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**EURO-LABS**

EUROpean Laboratories for Accelerator Based Science

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

Milestone report

Facilities ready to receive TA requests

milestone: MS17

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Abstract:

*The present document reports on the readings of the Research Infrastructures participating to the Work Package 3 of EURO-LABS. .*

EURO-LABS Consortium, 2023

For more information on EURO-LABS, its partners and contributors please see <https://web.infn.it/EURO-LABS/>

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Executive summary

*The key goal of the EURO-LABS project is to provide Transnational Access (TA) to major Research Infrastructures (RI) in Europe. WP3 groups thirteen facilities focused on High-Energy Accelerator Research. The document provides the status of the facilities at the startup of the project, and the readiness to receive and provide TA requests.*

*The document includes sections per Task. For what concerns the composition of the USP, the document will be updated in the course of the project if changes occur.*

# Introduction

EURO-LABS is a network of 33 research and academic institutions (25 beneficiaries and 8 associated partners) from 18 European and non-EU countries, involving 47 Research Infrastructures within the Nuclear physics, Accelerators and Detectors pillars. In this large network, EURO-LABS will ensure diversity and actively support researchers from different nationalities, gender, age, and variety of professional expertise.

EURO-LABS aims at fostering the sharing of knowledge and technologies across scientific fields to enhance synergies and collaborations between the RIs of the Nuclear and High Energy communities. Within EURO-LABS the Work-Package 3 (WP3) will provide Transnational Access (TA) to Research Infrastructures for Accelerator R&D.

WP3 will provide TA to a broad spectrum of installations, to test concepts for future accelerators, based on improving the present facilities, and for R&D studies for future colliders like CERN/FCC or the Muon Collider. These facilities will provide beam lines for testing advanced accelerator materials, superconducting or normal Radio-Frequency cavities, magnets and acceleration schemes. These tests use different particles and energies (low-energy protons, low-energy electrons, ultra-soft electron bunches and high-intensity high-energy electrons and could also have connections to industrial applications.

# WP3 – Task 3.1

## USP

*Composition*

*Frequency of meetings*

### Facilities

###### HiRadMat @ CERN

|  |
| --- |
| Photo of the facility |
|  |

Figure - View of the facility

*Paragraph 1 : Short description of the facility*

*Paragraph 2 : Status of the facility*

*Paragraph 3 : Expected users – “publicity” done or planned to promote the TAs*

# WP3 – Task 3.2

## USP

*Composition*

*Frequency of meetings*

### Facilities

###### FREIA @ UU

|  |
| --- |
| Photo of the facility |
|  |

Figure - View of the facility

*Paragraph 1 : Short description of the facility*

*Paragraph 2 : Status of the facility*

*Paragraph 3 : Expected users – “publicity” done or planned to promote the TAs*

###### INFN @ Milano

|  |
| --- |
| Photo of the facility |
|  |

Figure - View of the facility

*Paragraph 1 : Short description of the facility*

*Paragraph 2 : Status of the facility*

*Paragraph 3 : Expected users – “publicity” done or planned to promote the TAs*

# WP3 – Task 3.3

## USP

*Composition*

*Frequency of meetings*

### INFN Frascati electron Facilities

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|  |
| INFN Frascati electron facilities: a) Beam Test Facility (BTF); b) SPARC\_Lab |

Figure - View of the facility

*Paragraph 1 : Short description of the facility*

The Frascati National LABs (LNF) of the Italian Institute for Nuclear Physics (INFN) are participating to the EUROLABS project through the availability of two electron beam user facilities, namely the Beam Test Facility, that makes use of electron and positron beams of the DAΦNE collider injector complex, and SPARC\_Lab, which is a high brightness photoinjector.

BTF:

The LNF Beam Test Facility (BTF) is an infrastructure mainly dedicated to the development and testing of particle detectors, providing primary, fixed energy beam and secondary electron or positron beams with continuously tunable energy from 30 MeV to 780 MeV. The bunch multiplicity can be varied from 1010 particles/pulse, down to a single particle per pulse in a Poisson stochastic regime, with a bunch repetition rate up to 50 Hz. The facility was successfully running with an average of 200 beam days/year, 25 experimental groups, 150-200 users booking since 2004 apart from a few minor stops. Since 2020 the BTF has also been used in high-intensity modality to provide experimental runs as an electron irradiation source.

Recently a major BTF upgrade has been completed. The existing beamline positioned at the end of the DAΦNE collider injection linac has been split to add a second experimental hall (BTFEH2) to accommodate on weekly base additional experimental groups of users. The new area BTFEH2 will be not in time-sharing with the already existing BTFEH1: only one at a time could be used and booked. BTFEH2 is currently devoted for external users, since the presence of fixed target experiment in BTFEH1. The standard beam pulse length is 10 ns and the BTF injections regime is available via pulsed magnet, steering away DAΦNE transfer line some of the LINAC bunches. The beam could be pulsed electron and positron bunches: up to 49 pulses/second in relation to DAΦNE injection cycle type and operation mode, down to 1. The facility can be operated either in dedicated mode (only possible when DAΦNE collider is off), exclusive for BTF users, or in time-sharing mode, making use of DAΦNE spare injection pulses with beam parameters defined by DAΦNE injections needs.

BTF offers standard beam line services for users doing tests, including: BTF DAQ and DCS data (BTF standard, delivered on MemCached server), High Voltage (Caen SY5527 crate, 4 slots, some spare board), Networking (BTF standalone DHCP server and ETH switch), Detectors, Timing for beam synchronization, Payload setup logistics and dedicated expert staff. In addition, standard charged particle detection setups are available for the users: pixel detector, lead Glass Calorimeter, ICT (Particle/bunch counting, high multiplicity regime), beam Flags.

SPARC\_LAB:

SPARC\_LAB is a multidisciplinary facility able to provide unique features in terms of electron beams and laser pulses, especially on the overall resulting beam quality. It is based on two pillars: the SPARC photo-injector and the FLAME high peak power laser system.

The SPARC photo-injector produces electron beams in the range 5-140 MeV energy, 10 pC-1 nC charge and duration tunable in the range 20 fs-5 ps (rms). The beam is provided completely characterized in the 6D phase-space and can be delivered to three different beamlines that have been dedicated so far to Free-Electron Laser (FEL), tests for advanced diagnostics and laser-electron interaction (Thomson scattering). Recently, at the end of the LINAC, a plasma accelerator module has been installed providing accelerating fields up to 1 GV/m.

FLAME is based on a Ti:Sa laser has been produced by Amplitude Technologies and can deliver ultra-short pulses (~20 fs, 60-80 nm bandwidth) with energies up to 6 J in the IR range (800 nm). The resulting peak power is ~250 TW. So far, the facility has been used for solid-target experiments (production of electrons, protons and heaver ions), laser-driven plasma-based acceleration and as a betatron radiation source.

Concerning the services currently offered by the infrastructure, SPARC\_LAB offers to the users the possibility to perform innovative experiments involving electron beams and laser pulses. The two pillars are largely interconnected and share some diagnostics and the respective networks. SPARC\_LAB is configured as a test-facility, in the framework of the EuPRAXIA project, thus the

schedule of the activities can be planned and re-arranged just few months in advance without big constraints. The users are supported by the SPARC\_LAB researchers and LNF technical services.

The electron beams provided by SPARC have been employed in experiments concerning the generation of radiation in different ranges (visible, EUV, THz, and Xrays), for the development of advanced diagnostics (based on THz, OTR and Electro-Optical Sampling) and, in recent years, for the development of innovative acceleration techniques based on plasma.

The laser pulses provided by FLAME have been employed in experiments concerning plasma-based acceleration (up to few hundreds of MeVs adopting gasjets in the self-injection regime) and protons/ions generation and acceleration by means of solid-target interactions.

*Paragraph 2 : Status of the facility*

Both facilities have been in shutdown for maintenance at beginning of 2023. The DAFNE linac, which is the particle source of BTF, has been stopped to substitute one of the 4 S-band klystrons powering the accelerating structures and the facility operation is expected to be recovered by the end of March 2023. Meanwhile, the local user committee, which acts as the laboratory selection panel, is fully active with the goal of delivering the user schedule for the whole year.

SPARC\_LAB is presently undergoing a major consolidation shutdown, funded by a dedicated program called SABINA co-sponsored by the Lazio regional government, providing renewed hardware (photocathode laser system, Low Level RF systems, C-band HV modulator, …) and a new THz radiation line for user. The complex is expected to resume the operation in May 2023, so that EUROLABS users could be accommodated in time slots beyond that date.

*Paragraph 3 : Expected users – “publicity” done or planned to promote the TAs*

Presently, the participation of BTF and SPARC\_LAB to the EUROLABS project as INFN-LNF infrastructures open to Transnational Access has been advertised on the facility webpages https://da.lnf.infn.it/projects/btf/ and https://sparclab.lnf.infn.it/. At the moment there are not official applications for access through the EUROLABS platform yet, but facility coordinators and local user committees have established informal contacts and discussions with eligible international teams in preparation of formal applications. It seems very much probable that applications will arrive soon and the planned access units for 2023 will be finally delivered.

# Annex: Glossary

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| --- | --- |
| Acronym | Definition |
| TA | Transnational Access |
| VA | Virtual Access |
| RI | Research Infrastructure |