NEWSLETTER 02

***Italian* National Institute for Nuclear Physics**

AUGUST 2014

NEWS

PEOPLE

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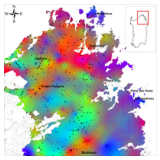


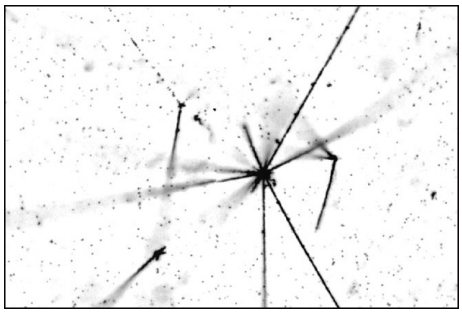
TECHNOLOGY TRANSFER

NEWS

Collaborations

JUNO, AN UNDERGROUND GIANT TO CAPTURE NEUTRINOS

An international agreement, which marks the birth of the *Jiangmen Underground Neutrino Observatory* (JUNO), in China, was signed in July. This new scientific project includes, in addition to China and Italy that participates with INFN, Czech Republic, Finland, France, Germany, Russia and the US. Hundreds of scientists from all over the world, gathered at the Institute of High Energy Physics (IHEP), announced the establishment of the international collaboration with the purpose of realizing a giant underground neutrino detector. It will be based on scintillator liquid technology, as Borexino experiment at the INFN Gran Sasso National Laboratories (LNGS). “We are very excited about this experiment and it’s a wonderful and comprehensive physics program”, said Gioacchino Ranucci, INFN scientist and deputy spokesperson of the collaboration. We are committed to the success of JUNO, since we could bring in our broad expertise carried out for almost two decades at the Gran Sasso National Laboratory.”



Science

AEGIS, THE EFFECT OF GRAVITY ON ANTIMATTER

The AEGIS experiment (*Antimatter Experiment: Gravity, Interferometry, Spectroscopy*) at CERN, with the collaboration of the INFN, has measured the deflection of a beam of antiprotons under the effect of an extremely weak magnetic force, using an instrument called “Moiré deflectometer”. In this initial test, scientists were able to verify the efficiency and sensitivity of the instrument, which has been designed to study the effect of gravity on antihydrogen atoms. Whether antimatter is subject to the effect of gravity in the same way as matter has never been demonstrated experimentally. “That is very probably true,” explained Gemma Testera, deputy spokesperson of the AEGIS project and coordinator of the INFN’s collaboration. “But our measurement will be very helpful for understanding how to formulate a quantum gravity theory and thus a unitary vision of the fundamental forces of nature”.

Awards

GSSI: POST-DOC RESEARCHER WINS THE MICROSOFT AWARD

Catia Trubiani, post-doc researcher in Computer Science at the Gran Sasso Science Institute (GSSI), the INFN international PhD school and centre for advanced studies, received the Microsoft Azure Research Award. Microsoft offers the availability of the Microsoft Azure Platform for 12 months to perform big data computation in the cloud. The estimated total market value of this offer is 40,000 USD. DESPACE (*DEtecting and Solving Performance Anti-patterns in Cloud Environments*) is the name of the awarded project: the goal is to develop a prototype of a performance analyser for the interoperability of online auctions with private owners of goods. “The system will be self-adaptive – Catia Trubiani explains – and, in particular, will detect the potential performance flaws and/or security issues for the used resources and take suitable refactoring actions while ensuring data confidentiality and synchronisation”, said Trubiani.

» PEOPLE

OECD REPORT ON RESEARCH INFRASTRUCTURES

Interview with Valerio Vercesi*, member of the OECD Global Science Forum (GSF) International Experts Group.**

Which reasons prompted the GSF to issue this report, approved by the OECD *Committee for Scientific and Technological Policy* last June?

The GSF was initially approached by CERN, which was interested in having an external perspective that could serve as a basis for further optimising its policies, as well as being of value to CERN member states. The GSF aimed then to address the potential economic and societal impacts of international research facilities, using examples from one of the largest global research infrastructures.
To achieve this goal, the GSF Secretariat staff carried out a small number of case studies, relying mainly on confidential interviews with the people most directly involved, and then the Forum worked out the outcome. Two of these investigations were addressed in detail: the development of the superconducting dipole magnets for the Large Hadron Collider (LHC), and CERN contribution to hadron cancer therapy using beams of carbon ions.

In both these investigations, the findings of the report attribute a relevant position to the Italian contribution through INFN.

The report stresses, of course, that the construction of the LHC has been a planetary enterprise with contributions from many research institutions and agencies. In that context, the INFN role is highly relevant on both the scientific and the foresight points of view. A major example is offered by the realization of the dipole magnets, one of the primary elements of the whole LHC accelerator complex, due to their high degree of novelty and risk. In the achievement of this high technological goal, the report underlines the importance of the existing collaboration between INFN and other Italian companies for research, development and production of high-field superconducting magnets. The largely positive test of two magnets “string”, which were constructed thanks to the virtuous relationship with these companies, led directly to the final approval of the LHC by the CERN Council. We can say someway that a little bit of the new CERN *motto* “Accelerating Science” stems also from this quick and timely decision by INFN.

The second case analyzed is the knowledge transfer from CERN to hadron cancer therapy.

Prior to the launch of the PIMMS (*Proton Ion Medical Machine Study*) project in 1996, which led to the development of the first design of a complete accelerator system, CERN had been active for ten years in the research on the use of hadron beams for cancer therapy. In the report one can find a detailed historical accounting on the different paths which brought this design to be adopted and transferred into the realization of the two existing European clinical treatment facilities with carbon ions, Heidelberg and Pavia (with a third one in

Wiener Neustadt nearing completion).
INFN was the principal technical partner of CERN for the Pavia infrastructure (CNAO, *National Centre for Oncological Hadron-therapy*), in the implementation of the synchrotron. The report acknowledges that the Institute was eminently able to do this work because of the half-century experience in nuclear and particle physics research. Besides this, the strong involvement of INFN in the construction of CNAO also allowed to highly limiting the costs of the structure.

The report also describes the fundamental role of CERN in the cases analyzed. Which aspects are highlighted?

The goal of this study was not a quantitative assessment, in the sense of praising or criticizing work done at CERN, or measuring the economic or social return on the financial investment by the member states. The goal was really to qualitatively identify characteristics of the laboratory that could be of interest to proponents of future large international scientific collaborations, specifically in terms of impacts on economic innovation and on society at large. The report recognizes that CERN is a reference point for accelerators science and the two cases studied in detail address two somewhat complementary facets of its developments. One common feature is the way CERN makes use of its status as a long-established, high-profile international research institution. Today CERN is one of the central nodes in a world-wide network of research organizations - institutions, agencies and industrial companies - that share and exchange knowledge, tools and people. With its merits in accelerators science CERN has made major contributions to this network and, at the same time, benefitted extensively from the work of participating institutions.

How could the OECD-GSF report be beneficial to the developments of future infrastructure?

The risks embedded in going beyond the current state of the art, due to the need to create new, original technological solutions and to generate innovation, can be managed or mitigated in different ways. In the case of the LHC dipoles – “core business” of the laboratory – it was important for CERN to maintain a full scientific and managerial coordination of the whole project, preserving locally almost all the added value resulting from the development of the project In the case of hadron therapy facilities – “knowledge transfer” of the laboratory – the system was self-regulated to solving fundamental conceptual and design problems, without mangling with the considerable ancillary studies, engineering and certification efforts required to create a medical facility. Using a form of “subsidiarity” that is now a familiar concept in European science and innovation policy, this has been left to the nationally-funded institutions.
In both cases, issues of intellectual property arose as well, and people will find in the report hints on how this was addressed in the different situations.

* INFN Delegate to European Institutions

** The Global Science Forum (GSF - http://www.oecd.org/sti/sci-tech/oecdglobalscienceforum.htm) is a venue for consultations among science policy officials of the Organisation for Economic Co-operation and Development (OECD) countries, on matters relating to scientific research. Its goal is to produce findings and recommendations for actions by governments, international organizations, and the scientific community. OECD-GSF recently published a report on "The Impacts of Large Research Infrastructures on Economic Innovation and on Society: Case studies at CERN" (http://www.oecd.org/sti/sci-tech/CERN-case-studies.pdf). The former Italian member Sandro Bettini also contributed to the first draft of the report.

» FOCUS ON

ELI-NP, THE SUPER LASER OF THE FUTURE

ELI-NP (*Extreme Light Infrastructure-Nuclear Physics*) is a new international physics laboratory to be built in Magurele, in Romania. The heart of the project will be a gamma-ray beam (high and ultra-high-energy photons) housed at the IFIN-HH (*Horia Hulubei National Institute of Physics and Nuclear Engineering*) research centre.

ELI-NP, which will study ultra-high-intensity laser-matter interaction, will be one of the three pillars of the ELI project to construct the most advanced laser system in the world, along with the facilities to study secondary sources (in Dolni Brezany, Czech Republic) and attosecond pulses (in Szeged, Hungary).

The ELI-NP laboratory is a very complex facility that will house two extremely high-power machines: a gamma-ray source, based on a high-energy electron linear accelerator and a high-power laser. The unique characteristics of the gamma beam will provide the international scientific community with new opportunities to study high-resolution and high-energy nuclear spectroscopy. ELI-NP will be especially helpful for understanding the mechanisms of stellar nucleosynthesis and the origin of heavy elements in nature. The technology developed here could be used in nuclear waste storage management and to develop new methods for producing isotopes for medical use.

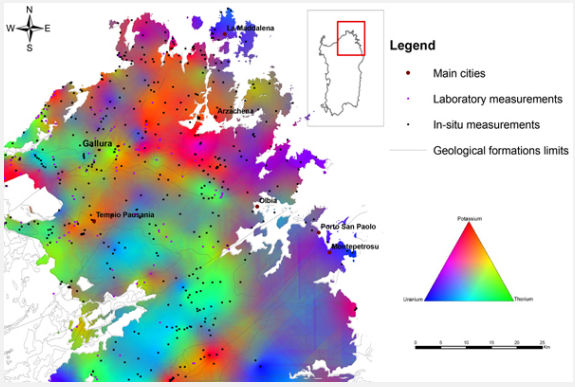
Funded by the Romanian government, with a contribution of 66.8 million euro by the EU, the total cost of the ELI-NP facility will be 300 million euro.

The facility will be constructed by the international consortium EuroGammaS, led by the Italian Institute for Nuclear Physics (INFN), with the collaboration of Sapienza University in Rome, the French National Centre for Scientific Research (CNRS), the UK Science and Technology Facilities Council (STFC) as well as numerous Italian and European organisations.

http://www.eli-beams.eu/

http://www.eli-np.ro/

» TECHNOLOGY TRANSFER



ITALRAD, A MAP OF THE NATURAL RADIOACTIVITY IN ITALY

The map of natural radioactivity in the Italian regions of Veneto and Tuscany has been completed, under the ITALRAD (ITALian RADioactivity) project. With the monitoring of Sardinia, recently started, this is the first step of the project, which aims to produce a complete map of natural radioactivity in Italy. The map shows the terrestrial radioactivity levels, which were measured as part of an advanced international study in the field of nuclear geophysics. The information will be useful for defining residential construction standards in order to mitigate radon levels in underground rooms and basements: a legacy for the benefit of future generations, who will be able to compare the effects of contamination of anthropic and natural origin.

The development of “technologies for monitoring and protecting the environment” ranks among the key strategic objectives of the National Research Plan for 2011-2013 and it is in accord with the European Horizon 2020 research programmes, especially with reference to the “secure societies” challenge and adoption of a multidisciplinary approach to scientific collaboration.

Measurements have been underway since 2010, under the supervision of a team of researchers from the Legnaro National Laboratory of the Italian Institute for Nuclear Physics (INFN), with the collaboration of the Universities of Ferrara and Siena. Scientists have been studying the presence of naturally occurring radionuclides in the rocks and soil, performing laboratory tests and obtaining more than 20,000 aerial images.

The project is an example of how it is possible to combine innovation with high quality standards and the transfer of knowledge to industries and business enterprises, with a view to fostering the scientific growth and involvement of talented young researchers. About half of the project’s budget has been spent on post-doctoral research grants and used to train young researchers in the field of nuclear geophysics and its environmental applications. The project includes the development of innovative prototypes for measuring gamma radiation installed on aircraft. This has attracted a university start-up grant and will result in the transfer of technology to the business of large-scale production of new environmental monitoring equipments.

Italian National Institute for Nuclear Physics

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