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### **LASA, EXCELLENCE IN THE TECHNOLOGIES FOR ACCELERATORS AND APPLIED SUPERCONDUCTIVITY**

The INFN LASA (Laboratory of Accelerators and Applied Superconductivity) facility in Segrate, near Milan, was established almost 30 years ago and is an internationally recognised centre of excellence for particle accelerator technology. The first Italian superconducting cyclotron, first in Europe and third in the world, was built at LASA: since 1994 it has been committed to the Southern National Laboratories of INFN in research and important applications to medicine. In developing advanced technology for superconductivity, radiofrequency systems, cryogenics and high-intensity magnetic fields production, the laboratory has become a centre of outstanding expertise in the field of accelerators, its expertise being channelled into studying innovative technology for major international particle physics projects. In this frame, the primary mission of LASA is the development of superconducting systems for particle acceleration (radio frequency cavity) and for steering the beams (magnets).

Fundamental is the contribution to the success of the LHC. Thanks to LASA's activities, the first prototypes of the accelerator's dipole superconductors and the toroidal magnet of the ATLAS experiment (the LHC's biggest detector) were developed. The laboratory also supplied and certified 50% of the superconducting cable and made the superconducting coils for the experiment. Now, with the MAGIX (Innovative MAGnets for future accelerators) project, LASA stands at the forefront in the development of technologies for future LHC projects. MAGIX involves the design, construction and cryogenic testing of prototypes of superconducting magnets for interaction points under the HiLumi project, the future high-luminosity accelerator that will follow the LHC's final phase of activity.

Among the research efforts in which LASA is involved, the study of superconducting radio-frequency (SRF) cavities for accelerators is certainly one of the most promising. The laboratory coordinates the Italian participation in XFEL (European X Free Electron Laser), the European infrastructure based on a powerful X-ray source (nowadays in an advanced construction phase) which will be operative in Hamburg starting from 2017, available to scientists worldwide for research activities and applications,

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in physics, biology, medicine, material science and other fields. Jointly with the national industry, LASA is responsible for the implementation of half of the 800 superconducting accelerator cavities for electrons, almost the half part of the cryogenic modules containing them and the charge control system to increase the current of the beam. Indeed, also in the production of coherent X-radiation, the research group on SRF cavities is an international reference point for the production of photo-cathodes for electron beams sources with very high brightness, which are provided to the major infrastructure active worldwide in this field.

LASA has also a fundamental role in the design and development of the superconducting cavities for protons beams acceleration, for the European project ESS (European Spallation Source), the most powerful neutron source for basic and applied research in the world, under construction in Lund, Sweden, to be operative in 2019.

Over the years, the skills acquired have led LASA to the development of many applied physics and technology transfer activities. Among these, it's worthwhile to list the development of linear compact accelerators (3 GHz) for medical applications (the first prototype, called LIBO, is exposed at the Globe of Science and Innovation, at CERN) and the collaboration in the design and construction of the accelerator cavities for the National Centre for Oncological Hadrontherapy (CNAO), in Pavia.

At present, as a partner of the European project ELI (Extreme Light Infrastructure), LASA deals with the application of laser accelerators to medicine, nuclear physics, inertial fusion, as well as to the advanced diagnostics of materials, through the development and characterization of proton beams produced by high power lasers.

Collaborations are also effective in the field of radionuclides, for the commissioning of the high intensity cyclotron SPES (Selective Production of Exotic Species), currently being installed at the INFN National Laboratory of Legnaro. The same laboratory also collaborates with the radiochemistry laboratory of LASA in the application of particle accelerators to the medical diagnostics and the metabolic radiotherapy.

Moreover, LASA carries out nano-toxicological studies on the environmental pollutants, in collaboration with the Applied Nuclear Energy Laboratory (LENA) at the University of Pavia.

In conjunction with the Scientific Degrees Project of the Italian Ministry of University and Research, LASA is finally involved in dissemination activities about the environmental radioactivity, through the installation of radioactivity measurements laboratories in schools. ■