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INTERVIEW

VACCINATION CAMPAIGN ANTI COVID-19: TOWARDS RECOVERY

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NEWS

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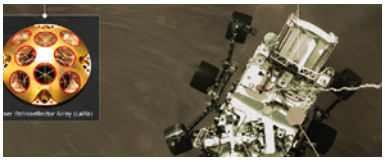

INFN _ COMMUNICATION OFFICE

» INTERVIEW

VACCINATION CAMPAIGN ANTI COVID-19: TOWARDS RECOVERY

MEETING WITH FRANCO LOCATELLI, PRESIDENT OF THE ITALIAN NATIONAL HEALTH COUNCIL AND COORDINATOR OF THE SCIENTIFIC TECHNICAL COMMITTEE

INFN promoted and organized last 22th March the webinar "Vaccination campaign anti CoViD-19: towards recovery". Introduced by INFN president Antonio Zoccoli, the seminar has been held by Franco Locatelli, president of the Italian National Health Council and recently appointed as coordinator of the Scientific Technical Committee which supports the Italian Government in the management of CoViD-19 sanitary emergency. The meeting, dedicated to INFN community, has been organized to take the stock of the situation on contagion diffusion and on the evolution of the pandemic, in particular in our country. It was a moment of information and discussion on the vaccination plan. Here is proposed a summary of the main topics of the seminar. The full recording of the seminar [in Italian] can be found on the web page "Emergenza CoViD-19", on the Institute website, dedicated to INFN community. Here is the direct link

The current scenario from an epidemiological point of view

I will start by presenting some data. To give you an idea of the global numbers, yesterday [21th March, ed] on the website of the John Hopkins Coronavirus Resource Center there were 123,308,000 cases of people infected by SarsCov-2, the whole globe was substantially affected by this pandemic. The other very sad fact is that unfortunately there are already more than 2,716,000 people in the world who have lost their lives, with extraordinarily high numbers in the United States, in Brazil or Mexico. However, as you well know, about 105,000 people have lost their lives by now even in Italy. If you will allow me a personal observation, I am from Bergamo, and this number is exactly equivalent to the population living in the city where I was born. Looking at the ECDC (European Centre for Disease Prevention and Control) data, more or less the whole of Europe is still affected by the circulation of the new Coronavirus, with some areas, such as Central Europe, particularly affected by the epidemic spread.

We have proof of how Italy is hit by what can be defined as a third wave: in terms of new infections, there is nevertheless a deceleration of the curve and perhaps even a reduction; this week we had 2,600 fewer

cases compared to those observed the week before. But the burden on intensive care units (ICU) is extremely high: the occupation of beds in intensive care units, now at 36%, has a 30% critical threshold, above which a whole series of other activities requiring the support of ICU beds are interrupted, or have a significant slowdown.
I can give you two more pieces of information: the average age of people affected by COVID-19 is 47 - whilst the median age of people who lose their lives is just over 80 - and there have been around 127,000 health workers affected.

Most common indicators of the infection's trend

On the matter of indicators, I would just like to comment on the 7-day cumulative incidence function, which has recently been added as an indicator for determining risk class assignment. Overall, the country had a cumulative incidence of exactly 250 cases in the week from March 8 to 14, which is the threshold that had been set to determine the automatic move into the red zone. Basically, there is a very large number of regions that have numbers well above this threshold. Another way of presenting the epidemic situation in the country is to look at the municipalities that have not been affected by a single case in the last 14 days, from March 1 to 14, which are very few and almost all located in Sardinia, and this explains why Sardinia was assigned the so-called white zone.
As a matter of fact, the increase in cases in the so-called third wave has affected all age groups. What has been observed, unlike in the past, is also an increase in the population aged between 0 and 18. From a purely biological point of view, this is due to the fact that the so-called UK variant is more contagious in the paediatric population, but I would like to make it quite clear that this does not translate into a greater severity of cases in those aged 18 or younger.
We previously spoke of deaths, sadly, but before getting on to the vaccines let me walk you through what the increase in mortality compared to the previous five years has been. Looking at the data from ISTAT you can clearly see that in northern Italy, especially in Val d'Aosta, Piedmont, Lombardy and the autonomous provinces of Trento and Bolzano, there has been the greatest increase in deaths compared to the previous five years.
COVID-19 represents the fourth most frequent cause of death in the country and, I believe, this gives a good idea of how dramatic the impact of the SarsCoV-2 pandemic has been worldwide. Obviously, Italy is no exception.

Assessment of the impact of the pandemic

In order to properly estimate the impact of the Covid-19 pandemic, it is perhaps worth talking about what

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the indirect impact is, and I do so by using two diseases in particular as examples: cardiovascular diseases and blood cancer diseases. Regarding cardiovascular disease, SarsCov-2 can cause direct and indirect damage to the body. However, there are also indirect effects pertaining to a reduction in hospitalisations for cardiovascular diseases, which in turn results in an increase in so-called indirect mortality, also in connection with a reduction in non-urgent medical procedures and cardiovascular prevention strategies. Compared to the previous year, the Federation of Italian Cardiologists (IFC) has documented, for example, almost a fourfold increase in the case fatality rate for acute myocardial infarction and this shows how the pandemic has also substantially caused a series of indirect deaths linked to pathologies for which all systems of timely diagnosis and equally rapid treatment have, in some way, been lacking. If we refer to the number of out-of-hospital cardiac arrests observed last spring, there is a clear increase in 2020 compared to what was observed in the previous year, in a clear correlation with the number of cases of COVID-19. Speaking of cancer, unfortunately, it must be acknowledged that both surgical and chemotherapy or radiation treatments have been cut back, and even cancelled, in order to reallocate staff to treating COVID-19 patients. Above all, we must be aware that for some cancers - bladder, breast, colon or head and neck - delaying treatment increases the risk of a poor outcome.
Then there is the big issue of screening. The National Cancer Institute (NCI) in the United States, for example, predicts that over the next 10 years there will be 10,000 more deaths from breast cancer or from colorectal cancer, and in the United Kingdom mortality is expected to rise by almost 17% for colorectal cancer and 10% for breast cancer. It is therefore clear that we need to get out of this critical situation as soon as possible in order to re-establish a whole series of activities that will also cancel out this effect on mortality, indirectly caused by the pandemic. The only way to do so is to have vaccines and, most of all, to vaccinate as many people as possible. On top of the the non-pharmacological containment and mitigation measures that we have extensively learned in recent months, from interpersonal distancing to the use of personal protective equipment, rather than frequent hand washing and the avoidance of gatherings, the only way to eradicate or at least contain an infectious disease, making it endemic, with a low mortality impact, is to adopt broad vaccination strategies, mass vaccination campaigns. Let me remind you that it is precisely thanks to the use of vaccines that we have been able to eradicate smallpox worldwide, just as there are no longer any cases of polio in Europe.

Vaccines currently in use around the world and how they work

There are four vaccine platforms that have been developed. There are vaccines based on dead or attenuated viruses: the model, as an example, is polio, and one of these vaccines is the so-called Sinovac vaccine developed in China. Then there are vaccines based on the spike protein combined with

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an adjuvant to increase its immune response power. Finally, there are two definitely innovative platforms. The first is based on the use of a viral vector, for which a harmless non-replicating virus (essentially an adenovirus). Before the COVID-19 pandemic, this type of vaccine platform had only been developed for the Ebola virus, whereas vaccines based on nucleic acids, particularly RNA, are completely new. The two examples of vaccines that have already become available in our country are the RNA vaccines developed by Moderna and Pfizer Biontech.

I think it may also be useful to look at what has been the investment of various countries in the development of candidate vaccines. Twenty-seven vaccine candidates have been developed in the United States, sixteen in China, and then down to single-digit numbers for all the other countries. Italy currently has two candidate vaccines in various stages of development. The development phases basically first refer to the design of the vaccine according to one of the four vaccine platforms I mentioned earlier, then to the execution of studies on animals and then to the execution of studies according to what are called boot clinical practices in different phases: phase one, phase two and phase three, before arriving at its market launch and use in large numbers, once a vaccine has been approved.

What is essentially common to all vaccines? The fact that they trigger an immune response of what we can define as the adaptive immune system, represented by B-lymphocytes, which produce antibodies as they mature into plasma cells, and by T-lymphocytes, which play a facilitating role in the development of the immune response, as well as generating cytotoxic populations in the cells that become infected by a given viral pathogen, in our case SarsCov-2. For example, in RNA vaccines, once injected, the cells are penetrated by this RNA with the subsequent production of proteins that are picked up, digested by the antigen-presenting cells, which are physiologically responsible for triggering both an humoral or cellular immune response.

Differences between different vaccines in terms of storage, numbers and intervals of doses to be administered

I would like to try to share with you some further thoughts on the vaccines and to do so we should start with an observation. Thirteen vaccines have been approved in various parts of the world and four are currently approved in Italy and EU: they are the Pfizer-BionTech RNA vaccine, the Moderna RNA vaccine, and the two vaccines I referred to earlier, which use an adenoviral vector to carry the genetic information inside the cells. The latter are the AstraZeneca's vaccine, which is based on a chimpanzee adenovirus, and the Johnson & Johnson's vaccine, which is based on a human adenovirus. The so-called Sputnik vaccine is also a vaccine based on the use of adenoviral vectors, with the peculiarity - all these four vaccines require two administrations to generate a complete immune response - that in the Sputnik

vaccine the adenovirus used for the first administration, which we could almost define as priming, differs from the second, which is instead defined as a vaccine boost.

Both the approved Pfizer BioNTech and Moderna vaccines require two doses: Pfizer BioNTech at 21-day intervals, Moderna at 28-day intervals. The maintenance, or storage, conditions differ. Those of Pfizer BioNTech's vaccine are more challenging, because it must be kept between -60°C and -80°C, it can withstand five days at a temperature between 2°C and 8° C and it should not be kept at room temperature for more than two hours. The storage conditions for Moderna are more favourable: it must be kept between -15°C and -25°C, it has a stability of one month between 2°C and 8°C and it substantially resists without alteration for 12 hours at room temperature. What is the efficacy of these vaccines? It is resoundingly high: 100% for both after the second dose.

Here is some information on the other two approved vaccines. The Johnson & Johnson vaccine was approved on March 11 by the European Medicines Agency (EMA) and a couple of days later by the Italian Medicines Agency (AIFA), but the first doses will arrive in the country in April. It requires only one dose, which makes it unquestionably attractive precisely because it results in immunisation with only one dose. In the case of AstraZeneca, the best immunisation results were observed when the two doses were 12 weeks apart. This can be explained by an immunological observation, because a too close administration risks generating an immune response against the adenoviral vector, which somewhat reduces the vaccine's immunising capacity. Once again, with respect to the severe forms of the disease, the protection is extraordinarily high. As far as AstraZeneca is concerned, you will certainly have noticed that it has not yet been approved by the US Food and Drug Administration.

Then there are vaccines based on the use of the spike protein with a neo-adjuvant. Novavax will in fact be submitted for evaluation by the EMA very soon and, here too, the vaccine involves two doses, ease of storage between 2°C and 8° C up to six months. Preliminary data that have been shared show significant efficacy for the Novavax vaccine as well. The one based on an inactivated virus is for example the CoronaVac vaccine, again with two doses two weeks apart. If we look at the list of countries where there has been approval for emergency use, we see that parts of the globe, especially in South America and in China, have had a widespread use of this vaccine platform.

The vaccination plan

This is what I think is a crucial point, namely the priorities regarding who to vaccinate. As you know, in our Country the choice was made to initially give priority to health workers and then to people living in Nursing Homes, before those who work there, and then to the over 80s. Regarding health workers, it is my personal opinion that getting vaccinated is an essential prerequisite for exercising the profession, because those who go to hospitals or Emergency departments must have the assurance that everything

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reasonably possible has been put in place to avoid the risk of infection. On the question of why we should vaccinate patients over 80, the observation I made earlier suffices: the median age of people who have died is just over 81, so immunising them obviously means saving the loss of many lives. It is clear that the aim is precisely to reduce mortality, because what we know for sure is that the available vaccines confer protection against the disease, while it is still a matter of some debate as to whether they offer complete protection in terms of preventing contagion. The vaccines we have provide immunity from disease, but we do not fully know whether they provide a sterilising immunity; it is possible that some vaccinated subjects may potentially become infected, but they will certainly no longer develop the more dangerous forms of COVID-19, specifically because of the data on efficacy with respect to serious forms of the disease. Moreover, this uncertainty about sterilising immunity justifies the reason why the use of personal protective equipment is also recommended for vaccinated subjects. I mentioned earlier some data showing the effectiveness of the vaccination campaign in the Country: since the start of vaccinations, the outcome, in terms of growth in the number of cases, differs dramatically between healthcare workers and the normal population, because we now see very few cases amongst healthcare workers. Therefore, the 126,000 cases I mentioned earlier, practically all, belong to the period before the vaccine campaign. Even the data on protection for residents in assisted living facilities, if you look at the percentage of outbreaks out of the total reported in the Nursing Homes after the start of the second vaccinations, once again, the number of cases drops dramatically. All of which obviously provides further confirmation of the effectiveness and appropriateness of the vaccines.

Current evidences of the efficacy of vaccines globally

Yesterday [21th March, ed] in the United Kingdom where, there have been lockdown measures, but above all there has been an extraordinarily high number of vaccinated people, the number of people who lost their lives was 17. On 26 January, so basically less than two months ago, we were exactly two logarithms above that because we were at 1600 deaths recorded in the UK.

An article published on Cell, no more than five days ago, summarises the cumulative incidences of SarsCov-2 infection in subjects vaccinated with either Pfizer's vaccine or Moderna's vaccine, compared to the control group that received a placebo in the phase three study. By observing the data, you can see that already at 10-12 days after the administration of the first dose, the curves open up markedly like scissors, thus determining a clear demonstration of the efficacy of the vaccines. Curves of this type are very rarely observed and can rightly be described as a demonstration of the extraordinary effectiveness that biology and medicine have had in developing vaccines in less than a year to begin the vaccination journey.

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Variants of the virus and the persistence of vaccine protection

The so-called UK variant is known for its greater rate of contagion, but the data on the possible lethality have yet to be consolidated. You may also have heard of the Brazilian and South African variants: it is a sort of physiological phenomenon, that some strains emerge with nucleotide mutations and consequently amino acid mutations of the spike protein, particularly the part that binds to the receptor. I am not one of those who think that these variants can really determine resistance to vaccines; there is research that does not confirm this hypothesis at all, even documenting results in the opposing direction.

On the other hand, what do we not yet know in full? We do not know how long the protection will last; therefore, we do not know whether we will need booster vaccinations and how often.

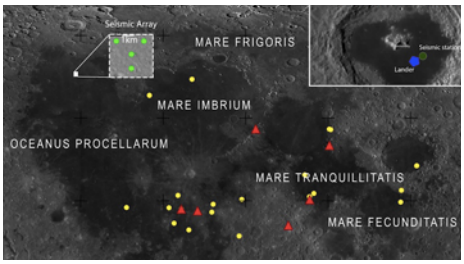
Just this morning [21th March, ed] I saw a scientific study documenting that while in the healthy population there is already a resoundingly high level of protection after the first dose, in cancer and blood cancer patients protection of over 85-90% is only obtained after the administration of the second dose: after the first dose these subjects have a level of protection in terms of antibody response that is no more than 20%.

Lastly, the other point refers to the ability of vaccines to induce a sterilising immunity. The data on the sterilising capacity still need to be assessed, analysed, and consolidated in order to draw definitive conclusions. But we certainly know that they give a formidable protection against disease. ■

RESEARCH

THE FIRST IMAGE OF MAGNETIC FIELDS AT THE EDGE OF A BLACK HOLE

The scientific collaboration EHT Event Horizon Telescope, which published the first image of a black hole in 2019, has now managed to produce a new representation of the huge astrophysical object at the centre of galaxy M87: this is the image of the black hole in polarised light. This is the first measurement of the polarisation of light - a phenomenon that indicates the presence of magnetic fields - in a region that lies practically on the "edge" of a black hole, on the so-called event horizon. The result makes a fundamental contribution to explaining how the M87 galaxy emits energetic jets of particles from its core. The study provides valuable information that will help us understand the behaviour of the magnetic fields around black holes and the processes that, in these very dense regions of space, are able to produce jets so powerful that they extend far beyond the galaxy itself. Thanks to the new observations, the EHT collaboration has understood that only theoretical models with strongly magnetised gasses can explain what is seen on the black hole's event horizon. The data indicate that the magnetic fields at the edge of the black hole are strong enough to repel the hot gas and help it resist gravity, leaving only part of the gas to spiral inwards to the event horizon. To observe the heart of the M87 galaxy, the collaboration linked eight telescopes around the world to create a virtual Earth-sized telescope, the Event Horizon Telescope. The results were published in two separate articles in *The Astrophysical Journal Letters* by the EHT collaboration. ■

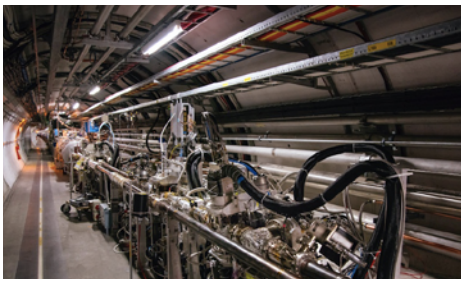


RESEARCH

LGWA: THE NEW PROJECT TO MEASURE GRAVITATIONAL WAVES ON THE MOON

Is it possible to detect gravitational waves on the Moon? This is the challenge proposed by the international team of scientists and engineers of the Lunar Gravitational-Wave Antenna (LGWA) collaboration, to which INFN is contributing together with the Gran Sasso Science Institute (GSSI), the National Institute of Astrophysics (INAF), the National Institute of Geophysics and Vulcanology (INGV) and Italian Aerospace Research Centre (CIRA). The proposal, which entails the installation of a network of lunar sensors capable of detecting the vibrations of our satellite produced by the passage of gravitational waves, was presented in a study published in the Astrophysical Journal, dedicated to the theoretical analysis of a similar scenario in the NASA and ESA programmes that plan the return of man on the Moon and the construction of permanent bases on our satellite in the near future.

This idea was at the basis of Joseph Weber's work some 50 years ago and led to the creation of the Lunar Surface Gravimeter, a gravimeter placed on the lunar surface in 1972, with the Apollo 17 mission, which, however, missed its research objective. The study proposes an extension of the lunar gravimeter idea in which the Moon itself is an essential part of the detector, thanks to its intrinsic mechanical capacity to respond to gravitational waves. Moreover, the study identifies as a theoretical possibility a system consisting of a network of seismographs placed at the South Pole of our satellite. This solution presents ambitious environmental and technological challenges, such as the development of a new generation of lunar seismographs.■



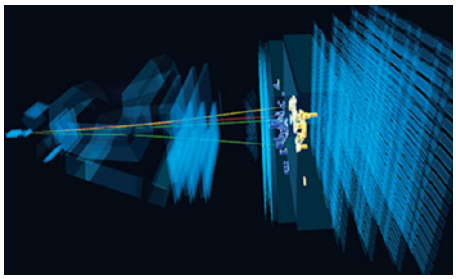
RESEARCH

TOTEM AND DØ ANNOUNCE ODDERON OBSERVATION

The scientific collaborations TOTEM at CERN, with a major INFN participation, and DØ at Fermilab have announced the observation of the odderon, an elusive state of matter formed by three fundamental particles called gluons and predicted almost 50 years ago. The outcome was observed with CERN's LHC particle accelerator, where the TOTEM experiment is located, and Fermilab's Tevatron, where the DØ experiment is installed. The presentation of the work at CERN follows the joint publication in December 2020 of a preprint by CERN and Fermilab.

The states comprising two, three or more gluons are usually called glueballs and are peculiar objects consisting only of the strong force mediators (the gluons). The advent of quantum chromodynamics (QCD) led theorists, in 1973, to predict the existence of the odderon formed by three gluons. Demonstrating its existence was a major experimental challenge, requiring detailed measurements of protons in high-energy collisions.

Already back in February 2018, the TOTEM experiment found evidence of the possible existence of this particle in the data on the elastic scattering of protons. The new work is based on an analysis of data from CERN and Fermilab based on measurements at different scattering angles. The TOTEM and DØ researchers compared the proton-proton data from the LHC with the proton-antiproton data from the Tevatron and found new evidence for the odderon with an independent method. The combination of the results of the two analyses (2018 and 2020) strengthened the initial evidence and upgraded it to the level of discovery. ■



RESEARCH

LHCB MEASURES A POSSIBLE VIOLATION OF THE LEPTON UNIVERSALITY

On 23rd March, during the session of the annual Moriond conference devoted to electroweak interactions and a CERN seminar, the results of the latest data-taking campaign of the LHCb experiment were presentented. LHCb is one of the four large detectors housed along the ring of CERN LHC.

Thanks to this campaign, it was possible to carry out one of the tests to verify the so-called leptonic universality, according to which decays involving the three different leptons (electron, muon and tau), should occur with the same probability. The study, which examined the rates of two different decays of a charged B meson, a particle containing a quark beauty, showed that, contrary to the predictions of the Standard Model, in addition to the charged K meson present in both transformations, the number of muon-antimuon and electron-positron pairs produced is not equivalent. With a statistical significance of 3.1 sigma, the measurement was not sufficient to assert the observation of the phenomenon, but it remains of considerable interest because its confirmation, for which 5 sigma will be needed, would indicate the existence of new physics. New and unexpected scenarios could therefore open up through the superior statistics that will be obtained from the third round of data-taking at the LHC, which is scheduled to begin by next year, unless there are delays due to the pandemic. ■

AGREEMENTS

ENEA TECH AND INFN SIGN AGREEMENT TO PROMOTE AND ENHANCE TECHNOLOGY TRANSFER

To promote and enhance the skills and technological innovations developed for research in fundamental physics, also to encourage the transfer of knowledge and the development of applications in other areas. This is the core of the framework agreement signed by ENEA Tech, the foundation that manages Italy's largest technology transfer fund set up by the Ministry for Economic Development (MiSE) with a budget of 500 million euros, and INFN. In line with their specific missions, ENEA Tech and INFN will collaborate on the planning and implementation of activities aimed at the analysis, evaluation and exploitation of technologies developed by INFN and believed to be of common interest; on the promotion of research and development initiatives between INFN and businesses of interest to ENEA Tech; INFN will give scientific and technological advice and support to ENEA Tech; INFN and ENEA Tech will participate in spin-offs and join strategic collaborations promoting, especially, innovative developments and applications of some of the technologies used by INFN in large Italian and international scientific facilities. ■

OUTREACH

PARTICLES OF ITALIAN INNOVATION, MAECI AND INFN FOR THE PROMOTION OF THE RESEARCH-INDUSTRY SYSTEM

The Italian Innovation, the project for the enhancement and promotion of Italian excellence in science and technology abroad, was launched on 16th March with an online event. It is promoted by MAECI, the Italian Ministry of Foreign Affairs and International Cooperation, in collaboration with INFN, ASI (Italian Space Agency), INAF (National Institute of Astrophysics), CNR (National Research Council), ENEA (National Agency for New Technologies, Energy and Sustainable Economic Development), and OGS (National Institute of Oceanography and Experimental Geophysics). The event was attended by the MAECI Minister Luigi Di Maio and the Presidents of the Institutions. Within the project, INFN, together with the MAECI, has created Particles of Italian Innovation, a journey in images in various steps through the most promising cases of technology transfer from INFN to Italian industry, opening with the projects implemented to carry out the great experiments in fundamental physics. Starting from the cutting-edge technologies for accelerators and particle detectors, Particles of Italian Innovation thus offers a narrative of the development of innovative technologies in collaboration with the national industries, and the creation of useful applications for society in various areas such as cultural heritage, medicine, health, the environment, security, and aerospace. The aim of the initiative is to give adequate international visibility to Italy's capabilities and potential in the innovation sectors, promoting the image of a highly competitive and innovative country capable of meeting the challenges of the future. ■

PUBLIC ENGAGEMENT

THE UNIVERSE INSPIRED BY ESCHER

The evolution of the universe, its origin and expansion are the key themes at the centre of a new semi-permanent INFN multimedia installation hosted since the beginning of March at Trieste's museum Immaginario Scientifico, at the new premises of Magazzino 26 in the Porto Vecchio (Old Harbour).
“Espansione” is an interactive multimedia exhibit that represents the structure of the universe and the way its evolution progresses, recalling one of the paintings by Dutch artist M. C. Escher, “Cubic Division of Space” (1952). Visitors can interact with the installation by moving their hands closer to and further from the exhibit to expand, rotate or contract the Universe back to the Big Bang. Hence, the installation brings visitors closer to understanding the mechanisms that govern the Universe. The installation is enriched by a video dedicated to the origin, development and future of our universe.
“Espansione” has been included in the “Trieste and Science” section of the museum, which hosts research centres and companies that are part of the network of scientific bodies that make up the Trieste System, including INFN, which is present in Friuli-Venezia Giulia with its Trieste division and its associated group in Udine. The exhibit was presented on 2nd March by Serena Mizzan, director of Immaginario Scientifico, Angela Brandi, councillor for school, education, university and research, a decentralisation of the Municipality of Trieste, and Rinaldo Rui, director of the INFN Trieste division. ■

TAKE PART IN

9-16 APRIL: SELECTIONS OF FAMELAB 2021, THE TALENT SHOW OF SCIENCE.

Telling science in three minutes is the challenge open to young people researchers, female researchers and university students proposed by Famelab, the international competition promoted by the British Council and coordinated in Italy by Psiquadro. Pre-selections and selections will take place between 9 and 29 April. The test to pass: two three-minute presentations on two topics freely chosen, to win over the jury and the public. This year eight cities participate in Famelab Italia; the INFN is co-organizer of the Pisa stage and collaborates with the organization in the offices of Catania, Genoa and Sassari. In all locations, online workshops open to all on the communication of the science and public speaking are planned in preparation for the selections: the next one is proposed by the Catania team on 9 April.
Registration: *https://famelab-italy.it/famelab2021/*.

FROM 29 MARCH 2021: GENOA ONLINE SCIENCE FESTIVAL.

While preparing the October 2021 edition, the Festival re-proposes the events of the 2020 edition.
For INFN in particular:

- Made in Italy Research. Born in Italy to be international.
With Anna Grassellino, Lucio Rossi, Viviana Fafone, Lucia Votano, Antonio Zoccoli, moderated by Beppe Severgnini

- Big Data in the fight against the pandemic
With Antonio Zoccoli, Giuseppe Ippolito, Gian Carlo Blangiardo, moderated by Marianna Aprile

- The Hidden Force. Women scientists in Physics and History.
With Fé Avougland and Elena Ruzza. Director: Gabriella Bordin. Curated by INFN Section of Turin and University of Turin.

- Unravel the secrets of the Universe with neutrinos.
Lectio magistralis with Takaaki Kajita

Read the programme: *https://www.festivalscienza.online/* All the events have been held in Italian.

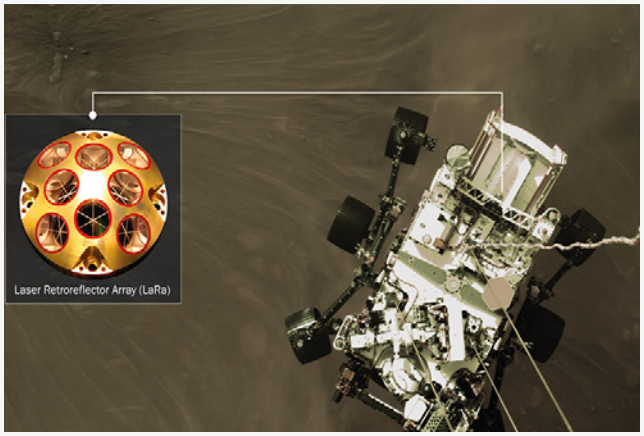
APRIL 15TH AT 9.00 PM: GALASSICA'S THURSDAYS

A look at the heart of the galaxy: how to do it they observe black holes and compact objects.
With Mariafelicia De Laurentis, professor at the Federico II University of Naples e INFN researcher
Read the programme: *https://galassica.it* The event will be held in Italian.

FROM 16 APRIL: PROGRAM - IQUANTI AGO MODENA FABBRICHE CULTURALI

April 22TH The technological quantum. From Quantum Mechanics to the computer of the future
With Stefania De Curtis, Raffaele Tripiccione, Paola Verrucchi, Leonardo Bianchi.
Read the programme: *https://www.agomodena.it/it/programma/iquanti/* The event will be held in Italian.

» FOCUS



LARA: INFN'S CONTRIBUTION TO MARS EXPLORATION

As part of NASA's Mars 2020 mission, the rover Perseverance, that in the coming years will have the task of searching for traces of present or past life on the surface of the Red Planet, landed on Friday 19th February. Among the instruments that Perseverance will use during its stay on Mars is the Italian Laser Retroreflector Array (LaRA), developed and built by the SCF_Lab group at INFN Frascati National Laboratories. LaRA, a device facilitating the identification of the rover by reflecting the light of the laser that will equip the probes expected to reach the Martian orbit in the near future, will perform various tasks, such as measuring the position of the vehicle on the planet's surface, geophysics and geodesy measurements and the verification of Einstein's theory of General Relativity.

Created as part of a collaboration between INFN-LNF and ASI, LaRA is one of the Italian contributions to the Mars Sample Return programme, with which NASA and the European Space Agency (ESA) aim to return samples of Martian soil to Earth by 2030. Consisting of a dome with a diameter of about 5 cm, above which are eight quartz prisms made from the edge of a cube of fused silicon, the micro-reflector is able to reflect light in the same direction as the light itself. LaRA is just the latest in a series of similar instruments made in recent years by LNF, already on Mars or ready to reach the Red Planet in the near future, thanks to which it will be possible to have a sufficient number of devices for the triangulation of the positions of Martian vehicles, thus making a laser navigation system operational in Martian orbit.

LaRA will allow scientists to perform laser-ranging distance measurements to accurately pinpoint Perseverance's position on the Martian surface, test Einstein's theory of General Relativity and make future landings on the Red Planet safer and more precise. However, this will have to wait for the arrival of a future Martian orbiter equipped with a laser system, as laser ranging cannot be performed directly from stations on Earth.

» FOCUS

The micro-reflector was conceived, designed, assembled and tested by the SCF_Lab, the LNF group specialising in space research. Set up in 2006, the lab is dedicated to the design, definition and modelling of space laser telemetry, the technique that allows distances in space to be measured by measuring the time-of-flight of laser pulses sent from a source to devices equipped with retroreflectors, such as LaRA. This technology will play an important role in the near future of space missions dedicated to exploring the Moon, asteroids and the Red Planet itself. ■

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