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Italian National Institute for Nuclear Physics

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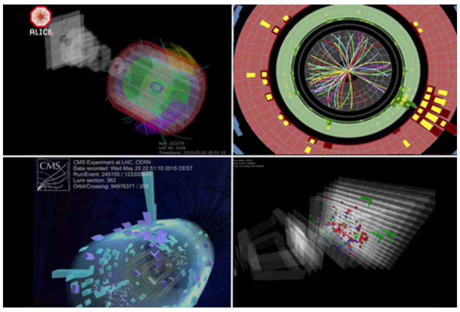
NEWS



RESEARCH
LHC PREPARES FOR PHYSICS: FIRST COLLISIONS AT 13 TeV

For the first time, at CERN in Geneva, in the LHC, the largest accelerator in the world, collisions at 13 trillion electron volts, 13 TeV, an energy never before achieved in the laboratory, have been produced. The new collisions represent a fundamental step towards the new phase of activity of the machine, the so-called RUN2 of LHC, now very close at hand. According to the scientists who work on the LHC and on its experiments, among which about 1400 are Italian, half coordinated by INFN, these collisions have the purpose of preparing the machine: for example, they allow the stability of the beams, which are more focused than in the past, and the protection systems of the probes themselves to be verified. “The first tests with 6.5 TeV beams have gone very well", said enthusiastically Anna Di Ciaccio, national coordinator of ATLAS, one of the four major LHC experiments. In a matter of days, when stable data collection will begin with the 6.5 TeV beams, a new and certainly fascinating chapter will open in the history of particle physics", pointed out Di Ciaccio. ■

LABORATORIES
AT LNL A NEW CYCLOTRON FOR NUCLEAR MEDICINE AND PHYSICS

Installation of the new particle accelerator, a P70 cyclotron, in the INFN national Laboratories in Legnaro has just been completed. The exotic nuclei that will be produced by the accelerator will be used to create radiopharmaceuticals for use in medicine and, at the same time, their study will allow us to investigate the processes that lead to the formation of heavy nuclei, such as those that are synthesized in the explosion of supernovae, thus expanding the knowledge of our universe. “The cyclotron at the Laboratories in Legnaro – explains Giovanni Fiorentini, Laboratory Director - is a machine in which every second ten million billion protons are accelerated up to seventy million volts, and constitutes the first part of SPES, a project that will be used to treat people and study the universe", concludes Fiorentini. The accelerator was built by the Canadian company BEST, in close collaboration with INFN, and the same company has also expressed interest in the marketing radioisotopes produced at the Laboratories in Legnaro. The new machine, in fact, will allow radioisotopes, such as Strontium 82, of exceptional interest for nuclear medicine and available only in a few centres worldwide, to be produced in quantity. This production will also open the way to research on innovative radiopharmaceuticals, in collaboration with the most important national and international centres. ■

INTERNATIONAL COLLABORATION
THE ITALIAN EXPERIMENT ICARUS WILL MOVE TO THE UNITED STATES

A transoceanic trip is planned for the Italian experiment ICARUS in 2017. Under the leadership of Nobel laureate Carlo Rubbia, from 2010 to 2014 ICARUS has been operating in the underground Laboratories of the Gran Sasso, where it has studied the artificial neutrino beam coming from CERN. Now, the largest liquid Argon detector in the world, 760 tonnes in weight and 20 metres long, after a period at CERN for maintenance and testing, will be transported to the Fermilab in Chicago. There, the detector will be integrated in a complex of three experiments, dedicated to the study of neutrinos. All three detectors will be filled with liquid Argon: this will allow a very sophisticated technology to be used to capture, through layers of super-thin wires, three-dimensional images of the traces left by the charged particles, produced by the interaction of neutrinos. “The liquid *Argon time projection chamber* is a very promising new technology that we originally developed with the collaboration of ICARUS– explains Carlo Rubbia – and we expect it to become the leading technology in large liquid Argon detectors due to its ability to record ionizing traces with pinpoint precision", concludes Rubbia. "The technique used by ICARUS to identify neutrinos produced artificially in an accelerator was developed by INFN, - underlines Antonio Masiero, Vice President of INFN - and we are proud that it can now make its substantial contribution to the American research on neutrinos, in the new experimental facility of the Fermilab".■

COMPUTING
ONE MILLION BILLION OPERATIONS PER SECOND FOR RESEARCH

After a brief period of testing and acceptance, Galileo, the new supercomputer installed at CINECA in Bologna, went into full operation. The investment is the result of a joint development between INFN and the University of Milan Bicocca. Galileo, which joins Fermi, the most powerful supercomputer for academic research in Italy, is dedicated to scientific and engineering computing and is available to the scientists of Italian research institutes and universities. Thanks to this new system, it will be possible to solve problems of interest to the most topical research, and also refine calculation strategies and programs that can then be supported at an international level in order to have access to the most powerful European supercomputing centres, such as PRACE, the infrastructure financed by the European Commission. “Galileo will provide a significant contribution to INFN research in computational theoretical physics, – explains Raffaele Tripiccione, coordinator of INFN activities in this area - providing adequate calculation tools to support the ambitious scientific programs in place in key areas of the physics of fundamental interactions and the physics of complex systems.”■

» INTERVIEW

THE L'ORÉAL-UNESCO PRIZE AWARDED TO THE USE OF PARTICLES IN MEDICINE

Interview with Nicoletta Protti, post doc researcher at the INFN division in Pavia, selected among the five winners of the XIII edition of the "L'Oréal Italia for Women and Science" award

The award is part of the international L'Oréal-UNESCO "For Women in Science" project, dedicated to the promotion of scientific vocations in women. In the Italian edition, every year the award selects five researchers under 35 years of age and their projects, selected from hundreds of submissions.
Nicoletta Protti's project, "Preliminary feasibility studies of X-ray treatment for Alzheimer's disease based on neutron bombardment of neurotoxic amyloid aggregates", falls within the scope of a broader programme of verification of innovative therapies for Alzheimer's disease and is part of the activities that INFN has been supporting for some time now in the biomedical field.

How did your passion for the application of physics to medical therapy arise?

It is largely due to chance and was initially love at first sight. In my second year of the degree course in physics, I had the opportunity to attend a lecture on hadrontherapy - the medical therapy that uses proton and ion beams - organised in Mortara, the town where I was born, by CNAO, the National Center for Oncology Hadrontherapy in Pavia. It was a lecture for general practitioners to which my mother had been invited. I merely accompanied her. A fortuitous encounter, therefore, and very enlightening. I was going through a phase in my studies that forced me to concentrate mainly on the fundamentals of physics, quite abstract issues and, at least at first sight, far from everyday life. The discovery of this concrete application of particle physics to a field of great usefulness for people was a true revelation. Also the second step took place a little by chance, when I met Saverio Altieri, the professor at Pavia dealing with BNCT (Boron Neutron Capture Therapy), a valuable application of particles to medical therapy: I graduated and I obtained my PhD with his group and was then able to continue with experiences also abroad.

INTERVIEW

What is the main objective of this innovative research?

It is believed that Alzheimer's is associated with the presence in the brain of the patient of an accumulation of extracellular plaques, composed mainly of a toxic protein, the amyloid beta peptide, which in healthy subjects has the function of promoting cell growth. Today, unfortunately, there are no effective therapies to arrest the course of the disease, although some strategies have been proposed to limit its progression, slowing the process of formation or, when possible, disintegrating the amyloid beta-aggregates in the brain. The research has precisely the objective of evaluating the effectiveness of a radiation therapy technique for Alzheimer's disease, based on irradiation of the amyloid beta plaques with high ionization density radiation. In my research, this radiation is alpha particles and lithium ions produced by neutron capture reactions (a particular nuclear reaction), which is induced by bombarding some specific chemical elements, in particular isotope 10 of boron and isotope 157 of gadolinium, with neutron beams. From the physical point of view and that of their action on biological tissues, the particles produced in this manner share many of the properties of radiation normally used in hadron therapy. To produce them, I use a low-energy source of neutrons made available to me by the University of Pavia at the LENA, Laboratory of Applied Nuclear Energy, research reactor of the University, with which INFN has for many years had an intense and fruitful cooperation in various fields.

In your opinion, which element in particular convinced the jury of the award to put your project in the list of the five winners, selecting it from hundreds of submissions?

Honestly, I think the key to winning was madness. And not only mine, but also that of the Mario Negri Institute in Milan which bravely believed in the idea of this research, which is quite daring. Of course when one speaks of research, even madness is based on concrete results. In particular, the literature provides several clinical cases of tracheobronchial amyloidosis (TBA) that have been effectively treated with conventional radiation therapy, in order to reduce or even reverse the accumulation of amyloid protein aggregates in patients' lungs. The chemical structure of the proteins involved in the TBA is very similar to that of the senile plaques of amyloid beta found in Alzheimer's patients.
Then, my personal courage is due to the support I have always received from my family and friends, among the latter, my colleagues at work with whom I have always been able to freely discuss, who have supported and believed in me.
Now I am very determined, but I will nevertheless approach the research with great caution. I know that from 2015 these studies can begin and I hope they will soon provide positive results. Even if today I cannot be certain of the outcome, the mere idea of having the opportunity to conduct research that, if successful, will provide a significant contribution to the treatment of Alzheimer's is in itself challenging and a great motivator.

INTERVIEW

What would you recommend to a young person about to embark on a research career?

Never give up. In addition to luck you need passion, but also this, without the necessary determination, is not sufficient. Even if I am at the beginning of my career, like everyone I have come up against a number of obstacles. Among them, there are extenuating waiting periods without immediate feedback, during which one often does not know in which direction one is heading. This is the moment where you have to be strongest and not give up. Research is also made of this: many days when it's like getting blood out of a stone. You must not give up.

The “L’Oréal Italia for Women and Science” project aims to support the scientific careers of women. Do you think that being a woman can affect your career? How do you see yourself in 10 years from now?

I cannot say to have encountered difficulties due to the fact of being a woman and I do not expect, honestly, to encounter any in the future. I do not believe that this aspect in particular can be more of an influence than others. My ambition is to pursue a passion for research together with my private life and, up to now, I am satisfied on both counts. Then, in ten years’ time, I would be happy to still be here doing research and being of help to others, with the same enthusiasm.

FOCUS ON

SCF_LAB: A FACILITY FOR SATELLITE TECHNOLOGY AND GENERAL RELATIVITY

The National Laboratories in Frascati (LNF) of INFN look at space, thanks to the *Satellite Characterization laser ranging Facilities Laboratory* (SCF_Lab), a unique laboratory of its kind in the world, created to do fundamental physics in space and precision satellite laser ranging. Implemented in a clean room of approx. 85m^2, it is dedicated to the design, characterisation and experimental modelling of the space segment of laser ranging, i.e. measurement, via laser pulses, of the position in which a particular type of retro-reflectors, the Cube Corner Laser Retroreflectors (CCR), are situated. Thanks to laser ranging, one of the most accurate measurement techniques currently available, it is possible to perform important studies on the properties of gravitational interaction and achieve precision measurements on the general relativity by Albert Einstein. Gravity measurements, in fact, are generally few and difficult to perform.

To improve this type of measurement, the SCF_Lab is planning to create a network of new generation laser retro-reflectors on the moon, also thanks to a scientific agreement recently signed between the laboratories in Frascati, the company Moon Express and the American University of Maryland. Through the reflectors already existing on our satellite since the first landing of man in 1969 with the American Apollo mission (lander 11, 14 and 15), and the Russian robotic missions (Lunokhod rover 1 and 2), and, overall, the 4 new MoonLIGHT reflectors - the first of which will be launched with a mission scheduled for the end of 2017 - it is in fact possible to make precision measurements on the principle of equivalence, to demonstrate, with higher precision, that bodies of different mass quality fall with the same acceleration. Similarly to what was done by the crew of Apollo 15 with the feather and hammer experiment. Another possibility is to create a similar experiment with the Earth and Moon, imagining them as two huge hammers (similar in mass quality but different as to quantity of mass) falling in the gravitational field of the Sun. Or even precision measurements of the precession of the lunar orbit and of the gravitational constant G, to assess whether it really is a constant, or subject to minor variations.

FOCUS ON

But the SCF_Lab in Frascati also has industrial applications in satellite technology. The reflectors are, in fact, essential for the precision positioning of satellites, from those for navigators to those for Earth observation. CCR's can be found, for example, on artificial satellites such as those for GPS and Galileo systems, indispensable not only for obtaining directions, but also for establishing the precise moment in which a financial transaction takes place. Finally, this is a technology that improves the precision mapping of celestial bodies. For example of the Moon, inside which the unexpected presence of a partially liquid core was thus discovered, or Mars. Or of the Earth as a whole, in order to evaluate, for example through the extension of polar glaciers or the level of the oceans, the effects of climate change. ■

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