EURO-LABS

EUROpean Laboratories for Accelerator Based Science

MILESTONE REPORT

IDENTIFICATION OF EXISTING SOLUTIONS IN THE EOSC ECOSYSTEM AND INTEGRATION OF THE NUCLEAR PHYSICS ECOSYSTEM

MILESTONE: MS36

Document identifier:	EURO-LABS-MS36
Due date of milestone:	End of Month 36 (August 2025)
Report release date:	31/08/2025
Work package:	WP5.2: Open Science and Data
Lead beneficiary:	IFIC
Document status:	Final

Abstract:

This document presents Milestone M36 of the EURO-LABS project, providing an overview of the current status and technical developments related to the deployment of services and solutions supporting open data practices in nuclear physics. The key achievement of this milestone is the implementation and release of an Authentication and Authorization Infrastructure (AAI) tailored to the needs of the nuclear physics community. This infrastructure enables secure user authentication for community-developed third-party services and functions as an identity broker, interfacing with established identity providers such as EduGAIN and ORCID. The report also outlines the services that have already adopted the EURO-LABS AAI and discusses future perspectives for integrating

these solutions within the broader European Open Science Cloud (EOSC) ecosystem to enhance data management capabilities.

Delivery Slip

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Executive summary

Within Work Package 5.2 on Open Science and Data, the EURO-LABS project has developed a set of shared tools and services to promote Open Science in nuclear physics. Milestone MS36 reports on the successful identification and integration of existing solutions within the European Open Science Cloud (EOSC) ecosystem and their adaptation for the needs of the nuclear physics community.

The main achievement is the deployment of the EURO-LABS Authentication and Authorisation Infrastructure (AAI), which provides secure, federated, and interoperable access to scientific resources across multiple institutions. This AAI enables single sign-on, fine-grained authorisation, and integration with international identity providers, ensuring sustainability and broad adoption. The centralized Authentication and Authorization Infrastructure now serves as the backbone for service integration across EURO-LABS.

The AAI has been successfully integrated with several core community services:
- openNP Data Catalog – metadata and dataset registry with federated login.
- Theo4Exp Calculation Platform – theoretical computation environment for supporting experiment programs.
- FRS Data Access Platform (GSI/FAIR) – repository and monitoring system with federated access.
- GANIL VAMOS Grafana Service – monitoring dashboards with unified authentication.

This integration highlights the flexibility and robustness of the federated model, while also fostering the adoption of FAIR (Findable, Accessible, Interoperable, Reusable) principles.

Looking ahead, EURO-LABS will promote these tools through training, expand governance frameworks for long-term sustainability, and extend distributed data platforms across facilities. By aligning with EOSC standards and best practices, EURO-LABS positions nuclear physics as a leading community in federated, data-driven science.

1. INTRODUCTION

Within Work Package 5.2 on Open Science and Data, the EURO-LABS project is developing a portfolio of shared infrastructures and digital services to advance Open Science in nuclear physics. Milestone MS36 marks an important step in this effort. It demonstrates how federated services can be identified, integrated, and put into operation within the broader ecosystem of the European Open Science Cloud (EOSC) [1], while being tailored to the needs of the nuclear physics community.

The milestone addresses several key objectives. First, it promotes the mutualisation of tools and services across various nuclear physics facilities, reducing duplication of effort and ensuring long-term sustainability. Second, it establishes federated authentication and authorisation as the cornerstone for secure and interoperable access to datasets, simulations, and monitoring platforms. Further, it fosters sustainability and reproducibility of data processing and analysis workflows based on the use of open standards used in other scientific communities.

By enabling researchers to share, discover, and analyse data with the same efficiency as in some other scientific fields, this work contributes directly to the adoption of FAIR (Findable, Accessible, Interoperable, Reusable) practices [2]. The most tangible result of MS36 is the deployment and widespread use of a centralized Authentication and Authorization Infrastructure (AAI) that now serves as the backbone for service integration across EURO-LABS.

2. AUTHENTICATION & AUTHORISATION INFRASTRUCTURE (AAI)

The EURO-LABS Authentication and Authorisation Infrastructure (AAI) is the technological backbone for secure and federated access to services across the project. It provides the means for heterogeneous user communities, spanning institutions and countries, to collaborate seamlessly while maintaining strong authentication and fine-grained authorisation.

2.1 GOALS

The AAI service has been designed with several objectives in mind. It provides secure, federated identity management across distributed communities, enabling researchers to access a catalogue of datasets, software, and services through a single sign-on. Authorisation is managed through group structures that reflect collaborations, experiments, or institutional roles. Furthermore, the AAI is fully aligned with the AARC (Authentication and Authorisation for Research and Collaboration) Blueprint Architecture [3], supporting interoperability with EOSC frameworks and ensuring that nuclear physics services can integrate with the broader European digital ecosystem.

2.2 DEPLOYMENT AND HOSTING

The production service, called EURO-LABS AAI, is hosted and operated at IJCLab (CNRS/IN2P3/ Université Paris Saclay). It is available at: https://iam-eurolabs.ijclab.in2p3.fr. The service is based on INDIGO IAM (Identity and Access Management) [4] framework. Continuous monitoring, automated updates, and a robust backup and failover strategy ensure operational reliability.

2.3 TECHNICAL SPECIFICATIONS

The EURO-LABS AAI relies on the INDIGO IAM software stack, which supports state-of-the-art standards and protocols. Authentication is handled via OAuth2 and OpenID Connect (including Authorization Code, Client Credentials, and Device flows), with additional provisioning via the SCIM (System for Cross-domain Identity Management) 2.0 API. Identity federation is a core feature: the AAI integrates with institutional Identity Providers through eduGAIN [5], supports ORCID [6] as a global researcher identifier, and also accepts X.509 (an International Telecommunication Union (ITU) standard)certificates and selected social logins. This dual reliance on eduGAIN and ORCID ensures both wide institutional coverage and persistent researcher identity across career stages but also allows access management for researchers affiliated to institutes that are not (yet) embedded in eduGAIN federation. Schematic view of the INDIGO IAM identity broker is shown in Fig. 1.

Group management is built into the system, allowing experiment-based or role-based subgroups to control access to resources. These groups are reflected in the access tokens issued by the AAI,

enabling services to enforce fine-grained authorisation rules. Security measures include the issuance of signed JSON Web Tokens [7] with rotating keys, TLS-only endpoints.

Figure 1: (left) Schematic view of the principle of INDIGO-IAM identity broker. (right) login page of the EURO-LABS service.

2.4 GOVERNANCE

From a governance perspective, access is controlled via an Acceptable Use Policy (AUP) that users are required to accept upon login. Token lifetimes are managed to balance usability and security, with policies in place for access reviews and sustainability of the service. The governance framework also ensures alignment with EOSC federated AAI practices, guaranteeing future interoperability within European e-infrastructures.

2.5 USERS PROFILE

To date, 352 users have registered to the IAM EURO-LABS service. The users are both permanent and non-permanent members of institutes and universities as well as students. Users come from a wide range of countries worldwide. The distribution of accounts per main institute's country is as follows: Spain : 97, France : 41, Italy: 37, Germany : 33, United States of America: 20, Poland: 16, Romania: 10 UK: 8.

3.   DATA ACCESS PLATFORMS AND INTEGRATIONS

The deployment of the EURO-LABS AAI has been followed by its concrete use across a range of scientific services that support the community. Four examples are given in section 4 of this report. By providing a single, federated authentication and authorization mechanism, it enables seamless and secure access to heterogeneous services from data catalogues to theoretical computing environments, from experimental data repositories to monitoring dashboards. This integration confirms that this AAI is not only technically robust, but also flexible enough to support the diverse needs of EURO-LABS partners.

3.1 OPENNP DATA CATALOG

The openNP catalog (opennp.in2p3.fr) serves as a metadata and dataset registry for experimental nuclear physics (See Deliverable 5.3 of EURO-LABS). It is integrated with the AAI through OpenID Connect protocol, enabling users to securely use institutional or ORCID credentials. In the future, roles such as curator or contributor are managed through IAM groups, ensuring fine-grained access policies. With this integration, users benefit from single sign-on across the catalogue's interface and APIs. Figure 2 shows the signup page of the openNP catalog, illustrating signup using EURO-LABS IAM service.
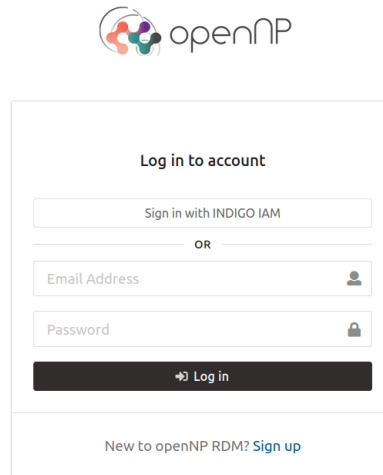
Figure 2 : Login page of the OpenNP catalogue.

3.2 THEO4EXP CALCULATION PLATFORM

The Theo4Exp platform, developed under WP2 (Research Infrastructures for Nuclear Physics) of the EURO-LABS project, provides a computing environment for theoretical calculations in support of experimental work. Integration with the AAI is achieved through OpenID Connect, supporting both browser-based login and device flows for command-line tools. Token exchange mechanisms allow seamless and secure identification and accounting. The platform is already being used, with more than 100 active users, and was successfully employed during a computing training school in ECT* : Theory Service for the Low Energy Nuclear Physics Community: a Hands-on Workshop in July 2025 with 40 registered participants.

In addition to supporting research activities it also contributes to educating students. Authentication through eduGAIN, using students' university accounts, facilitates seamless access while ensuring proper identification and secure usage of the resources.

Figure 3 : Screenshot of the web portal of Theo4Exp at https://institucional.us.es/theo4exp/

3.3 FRS DATA ACCESS PLATFORM (GSI/FAIR)

At GSI, the Fragment Separator (FRS) supports experimental collaborations and also hosts a public data repository that includes logbooks, simulation outputs, and processed experimental datasets. These per-experiment files are stored on a large, backed-up server operated by GSI and made available on the Internet through an Apache Web Server. Researchers access this content including the FRS Data Server interface available at lxfrs.gsi.de, which provides intuitive browser-based navigation of experiments, logbooks, and shared files via a web portal at https://lxfrs.gsi.de.

Access control is enforced using the EURO-LABS AAI. Authentication is handled via the OpenID Connect protocol, with INDIGO IAM verifying the user's institutional credentials. Once authenticated, fine-grained authorization is enforced using experiment-specific sub-groups defined within the IAM. In addition, the same AAI integration governs access to a Grafana (an open source visualization and analytics software) instance that provides live monitoring of FRS detectors. This unified identity and access model ensures that both data sharing and operational monitoring are conducted under a coherent, secure, and federated framework.

FRS Data Server via Web Browser

Logbooks:

SEC E-Log

Link to scanned Logbooks

Technical Information:

FRS Virtual Messhütte

FRS Wiki

Link to HV of FRS detectors

Experiments at the FRS:

Year	Beam	Number	Spokesperson	Title	Files
2020	124Xe	S475plus	Mukha, Ivan, GSI Darmstadt, DE		Files
2021	12C and 16O	S533	Purushothaman, Sivaji, GSI Darmstadt, DE		Files
2023	14N and 238U		Scheidenberger, Christoph, GSI Darmstadt, DE		Files
2024	12C	G-22-00118	Gernhäuser, Roman, TU München, DE		Files
2024	12C	G-22-00111	Chudoba, Vratislav, Silesian Univ., CZ		Files
2024	12C	BIO	Durante, Marco, GSI Darmstadt, DE		Files
2024	18O	G-22-00091	Petri, Marina, York Ac, GB		Files
2024	170Er	G-22-00100	Albers, Helena, GSI Darmstadt, DE		Files
2024	100Mo	G-22-00160	Scheidenberger, Christoph, GSI Darmstadt, DE		Files

Figure 4 : Screenshot of the FRS/GSI Data web portal at https://lxfrs.gsi.de.

3.4 GANIL VAMOS GRAFANA SERVICE

At GANIL, the VAMOS Grafana service provides real-time monitoring dashboards for detectors and infrastructure. Grafana is an open-source analytics and visualization platform used to monitor, analyze, and display data from various sources in real-time. The service has been integrated with the AAI using OAuth-based single sign-on, with IAM groups controlling role assignment within Grafana. Currently, the system includes 25 dashboards and serves around 20 regular users. Presently, it is an internal service that can be accessed only within GANIL networks, illustrating that this solution also allows use of external AAI for closed internal services.
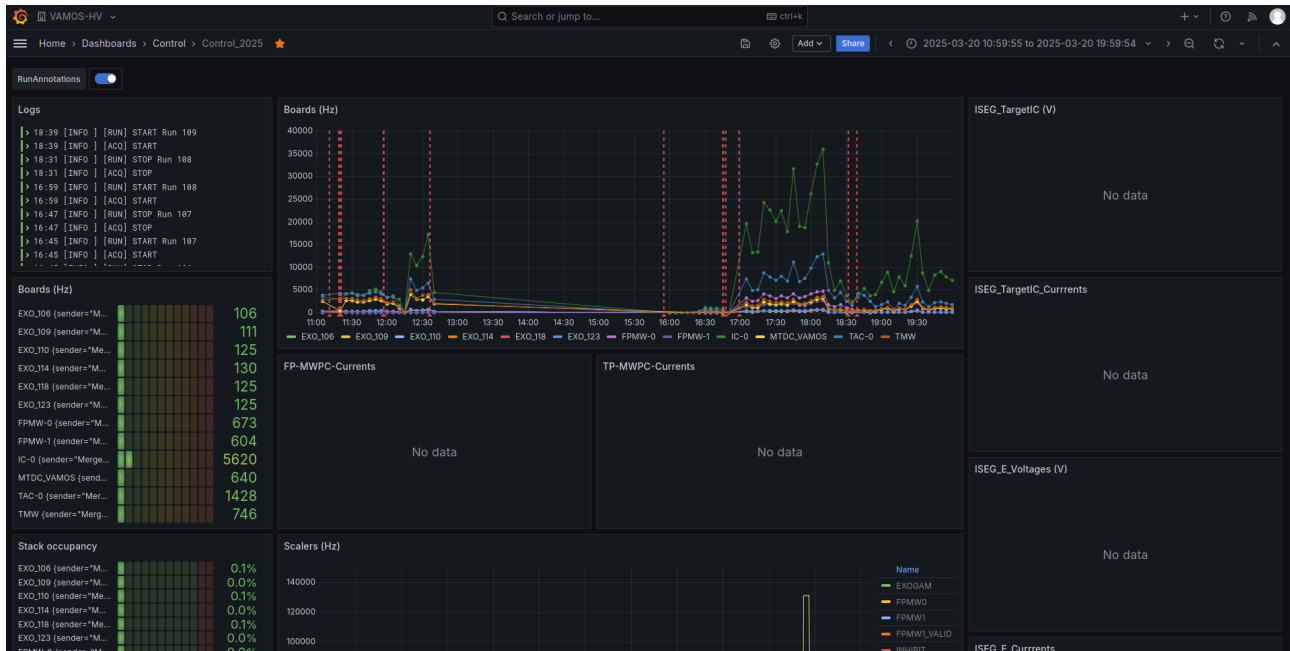
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Figure 5 : Screenshot of the Grafana web service used for the VAMOS spectrometer at GANIL.

4.   USAGE OF AAI

The EURO-LABS AAI has quickly become a practical enabler of interoperability across multiple services:

- For openNP, it secures federated login and group-controlled dataset curation.

- For Theo4Exp, it streamlines access to computing resources and workflows.

- For the FRS platform, it enables federated access to distributed collaboration data.

- For GANIL Grafana, it simplifies monitoring access with unified login, illustrating that the AAI solution could also be applied to a service deployed in a restricted environment.

This consolidation of access illustrates the immediate added value of the AAI, reducing fragmentation and creating a robust foundation for federated services across the community.

5. PERSPECTIVES AND ROADMAP

5.1 PROMOTION OF TOOLS

The EURO-LABS AAI and associated platforms will be promoted via user training sessions, documentation, and active participation in EOSC-related initiatives. The aim is to position the AAI as a cross-collaboration enabler within the nuclear physics community.

5.2 POLICIES AND GOVERNANCE

Future work will define a clear taxonomy of roles (Viewer, Contributor, Curator, Operator, Adminstrator), establish robust group lifecycle management, and conduct regular access reviews. Governance processes will be designed in alignment with EOSC and e-infrastructure partners, ensuring sustainable long-term operations.

5.3 DATA ACCESS PLATFORMS

The goal of the present work was not to deliver a complete storage infrastructure, but rather to demonstrate that a federated approach to data storage represents the most promising path forward for nuclear physics. Instead of centralizing resources at a single site, the emphasis is on building a distributed ecosystem that connects facilities, collaborators, and experiments through common standards and technologies. This concept is now well identified as data-lake infrastructure.

The next steps toward realizing such a data lake focus on scaling and extending this foundation. Integration of the FRS with XRootD-based storage [8] will provide a performant and extensible backbone required to manage rapidly growing experimental datasets. At the same time, federated repositories will be expanded beyond GSI and GANIL to include additional research facilities, enabling a more resilient and inclusive data infrastructure. To strengthen collaboration across the field, remote upload capabilities are envisaged to be introduced for partners using role based identification capabilities of AAI, ensuring that contributions from the broader community can seamlessly flow into the system. These efforts will be coordinated through the adoption of Rucio [9], drawing on the tools and practices developed within the ESCAPE project [10], and aligning nuclear physics with data management strategies already proven in other large-scale scientific domains.

6. CONCLUSION

MS36 reports that EURO-LABS has successfully deployed a production-grade Authentication and Authorisation Infrastructure, and is already integrated with critical community services such as openNP, Theo4Exp, FRS, and GANIL Grafana. This milestone not only establishes FAIR data management practices but also advances the alignment of nuclear physics with the EOSC vision of Open Science.

By mutualising tools, adopting open standards, and enabling secure federated access, EURO-LABS position nuclear physics as an active contributor to data-driven collaborative and open research.

7. REFERENCES

[1] European Open Science Cloud (EOSC). Available at: https://eosc.eu

[2] FAIR Principles for Scientific Data Management and Stewardship. Available at: https://www.go-fair.org/fair-principles/

[3] AARC Blueprint Architecture. Authentication and Authorisation for Research and Collaboration. Available at: https://aarc-community.org/

[4] INDIGO IAM – Identity and Access Management Software. Available at: https://indigo-dc.gitbook.io/iam

[5] EDUGAIN : https://edugain.org/

[6] ORCID : https://orcid.org/

[7] JSON Web Token (JWT) : https://datatracker.ietf.org/doc/html/rfc7519

[8] XROOTD project Available at : https://xrootd.org

[9] Rucio Data Management Framework. Available at: https://rucio.cern.ch/

[10] ESCAPE Project – European Science Cluster of Astronomy & Particle physics ESFRI research infrastructures. Available at: https://projectescape.eu/

ANNEX: GLOSSARY

Acronym / Term	Definition
AAI (Authentication and Authorisation Infrastructure)	A federated system that enables secure login and access control across distributed services.
AUP (Acceptable Use Policy)	The policy that defines conditions of use for digital services and resources.
CNRS (Centre National de la Recherche Scientifique)	The French National Centre for Scientific Research.
EOSC (European Open Science Cloud)	A federated digital environment for European researchers to access and share scientific data and services.
FAIR Principles	Guidelines ensuring data is Findable,

	Accessible, Interoperable, and Reusable.
FRS (Fragment Separator)	A facility at GSI/FAIR used for experiments with exotic nuclei.
GANIL (Grand Accélérateur National d'Ions Lourds)	A French national heavy-ion accelerator facility.
IAM (Identity and Access Management)	Software for managing digital identities and access rights.
INDIGO IAM	An open-source identity and access management service adopted by EURO-LABS.
OpenID Connect (OIDC)	An authentication protocol based on OAuth2, enabling federated login.
openNP	A nuclear physics data catalog developed in EURO-LABS.
ORCID	A persistent digital identifier for researchers.
Rucio	A scientific data management software used in high-energy physics and other large-scale projects.
Theo4Exp	Theoretical calculation platform integrated into EURO-LABS for supporting nuclear experiments.
VAMOS	A spectrometer facility at GANIL, with monitoring dashboards integrated via Grafana.