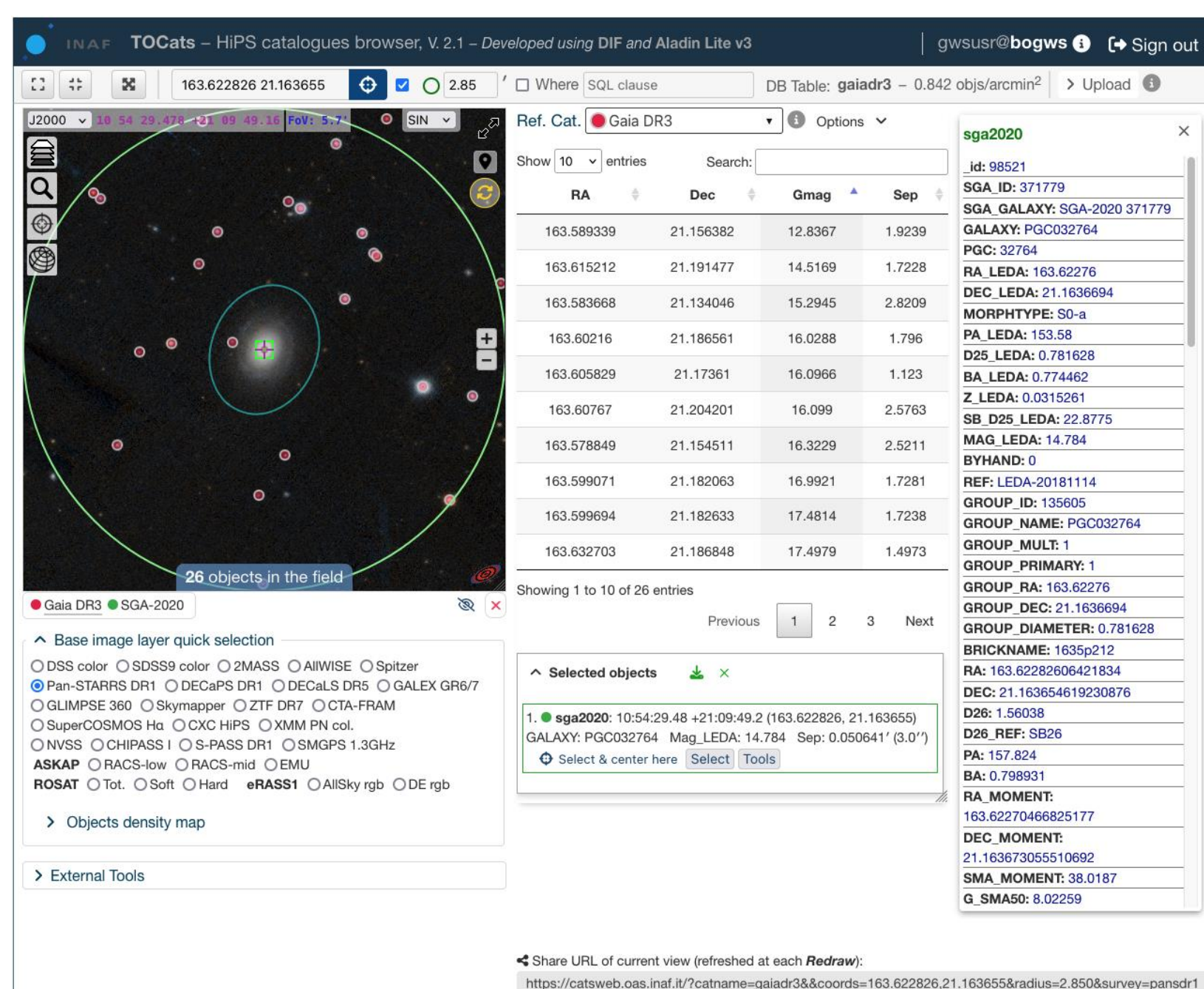
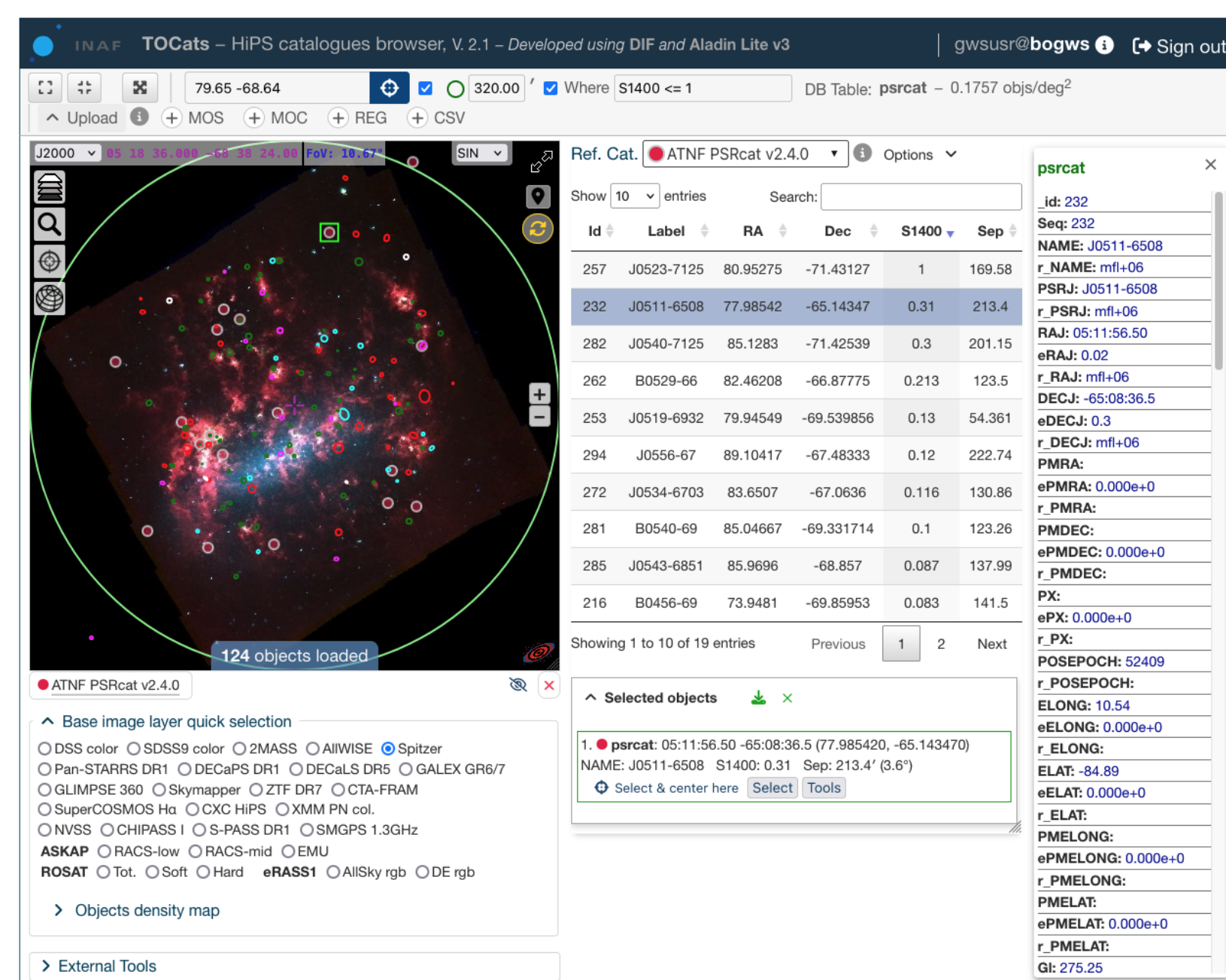


**ABSTRACT:** Web tools that combine access to archives with the ability to visualize or even process data are becoming more and more common and effective; this thanks to the speed of the systems that host the data and the speed of the network. The advantages for the users of this "data-centric" approach are countless: no data duplication, no need to worry about backup, no need to install and maintain software, and so on.

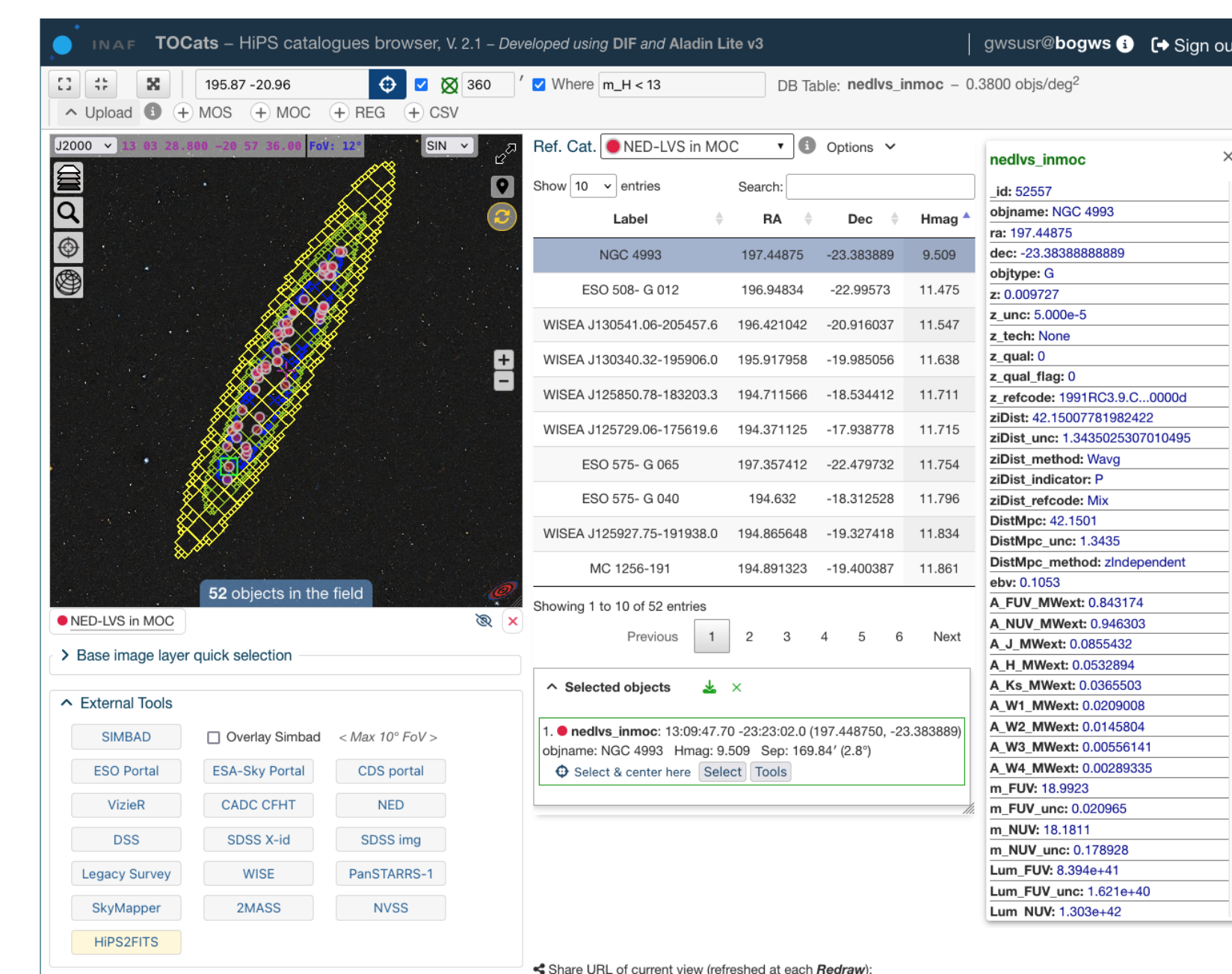
**TOCats** is a tool for fast access of object catalogues, astronomical surveys, etc. using hierarchical scheme techniques to split the celestial sphere, in particular the **HEALPix** scheme. All the catalogues, and the metadata describing them, are stored in a relational database (MySQL) whose capabilities are leveraged by the custom made, astronomy oriented, dynamic indexing library **DIF** and additional functions. Users can freely access the catalogues and the associated data either directly from client applications or through the webtool **TOCatsweb**.



**Fig. 1:** TOCatsweb interface showing a simple search on the Gaia DR3 and SGA-2020 catalogues around PGC032764.



**Fig. 2:** LMC in the Spitzer survey with pulsars (PSRs) and user supplied (local) regions of interest (via "Upload → REGion file").



**Fig. 3:** The 50%, 70% and 90% MOC coverage of the GW170817 probability regions with the selection of the brightest galaxies present in the NED-LVS catalogue (via "Upload → MOS or MOC" file).

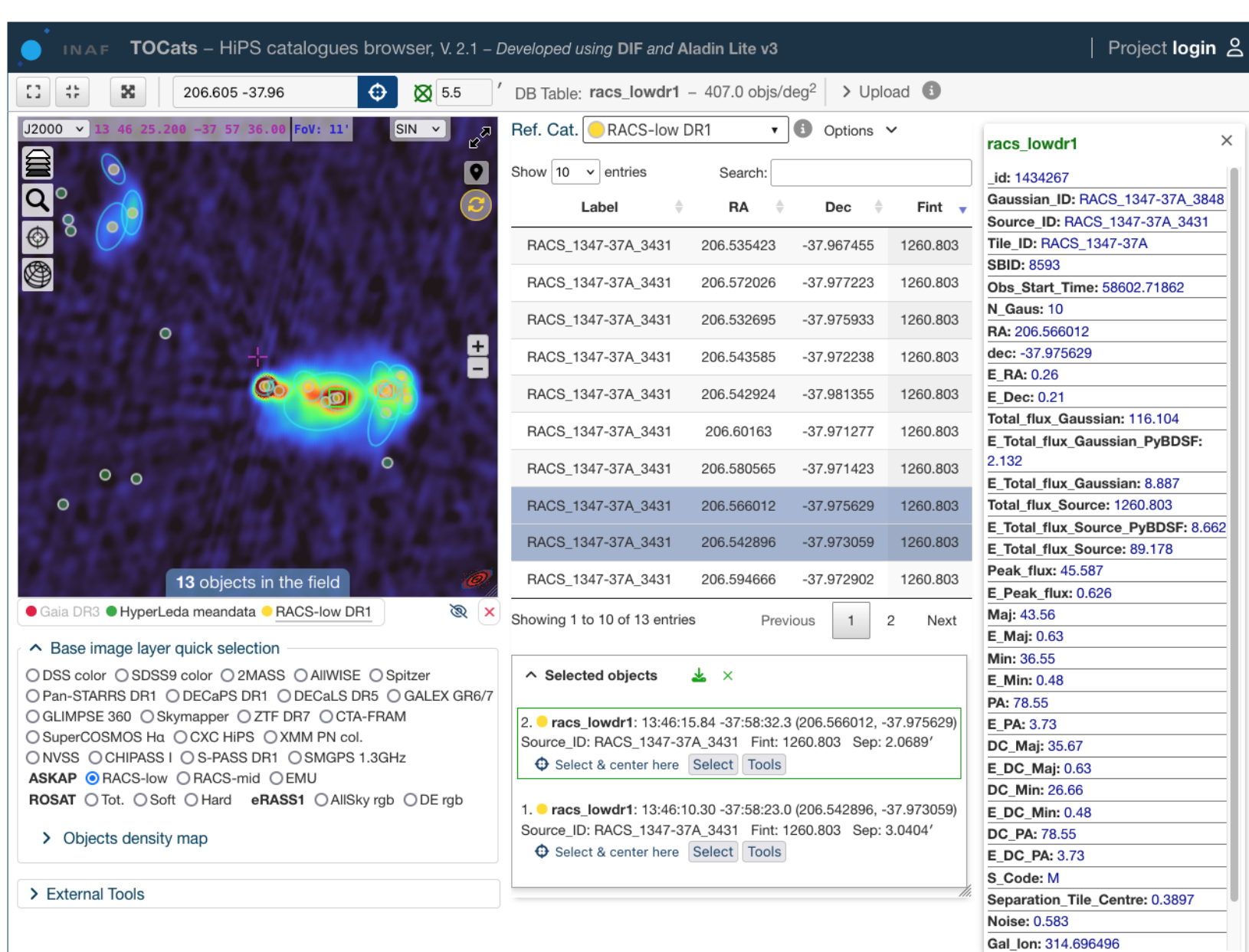
**DESCRIPTION:** TOCats, and the accompanying web tool **TOCatsweb**, is a public astronomical internet accessible service that allows a fast access, programmatic or via web interface, to object catalogues covering the whole electromagnetic band. It combines the following three main components:

1. a relational database management server (**RDBMS**), with hierarchically structured tables containing various types of astronomical catalogues and associated metadata;
2. a web service that makes images and catalogues easily queryable and accessible from a browser or a script;
3. a repository of Hierarchical Progressive Surveys (**Hips**).

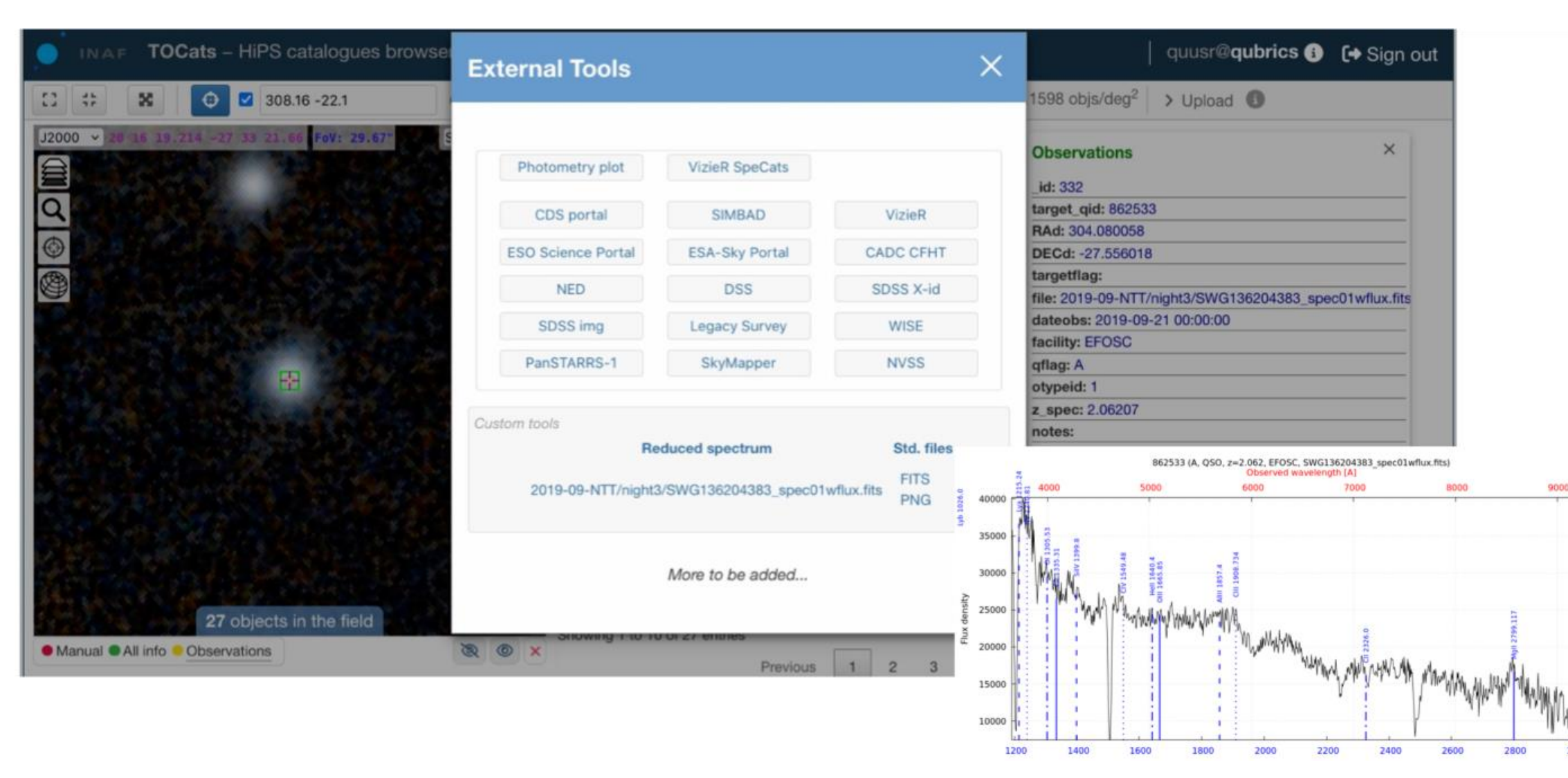
Additionally, TOCatsweb uses **Aladin Lite v.3**, a webtool which offers additional facilities like direct links to external data archives and local images and object tables.

TOCats can host data/catalogues coming from private projects and make them accessible only to authorized users. Users can add custom plugins to leverage its capabilities. TOCats is a centralized service, so it does not require any software installation and is VO(Table)-compliant.

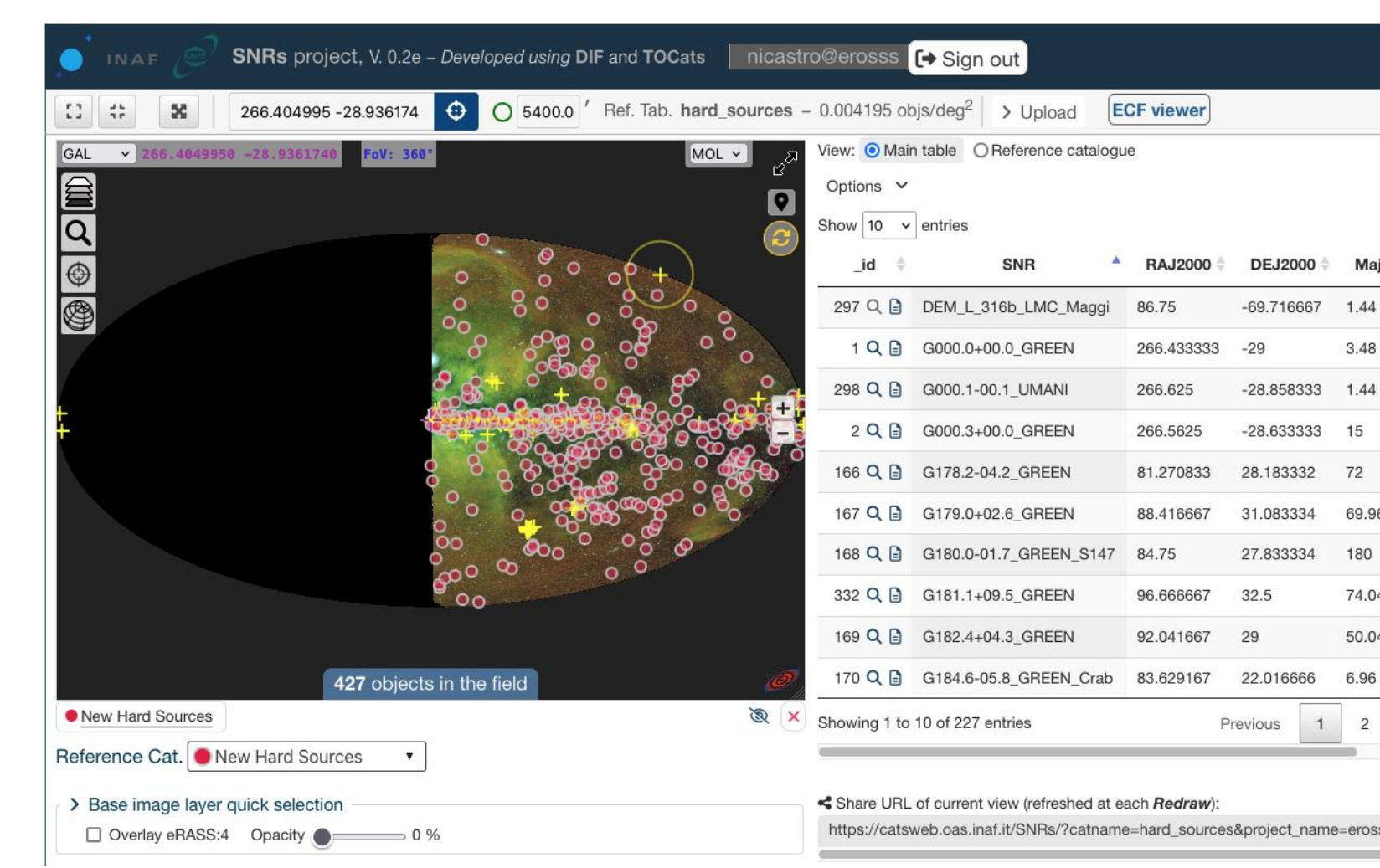
**USAGE:** TOCats hosts more than 100 public and 50 private catalogues. It also handles some project archives. Catalogues can be imported in various formats, like **VOTable**, **FITS** and **CSV**. Survey images are handled through **Hipsgen**. Other types of data, e.g. spectra, can either be stored in the original format or imported into DB table(s). Another TOCats feature is the capability to handle catalogues whose objects are described by **regions**, for example galaxies. Handled object region types are: circle, ellipse, rectangle/box and polygon. Client-side JavaScript libraries are used to dynamically present the web page content on the users' browser. In addition to custom developed code, the main public libraries used are **Aladin Lite** and **DataTables**. Some interface screenshots are shown in Figs. 1 – 7. In particular in Fig. 3 it is shown how it is possible to upload, either using a web link or a local file, the credible regions of a GW event and select the galaxies falling in those regions. These regions can either be Multi-Order Coverage (**MOC**) maps or multi-order sky maps (**MOS**). In addition to MOC and MOS FITS files, TOCatsweb can also display user's local catalogue saved as CSV-like text files and DS9 **REGion** files. Moreover, Aladin Lite itself offers the capability to visualize local FITS images, MOC and VOTable files. TOCatsweb also provides direct links to external archives/tools and data/images dynamically built from the sky coordinates one is looking at.



**Fig. 4:** ASKAP-RACS-low survey with the identified sources defined in the catalogue via elliptical regions.



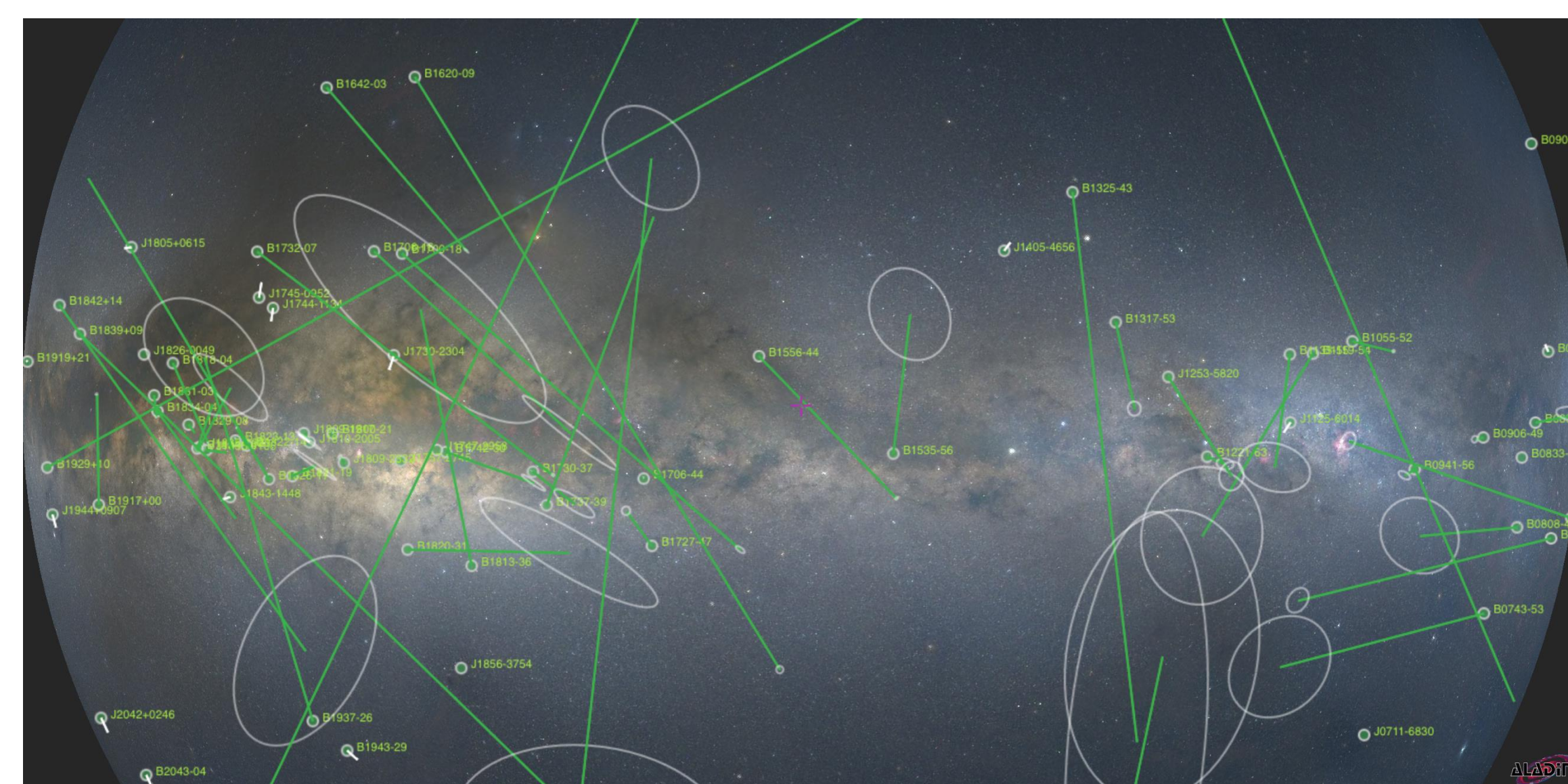
**Fig. 5:** Managing the QUBRICS spectra via custom tools. The reduced spectra archived as FITS and PNG files are accessible. Additional custom operations are foreseen.



**Fig. 6:** TOCatsweb custom interface used for the eROSITA-SNRs project. The German half sky map of the released eRASS1 is shown with the identified new hard X-ray emitting sources marked. Yellow crosses mark known SNRs.

**WHAT NEXT:** I'm seeking "active" collaborations by single persons and projects to consolidate and extend the TOCats capabilities and usability to make it even more user friendly and easily accessible by the INAF community. A list of foreseen activities and improvements include:

1. further support for catalogues with extended sources and local text files handling;
2. saving of the users' web uploaded data into the project database;
3. creation and management of small/medium-size catalogues via web interface;
4. upgrade and extend the capabilities of the plug-ins for the currently supported projects (e.g. GUCDS, QUBRICS and eROSITA-SNRs);
5. extend the usability of some, now project-restricted, tools to all the publicly accessible data;
6. make available a full documentation and a hands-on course for users and project managers;
7. add an object visibility calculator.



**Fig. 7:** Putative place of birth (ellipses) and direction (white lines) of fast moving PSRs.



TOCats can be a formidable educational tool for students of all ages and the general public, too. In fact, we used it in various PCTO courses and public events. Dedicated projects for this type of usage can be considered in collaboration with the colleagues of the D&D office.