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FRASCATI NATIONAL LABORATORIES: FROM HIGH ENERGY PHYSICS TO INTERDISCIPLINARY RESEARCH

Interview with Fabio Bossi, newly elected director of Frascati National Laboratories and former director of the INFN division in Lecce.

The Frascati National Laboratories (LNF) complex is the first, in terms of size and age, of the four INFN National Laboratories. It has taken on the role of forerunner in particle collider research worldwide since its inception, with the pioneering Ada and Adone, also sowing the seeds for the development of the large colliders at CERN in Geneva, which saw the laying of the foundation stone in the same years. Since 2000, LNF has hosted DAFNE, the collider, still operating, that holds the world record for low energy instantaneous brightness.

The technical and scientific expertise of the LNF in the field of accelerators is unique in Italy and competitive in Europe. Thanks to the broad spectrum of expertise put in place to pursue fundamental physics objectives, activities complementary to research in high energy physics have grown, including the study of condensed matter, the study of new detectors, medical and space applications, radiation dosimetry and environmental control, computer network management and the construction of advanced computing centres. A vital part of the Laboratories is the the SPARC free-electron laser, built in collaboration with ENEA and CNR, and the very high-power FLAME laser for the study of innovative particle acceleration techniques.

Fabio Bossi, former director of the INFN division in Lecce, has been appointed as the new director of the Frascati National Laboratories, taking over from Pierluigi Campana who has managed the structure since 2015 and who, at the beginning of 2020, was appointed as a supervisory member of the Ministry of Education, Universities and Research, on the INFN Executive Board.

Fabio Bossi, from Rome, is an elementary particle experimental physicist. He has worked at CERN and LNF on electron-positron collision experiments. He has also been involved in precision measurements of the Standard Model, flavour physics and light dark matter research. He was head of the KLOE-2 collaboration at the LNF Dafne accelerator and head of the Research Division of the Laboratories themselves. We asked him, as the newly appointed director, to tell us how he sees the LNF in the near future.

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How does it feel to move from managing the INFN division in Lecce to managing the largest of the INFN laboratories?
Beyond the human aspect, which was extraordinary, the four-year period in Lecce was an excellent training ground for me to understand many aspects of the management of the Institute that I only partially knew. Certainly, the big step towards LNF is a great challenge not only because of the size of the structure, but also because running a National Laboratory also means steering and supervising its scientific production and ensuring it meets the highest possible quality standards. In addition, LNF plays a central role in INFN, because it has skills that in certain cases are unique in the institute, skills that under no circumstances must be lost. Managing it, therefore, is a great responsibility.

The historical tradition of LNF is an important legacy. How can the unique skills of the laboratories be best developed, projecting their qualities in the near future? Through which scientific and/or technological challenges?
Our subject, Particle Physics, is experiencing an epochal turning point. We need to take a conceptual and technological leap forward in our ability to accelerate particles at increasingly higher energies. We also need to build more refined detectors to detect phenomena that are hitherto still mysterious. LNF has the necessary skills to tackle these challenges as a protagonist. It also has very ambitious development programmes in these fields; I am thinking mainly, but not exclusively, of the Eupraxia (European Plasma Research Accelerator with eXcellence In Applications), the European project for the developement of a plasma accelerator. Apart from the technical issues, however, I believe that the of the process to develop innovative instruments and technologies is strongly linked to our ability to train and grow a new generation of researchers, engineers, technicians and staff with administrative and management skills) who will have to manage the developement of research in the years to come. I believe that investing in the younger generation is a key strategic task.

At the beginning of your career, the results achieved in recent years, with the discovery of the Higgs boson at CERN, also thanks to many LNF researchers, and the discovery of gravitational waves, in the search for which LNF has played an important role since the 1980s with the Nautilus experiment? A new research path is now opening, perhaps less marked than the previous one...
When you are young you are always optimistic and full of hope. So, I have to say yes, I thought and hoped so. In fact, I must admit that I was hoping that we could open an even more important window on New Physics, beyond the Standard Model. We have learned that this enterprise is more challenging than we expected at the time, but physicists never give up, so I expect the years to come

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to be just as exciting and full of good results as the past ones.

For several years, you were the spokesperson for the KLOE-2 collaboration at LNF, contributing to publications on the research of dark photons, particles potentially related to dark matter. In this context you are among the founders of the PADME collaboration at LNF for the search for dark photons and light dark matter. What does it involve?
The nature of dark matter is surely one of the unsolved mysteries of physics. To date, we have no definite indication in this regard, but we can only put forward reasonable hypotheses to be tested experimentally. One of these hypotheses envisages that dark Matter is subjected to a new type of interaction whose mediator is similar to the photon of electromagnetism but is endowed with a mass, albeit small: the dark photon. This particle can be generated in electron-positron collisions at relatively low energies, such as those achievable with LNF's accelerators. When, ten years ago or so, together with other colleagues, we realised that our laboratory could be the protagonist of this research, we jumped headlong into the enterprise and published a series of experimental works on the subject. Unfortunately, to date we have not obtained any evidence of the existence of this particle, but as is well known, this is the nature of science: searching does not necessarily always translate into finding something, but also important information can be drawn from this "not finding".

LNF also played an important role in the creation of CNAO, the oncological Hadrontherapy Centre in Pavia. How did the vocation of LNF in interdisciplinary research and applied physics arise?
The awareness that our research can, sometimes unexpectedly, find applications in areas other than fundamental research has been growing over the years, and now an important part of our scientific programme is specifically dedicated to this type of issue. Certainly, the development of accelerators and detectors for oncological Hadrontherapy is a reality which we are very proud of, but today we are designing and building facilities that also have an impact in other areas, for example in cultural heritage or aerospace. Furthermore, lines of contact with the business world are opening up, in particular through the SABINA (Source of Advanced Beam Imaging for Novel Applications) e LATINO (A Laboratory in Advanced Technologies for INnOvation) projects which aim to transfer our technical-scientific skills to regional and national industries. I believe that this virtuous circle: "fundamental research, applied research, transfer to industry" is a significant key to understanding the central role that INFN plays in the development of our country. ■