» INTERVIEW

NUCLEAR PHYSICS IN EUROPE

Interview with Angela Bracco, president of the international committee NuPECC (Nuclear Physics European Collaboration Committee), "Expert Board" of the European Science Foundation.

NuPECC has the task of defining the priorities in the field of nuclear physics and promoting the coordination of European research in this field. What are the tools for defining recommendations for the national agencies?

NuPECC is recognized by the European Community as the entity of reference for defining a strategic plan for nuclear physics. It is included as observer in the strategic plan for particle physics and in the working group for the physics infrastructures of the European Strategy Forum on Research Infrastructures (ESFRI).
NuPECC's primary goal is defining the strategic Long Range Plan (LRP) for nuclear physics, a collection of recommendations that direct the coordinated choices of the individual national agencies. The document is issued by the Committee in alternate periods according to the American plan, every 5 or 6 years. This phasing allows periods of dialogue and ongoing communications able to create worldwide integration.
Additional goals are the preparation of specific reports, useful for drafting said LRP, and able to highlight the importance of the existing and future research infrastructures, for example in the field of technological applications and results.
Further tasks performed by NuPECC are the assessment and monitoring of the European projects that provide financing for access by foreign users to the research infrastructures in the various European countries; in the case of Italy, these are the three INFN laboratories of Frascati, Legnaro and Catania. Furthermore, it closely monitors the activities of the European Institute for theoretical studies in nuclear physics, the ECT*, with headquarters in Trento.

What priorities are indicated in the latest LRP 2010?

At the level of large facilities, we must certainly mention the two infrastructures of ESFRI (*European*

» INTERVIEW

Strategy Forum on Research Infrastructures), FAIR (*Facility for Antiproton and Ion Research in Europe*) in Darmstadt, engaged in wide-spectrum modern nuclear physics, from Hadronic physics to nuclear astrophysics, and SPIRAL2 (*Système de Production d'Ions Radioactifs en Ligne*) in Ganil, engaged in research on nuclear structures and nuclear astrophysics. Although in these cases, as in others, the driver for development of infrastructures of research is basic science, both projects have significant impact on applications, from the science of materials and recovery of cultural heritage, to Hadrotherapy and the development of radiopharmaceuticals.
Then there are the *Major Upgrades,* already existing infrastructures that provide updates in the direction of the new physics. Among these, the most demanding is SPES, a new and complex structure of accelerators at the National Laboratories of Legnaro for providing radioactive beans. Italy's involvement, with the INFN, includes the AGATA detector, an infrastructure used throughout the European territory, and the ALICE detector at the LHC accelerator at CERN.
To build parts for the new infrastructures, the 2010 issue of LRP made clear its desire for optimized use of the existing structures. This allows avoiding abrupt passage from the old to the new facilities, guaranteeing greater continuity for research. A further benefit of the continuity between the new and the old projects is to the *training & education* sector, which finds in medium-sized projects useful terrain for training new generations of researchers.

If we could summarize nuclear physics research goals in any general questions, in terms of knowledge acquisition, what would be the most relevant?

The first of the questions to which nuclear physics wishes to answer today is the origin of the elements that are differently distributed on Earth. The distribution depends on astrophysical processes that we call precursors, involving unstable atomic nuclei. By studying their behavior, it is possible to understand the processes that have led to the current elements distribution. This research requires very experimentally-advanced techniques and technologies, since it is necessary to study the nuclei during their formation. The times of instability are very brief, and currently we can study only those that survive more than a few microseconds.
An interesting analogy links the behavior of matter at the macroscopic and nuclear levels: this is the case of neutron stars. The knowledge of the structure of these stars requires detailed study of the behavior of the state of *quark gluon plasma* and of neutron matter that, together, determine the equilibrium of the atomic nuclei as well as of the neutron stars.
Moreover, the atomic nucleus is a complex many bodies system. This generates many analogies with matter physics; such as, for example, phenomenological studies on collective behaviors associated with superconductivity. In these aspects, the affinity stops at the descriptive level and in the nuclear field does not lead to direct applications, as in the case of the physics of superconductive materials, but it is of great interest in terms of knowledge.

There are many applications of nuclear physics to industrial and social utility. The

» INTERVIEW

importance of the applications in the medical field is such that NuPECC has dedicated a rich and detailed report to these aspects.

"*Nuclear Physics for Medicine*" will be presented in Brussels on November 24 in a conference at the University Foundation.
The event is sponsored by the Italian Ministry of Education, University and Research (MIUR) among the activities for the Italian Presidency of the EU Council. The main goal of the report is to highlight the role of nuclear physics research in the developments of modern medicine, in the diagnostic and therapeutic fields.
Also in the past, NuPECC has paid particular attention to applied research and has prepared other reports about applications of industrial and social utility, from the science of materials and the care of cultural heritage to medicine. The new report "*Nuclear Physics for Medicine*" aims to shed light on three aspects in particular: the same accelerators used in nuclear physics are increasingly used for treating tumors; the production of radioactive beams has an impact on the production of radioisotopes used for diagnostics; the new developments for complex particle detectors, and in particular for gamma radiation, allow increasingly precise image reconstruction of internal parts of the human body. ■

* NuPECC is an Expert Committee of the European Science Foundation, which includes members from 19 European countries. Its primary goal is defining priorities in the field of nuclear physics and coordinating research at the European level. The activities of NuPECC are regularly followed by non-European observers, and it is regularly evaluated by the European Science Foundation as its "expert board."