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NEW PROJECTS

SEARCHING FOR DARK MATTER IN AN AUSTRALIAN GOLD MINE

Stawell, a gold mine just under 300 kilometres from Melbourne, could become the first underground laboratory in the Southern hemisphere. Its purpose would be to search for dark matter, a project already underway at the Gran Sasso National Laboratories (LNGS-INFN), and to replicate the DAMA/LIBRA

experiment which has running at the LNGS since 2008. A delegation of Italian scientists, including Antonio Masiero, Vice President of the INFN, and Stefano Ragazzi, Director of the LNGS, has already visited the site and met local representatives to discuss this possibility. DAMA/LIBRA looks for seasonal modulation in dark matter due to the rotation of the Earth around the Sun, and should therefore detect a corresponding modulation at a site where the seasons are inverted. Having a new research infrastructure in the Southern hemisphere would therefore be an opportunity to verify the findings of the DAMA/LIBRA experiment so far. The new laboratory might also house scientific experiments from different fields, involving astrophysics, neutrino detection, biology, geosciences and engineering.



SCIENCE

GRAN SASSO LABORATORIES SET NEW RECORD FOR COLD TEMPERATURES

The CUORE (Cryogenic Underground Observatory for Rare Events) experiment at the INFN Gran Sasso National Laboratories has set a world record by cooling a copper vessel with a volume of one cubic metre to a temperature of 6 millikelvins: this is the

first experiment ever to cool a mass and a volume of this size to a temperature this close to absolute zero. CUORE, built to study the properties of neutrinos, involves an important collaboration between the INFN and the Milano Bicocca University for the design of the cryogenic system to cool the detectors. "This is an important example of record-breaking performance by Italian scientists in the field of ultra-cold technology and was made possible thanks to the integrated and collaborative effort of researchers, universities and enterprises", commented Carlo Bucci, researcher at the INFN and Italian coordinator of CUORE. The experiment is seeking to detect a rare process called neutrinoless double-beta decay: detection of this process would allow researchers to measure the mass of neutrinos, but also to determine whether or not they are Majorana particles, thus offering a possible explanation for the matter-antimatter asymmetry that characterises our Universe.



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SCIENCE

LATEST AMS-02 RESULTS REACH UNPRECEDENTED ENERGIES

The latest results of the large antimatter detector AMS-02 (Alpha Magnetic Spectrometer) have been published in Physical Review Letters. The INFN and the Italian Space Agency (ASI) are taking part in the experiment that has been

orbiting the Earth aboard the International Space Station since May 2011. Of the 41 billion cosmic ray events analysed in the first 30 months of the mission, 10 million have been identified as electrons and positrons. Recent studies have measured the positron flux up to 500 GeV and the electron flux up to 700 GeV: energy levels never reached before in these cosmic rays. "This result represents an important step forward in the study of a phenomenon (excess of positrons) first detected by the PAMELA space experiment and which is currently being measured by AMS-02 with unprecedented precision and covering a wider range of energies than ever before", remarked Fernando Ferroni, President of the INFN. "The partnership between the INFN, ASI and Italian industry in this experiment has achieved an important milestone, providing significant new insights into the nature of a mysterious phenomenon and opening the way to new discoveries".



ITALY THE INFN NATIONAL LABORATORIES ON GOOGLE STREET VIEW

You can now visit the Frascati, Gran Sasso, Legnaro and Southern National Laboratories using the Street View option in Google Maps. These are the first Italian research centres to be photographed and "mapped" by Google: further recognition

of the INFN's research facilities as centres of scientific excellence just months after the issue of four postage stamps dedicated to the Labs. Using the Street View service, you can go on a virtual tour of the rooms at the laboratories and get a 360-degree view of particle accelerators and experiments looking for dark matter and the elusive neutrinos. The four virtual tours were created by taking some 1,300 panoramic pictures in six sessions during which researchers at the INFN worked in collaboration with staff from Google.



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>> INTERVIEW



THE ROLE OF EVALUATION IN A PERIOD OF CHANGE

Interview with Persis Drell, CVI outgoing president

The INFN is aware of the importance of unbiased evaluation in order to continue as a centre of excellence and maintain a competitive edge. For this reason, ever since 1997 its research activities have been subject to evaluation by an International Evaluation Committee (Comitato di Valutazione Internazionale – CVI) made up of seven experts from different countries in the fields of economics, industry and research. Each year the CVI produces a report on the INFN's research activities, along with its proposals for ways of improving overall performance. This report is sent to the Italian Ministry of Education, Universities and Research together with the three-year plan. The last meeting of the CVI with the INFN's management was held on 20-22 October at the INFN Southern National Laboratory. It was also the last meeting to be chaired by Persis Drell, an accomplished scientist of international acclaim who has held several leading positions and whose four-year term as Chair of the CVI has come to an end. Persis Drell joined the Physics Department at Cornell University in 1998. In 2000 she became head of the Cornell high-energy group; in 2001 she was named Deputy Director of the Laboratory of Nuclear Studies. In 2002, she accepted a position as Professor and Director of Research at SLAC National Accelerator Laboratory, in the United States. In 2007 she was named Director at SLAC. She is a member of the American Physical Society, the American Academy of Arts and Sciences and was elected in 2010 to the National Academy of Sciences. Her current research activities are in particle astrophysics.

At the end of the recent meeting of the CVI, we asked Persis Drell to speak about her experience and give us her views on the evaluation of scientific research.

You have been Chair of the INFN's International Evaluation Committee for the last four years. What has this experience been like for you?

I've thoroughly enjoyed it! First because I've learnt a lot. The INFN is heading towards some significant changes and its future is going to be very different from its past. We've seen



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similar transitions in the United States and in situations like this you always learn from one another, sharing and exchanging experiences can be a useful tool when crucial decisions have to be made. Apart from this, having the opportunity to appreciate good science and advanced technology at the laboratories we visit is always a pleasure, and this has been the case for me over these past four years during which I've become familiar with the INFN's research infrastructures and scientific projects. Lastly, on a personal note, this experience has also given me the opportunity to make a lot of valuable friendships.

What are the main criteria applied by the Committee you chaired in evaluating the INFN's research activities? Based on your experience, have you any suggestions on how to enhance the impact of evaluations?

On the one hand, one of our main objectives is to check for results worthy of note, that can set new standards of excellence in international science. On the other, we expect the organisation being evaluated to define a clear and realistic long-term strategy for the future: the directions of its scientific activities. How its laboratories are being developed and equipped to serve the national and international scientific community in the coming decades. How they will use their technology to benefit society, in order to justify investments of public resources, which are often substantial. Without overlooking another fundamental aspect: the need for a strong leadership team so that our evaluations can be used in the most effective way possible.

What is the role of evaluation within the context of a European Research Area.

The field of research is highly competitive in Europe. The difficulties facing Europe are also affecting research policies, because scientific research is a common and shared asset. The INFN as well needs to understand the criteria being used and then compete and win on the basis of these rules. This culture of science is very different from the one we were used to even just ten years ago. Now we must all learn how to adjust to the changes and these new circumstances. Today we are faced with this difficult but exciting challenge of achieving the delicate balance between international collaboration and competition, an issue for all those involved in high-level scientific research. I wish the INFN every success in this venture!



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» FOCUS ON



AN INTERNATIONAL INFRASTRUCTURE FOR GRAVITATIONAL WAVES

There is one phenomenon predicted by Albert Einstein in his theory of General Relativity that has not yet been directly detected: gravitational waves. Ripples in space-time that propagate at the speed of light, created by the acceleration of masses. Astrophysical sources such as explosions of stars, the collapse of galaxies and black holes cause vibrations in what is metaphorically described as the "fabric" of space-time, on which stars, planets and galaxies rest. These waves are infinitesimal and to detect them scientists have had to build large detectors: laser interferometers, like VIRGO, which is located in the countryside at Cascina, near Pisa in Italy. VIRGO is the result of a Franco-Italian partnership between the INFN and the CNRS (Centre National de la Recherche Scientifique), operated by the EGO (European Gravitational Observatory) consortium. The huge research infrastructure has been in use since 2003 and since 2007 has been part of an international collaboration involving the US LIGO observatories and the German Geo600 project. The aim is to make the activities and results of each of the research centres more effective and expeditious. By obtaining data from different detectors, scientists can identify and reject any spurious signals. And if a gravitational wave is detected, it will be possible to locate its source based on the different times of its arrival at the various devices.

A coordinated scheme to enhance the sensitivity of the interferometers is now in the final stages. This will enable gravitational waves to be detected on a regular basis in the coming years, thus paving the way for a new kind of astronomy: gravitational astronomy. VIRGO embodies cutting-edge technology capable of achieving hitherto unimaginable levels of precision. It consists of a detector with two perpendicular arms each three kilometres long, through which two laser beams travel in a vacuum environment inside large pipes. The initial laser beam is split into two rays by a beam splitter mirror. These are then reflected back and forth several hundred times by special mirrors so as to increase their path, before being recomposed. The resulting interference pattern is created by overlapping the beams. If a gravitational wave passes through the interferometer, the length of the arms changes and



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the interference pattern is altered.

VIRGO is capable of measuring changes in the length of the arms that are a billion times smaller than the diameter of an atom. VIRGO's mirrors meet extremely high quality standards. Their surfaces are so smooth that any flaws are less than one billionth of a metre in size and less than one millionth of the incident light is dispersed. A system of superattenuators has been built to prevent any vibrations due to seismic noise: huge shock absorbers that support the mirrors by means of pendulum structures. And to avoid any background noise caused by the refraction of air, the laser beam travels inside ultra-high vacuum pipes, where the pressure is one thousandth of a billionth of an atmosphere. These devices have been implemented in close collaboration with scientists from the INFN and CNRS and industries, including many small Italian companies that have accepted the challenge and chosen to invest in the scientific and technological venture of building this important research infrastructure.



>> TECHNOLOGY TRANSFER



ITALY AT CERN, A SHOWCASE FOR ITALIAN ENTERPRISES

For companies that collaborate with scientific research, investments in the design and development of frontier technology frequently continue beyond the order, opening up the way for new areas of specialisation and new markets, even abroad. Some thirty Italian business enterprises took part in the fifth edition of "Italy at CERN" on 7-10 October, organised by the Industrial Liaison Officer (ILO) at CERN and the Permanent Representation of Italy to the International Organisations in Geneva, in partnership with the Italian Chamber of Commerce in Switzerland. The three-yearly event is an opportunity for Italian companies to meet the purchasing departments of CERN, a sort of showcase aimed at fostering contacts with potential buyers. The LHC project offered excellent openings for Italian industries and supplying CERN offers opportunities for growth: of the numerous companies that produced ultra-high-tech products, many are small and medium-sized enterprises that have chosen to invest in innovative projects and the development of cutting-edge technology. Italy was second only to France in terms of supplies to CERN for the LHC project. In detail, of the 20 countries that took part, Italy (in 2006) ranked second in the civil engineering sector (23.9% of the total), second for electrical engineering (29.3%), second for mechanical parts (18.9%), third for vacuum and low-temperature technology (cryogenics) (12.7%), second overall (18.6%) preceded only by France (34.2%) and followed by Germany (15.6%). During the years of peak activity to construct the machine and the experiments, the economic return for Italy, in terms of orders for Italian industries, exceeded the investments made. This was calculated using the so-called "return coefficient" which is the ratio between a country's percentage share of the total value of all contracts awarded and its total percentage contributions. Italy, also with the INFN, now plans to take part in the project to construct the large European Spallation Source (ESS) research infrastructure: this represents a new opening for Italian enterprises, since the countries taking part will sign agreements for contributions in kind, i.e. in the form of supplies of machine parts, manufactured by national industries. The Italian ILO offers support and advisory services to companies and will also follow the ESS project. Information will be made available on the www.pd.infn.it/ilo website.



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