ISBN: 978-3-95450-208-0 doi:10.18429/JACoW-IPAC2019-THPMP009

LATINO: A LABORATORY IN ADVANCED TECHNOLOGIES FOR INNOVATION

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Abstract

LATINO (a Laboratory in Advanced Technologies for INnOvation) is an open Research Infrastructure that will be hosted at the Frascati National Laboratories (LNF) of the Italian National Institute for Nuclear Physics (INFN). LATINO will allow the scientific community and the SMEs to get access to the technologies and competences developed for particle accelerators. The Infrastructure will be organized in four Laboratories: Radio Frequency, Vacuum and Thermal Treatments, Magnetic Measurements, Mechanical Integration. The list of the available instruments will include, besides others, a high power X-Band station to test cavities up to 50 Hz repetition rate and 200 MW input power, a network analyser to characterize microwave devices up to 100 GHz, a ultra high vacuum oven for thermal treatments and brazing, an outgassing measurement system to characterize vacuum materials, a stretched wire bench and a rotating coil for the magnetic field measurements of multipoles, environment and laser scanners. The regional and national industrial background comprises a remarkable number of highly qualified small and medium enterprises [1-4] that could take advantage of the technologies offered by LATINO infrastructure to develop novel products within the Key Enabling Technologies and to get the access to new market segments [5-8]. The Infrastructure will be fully operational at the beginning of 2020. For further information please visit www.latino.lnf.infn.it.

LATINO

The infrastructure is based on 4 different laboratories already in operation at LNF, which are currently under an upgrading and refurbishing process in order to enhance and improve their capabilities. INFN Roma1 – one of the other divisions located in the Lazio region and one of the most ancient of the whole institute – will collaborate with LNF sharing its relevant knowledge about mechanical 3D design and integration of large facilities. The laboratories involved are: Radio Frequency, Magnetic Measurements, Vacuum and Thermal Treatments, Mechanical Integration. The program, which is co-funded by local government (Regione Lazio – call "Open Research Infrastructures" within POR-FESR 2014-2020 European activities), is structured in two phases. The first phase (2018-2020) is focused on the upgrading, procurement and refurbishing of the existing facilities and to set up the commercial and administrative framework. In the second phase (2020-2025) the activities will start and will be monitored by the main stakeholder (Regione Lazio) in order to assess the financial sustainability as presented in the business plan. LATINO will be mainly focused to provide added value services for small and medium industries but will also act as collaborator for other research infrastructures that are interested in the technologies developed and offered by LATINO and by LNF.

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RADIO FREQUENCY

The Radio Frequency laboratory will be organized in two sections: high power RF and low power RF. The high power section comprises a 12 GHz (X-Band) test station driven by a solid state pulsed modulator. It provides RF pulses 1 μs long at peak power of 50 MW or (if used with a pulse compressor) 100 ns up to 200 MW at 50 Hz repetition rate. The X-Band station will be installed in a dedicated temperature controlled bunker to satisfy radioprotection requirements, and equipped with all the necessary ancillary utilities. A 3D view of the bunker is reported in Fig. 1.

The low power section includes a complete set of instruments that allow the characterization of RF devices in frequency domain up to 100 GHz, and signal measurements in time and frequency domain up to 20 GHz. The services that will be provided are:

- RF structure high power test and conditioning.
- High frequency RF measurements.
- RF device characterization.

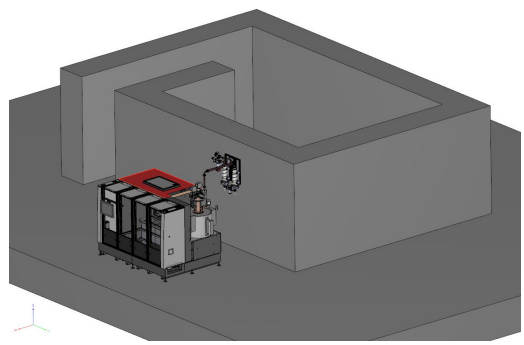

Figure 1: A 3D view of the bunker for the X-band station.

MAGNETIC MEASUREMENTS

The Magnetic Measurements Laboratory will be able to fully characterize magnets, from field maps to harmonic analysis.

The field maps will be performed with a Hall probe mounted on a five-axis movement system located on a granite bench, with a probe positioning precision of

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10 µm and a measurements sensitivity of about 0.01%. The harmonic analysis of the multipoles will be carried out with a rotating coil bench, having a relative accuracy of integrated main harmonic of 3 10^{-4} and a positioning accuracy of about 30 µm. The integral magnetic field measurements and fiducialization of magnets will be done with a stretched wire bench, with a centering accuracy of 2 µm and integrated field precision of 0.2 Gm. A sketch of the stretched wire bench is reported in Fig. 2.

With these instruments, this laboratory will be able to perform:

- Harmonic analysis of multipolar fields.
- Field maps with Hall probe.
- Integral magnetic field measurements and fiducialization.
- Magnetic design of electromagnets.

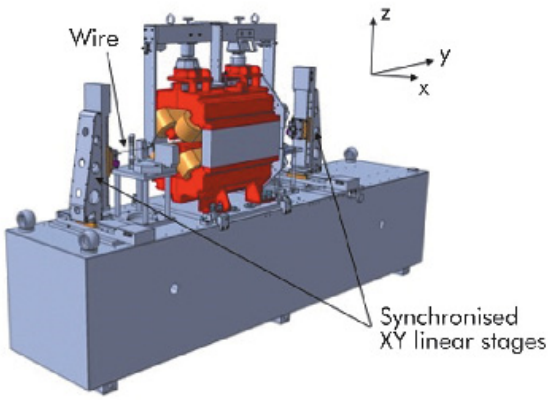

Figure 2: The ESRF stretched wire measurement bench.

VACUUM AND THERMAL TREATMENTS

The Vacuum and Thermal Treatments Laboratory provides added value services for particle accelerator and UHV system. It will implement two facilities: a dedicated system for outgassing rate measurements and an ultra-clean vacuum furnace. The first system will be able to provide specific outgassing measurements of materials used in UHV and HV applications and material used in aerospace technology and particle accelerators. It will integrate two chambers, one for UHV materials with low outgassing rates, the other for HV materials and larger outgassing rates. It will be equipped with a residual gas analyser at 200 amu and partial pressure sensitivities up to 2 10^{-14} mbar. Outgassing rates measurements at different temperatures will be also possible.

The ultra clean vacuum furnace for thermal treatments and brazing will have a diameter of 50 cm and a length of 1.5 m. It will be able to reach up to 900°C with an internal pressure of about 10^{-7} mbar in a very clean environment since it will avoid internal resistors in vacuum. It will be used for brazing and thermal treatments, also in controlled atmosphere (N_2, H_2, etc.), of materials for particle accelerators, normal and superconducting cavities, detectors, ultra clean systems in general and materials used in aerospace technology.

The list of services that will be provided includes:

- Ultra high vacuum or controlled atmosphere thermal treatments.
- Brazing in ultra high vacuum.
- Specific outgassing measurements of samples.

Figure 3 and 4 show the sketches of the ultra high vacuum furnace and of the outgassing measurement system.

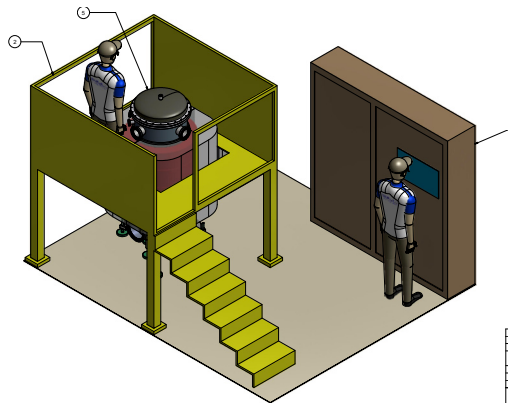

Figure 3: The ultra high vacuum furnace.

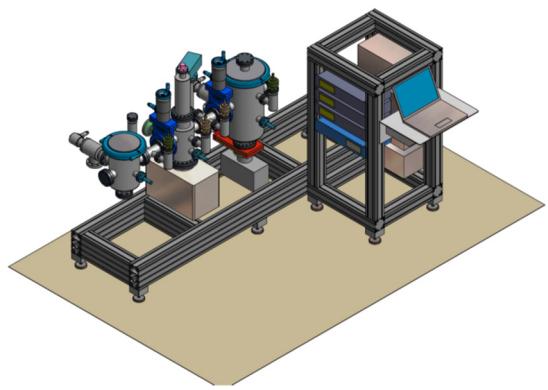

Figure 4: The outgassing measurement system.

MECHANICAL INTEGRATION

The mechanical Integration Laboratory will be provided with two laser scanners, one for architectonic measurements and one for stereoscopic scans.

The architectonic laser scanner will be used to measure environments, buildings, plants. The range of measurements is broader than 140 mm with a positioning precision at 10 m of less than 2 mm. These measurements are useful for space management applications, such as to plan installation or handling of instruments and components.

The stereoscopic laser scanner will allow the design, quality control checks and dimensional survey of mechanical components and interfaces. The distance between points in the scan is of 0.04 mm with accuracy of 0.018 mm in its best configuration, 6 Mpixel for each camera and a field of view of 460 mm.

The list of services of this Laboratory is:

- Building and utilities CAD reconstruction for space management and integration analysis.

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- Mechanical components quality inspection and dimensional survey.
- Reverse engineering applications.

The lasers will be able to operate both inside the INFN structures and outside for industrial applications.

THE INFRASTRUCTURE

The laboratories will be hosted in two different buildings within LNF premises. At the moment those buildings are under a refurbishing and upgrading process in order to be fully prepared for the upcoming activities.

Building #38 will host the Magnetic Measurements laboratory. Building #7 will host the RF laboratory and the RF Bunker. It also will host the vacuum treatment facility and the office of the Mechanical Integration laboratory.

Both buildings are located in the LNF premises and are fully provided with all logistics facilities. A Manager supported by an administrative and secretariat staff leads the infrastructure. The technical team belongs to the accelerator division and it is led by experienced subject matter experts.

CONCLUSION

LATINO is aimed to provide added value services for industries interested in the development of new technology for a wide range of applications. Even during the preparatory phase several companies showed interest in such infrastructure proposing letters of intent for future collaborations.

ACKNOWLEDGEMENTS

The LATINO project is co-funded by the Regione Lazio within POR-FESR 2014-2020 European activities (public call “Open Research Infrastructures”).

We acknowledge the support from many colleagues at LNF, including Administration Service, Technical Division, Scientific Information and Dissemination Service.

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