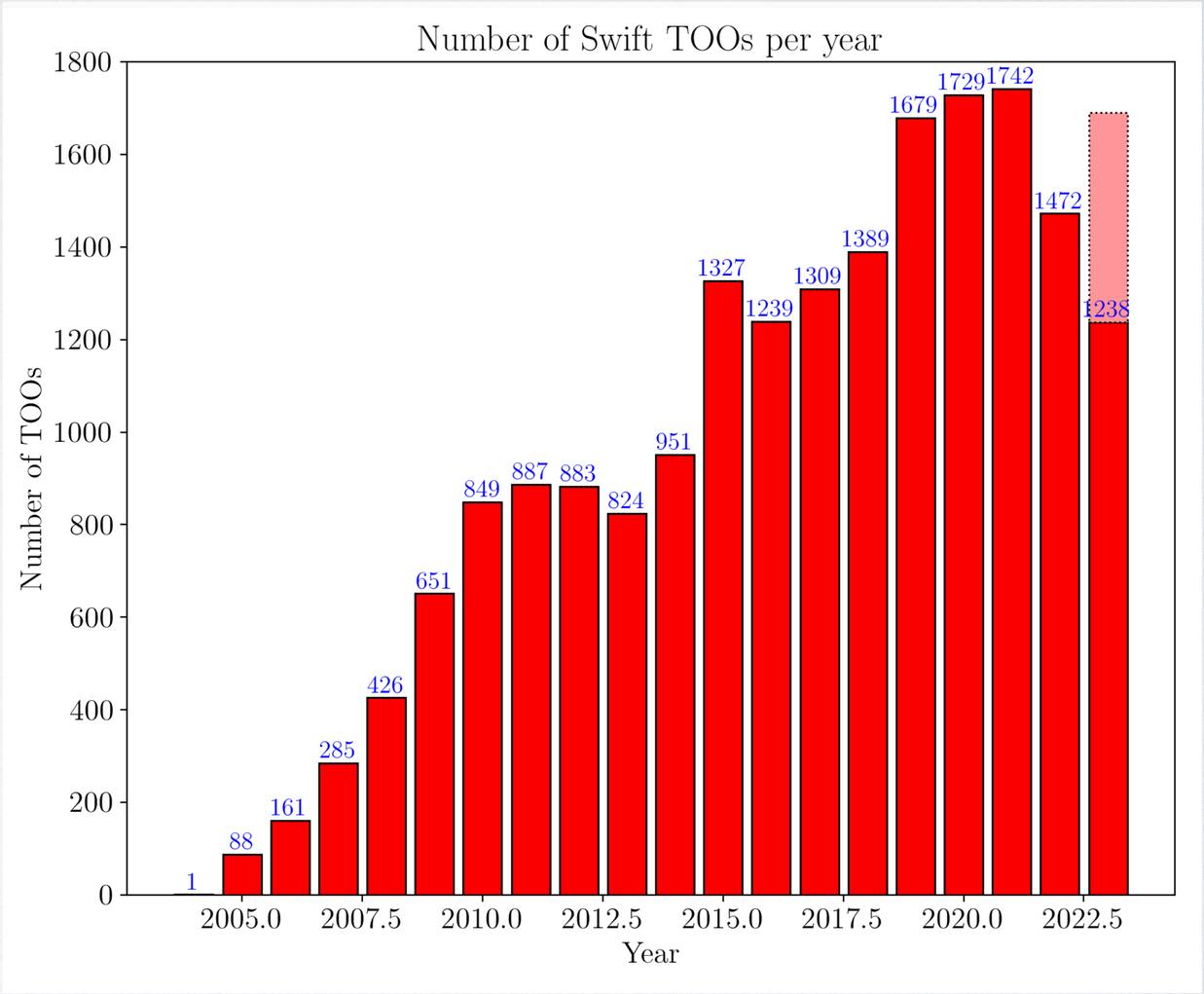
NEIL GEHRELS SWIFT OBSERVATORY



- **Multi-wavelength observations -** Space unique Hard X-ray/ X-ray / UV all in one package, simultaneously.
- **Transient discovery -** BAT is a hard X-ray transient all-sky (in a day) monitor.
- **Broad Science Portfolio** - Swift observes >100 targets per day, with a broad range of science topics.
- **Rapid slewing -** gets you to a GRB fast. Also allows for **very high efficiency** of operations (~72%, despite being in LEO and spending time in SAA). Also allows **time domain astrophysics** due to ability to perform high cadence high sensitivity monitoring.
- **Constantly evolving ground and onboard software -** we don't stand still evolving the operations concept.
- **Open Target of Opportunity (TOO) program with open data program -** Our TOO program is extremely open, with low rejection rates, and our data is made public ASAP.

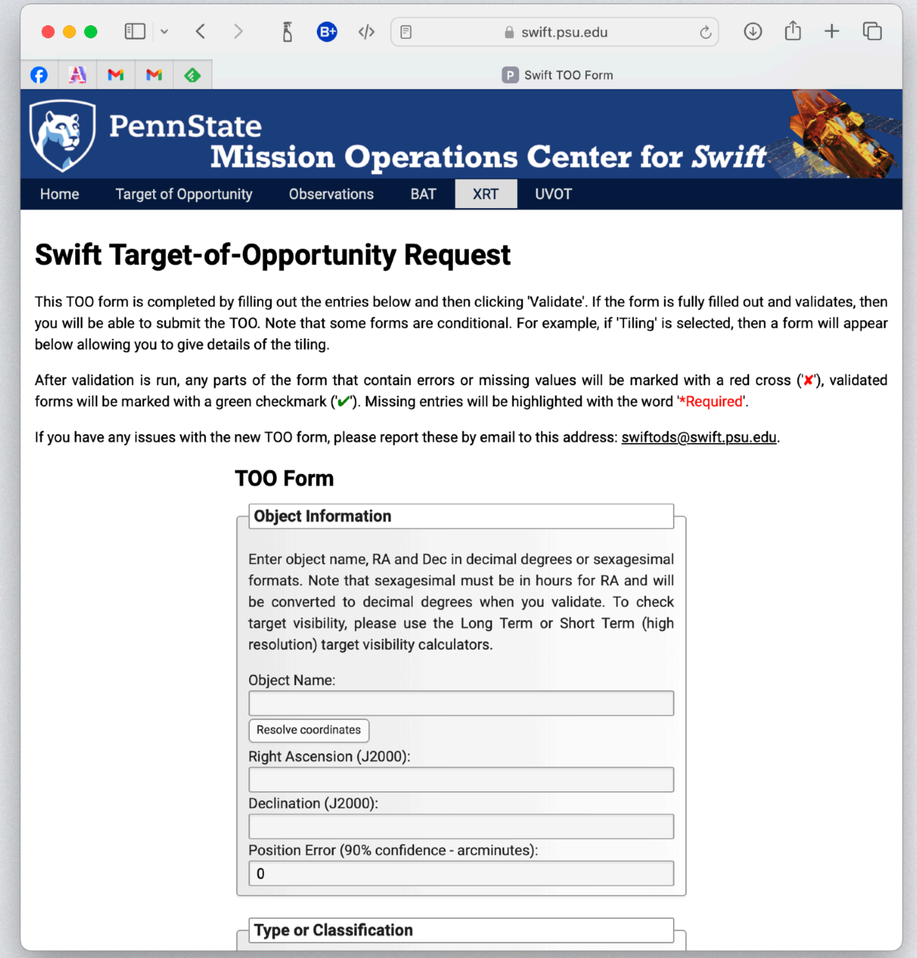
SWIFT RECEIVES A LOT OF TOOS

- 2021 - received 1742 TOOs in 1 year. 2023: ~1700 predicted.
- TOOs performed on “best effort” basis.
- The advent of large surveys such as ZTF and the upcoming Vera Rubin lead to development of an API to submit TOOs for Swift.
- Also we wanted to make Swift responsive to triggers from other GRB missions and also GW, so programatic submission of TOOs was a necessary step for this.



HOW TO SUBMIT A TOO

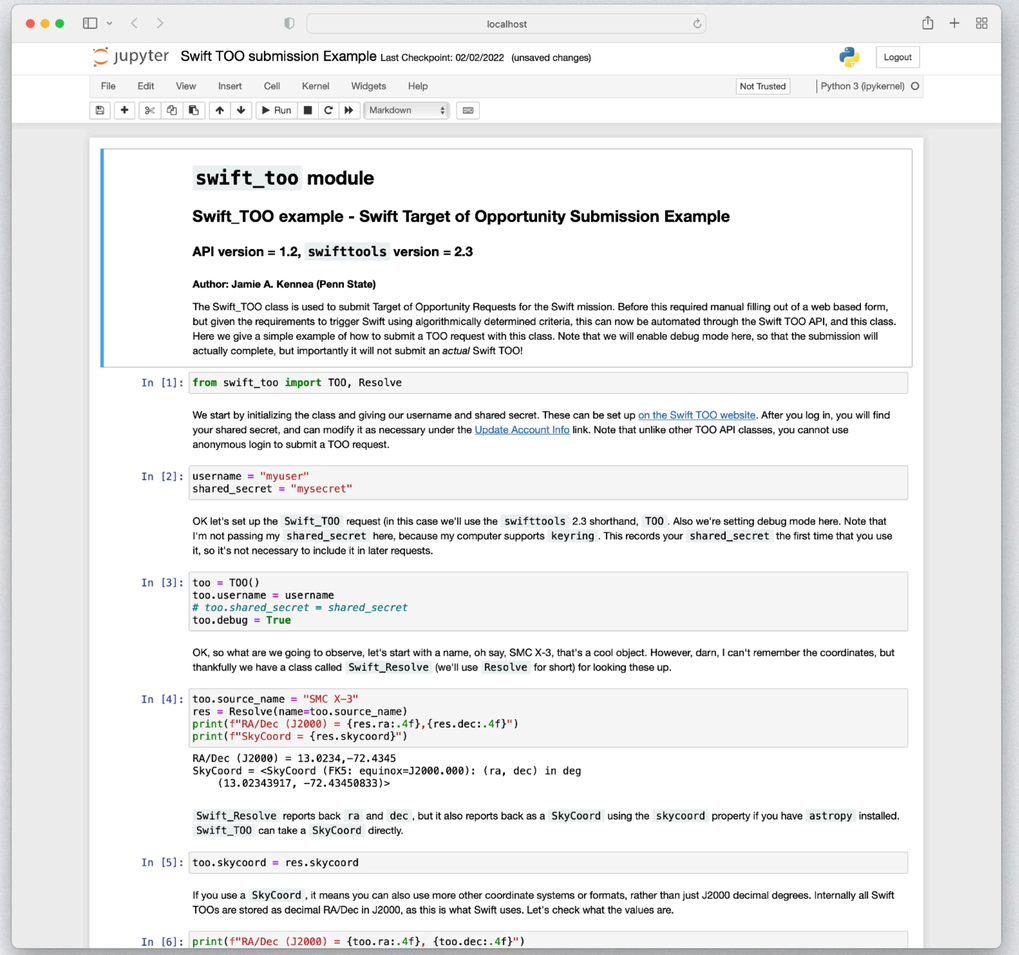
Using the TOO Web Page



https://www.swift.psu.edu/toop

(This is just an API client)

Using the Swift TOO API




```
# pip install swifttools
```

https://www.swift.psu.edu/too_api

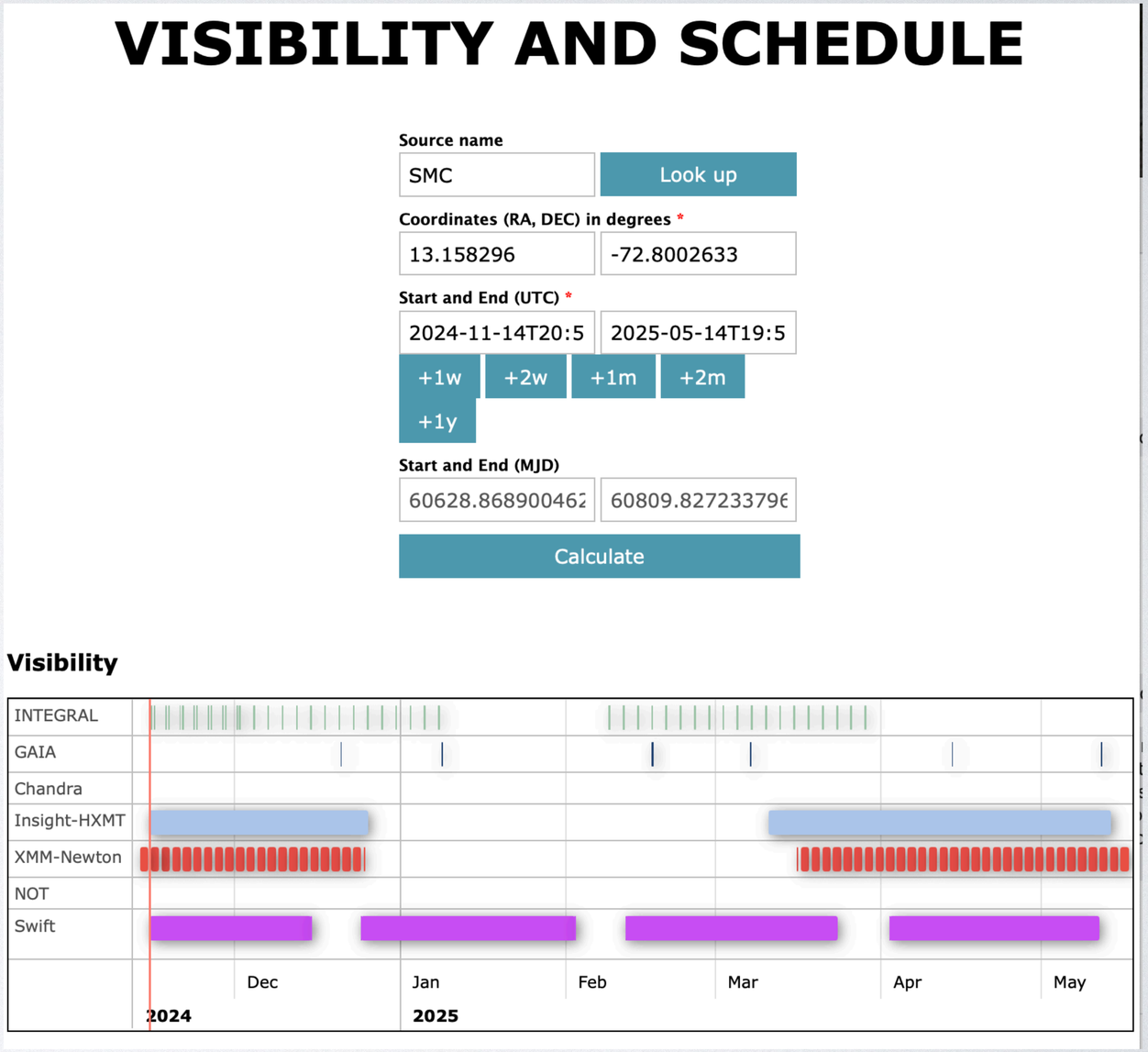
SWIFT TOO API

- Python / JSON based API with two main servers:
  - University of Leicester - X-ray Telescope Analysis API
  - Penn State Swift Science Operations Team API
- TOO API started off as just an API to submit TOOs but soon broadened to:
  - Fetching Observation Plan and Performed Observations
  - Instrument configuration APIs (e.g. convert UVOT hex modes into
  - Object Visibility Calculator
  - API for downloading data from Swift data from the three data centers in the USA (HEASARC + Swift quicklook), UK and Italy.
- As of last night, Penn State side of API has processed more 15 million API requests since launching in August 2020.
- Swift API has been **wildly successful.**

LCO's TOM Toolkit and SkyPortal have Swift TOO capabilities built in now thanks to the Swift TOO API integration.

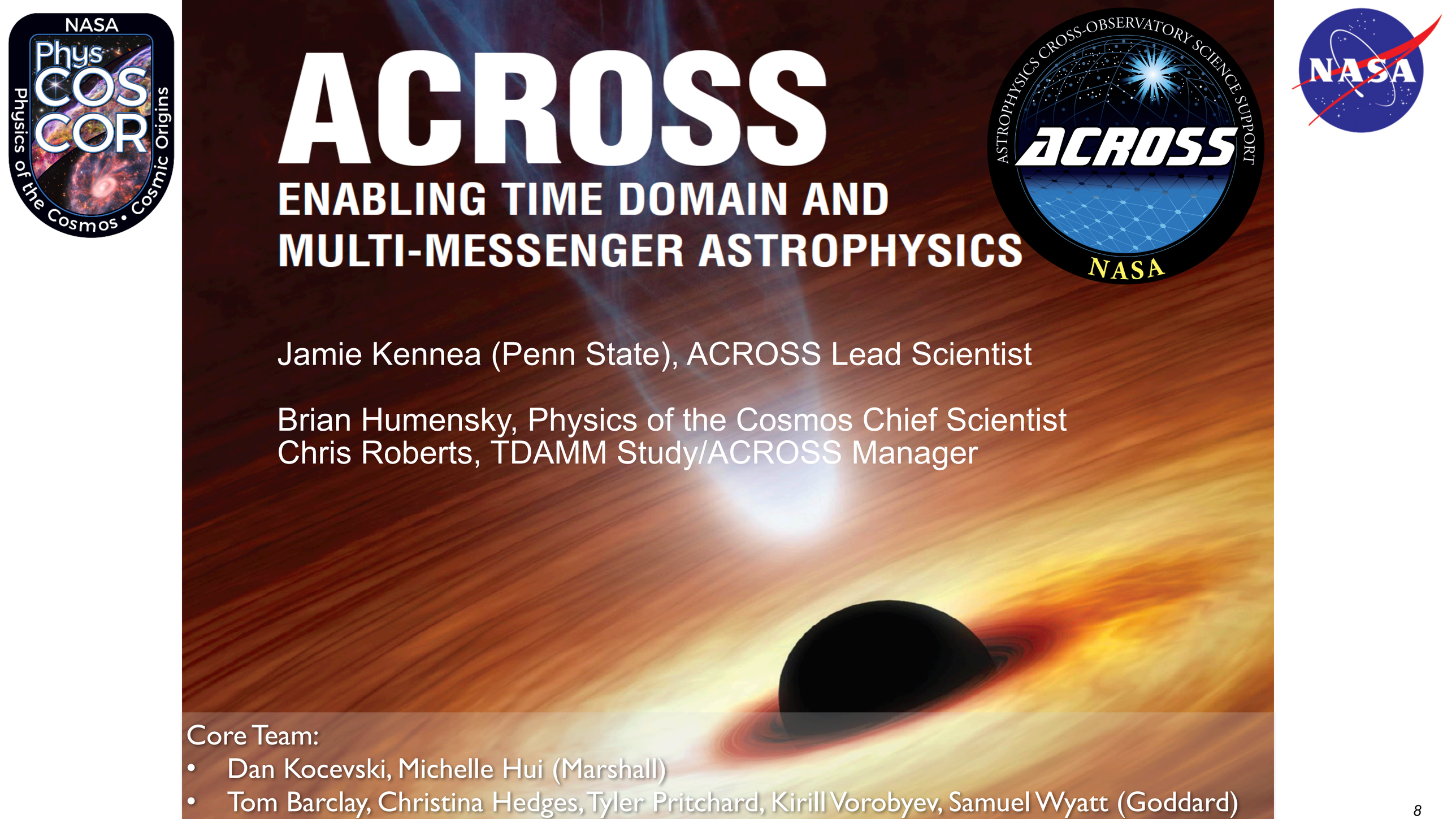
SWIFT AND VO

- I am a co-author of the ObsLocTAP and ObsVisSAP (AKA ObjObsSAP) protocols.
- Swift implemented ObsVisSAP protocol, simply as a WSGI application that calls the swifttools `VisQuery` python class and converts JSON output to VO format.
  - This implementation can be seen in action in the TOBY application: http://integral.esa.int/toby
- Swift does not currently implement ObsLocTap at the Science Operations Center.



WHY NO SWIFT OBSLOCTAP?

- Swift API `ObsQuery` and `PlanQuery` provides similar functionality, with Swift specific search parameters.
  - Should be possible to build support for a simple cone search version of ObsLocTAP on top of this like done for ObsVisSAP.
  - We haven't seen any demand for this feature from the community, so the resources haven't be put into it. Swift is highly cost constrained and low staffed.
- HEASARC should be able to provide this feature for data that has been sent to the archive. Caveat here is that Swift API data is updated in near realtime, HEASARC is longer latency.
- ADQL queries are complex to set up and APIs that process user submitted SQL queries caused Penn State IT Security to red flag it and clearly state "you cannot do this".
- Generally there's an issue where small missions like Swift do an outsized amount of stuff compared to their funding level.
  - Implementing things like the Swift API are out of working hours tasks for us.
  - Implementing VO standards will only be done if it can compellingly be shown to be wanted and **needed**. No funding available to do this.


ACROSS
ENABLING TIME DOMAIN AND
MULTI-MESSENGER ASTROPHYSICS
ASTROPHYSICS CROSS-OBSERVATORY SCIENCE SUPPORT
ACROSS
NASA
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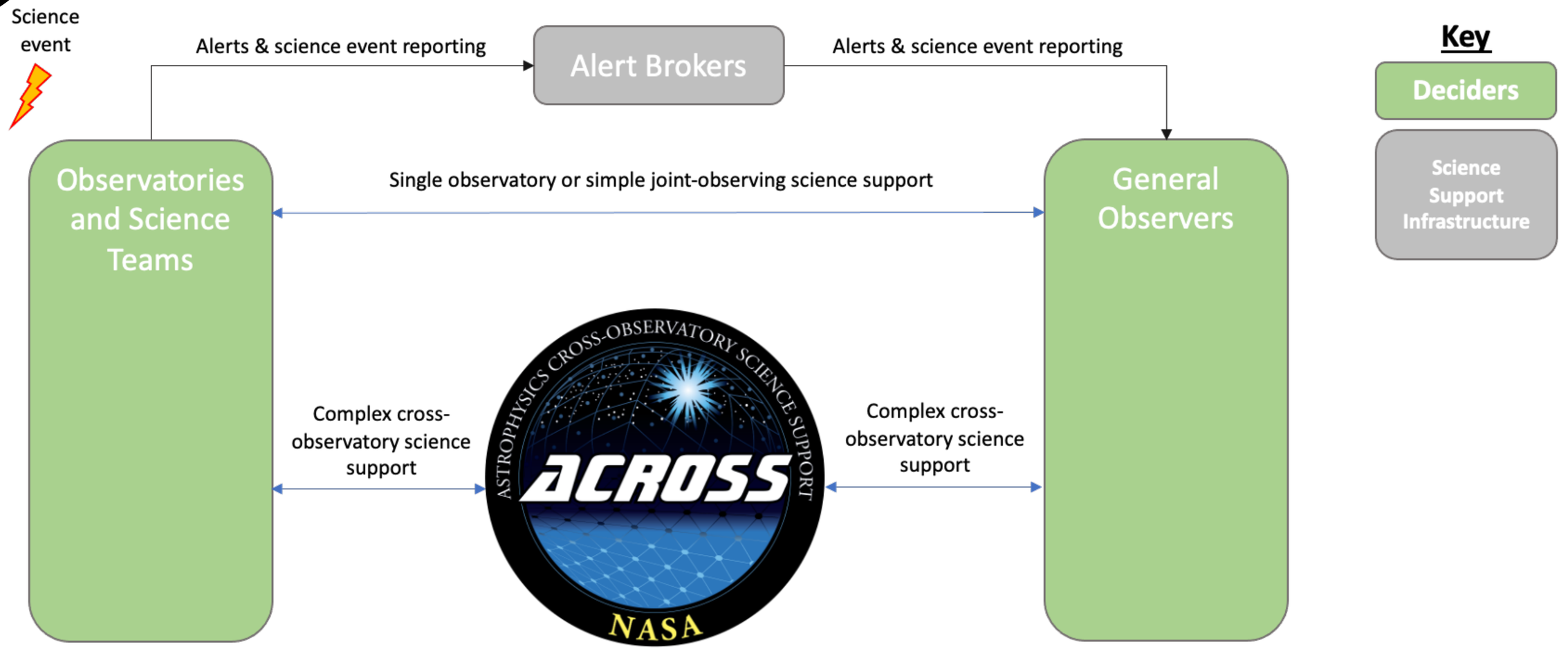
Background

- **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, and
  3. Recommending one or more potential implementations for enabling TDAMM science support.

- **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.

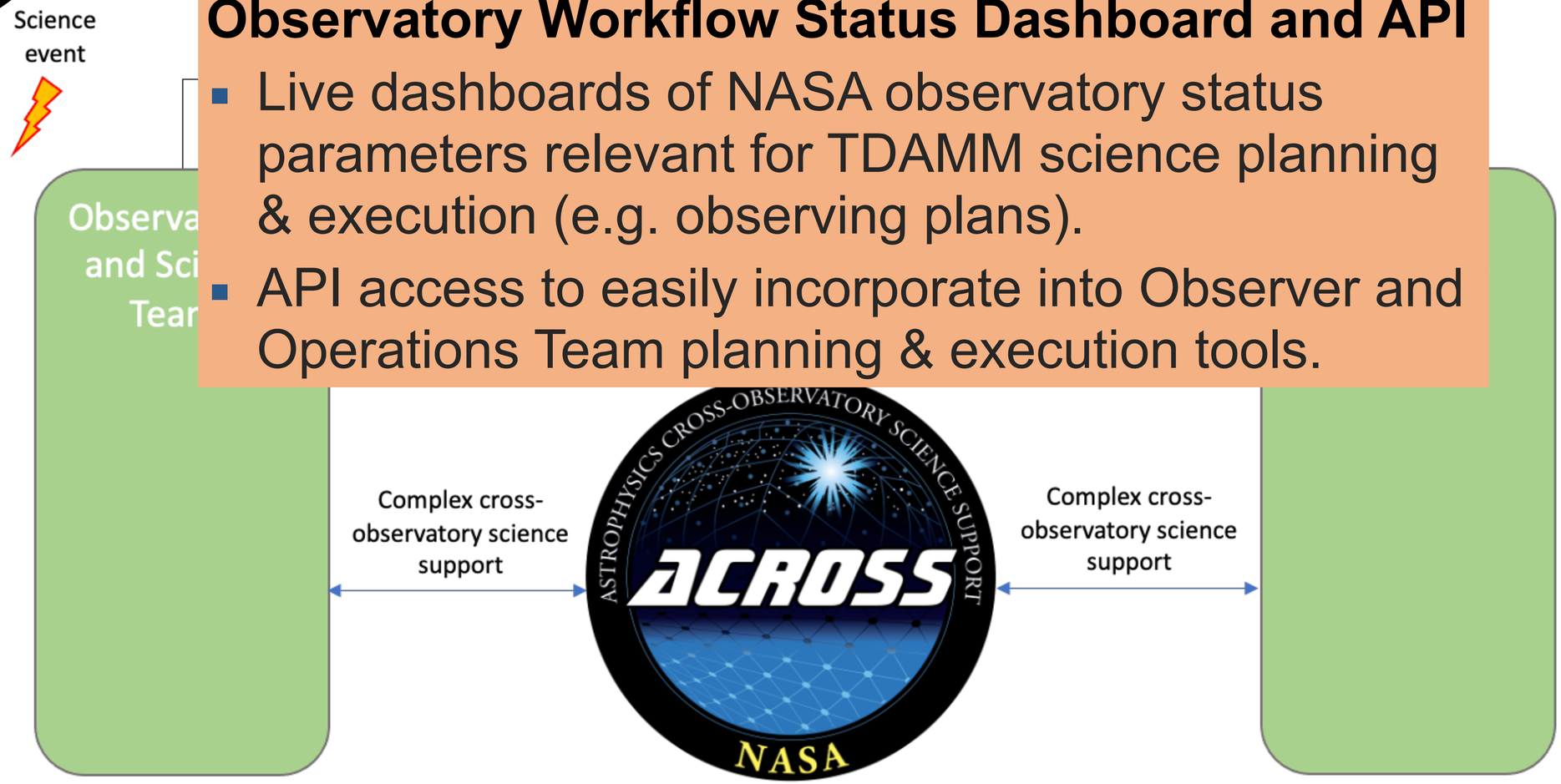
High-Level Architecture: Future-State Context Diagram



High-Level Architecture: Future-State Context Diagram

Observatory Workflow Status Dashboard and API

- Live dashboards 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.



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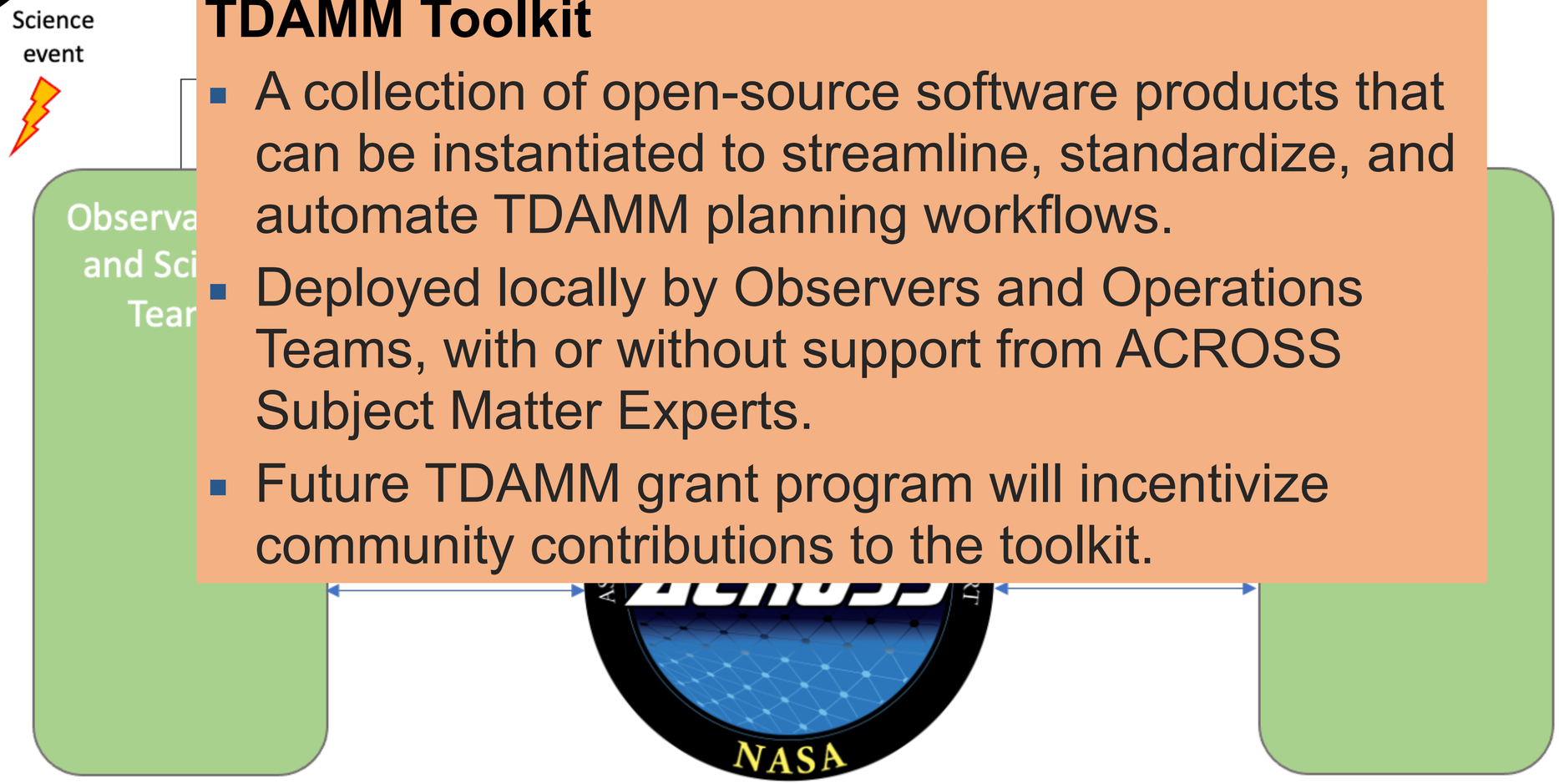
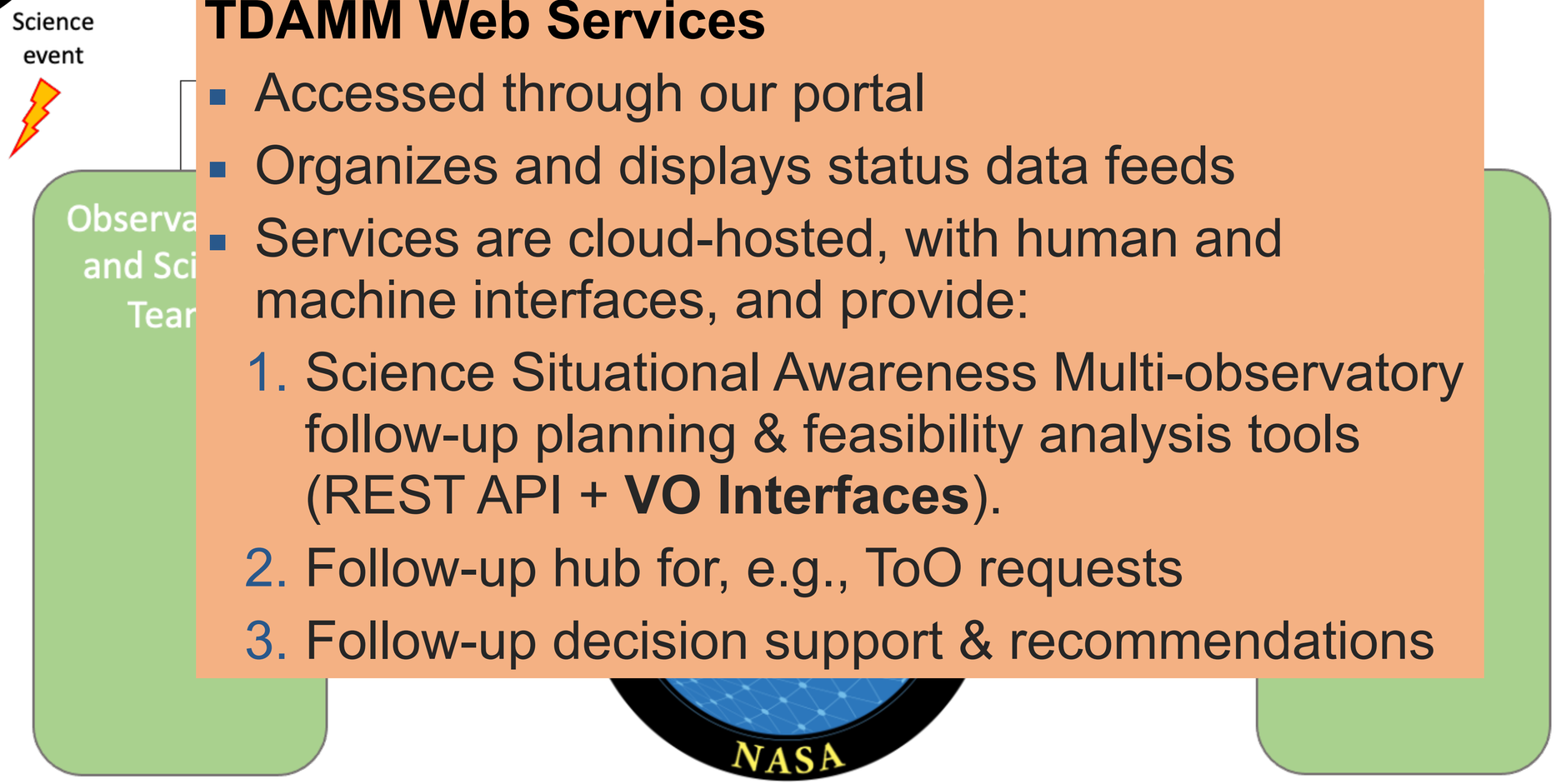


TDAMM Toolkit

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

High-Level Architecture: Future-State Context Diagram



TDAMM Web Services

- Accessed through our portal
- Organizes and displays status data feeds
- Services are cloud-hosted, with human and machine interfaces, and provide:
  1. Science Situational Awareness Multi-observatory follow-up planning & feasibility analysis tools (REST API + **VO Interfaces**).
  2. Follow-up hub for, e.g., ToO requests
  3. Follow-up decision support & recommendations

ACROSS and VO

- ACROSS aims to make cross coordination of observations easier for NASA missions and beyond, to enable TDAMM science.
- Baked into ACROSS is support for VO standards, therefore implementations of ObsLocTAP and ObjObsSAP will be provided by ACROSS's for all supported NASA astrophysics missions.
- ACROSS also leverages existing VO infrastructure. Therefore if your mission already provides ObsLocTAP and ObjObsSAP VO, the ACROSS will use those in favor of local implementations.
- As we intend to support every NASA mission, and also ground based telescopes and missions from other. Therefore ACROSS should broaden the availability of certain VO protocols for missions.
- ACROSS tools will be open-source and provided to all future missions, so even small low cost missions (e.g. cubesats) can implement these interfaces without overly burdening the teams.
- ACROSS should lead to more missions having available implementations of VO ObjObsSAP and ObsLocTAP.