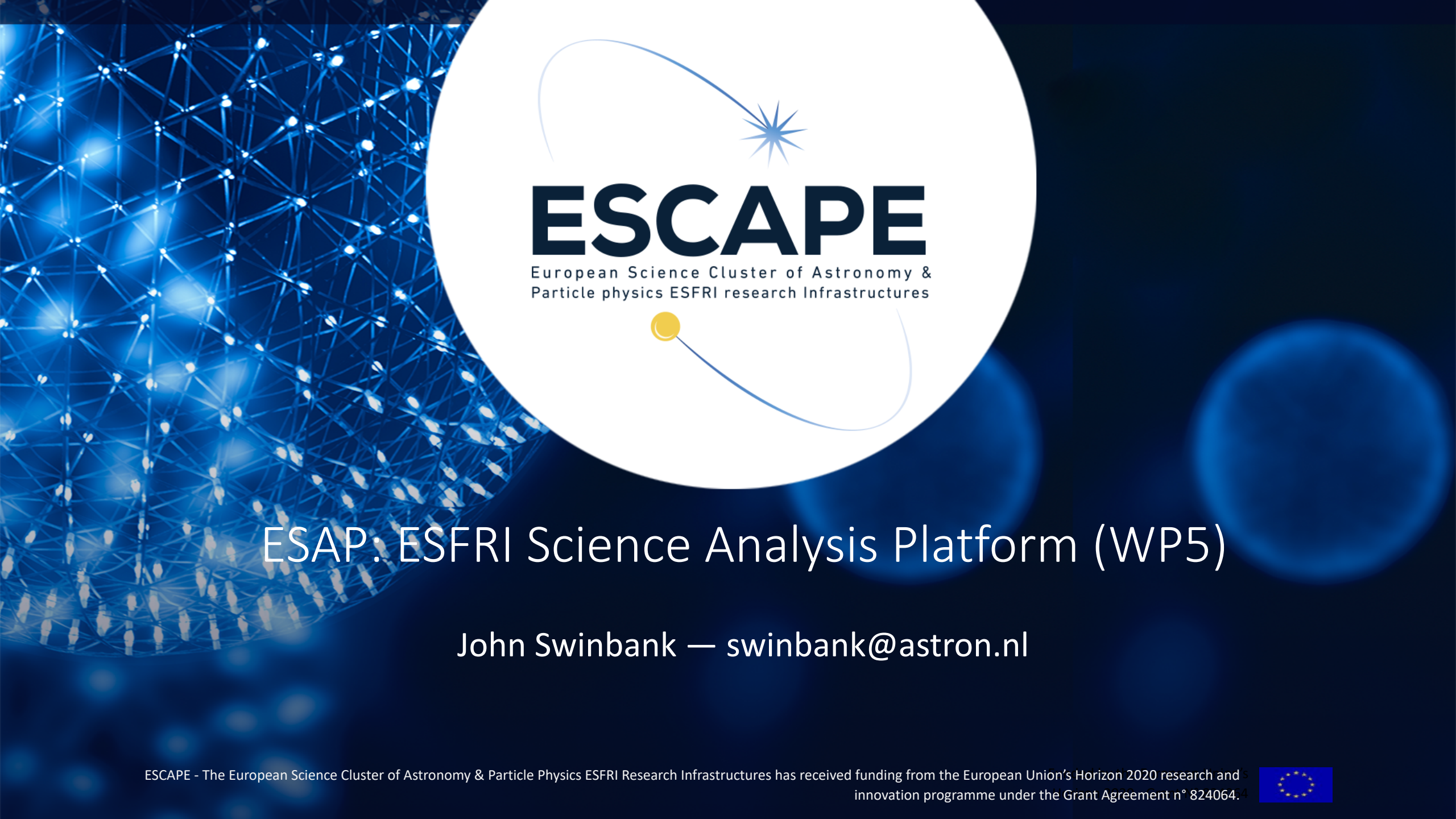
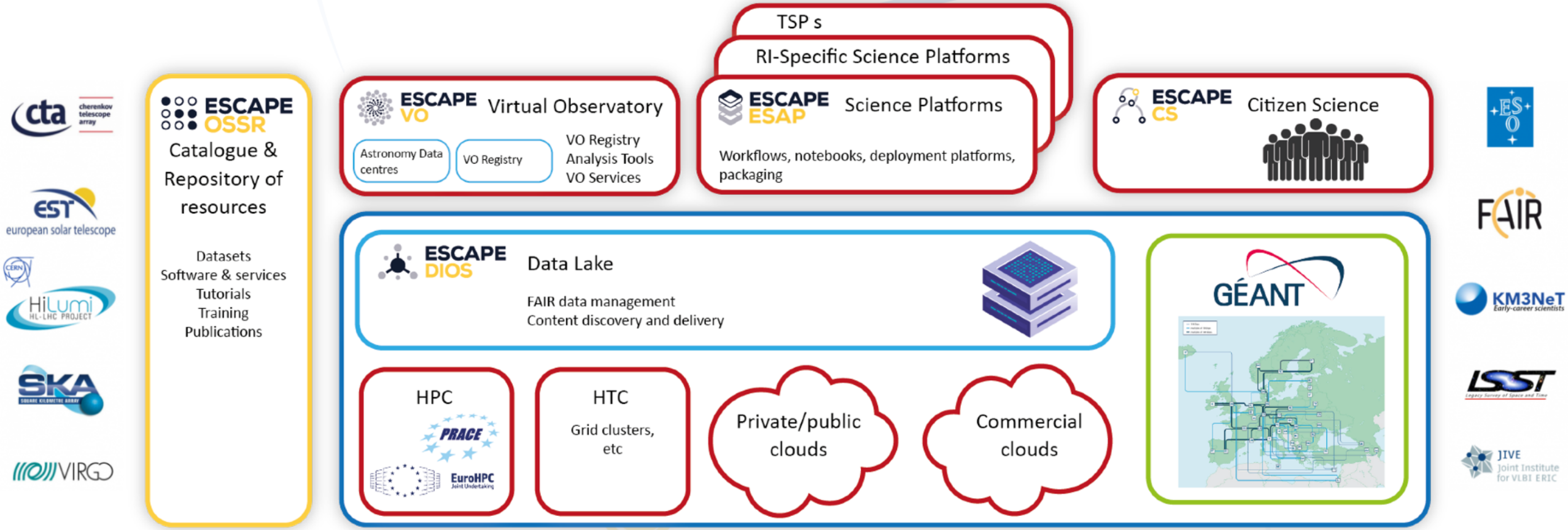


ESAP: ESFRI Science Analysis Platform (WP5)

John Swinbank — swinbank@astron.nl

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.

The ESCAPE EOSC Cell



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WP5 / ESAP in the ESCAPE “big picture”

- The twin goals of WP5:
  - Development of the **ESFRI Science Analysis Platform**: a toolkit for building platforms through which users can discover and interact with the data products, software tools, workflows, and services that are made available through ESCAPE.
  - Preparing ESFRI services, data products, and tools for integration with ESAP and their subsequent use within ESCAPE and EOSC.

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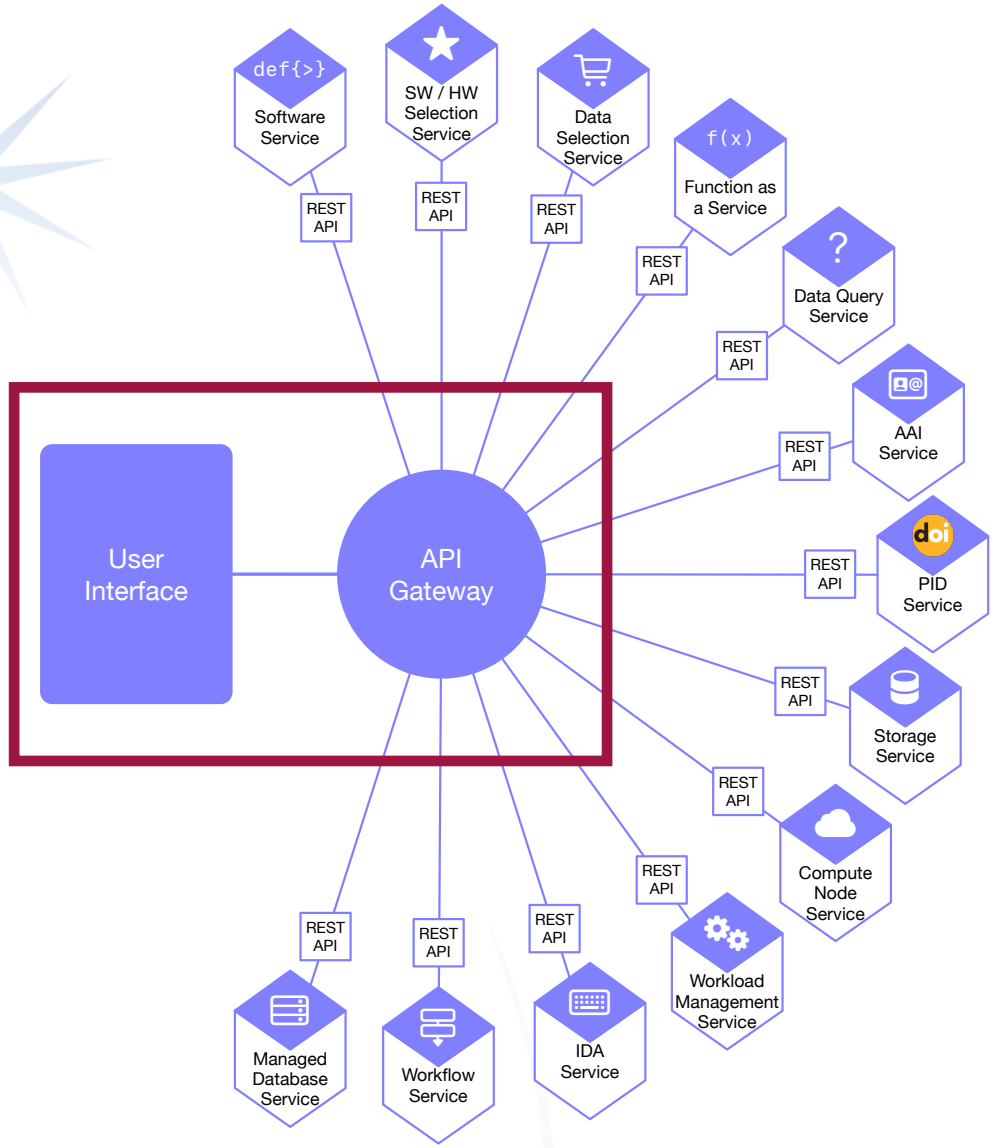
ESAP: Core & Services

- ESAP provides a focal point for integrating diverse services from across the ESCAPE project and from individual ESFRIs.
- The heart of the system is the web-based *User Interface* and the *API Gateway*. These software products are *core WP5 deliverables*.
- 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.
- WP5 members and ESFRI partners collaborate on developing & integrating a variety of external services.
- It is possible to extend ESAP to operate in a variety of different environments by implementing & integrating new service connectors.



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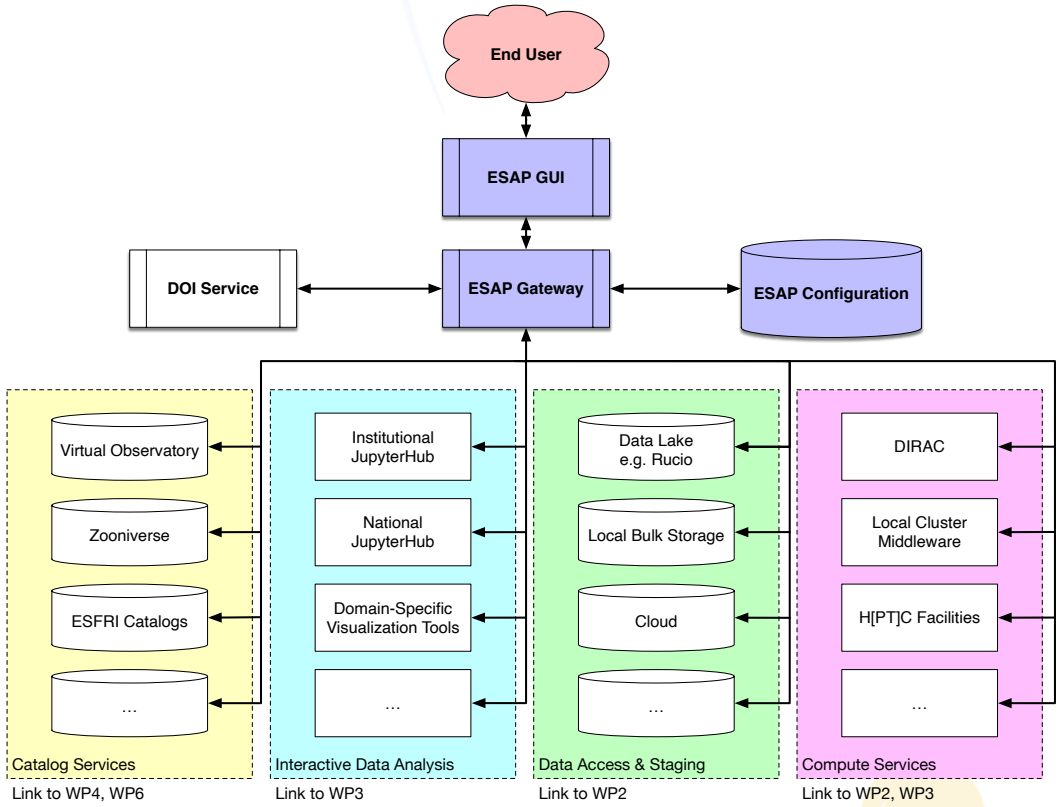
ESAP as a *toolkit*; integration with ESFRIs, EOSC



- WP5 is not resourced to operate or provide science platform services, except for development and test systems.
- The ESAP deliverables are oriented around enabling ESFRIs, other projects, and institutions to *deploy their own science platforms*.
- Individual ESAP instances can be registered with the EOSC Portal.

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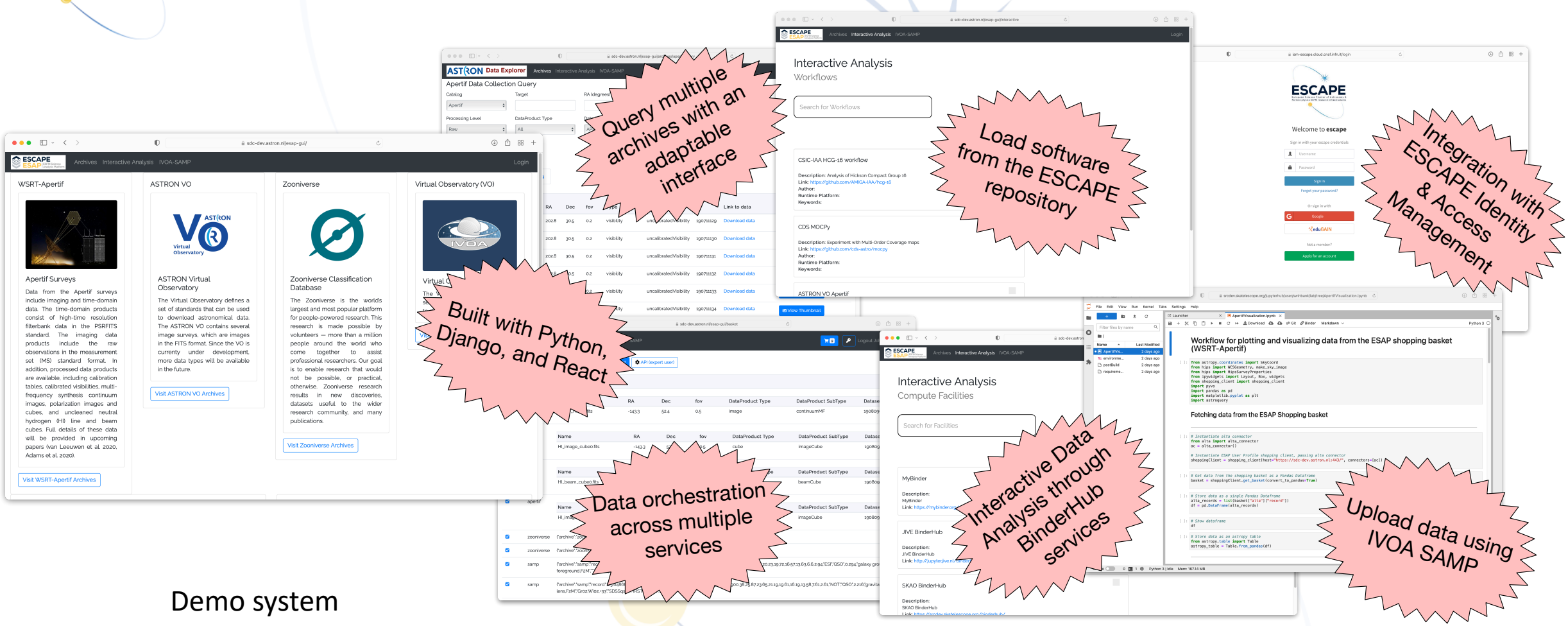
Current Status & Capabilities



Demo system

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

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WP5 Structure

- **Task 5.1**: Data Aggregation & Staging
  - *Provide ESAP users with the capability to access and combine data from multiple collections and to stage that data for subsequent analysis.*
  - *Links to **WP2/DIOS**, **WP4/VO**.*
- **Task 5.2**: Software Deployment & Virtualization
  - *Make the codes, tools, scripts, and other packages developed in support of the various ESFRIs and other RIs readily available to ESAP users.*
  - *Links to **WP3/OSSR**.*
- **Task 5.3**: Analysis interface, work flows, and reproducibility
  - *Integrate the data access services provided in Task 5.1 with the software from Task 5.2 to provide users with a coordinated approach to data analysis in the ESAP context.*
  - *Links to **WP2/DIOS**, **WP3/OSSR**, **WP4/VO**.*
- **Task 5.4**: Integration with HPC and HTC infrastructures
  - *Make it possible for ESAP users to deploy their workflows and analysis jobs at scale on a range of HPC and HTC infrastructures.*
  - *Links to **WP2/DIOS**, **WP3/OSSR**.*
- **Task 5.5**: Work Package Management

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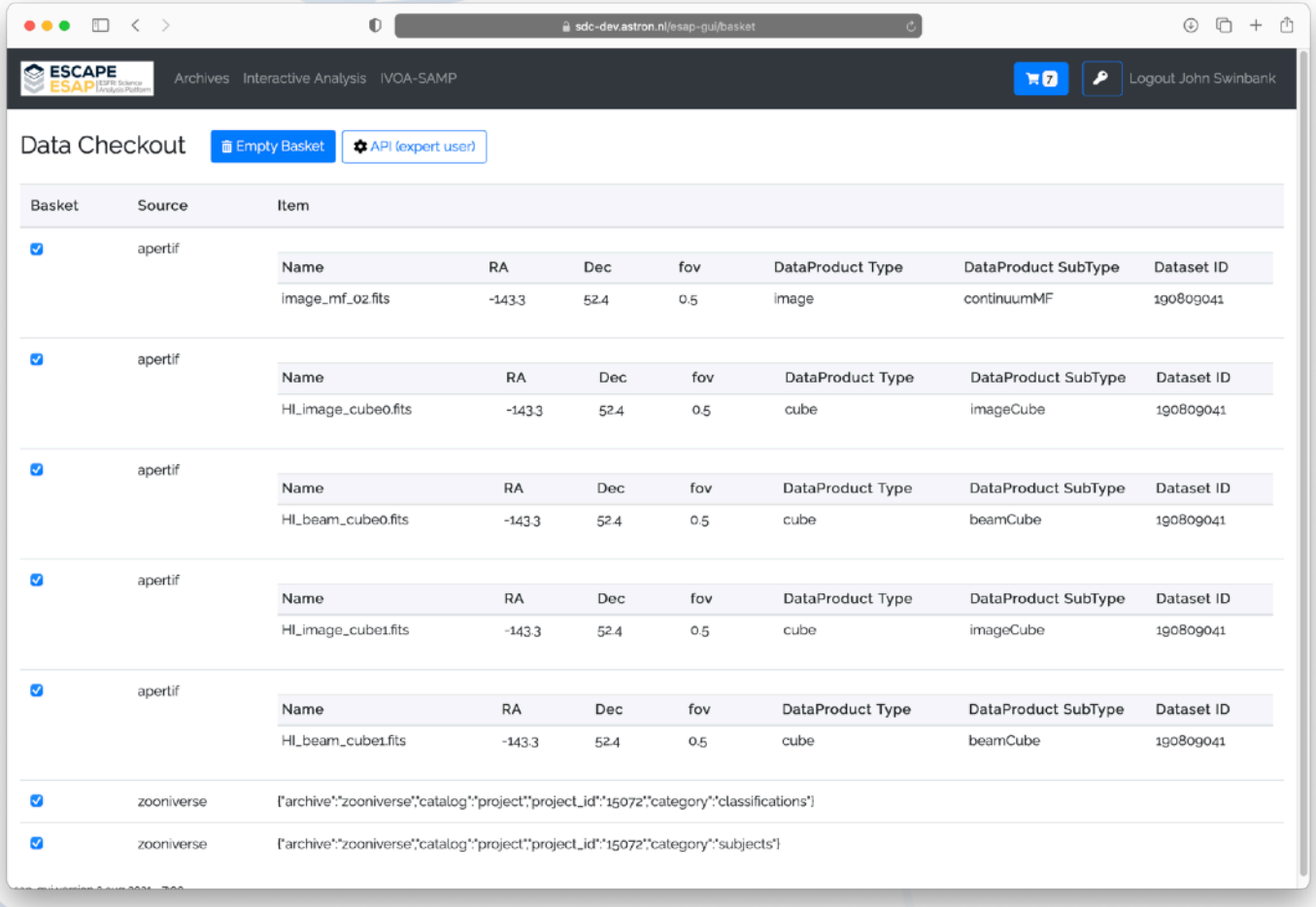
RP2 Technical Highlights: Data Orchestration

- The ESAP “Shopping Basket”, deployed during RP2, is **the core data orchestration metaphor** within ESAP.
- Results of queries and analysis tasks are place in the Basket and are carried through the system.
- Future analysis jobs or other tasks manipulate and augment the basket contents.



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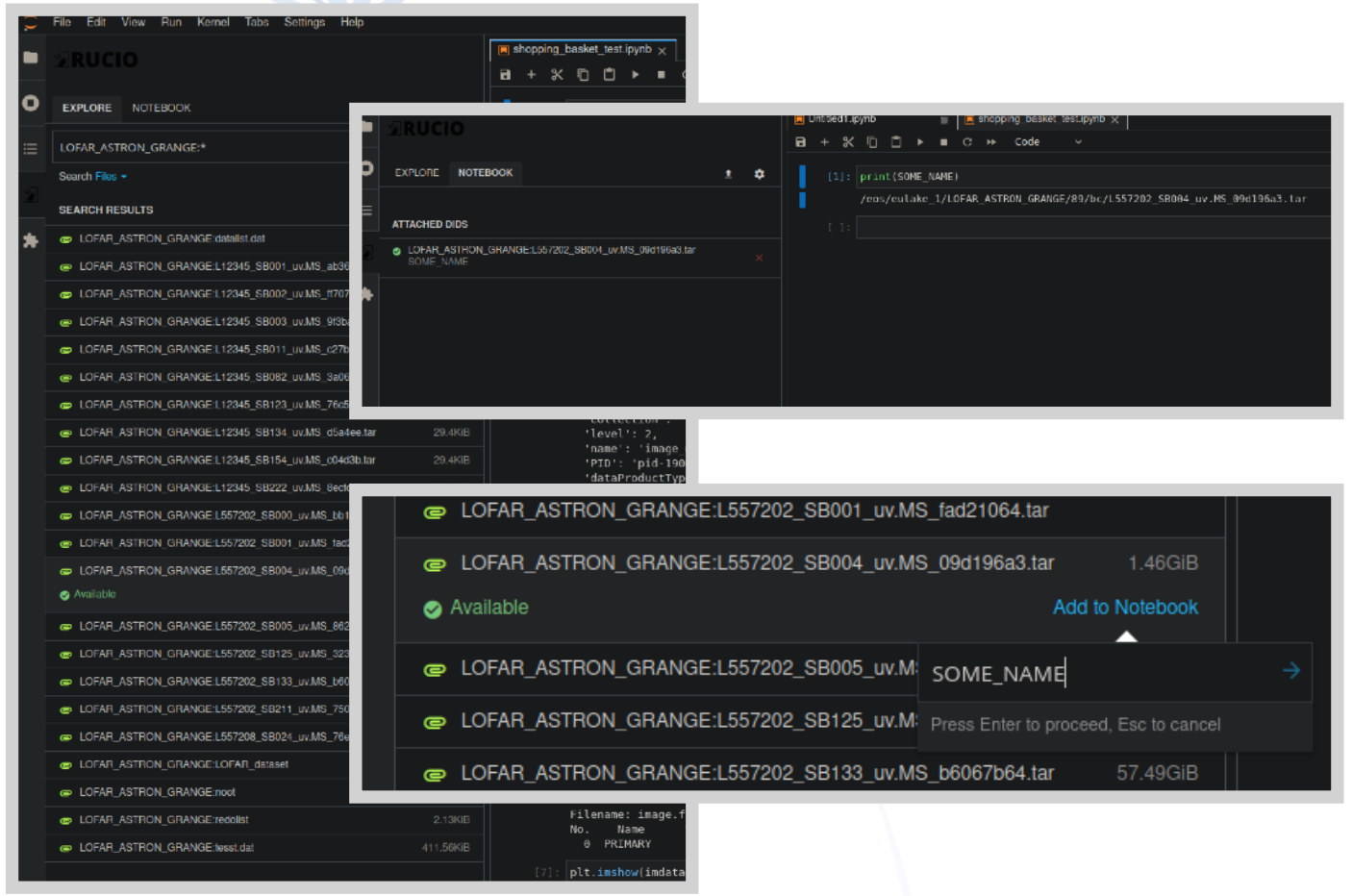
RP2 Technical Highlights: Data Lake as a Service

- **The key integration with the WP2/ DIOS Data Lake.**
- ESAP users can access and manipulate Data Lake contents from within ESAP supported analysis environments.
- Includes a data browser, file upload/ download, local storage, latency-hiding content-delivery.



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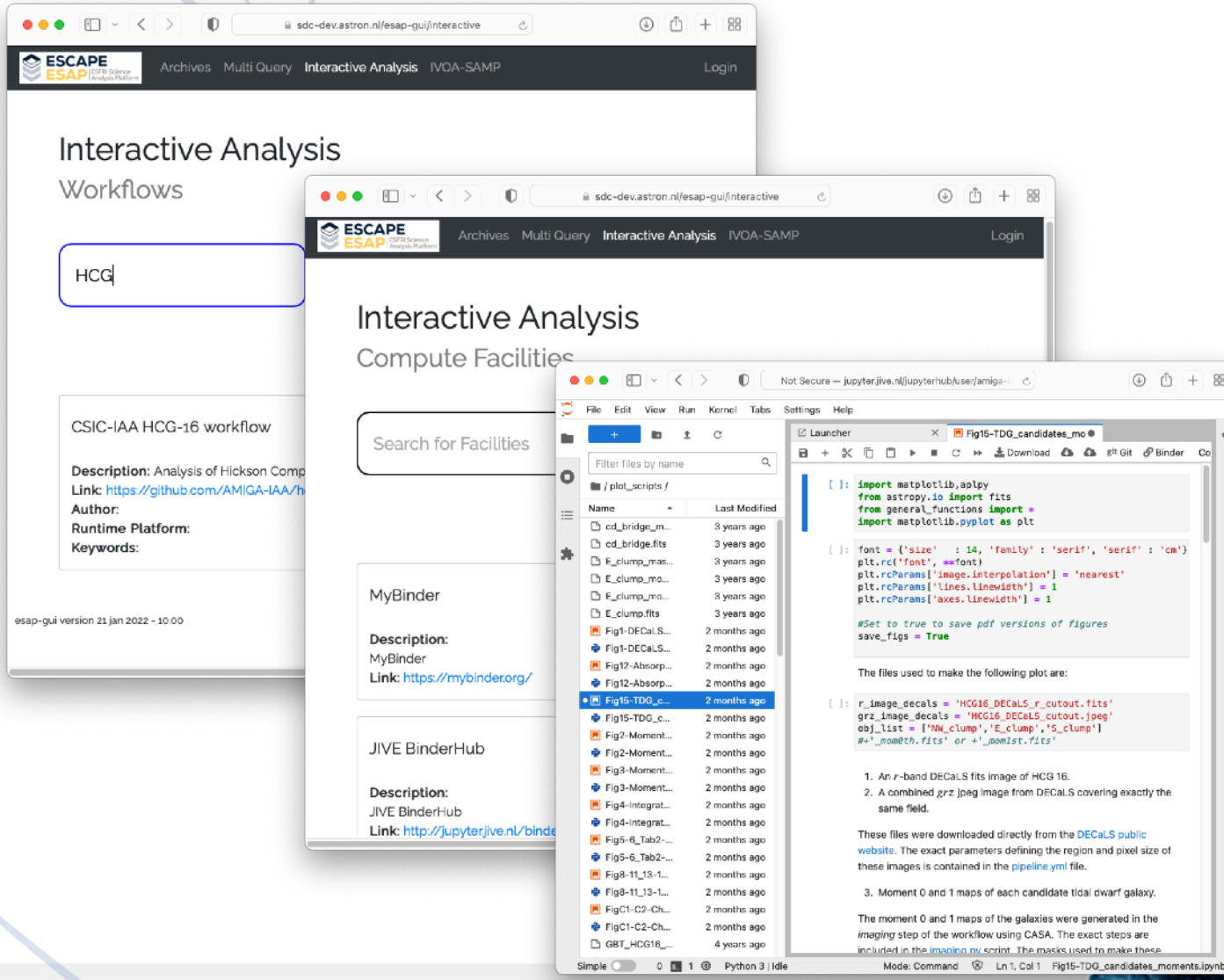
RP2 Technical Highlights: OSSR Integration

- **Dispatch software discovered in the WP3/ OSSR repository to compute services accessible through ESAP.**
- ESAP makes it possible to quickly leverage the variety of general scientific and ESFRI-specific software available through the OSSR.
- Increasing range of searching, sorting, filtering capabilities.
- Work in progress: smart routing of jobs to appropriate compute resources.



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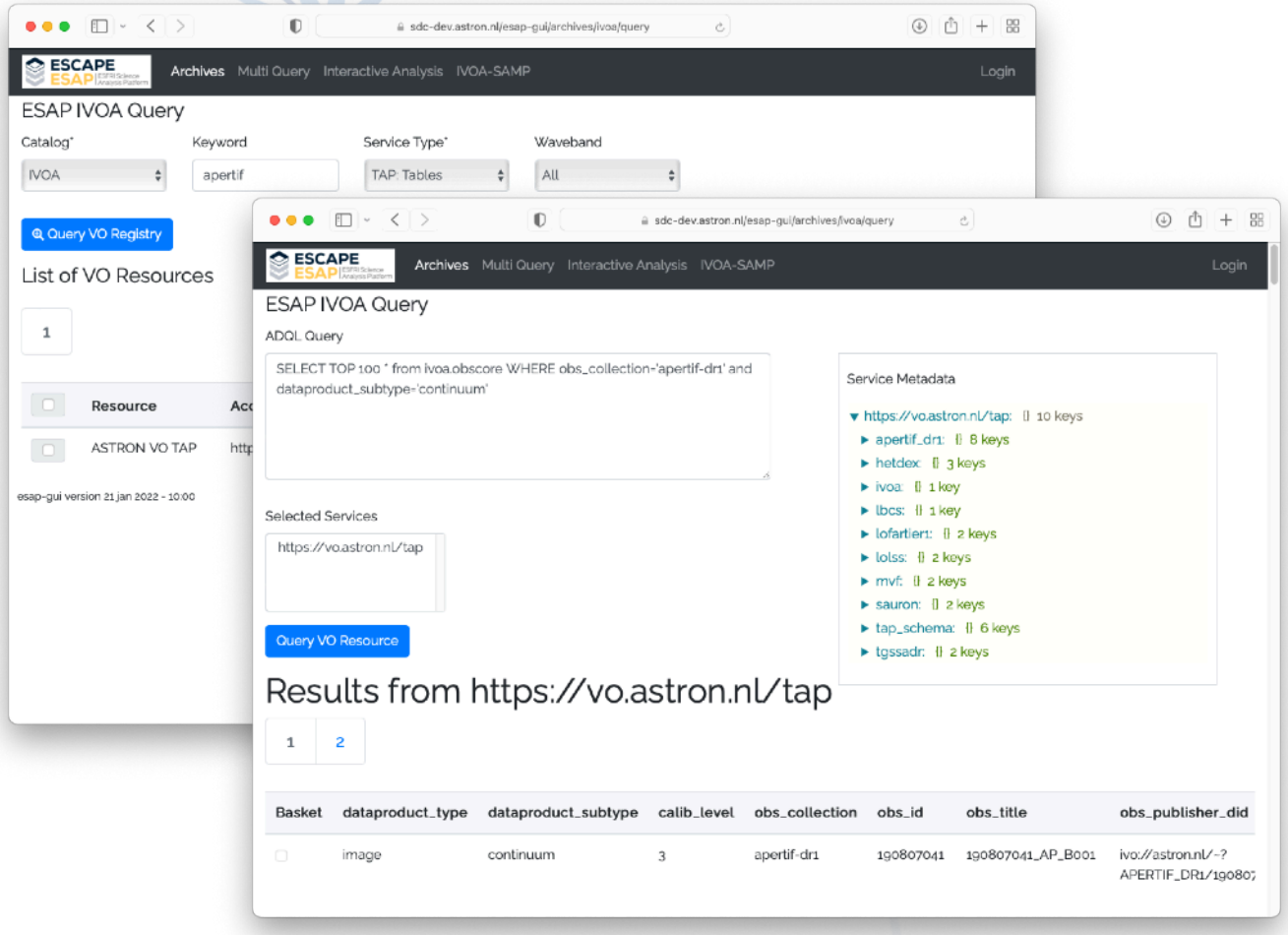
RP2 Technical Highlights: Virtual Observatory

- **Close integration between ESAP and WP4/VO make a wide range of science cases possible.**
- Extensive support for querying a variety of VO services, within the ESAP system itself and from analysis environments
- SAMP support provides seamless integration with other VO services and desktop applications.
- Collaboration with **WP4** to develop a technical note exploring concepts for a web-service interface providing a simple way to discover and access computing services. This is an important step towards *common, interoperable standards* emerging from the ESCAPE project.



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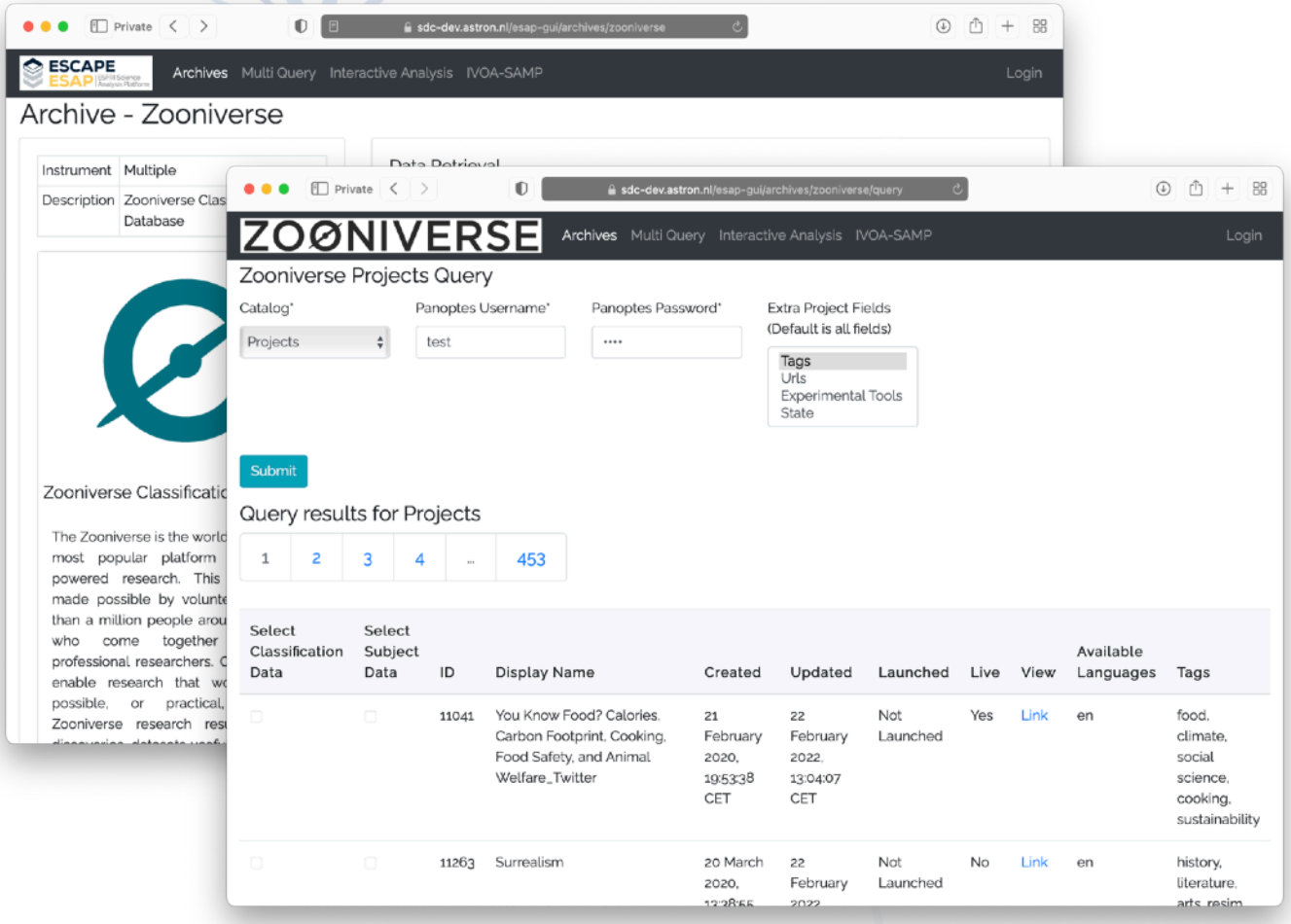
RP2 Technical Highlights: Zooniverse

- **Full integration of ESAP with the WP6/Zooniverse "Panoptes" system.**
- ESAP users can directly query into the Panoptes database and add data to their basket.
- Notebook users can use Python APIs to access the shopping basket, combine with astronomical data, etc.



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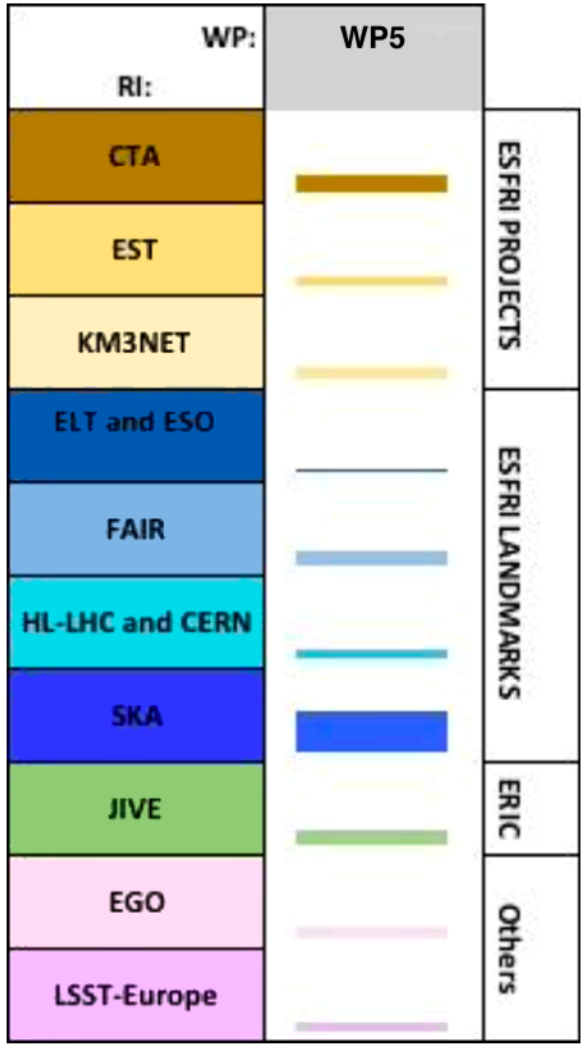
Research Infrastructure Engagement

- Wide representation of RIs in WP5.
- ESAP is *customizable for different RIs.*
- The partners contribute to the development of a common core — the UI & API gateway — and collaborate to develop plugins to address their particular needs.



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Research Infrastructure Engagement Results and Ongoing Activities

cta	• Data and analysis notebooks published and made available through ESAP. • Initial batch processing capabilities based on DIRAC integrated with ESAP in test form; full ESAP batch interface will be forthcoming. • Development of CONCORDIA, a containerized system for execution the CORSIKA air-shower simulation system. • Integrating ESAP for use in the CTAO Second Science Data Challenge.
EGO	• EGO/VIRGO pipelines packaged and made available; integration with the WP2/DIOS Data Lake. • Managed database service in support of EGO/VIRGO processing currently in early prototype.
ESO	• Detailed use cases describing potential evolution of ESAP into ESO role.
FAIR	• Batch processing on miniCBM data, including integration with the WP2/DIOS Data Lake. • Batch processing of PANDA experiment data. • Dockerized FAIR applications (R3BRoot, CMBRoot).
HiLumi HL-LHC PROJECT	• Data Lake as a Service provides integration between analysis environments and Dake Lake storage.

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Research Infrastructure Engagement Results and Ongoing Activities

- Released a Jupyter plugin providing seamless access to the European VLBI Network archive.
- BinderHub/Jupyter system at JIV-ERIC integrated with ESAP, provides specialist radio astronomy Jupyter kernel (with CASA 6.4).
- Developing the capability to archive and provide persistent identifiers to notebook analysis runs.

- LOFAR DDFacet pipeline packaged and containerized for deployment on ESCAPE infrastructures.

- Rubin Science Platform deployment at CNRS-LAPP; investigating integrations with ESAP.

- Interfacing persistent, network-attached storage (NFS, Ceph) to interactive data analysis environments.
- Making use of an ESAP instances in the STFC cloud and at the Spanish SKA Regional Centre.
- ESAP identified as a technology of interest for SKA Regional Centre prototyping during 2022/23.
- Solution package for SKA Data Challenge 1 published to WP3 Software Repository and made available through ESAP.

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Research Infrastructure Engagement Summer 2021 workshop, MS31/D5.3

- The *Second WP5 Workshop* (2021-08-05) presented the current status of ESAP development & solicited input from the community.
  - http://indico.in2p3.fr/e/SecondWP5Workshop for agenda, materials, etc.
- D5.3 summarizes the results of that workshop, and compares the current status of ESAP to:
  - *Requirements*, captured in D5.2 (Detailed Project Plan);
  - *Use cases*, captured in the Project Platform.
- D5.3 made a number of suggestions for minor “course corrections”, but concludes that the overall direction of travel and functionality is appropriate.

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Deliverables

Number	Title	Due	Completed
D5.1	Preliminary report on D5.1 requirements for ESFRI WP5 science analysis use cases	M6 (July 2019)	M6 (July 2019)
D5.2	Detailed project plan for WP5	M9 (Oct. 2019)	M9 (Oct. 2019)
D5.3	Performance assessment of initial Science Platform prototype	M31 (Aug. 2021)	Submitted M31
D5.4	Final assessment of the performance of the Science Platform prototype and plan for deployment of production version within the EOSC	M42 (July 2022)	-

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Milestones

Number	Title	Due	Completed
MS27	First WP5 workshop on Science Platform design and requirements	M4 (May 2019)	M4 (May 2019)
MS28	Review of preliminary report on requirements for ESFRI science analysis use cases	M5 (June 2019)	M5 (June 2019)
MS29	Initial science platform prototype with discovery and data staging	M22 (Nov 2020)	M22 (Nov 2020)
MS30	Deployment of initial set of ESFRI software on prototype platform	M23 (Dec. 2020)	M24 (Jan. 2021)
MS31	Second WP5 workshop to analyse prototype performance	M31 (Aug. 2021)	Submitted M31
MS32	Integration of Science Platform with OSSR repository	M32 (Sep. 2021)	Submitted M32
MS33	Integration of Science Platform with Data Lake expanded prototype	M34 (Nov. 2021)	Submitted M34
MS34	Delivery and integration of new ESFRI visualization and analysis tools	M39 (Apr. 2022)	-
MS35	Final WP5 ESFRI user training workshop on the Science Platform	M40 (May 2022)	-

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Risks Analysis: Grant Agreement

Risk	Description	Current Status
17	Poorly defined requirements on Science Platform functionality to support ESFRI science	• Primarily addressed through D5.1 & Project Platform, which extensively document the use cases being addressed. • Ongoing engagement of ESFRIs with WP5 to refine and address use cases. • Successful summer 2021 workshop validated project goals with ESFRIs.
18	Lack of commonality between ESFRI requirements	• Modular design of ESAP makes it possible to service multiple ESFRI needs from a common core.
19	Lack of availability or immaturity of underlying core EOSC services	• Development and test is isolated from EOSC services. • Active engagement with the EOSC Future TSPs will drive EOSC integration.
20	Insufficient ICT infrastructure available to support Science Platform deployment and testing	• Adequate infrastructure is available thanks to resource made available be a variety of project partners (thank you!).

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Risks Analysis: Detailed Project Plan

- Lower-level risks are identified in D5.2 (Detailed Project Plan).
- “Retention of key staff, with domain knowledge” is (partially) realised through extended leave of WP5 Technical Lead.
  - Mitigations put in place included proactive engagement of the WP Coordinator, development of a common ESAP vision, and formation of a regular technical leadership team.
  - Milestone MS31 and Deliverable D5.3 were delayed relative to the original scheduled, but delivered in August.
- No other major concerns.
- We continue to monitor and proactively respond to risks.

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Future plans

- *Focus on integration and stabilization of the various capabilities than have been developed across the work package and the ESCAPE ecosystem:*
  - Complete integration of the various data and analysis services which have been developed by project partners.
  - (Continue to) engage with ESFRIs on ESAP deployment and service provisioning.
  - Provide support to EOSC Future Test Science Projects (we have already had significant engagement with the Extreme Universe TSP).
- *ESAP technical improvements*:
  - Better support for asynchronous services.
  - Integrate more execution engines, providing a wider variety of compute and analysis task types.
  - More advanced software selection and dispatching: deeper integration with OSSR and with DIOS data locality.
  - Deploy a batch processing management system based on DIRAC.

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Conclusions

- ESAP provides a central coordinating element across the diverse ESCAPE ecosystem, bringing together work from WPs 2, 3, and 4 into a single user-facing system.
- During RP2, the WP5 team has made important technical progress...
  - ...on development of the ESAP system itself.
  - ...on packaging and providing a range of scientific analysis capabilities.
  - ...on engaging with the other work packages.
- Over the next several months, we will focus on consolidating and integrating this work so that we deliver a compelling package to all ESCAPE ESFRIs.

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