



# NEWSLETTER 87

Istituto Nazionale di Fisica Nucleare



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### **8 AUGUST 1951: THE ORIGINS OF INFN OUTLINED BY GIORGIO SALVINI**

*On 14 November 2001, during the event organised at the Accademia Nazionale dei Lincei for the celebrations of INFN Fiftieth Anniversary, Giorgio Salvini, the driving force behind the early years of the Institute, of which he had been president from 1966 to 1970, after Edoardo Amaldi, retraced, in the course of a speech, the salient stages and successes of the first half-century of the institute's life. The speech, full of background and personal memories, still represents a unique historical testimony, able to provide a clear picture of the scientific, political and social context in which INFN was born, while outlining the character and qualities of the extraordinary figures who played a leading role in this history. In the year in which the Institute celebrates its 70<sup>th</sup> anniversary, we have therefore decided to offer you an extract of Giorgio Salvini's speech, which, starting from the crisis of Italian physics after World War II, describes the challenges faced by the INFN towards the first great successes obtained starting from the first half of the 1950s with the Frascati Electrosynchrotron and the ADA and ADONE colliders, and with the subsequent ones linked to the beginning of international collaborations.*

#### **Enrico Fermi and Bruno Rossi**

Our country contributed to the progress of science throughout the world in the first decades of the last century, with people, initiatives and institutes of great value: astronomy with Giovanni Schiaparelli and his school; chemistry with contributions ranging from Stanislaw Cannizzaro to Giulio Natta; biology with Giovanni Battista Grassi; mathematics with Tullio Levi Civita's inspiring openness to quantum physics and general relativity fundamental physics research with Enrico Fermi and Bruno Rossi. The stop due to the racial laws, the war and its disasters, slowed down and risked compromising our scientific progress in the 1930s and 1940s. The Italian National Institute for Nuclear Physics, of which I am speaking, represents our desire to resume our efforts to participate in a concrete way in the European, or rather worldwide, aspiration to increase the scientific heritage of our planet, particularly, but not only, in the field of physical sciences. In the belief that this participation is the most convenient way to defend our culture, our universities, the development of our young people and their future jobs.

I will start somewhat distantly, with Enrico Fermi and Bruno Rossi in the early 1930s. Fermi, whose centenary we have just celebrated, created the School of Physics of the Atomic Nucleus with his unforgettable companions and students Rasetti, Amaldi, Segrè, Pontecorvo and D'Agostino. He went down in the history of world physics with his discoveries on neutrons, and with the theory of a new force field, the weak or fermian forces (1933). Bruno Rossi,

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also very young, opened our research in the field of cosmic rays, leading the "Arcetri group". A group of young researchers who gathered around Bruno Rossi and Gilberto Bernardini, Persico's assistants, in 1928. They included Giuseppe Occhialini, another great scientist, Bocciarelli and Racah.

### **Early research to establish a national centre**

The objective of these two schools, in Florence and Rome, was clearly the study of atoms, nuclei and of the new radiations. The physics of cosmic rays seemed to be well under way. As far as nuclear physics was concerned, it became clear, after the successes in Rome in 1932-35, that new means were needed to study the atomic nucleus. In particular, in those years Fermi sought to establish a national laboratory to house a particle accelerator. This was necessary to compete with the most advanced countries, France, England, Germany and the United States, which in those years had already succeeded in acquiring these new means. This was happening in 1937-38. But then the fascist madness of the racial laws hit our country. Rossi was expelled from the University of Padua because he was Jewish. Fermi, who was not Jewish but had a Jewish wife, Laura Fermi Capon, left Italy on the way to his Nobel Prize; Levi Civita was expelled from the university, and the same fate was shared by Giulio Racah, Ugo Fano and many other scientists from Padua and Rome. The project for a new machine was reduced to an electrostatic accelerator supervised by Amaldi and Rasetti. It seemed that in Italy, with Segrè, Pontecorvo, Rasetti and Rossi having fled or emigrated, all the good that our country had achieved was undone. I can only tell this story in bits and pieces, but it was from this disaster of the war that the recovery of our country was born, and what was later to become INFN.

### **The reconstruction**

Among the remaining physicists who worked on the reconstruction of Italian research after 1943-45, I must mention Edoardo Amaldi and Gilberto Bernardini. They are the most significant sign of our recovery. Let me just remind you of an experimental research project in Rome that was born during the bombing and was triumphant in 1946 because of its precise results and the enlightenment brought to it by Fermi, Teller and Weisskopf, to whom Amaldi immediately reported the results. I refer to the discovery at the University of Rome by Marcello Conversi, Ettore Pancini and Oreste Piccioni. They found that the mesons of cosmic rays (today's  $\mu$  leptons) were different from nuclear particles such as protons and neutrons. This was a fundamental discovery, which together with the discovery of the true nuclear mesons, the pions, made a first fundamental contribution to our nuclear knowledge. I must point out that the years of reconstruction, starting from 1945, have been intense and well spent by our country.

### **Birth of the Italian National Institute for Nuclear Physics**

The physicists of the principal Italian universities were thus able, in those years 1945-1950, to work together to officially found the national institute for fundamental research that I have mentioned. I cannot go into the inevitable difficulties of fitting the new Institute into the framework of the existing research institutes and organisations. There were plenty of them. I will simply say that, to promote fundamental research, Gustavo Colonnetti, President of the CNR, Edoardo Amaldi and the Physics Committee finally set up a special institute. It was on 8 August 1951 that the institute took the name "Istituto Nazionale di Fisica Nucleare" (Italian National Institute for Nuclear Physics). The

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Institute's task was "to coordinate the scientific activities of the Centre for Nuclear Physics in Rome, the Centre for the Study of Fast Ions in Padua and the Theoretical Centre for Nuclear Physics in Turin". And finally, the long-awaited National Laboratory was born, with an accelerator of the highest international standard.

### **The INFN Frascati National Laboratories**

It was not a choice without debate. Fermi himself advised us to keep our energy high, at least 600MeV (we actually reached 1100MeV, almost officially hiding this maximum limit). The final decision was taken on 19 January 1953. Gilberto Bernardini proposed to equip the INFN with a 500-1000MeV electron accelerator. It was decided to set up an ad hoc group to build the machine. The minutes state: "after a few exchanges of ideas, the President proposed that Giorgio Salvini of the University of Pisa should be entrusted with the construction of the machine. The proposal was unanimously accepted. We formed the group. We decided that this was a new type of physics, and that the important thing was to have intelligent young people with good will, much more so than people who were already experts in using this machine. I went with Gilberto on a first tour of Italy and gathered a group of physicists and engineers who answered to the names of Fernando Amman, Carlo Bernardini, Giordano Diambrini, Giorgio Ghigo, Mario Puglisi, Giancarlo Sacerdoti and others. These people were all "top of the class", and they became the core of the initiative, together with some already established physicists who were about my age, and who, like me, had never built synchrotrons. So, there was a base of 24-year-olds or younger, a floor of 35-year-olds, and at the top of it all was Enrico Persico, Fermi's unforgettable friend, who was the group's chief theorist, and who directed the theoretical preparation of the machine. Two big decisions awaited us. One was the choice of the machine, whether circular or linear (i.e. electrosynchrotron or linear accelerator); the other, slower and more tormenting, was the choice of location. As for the choice of machine, we chose the circular machine. The decision on the city oscillated between Milan, Pisa, Lucca and Rome. It is a moving page of our country's history, an honest, intense, obstinate game. As we all know, the choice fell on Frascati, where there are now large scientific facilities. But back then there was nothing: a field of rooted cuttings, no water and no roads. This was in 1954. I can see the lorries taking us from one site to another, along a ramshackle cattle track. I feel like chasing them - but I don't have the breath for it anymore - and shouting at them: "Guys, you were lucky! Thank the country that believed in you, encouraged you, helped you." Because this has been the real miracle of these years. And if it wasn't me, it was someone else. The story of the event that led to the completion of the synchrotron and to its being made available for research at the end of 1958 is covered in many accounts and perhaps too generously. But in other fields, meanwhile, my country had continued with remarkable successes. Let me tell you about them.

### **Computing**

The seed sown by Enrico Fermi in 1954 in Varenna, with little emphasis and immense content ("Make an electronic computing machine!"), proliferated thanks to Conversi and others. Fermi encouraged an initiative in Pisa to make useful use of the available funds, which were not used to host the synchrotron assigned to Frascati. Intensive work was done to create the first computing machine in Pisa (CEP). It was with this in mind that the CSCE, the Centre for the Study of Electronic Calculators, was founded in Pisa under the direction of Marcello Conversi. A first prototype

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was ready in 1958, and it was taken over and enhanced by Olivetti, which used international experts. This led to the ELEA 9003, the first commercial electronic computer, the progenitor of a whole series. I have dwelt on this story to underline the importance of doing things at home: you gain a self-confidence that allows you to aim for any goal. [...] But I also learnt - let me say this because it is a general observation that concerns our culture - that the collaboration of physicists and engineers, as they were then churned out by Italian universities, was a theoretical and experimental asset of our scientific and technical culture.

### **INFN legal status**

A question of increasing importance was the failure to resolve the normative and legal status problems that continued to burden INFN, after the revisions following the Ippolito trial. (We were the beloved and respected sons of Italian culture: but of which father or institution?) Amaldi and I were charged with clarifying this problem. I quote Amaldi's opinion: "Numerous conversations and correspondence were made by Salvini and myself with high bureaucrats, parliamentarians and members of the government throughout 1965. But despite the widespread understanding and interest, the problem remained unsolved, giving at times the feeling of the inanity of human actions, in an atmosphere that would recall a Kafkaesque cadence, if it did not take place in the sun and rain of Rome. This problem is undoubtedly the most important issue that I leave open with regret at the end of my office". Since January 1966 I had taken over the presidency of INFN. And it was me who solved the normative problem inherited from Amaldi. In the spring of 1967 I informed my Minister of Industry and President of CNEN, Hon. Giulio Andreotti, that in the absence of any clarification on the legal status of the Institute, I would ask him, my Minister, for a specific authorisation to exercise my signatory powers, starting with those related to the payment of the upcoming salaries. I must say that I considered this move certainly risky for me, but I was hopeful of my government's understanding and ability to act. Mr Andreotti asked me to sign again, just once more, and he committed himself to solving the problem before the next signature. I believed him, because I always thought that if a minister makes a promise, he considers himself bound. I signed the salaries, and here began a job that at first seemed simple, and then became demanding and very intense. [...] The agreed text was published on the Official Gazette of 8 September 1967.

### **The progress of INFN**

[...] During Amaldi's presidency a five-year plan for physics research in Italy was devised. [...] The 50s and 60s of the INFN were years of progress and significant scientific discoveries, not only in the National Laboratories but in all the divisions. [...] I would like to take this opportunity to recall, en passant, that the merits of discoveries in fundamental physics are equally divided between men and women, in Italy and throughout Europe.

Research at Frascati proceeded with various successes in the 1960s. However, the fact that has most delivered this laboratory to immortality so far is the AdA accumulation ring. It was a programme launched in 1960, that I defended when I was still director. But the great credit for the invention and the rapid and clear execution of the programme goes to our Austrian professor Bruno Touschek, who proposed and defended this innovative project, and to his collaborators Carlo Bernardini, Gianfranco Corazza, Giorgio Ghigo and Ruggero Querzoli. They were the same physicists and engineers who had built our beautiful synchrotron, and this explains why AdA was completed in a very

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short time (one year). [...] From AdA came ADONE, an accelerator based on the same principles as AdA, but with high energy, three thousand MeV at the centre of mass. It was built in Frascati in 1962-70 and succeeded in studying new processes. The final success of ADONE in the 1970s was due to Fernando Amman, director of the project, and Bruno Touschek, an enlightened theorist in the study of beams.

The 1960s and 1970s are extraordinary years in the history of elementary particle physics. They are important years of success and of continuous understanding between different nations, and for us at INFN of a magnificent alliance with CERN. Here we are at CERN. I was saying that INFN was born with a worldwide mission, to expand our scientific thinking beyond our national borders. This is true of every powerful scientific aspiration. But let me say a few words about CERN. It was set up in the 1950s by enlightened French, Italian and British physicists. But here I would like to emphasise the fundamental contribution of Edoardo Amaldi, the secretary and organiser of the enterprise. CERN was founded by the European states, but then the collaboration was extended to the whole world, it overcame barriers and iron curtains, it bonded scientific culture in new ways, which lead me to look with admiration at this very young Europe of mine. [...]

[...] A particular characteristic of the INFN in recent decades has been the courage, albeit prudent, to enter into research enterprises impossible for a single country. I have tried to give meaning to the history of INFN in these fifty years of its life, and I have found it in its permanent desire to participate in fundamental physics research in the world, often by initiating and setting it up.

I have told the origin and history of our Institute. It is in fact the history of scientific Europe in recent years, seen from an inevitably national angle. But let me reiterate how necessary it is for our country that INFN, after its first fifty very intense years, continues along its path. We are like sailors on a ship in full sail, who have seen new lands and seas, and know that other discoveries will come. We have understood and we now know a great deal; but we do not know how much and what we still do not know. ■



**ANNIVERSARIES****HAPPY BIRTHDAY TO INFN LEGNARO  
NATIONAL LABORATORIES**

The celebration ceremony for the 60<sup>th</sup> anniversary of the INFN Legnaro National Laboratories took place on 15<sup>th</sup> October. The event was attended, among the others, by the President of INFN Antonio Zoccoli, the main protagonists of the scientific and institutional history of the Laboratories, the Rector of the University of Padua and the main representatives of the local Institutions and Administrations. To welcome the guests, the Director of the Legnaro Laboratories, Fabiana Gramegna. Attended by the main protagonists of the scientific and institutional history of the Laboratories, the event prosecuted with a commemorative seminar by Renato Angelo Ricci, Professor Emeritus of the University of Padua, former director of the Legnaro Laboratories from 1968 to 1979, and ended with a review on the activities and prospects of the Laboratories, conducted by Jose Javier Valiente Dobón.

Founded in 1961 as the Nuclear Research Center of the Veneto Region, the Legnaro Laboratories became the second INFN National Laboratories in 1968. Today they represent one of the major research infrastructures of the Veneto Region. They work in close synergy with other research institutions, primarily the University of Padua, but also other Public Research centres, such as the RFX consortium. Their activity not only produces internationally recognized scientific results, but also generates a significant indirect income in the Region, with important orders especially in the fields of mechanics and electronics. In their 60 years of history, the Legnaro Laboratories have been architects of successes and promoters of growth, thanks to the great work of all the staff that has followed over the years, with the passage of skills and the development of activities that, in the different historical periods, have often reached the frontiers of technology and research, becoming a place of culture, where ideas can arise, grow and be realized.

The whole recording of the event “60 years of physics and innovation at Legnaro National Laboratories” can be found at: <https://youtu.be/79SviU-7aX8>. ■



## APPLICATIONS

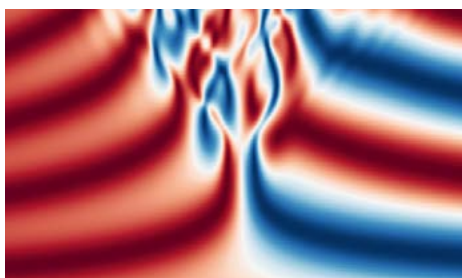
### FLASH THERAPY GIVES NEW HOPE FOR TREATING TUMOURS

Fondazione Pisa will support with a grant of €1.3 million the research project 'Electron Flash Therapy', which was presented on 12 October at a press conference in the Palazzo Blu auditorium. The project involves conducting a thorough study of the so-called FLASH effect, a line of research on which an agreement with the University of Pisa, the institution leading the project, was signed, together with the University Hospital of Pisa, CNR (the Italian National Research Council), and INFN. The Flash effect is a radiobiological effect that makes it possible to drastically reduce the damage to healthy tissue, by distributing the radiotherapy dose in fractions of seconds, while maintaining the same therapeutic effect on the tumour and, therefore, effectively treating tumours entailing a bad prognosis.

The Multidisciplinary Pisan Centre for Clinical Research and Implementation of Flash Radiotherapy (CPFR) was recently founded in Pisa. The centre combines the top scientific and clinical experience and expertise in the region and involves the University of Pisa, the University Hospital of Pisa, CNR-Neuroscience Institute, and INFN. The CPFR is being equipped with a LINAC (linear electron accelerator) specially designed that will have a triode electron gun, a unique feature among this type of source that should enable a series of decisive experiments for understanding the Flash Therapy mechanism.

The specific Flash Therapy accelerator and the synergy between multidisciplinary expertise are the basis for the Electron Flash Therapy project research line that aims to be the first in Italy to obtain authorisation for Flash Therapy clinical testing on human beings. ■





## RESEARCH

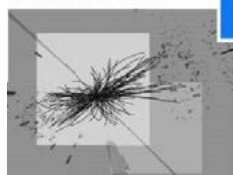
### STUDYING THE ELECTRONICS OF THE FUTURE WITH QUANTUM GAS

Research published in the October edition of the journal *Nature Physics* sheds light on some quantum mechanisms at the basis of spintronics, a sector dedicated to developing high-performance, low-consumption electronic devices. The study was conducted as part of a collaboration between the National Institute of Optics of the CNR, the Department of Physics of the University of Trento, and the Trento Institute for Fundamental and Application Physics, the TIFPA of INFN, as part of the Quantum at Trento (Q@TN) initiative. It provides new information on the magnetic orientation induced in a material as a result of aligning the spin of its electrons.

To achieve this result, the researchers cooled a gas of sodium atoms to temperatures close to absolute zero and, through the use of laser and microwave beams, manipulated the atoms in an extremely precise manner in order to obtain a particular quantum state able to mimic the interface between two different magnetic materials. This made it possible to identify a new type of magnetic wave that propagates within a cloud of atoms without friction, destroying the interface from which they were generated. This observation paves the way for future research into simulating magnetic materials in never observed before conditions, which are useful for understanding spintronics frontier phenomena.

Thanks to the universality of these mechanisms, which extend beyond the world of magnetic materials, this result also represents a first step towards the simulation of phenomena that are usually studied in subnuclear physics and astrophysics. ■

**COMPETITIVE CALL**  
for the design of  
a brand/logotype and a poster



International  
Conference on  
High Energy Physics  
**ICHEP 2022**

ICHEP2022  

## EVENT

### 2022 INTERNATIONAL ICHEP CONFERENCE COMES TO ITALY AND SEEKS ITS IMAGE

ICHEP, the International Conference on High Energy Physics, is coming to Italy for the first time from 6-13 July 2022. It will gather in Bologna theoretical and experimental physicists from around the world who are engaged in the field of particle physics. On the occasion of this big event, the conference organising committee has launched, in collaboration with [AIAP, the Italian Association for Visual Communication](#), a competition for designing a brand or logotype and poster that define the visual identity of the 2022 edition of the prestigious conference, with a prize of €3,000.

The competition is aimed at students in design, graphic design, and communication design courses as well as graphic designers and designers - both individually or organised in groups - who will have up to 15 December to send in their work. The brand or logotype will need to constitute the distinctive, identifying element of the event, synthesising, in a single image, both regional aspects, linked to the peculiarities of the host city, and scientific ones, i.e. those pertaining to the conference theme. The poster will, on the other hand, be the essential tool for presenting the event: it will need to be visually coherent with the brand or logotype and will need to contain text and institutional logos. The organisation of the 41<sup>st</sup> edition of the conference, was entrusted to the INFN divisions of Bologna and Ferrara. ■



## OUTREACH

### INFN CELEBRATED DARK MATTER DAY AT THE INFN GRAN SASSO NATIONAL LABORATORIES

On the occasion of [Dark Matter Day](#), on Friday October 29, INFN organised a live event on its own [Facebook](#) and [YouTube](#) channels at the Gran Sasso National Laboratory.

Like every year, the Dark Matter Day presents the public with the research and efforts undertaken in the field of mysterious dark matter research. It is thought that dark matter composes almost 85% of all the matter in the universe, but its nature or characteristics are still not understood.

During the event, the audience learned more about the CRESST, DAMA, DARKSIDE, and XENON experiments that, by using different technologies and approaches, seek to answer the same question, i.e. discovering something more about this very mysterious kind of matter.

Dark Matter Day is an initiative that was devised and organised for the first time in 2017 by the [Interactions](#) collaboration, which unites scientific communicators of the world's main particle physics laboratories. ■



## OUTREACH

### ASIMOV PRIZE AT THE TURIN INTERNATIONAL BOOK FAIR. 5 FINALIST BOOKS ANNOUNCED

Will it be the “monstrous” theorems that populate mathematics books or images of the cosmos or pseudoscience to conquer the thousands of students who will participate as jurors in the 7<sup>th</sup> edition of the Asimov prize?

In the Bronze Room of Turin’s International Book Fair, on 15 October 2021, during “The end of the Asimov Prize and the new beginning” event, organised by INFN and by the Italian Booksellers Association (ALI), the five finalist books that will compete for the 2022 Asimov Prize were announced, kicking off the 7<sup>th</sup> edition of the prize for popularising science promoted by INFN.

Competing for the prize this year are: Paolo Alessandrini with "Bestiario matematico" (Mathematical Bestiary), Marco Ciardi with "Breve storia delle pseudoscienze" (A brief history of pseudoscience), Agnese Collino with "La malattia da 10 centesimi" (The 10-cent disease), Paul Sen with "Einstein’s Fridge", and Licia Troisi with "La sfrontata bellezza del cosmo" (The brazen beauty of the cosmos). Of the popular science books published in the last two years, the Asimov Prize national scientific committee selected these five books, with the help of a broad, national collaboration of teachers, researchers, and culture, university, and research representatives. Now it will be up to students to read them, review them, and evaluate them to establish who will be awarded the prize this year. ■

## » FOCUS



### **FROM THE SYNERGY BETWEEN RESEARCH AND INDUSTRY: THE NEW SUPERCONDUCTIVE DIPOLES FOR HL-LHC**

The High Luminosity LHC (HL-LHC) project is aimed at upgrading the LHC accelerator, the most powerful particle accelerator in the world, for a further improvement in its performance from 2026 onwards. With this goal, HL-LHC is exploring new configurations and advanced technologies in the fields of superconductivity, cryogenics, radiation shielding materials, electronics and remote handling. Launched in 2011 as a design studio under the European Commission's Seventh Framework Program (FP7), HL-LHC will be installed in the LHC tunnel during the Long Shutdown 3 (LS3), happening between 2025 and 2027, though installation of a few component of HL-LHC have been anticipated in Long Shutdown 2 (LS2), between 2019 and 2021. At the moment, CERN and INFN are collaborating for the procurement of models, prototypes and magnets, intensifying relations with companies that have built fundamental parts of the detectors and the accelerator itself. Among these, great part of the superconducting coils of the two magnets that are at the heart of the two ATLAS and CMS detectors, as well as a third around (450 magnets) of the superconducting dipoles of the LHC, were realized by the company ASG Superconductors of Genoa. Currently installed in a 27 km circumference tunnel, about 100 m deep underground, LHC accelerates and makes beams of protons collide, but also heavier ions up to lead, thanks to a design based on superconducting magnets cooled with superfluid helium at a temperature of  $-271^{\circ}\text{C}$  (about two degrees above absolute zero). In addition to the technological upgrade, HL-LHC will require a new technical structure including the construction of a cavern and an additional 300 m long gallery, along the region of insertion of the collision points 1 (where the ATLAS experiment is installed) and 5 (where the CMS experiment is installed). In its final configuration, HL-LHC will result in an increase in peak luminosities by a factor of five over the LHC's nominal value and will therefore be able to achieve an integrated luminosity level that is nearly ten times higher than that of LHC. To cope with the high intensity beam emitting in these extreme conditions, several magnets currently in use will need to be replaced. Among these, the superconducting dipoles that recombine the particles of the two proton beams around the interaction regions (D2 magnets), a type of magnets whose role is fundamental for achieving

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the performance expected from HL-LHC. The magnet design was developed by the INFN Genoa division in a collaboration framework with CERN. Then in 2019 ASG was awarded to build the D2 short dipole model (MBRDS1 - Main Bending Recombination Dipole Short Model 1) which was successfully tested at CERN in 2020, confirming the required performance at a temperature of  $-271\text{ }^{\circ}\text{C}$ . More recently, in October 2021, the prototype full-scale magnet (MBRDP1 - Main Bending Recombination Dipole Prototype 1) was completed and delivered to CERN and the construction phase of six series of magnets was started, the realization of which was awarded to ASG in 2020. The MBRDP1 magnet is a double aperture magnet (each 105 mm in diameter), 8 meters long, which generates an integrated dipolar magnetic field of 35 T-m (Tesla x meter) in both apertures, with the same polarity. The magnet contains all components cooled by superfluid helium. Each dipole consists of the so-called active part, consisting of two coils with 105 mm diameter openings, contained in a mechanical structure of stainless steel collars, and an aluminum sleeve and an outer magnetic steel structure (the iron yoke). The mass of the dipole has an almost elliptical cross section with an overall length of 8,010 mm, a maximum diameter of 614 mm and an overall weight of 14.2 tons.

This milestone is a further step towards the realization of the Hi-Lumi LHC project at CERN, while the new magnets are a testimony of the fruitful relationship between the world of research and highly specialized industry, a collaboration that has already contributed to the achievement, in 2012, of an epoch-making milestone such as the discovery of the Higgs boson. ■





### TAKE PART IN

## THE UNCERTAINTY EXHIBITION AND ITS PROGRAMME OF PUBLIC EVENTS CONTINUE UNTIL 27 FEBRUARY 2022

The exhibition "Uncertainty: Interpreting the present, predicting the future" organised by INFN continues at Rome's Palazzo delle Esposizioni. The show is dedicated to the scientific approach to

this broad and variegated theme, which is so central to contemporary society and, now more than ever, very relevant. The rich programme of public events that are part of the wider Azienda Speciale Palaexpo project "Three Stations for Art-Science", promoted by Roma Culture, also continues. This includes both "Uncertainty" and "The Science of Rome" and "T Zero" exhibitions.

### ■ INFN AT THE ROME SCIENCE FESTIVAL

From 22 to 28 November 2021, the Rome Science Festival returns to the Auditorium Parco della Musica and online. Produced by Fondazione Musica per Roma, with the planning partnership of Codice Edizioni, the Festival is promoted by Roma Capitale - Department of Cultural Growth. The theme chosen for the 16<sup>th</sup> edition is "Challenges", with the intention of describing numerous challenges that science must confront in a world of continuous and increasingly rapid change. INFN, festival partner together with the Italian Space Agency (ASI), is also contributing this year to enrich the programme with round tables, shows, exhibitions, and activities for schools and teachers.

Online events will be available on [Festival website](#) and on [Auditorium Parco della Musica YouTube channel](#).

### FROM 22 TO 28 NOVEMBER, "FACES AND CHALLENGES OF PHYSICS" EXHIBITION

**Archaeological Foyer, Auditorium Parco della Musica, Rome**

Organised by INFN, ScienzaPerTutti [Science For Everyone] project; curators: Susanna Bertelli, Francesca Cuicchio, Pasquale Di Nezza, and Chiara Oppedisano.

The exhibition, devised in collaboration with ISIA Rome Design, is dedicated to 20<sup>th</sup> century scientists and to some of the most important discoveries of modern physics.

[Information and booking](#)

### FROM 22 TO 28 NOVEMBER, ONLINE LABORATORIES FOR SCHOOLS AND TEACHERS

23 November, 10.00 – 11.30 a.m., **Waves: sound and light**, 8-10 years old. Organised by INFN, INFN Kids project.

24 November, 4.00 p.m. – 6.00 p.m., **Scratch meets School**, for intermediate and secondary school teachers. Organised by INFN, AggiornaMenti and Lab2Go project, with Gianluigi Cibinetto and Mirco Andreotti. [Information and booking](#)

25 November, 10.00 – 11.30 a.m., **Electricity**, 8-10 years old. Organised by INFN, INFN Kids project.  
26 November, 4.00 p.m. – 6.00 p.m., **The smartphone as laboratory**, for intermediate and secondary school teachers. Organised by INFN, AggiornaMenti and Lab2Go project, with Davide Pinci.

[\*Information and booking\*](#)

## **ROUND TABLES AND SHOWS**

### **23 NOVEMBER, 5.00 p.m, VOICES FROM THE DARK UNIVERSE**

**Online on the Auditorium Parco della Musica and Festival of Science channels**

With Elisabetta Baracchini, Massimo Pietroni, and Gianluca Polenta; moderated by Giada Rossi.

[\*Find out more\*](#)

### **25 NOVEMBER, 9.00 p.m., ORDER IN CHAOS. A CONVERSATION WITH GIORGIO PARISI, 2021 NOBEL FOR PHYSICS**

**Petrassi Room, Auditorium Parco della Musica, Rome**

With Giorgio Parisi, Luciano Maiani, and Antonio Zoccoli; moderated by Edoardo Camurri.

[\*Find out more\*](#)

### **26 NOVEMBER, 11.00 a.m. and 7.00 p.m, THE HIDDEN FORCE**

**Borgna Theatre, Auditorium Parco della Musica, Rome**

With Elena Ruzza, actress, e Valentina Varriale, soprano.

[\*Find out more\*](#)

### **26 NOVEMBER, 9.00 p.m., A SIGN IN SPACE**

**Petrassi Room, Auditorium Parco della Musica, Rome**

With Serena Dandini and Marco Pallavicini, music by Fabrizio Sartini and India Simi, readings by Mariagiulia Scarcella from “Le Cosmicomiche” by Italo Calvino.

[\*Find out more\*](#)

### **23 NOVEMBER, 9.00 p.m, TOURNAMENT: SCIENCE TAKES THE FIELD**

**Petrassi Room, Auditorium Parco della Musica, Rome**

With Elisabetta Baracchini, Fernando Ferroni e Francesco “Ciccio” Lancia.

[\*Find out more.\*](#)

### **27 NOVEMBER, 12.00 p.m., MULTIMESSENGER ASTRONOMY: LISTENING TO THE UNIVERSE**

**Borgna Theatre, Auditorium Parco della Musica, Rome**

With Ornella Piccinni and Silvia Piranomonte; moderated by Elisa Nichelli.

[\*Find out more\*](#)

**28 NOVEMBER, 10.00 a.m., THE TECHNOLOGICAL QUANTUM**

**Online on the Auditorium Parco della Musica and Festival of Science channels**

With Daniele Bonacorsi and Paola Verrucchi; moderated by Elisabetta Curzel.

[Find out more](#)

**28 NOVEMBER, 12.00 p.m., GRAVITATIONAL WAVES: FROM THE COSMOS TO THE SUBSOIL**

**Borgna Theatre, Auditorium Parco della Musica, Rome**

With Alessandro Cardini and Gilberto Saccorotti; moderated by Enrica Battifoglia.

[Find out more](#)

**28 NOVEMBER, 4.15 p.m., TECHNOLOGICAL CHALLENGES: FROM BASIC RESEARCH TO SOCIETY**

**Online on the Auditorium Parco della Musica and Festival of Science channels**

With Massimo Ferrario and Velia Siciliano; moderated by Elisa Buson.

[Find out more](#)

**28 NOVEMBER, 9.00 p.m., BASICALLY NEGLIGIBLE. THE EPIC SEARCH FOR GRAVITATIONAL WAVES**

**Petrassi Room, Auditorium Parco della Musica, Rome**

With Eugenio Coccia, music by Paola Crisigiovanni.

[Find out more](#)

**■ INFN AT THE "REMOTE FUTURE" FESTIVAL**

"Transitions" is the theme of the 35<sup>th</sup> edition of the "Remote Future" Festival, the historic event dedicated to science hosted by the Città della Scienza in Naples from 23 November to 3 December 2021, this year in a mixed online and in-person edition, in which INFN is participating with a conference-show and several initiatives, including two virtual visits to major international research infrastructures, by the INFN Division of Naples. [Find out more](#)

**26 NOVEMBER, 10.45 a.m., BLACK HOLES EXPLORERS**

**Dialogue and Virgo experiment virtual tour**

Curated by INFN e EGO – European Gravitational Observatory

With Martina De Laurentis, Valeria Sequino, Lucia Trozzo, moderated by Mariafelicia De Laurentis.

**26 NOVEMBER, 11.45 a.m., GAMMA RAY BURSTS FROM EXTREME UNIVERSE: DISCOVERING CHERENKOV TELESCOPE ARRAY OBSERVATORY AND THE LARGE-SIZED TELESCOPE PROTOTYPE**

**Dialogue and virtual tour of Astronomical Observatory of La Palma**

With Carla Aramo, Alba Fernandez Barral, Rubén López-Coto, Paolo Calisse.

**27 NOVEMBER, 7.00 p.m. DANTE AND MODERN SCIENCE**

**Newton Room, Città della Scienza**

With Antonio Zoccoli, readings by Stefano Sabelli from “The Divine Comedy” by Dante Alighieri, music by Manuela Albano and Luca Iovine, animated set design by Luca Ralli.

**■ 70 INFN – NEXT EVENTS****18 NOVEMBER, 3.00 p.m., INFN70: A SUCCESSFUL ITALIAN STORY**

**Rostagni Room, “Galileo Galilei” Department of Physics and Astronomy, University of Padova**

With Lucia Votano. [Find out more](#)

**24 - 25 NOVEMBER, DAYS IN MEMORY OF MILLA BALDO CEOLIN**

**Rostagni Room, “Galileo Galilei” Department of Physics and Astronomy, University of Padova**

Curated by Università degli Studi di Padova and INFN Division of Padova.

[Find out more](#)

**2-4 DECEMBER, BRUNO TOUSCHEK MEMORIAL SYMPOSIUM**

**Three days dedicated to remembering the scientific legacy of the physicist Bruno Touschek.** Organised by the Sapienza University of Rome, Department of Physics, INFN - National Laboratories of Frascati, Accademia dei Lincei of Rome.

[Find out more](#)

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Prototype of a quadrupole magnet for the High-Luminosity LHC.

Image: Robert Hradil, Monika Majer/ProStudio22.ch

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