ObjObsSAP: A Standard Protocol for Coordinated Multi-Messenger Observations

Enabling interoperable observability queries across observatories in the Virtual Observatory framework

Motivation

Multi-messenger astronomy relies on the ability to rapidly coordinate follow-up observations of transient events detected across different messengers; electromagnetic, gravitational, neutrino, or cosmic-ray.

To achieve this, observatories must know when and where they can observe a target and be aware of what is already planned by other facilities.

Today, each observatory maintains its own observavility and planning tools, typically with different formats and access methods. This fragmentation hinders real-time coordination and makes it difficult to automate follow-ups or proposal planning across missions.

The Object Observability Simple Access Protocol (ObjObsSAP) addresses this limitation by providing a uniform, machine-readable standard to retrieve constraint-free observability intervals for any sky position.

When combined with the Observation Locator Table Access Protocol (ObsLocTAP), the Use Cases and Benefits described here can be achieved.

Concept

- ObjObsSAP defines a **Simple Access Protocol** to query constraint-free observability for any sky position
- Standardized under IVOA's Data Access Layer (DALI) and compatible with **ObsCore**.
- Input: RA, Dec, and (optionally) time range.
- Designed to be easily implemented by observatories.

Integration within the Virtual Observatory

- Registered in the IVOA Registry using VOResource metadata.
- Compatible with existing VOSI-capabilities and DataLink standards.
- Enables discovery and integration within VO applications (e.g., ESASky, SciApp, Astro-RAPID, etc.).

How to....

- Joshua Fraustro, from STSCI, has developed a Python implementation of the ObjObsSAP protocol using FastAPI framework.

https://vo-labs.dev/objobssap

- Source code of the implementation can be found here

https://github.com/jwfraustro/fastapi-objobssap

Use Cases

Coordinated follow-up

- Trigger from LIGO/Virgo, IceCube, or transient survey (e.g. ZTF, SKA pathfinder).
- Query ObjObsSAP services of multiple observatories.
- Identify overlapping observability windows → schedule joint observations.

Observatory Planning

- automated observability checks for proposals and scheduling.
- Integration into cloud and AI-driven planning systems.

Example Query

http://xmmvisibility.esac.esa.int/vischecker/ServVISC?s_ra=82.1869593&s_dec=65.44867&t_min=60962.32747685185&t_max=60976.32747685185&min_vis=5000&votable=true


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   <FIELD datatype="timestamp" name="t_start" unit="d"/>
   <FIELD datatype="timestamp" name="t_end" unit="d"/>
   <FIELD datatype="double" name="t_visibility" unit="s"/>
   <FIELD datatype="char" name="Rev" unit="string"/>
   <FIELD datatype="double" name="Round" unit="s"/>
   <FIELD datatype="double" name="StarPh" unit="arcmin"/>
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Benefits

- **Interoperability and standardization**: Provides a unified way to query observability information across all observatories, using IVOA Data Access Layer (DALI) conventions and VOTable outputs.
- **Simplified access to observability data**: Offers a lightweight HTTP-based interface that any observatory can implement with minimal effort, making constraint-free observability data FAIR — Findable, Accessible, Interoperable, and Reusable.
- **Automation of follow-up observations**: Enables software agents, schedulers, and alert brokers to automatically determine which observatories can observe a target at a given time, a key capability for multi-messenger follow-ups.
- **Support for multi-wavelength astronomy**: The use of the generic term "observability" (rather than "visibility") ensures applicability to all domains — from radio to X-rays — with optional parameters to handle facility-specific constraints (elevation, Sun/Moon separation, energy range, etc.).
- **Efficiency in scientific coordination**: By exposing observability windows in a machine-readable format, ObjObsSAP reduces duplication of effort and facilitates the coordination of campaigns across facilities.
- **Integration within the Virtual Observatory**: Fully compatible with existing IVOA standards such as VOSI, ObsCore, and DataLink, making it immediately usable within VO clients like ESASky, SciApp, or other observatory planning tools.

Outlook

The **ObjObsSAP protocol (Working Draft 1.0, 2025)** marks a significant milestone in extending the IVOA framework from archival data discovery to future observability planning.

Short Term Goal:

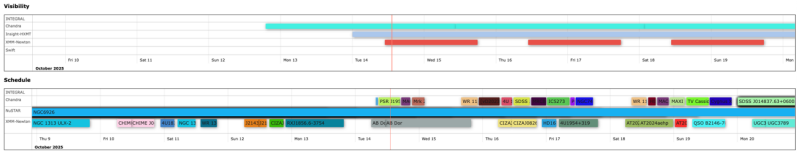
- Validate the protocol with pilot implementations at **ESA/ESAC** using **XMM-Newton** and **INTEGRAL** observatories.
- Engage additional facilities — including **ground-based telescopes** in the Canary Islands, La Silla, and Hawaii — to demonstrate interoperability across wavelength regimes.
- Finalize the protocol's promotion to **IVOA Proposed Recommendation**,

Long Term Goal:

- Establish ObjObsSAP as the standard layer for constraint-free observability queries across the astronomical community.
- Integrate with **alert and coordination systems** (e.g., VOEvent, TOMs, or AI-based brokers) to enable real-time follow-up planning.
- Encourage adoption by future missions such as **NewAthena**, **LISA**, or **SKA**, etc...

Future: cross-facility alert systems and AI-based scheduling.

TOOL FOR OBSERVATION VISIBILITY AND SCHEDULE (TOBY)



Synergy for Multi-Messenger Coordination

ObjObsSAP — Constraint-Free Observability

Purpose: Determine *when* a target *could* be observed.
Scope: Future, constraint-free observability windows.
Input: Target coordinates (RA, Dec), optional time range.
Output: Intervals of possible observation (VOTable/JSON).
Key use: Fast response to transient alerts (e.g. GW, GRB, neutrino) to find which observatories *can observe* the source.
IVOA Layer: Data Access Layer (DALI-based).

ObsLocTAP — Observation Scheduling and Planning

Purpose: Determine *when* a target *will* be observed (or was observed).
Scope: Planned, scheduled, performed, and aborted observations.
Input: ADQL query via TAP.
Output: Observation metadata (start/stop times, facility, instrument, status).
Key use: Track ongoing campaigns and avoid duplicated proposals.
IVOA Layer: TAP-based discovery of observation plans.

Credits

Aitor Ibarra on behalf of Object Observability team.
European Space Astronomy Centre (ESAC)
IVOA Data Access Layer Working Group
https://www.ivoa.net/documents/ObjObsSAP