EURO-LABS

European Laboratories for Accelerator Based Science

HORIZON-INFRA-2021-SERV-01-07 Project EURO-LABS

Deliverable Report

WP3- Access to RI for Accelerator R&D

Deliverable: D3.2: Report on the progress of TA for Technology Infrastructure RIs

Document identifier:	`EURO-LABS_Deliverable_DD3.2_v2.0.pdf`
Due date of deliverable:	End of Month 42 - (February 2026)
Justification of delay:	NONE
Report release date:	06/03/2026
Document status:	FINAL

Abstract

This document reports on the progress of the Transnational Access (TA) activities at the CERN Technology Infrastructure facilities, conducted within Work Package 3, Task 2 of the EURO-LABS project. This TA task groups five RIs proposing six installations, devoted to testing of superconducting magnets and related instrumentation, as well as Radio-Frequency cavities operating at cryogenic temperature and at X-band frequencies. It also includes test stands for specialized R&D on materials used in superconducting cavities and for mechanical tests made available to industry.

The TA projects carried out at these facilities to date are described, together with their impact on the relevant research domains and selected highlights of the results obtained. In addition, the ongoing and planned projects foreseen up to the end of the project in August 2026 are outlined. Unfortunately, due to technical reasons related to upgrades and laboratory priorities, two of the facilities were not able to provide any access. A third facility, owing to its narrow scope of use and focus on dedicated R&D activities, did not receive any access requests.

This project has received funding from the European Union's Horizon Europe Research and Innovation programme under Grant Agreement No 101057511.

For more information on EURO-LABS, its partners and contributors please see:

https://web.infn.it/EURO-LABS

The EUROpean Laboratories for Accelerator Based Science (EURO-LABS) project has received funding from the European Union's Horizon Europe programme dedicated to Research Infrastructure (RI) services advancing frontier knowledge under Grant Agreement no. 101057511. EURO-LABS began in September 2022 and will run for 4 years.

Delivery Slip

	Name	Partner	Date
Authored by	T. Proslier [Task 3.1 Leader]	CEA	01/02/2026
Edited by	R. Santiago Kern [FREIA] D. Longuevergne [SUPRATECH] T. Proslier [IRFU-Synergium/MACHAFILM] D. Giove [LASA] A. Chiuchiolo [THOR] R. Corsini [XBOX]	UU CNRS CEA INFN-MI INFN-UnivSa CERN	23/02/2026
Reviewed by	I. Efthymiopoulos [WP3 coordinator]	CERN	27/02/2026
Approved by	A. Navin [Scientific coordinator]	GANIL	06/03/2026

Table of Contents

Executive Summary

Task 3.2 of EURO-LABS WP3 is encompasses six large-scale specialized **Technical Infrastructure** facilities dedicated to accelerator component R&D. These facilities maintained close collaboration with ongoing R&D initiatives across Europe and globally, such as the PIP-II project [1]. To date, three facilities —FREIA, SUPRATECH, and MACHAFILM— have actively supported Transnational Access (TA) projects, collectively delivering approximately 68% of the planned Access Units (AU).

Meanwhile, technical upgrades and initiatives undertaken by facility management after the start of EURO-LABS to secure long-term service contracts with major projects have temporarily limited the availability of certain infrastructures for individual TA projects eligible for EURO-LABS funding, particularly at the LASA and THOR INFN facilities.

The supported projects span a broad scientific spectrum, addressing advanced accelerator concepts, superconducting components such as cavities and magnet assemblies, as well as raw materials used. They provided access to state-of-the-art technological infrastructures that are not widely available at the national level, fostering transnational collaborations—precisely the type of activity EURO-LABS aims to promote. These efforts significantly strengthen Europe's research capacity and innovation potential.

[1] https://pip2.fnal.gov

1 Introduction

Task 3.2, **Technology Infrastructures** of EURO-LABS Work Package (WP)3 brings together six Research Infrastructures (RIs), offering five installations dedicated to Technology Infrastructures. These facilities are devoted to the testing of superconducting magnets and related instrumentation, as well as radio-frequency (RF) cavities operating at cryogenic temperatures and at X-band frequencies. The task also includes test stands for specialized R&D on materials used in superconducting cavities, along with mechanical testing facilities made available to industry.

FREIA - University of Uppsala, Sweden
The Facility for Research Instrumentation and Accelerator development (FREIA) Laboratory is equipped with the infrastructure required to accommodate research with high electro-magnetic fields. The facility hosts a large capacity helium liquefier, cryostats for the superconducting devices, power supplies to drive the superconducting devices and experimental areas. All the parts are controlled by a common control system. Offered to EURO-LABS, are three cryostats: A horizontal cryostat HNOSS for the testing of superconducting cavities equipped with a helium tank and with or without fundamental power coupler; a vertical cryostat Gersemi for testing of cavities without a helium tank or magnets up to 2kA current; and a portable, and smaller, cryostat for much smaller devices that require cryogenic temperatures for testing.

SUPRATECH - CNRS, France
The SUPRATECH research platform is dedicated to R&D on superconducting accelerating cavities intended to constitute future powerful accelerators of high-energy particles. It provides all the equipment required to perform surface processing, assembly and testing at cryogenic temperature of superconducting accelerating cavities and their associated components as power coupler and frequency tuning system. SUPRATECH platform was and is still involved in the production and qualification of accelerator components or full cryomodules for several national and international projects as SPIRAL2, XFEL, ESS, MYRRHA and PIP2.

SUPRATECH hosts two experimental halls, equipped with dedicated cryostats to test and qualifiy superconducting accelerating cavities. The larger cryostat in operation is dedicated to test and qualify accelerating cavities down to 1.7K. It can accommodate 2 large cavities and is equipped with a wide range of dedicated sensors.

The main goal was to provide to users the capability to test large cavities in Europe. Indeed, Supratech is hosting a large cryostat to test 2 large cavities with typical dimensions of 1m at once.

IRFU-Synergium/MACHAFILM, CRYOMECH - CEA, France
The CEA/Irfu-Synergium infrastructure comprises two complementary installations: **MACHAFILM**, dedicated to the manufacturing and characterization of superconducting thin films for radio-frequency (SRF) cavities, and **CRYOMECH**, focused on the low-temperature characterization and mechanical testing of materials.

The performance of key accelerator components — such as Superconducting RF (SRF) cavities, superconducting magnets, and beamline elements — is often limited by material properties under extreme operating conditions, including ultra-high vacuum, cryogenic temperatures, high electromagnetic fields, and irradiation. Addressing future challenges in particle acceleration therefore requires the development of advanced materials, innovative surface treatments, optimized fabrication processes, and rigorous quality control. This is particularly critical for SRF cavities, whose performance is governed by phenomena occurring within a thin surface layer and strongly dependent on electrical, thermal, and surface properties.

CEA brings world-leading expertise in testing and developing superconducting linacs and SRF science, supported by advanced technological platforms. MACHAFILM provides capabilities for testing innovative thin-film deposition and superconducting material characterization, while CRYOMECH offers dedicated facilities for thermal and mechanical testing of materials at cryogenic temperatures. Together, these installations support R&D for next-generation accelerators, high-field superconducting magnets, fusion devices, medical applications, and energy technologies.

The MACHAFILM platform aims at accelerating the development of next generation SRF cavities with higher operation temperature and high quality thin superconducting films with both fundamental investigations and applied treatments. The upgrades of the facility enabled the measurements by tunneling spectroscopy of several samples at cryogenic temperature for 3 different users. they also enabled the X-ray diffraction analysis of thin Nb_3Sn superconducting films.

INFN-LASA facility, Milano - Italy

The INFN laboratory Laboratory for Accelerators and Applied Superconductivity (LASA), is a centre of excellence at an international level in the field of advanced technology for particle accelerators based in Segrate, near Milan. The LASA develops advanced technologies for superconductivity, cryogenics and the productions of high intensity DC and RF electromagnetic fields. Here the first European superconducting cyclotron, and third ever realized worldwide, was designed, assembled, and tested. The cyclotron has been in operation since 1994 at the INFN National Laboratories of the South in Catania. The main mission of LASA currently is the development of radiofrequency superconducting resonators for particle beam acceleration and superconducting magnets for particle beam orbit and focusing.

Alongside this, LASA perpetuates its tradition in the experimental field by participating in the study and development of experiments in the field of innovative acceleration schemes. The activities undergoing and starting at LASA foresee the presence of four main test installations devoted to: Superconducting Magnets, Superconducting RF cavities, High Brightness Photocathodes for Electron Sources, and Laser Applications to High Power Fabry Perot Cavities and Advanced Timing Systems.

INFN-THOR, University of Salerno, Italy

THOR is an infrastructure dedicated to horizontal test of accelerator superconducting magnets, specifically built to perform final test of complete cryomodules. The actual laboratory size is 30 m x 15 m, with a 20 ton crane (8m clearance below). It also has dedicated workshops. The infrastructure includes a refrigerator system in the isobaric mode (200 W @[4.5-6] K, 15 g/s, plus 500W @[50-80] K for shields), but it also has the J-T stage for LHe production (up to 120 l/h), and it is provided with a gas purifier. The laboratory is also equipped with a fast ramped Danfysik power converter [10+10] kA (series/parallel switchable, +25/-20V each). The facility will include two test lines to host two modules. Presently the first is under commissioning while the second has just been contracted for manufacture).

XBOX - CERN, Switzerland
The XBOX facility hosts klystron-based X-band test stands located at CERN. These test stands are dedicated to the testing and development of high-gradient accelerating structures and high-power RF components, initially developed for the CLIC project, but also applicable to R&D for X-band FELs, Compton/Thomson sources, and potential RF units for linear accelerators. As a result, XBOX offers unique, state-of-the-art yet highly specialized capabilities, which makes it challenging to meet a broader and more diverse needs of a wider external user community.

1.1 Purpose and Scope of the Document

This report provides an overview of the activities carried out to meet the commitments defined in the Description of Action (DoA) and in the MS17 [2] document at the start of the project, particularly with regard to the provision of Transnational Access (TA) to user teams. It summarizes the access opportunities offered, the level of implementation achieved across the participating facilities, and the support provided to external users.

The facilities at the University of Uppsala (FREIA), CNRS (SUPRATECH) and CEA (MACHAFILM), have been operational since the beginning of the project and have delivered a large fraction of the planned AUs. In contrast, the facilities at INFN laboratories, (LASA and THOR), were unable to host users due to technical issues, as well as planned upgrades and schedule conflicts with higher-priority programs at the laboratories. In agreement with the GA conditions, the funds originally allocated to these facilities will be re-distributed to other facilities within the WP

The document therefore presents a balanced account of both the challenges encountered and the progress achieved in fulfilling our TA commitments.

1.2 Structure of the Document

This document is organised as follows. Section 1, the present section, outlines the content and structure of the report. Section 2 describes the TA projects carried out at each facility, including their main highlights, key results, and impact on the field. The deliverable concludes with Section 3, which summarizes the main outcomes and perspectives.

2 TA Activities

This section describes the TA projects conducted at each facility, highlighting their main results and impact on the field.

2.1 FREIA, Univ. Uppsala, Sweeden

Up to now, FREIA has provided access to two projects, where a brief summary of each project is given in Table 1 while more information is given in the following subsections.

In total, FREIA delivered 480 AU that correspond to 50% of the originally planned accesses. Unfortunately since the end of 2023 the FREIA facility is fully engaged in large-scale, long-term contracts for series testing of production modules destined for major future accelerator installations in Europe. This series testing significantly restricts the facility's availability for small, short-term TA projects targeted by EURO-LABS. At the same time, despite several publicity campaigns no requests were received that could not be satisfied.

Table 1: List of projects at FREIA.

Acronym	Project Title	PI Origin	AUs [h]
EURO-LABS-UU-2023-01	FCC SuShi septum testing	Wigner Reseacrh Center for Physics	314
EURO-LABS-UU-2023-02	Prototype crab cavity testing for HL-LHC	CERN	166

2.1.1 FCC SuShi septum testing

The SuShi septum for the Future Circular Collider is using a novel concept, the application of a passive superconducting shield within the bore of a superconducting Canted Cosine Theta (CCT) magnet, to create a high field and low field domain in close proximity. The magnet is one of the first CCT magnets impregnated with wax. Within the framework of this test series the magnet's performance and quench behaviour was studied, at that stage, without the shield.

A CCT magnet called SuSHi from Hungary was tested in Gersemi, see Figure 1. This magnet is the first of its class that has wax as a impregnating material. These tests proved that this magnet did not quench, which sets a good starting point for future tests and further development.

Publication: The successful completion of this project led to a main publication listed below, and many discussions in the community due to its novelty and possible ramifications.

- Barna, D and Brunner, K and Novák, M and Borburgh, J and Atanasov, M and Lackner, F and Olvegård, M and Pepitone, K and Santiago Kern, R and Svanberg, C and Bagni, T, Training-free performance of the wax-impregnated SuShi septum

magnet, Superconductor Science and Technology, V37, 4, 045006, 2024, IOP Publishing, doi:10.1088/1361-6668/ad2981, https://doi.org/10.1088/1361-6668/ad2981,

Figure 1: Picture of the CCT magnet SuShi placed on Gersemi's magnet insert.

2.1.2 Prototype crab cavity testing for HL-LHC

By using a prototype cavity, this project addressed some important technical aspects of the crab cavities for the HL-LHC project.

The tests of the crab cavity done in Gersemi (see Figure 2) proved that the cavity has been degraded over time and revealed criticality of the transport process with such a complicated and fragile geometry. This is an important feedback to the users for future projects. The tests also proved that the cavity measurement is feasible in Gersemi and reproduced the performance at a low accelerating gradient with two independently developed measurement circuits.

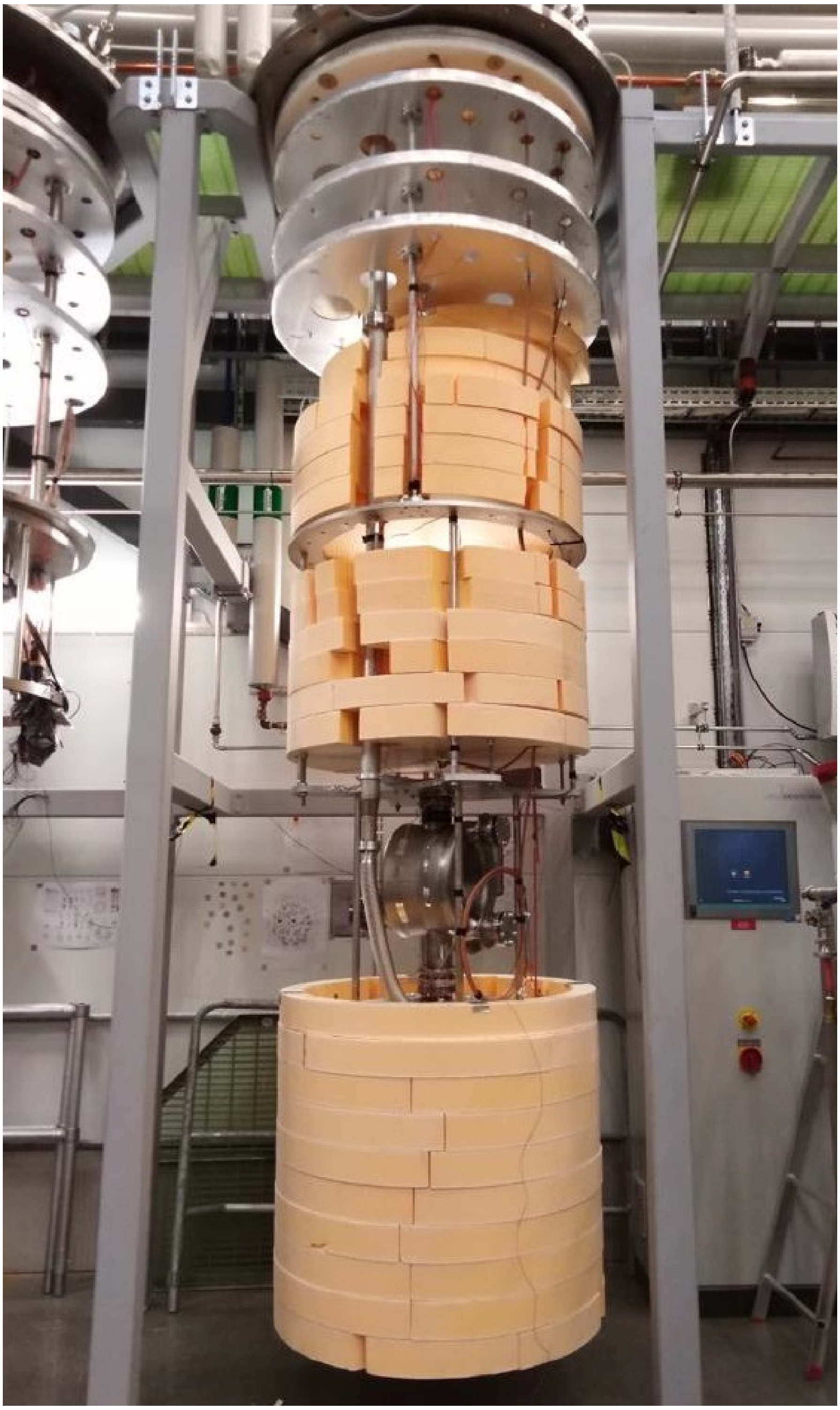

Figure 2: Picture of the Crab cavity placed on Gersemi's cavity insert.

Apart from the outcomes mentioned above, these tests had two added values: from the cryogenic point of view these tests helped debug the cryogenic sequence used to cooldown superconducting cavities from room temperature to below 80 K, where a certain temperature gradient across the cavity needs to be kept during the complete process to avoid having magnetic fields trapped in the cavity's surface during the transition from normal conducting to superconducting, which would affect its RF performance. And this project was a crucial step to train technicians and qualify their work and infrastructure in UU for future potential contributions to the HL-LHC project.

Publication: A complete report of the tests performed is available under:

- Santiago Kern, R, Gersemi tests with the DQW Crab Cavity Niowave 001 at FREIA, 2023,Uppsala Universitet, urn:nbn:se:uu:diva-497703, http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-497703

2.2 SUPRATECH, CNRS-IJCLab, France

SUPRATECH realized three TA projects all in remote access with three different user teams, delivering in total of 312 AU as described in Table 2. No additional TA will be realized at SUPRATECH as the facilities are being upgraded for a series production. No time slots could be allocated to R&D activities. Remaining AU funds have been transferred to other facilities in the project.

Table 2: List of projects at SUPRATECH.

Date of completion	Project Title	PI Origin	AUs
10/01/2024	QPR sample rejuvenation	HZB, Germany	12
15/07/2024	PIP-II spoke resonator qualification	Zanon, Italy	150
09/05/2025	PIP-II SSR1 plasma cleaning test	Fermilab, USA	150

2.2.1 QPR sample rejuvenation

The goal was to perform an advanced surface preparation of 2 specific samples made of bulk Niobium. These samples are used on a set-up, called QuadruPole Resonator (QPR) in operation at HZB. This device is used to assess the surface resistance of superconducting materials exposed to intense radiofrequency waves. This is typically used to develop new superconducting materials deposited as thin films for accelerator applications. For that, before thin film deposition, the substrate has to be baselined to measure the subsequent relative improvement with the new material. As for today, surface quality of Niobium QPR samples as received is extremely damaged.

A specific procedure has been developed to ensure a robust and reproducible baseline. This consists in a two-step procedure shared between two EURO-LABS platforms:

- SUPRATECH@ IJCLab, and,
- MACHAFILMS@CEA.

Based on previous experience of QPR sample surface treatments done at CEA and IJ-Clab that showed very good baseline performances, two QPR sample substrates (HZB-QS-A2 and HZB-QS-A3) have been processed in a similar manner for optimum baseline performance. For this, the following steps have been executed: mechanical polishing @ SUPRATECH as shown in Figure 3, Electropolishing and heat treatment @ MACHAFILM.

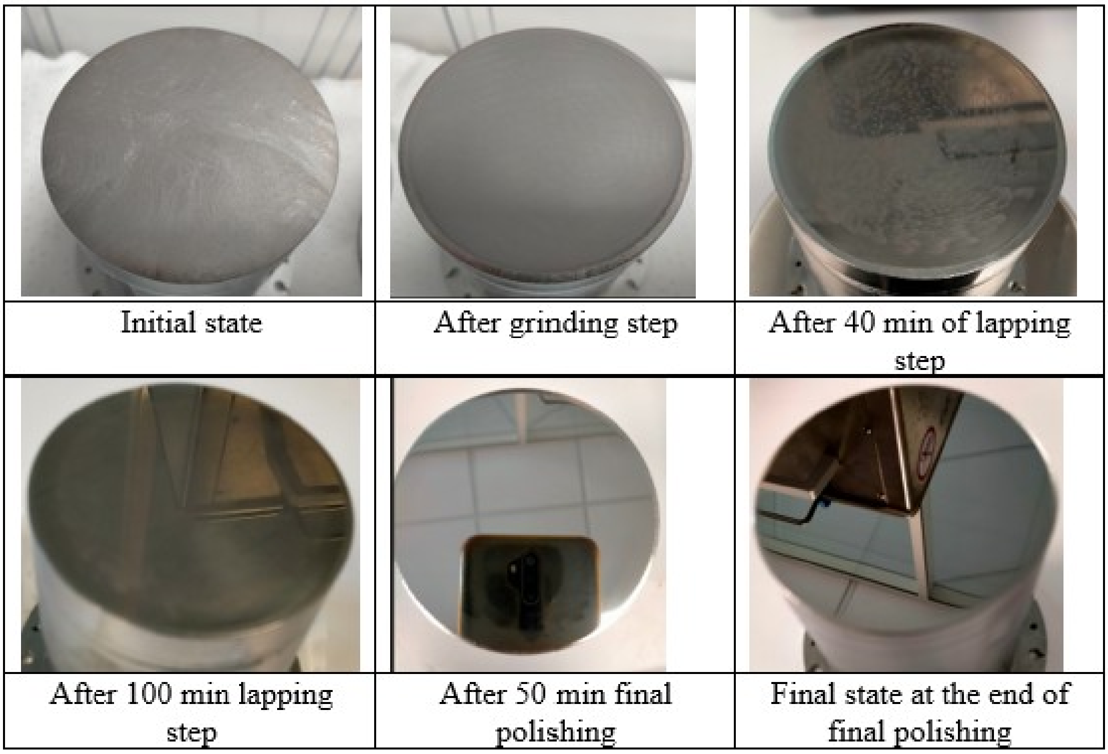

Figure 3: Evolution of the surface of QPR sample versus number of polishing steps

2.2.2 PIP-II spoke resonator qualification

Three Prototype Spoke resonators for PIP-II project (Fermilab) have been built and surface processed by Zanon Research & Innovation SRL in Italy. So as to guarantee cavity performances before shipping to the USA at Fermilab, it is required to qualify these cavities in Europe. Supratech is one of the only platform where this work could be done. This project aimed at testing at cryogenic temperature (2K) the 3 prototypes for PIP-II project. These cavities are Single Spoke resonators (SSR2) which have to operate at a nominal gradient of 11.5 MV/m with an intrinsic quality factor exceeding 9E9. The cavities have been successfully tested. However, eventhough the quality factor of cavities surpassed requirements, the cryogenic tests revealed that the surface final cleaning done was not satisfactory triggering problems related to field emission (X-rays emission).

Publications: Part of the results have been published in:

- D. Longuevergne et al., CNRS contribution to PIP-II project: overview and lessons learned from SSR2 cavities prototyping, Proc. SRF2025, 162-167,MOP44, Tokyo, SRF2025 - 22nd International Conference on RF Superconductivity, 22, JACoW

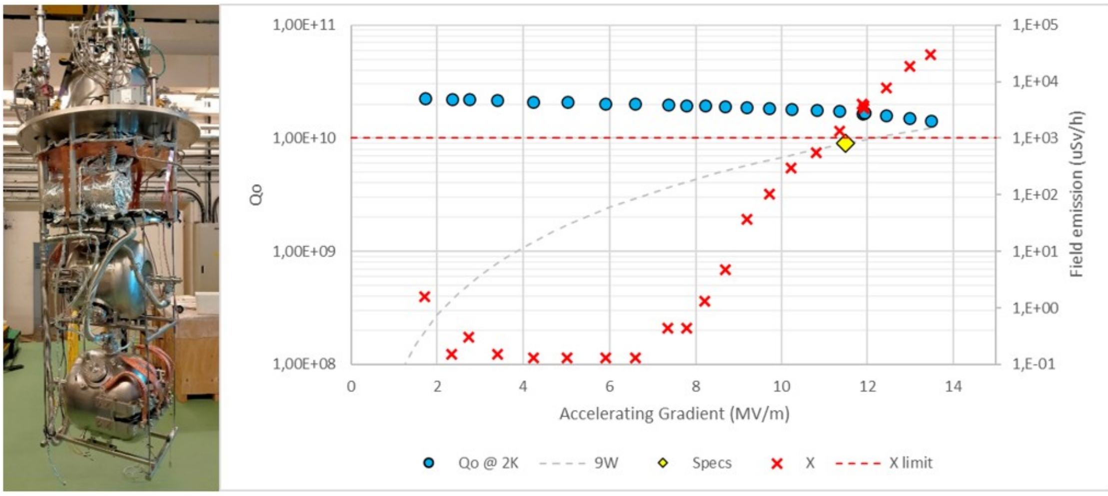

Figure 4: On left, picture of 2 SSR2 cavities installed on cryogenic insert before loading into the cryostat. On right, graph representing the quality factor versus the accelerating gradient of one of the 3 cavities tested. This cavity was successfully qualified after reprocessing at IJCLab as nominal gradient was exceeded and quality factor is above 1E1O at 11.5 MV/m.

Publishing, Geneva, Switzerland, 2025, 2673-5504, isbn:978-3-95450-256-1, doi:10.18429/JACoW-SRF2025-MOP44, https://indico.jacow.org/event/89/contributions/10956, 2025-09-18/2025-09-26,

2.2.3 PIP-II SSR1 plasma cleaning test

Prototype Spoke resonator for PIP-II project (Fermilab) has been shipped by Fermilab to IJCLab to perform plasma cleaning test. This treatment, involving ignition of a reactive plasma inside the cavity at room temperature, has the capability to recover significantly initial cryogenic performances of cavities that have been degraded due to field emission. The test proposed here was to perform a baseline test of a SSR1 spoke resonator, perform plasma ignition and re-test the cavity to characterize any positive or negative impact on cavity cryogenic performance. It has been successfully demonstrated that a typical plasma decontamination process is not degrading cavity quality factor. Unfortunately, this cavity suffered from heavy multipacting, an electron-resonance phenomenon preventing to reach nominal accelerating gradient.

Publication: Part of the results have been published in

- D. Longuevergne et al., First results on plasma cleaning tests in a SSR1-type spoke resonator for PIP-II project at IJCLab, Proc. SRF2025, 157-161, MOP43, Tokyo, SRF2025 - 22nd International Conference on RF Superconductivity, 22, JACoW Publishing, Geneva, Switzerland, 2025, 2673-5504, 978-3-95450-256-1, doi:10.18429/JACoW-SRF2025-MOP43, https://indico.jacow.org/event/89/contributions/11149, 2025-09-18/2025-09-26,

2.3 IRFU-Synergium/MACHAFILM - CEA, France

CEA MACHAFILM have provided five TA projects to four different users for a total of 643 AU granted as described in Table 3. An additional 115 AU have been requested and obtained to fulfill additional requests received in 2025 from STFC and University of Hamburg.

Table 3: List of projects at MACHAFILM.

Date of completion	Project Title	PI Origin	AUs
11/2024	QPR sample rejuvenation	HZB, Germany	48
04/2025	Tunneling spectroscopy measurements	JLAB, USA and INFN, ILtaly	240
04/2025	QPR Surface treatments	DESY-HUH, Germany	52
09/2025	High Tc superconducting alloys characterization	STFC, UK	160
02/2026	1.3 GHz Nb cavity surface treatments	STFC, UK	143

2.3.1 QPR sample rejuvenation

Based on previous QPR successful surface treatments conducted at CEA and IJCLab and exceptionally good RF tests at HZB, we conducted a 2-step procedure shared between 2 EURO-LABS platforms : Supratech @ IJCLab and Machafilms at CEA. Two QPR sample substrates (HZB-QS-A2 and HZB-QS-A3) have been processed in a similar manner for optimum baseline performance. For this, the following steps have been executed: mechanical polishing @ SUPRATECH, Electropolishing and heat treatment @ MACHAFILM. The QPR samples received a 50 microns EP followed by a 800 °C annealing for 3 hrs and a final flash EP with 5-10 micron removal. The QPR have been shipped back to HZB and we are awaiting for the RF test results.

Publication: Part of the results have been published in

- O. Hryhorenko et al., Impact of metallographic polishing on the RF properties of niobium for SRF applications, J. Appl. Phys., 139, 015104, 2026, AIP Publishing

2.3.2 Tunneling spectroscopy measurements

In this project tunneling spectroscopy was used to characterize the surface superconducting properties of Nb, NbTiN and Nb3Sn thin films prepared by plasma assisted deposition pertinent for next generation SRF cavities in particle accelerators. 6 samples have been measured from INFN-LNL (Nb_3Sn/Nb-35/Cu, Nb_3Sn/Nb-30/Cu, Nb_3Sn/Nb, Nb3Sn/Sapphire) and JLAB (NbTiN/MgO, Nb/Sapphire). The measurement showed that the Nb_3Sn/Nb-35/Cu sample had the best superconducting properties of all Nb_3Sn thin film sample on copper ever measured (as compared to STFC, CERN and FNAL) as shown in Figure 5. The TS further confirmed that the Nb_3Sn on thick Nb film is a promising structure for SRF cavity 4.2K operation. The samples from Jlab were used as referenced samples to compare with other deposition methods (ALD, DC sputtering); in particular the NbTiN samples showed the highest ever measured superconducting gap of 3.1 meV and extremely low inelastic scattering parameter.

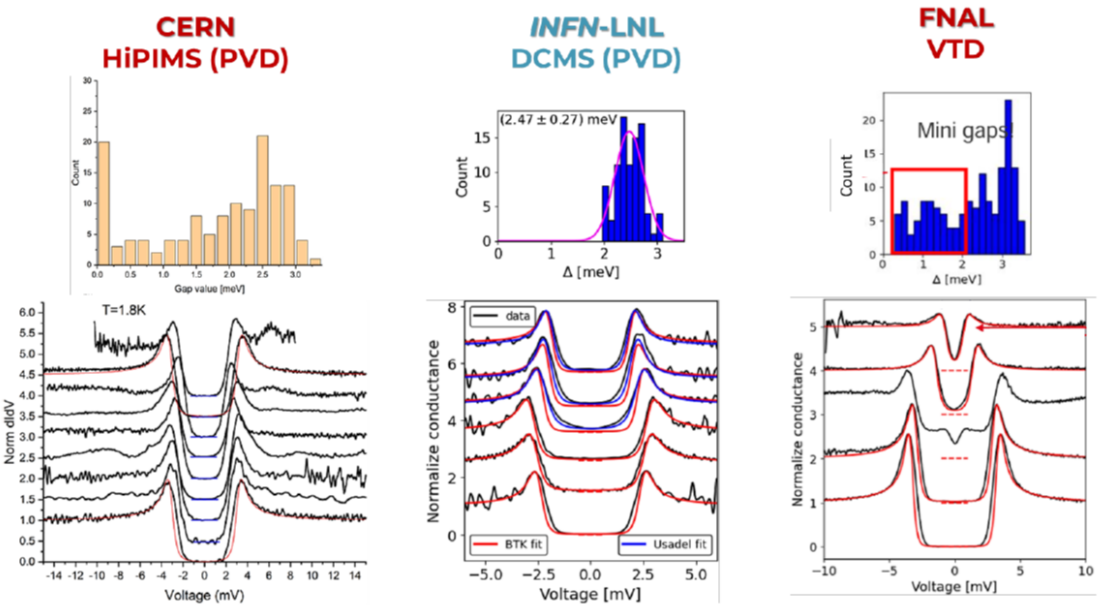

Figure 5: Tunneling spectroscopy measurements on Nb3Sn thin films deposited by 3 different methods from 3 different laboratories.

Publications: Part of the results have been published in

- D. Fonnesu, et al., Development of Nb_3Sn coatings on copper at INFN-LNL, Proc. SRF2025, THA02, Tokyo, SRF2025 - 22nd International Conference on RF Superconductivity, JACoW Publishing, Geneva, Switzerland, 2025, issn:2673-5504, isbn:978-3-95450-256-1, doi:10.18429/JACoW-SRF2025-THA02, https://indico.jacow.org/event/89/contributions/8889/, 2025-09-18/2025-09-26,
- M. D. Asaduzzaman, et al., Superconducting properties of thin film N studied via the NMR of implanted 8 Li, J. Phys. : Cond. Matt., 37, 39, 395701, 2025, IOP Science

2.3.3 QPR surface treatments

Based on previous success obtained with QPR rejuvenation, we treated two QPR samples from DESY-University of Hamburg. One of the QPR received a baseline, cavity-like, surface treatments at CEA: bulk EP, annealing at 900C for 3 hrs and flash EP (Fig. 6). The second QPR received a mechanical polish at Supratech - IJCLab followed by a light EP, an annealing at 900 °C for 3 hrs and a flash EP. Both samples have been shipped back to DESY for RF tests, together with the corresponding report, and the tests are expected to take place soon.

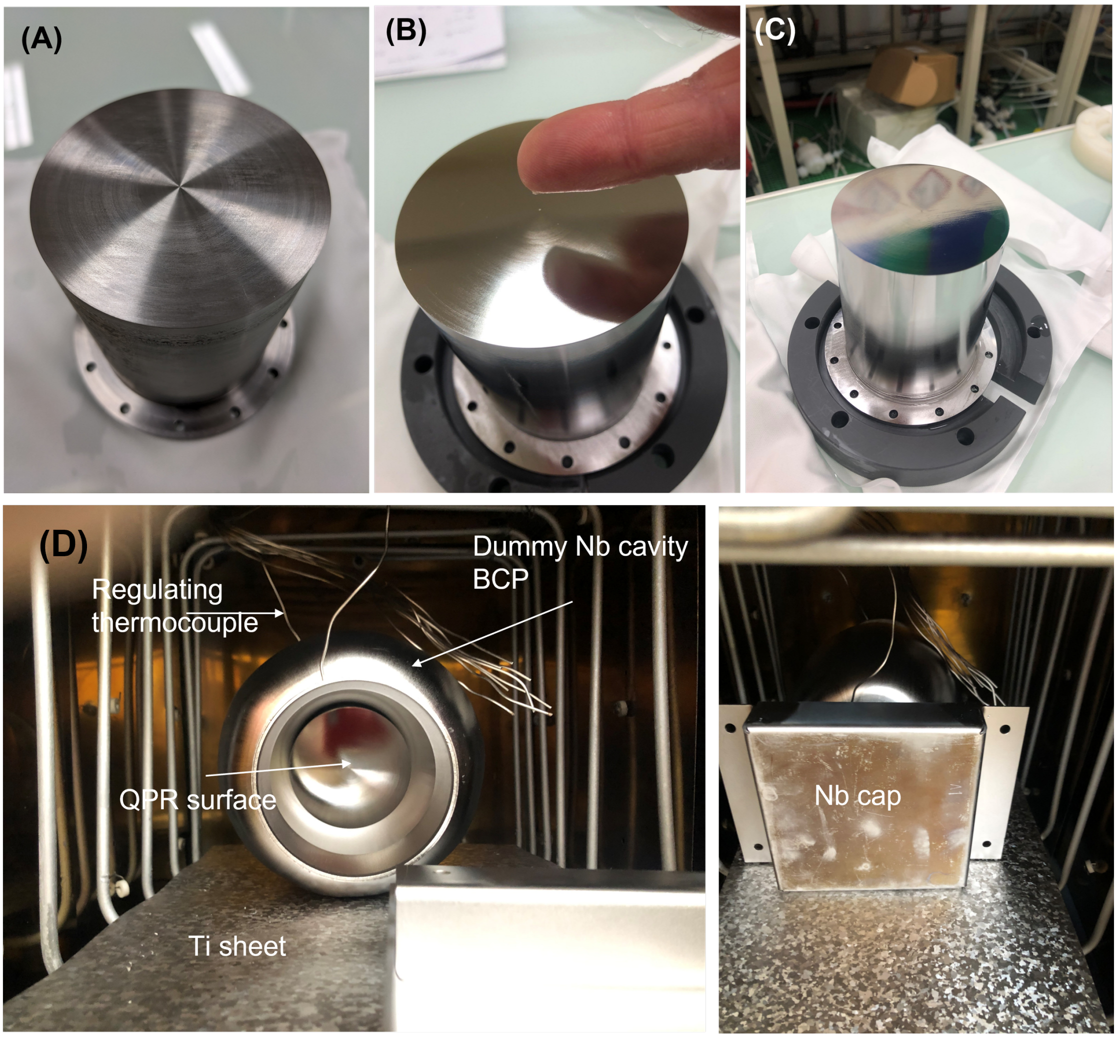

Figure 6: Photos illustrating QPR surface treatments in MACHAFILM: (A) Surface of the QPR as received. (B,C) Surface after bulk electropolishing (EP). (D) QPR setup inside the high-vacuum oven prior to annealing.

2.3.4 High Tc superconducting alloys characterization

Tunneling spectroscopy, X-ray diffraction (XRD), X-ray photoemission spectroscopy (XPS) and electron microscopy is used to characterize 4 samples from STFC: two Nb_3Sn/Cu, one Nb_3Sn/Sapphire, and one NbTiN/Sapphire. The measurement showed reduced gap values on the surface of Nb_3Sn/Cu samples and lattice parameters off-reference that can be explained by the presence of Cu on the surface of the films probably caused by either diffusion of Cu during the early stage of the deposition or contamination from the target (Fig. 7). These preliminary results seem to suggest (as compared to similar samples tested in the past from INFN-LNL) that a diffusion barrier between the Cu and the Nb_3Sn film is necessary to optimize the superconducting properties of the film. The Nb_3Sn film on Sapphire showed nanometric size pure Sn droplets on the surface (as for INFN-LNL sample on Sapphire) and strongly reduced superconducting gaps. These last results on Sapphire are consistent between several labs and point toward a Sn excess during the deposition. Adjusting the deposition process parameters to avoid such excess is mandatory to achieve high performing SRF cavities [1].

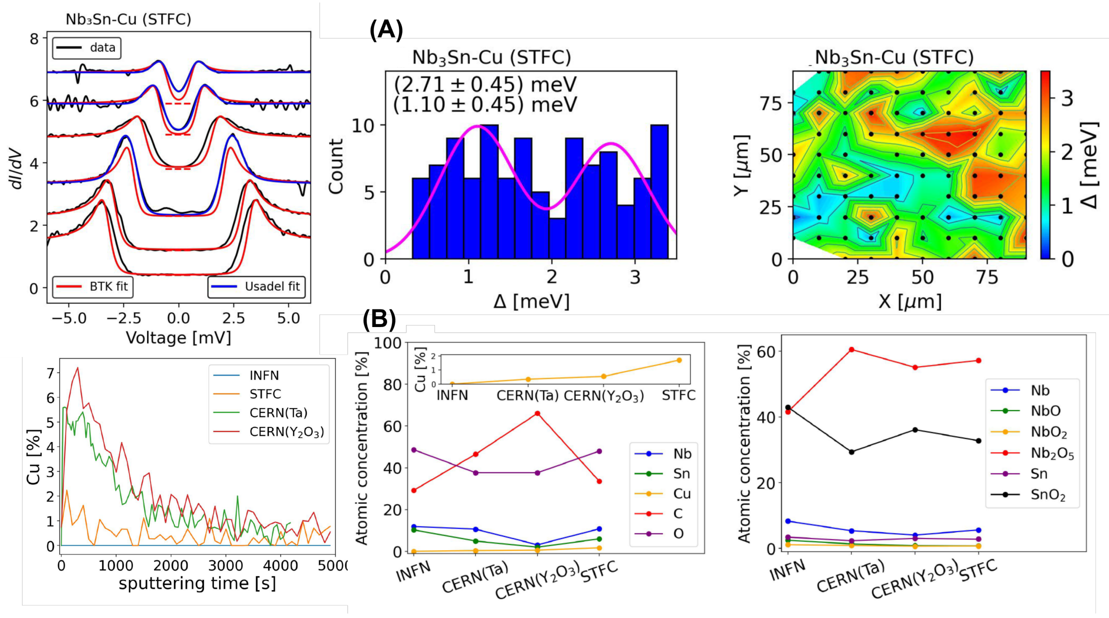

Figure 7: (A) summary of the TS results obatined on the Nb_3Sn/Cu samples from STFC. (B) Comparison of the Nb_3Sn films chemical composition from different institute.

2.3.5 1.3 GHz Nb cavity surface treatments

We treated three bulk Nb 1.3 GH SRF cavities from STFC using the synergium infrastructure at CEA: the chemistry, high vacuum Oven and clean room facilities. These cavities will be used as part of ISAS project as substrates for Nb_3Sn deposition [3].

One Nb cavity received a high pressure rinsing (HPR), leak test and was shipped back to STFC. Two Nb cavities received full standard treatments: a bulk EP (approximately 150-200 microns removal) followed by an annealing at 800C for 3 hrs in high vacuum, and a subsequent flash EP (approximately 10 microns removal). After these three steps, the 2 Nb cavities received a HPR and leak tests prior to be shipped back to STFC.

2.4 INFN-LASA - Univ. Milano, Italy

So far, LASA has not been able to accept any transnational access (TA) projects. The transition of these facilities towards external user access progressed more slowly than initially anticipated during 2023, due to two main factors. First, a significant portion of the researchers and the already limited technical support staff were heavily involved in planning the expansion of LASA's infrastructure, which is set to double the laboratory's surface area. Second, the gradual conversion and upgrading of critical infrastructures — including electrical systems and the cooling systems for cavities and magnets — toward the new layout and future installations blocked the availability for external users.

According to the initial planning, the upgrade activities at LASA were expected to be completed in 2025; however, they were delayed. As a result, it was considered unlikely that LASA would be able to host and complete any TA projects before the end of the project in August 2026. The allocated funds were therefore reallocated to other facilities, primarily within WP3, as well as to other Work Packages of the project.

2.5 INFN-THOR

The THOR facility in Salerno is dedicated to the testing of superconducting magnet systems, primarily in support of major accelerator projects such as FAIR. During the EURO-LABS timeframe, no TA was granted. Starting from July 2024 in fact, the facility underwent an extensive phase of consolidation, upgrade and maintenance. To ensure long-term reliability, safety and improved performance these activities involved essential components for operation, including critical cryogenic and electrical subsystems. The commissioning, originally planned for February 2025, was delayed until October 2025 due to technical issues encountered during integration and system optimization (see Fig. 8 As a result, the facility was not ready to host external users for most of the report-

Figure 8: THOR lab and test lines, fully equipped and under commissioning (19 February 2026).

ing period. Moreover, the delay in commissioning overlapped with a highly demanding testing schedule linked to the SIS100 project. Considering the strategic relevance of these activities and the need for a strict allocation of technical and human resources, opening TA access was not compatible with the core mission and timeline constraints of the facility during this time frame.

The upgraded infrastructure is now in the final phase towards full operational readiness. The improvements implemented significantly enhance the facility's capabilities and confirm its strategic importance as a test infrastructure for research and technological development in the field of applied superconductivity.

2.6 XBOX

XBOX offers unique, state-of-the-art yet highly specialized capabilities, which makes it challenging to meet a broader and more diverse needs of a wider external user community.

Despite sustained publicity efforts during the reference period, the XBOX facility did not attract any new transnational access (TA) projects.

The allocated funds were therefore reallocated to other facilities, primarily within WP3, as well as to other Work Packages of the project.

3 Conclusions

For the infrastructure provided by FREIA, it has offered TA for half of the total AUs and, last year, we were approached by FNAL to inquire about the possibility of testing PIP-II single spoke resonators in HNOSS. After the start of EURO-LABS FREIA started a contract with another institution to test cavities for their accelerator using HNOSS, so unfortunately this facility is not available under the EURO-LABS program anymore. Due to this and the lack of a qualified engineer to operate the magnet insert for Gersemi, for the remainder of EURO-LABS funds were taken and given to other facilities for better use.

SUPRATECH platform provided about half of the AUs expected. The 3 TAs were successfully achieved and all users were satisfied with the service provided. Due to delays in on-going projects as PIP-II and the need to close the cryogenic facility to allow its upgrade, Supratech was not able to continue to provide any TAs for R&D activities.

Concerning the MACHAFILM platform, 643 AUs have been provided to various academic partners from europe and the US and achieved for a total of 640 initially planned. An additional 115 AUs have been requested and obtained to fulfill requests in 2025 from University of Hamburg and HZB. These last request will be completed by June 2026. In total 755 AU units have been granted to the MACHAFILM platform. Overall, users were quite satisfied with the quality of work provided; niobium surface treatments enabled a world record low surface impedance of QPR RF tests and the first Nb3Sn deposition in a Nb cavity at STFC. The state of the art surface characterizations provided in depth understanding of Nb3Sn films performance limitation and identified technological pathways to overcome them. EURO-Labs enabled important seed investigations and collaborations that will continue through other European initiatives (EPITA, ISAS).

The three facilities INFN-LASA, INFN-THOR, and XBOX were not able to host any TA projects. In the case of LASA, this was due to ongoing upgrade activities decided at the laboratory's management level, aimed at reorienting the facility toward supporting R&D within a future framework in which it is expected to be more open to external users in a project following EURO-LABS.

For THOR, the facility is currently fully engaged in the series production of modules for a new accelerator, leaving limited flexibility for ad hoc experiments. This situation is understandable given the high operational costs associated with maintaining such installations, which encourage laboratories to prioritize long-term, programmatic activities. Finally, XBOX is highly specialized, focusing on R&D activities for the CLIC project, which makes it challenging to attract users outside this specific framework. Nevertheless, the facility remains available should developments in the relevant R&D landscape evolve toward its operational parameter range.

References

[1] Ivana Curci. "Coherence loss mechanisms in superconducting resonators studied by tunneling and X-rays spectroscopy". PhD thesis. University Paris-Saclay, 2025.

[2] WP3 EURO-LABS Consortium. *WP3 Research Infrastructuress ready for TAs*. Tech. rep. MS17. EURO-LABS, 2023. url: https://web.infn.it/EURO-LABS/wp-content/uploads/2024/05/EURO-LABS_MS17_Report_v1.0-1.pdf.

[3] C Pira et al. *IFAST Final report task 9.2 - RF test on coated resonant cavity*. Tech. rep. IFAST, 2025.

List of Figures

List of Tables

List of Abbreviations

AU	Access Units
DoA	Description of Action
FREIA	Facility for Research Instrumentation and Accelerator development
LASA	Laboratory for Accelerators and Applied Superconductivity
QPR	QuadruPole Resonator
SRF	Superconducting RF
TA	Transnational Access
WP	Work Package