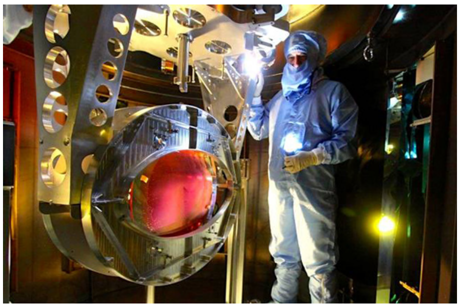
NEWSLETTER 07

Italian National Institute for Nuclear Physics

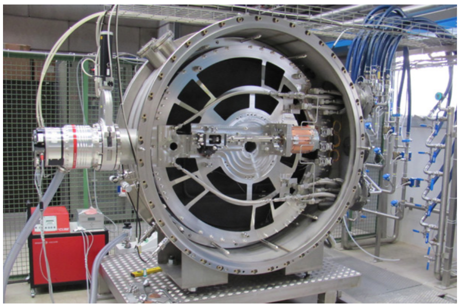
JANUARY 2015

NEWS



RESEARCH
FIRST MIRROR FOR VIRGO

A new milestone has been achieved by Advanced Virgo, the experiment for the study of gravitational waves of the Italian-French consortium Ego, in the countryside near Pisa. The first mirror has, in fact, been successfully installed: the beam splitter, which has the task of dividing the laser beam that runs inside of the arms of the interferometer. The mirror, with its suspension and control system, has been placed on the super-attenuator, the seismic isolation system of the device. The Advanced Virgo beam splitter, with its 55 cm diameter, is the largest mirror ever made in the world for a gravitational wave detector. The INFN Virgo groups were the protagonists in this complex integration job. “The installation has entered the most delicate phase, that of integration in situ of the components developed in the various laboratories”, explains Giovanni Losurdo, coordinator of the Advanced Virgo project. “We have just obtained a major success in the construction of the detector that will be completed by next year, becoming part of the network of second generation detectors, and which will thus begin acquiring data, along with Ligo, the pair of American detectors”, concludes Losurdo. ■



APPLICATIONS
FROM VENETO TO NORMANDY: THE CORE OF SPIRAL2 DELIVERED

The main component of the Spiral2 project was entirely conceived and designed in the INFN Laboratories in Legnaro: a neutron converter for the production of radioisotopes which will be installed in the accelerator complex of the French laboratory of Ganil, in Normandy. The device required the development of the highest nuclear technology skills and will be used for the production of radioisotopes to be widely used in research in nuclear physics, both basic and applied, medicine, biology, solid state physics and industrial applications. “Spiral2 is an example of how the INFN laboratories play a leading role in international projects”, remarked Luigi Tecchio, who coordinated the entire project. “But it is also an example of the transfer of technology with high added value to small and medium-sized industries in Italy”.The project, supported by the European Union through the collaboration with 25 European research institutes, including INFN, is part of a cooperation between Italy and France for research in nuclear physics: the Legnaro National Laboratories have designed and built the neutron converter, while in France they are implementing the charge breeder, which will be installed in Legnaro within the scope of the INFN SPES project. ■

COMPUTING
A CLOUD FOR EUROPEAN RESEARCH

The INDIGO-DataCloud project, has been approved by the European Commission within the scope of Horizon 2020 and will be financed with 11 million euros in 30 months. The project, coordinated by the Italian Institute for Nuclear Physics (INFN), will bring together 22 institutions and major companies from 11 different European countries, with the objective of developing a new CLOUD software platform for scientific research. Davide Salomoni of INFN-CNAF in Bologna and Principal Investigator of INDIGO, says: “With this project our efforts will focus on building a software platform which will be completely free of charge and open source, able to operate on both public as well as private network infrastructures. We will thus be able to respond at the same time to the calculation, processing or data storage needs of researchers in a wide spectrum of disciplines, without having to rewrite the software from scratch each time.” This will build on the experience acquired during the development of the European Grid Infrastructure (EGI), which interconnects hundreds of computing centres across Europe via grid computing technologies and which was created to store, distribute and analyse, among others, the hundreds of millions of gigabytes of scientific data produced by the Large Hadron Collider (LHC) at CERN.

» INTERVIEW

GLOBAL RESEARCH INFRASTRUCTURES (GSO)

interview with Giorgio Rossi, present Chairman of GSO and Deputy Chairman of ESFRI

On 15 December last, INFN hosted the 5th meeting of the GSO (Group of Senior Officials), composed of ministerial representatives for Global Research Infrastructures (GRI) of the G8 member countries and of Australia, Brazil, Canada, China and Mexico.
The meeting provided an opportunity to explore the issue of research infrastructures with Giorgio Rossi, representative of Italy in the GSO - of which he is the rotating Chairman - and Deputy Chairman of ESFRI (European Strategy Forum on Research Infrastructures), the European institution founded in 2002 to support coherent development policies of European research infrastructures.

Research infrastructures constitute one of the strategic priorities for implementation of the European Research Area. Why? What do they represent and what is their value?

Research infrastructures (RI) provide the opportunity for the most talented researchers to access use of the most powerful and advanced scientific instruments for their research, based solely on the viability of their proposal. RI thus represent the backbone of the European Research Area because they make excellence available, provide the conditions for mobility and facilitate the development of interdisciplinary skills. The value in terms of scientific return from the investment in RI is very high because they are intensively used by the best researchers on cutting edge scientific topics, including the “big challenges” (climate, health, ageing, energy, etc.). The investment in RI with competitive open access has a high strategic value. Currently, RI costs represent 3% of the annual Gross Expenditure on Research and Development (GERD) of European countries.

INTERVIEW

Which are the main challenges facing Europe and what do you therefore consider to be strategically important?

Europe's challenges related to the "knowledge society" are those of an increase in investment in new knowledge and its dissemination. The Lisbon objectives for 2010 (3% of GDP of investment in research, 8 researchers per thousand workers, mobility between research, industry and services) were and are correct, but the delay is significant and the crisis on the one hand makes these objectives more urgent and on the other penalises investment. RI are a key element, which also requires substantial and continuous investments since the skills are not acquired once and for all, but must be renewed with the new generation of scientists and technologists, otherwise they can be lost for ever.

Which are the projects that ESFRI indicates as priorities in its roadmap and which criteria have been followed to identify them?

ESFRI has the mandate to identify the RI necessary for European competitiveness, in all research fields, from social sciences and cultural heritage to the environment, from bio-medicine to energy, from the analysis of matter to physics. The ESFRI roadmap includes 48 projects and it has been necessary to define a number of priorities that are reflected in the Horizon 2020 figure for implementation of 60% of the roadmap by 2015. Today ESFRI is working on a new roadmap which will be released in 2016 and that will be substantially more agile than its predecessor. It will include 25 projects selected as well on the base of their scientific interest, also according to the "maturity" of the proposal in terms of governance, sustainability, financial plan for the construction and operation phase and, finally, the criteria of "pan-European added value". Projects will remain in the roadmap for a maximum of 10 years. If they successfully reach implementation they will be described in the *landscape* of infrastructures of pan-European importance, together with other RI (national or international) that provide access for European researchers. There are (and there must be!) indeed many excellent and entirely necessary RI projects which, however, do not have their most appropriate or most efficient implementation in the European "format". The most important ones will be identified in the *landscape* of the ESFRI 2016 roadmap.

» INTERVIEW

The ESFRI roadmap represents a point of reference and a tool for the scientific community and for the policy makers of the Member States of the European Union. Which are the actions that the governments of European countries in general, and of Italy in particular, should take at a national level?

ESFRI has developed a method and indicated projects with a broad impact for the construction of the European Research Area. European countries should consider, in a concerted manner, that investment in RI is an opportunity for a recovery plan to exit from the crisis, and a formidable tool to train and strengthen a generation of young researchers and developers of innovative technical solutions, that translate into competitiveness for Europe and rooting of scientific culture in the economy.
The industry based on physics counts for more than 15% of the European economy and is second only to manufacturing, exceeding the construction industry. This suggests that it is necessary to feed the base with new knowledge and the chain of young scientists and engineers who, due to their skills and number, are able to exploit them, develop them and translate them into innovative products, services and methods.

Which were the main issues discussed and the most significant conclusions emerging from the last GSO meeting?

The discussion focused on practical initiatives. Based on the definitions of Global Research Infrastructure (GRI), i.e. a single infrastructure at the global level with competitive access for all scientists worldwide, a list of approx. sixty proposals was put together and their potential illustrated. In the next few months, the GSO will identify those GRI proposals with the broadest interest and willingness of countries to immediately proceed in exploring ways to implement them. We are therefore moving from the general definition of GRI to the feasibility study of a number of specific cases. Italy has made four proposals in different areas (environment, biology, cultural heritage and physics). Among them is the proposal for internationalisation of the Gran Sasso National Laboratories, a visit of which was offered to the GSO during the second day of the meeting, together with the analysis of the possible initiatives for a GRI of the underground laboratories.

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» SPOTLIGHT

GROUNDBREAKING FOR THE JIANGMEN UNDERGROUND NEUTRINO OBSERVATORY (JUNO) IN CHINA.

On 10 January in Jiangmen, a city in the province of Guangdong, China, the excavation works began for the construction of the *Jiangmen Underground Neutrino Observatory* (JUNO): a gigantic international experiment for the study of neutrinos. JUNO, together with HYPER-KAMIOKANDE in Japan and ELBNF in the USA, will be one of the three big neutrino detectors to be built in the coming years. In particular, JUNO will be an underground liquid scintillator neutrino detector and will exploit a technology similar to that used at the INFN National Laboratories of Gran Sasso for the Borexino experiment. According to the plan, the experiment will start to acquire data in 2020 and should remain in operation for 20 years.

JUNO will investigate a crucial parameter of neutrino physics: the way in which nature has ordered the masses. We know that neutrinos can be of three types called electron, muon and tau and that they can mutate (process called oscillation) and transform themselves from one type to another. The experiment will study neutrinos produced and "sent" by two nuclear complexes situated 52 km away from the detector, comprising a total of 10 reactors.

The international collaboration includes forty-five scientific institutions from eleven countries: in addition to China and Italy, it counts Armenia, Belgium, France, Finland, Germany, Czech Republic, Russia, the United States and Taiwan. Internationality is a key aspect of the JUNO project which involves scientists from all around the world in the construction of the device. Italy, with the National Institute for Nuclear Physics, has a prominent role and INFN physicists are engaged in crucial areas, such as purification of the scintillator, electronics, plastic scintillators, data acquisition, analysis and simulation, study of geo-neutrinos and evaluation of the operation mode of the reactors that generate the neutrinos used in the experiment.

The study of neutrino oscillations is one of the most promising frontiers of contemporary physics. Currently, the T2K experiment in Japan and the NOVA experiment in the US are in the data acquisition phase and from them, in the coming years, some preliminary indication on the neutrinos masses ordering is expected. In addition to JUNO, the ORCA experiment in the Mediterranean Sea and the PINGU experiment at the South Pole, which will

SPOTLIGHT

study the effects of the interaction of neutrinos of atmospheric origin with matter, are in the design phase. Atmospheric neutrinos are also the subject of the INO experiment to be realized in an underground laboratory in India. After JUNO, two giant argon and water detectors will arrive: ELBNF and HYPER-KAMIOKANDE. The first will confirm with very high precision the ordering of the masses that JUNO at that time should have already determined, and will also measure an additional physical parameter called “CP violation phase” on which the Japanese HYPER-KAMIOKANDE will focus. As of today, physicists assume that when all these experiments will have completed their programmes, between 2035 and 2040, the study of neutrino oscillations will be finally completed even in its most complex details. ■

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