The RAPAS Data Processing and Archival System

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1 - RPP: RAPAS Photometry Pipeline

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Summary

- Architecture and libraries
- The Pipeline in detail
- Typical Results
- Future developments

✚ Live Demo

Introduction

✨ RAPAS Photometry Pipeline

RAPAS Photometry Pipeline (RPP), is a Streamlit / FastAPI web application for homogeneous reduction of RAPAS fits image observations project. Everything you need is in the application, no need to install anything. All you need is your fits image and some minutes on patience :-)

Main Goal : ***Photometry of Transients Source using RAPAS filters from GAIA Bands***

RPP Architecture

Dev →  + 

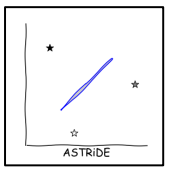
Back-end / Front-end →  + FastAPI + Streamlit

Database → SQLite + SQLAlchemy

RPP libraries choise

https://www.astropy.org/

https://photutils.readthedocs.io/en/stable/index.html



https://github.com/dwkim78/ASTRiDE

https://astrometrynet.readthedocs.io/en/latest/

***STDPipe** Library*

https://github.com/karpov-sv/stdpipe

SEP *Python library for Source Extraction and photometry*

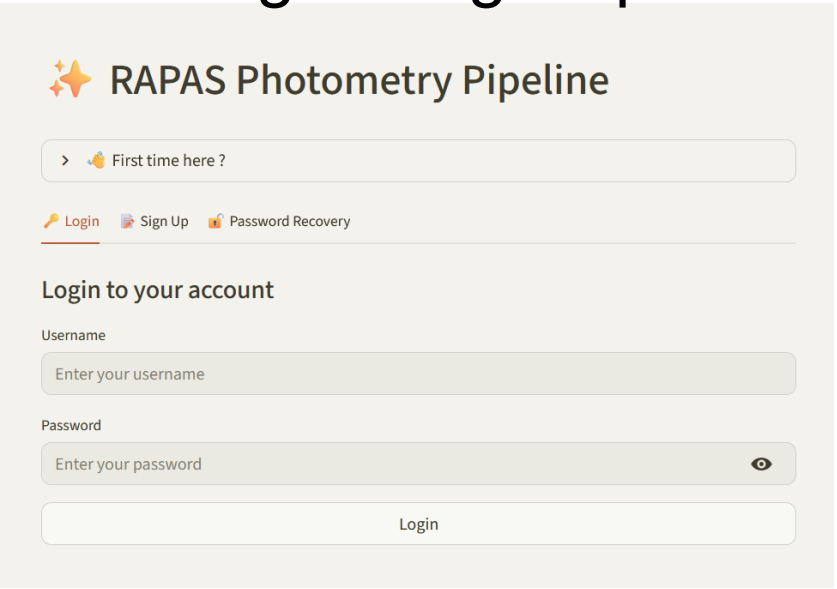
https://sep.readthedocs.io/en/stable/index.html

RPP Analysis steps

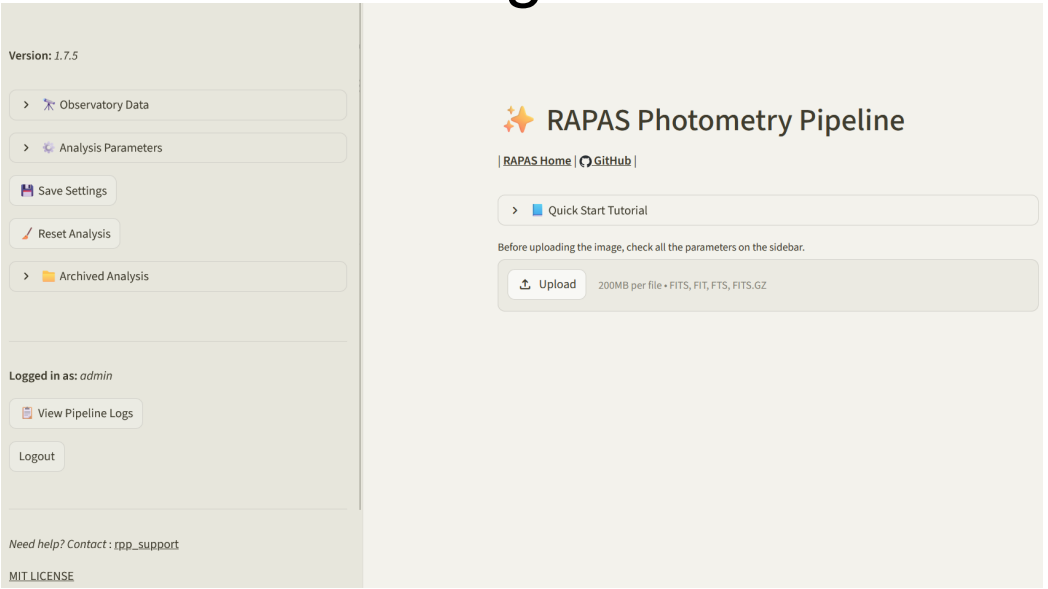
1. *Plate solving via **Astrometry.net**, as well as astrometric refinement using the **stdpipe library**.*
2. *RAPAS filters (Gp, GBp, GRp), Sloan filters (ugriz) and Johnson-Cousins filters (UVBRI).*
3. *Cosmic Ray with **Astroscrappy** and Satellites trails with **Astride** (beta).*
4. *Background extraction and Source detection with **Sep** and **Photutils**.*
5. *Aperture and PSF photometry with **Photutils** : aperture in 1.1 x FWHM, 1.3 x FWHM, <User Defined> x FWHM.*
6. *Zero-point calibration based on **Gaia DR3**, **Pan-STARRS DR1**, and **SkyMapper DR4**.*
7. *Catalog enrichment using **Gaia**, **SIMBAD**, **SkyBoT**, **VSX**, **Milliquas**, and **Astro-Colibri**.*
8. *Search for transient candidates using the **stdpipe library** (beta).*
9. *Final catalogs saved in CSV and VOT format plus downloadable zip.*

The Pipeline front pages

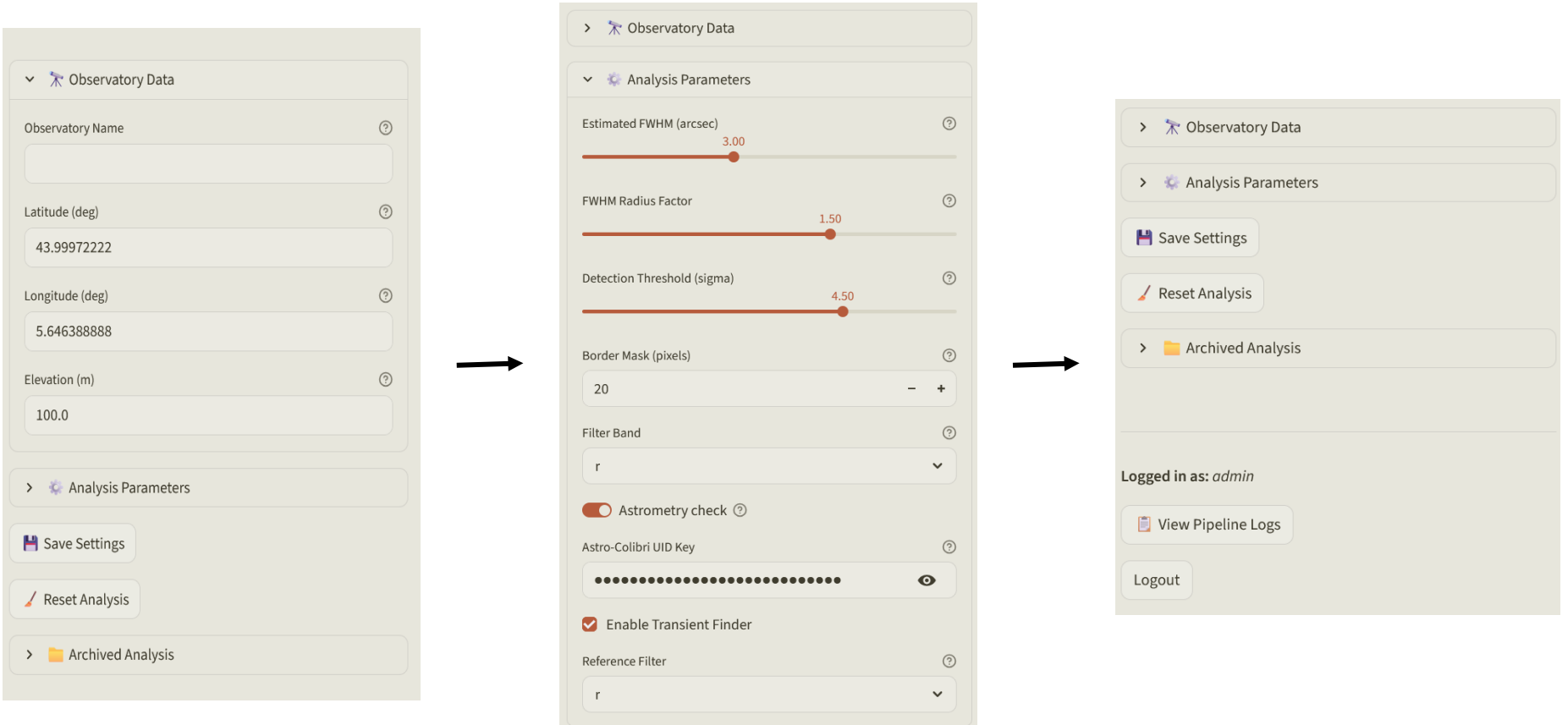
Login / Sign Up



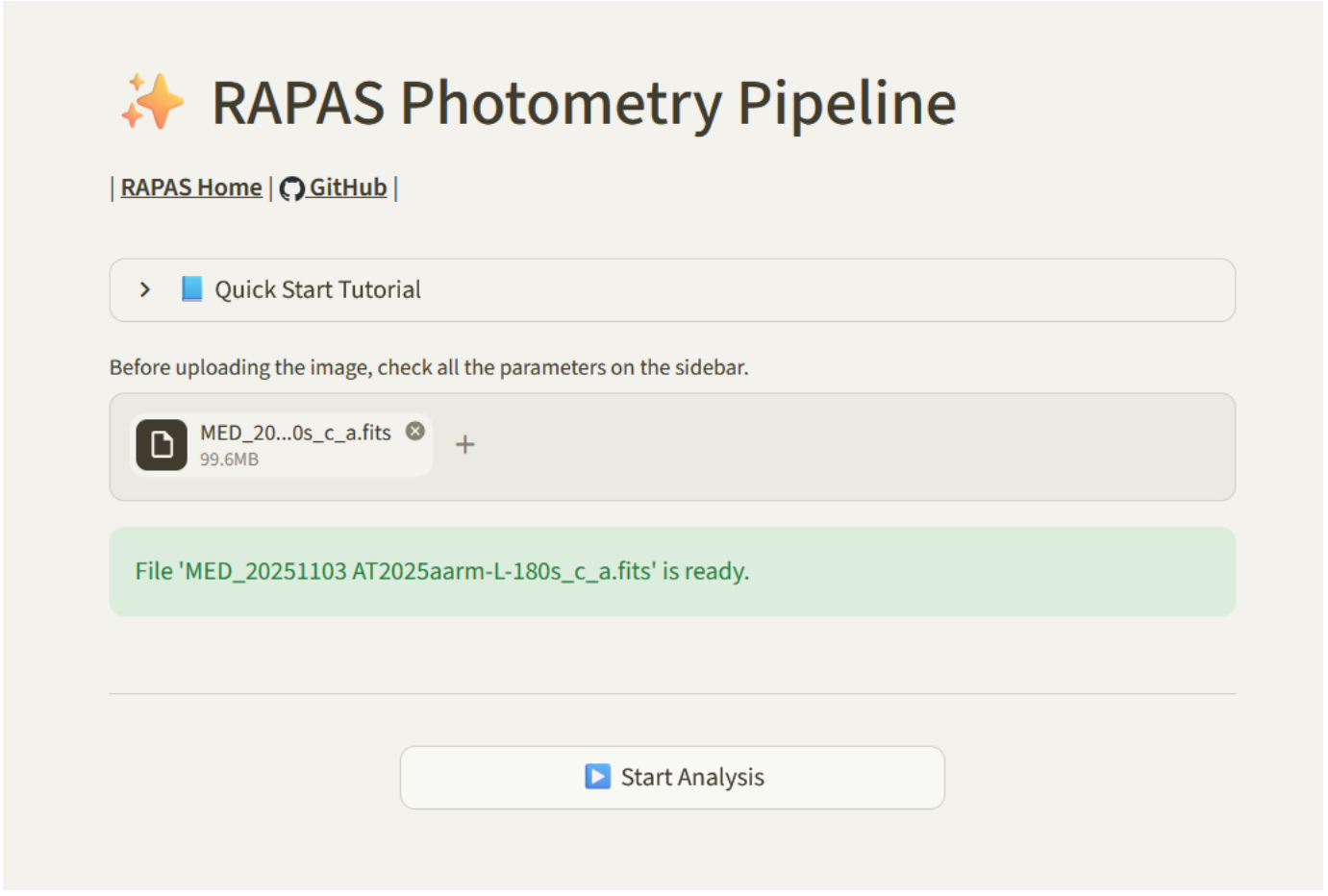
Main Page of RPP



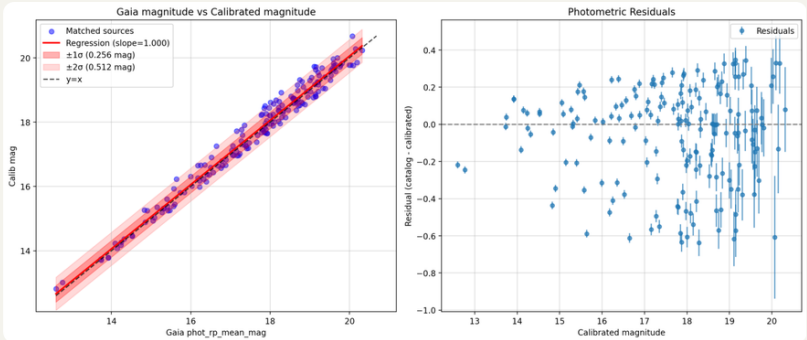
The Pipeline parameters



The Pipeline Input



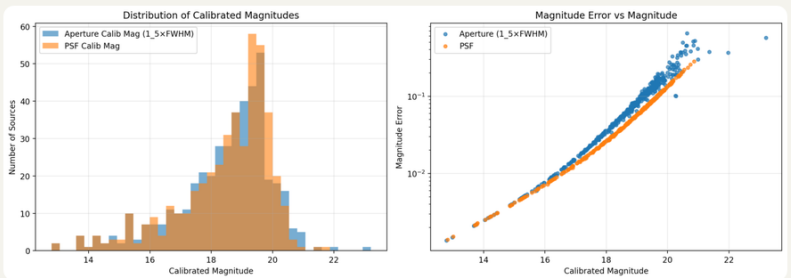
The Pipeline Output

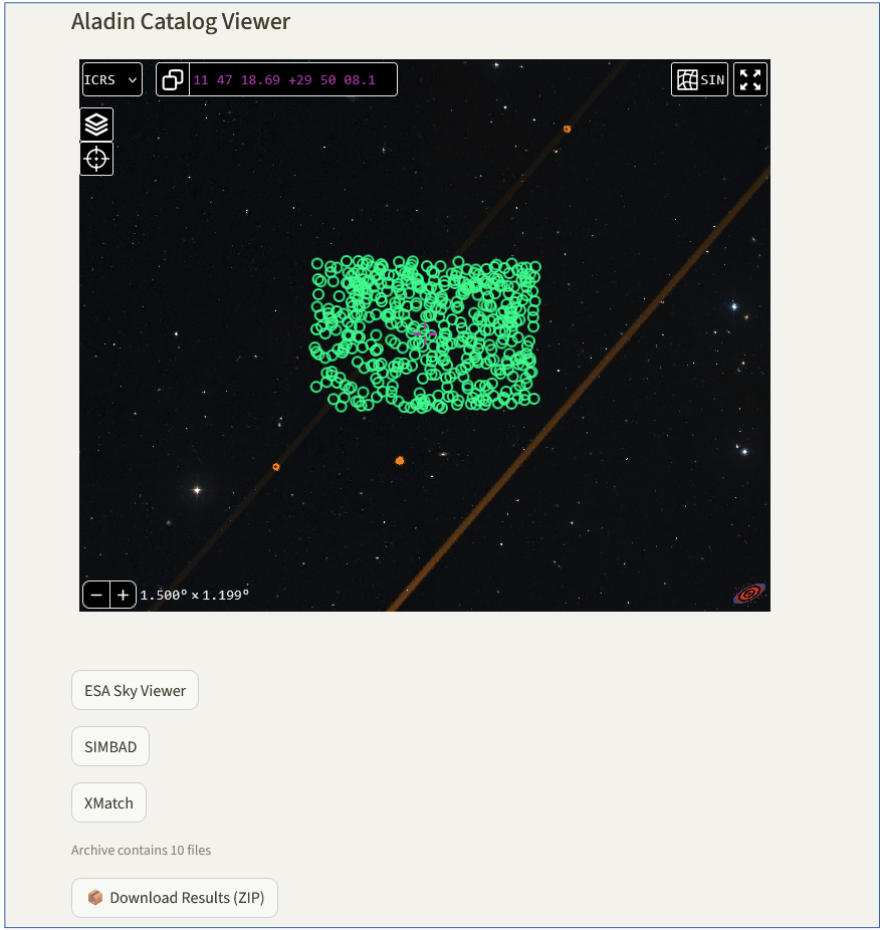


Calculated Zero Point: 17.32 ± 0.019 (formal uncertainty, N=181), calibrator scatter = 0.257 mag

Catalog includes 445 sources.

Magnitude Distribution (Aperture & PSF)



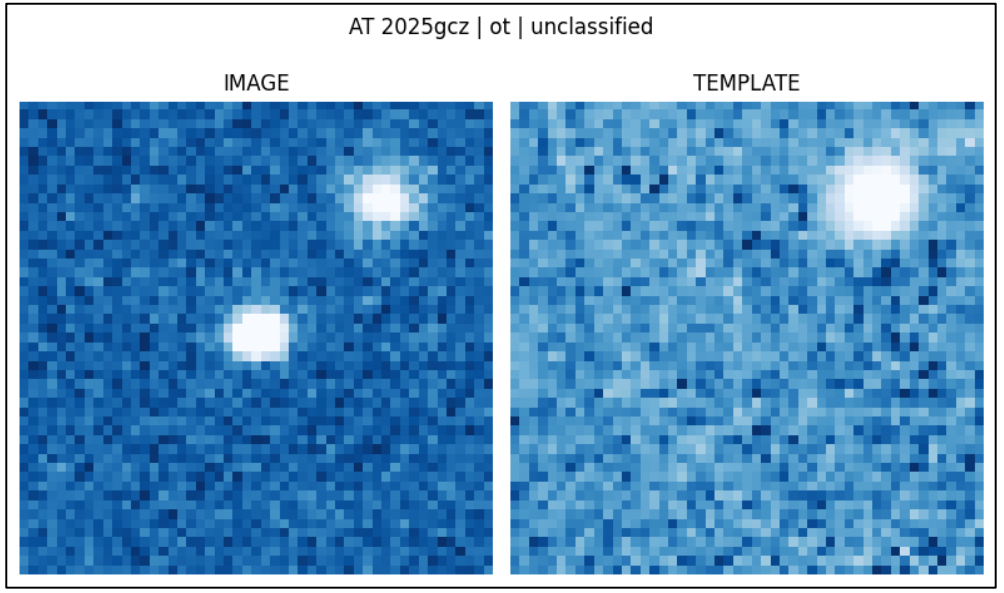


What's in the ZIP file

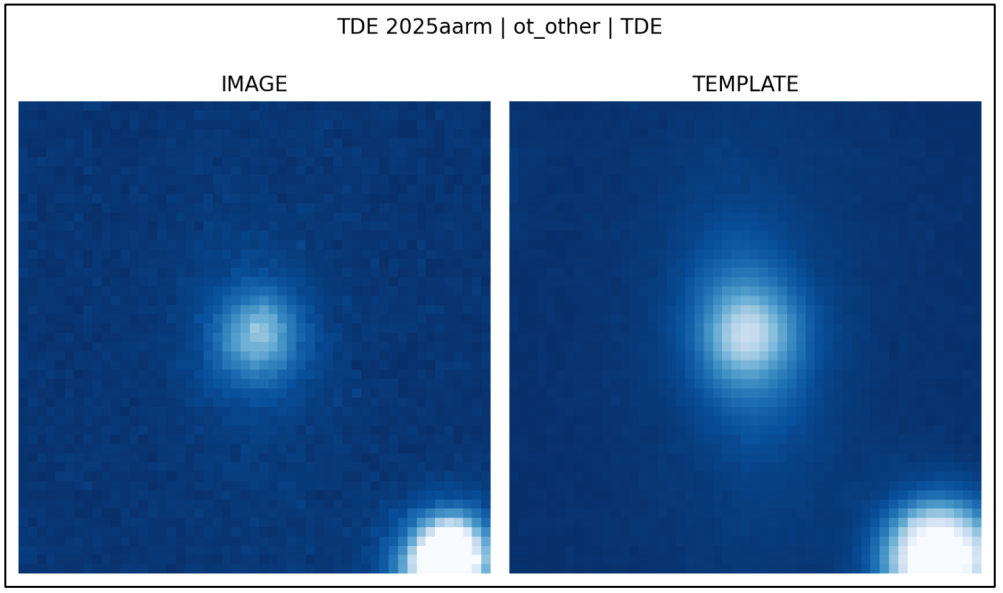
Name	Size
20251101T080341_AT2025aarm-MED5x180s_Sdssr_B2x2MedT°-10_HGMG56Of10_RHellot-AITP_CA.csv	179 417
20251101T080341_AT2025aarm-MED5x180s_Sdssr_B2x2MedT°-10_HGMG56Of10_RHellot-AITP_CA.log	9 261
20251101T080341_AT2025aarm-MED5x180s_Sdssr_B2x2MedT°-10_HGMG56Of10_RHellot-AITP_CA.vot	421 407
20251101T080341_AT2025aarm-MED5x180s_Sdssr_B2x2MedT°-10_HGMG56Of10_RHellot-AITP_CA_astrocolibri_01_TDE_2025aarm.png	27 484
20251101T080341_AT2025aarm-MED5x180s_Sdssr_B2x2MedT°-10_HGMG56Of10_RHellot-AITP_CA_header.txt	2 099
20251101T080341_AT2025aarm-MED5x180s_Sdssr_B2x2MedT°-10_HGMG56Of10_RHellot-AITP_CA_histogram_mag.png	87 038
20251101T080341_AT2025aarm-MED5x180s_Sdssr_B2x2MedT°-10_HGMG56Of10_RHellot-AITP_CA_image.png	344 878
20251101T080341_AT2025aarm-MED5x180s_Sdssr_B2x2MedT°-10_HGMG56Of10_RHellot-AITP_CA_transients.csv	701
20251101T080341_AT2025aarm-MED5x180s_Sdssr_B2x2MedT°-10_HGMG56Of10_RHellot-AITP_CA_wcs_header.txt	2 099
20251101T080341_AT2025aarm-MED5x180s_Sdssr_B2x2MedT°-10_HGMG56Of10_RHellot-AITP_CA_zero_point_plot.png	122 118

Typical Results

AT 2025gcz - psf_mag = 17.41 +- 0.02



TDE 2025aarm - psf_mag = 14.68 +- 0.01



Future Developments

Pipeline Robusteness and small bugs to fix (ex: SkyBot Failures).

Fine-tuned the stdpipe transient function to be more reliable.

Try out the subtraction pipeline using HotPants.

Compare the results with others pipeline (ex: stdpipeWeb).

2 – The RAPAS Archive

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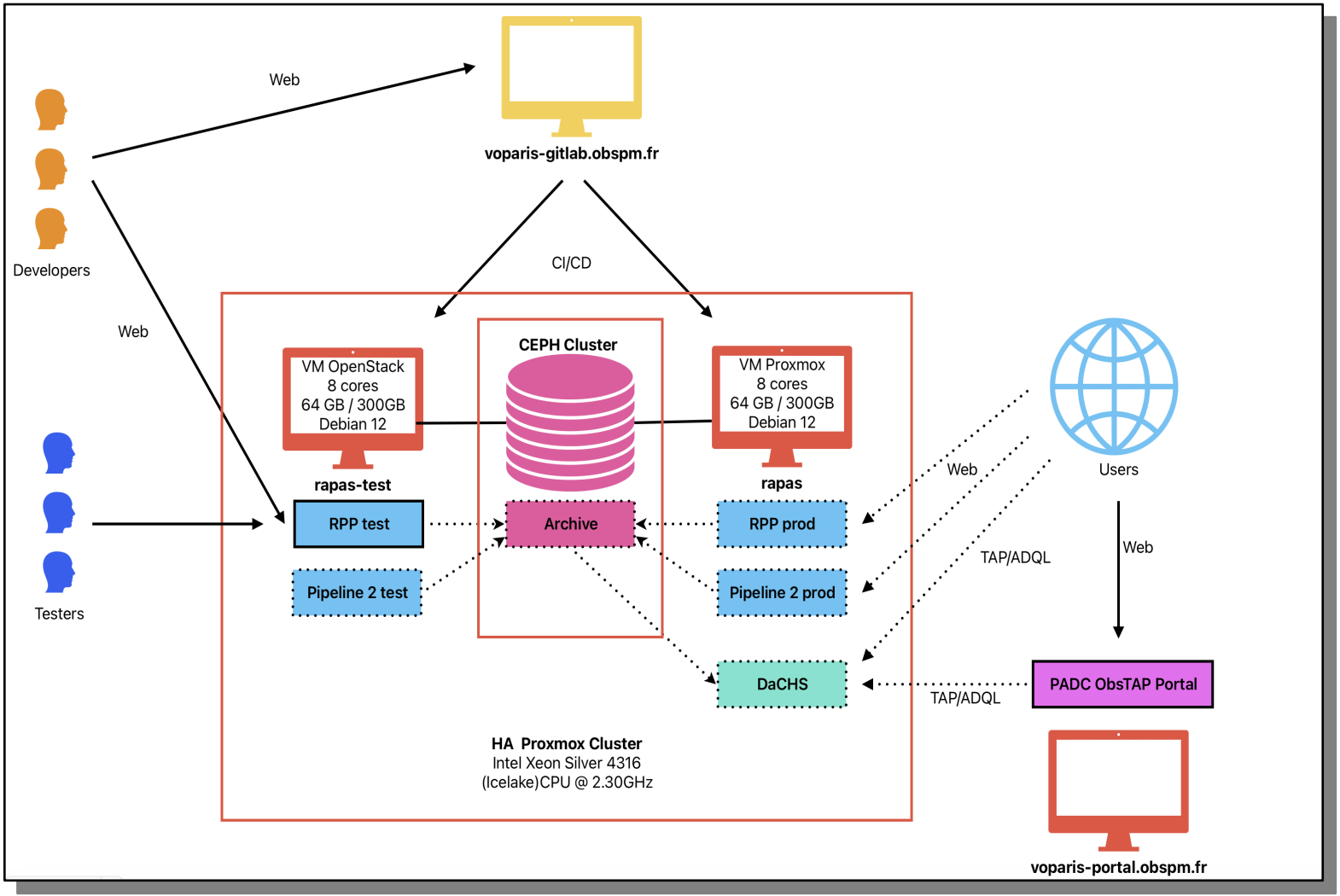
The RAPAS Archive

- Design and Architecture
- Implementation with DaCHS
- VO Services: SIAPv2 and TAP/ObsCore
- Accessing the archive with Aladin/TOPCAT
- The PADC ObsCore Portal

RAPAS@PADC: Architecture



DaCHS - Data Centre Help Suite

- DaCHS = software framework developed by the German Astrophysical Virtual Observatory (GAVO) for publishing astronomical data and services

- The resource descriptor (an XML file) defines the services' metadata, data model, and access methods

Virtual Observatory Services

RAPAS data and metadata are available through 2 IVOA (International Virtual Observatory Alliance) – compatible web services:

1) **SIAPv2 = Simple Image Access Protocol v2**
   - HTTP GET request (example query: ConeSearch and Gaia BP filter)

     `http://rapas.../rapastest/q/i/siap2.xml?POS=CIRCLE 67.7 -68.5 1.0`
     `&BAND=3.25e-7 6.80e-7`
     `&RESPONSEFORMAT=text/xml | text/csv ...`

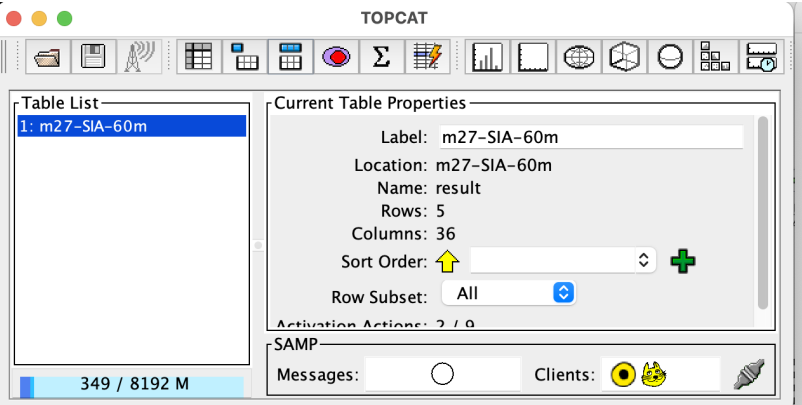
   - Output=VOTable or CSV... with standard SIAPv2 FIELDS

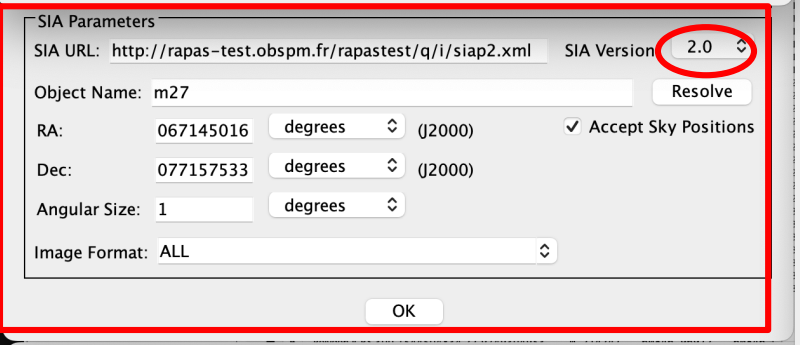
2) **TAP = Table Access Protocol / Astronomical Data Query Language**
   - POST request to web service: `http://rapas.../tap` with ADQL query:

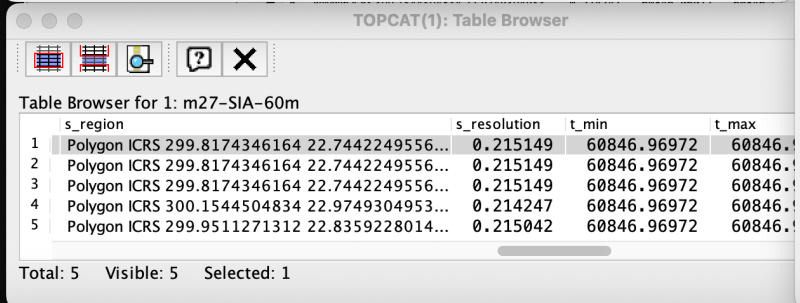
```
SELECT * FROM ivoa.obscore WHERE 1=CONTAINS(POINT('ICRS',67.7,-
68.5),s_region) AND em_min >= 3.25e-7 AND em_max <= 6.80e-7
```

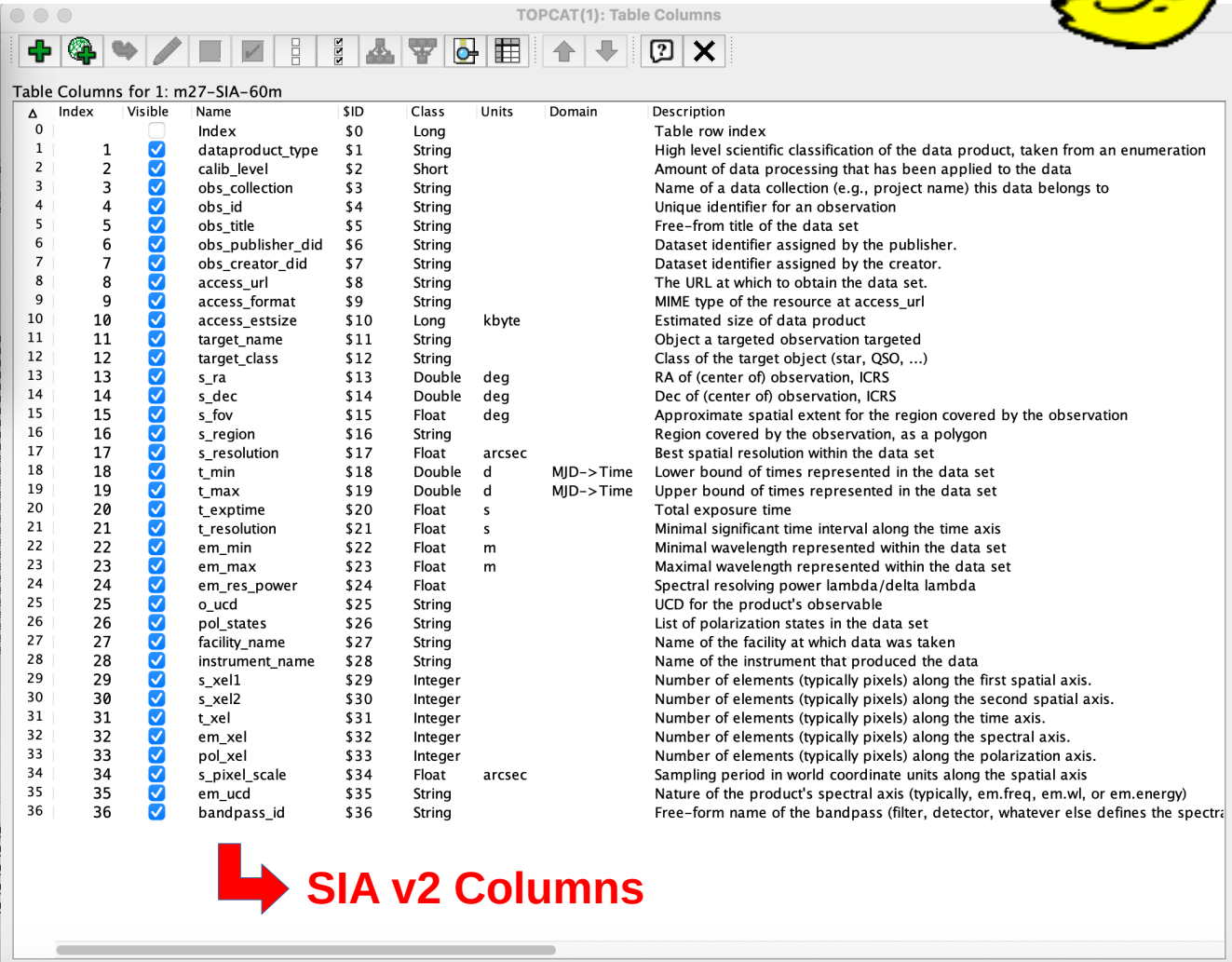
   - Output=VOTable or CSV… with standard ObsCore FIELDS (and others)

SIA Access with TOPCAT



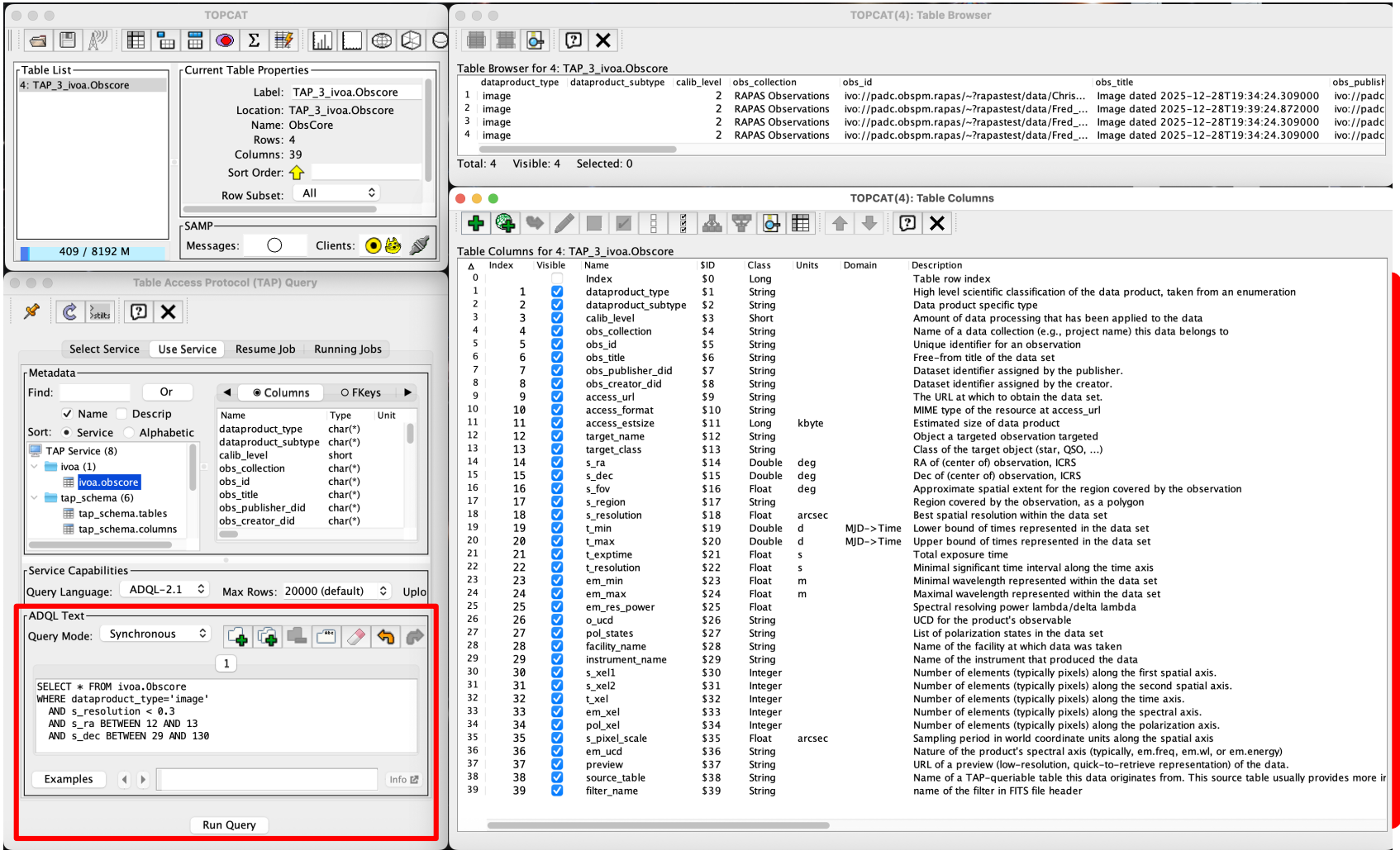






SIA v2 Columns

TAP Access with TOPCAT



Accessing the TAP service with ALADIN

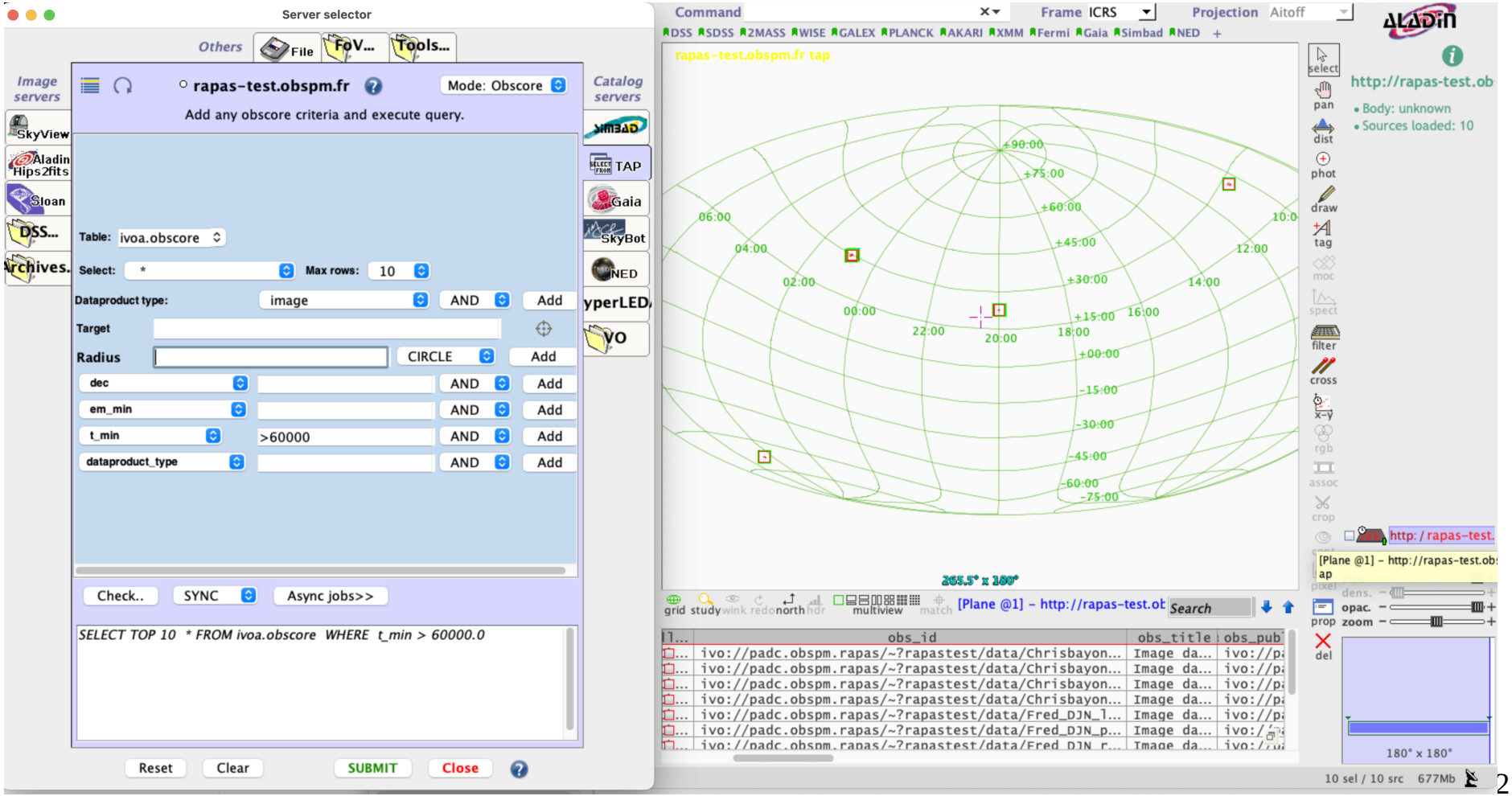


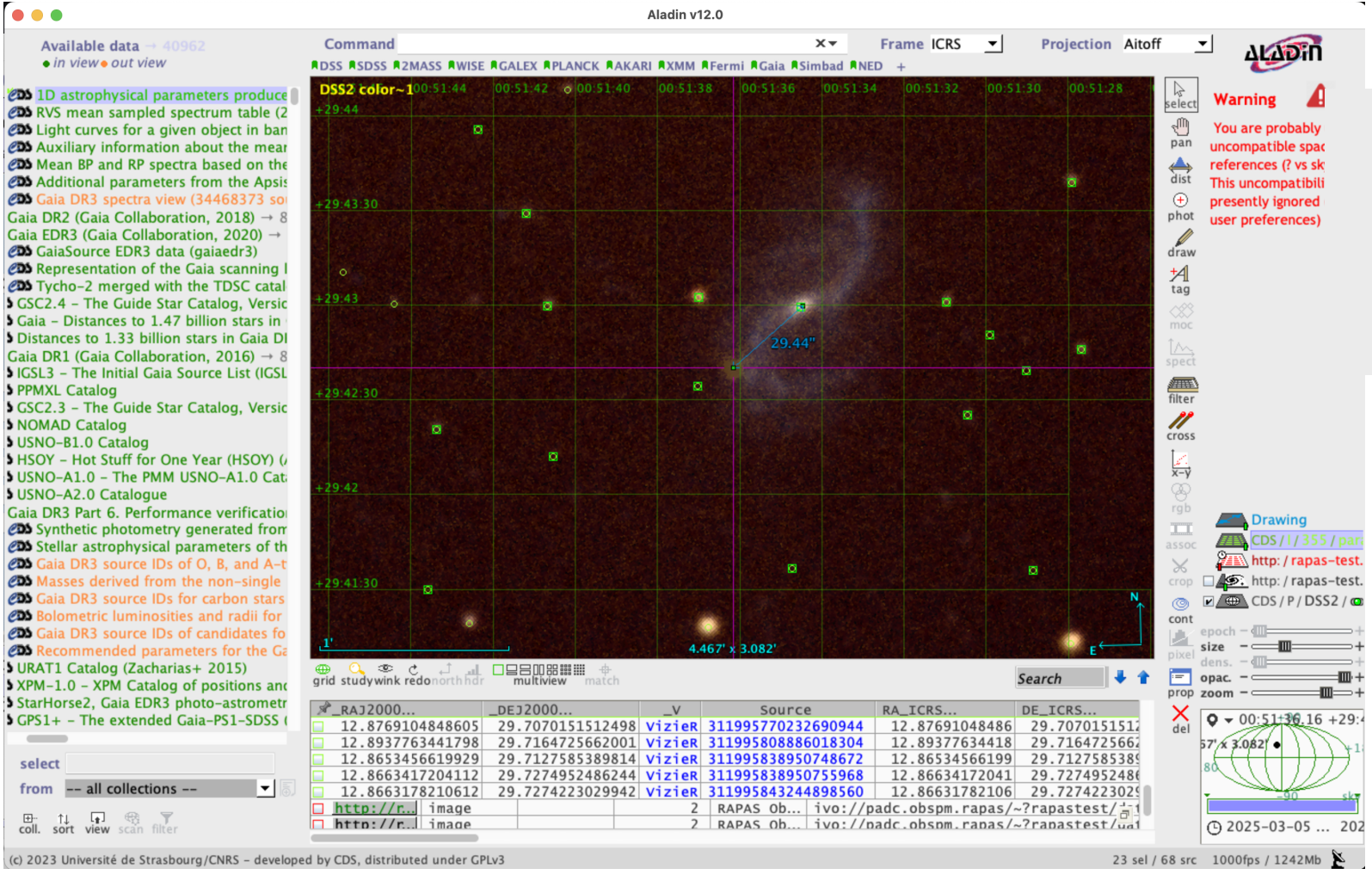
Image analysis with ALADIN

SN2025ahxd

Images:

- DSS2 color
  Fred Danjean

Sources from Gaia DR3



The PADC ObsTAP Portal