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Istituto Nazionale di Fisica Nucleare

INTERVIEW

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Interview with Valentina Mariani: winner of the For Women in Science Award 2020, pag. 2

NEWS

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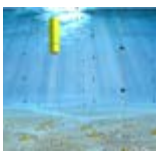


INFN - COMMUNICATIONS OFFICE

» INTERVIEW

L'ORÉAL-UNESCO GRANT GOES TO ACCELERATOR PHYSICS

Interview with Valentina Mariani: winner of the For Women in Science Award 2020

In Italy, women represent almost half of research workers. This piece of data alone would be enough to prove their decisive and essential contribution to the scientific enterprise and production of new knowledge. Despite this, a gap generally persists, especially at higher levels, between the professional careers of female and male researchers. Thus, in recent years, there have been many initiatives and campaigns that, drawing attention to the problem of gender inequality in science, are engaged in highlighting the results obtained by women researchers, on the one hand to inspire new generations of women to undertake scientific careers and, on the other hand, to raise awareness regarding these issues. One of the most famous and enduring initiatives is "For Women in Science", an international award promoted by the L'Oréal foundation in collaboration with UNESCO. Every year, the award offers grants to benefit young scientists who come from STEM (Science, Technology, Engineering, and Mathematics) disciplines and who therefore cover a wide range of research fields with their projects: from those relating to biological sciences, to research in the field of high-energy physics. The women researchers that win in the Italian section are awarded for the quality of their projects and for continuing to undertake their work in Italy. The 2020 national edition of the competition concluded at the end of September with the announcement of the names of six winners. Valentina Mariani, a researcher with the INFN division of Perugia who is part of the CMS experiment's international scientific collaboration at CERN's LHC accelerator, was awarded a prize for her project that looks to the future of the LHC and is dedicated to improving the capacity of detectors for investigating rare phenomena that can provide us with clues regarding the new physics.

What is the "L'Oréal For Women in Science" award?

It is an international initiative that is held at the national level, and which involves awarding prizes in the form of grants for scientific research, which are financed by L'Oréal and UNESCO. In Italy, in the last 18

» INTERVIEW

years, six grants have been awarded to as many scientists. The prize is aimed at young researchers under 35, who are encouraged to pursue their research activity in STEM fields in an Italian research centre or university. Each grant covers a period of ten months, for which 20,000 Euros are allocated, which, thus, allows researchers to keep working in Italy.

What does your winning project focus on?

My project, which was selected by the award committee, is focused on the field of high energy physics and accelerator research. In detail, my proposal concerns CMS, the LHC experiment on which I collaborate, and the Hi-Lumi LHC project (the high-luminosity phase of the CERN accelerator), which involves upgrading the machine to look for new physics. In fact, beginning in 2027, for the following 10 years, LHC will make protons collide with a greater intensity than today, and this will translate into a greater number of collisions and, therefore, into a greater quantity of data to analyse. It's a prospect that will allow us to open a window onto rare phenomena that are currently inaccessible for statistical reasons.

What, specifically, does your proposal entail?

The high-luminosity LHC entails a technological effort in terms of its update. This is very significant for the experiments located along the accelerator. These wouldn't be able to work in their current configuration because they would be "blinded" and they would be damaged quickly by the radiation emitted in the collisions. So, we need to update the experiments and adapt them to high-luminosity data acquisition. My research project is, thus, divided into two parts, which are different but complementary. On the one hand, there is the development and update of a new, main component of the CMS experiment, called "tracer", which will be bigger, more resistant, and it will be moved forward. This latter improvement will enable us to reduce the blind spot of the experiment. On the other hand, there is the design of silicon detectors that can also support an increase in radiation.

What are the scientific objectives of the project?

Thanks to the new capacity that the experiment will acquire in observing regions that, today, are precluded from investigation, we could identify rare phenomena like vector boson scattering, which is the collision between two vector bosons, W and Z. This is an event predicted by the Standard Model that could be particularly sensitive to some new physics phenomena that can interfere indirectly with this process. By measuring the impact cross-section of the collision in an extremely sensitive manner, we could, thus, detect how much it deviates from the Standard Model prediction.

» INTERVIEW

What did you feel after being awarded the prize?

I was very happy to be awarded the prize, also because I wasn't expecting that my research field would be of interest to a foundation like L'Oréal. The awarding of the grant showed me, in contrast, that the competition was actually aimed at truly heterogenous scientific sectors, as the CVs of the members of the Italian committee, charged with evaluating the proposals, also show. It is chaired by Lucia Votano, former research director of INFN and director of the INFN Gran Sasso National Laboratories. On the other hand, the fact that gender initiatives are still necessary shows how the scarce representation of women within research and science is still a problem. It's a lack that is even more evident if you consider more prestigious positions, the managerial roles, which still reflect the gender disparity that has distinguished the recent past. Fortunately, over the last few years, I've noticed that this inequality is slowly flattening out. Today, the number of men and women researchers is already almost equal. The real challenge is trying to keep this number constant, because the great precariousness that characterises all scientists' careers in Italy disincentivizes and penalises women most.

Can you tell us about your education?

I completed my undergraduate degree and Masters in Perugia, where I also stayed for my PhD, during which I spent one year at CERN thanks to a simil-fellow scholarship provided, in the context of an agreement with INFN, to doctoral students and post-docs working on experiments in Geneva. It was a very formative experience because it allowed me to live for one year in contact with the tools on which my research is based and to understand how they function. After this, I got my research fellowship with the university and the INFN Division of Perugia, thanks to which I'm continuing my professional path.

What would you suggest to a young woman who wanted to embark on a journey in the field of high energy physics?

The only thing that I would advise is to not let yourself get scared by the difficulties. Remembering the moment when I decided to undertake the physics route at the end of high school, I remember in fact being torn between my passion for this world and the fear of not being able to make it. Today, I'm extremely happy that I didn't let these fears stop me.

Valentina Mariani completed her degree in physics at the University of Perugia with an experimental thesis in High Energy Physics. In 2016, she obtained her PhD on the first measurement of the impact cross-section produced by "charmed" mesons from proton-proton collisions at CERN's Large Hadron Collider. Her research activity is undertaken in a very important field for understanding the Standard Model of Fundamental Interactions and fits into a wide international context: the CMS experimental collaboration,

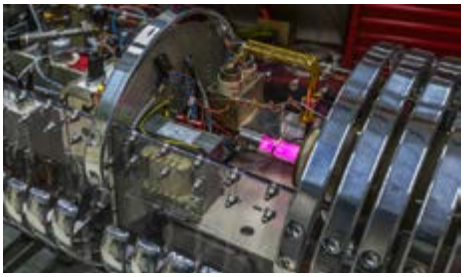
» INTERVIEW

which involves approximately 4,000 researchers from more than 40 countries throughout the world. During her PhD, in 2017, she won an important external fellowship at CERN that allowed her to develop her research in the best context possible, getting to the heart of the experiment, with significant responsibilities too. She is the author and co-author of more than 300 articles published in the most prestigious journals in the sector, such as the Physical Review Letters and the Journal of High Energy Physics. She has also participated in numerous international conferences and meetings, reporting on the results obtained on behalf of the CMS collaboration. ■

RESEARCH

FROM BOREXINO THE FIRST EXPERIMENTAL TEST OF HOW MASSIVE STARS SHINE

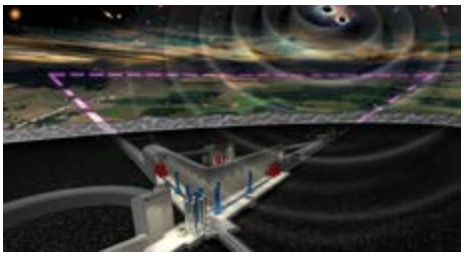
The Borexino scientific collaboration, an experiment at the INFN Gran Sasso National Laboratories, published on the November 26th issue of Nature the announcement of the first ever detection of neutrinos produced in the Sun by the CNO cycle (carbon-nitrogen-oxygen). It is an experimental result of historical value, which completes a chapter of physics that started in the 1930 decade of the last century. The implication of this new measure for understanding stellar mechanisms is enormous: in fact, since the CNO cycle is predominant in the most massive stars than the Sun, with this observation Borexino has reached the experimental evidence of what is in fact the dominant channel in the universe for hydrogen burning. Previously Borexino had already studied in detail the main mechanism of energy production in the Sun, the proton-proton chain. Now, by measuring the neutrinos produced by the CNO cycle, which is present in the Sun at 1% level, Borexino provides the first experimental evidence of the existence of this additional energy generation mechanism.■



RESEARCH

LUNA MEASURES THE DENSITY OF ORDINARY MATTER

There is a key reaction of that fundamental process, called Big Bang nucleosynthesis, which led to the production of lighter chemical elements in the first moments of life of our universe. It is the reaction leading to one of the two stable Helium isotopes, Helium-3, from one proton and one deuterium nucleus. The LUNA experiment has now investigated this reaction with unprecedented precision at the INFN Gran Sasso National Laboratories. It was, thus, possible to refine the calculations of Big Bang nucleosynthesis, obtaining an accurate determination of the density of ordinary matter (baryonic matter), of which everything that we know is made. The density of baryonic matter obtained through the LUNA result coincides very well with the value obtained from the study of cosmic background radiation, the residual “fossil” of the Big Bang. The results of the LUNA measurements, together with a discussion of their cosmological consequences, were published on 11 November in the journal Nature. The LUNA experiment will continue its scientific activity over the next decade with the LUNA-MV project, which is focused on studying key processes for the chemical composition of the universe and the nucleosynthesis of the heaviest elements. ■



INTERNATIONAL PROJECTS

SARDINIA, THE SOS ENATTOS MINE HAS THE IDEAL CHARACTERISTICS TO HOST ET

To implement a third-generation gravitational wave observatory, the Einstein Telescope – ET, able to observe cosmic processes with unprecedented sensitivity, a multidisciplinary team, made up of researchers from the National Institute for Geophysics and Volcanology (INGV), INFN, the Universities of Sassari, Padua, Sapienza of Rome, Federico II of Naples, GSSI Gran Sasso Science Institute and EGO European Gravitational Observatory, conducted a study on the dismissed metal mine of Sos Enattos, in Sardinia, thanks to the support of IGEA S.p.A., the company that now manages the mine. To operate at its best, the ET observatory requires a geologically stable and sparsely inhabited area; the vibrations of the ground (of either artificial or natural origin) can in fact mask the weak signals generated by the passage of a gravitational wave. The multidisciplinary study, which had the aim of seismologically characterizing the Sos Enattos site, has demonstrated its full suitability to host ET. The paper “A Seismological Study of the Sos Enattos Area - the Sardinia Candidate Site for the Einstein Telescope” presenting the results has been published in the international journal Seismological Research Letters. Sardinia and Limburg – a region at the borders between Belgium, Germany and Holland - are the candidate sites to host ET. ■

EUROPEAN PROJECTS

CHETEC-INFRA: A NEW NETWORK TO SUPPORT NUCLEAR ASTROPHYSICS

In Europe, researchers studying the mechanisms for the synthesis of chemical elements in stellar combustion or in extreme cosmic events will be able to make use of a new resource: the ChETEC-INFRA (Chemical Elements as Tracers of the Evolution of the Cosmos-Infrastructure) project, which seeks to facilitate the sharing of results obtained and methodologies used in this field of investigation. ChETEC-INFRA will constitute a network between the three different types of infrastructures on which research in this sector is based: astro-nuclear laboratories, which provide data on impact cross-sections of nuclear reactions; supercomputers, which perform calculations of stellar structure and nucleosynthesis; and telescopes and mass spectrometers, which collect data on the quantity of elements and isotopes. The data will be stored and catalogued for their long-term, open-access use within ChETEC-INFRA. Financed within the context of Horizon2020 with 5 million Euro for four years, the network unites 32 institutions in 18 European countries. The bodies involved include many Italian universities and INFN, which will contribute to the initiative with its own expertise in the creation of targets and detectors. In particular, it will be responsible for developing new materials to be used as targets for accelerated beams of particles for studying nuclear reactions at very low energy. In addition, it will be in charge of designing innovative neutron detectors, such as composite scintillators and new plastic materials, in collaboration with industrial partners, and will coordinate the activities for validating the impact cross-sections of the reactions studied, creating and maintaining an open-access database. Finally, it will support the dissemination of results and the training of future generations of researchers, through schools and masterclasses. ■

PUBLIC ENGAGEMENT

MANY INFN OUTREACH EVENTS IN NOVEMBER

November is rich in meetings with the public and with students, from primary schools to secondary schools. November saw INFN researchers engaged in many public engagement activities, starting with the International Cosmic Day, continuing with the “Futuro Remoto” Festival and the National Geographic Festival of Sciences, and concluding with a huge number of activities that spangled the European Researchers' Night, 27 November.

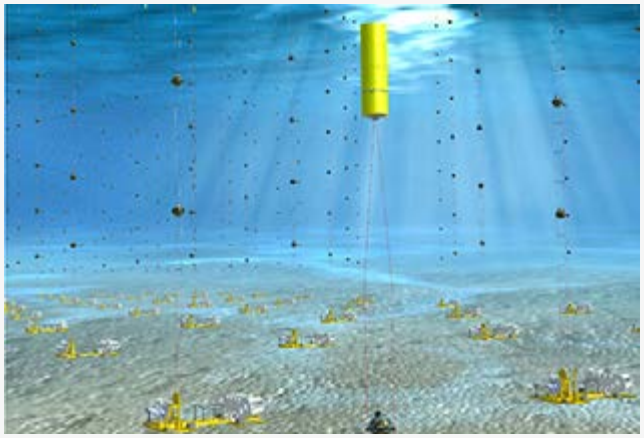
For the International Cosmic Day, on 4 November, the researchers of the OCRA INFN project organised an online event at the Gran Sasso National Laboratories, in which 3,500 students from all over Italy participated. These students worked on analysing original data, thanks to an app, just like in a real scientific experiment.

From 23 to 29 November, the NGFS - National Geographic Festival of Sciences, dedicated to “optimism and science”, saw INFN researchers as protagonists in many meetings, conferences, and conversations on diverse themes: from gravitational waves to environmental physics, from the dark part of the cosmos to particle accelerators, from black holes to supercomputers, also touching on current topics, such as open access and multicultural collaboration. In the context of the NGFS, INFN proposed an original event entirely dedicated to children: FISICAxKIDS.

And from 20 to 29 November, the researchers of the INFN Division of Naples participated in the XXXIV edition of “Futuro Remoto” with meetings that ranged from particle and astroparticle physics to the dialogue between physics and art.

With hundreds of events, the European Researchers’ Night returned on 27 November. This saw INFN engaged in dozens of events throughout Italy, from Catania to Trieste. Among these, on 27 November, the LNGS Gran Sasso National Laboratories hosted “Universo Underground”, a show about the story of the universe, led by Neri Marcorè, with the director of the LNGS Ezio Previtali, the young researcher of the CUORE experiment Laura Marini, and the INFN president Antonio Zoccoli. ■

» FOCUS



IDMAR FOR THE DEVELOPMENT OF STRATEGIC RESEARCH INFRASTRUCTURES IN SICILY

An ambitious project for the creation of a distributed multidisciplinary underwater laboratory off the coast of Sicily, for scientific and technological research in the marine environment that is connected to a land laboratory through submarine cables equipped with electrical conductors and optical fibre. This project is called IDMAR and it is co-funded by the Region of Sicily with the action 1.5.1 (development of research infrastructure) of the European Regional Development Fund. Operational Programme 2014-2020, Regional Business Department, and the Ministry of Education, Universities and Research included it among the infrastructure works deemed priorities by the National Roadmap for Research Infrastructure. INFN, as leader, INGV the National Institute for Geophysics and Volcanology and CNR the National Research Council are all collaborating in setting it up.

Launched in 2018, IDMAR is keeping to the work schedule and has already obtained significant results. The most recent, announced at the beginning of November, is the completion of works for expanding the land station of INFN Southern National Laboratories in Portopalo di Capo Passero. The station hosts the technological equipment to support the two large European research infrastructures, KM3NET, the underwater neutrino telescope under construction at a depth of 3500 metres, off the coast of Capo Passero, and the EMSO-ERIC, a distributed network of sensors dedicated to studying the Mediterranean in terms of geophysics, volcanology, and the marine environment.

Thanks to IDMAR, the underwater infrastructures will be expanded, to allow the management and acquisition of data from the large KM3NeT telescope, and to put into operation the largest cabled underwater laboratory in the Mediterranean. The laboratories of the Portopalo station are now expanded and completed thanks to the funding for the upgrade of the IDMAR research infrastructure. They will host the ground termination of two electro-optical cables (one already installed and one almost installed) that will enable the management of data from underwater detection structures (KM3NeT and EMSO in the

» FOCUS

first place) and the progress of the FOCUS research project, thanks to a new computation centre already connected through the 20-Gbps GARR network, but already ready to go to 100 Gbps

Funded with an ERC Advanced Grant in 2018, for a total of 3.5 million Euros over 5 years, the FOCUS experiment went into operation this October and uses the additional 28 km long electro-optical submarine cable of the IDMAR network, installed by the LNS-INFN off the coast of Catania.

The project aims to validate a new, fibre-optic technology based on laser reflectometry, commonly used for monitoring engineering structures to detect small seismic movements on the submarine fault of Mount Alfeo, recently mapped.

The data taken by FOCUS can be correlated with those coming from the submarine acoustic station SMO, of the Southern Laboratories, and from the observatories of the Catania node of the EMSO-ERIC infrastructure. Therefore, this provides a single pole of observatories in the Mediterranean to study the evolution of Earth's crust in correspondence with one of the most active and interesting geological areas in the world, that of the volcanic complex of Etna

Once the techniques for monitoring the fault lines has been verified and calibrated in Sicily, the aim is to extend it to other fibre-optic cable networks, like the already existing research networks. ■

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