ESCAPE

European Science Cluster of Astronomy & Particle physics ESFRI research Infrastructures

WP4 ‘CEVO’ status

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Changing landscape of Data Sharing

Convergence of principles and language:

- **FAIR**
  - **F**indable, **A**ccessible, **I**nteroperable, **R**eusable

- **Open Science**
  - Data sharing with open and seamless services to analyse and reuse research data to improve science

- **Stewardship**
  - Human skills for curation, quality content, data management, services

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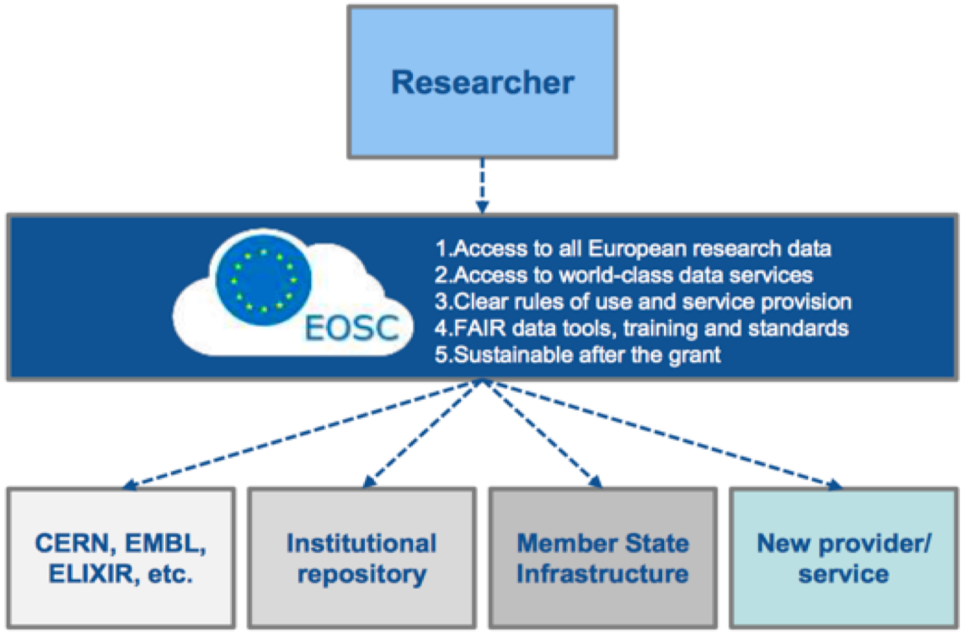
In Europe… there is a new big initiative for data: **European Open Science Cloud (EOSC)**

European Commission

A. The EOSC will allow for universal access to data and a new level playing field for EU researchers



- Easy access through a universal access point for ALL European researchers
- Cross-disciplinary access to data unleashes potential of interdisciplinary research
- Services and data are interoperable (FAIR data)
- Data funded with public money is in principle open (as open as possible, as closed as necessary)
- EOSC will help increase recognition of data intensive research and data science

Seamless environment, enabling interdisciplinary research

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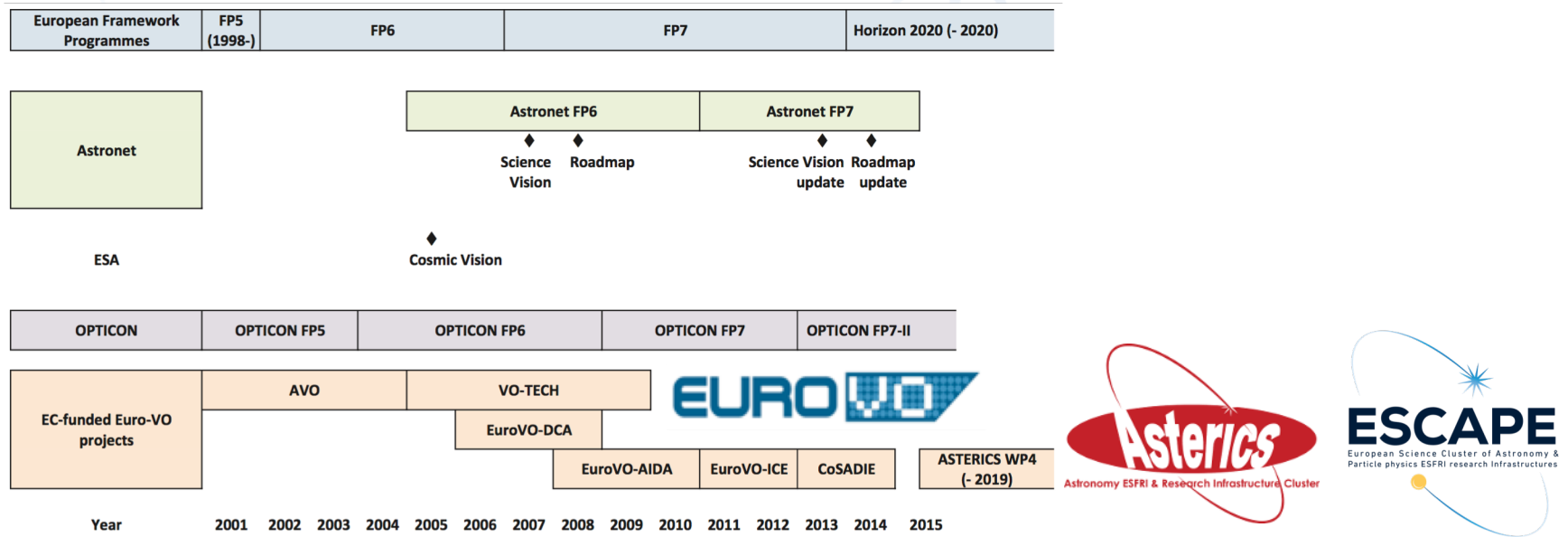
Background of the VO data aspects in Europe…
How we got here, and where we're going

- Virtual Observatory infrastructure for astronomy



Genova et al. 2015

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What is the Virtual Observatory?

- **Operational framework** for interoperable access to astronomical data and services across all areas of astronomy

- Provides unique scientific capabilities, opening up new ways of using rich data in astronomy archives and services

- **A pioneer of FAIR data sharing** - **an existing global framework** – populated by major data providers (space and ground based) that is heavily used by the community *(e.g. Gaia data access is fully VO)*

- **Re-used and customized** by planetary science (EuroPLANET), atomic and molecular physics (VAMDC) and materials sciences (via RDA Working Group)

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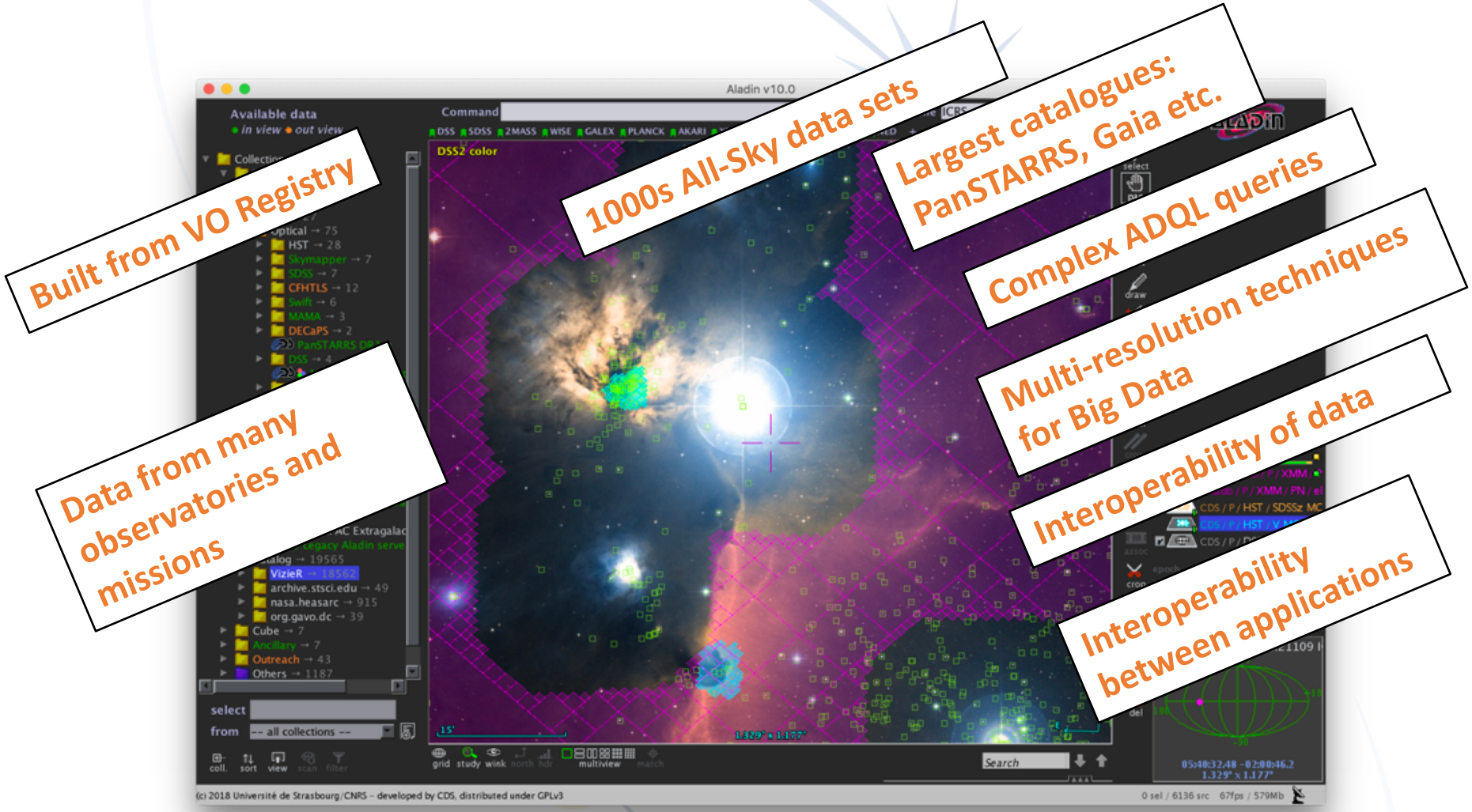
One view of the VO from an application:



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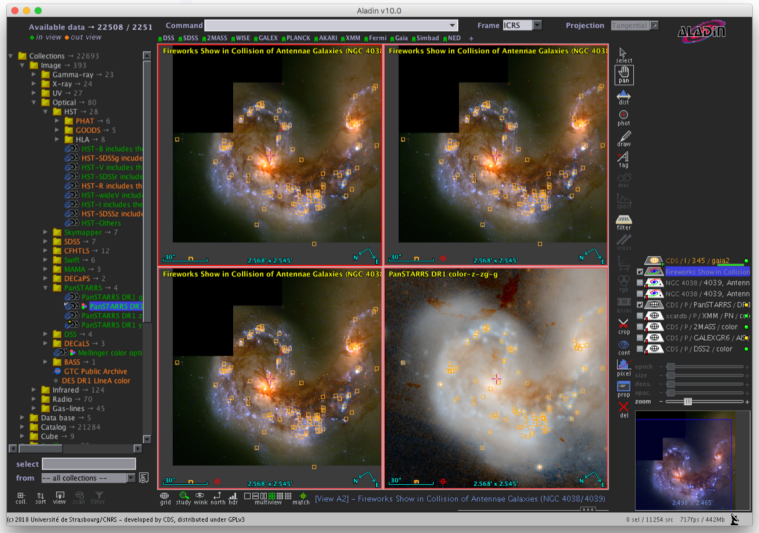
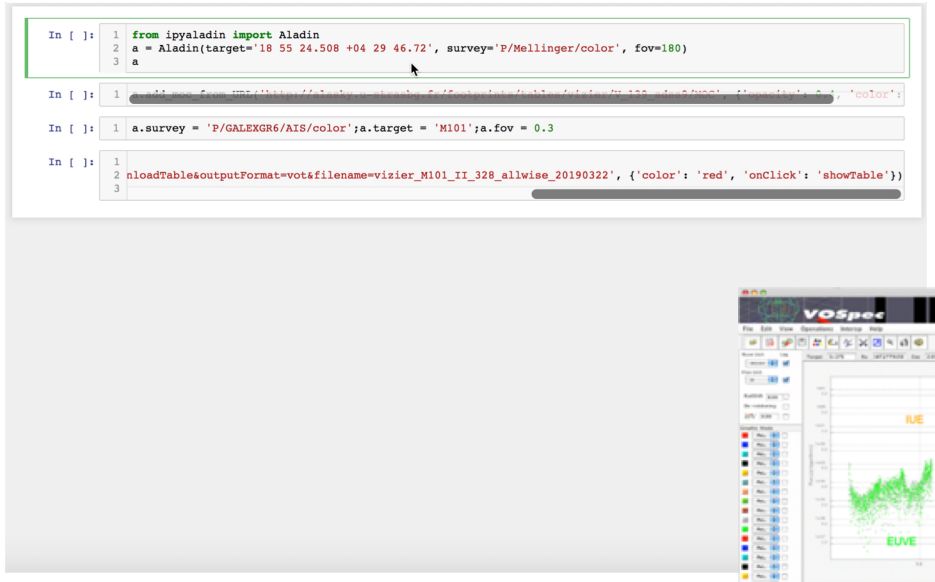
Interoperable applications and services

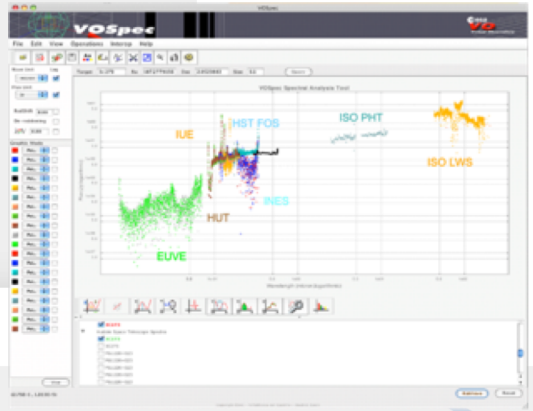


Data exploration and integration tools

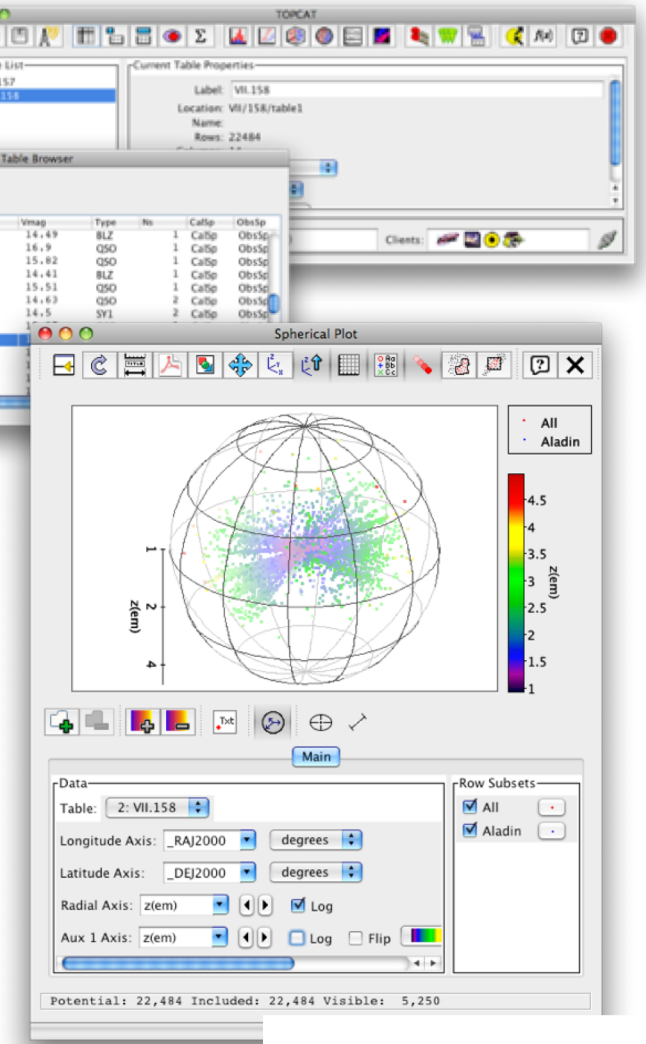


Notebooks

Your apps
& programs



Spectral tools



TOPCAT

Broadcast

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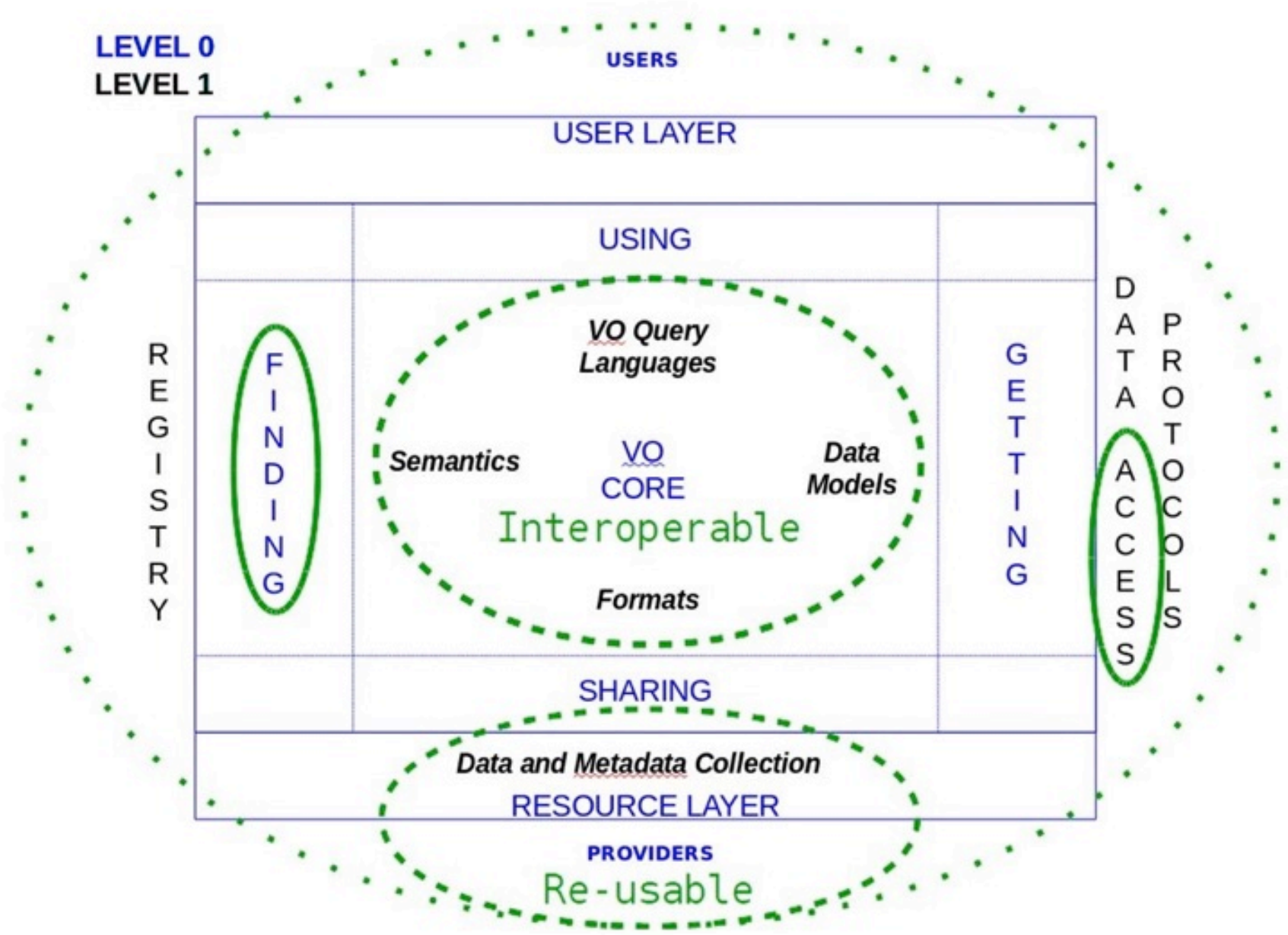
VO is FAIR



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ESCAPE in a nutshell

ESCAPE convenes a large scientific community

- **31** partners : **7** ESFRI & landmarks: CTA, ELT, EST, FAIR, HL-LHC, KM3NeT, SKA
- **2** pan-European International Organizations: CERN, ESO (with their world-class established infrastructures, experiments and observatories).
- **4** supporting ERA-NET initiatives: HEP (CERN), NuPECC, ASTRONET, APPEC
- **1 involved initiative/infrastructure: EURO-VO (Virtual Observatory)**
- **2** European research infrastructures: EGO and JIVE-ERIC
- Budget: **16 M€,** Started: **Feb 2019**, Duration: **42** months
- Coordinator: **CNRS (**Centre National de la Recherche Scientifique**)**

Home page: https://projectescape.eu

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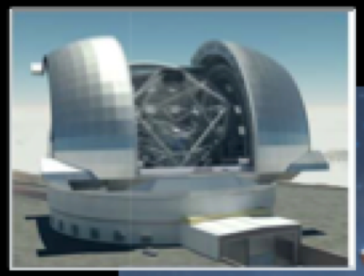
ESCAPE
European Science Cluster of Astronomy & Particle physics ESFRI research Infrastructures

Radio

JIVE-VLBI

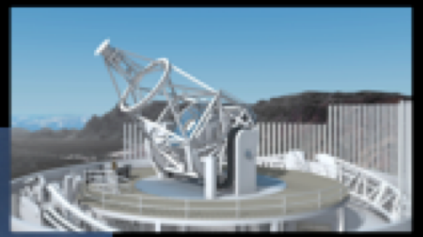
SKA

Visible light



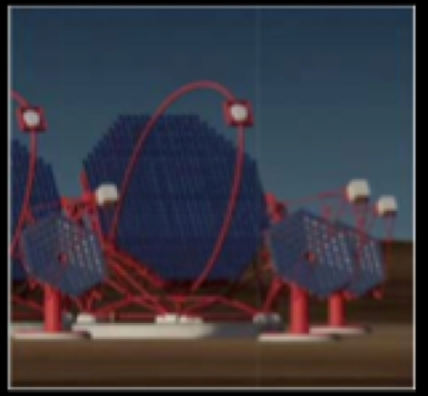
ELT

ESO



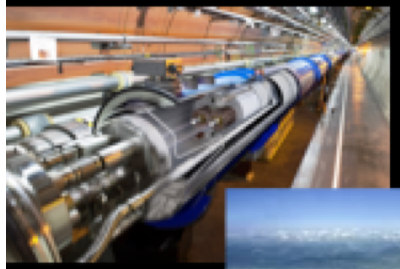
EST

Gamma rays

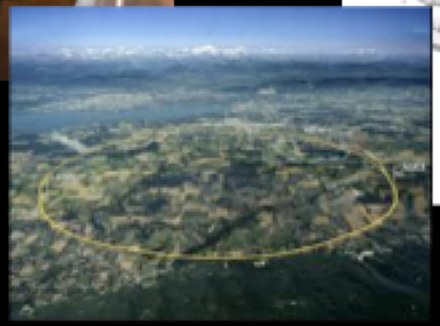


CTA

Accelerator-based Particle Physics

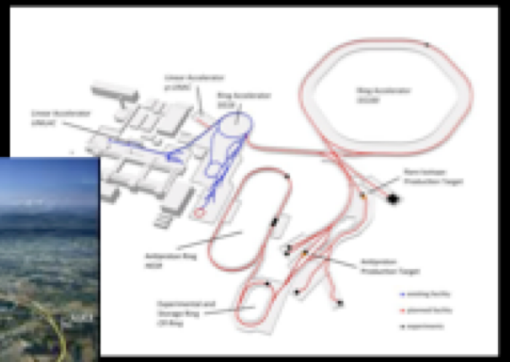


HL-LHC



CERN

Accelerator-based Nuclear Physics

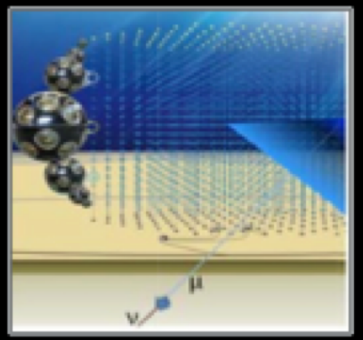


FAIR

Gravitational Waves

EGO-VIRGO

Cosmic-rays Neutrinos



KM3NeT

ESCAPE goals

1. Implementing **Science Analysis Platforms** for EOSC researchers to stage data collections, analyse them, access ESFRIs' software tools, bring their own custom workflows.

2. Contributing to the **EOSC** global resources federation through a Data-Lake concept implementation to manage extremely large data volumes at the multi-Exabyte level.

3. Supporting **"scientific software"** as a major component of ESFRI data to be preserved and exposed in EOSC through dedicated catalogues.

4. Implementing a community foundation approach for continuous software shared development and training new generation researchers.

5. ***Virtual Observatory standards and methods for FAIR principles to a larger scientific context; demonstrating EOSC capacity to include existing frameworks***.

6. Further involving SMEs and society in knowledge discovery.

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http://projectescape.eu

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- ESCAPE Executive Board : E-EB – having regular meetings
- Other WPs – having regular telecons, and setting up meetings
- Communication – active, looking for things to highlight

- WP4 - First Milestone – Paris IVOA meeting report
- WP4 – First Deliverable – WP4 Project Plan
- coming up – Second Milestone – Groningen IVOA meeting
  - calendar – see Project Plan document
- Project tools: Indico / mailing lists / file sharing repository

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WP4 Objectives

- Assess and implement the connection of **ESFRI** and other **astronomy research infrastructures** to the **EOSC** by the **Virtual Observatory**
- Refine and pursue implementation of **FAIR principles for astronomy** data via common interoperability standards - extending the VO to new communities
- Establish **data stewardship practices** for adding value to scientific content of ESFRI data archives

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Connecting ESFRI to the EOSC via the VO

In practice: ESFRI-VO-EOSC connection

- Inclusion of **VO registry** will be a key factor
- Implement **FAIR principles via interoperability standards**
- **VO next-steps:**
  - Requirements of ESFRI and European data providers, e.g. value added data at ESO, preparing for Big Data
  - Connection to computing, and extension to new communities
- **Stewardship** – technical and human
- **Training** – ”Interoperable data schools”

Following all steps of EOSC evolution – making the connection with VO and astronomy needs

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WP4 Tasks

Task 4.1 Integration of astronomy VO data and services into the EOSC

Lead: Marco Molinaro (INAF)

Task 4.2 Implementation of FAIR principles for ESFRI data through the Virtual Observatory

Lead: Françoise Genova (CNRS-ObAS)

Task 4.3 Adding value to trusted content in astronomy archives

Co-leads: Mark Allen (CNRS-ObAS) & Martino Romaniello (ESO)

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WP4 Partners

Partners from ESFRIs and astronomy Research Infrastructures

Partners bringing experience from European Virtual Observatory projects

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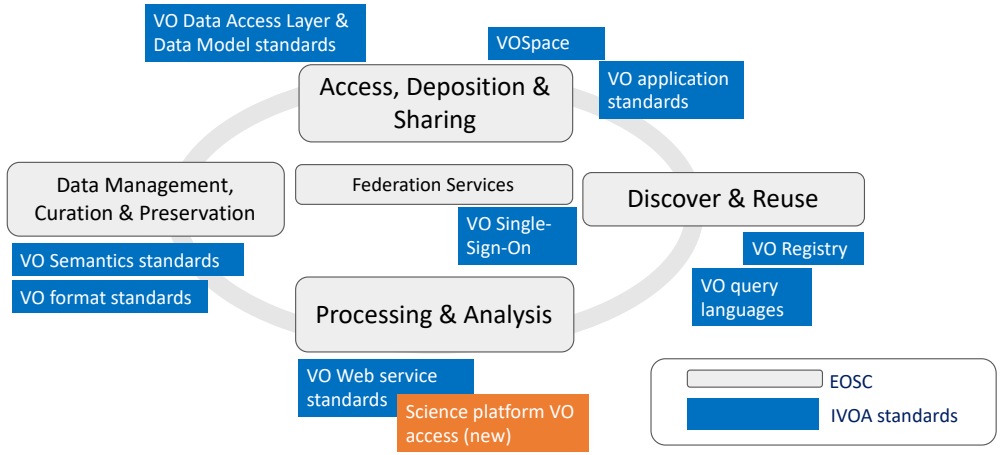
Task 4.1 Integration of astronomy VO data and services into the EOSC

- Map the VO framework to EOSC
  - *Aim to include the VO enabled archive services from ESFRI into EOSC*
- VO Registry in EOSC
- Portfolio of astronomy VO services
- Contribution to EOSC hybrid cloud
- Containerised domain-specific services



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Task 4.1 - overview

“Integration of astronomy VO data and services into the EOSC”

- Interfacing the VO framework with EOSC
  - VO registry federated as **EOSC catalogue/s**
  - Astronomy vocabularies as EOSC services
- **Portfolio** of astronomy VO services
- EOSC **Hybrid Cloud contribution**
- Domain-specific services **containerisation**

WP5 (ESAP) coordination on computing “close” to data
WP2 (DIOS) coordination to test the above on the “data lake” solution

(of course) collaboration with the other WP4 Tasks to work on latest VO standards and data resource integration in the EOSC.

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Task 4.1 - tentative roadmap

- **Clarify “level of compliance” within EOSC (architecture check)**
- **Identify EOSC attachment points**
  - requires EOSC projects interaction
  - detailed Task 4.1 input to project plan for CEVO (month 6)
- **VO Registry integration**
  - standards
  - data resources
  - service resources
- **Vocabulary integration**
- **Standards implementation containerisation**
- **Build-up of the portfolio**
  - after defining its solution: EOSC integrated, VO managed

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Task 4.2 Implementation of FAIR principles for ESFRI data through the Virtual Observatory

Definition and adoption of common open IVOA standards for interoperability based on ESFRI requirements

Connection to EOSC through Task 4.1

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Task 4.2 Activities: Requirements and VO update

- Gathering requirements from ESFRIs/RIs on their use of the VO framework and its connection to EOSC
  - Initial priorities interferometric data (SKA and JIVE), event based data (CTA, EGO/VIRGO, SKA), scalability for extremely large data sets and their use in the science platform (WP5)
  - EST – new participant in VO interoperability
- Update definition of standards and representation of ESFRI/RI interests in IVOA

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Task 4.2 Activities: problem solving platform and support to science community

- Establish a practical problem-solving platform
  - Expertise and documentation for common solutions to support implementation by ESFRI/RIs
  - One Hands-on Training (M24)
- Support of the science community
  - Vizualisation tools multi-wavelength/multi-messenger
  - Two Hands-On Schools providing reusable materials
    - Use cases a essential feature of the schools
- Engagement with RDA

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Task 4.2 - Partner expected contribution

- All ESFRIs/RI to contribute requirements, feedback and implementation, incl. test. Specific effort on
  - **ORB & KIS (EST)**: Solar VO – a new domain for the VO
  - **JIVE, SKA**: interferometric data
  - ASTERICS demonstrated the power of direct involvement of **ESFRIs**/RIs in the IVOA
- All VO teams contribute their expertise, in particular
  - **INAF**: expertise in VO standards, scalability, and liaison with Task 4.1 and WP5
  - **INTA**: scientific schools
  - **UEDIN**: time-domain, scalability, a link to WP5
  - **UHEI**: support to implementation

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JIVE	
Develop the concept of Radio Astronomy UV data in the VO - Contribute to the development of IVOA standards to enable interferometric data in the VO - Participate in IVOA to provide feedback on common standards relevant to radio astronomy *(Part of Tasks 4.2.a 4.2.b, contributes to D4.2, D4.8.)*	
Implement VO services for the EVN archive - Build up expertise on the implementation of VO standards, libraries and tools for use in the EVN archive - Implementation of VO data access standards for the EVN archives - Register JIVE resources in the VO registry *(Part of Tasks 4.2.a 4.2.c, contributes to D4.2, D4.8. Potential application in training events of 4.2.d)*	

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Gravitation Wave astronomy – EGO-Virgo	
Development of VO infrastructure and tools for GW events relevant to EGO-Virgo - Identify detailed requirements for the EGO-Virgo use of VO tools (Aladin and Aladin Lite) and for sky coverage systems (Skymap and HEALPix standards). - Prototyping of advanced all-sky visualization for GW events including IVOA standards – HiPS and MOC o Implementation of common standards for managing complex sky regions (in particular interoperability with the multi-order HEALPix maps produced by the LIGO/Virgo localization algorithms). o Prototype implementation in VO tools (GWsky). - Identify requirements for catalogues of GW events (and the use of localization information in catalogues). *(Part of Task 4.2.a, 4.2.b, contributes to Deliverables D4.2, D4.8)*	
Input to the development of VO standards relevant to gravitational wave astronomy. - Develop use cases for Time-Space-Multi-order coverage systems. - Exploration of GW data as a time series – for possible publication of the GW event wave-form as a time series using VO standards. *(Part of Task 4.2.a, 4.2.b,. Contributes to D4.2)*	
Update of tutorials for training events.	

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Task 4.3 Adding value to trusted content in astronomy archives

*Next generation functionalities for creation and publication of **high-level, value-added data products** from ESFRIs*

- Assessment and application of **new techniques** – machine learning analytics. (connection to WP3)
  - *Specific example applied to ESO archives data products*
- Identification of **stewardship best practices**
  - Curation and publication of next-generation data products via ESFRI archives
  - Technical and human aspects

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