



ESCAPE

European Science Cluster of Astronomy &
Particle physics ESFRI research Infrastructures

ESAP ESFRI Science Analysis Platform

S. Bertocco

From Science Gateways to Papers

Palermo, 22-26 May 2022

ESCAPE - The European Science Cluster of Astronomy & Particle Physics ESFRI Research Infrastructures has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n° 824064.

Horizon 2020 - Grant N° 824064



Summary

- ▶ Brief EU ESCAPE projects description
 - introduction
 - partners
 - work program
- ▶ ESAP
 - in the project proposal
 - in the concrete design and development
 - current status



ESCAPE aims to address the Open Science challenges in data accessibility shared by

- ▶ **ESFRI facilities** (SKA, CTA, KM3Net, EST, ELT, HL-LHC, FAIR)
- ▶ **pan-European research infrastructures** (CERN, ESO, JIVE)

both in astronomy and particle physics.

Goal: to make data and software open, accessible and interoperable in multi-messenger astronomy and accelerator-driven particle physics



Use cases providers

ESFRI Research Infrastructures are facilities, resources or services identified by the European research communities, based on the excellence of their scientific case and their maturity, to conduct and to support top-level research activities in their domains.



Astrophysics

Cherenkov Telescope Array



Astrophysics

Rubin Observatory Legacy Survey of Space and Time (LSST)



Astrophysics

Extremely Large Telescope



Astrophysics

EGO-Virgo



Astrophysics

Square Kilometre Array



Particle Physics

High Luminosity LHC



Particle Physics

Facility for Antiproton and Ion Research



Astrophysics

European Solar Telescope



Astrophysics

Joint Institute for VLBI ERIC



Astrophysics

KM3NeT



ESCAPE partners



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ESCAPE technical Work Packages

► **Data Lake (DIOS: Data Infrastructure for Open Science):**

Build a scalable, federated, data infrastructure for open science for the ESFRI
Enable connection to compute and storage resources. [Rucio]



► **Software Repository (OSSR: Open-source Scientific Software and Service Repository):**

Open source scientific software and service repository. [Zenodo]



► **Virtual Observatory (CEVO: Connecting ESFRI projects to EOSC through VO framework):**

Extend FAIR standards, methods, tools of the Virtual Observatory;
demonstrate EOSC ability to include existing platforms [IVOA]



► **Citizen Science (ECO:Engagement and COmmunication):**

Open gateway for citizen science on ESCAPE data archives and ESFRI CS projects



► **Science Platforms (ESAP: ESFRI Science Analysis Platform):**

Flexible science platform to enable the analysis of open access data



Summary

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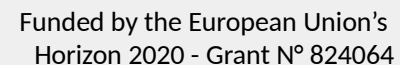
ESAP: ESFRI Science Analysis Platform in the EU ESCAPE project proposal

A high-performance, scalable science platform-service prototype

- ▶ to identify and stage existing data collections for analysis
- ▶ to run a wide-range of software tools and packages developed by the ESFRIs
- ▶ to allow researchers to bring their own custom workflows to the platform
- ▶ to take advantage of the underlying HPC and HTC computing infrastructure to execute those workflows
- ▶ to share results and workflows

tailored to the requirements of the ESFRI and other Research Infrastructures involved in the project





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ESAP: A platform... or a toolkit?

In the ESCAPE project ESAP is conceived as an integrated open science platform for data analysis
but

we are *not resourced* to build and maintain the great variety of available tools: Jupyter, batch computing services, desktop tools, etc. for common/EOSC access.

Many ESCAPE partner institutions do make available systems for testing, developing, and experimenting on.

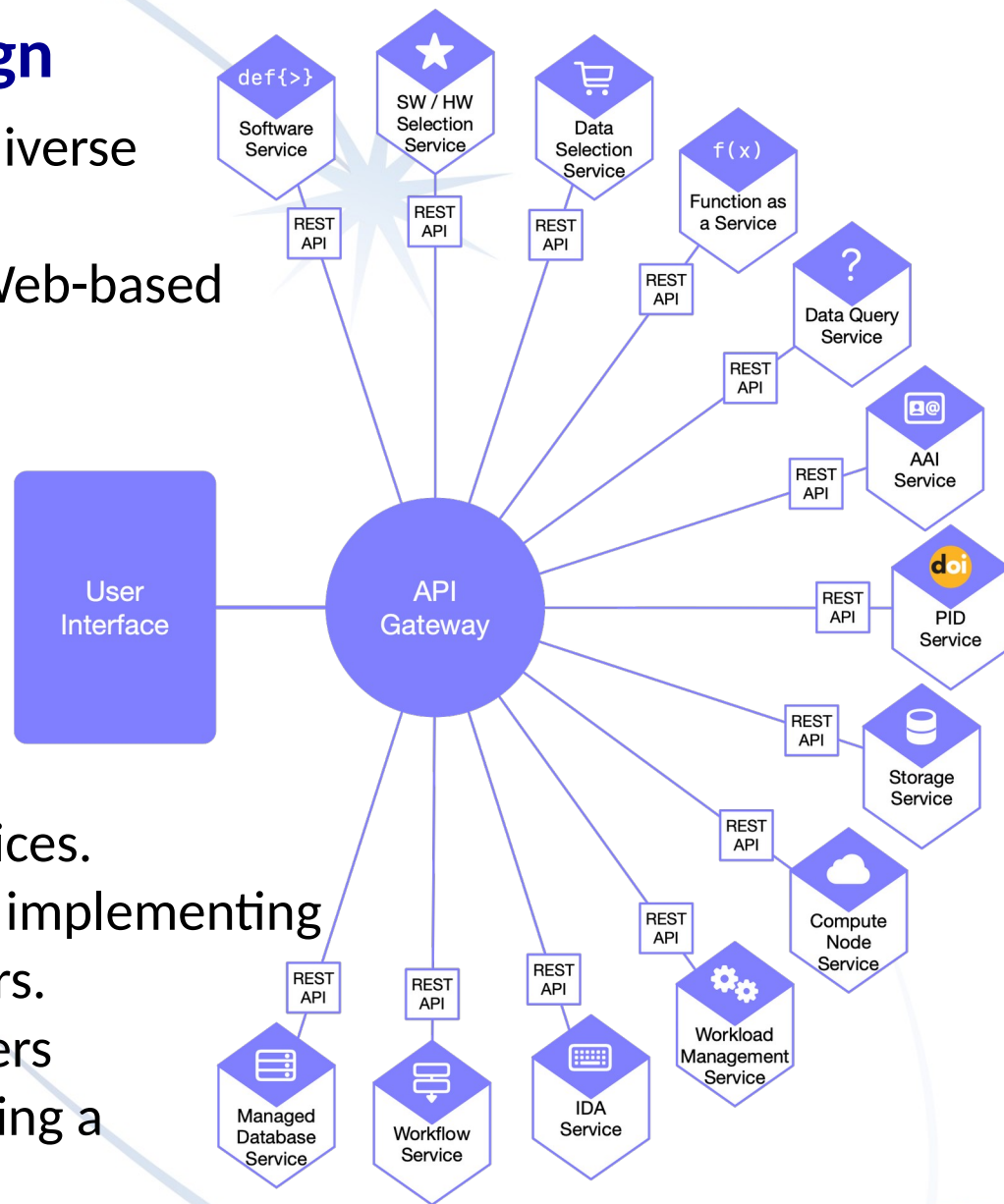
ESAP is a *toolkit* for building “science platforms” which are customized to particular applications.

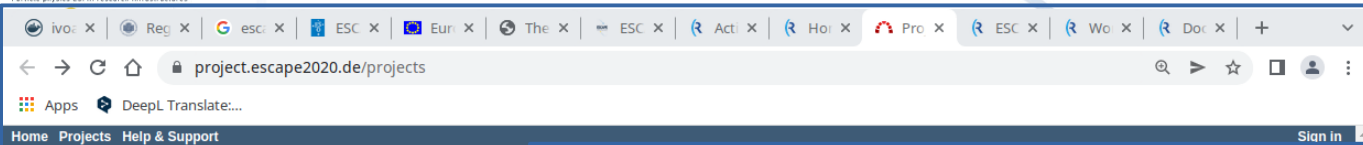
- At a variety of scales:
 - ▶ “Centralized ESAP”, providing flexible and convenient access to a wide spectrum of ESCAPE services.
 - ▶ “Project ESAP”, providing a way for individual infrastructures, projects, etc to quickly integrate diverse capabilities into a unified service offering.



ESAP Architectural Design

- ESAP is an integration point of diverse services from ESCAPE partners.
- The heart of the system is the Web-based *User Interface* and the *API Gateway*.
- The API Gateway modulates communication with a range of external services using REST APIs. A “service connector” system provides a standardized, plugin-based mechanism for integrating new services.
- It is possible to extend ESAP by implementing & integrating new service connectors.
- WP5 members and ESFRI partners collaborate on developing & integrating a variety of external services.





ESCAPE 2020 Projects

Projects Activity Issues Spent time Gantt Calendar

Projects

Any cross-WP project

ESFRI: CTA
Projects and Use Cases by CTA
Use Cases

ESFRI: EGO-Virgo

ESFRI: ESO

ESFRI: EST

ESFRI: FAIR
Projects and Use Cases by GSI/FAIR

ESFRI: HL-LHC

registro_21-22_....pdf

ESFRI: EGO-Virgo

Issues

Filters

☒ Status open

☒ Tracker is Use Case

Add filter

Options

☒ Apply

<input type="checkbox"/> #	Tracker	Status	Priority	Subject	Updated
<input type="checkbox"/> 142	Use Case	New	Normal	Enabling gravitational waves pipelines to process a stream of data from the ESCAPE datalake	11/30/2021 09:44 AM ...

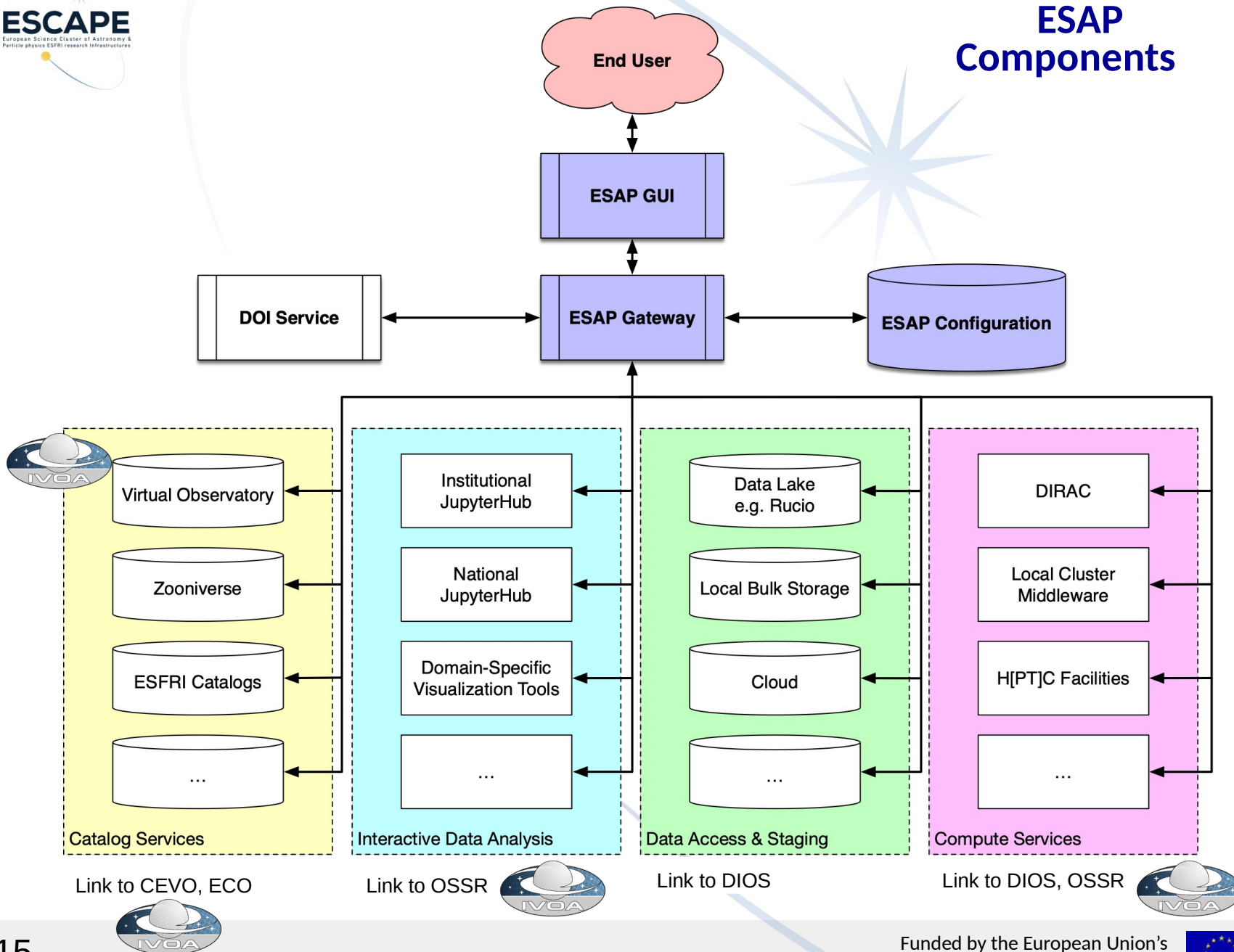
(1-1/1)

Also available in: [Atom](#) | [CSV](#) | [PDF](#)

registro_21-22_....pdf Show all



ESAP Components



Current Status & Capabilities

Query multiple archives with an adaptable interface

Load software from the ESCAPE repository

Integration with ESCAPE Identity & Access Management

Built with Python, Django, and React

Data orchestration across multiple services

Interactive Data Analysis through BinderHub services

Upload data using IVOA SAMP

The collage includes screenshots of the following interfaces:

- ASTRON Data Explorer**: A web interface for querying astronomical data, showing a search bar and a table of results.
- Interactive Analysis Workflows**: A page showing various workflows like 'CSG-IAA HCG-35 workflow' and 'CDS MOCPY'.
- ESCAPE Welcome**: A login page with fields for username and password, and a 'Sign in' button.
- Virtual Observatory (VO) interfaces**: Screenshots of the ASTRON VO, Zooniverse, and Virtual Observatory (VO) interfaces.
- Workflow for plotting and visualizing data from the ESAP shopping basket**: A Jupyter Notebook interface showing code for data processing and visualization.
- Table of astronomical data**: A screenshot of a table with columns like 'Name', 'RA', 'Dec', 'flow', 'DataProduct Type', 'DataProduct Subtype', and 'Dataset'.

Demo system

<https://sdc-dev.astron.nl/esap-gui>



Current Status & Capabilities

ESAP-GUI — Mozilla Firefox

Google Traduttore

Inbox (3,817) - sara.bertocci

ESAP-GUI

PyVO.ipynb - JupyterLab

indigo iam - Google Search

https://sdc-dev.astron.nl/esap-gui/

Getting Started

Other Bookmarks

ESCAPE

ESAP

European Science Cluster of Astronomy & Astrophysics

Archives

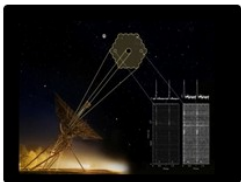
Multi Query

Interactive Analysis

IVOA-SAMP

Login


WSRT-Apertif



Apertif Surveys

Data from the Apertif surveys include imaging and time-domain data. The time-domain products consist of high-time resolution filterbank data in the PSRFITS standard. The imaging data products include the raw observations in the measurement set (MS) standard format. In addition, processed data products are available, including calibration tables, calibrated visibilities, multi-frequency synthesis continuum images, polarization images and cubes, and uncanceled neutral hydrogen (HI) line and beam cubes. Full

ASTRON VO




ASTRON Virtual Observatory

The Virtual Observatory defines a set of standards that can be used to download astronomical data. The ASTRON VO contains several image surveys, which are images in the FITS format. Since the VO is currently under development, more data types will be available in the future.

Visit ASTRON VO Archives

Zooniverse




Zooniverse Classification Database

The Zooniverse is the world's largest and most popular platform for people-powered research. This research is made possible by volunteers — more than a million people around the world who come together to assist professional researchers. Our goal is to enable research that would not be possible, or practical, otherwise. Zooniverse research results in new discoveries, datasets useful to the wider research community, and many publications.

Visit Zooniverse Archives

Virtual Observatory (VO)




Virtual Observatory (VO)

The Virtual Observatory defines a set of standards that can be used to download astronomical data.

Visit Virtual Observatory (VO) Archives

RUCIO



Rucio

Built on more than a decade of experience, Rucio serves the data needs of modern scientific experiments. Large amounts of data, countless numbers of files, heterogeneous storage systems, globally distributed data centres, monitoring and analytics. All coming together in modular solution to fit your needs.

Visit RUCIO Archives

https://sdc-dev.astron.nl/esap-api/oidc/authenticate



Existing Query Capabilities

ESAP can query the registry for services and data

ADQL Query

```
SELECT TOP 100 * from ivoa.observatory WHERE obs_collection='apertif-dr1' and dataproduct_subtype='continuum'
```

Service Metadata

► <https://vo.astron.nl/tap> 11 keys

Selected Services

<https://vo.astron.nl/tap>

Archives Multi Query Interac

ESAP IVOA Query

Catalog* Keyword

IVOA radio

Query VO Registry

List of VO Resources

1

Resource	Access URL	Waveband	Title	Service Type	Content Types
<input type="checkbox"/> CSIRO ASKAP TAP	https://casda.csiro.au/casda_vo_tools/tap	radio	CSIRO ASKAP Science Data Archive TAP Service	vs:catalogservice	[other]
<input type="checkbox"/> CSIRO Pulsar TAP	https://data.csiro.au/psrdavo/tap	radio	CSIRO Parkes Pulsar Data Archive	vs:catalogservice	[other]
<input type="checkbox"/> HALCA	http://jvo.nao.ac.jp/skynode/do/tap/halca	radio	HALCA VSOP (the VLBI Space Observatory Programme) Correlated Data	vs:catalogservice	[archive]

Results from <https://vo.astron.nl/tap>

Basket	dataproduct_type	dataproduct_subtype	calib_level	obs_collection	obs_id	obs_title	obs_publisher_did	obs_creator
<input type="checkbox"/>	image	continuum	3	apertif-dr1	190807041	190807041_AP_Boo1	ivo://astron.nl/-/?APERTIF_DR1/190807041_AP_Boo1/image_mf_02.fits	

Archives Multi Query Interactive Analysis IVOA-SAMP

Archive - Virtual Observatory (VO)

Instrument	Virtual Observatory
Description	Virtual Observatory (VO)

Virtual Observatory (VO)

The Virtual Observatory defines a set of standards that can be used to download astronomical data.

Data Retrieval

Data from the VO can be downloaded using the query functionality of the web page. Also, the VO standard protocols can be used to find the data that is shared through the service using external tools like TOPCAT, Aladin or DSG.

Data in Virtual Observatory (VO)

Dataset or Category	Catalog	Query Access
VO Registry	Virtual Observatory (VO)	Query this Dataset

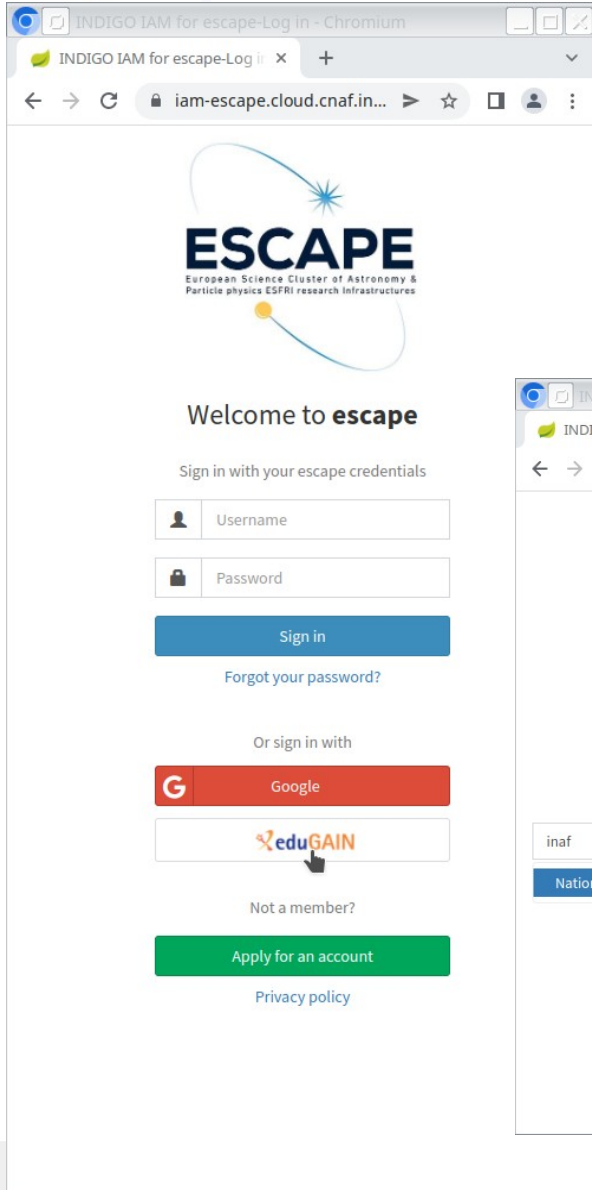
VO Registry

The table access protocol (TAP) defines a service protocol for accessing general table data, including astronomical catalogs as well as general database tables. Access is provided for both database and table metadata as well as for actual table data. This version of the protocol includes support for multiple query languages, including queries specified using the Astronomical Data Query Language ADQL within an integrated interface. It also includes support for both synchronous and asynchronous queries. Special support is provided for spatially indexed queries using the spatial extensions in ADQL. A multi-position query capability permits queries against an arbitrarily large list of astronomical targets, providing a



Authentication using IAM

INDIGO Identity and Access Management



INDIGO IAM for escape-Log in - Chromium

INDIGO IAM for escape-Log in

iam-escape.cloud.cnaf.in...

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Welcome to **escape**

Sign in with your escape credentials

Username

Password

Sign in

Forgot your password?

Or sign in with

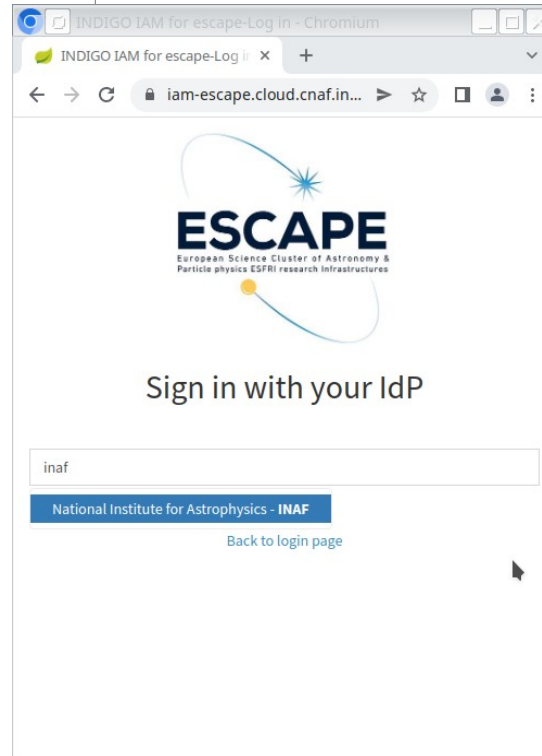
Google

eduGAIN

Not a member?

Apply for an account

Privacy policy



INDIGO IAM for escape-Log in - Chromium

INDIGO IAM for escape-Log in

iam-escape.cloud.cnaf.in...

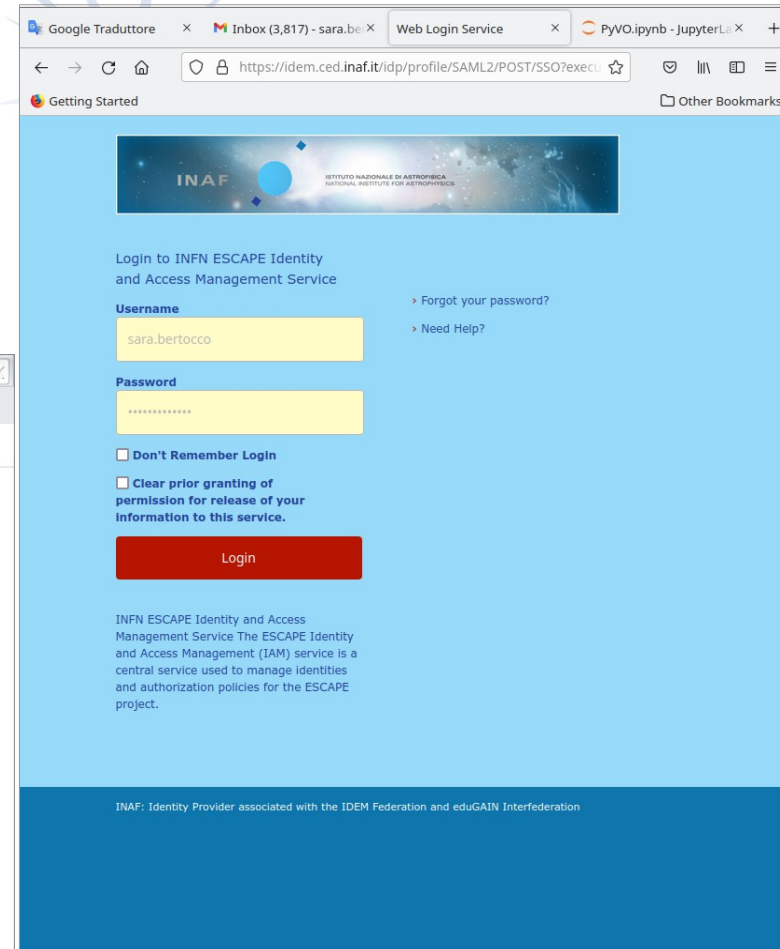
ESCAPE
European Science Cluster of Astronomy &
Particle physics ESFRI research Infrastructures

Sign in with your IdP

inaf

National Institute for Astrophysics - INAF

Back to login page



Google Traduttore x Inbox (3,817) - sara.be x Web Login Service x PyVO.ipynb - JupyterLab x +

https://idem.ced.inaf.it/idp/profile/SAML2/POST/SSO?execu

Getting Started

INAF
ISTITUTO NAZIONALE DI ASTRONOMIA
NATIONAL INSTITUTE FOR ASTROPHYSICS

Login to INFN ESCAPE Identity and Access Management Service

Forgot your password?

Need Help?

Username

sara.bertocco

Password

Don't Remember Login

Clear prior granting of permission for release of your information to this service.

Login

INFN ESCAPE Identity and Access Management Service The ESCAPE Identity and Access Management (IAM) service is a central service used to manage identities and authorization policies for the ESCAPE project.

INAF: Identity Provider associated with the IDEM Federation and eduGAIN Interfederation



Authenticated user operations

ESAP-GUI — Mozilla Firefox

Google Traduttore
Inbox (3,817) - sara.bertocco
ESAP-GUI
PyVO.ipynb - JupyterLab
indigo iam - Google Search

https://sdc-dev.astron.nl/esap-gui/archives/apertif/query

Getting Started

Other Bookmarks

ASTRON Data Explorer
Archives
Multi Query
Interactive Analysis
IVOA-SAMP

3

Save Basket

Logout Sara Bertocco

Apertif Data Collection Query

Catalog

Target

RA (degrees)

dec (degrees)

search radius (degrees)

Apertif Collections

Apertif

342.16

33.94

2

Imaging

Processing Level

DataProduct Type

Data Release

Processed

All

Science Verification Campa

Submit

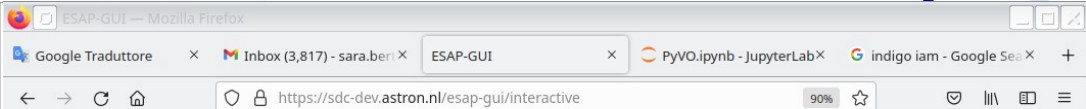
Query results for Apertif

1
2
3
4
...
5

Basket	Name	RA	Dec	fov	DataProduct Type	DataProduct SubType	Dataset ID	Link to data
<input type="checkbox"/>	S2248+33.UVFITS	-17.8	33.9	0.5	visibility	calibratedVisibility	190409015	Download data
<input type="checkbox"/>	image_mf_02.fits	-17.8	33.9	0.5	image	continuumMF	190409015	Download data
<input checked="" type="checkbox"/>	HI_image_cube0.fits	-17.8	33.9	0.5	cube	imageCube	190409015	Download data
<input checked="" type="checkbox"/>	HI_beam_cube0.fits	-17.8	33.9	0.5	cube	beamCube	190409015	Download data
<input checked="" type="checkbox"/>	HI_image_cube1.fits	-17.8	33.9	0.5	cube	imageCube	190409015	Download data
<input type="checkbox"/>	HI_beam_cube1.fits	-17.8	33.9	0.5	cube	beamCube	190409015	Download data
<input type="checkbox"/>	HI_image_cube2.fits	-17.8	33.9	0.5	cube	imageCube	190409015	Download data



Workflows & computing facilities selection



Interactive Analysis

Workflows

[Advanced Search](#)

CSIC-IAA HCG-16 workflow

Description: Analysis of Hickson Compact Group 16
Link: <https://github.com/AMIGA-IAA/hcg-16>
Author:
Runtime Platform:
Keywords: jupyter-notebook

CDS MOCpy

Description: Experiment with Multi-Order Coverage maps
Link: <https://github.com/cds-astro/mocpy>
Author:
Runtime Platform:
Keywords: jupyter-notebook

ASTRON VO Apertif

Description: ASTRON VO Apertif
Link: <https://git.astron.nl/astron-sdc/escape-wp5/workflows/apertif-vo-example>
Author:

Interactive Analysis

Compute Facilities

JIVE BinderHub

Description:
JIVE BinderHub
Link: <http://jupyterjive.nl/binderhub/>

MyBinder

Description:
MyBinder
Link: <https://mybinder.org/>

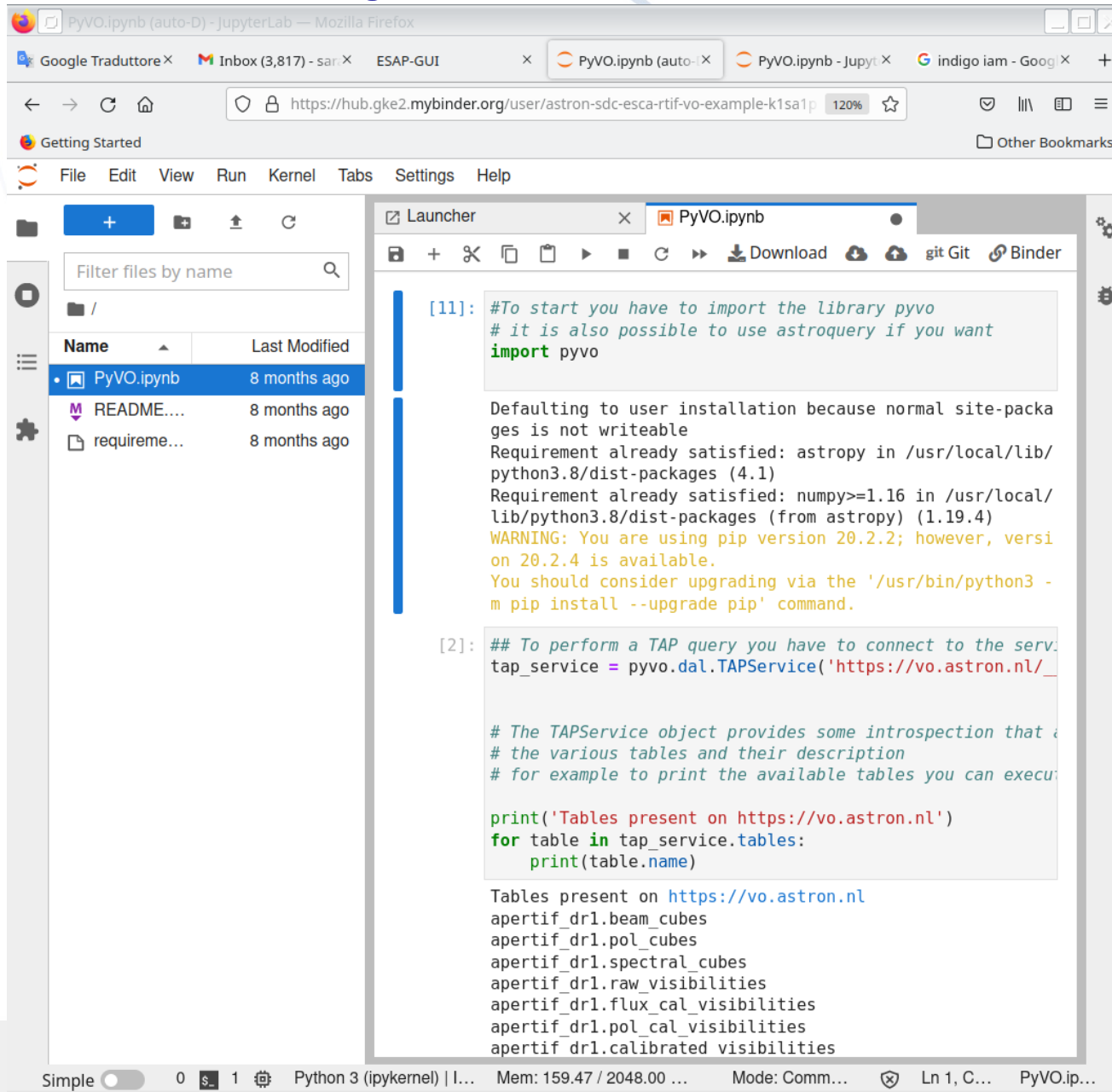
Rosetta @ INAF OATS

Description:
The Rosetta platform deployed at INAF OATS computing centre
Link: <https://esap-rosetta.oats.inaf.it/>

SKAO BinderHub

<https://sdc-dev.astron.nl/esap-api/ida/deploy?facility=https://mybinder.org/&workflow=https://git.astron.nl/astron-sdc/escape-wp5/workflows/apertif-vo-example>

Analysis facilities access



PyVO.ipynb (auto-D) - JupyterLab — Mozilla Firefox

Google Traduttore X Inbox (3,817) - sar X ESAP-GUI X PyVO.ipynb (auto-D) X PyVO.ipynb - Jupyter X indigo iam - Google X

← → ↻ 🏠 🔒 https://hub.gke2.mybinder.org/user/astron-sdc-esca-rtif-vo-example-k1sa1p 120% ☆

Getting Started Other Bookmarks

File Edit View Run Kernel Tabs Settings Help

Filter files by name 🔍

Name	Last Modified
PyVO.ipynb	8 months ago
README....	8 months ago
requireme...	8 months ago

Launcher x **PyVO.ipynb**

📁 + ✂ 📄 ▶ ⏏ ↺ ⏴ ⏵ ⬇ Download 🌥 🌥 git Git 🔗 Binder ⚙ ⚙

```
[1]: #To start you have to import the library pyvo
# it is also possible to use astroquery if you want
import pyvo

Defaulting to user installation because normal site-packages
is not writeable
Requirement already satisfied: astropy in /usr/local/lib/
python3.8/dist-packages (4.1)
Requirement already satisfied: numpy>=1.16 in /usr/local/
lib/python3.8/dist-packages (from astropy) (1.19.4)
WARNING: You are using pip version 20.2.2; however, versi
on 20.2.4 is available.
You should consider upgrading via the '/usr/bin/python3 -
m pip install --upgrade pip' command.

[2]: ## To perform a TAP query you have to connect to the serv
tap_service = pyvo.dal.TAPService('https://vo.astron.nl/

# The TAPService object provides some introspection that
# the various tables and their description
# for example to print the available tables you can execu

print('Tables present on https://vo.astron.nl')
for table in tap_service.tables:
    print(table.name)

Tables present on https://vo.astron.nl
apertif_drl.beam_cubes
apertif_drl.pol_cubes
apertif_drl.spectral_cubes
apertif_drl.raw_visibilities
apertif_drl.flux_cal_visibilities
apertif_drl.pol_cal_visibilities
apertif_drl.calibrated_visibilities
```

Simple 0 1 Python 3 (ipykernel) | ... Mem: 159.47 / 2048.00 ... Mode: Comm... Ln 1, C... PyVO.ip...



Work in progress

- ▶ Enlarge the supported computation facilities (EGI under investigation)
 - Add workflows search capabilities through workflow metadata description (metadata needed)
- ▶ Add computation facility search (metadata needed) and
- ▶ Automate workflow upload and run in a computation facility through compute facility metadata description



ESAP Software Execution (1)

Interactive Analysis Workflows

Search for Workflows

Next

Advanced Search

CSIC-IAA HCG-16 workflow

Description: Analysis of Hickson Compact Group 16

Link: <https://github.com/AMIGA-IAA/hcg-16>

Author:

Runtime Platform:

Keywords: jupyter-notebook

CDS MOCpy

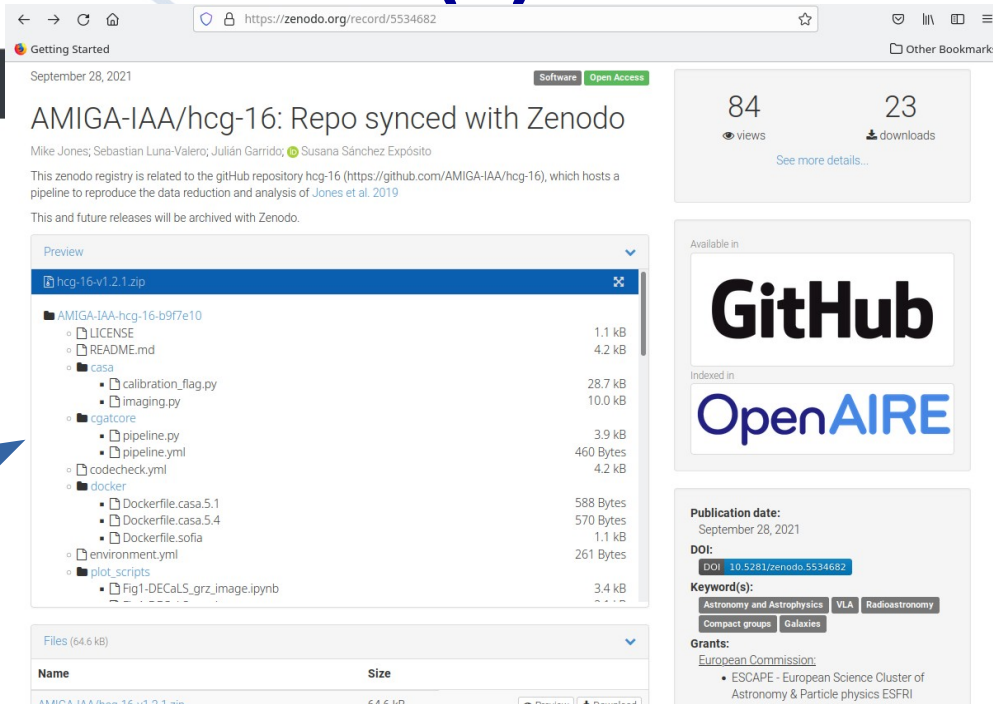
Description: Experiment with Multi-Order Coverage maps

Link: <https://github.com/cds-astro/mocpy>

Author:

Runtime Platform:

Keywords: jupyter-notebook



Getting Started
September 28, 2021
Software Open Access

AMIGA-IAA/hcg-16: Repo synced with Zenodo

Mike Jones; Sebastian Luna-Valero; Julián Garrido; Susana Sánchez Expósito

This zenodo registry is related to the gitHub repository hcg-16 (<https://github.com/AMIGA-IAA/hcg-16>), which hosts a pipeline to reproduce the data reduction and analysis of Jones et al. 2019

This and future releases will be archived with Zenodo.

Preview

File	Size
hcg-16-v1.2.1.zip	64.6 kB
AMIGA-IAA-hcg-16-b9f7e10	
LICENSE	1.1 kB
README.md	4.2 kB
casa	
calibration_flag.py	28.7 kB
imaging.py	10.0 kB
cgatcore	
pipeline.py	3.9 kB
pipeline.yml	460 Bytes
codecheck.yml	4.2 kB
docker	
Dockerfile.casa.5.1	588 Bytes
Dockerfile.casa.5.4	570 Bytes
Dockerfile.sofia	1.1 kB
environment.yml	261 Bytes
plot_scripts	
Fig1-DECaLS_grz_image.ipynb	3.4 kB

Files (64.6 kB)

Name	Size
AMIGA-IAA/hcg-16-v1.2.1.zip	64.6 kB

84 views 23 downloads

Available in

GitHub

Indexed in

OpenAIRE

Publication date: September 28, 2021

DOI: 10.5281/zenodo.5534682

Keyword(s): Astronomy and Astrophysics VLA Radioastronomy Compact groups Galaxies

Grants: European Commission

• ESCAPE - European Science Cluster of Astronomy & Particle physics ESFRI research Infrastructure (131464)

Workflow metadata description needed:

- OSSR & CEVO working on it
- codemeta.json

<https://escape2020.pages.in2p3.fr/wp3/eossr/v0.4/metadata.html>



ESAP Software Execution (2)

Interactive Analysis

Compute Facilities

Search for Facilities



Deploy

JIVE BinderHub



Description:

JIVE BinderHub

Link: <http://jupyterjive.nl/binderhub/>

MyBinder

Description:

MyBinder

Link: <https://mybinder.org/>

Rosetta @ INAF OATS

Compute facilities metadata description needed:

- ExecutionPlanner

<https://github.com/ivoa/ExecutionPlannerNote>

<https://wiki.ivoa.net/internal/IVOA/InterOpApr2022GWS/20220426-ExecutionPlanner.pdf>



Acknowledgment



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Special thanks to John Swinbank (WP5 leader) for sharing his slides.





ESCAPE

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Thank you !

