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**FROM STARS TO MEDICINE:
A LABORATORY FOR BASIC AND
APPLIED RESEARCH**

*Interview with Diego Bettoni, director of the
INFN Legnaro National Laboratories*

Diego Bettoni is the new director of the Legnaro National Laboratories (LNL) starting from January 2017. LNL is one of the four INFN national laboratories; it is engaged in basic research in nuclear physics and astrophysics and in the applications arising from the development of nuclear technologies. The laboratory, inaugurated on 27 November 1961 as "Centre on Nuclear Research of Veneto Region", has its roots in INFN excellence for particles accelerators and detectors. LNL strength points are nuclear particles accelerators and nuclear radiation detectors; it is hence a centre that gathers many researches and developments on low energy nuclear physics in Northern Italy. Today, over 800 researchers coming from all over the world regularly join LNL research programmes. The laboratory does not only host its five accelerators and the detectors for its ongoing experiments but also major European collaborations' research projects.

Is it possible to identify a progressive development of the Laboratories in a defined direction? What are the main basic research topics that the laboratory is focussing on today?

Ever since their foundation in 1961 the Legnaro National Laboratories (LNL) have distinguished themselves for forefront research in the field of fundamental nuclear physics. This excellence has been maintained over the years, on one hand thanks to the construction and operation of accelerators meeting the demands of an ever growing national and international user community; on the other hand thanks to the development of innovative detectors for nuclear spectroscopy, from the early scintillation detectors, to Germanium-Lithium detectors, until the modern "gamma arrays". This advanced know-how in the field of accelerators and detectors for nuclear spectroscopy has been attracting an ever growing international community. The next step of this development will be the fulfilment of the SPES (Selective Production of Exotic

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Species) project, a second generation ISOL (Isotope Separation On-Line) facility which will become a reference for the international nuclear physics community.

Another characterising feature in the history of Legnaro is the ever increasing role of applied and interdisciplinary research, which represents a natural integration to the fundamental science.

The most prominent research lines in Legnaro are the study of nuclear spectroscopy and of reaction dynamics. Also the applied part gives a significant contribution to the laboratory's activities: an example is the laboratory for Superconductivity and Surfaces Treatment.

Experiments at LNL are characterised by a strongly applicative tendency starting from the design phases. Is this due to a characteristic of nuclear physics research or is it a consequence of a defined strategy?

It is undoubtedly a feature of Nuclear Physics to have many applications in other fields. The relevance of applied research in the activity of Legnaro is however the result of a precise strategy of the management, both of the lab and of INFN, which has led to the establishment of various applied research programs in fields such as biomedicine, environment and cultural heritage. This strategy creates synergies between basic and applied research and thus enhances the potential of the laboratory. Basic and applied researches are both fundamental components of a modern nuclear physics laboratory. Curiosity-driven research allows maintaining a lively and motivated community, whose projects and ideas can then be applied to other fields. Technology transfer is the natural fallback of our research and provides a partial return of the financial investments sustained by society to fund basic science.

Applied research at LNL covers very different activities: from environmental radioactivity monitoring, at regional scales, to the study of the materials for the future of nuclear reactors, in partnership with international research centres, until the analysis of materials and the development of technologies for cultural heritages, in partnership with companies and private and public institutions. How do you deal with so diverse contexts?

Interdisciplinary research has always been a fundamental part of the LNL activity, so that the interaction with other, very diversified communities has somehow entered into the laboratory DNA. The relationship and interaction with other communities represent an added value. The research activity in physics requires great flexibility and an open mind, the ability to deal with and find solutions for problems of all kinds. These features become an essential part of our culture and allow us to interact efficiently with the other communities.

In the past you have been working not only in INFN but also in major international collaborations such as CERN, Fermilab and SLAC. How big is the influence of international collaborations on LNL activities?

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The international context plays a fundamental role for LNL, whose project for the future is to become a major research pole attracting a large national and international community. Now researchers from Europe and all over the world have already an experimental activity in Legnaro while our researchers work on experiments in various laboratories abroad. The international nuclear physics community exploits the synergies coming from the complementarities of the various laboratories, whose experimental programmes are at the same time competing and complementary. In this context the laboratory strongly supports an initiative, called EURISOL-DF, which aims at the creation of a network of nuclear physics laboratories in Europe, to be managed as a single distributed research infrastructure, allowing scientists to choose the best laboratory for their experiments.

Furthermore LNL participates in important international programs, such as the realization of the European Spallation Source (ESS) or the IFMIF (International Fusion Materials Irradiation Facility) project, which exploit the competencies of the laboratory in the field of accelerator technology, which represent one of its major strengths and allow the acquisition of significant external funds.

A leading project for the next future of the Laboratory is the new infrastructure SPES, dedicated to fundamental research in nuclear physics and to the interdisciplinary applications. What are the objectives and the state of art of this project?

The SPES project is the perfect declination of the twofold nature of the lab as a centre for basic and applied science. SPES is a second-generation ISOL facility with two main objectives. The first goal is to better understand the origin of elements in the universe, an ambitious endeavour requiring the study of the properties of unstable (radioactive) nuclei through their decays and interactions. The second important objective of SPES is the construction of a laboratory for the production of innovative radioisotopes for nuclear medicine (therapy and diagnosis). A further project under study is the possible realisation of a neutron source with applications to material science, medicine and astrophysics.

The first phase of the project is presently being completed, consisting in the construction of the building and in the acquisition and commissioning of the proton cyclotron. In the next few years the remaining elements for the production and reacceleration of radioactive beams will be built and installed. The medium term goal is to begin experiments with non-reaccelerated beams in 2019 and with reaccelerated beams two years later.

The activity bound to the production of innovative radioisotopes of biomedical interest will start in parallel. This activity will be conducted in partnership with a private company within the framework of a collaborative research agreement.

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Is there a link between the LNL attitude to research and the scientific tradition of Padova, mainly arisen after Galileo's first astronomic observations?

The Legnaro National Laboratories were founded thanks to the initiative of a group of scientists from the University of Padua. The relationship between Padua and Legnaro is still very strong, it concerns the core activities of the laboratory and involves not only the Physics and Astrophysics Department and the local INFN unit, but also other university structures (Engineering, Pharmacology and more Departments). The research activity in LNL is principally in the field of nuclear physics and astrophysics and is in continuity with the Padua scientific tradition. ■