



# The ESO Astroquery module: a Jupyter Notebooks walkthrough

---

*Juan M. Carmona L. & Ashley Barnes*

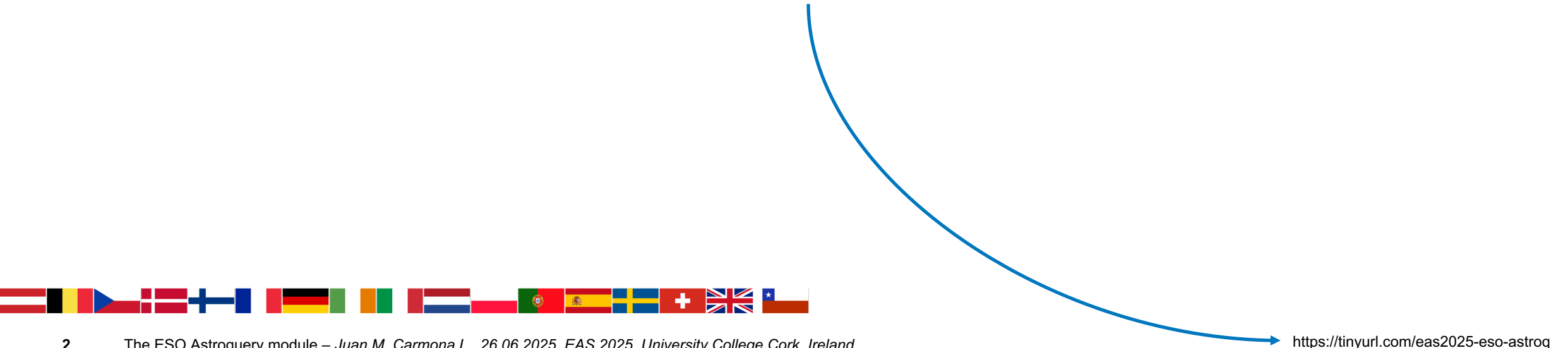


# Hands-on session

## Please download the slides from below

---

[https://github.com/eso/astroquery\\_examples/blob/main/assets/eas2025-ucc-eso-astroquery.pdf](https://github.com/eso/astroquery_examples/blob/main/assets/eas2025-ucc-eso-astroquery.pdf)





# What is Astroquery?

# Astroquery enables end-to-end analyses

 “Astroquery is a set of tools for querying astronomical web forms and databases.”

 **Documentation:** [astroquery.readthedocs.io](https://astroquery.readthedocs.io)

 **Code and issue tracker:** <https://github.com/astropy/astroquery>

 **Paper:** Ginsburg, Sipőcz, Brasseur et al 2019.

## Available Services

The following modules have been completed using a common API:

- ALMA Queries ([astroquery.alma](#))
- Atomic Line List ([astroquery.atomic](#))
- Besancon Queries ([astroquery.besancon](#))
- CADC ([astroquery.cadc](#))
- CASDA Queries ([astroquery.casda](#))
- Cologne Database for Molecular Spectroscopy (CDMS) Queries ([astroquery.linealists.cdms](#))
- ESA EUCLID Archive ([astroquery.esa.euclid](#))
- ESA Herschel Science Archive ([astroquery.esa.hsa](#))
- ESA HST Archive ([astroquery.esa.hubble](#))
- ESA Integral Science Legacy Archive (ISLA) ([astroquery.esa.integral](#))
- ESA ISO Archive ([astroquery.esa.iso](#))
- ESA JWST Archive ([astroquery.esa.jwst](#))
- ESA XMM-Newton Archive ([astroquery.esa.xmm\\_newton](#))
- ESASky Queries ([astroquery.esasky](#))
- ESO Queries ([astroquery.eso](#))
- FIRST Queries ([astroquery.image\\_cutouts.first](#))
- Gaia TAP+ ([astroquery.gaia](#))
- GAMA Queries ([astroquery.gama](#))
- Gemini Queries ([astroquery.gemini](#))
- HEASARC Queries ([astroquery.heasarc](#))
- HiPS2fits Service ([astroquery.hips2fits](#))



- HITRAN Queries ([astroquery.hitran](#))
- IRSA Moving Object Search Tool ([astroquery.ipac.irsa.most](#))
- IRSA Dust Extinction Service Queries ([astroquery.ipac.irsa.irsa\\_dust](#))
- IRSA Image Server program interface (IBE) Queries ([astroquery.ipac.irsa.ibe](#))
- IRSA Queries ([astroquery.ipac.irsa](#))
- JPL Spectroscopy Queries ([astroquery.jplspec](#))
- MAGPIS Queries ([astroquery.magpis](#))
- MAST Queries ([astroquery.mast](#))
- CDS MOC Service ([astroquery.mocserver](#))
- Minor Planet Center Queries ([astroquery.mpc/astroquery.solarsystem.MPC](#))
- NASA ADS Queries ([astroquery.nasa\\_ads](#))
- NED Queries ([astroquery.ipac.ned](#))
- NIST Queries ([astroquery.nist](#))
- NVAS Queries ([astroquery.nvas](#))
- SIMBAD Queries ([astroquery.simbad](#))
- Skyview Queries ([astroquery.skyview](#))
- Splatalogue Queries ([astroquery.splatalogue](#))
- SVO Filter Profile Service Queries ([astroquery.svo\\_fps](#))
- UKIDSS Queries ([astroquery.ukidss](#))
- Vamdc Queries ([astroquery.vamdc](#))
- VizieR Queries ([astroquery.vizieR](#))
- VO Simple Cone Search ([astroquery.vo\\_conesearch](#))
- VSA Queries ([astroquery.vsa](#))
- xMatch Queries ([astroquery.xmatch](#))



# The ESO module delivers complex datasets quickly

 “Simple python functions to script your access to the ESO archive via TAP.”

 ESO astroquery fork: <https://github.com/eso/astroquery>

 ESO example notebooks: [https://github.com/eso/astroquery\\_examples](https://github.com/eso/astroquery_examples)

- The ESO astroquery module allows users to search for raw and reduced data, retrieve metadata, and download data products. Proprietary access is also supported.
- The **new** ESO module enables faster, larger and more complex dataset analyses by using the the Table Access Protocol (**TAP**), an International Virtual Observatory Alliance (**IVOA**) standard.

## WDB (“Old”)

- Limited query interfaces with predefined queries
- Users can only enter constraints on predefined queries
- No direct query language
- Users cannot modify underlying queries
- Catalogues not accessible
- Simplified access for specific, common queries

## TAP (“New”)

- Full read-only access to ESO databases
- Users can write their own custom queries
- Uses ADQL 2.0 (SQL-based, VO standard)
- Users fully control query structure
- Catalogues accessible via dedicated interface
- Advanced, flexible querying for complex data retrieval

# Functionality

- List instruments and data releases.
- Instrument-specific and instrument-independent raw data search.
- Search across / by data releases.
- Automatic calibration selection (raw).
- Get extended FITS header information.
- Download datasets by their identifiers.
- Authenticated access to your assets.
- Run custom / complex ADQL queries.
- Retrieve atmospheric conditions data.

---

→ Automate all the above ←





**Where to get the new  
ESO astroquery module and examples?**



# Get the ESO module and examples from GitHub

Overview Repositories 3 Projects Packages Teams People 9

**ESO** 11 followers International http://www.eso.org Follow

Popular repositories

- homebrew-pipelines** Public  
A homebrew tap for ESO instrument pipelines  
Ruby ☆ 1 🔗 1
- astroquery\_examples** Public  
Jupyter notebooks for querying, accessing, and analyzing data from the ESO Science Archive using astroquery.eso. Includes examples for La Silla, Paranal (VLT), APEX, and ALMA datasets.  
Jupyter Notebook ☆ 1
- astroquery** Public  
Forked from astropy/astroquery  
Functions and classes to access online data resources. Maintainers: @keflavich and @bsipocz and @ceb8  
Python

View as: Public

You are viewing the README and pinned repositories as a public user.

People

Top languages

- Python
- Ruby
- Jupyter Notebook

[github.com/eso/astroquery](https://github.com/eso/astroquery)

- Fork of the official astroquery repository
- Latest ESO features not yet part of an official astroquery release

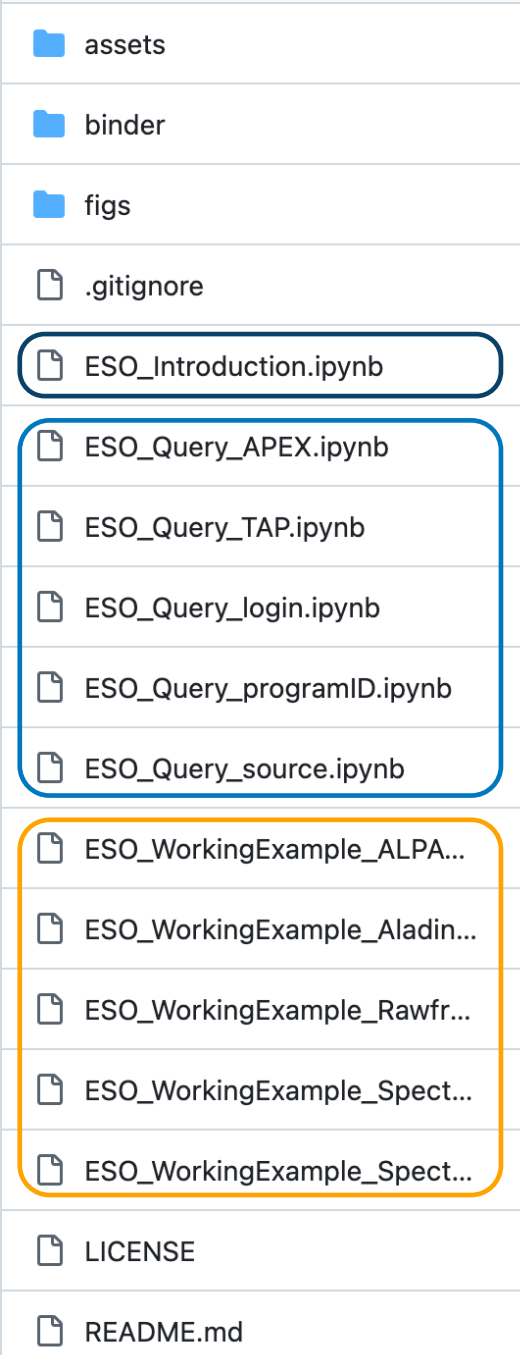
[github.com/eso/astroquery\\_examples](https://github.com/eso/astroquery_examples)

- Jupyter notebooks with tutorials and real application examples
- Submit your own! ;)



[github.com/eso](https://github.com/eso)





>github.com/eso/astroquery\_examples



## Introduction to basic functionality

- Query the archive for raw\* and reduced data
- Perform a simple cone search
- Obtain extended information on data products
- Download datasets from the archive

\*Either instrument-specific or generic

## Tutorials on basic functionality

- APEX products - reduced, raw, quick looks
- Searching via ADQL (SQL-like syntax)
- Downloading datasets by identifier
- Searching a source by name

## Real life examples and use cases

- Find the closest observation to a given time
- Investigate ESO data using Aladin
- Download raw data for a reduced data product
- Examine Spectral Data as function of time



# **Take a test drive**

## **– Hands-on session –**

# Take a test drive on the cloud



1. Go to [mybinder.org](https://mybinder.org)
2. Fill in [eso/astroquery\\_examples](https://mybinder.org/v2/gh/eso/astroquery_examples)
3. Click “Launch”

### Build and launch a repository

GitHub repository name or URL

GitHub

Git ref (branch, tag, or commit)

File to open (in JupyterLab)

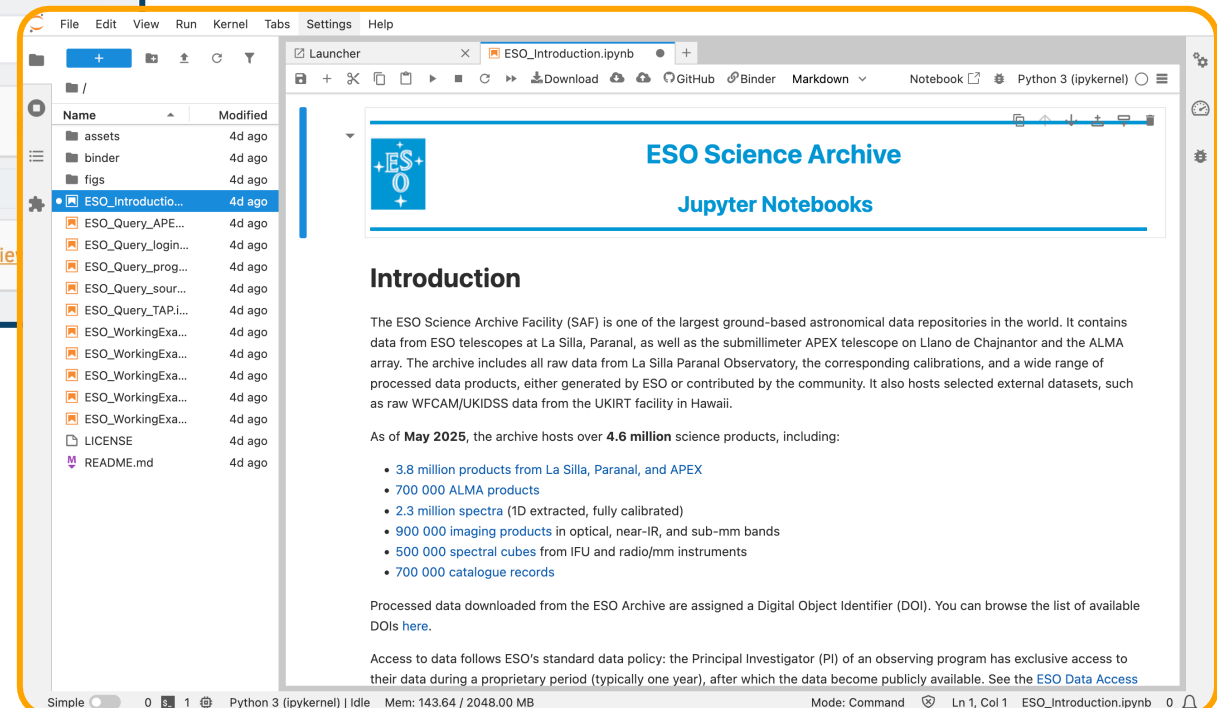
File

Launch

[https://mybinder.org/v2/gh/eso/astroquery\\_examples/HEAD](https://mybinder.org/v2/gh/eso/astroquery_examples/HEAD)

Badges for your README

Build Logs



**ESO Science Archive**  
Jupyter Notebooks

## Introduction

The ESO Science Archive Facility (SAF) is one of the largest ground-based astronomical data repositories in the world. It contains data from ESO telescopes at La Silla, Paranal, as well as the submillimeter APEX telescope on Llano de Chajnantor and the ALMA array. The archive includes all raw data from La Silla Paranal Observatory, the corresponding calibrations, and a wide range of processed data products, either generated by ESO or contributed by the community. It also hosts selected external datasets, such as raw WFCAM/UKIDSS data from the UKIRT facility in Hawaii.

As of **May 2025**, the archive hosts over **4.6 million** science products, including:

- 3.8 million products from La Silla, Paranal, and APEX
- 700 000 ALMA products
- 2.3 million spectra (1D extracted, fully calibrated)
- 900 000 imaging products in optical, near-IR, and sub-mm bands
- 500 000 spectral cubes from IFU and radio/mm instruments
- 700 000 catalogue records

Processed data downloaded from the ESO Archive are assigned a Digital Object Identifier (DOI). You can browse the list of available DOIs [here](#).

Access to data follows ESO's standard data policy: the Principal Investigator (PI) of an observing program has exclusive access to their data during a proprietary period (typically one year), after which the data become publicly available. See the [ESO Data Access](#)

In general:



1. Open your preferred cloud service
2. Type the repository address
3. Launch the examples



# What's next?

# What's next?

- Official **astropy** release (~weeks)
- 

- Include catalogues
  - Use of native python operators
  - Query by header keywords
- 

- Increase number of example notebooks and tutorials
  - Turn specific use-cases into general blue-prints
- 

→ Submit your notebooks! ←





# Thank you!

---

**Juan M. Carmona L.**

**[jcarmona@eso.org](mailto:jcarmona@eso.org)**

**Ashley Barnes**

**[ashley.barnes@eso.org](mailto:ashley.barnes@eso.org)**



@ESO Astronomy



@esoastronomy



@ESO



european-southern-observatory



@ESOobservatory

