

## INTERFACING VIRTUAL OBSERVATORY TOOLS FOR AMATEUR ASTRONOMERS

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**Abstract.** In spite of the growing number of pro-am projects, the amateur community has not been using Virtual Observatory (VO) tools as much as expected, perhaps due to some complexities in their use. Here we interface VO tools with two widely-used software as an example of the intended use. First, JSON data for transients announced in Astro-COLIBRI are grabbed and imported into PRISM, an ASCOM-compliant software to manage observatories and data acquisition. The user can select the transient and the telescope will be automatically pointed to its direction, while the screen presents Aladin images and ancillary data. Second, we implement a SAMP interface within SharpCap, a widely-used easy-to-use USB frame grabber tool. We expect these tools to be the first steps towards the adoption of IVOA standards by the amateur community, enhancing and improving pro-am projects across a wide range of topics.

Keywords: Virtual Observatory, Amateur astronomy, Pro/am collaborations, Citizen science, Transients

### 1 The WIVONA Project

The Virtual Observatory is a collection of standardised protocols to find and access data archived at over 50 data centers such as CDS, NASA, ESO, and ESA. The archives contain catalogues, bibliographic data, images, spectra, data cubes, time series and alerts, therefore they are of interest for the amateur community. The access is carried out through simple protocols such as SCS, SIAP, SSAP, and a more flexible one: TAP/ADQL, yet amateurs astronomers are not (yet) used to make queries and access data with them perhaps because the use of SAMP (Simple Application Messaging Protocol, Taylor et al. 2015) may not be simple enough. Yet it is SAMP which allows the user to access the data through tools such as TOPCAT (Taylor 2005), an interactive graphical viewer and editor for tabular data\*, Aladin (Bonnarel et al. 2000), an interactive sky atlas†, and CASSIS (Vastel et al. 2015), a free interactive spectrum analyser‡, among others.

The WIVONA (We Implement Virtual Observatory Needs of Amateurs) project aims at providing the amateur community with simple tools that allow the interfacing of these complex protocols with widely-adopted and familiar software such as PRISM§, which deals with astronomy, telescope and observatory control, as well as image processing and analysis, and the simple camera capture tool SharpCap¶, as illustrated schematically in Fig. 1.

As an example of application, we show how to access databases with elusive phenomena associated with transient sources. This is particularly important as they probe not only the full electromagnetic spectrum but also bursts of neutrinos and sources of gravitational waves. Searching for the optical counterparts of these sources can be carried out by amateurs and can constitute another example of citizen science. For this we also interface Astro-COLIBRI (Schüssler et al. 2023) ‖.

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\* <https://www.star.bris.ac.uk/~mbt/topcat/>

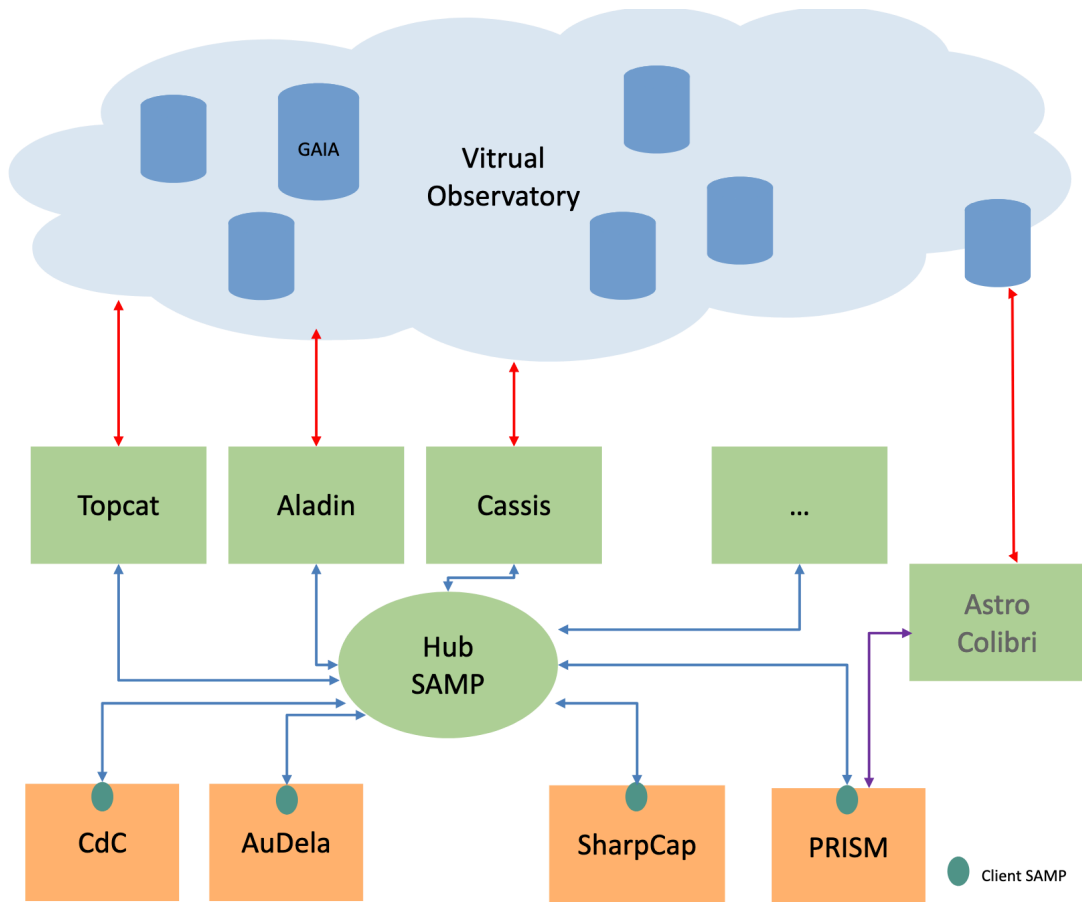
† <https://aladin.cds.unistra.fr/>

‡ <http://cassis.irap.omp.eu/>

§ <https://www.prism-astro.com>

¶ <https://www.sharpcap.co.uk/>

‖ <https://astro-colibri.science/home>



**Fig. 1.** An illustration of the interfaces between the data repositories held at various archives over 20 countries, and popular amateur astronomy software tools such as CdC, AuDela, SharpCap and PRISM, through the SAMP Hub and Astro-COLIBRI, allowing a simultaneous seamless interaction of telescope control and image acquisition with the Virtual Observatory tools such as TOPCAT, Aladin and CASSIS, among many. The amateur astronomer is not required to be proficient with these tools, as they are provided directly by our new VO-compliant version of PRISM.

## 2 Choosing a SAMP Hub for PRISM

The SAMP Hub could be integrated within PRISM: this would be useful but not really required. Another possibility would be to use JSAMP, an external Java SAMP Hub that while providing useful debugging tools, has no associated applications. The `astropy.samp` hub with python scripts requires advanced python and Delphi4Python integration. We therefore recommend Aladin, a popular application which embeds a SAMP Hub, allows the resolution of astronomical object names using SIMBAD and provides a resources tree containing all VO services (including over 25,000 catalogues from VizieR, Ochsenbein 1996) that can be queried, along with a GUI presenting images extracted from various imaging surveys (SDSS, 2MASS, GALEX, Planck, WISE, etc.).

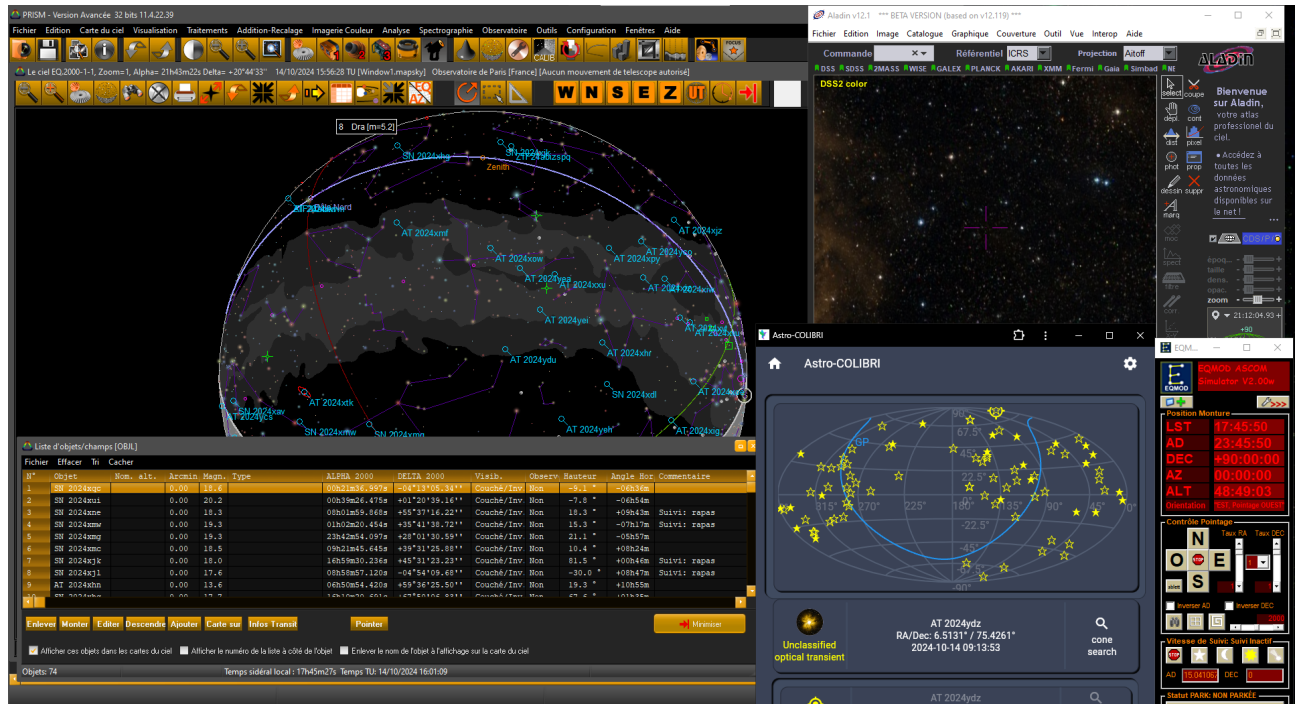
For the application to transients, an external alert monitor is required which listens 24/7 to brokers and stores alerts, while providing, at the same time, filters for the selection of events and returns proper VO Events. Astro-COLIBRI fits these requirements and provides a HTTP/JSON API which we use to retrieve the alerts database into PRISM.

The interface between Astro-COLIBRI and PRISM must fulfill a number of requirements:

1. Compliance with existing documented API,
2. Filters must be tuned using the Astro-COLIBRI web application,
3. There must be a minimal GUI at the PRISM side,

4. Must be fully integrated in the PRISM observation workflow (2 clicks pointing),
5. Must support follow-up requests to the amateur community (RAPAS Tags).

To ensure a fast, user-friendly interface, we implemented a two-click procedure in the new VO-compliant version of PRISM. The first click on the PRISM screen requests the latest transients from Astro-COLIBRI and plots them on a sky map (Fig. 2). A second click selects the object to be observed and the VO-updated PRISM (1) provides an Aladin-based zoomed image of the selected area, and (2) automatically points the telescope to that position, as illustrated in Fig. 2.



**Fig. 2.** A screenshot from the VO-updated version of PRISM showing the Astro-COLIBRI web application's skymap with the current transient events (bottom right), the PRISM skymap (top left) and the list of targets (bottom left) displaying transient sources gathered from Astro-COLIBRI, and the zoomed sky around the selected target (top right) with the current position of the telescope mount at the extreme bottom right.

### 3 Conclusions

At the moment, SAMP, Python, Astro-COLIBRI are being integrated into PRISM in the light and advanced versions. SAMP Delphi sources for PRISM will be available in Github and the python sources for the SharpCap SAMP interface are publicly available\*\*.

We have also integrated a python console within PRISM using Python4Delphi so that the user can load python scripts, edit, parametrise and execute them. This console provides a direct access to the VO protocols using python modules such as astropy, pyvo and astroquery. The goal is to be able to use python to exchange data with the PRISM interface and fully automatise observations.

We expect the development of these tools will greatly help the amateur community to access professional databases and tools. Tutorials and demos have been provided at the S21 session of the SF2A Journées in 2024, as well as at the Photometry and Data Analysis School for Amateurs in June 2024.

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\*\*<https://github.com/rsav/samp4sharpcap>

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