## COMMUNICATION AND OUTREACH

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The Education and Public Outreach Service (EPOS) of LNF fosters the scientific literacy through a wide program of initiatives addressed to students, teachers and general public to bridge science and society, either inside or outside the LNF site. The main missions are to engage the public with science, to inform about the latest issues in research conducted by INFN-LNF and the collaborations, to enhance the valorization of scientific heritage and to build network with the society. The Service includes many activities: communications (web and social), press and media relations, multimedia, graphics and photos, public events and visits, student and teacher programs. During 2022, the activities have been carried out both online and in person, in accordance with the restrictions due to the pandemic. Many events INFN Kids, INSPYRE, OCRA, and AggiornaMenti are national projects funded by the INFN Third Mission commitee.

#### 1 Student program

EPOS-LNF offers different types of activities to raise awareness, curiosity and passion towards science and its applications to society among young people. In some of these initiatives pupils work together with LNF researchers in laboratory-based activities, having the chance to experience life inside a research centre. These events represent an unique opportunity for High School students that could help in the choice of higher education or career. The activities can be recognized in terms of work-related learning project.

1.1 Primary and Middle School: INFN Kids

INFN Kids is a popularization of science project addressed to pupils attending Primary and Middle Schools. The project aims at engaging young people with science through different activities such as hands-on didactic labs, comics, videos, podcasts, animations and tales. During 2022, the LNF team was involved in the realization of 15 virtual lectures dedicated to hands-on experiments that were also included in the Science Festivals' program held in Bergamo and in Genova.

Moreover during July 2022 the LNF team contributed in the realization of a summer camp broadcasted online.

From October 28 to November 1, we took part at the Lucca Comics and Game festival - Lucca Junior area, presenting the INFN Kids activities and science demos and games to investigate the inner structure of matter. More than 2000 people participated to our initiatives. Finally during the Christmas time, the LNF team was involved in the design and the creation of the INFN Kids' Advent Calendar.

Concerning the INFN Kids activities see ref. [1].

https://web.infn.it/infn-kids/

https://bit.ly/INFNKids\_sc22

### 1.2 High School: Researchers @Home

From February to May 2022 a series of 6 webinars devoted to the latest issues of Modern Physics and presented by INFN researchers and professors were held online on the LNF YouTube channel.
L. Bandiera - Come l'elettromagnetismo ci ha cambiato la vita
G. Battimelli - Le origini della relatività ristretta
P.Astone - 100 anni di relatività generale: la visione di Einstein del nostro Universo
L.Maccone - Il gatto di Schroedinger: vivo, morto oppure...
D. Domenici - Come abbiamo liberato l'energia dal nucleo atomico
C.Oppedisano - Introduzione alla fisica delle particelle

57 class groups subscribed to this event.

The videos are available in the dedicated INFN LNF YouTube playlist while the slides are available on AccendiScienza e-learning platform.

https://bit.ly/RHome22

1.3 High School: International Day of Women and Girls in Science

For the International Day of Women and Girls in Science, 11th of February, established by the UN General Assembly to promote STEM careers (Science, Technology, Engineering and Mathematics), LNF organized an online event addressed to High School students in their last years. During this event female and male researchers shared with the students their experiences and talked about female scientists and their contributions.



https://edu.lnf.infn.it/international-day-of-women-and-girls-in-science-2022/

Figure 1: The poster of the International Day of Women and Girls in Science.

1.4 High School: INSPYRE INternational School on modern PhYsics and REsearch

INSPYRE - INternational School on modern PhYsics and REsearch, *From particles to the stars:* an *INSPYRING adventure* is a course dedicated to the latest issues of Modern Physics addressed to students in their last two years of High School. The 2022 edition (4-8 April) was held online and transmitted on the LNF INFN YouTube channel. Number of registered students: 191 from 13 countries (Italy, Luxembourg India, Sweden, Lithuania, Germany, Ireland, France, Turkey, Romania, Czech Republic, Portugal, Indonesia).

edu.lnf.infn.it/inspyre-2022/

1.5High School: IPPOG Masterclass

The International Particle Physics Outreach Group Masterclass is a school dedicated to the main issues related to particle accelerators and detectors with a focus on the LHCb experiment and a coding course based on complex systems. As in a real collaboration, students were asked to share the results obtained in the data analysis session during a video conference with other students from Bonn, Geneva, Bari, Ferrara and Birmingham.

The 2022 edition (7-11 March) was held in presence.

Number of registered students 50.

https://edu.lnf.infn.it/ippog-international-masterclass-2022

1.6 High School: Summer School

The INFN LNF Summer School is open to students who attended their fourth year in High School. The 2022 online edition (13-17 June) has been devoted to Particle Physics and to popularization of science. It was structured in 5 lectures, guided tours to the Visitor Centre and the Dafne accelerators, 3 hands-on experimental sessions and a laboratory of popularization of science. In this latter laboratory, pupils were asked to work in small groups in the design of a product, chosen by them between comics, interviews, games, videos to present a theme of physics presented during the school, to share their experience with the public. 53 students participated to the 2022 edition.

edu.lnf.infn.it/summer-school-2022

High School: Art & Science across Italy 1.7

Art & Science across Italy is an European project on art and science addressed to students, attending the third and fourth year, with the aim of bringing them closer to the world of science and scientific research using art as the main language. The LNF team organized the final event which was an exhibition conceived to showcase the artworks produced by students. The exhibition took place at the Scuderie Aldobrandini in Frascati from March 12 to March 27.

https://edu.lnf.infn.it/mostra-artscience-2022/

1.8 Open Day for Technical and Vocational Institutes

On April 29, LNF organized an open day addressed to High school students attending Technical and Vocational Institutes to present the main research activities and technology-based outcomes, to show the cutting edge devices as well as laboratories and workshops and to illustrate the employment opportunities. 46 students attended this open day.

https://edu.lnf.infn.it/open-day-per-istituti-tecnici-e-professionali/

1.9 Ocra - International Cosmic Day

On November 22, LNF organized the International Cosmic Day with a seminar and hands-on activities devoted to the investigation of cosmic rays.

43 students participated at this event.

# 2 University student

In the framework of the *Corso di Eccellenza* of Sapienza Rome University, LNF organized two different courses addressed respectively to 38 undergraduated and 3 Master's students to deepen the main issues in particle physics, accelerators and related technology. Both courses were structured in lectures, laboratory-based sessions ang guided tours to the main facilities.

https://bit.ly/ce\_triennale
https://bit.ly/ce\_magistrale

## 3 Guided Tours

During 2022 several guided tours were organized to the Bruno Touschek Visitor Centre, the Dafne and Sparc accelerators, and to the main facilities. The activity is aimed to present the very sites where research is conducted, to raise awareness towards modern physics and technology, and to make students interacting with researchers (serving as career orientation).

There were 1319 participants between School (942) and University (377) students.



Figure 2: Students during laboratory-based activities at LNF.

## 4 Teacher program

This programme consists in two courses addressed to Science Teachers who want to deepen their knowledge in the fields of Physics and Technology.

# 4.1 AggiornaMenti

Aggiorna Menti is a course of Phyics addressed to Middle School teachers with a focus on the hands-on methodology. The 2022 edition (28-30 November) was held in person and consisted in seminars and hands-on activities to deepen the following topics: experimental method, heat, optics, pressure, acoustics, electricity. The program also includes a course dedicated to coding. 4 teachers participated to the 2022 edition [2],[3].

https://edu.lnf.infn.it/aggiornamenti-2022/

### 4.2 Incontri di Fisica - Physics Meetings

This training and refresher course is addressed to Science High School teachers and is dedicated to modern physics, deepening the aspects concerning the leading ongoing research, the development of cutting-edge technology and their impacts in society. The course is organized every year by LNF since 2000 and gathers teachers from all Italy. In 2022 two edition were organized in March 30- April 1 and November 16-18. The course was structured in lectures and one experimental session. Besides the traditional talks related to particle physics and astrophysics, the program included lectures on the latest issues in science. The experimental session lasted one day and



Figure 3: Teachers during the experimental hands-on activity dedicated to innovative photovoltaic systems.

is conceived to enhance teaching/learning of modern physics with experiments. Given the large number of participants, different laboratory-based activities were organized in collaboration with researchers of other universities and research centres. In this session, teachers worked together with researchers in the realization of experiments either with high and low tech instruments. Teachers could choose just one among the proposed activities that in the November edition included: investigation of radioactivity, innovative particle accelerator technique, use of detectors to study cosmic rays, characterization of particle detectors, key experiments in quantum mechanics, space-time and gravity, superconductivity and the Meissner effect, use of X rays to study the structure of matter, innovative photovoltaic systems, infrared spectroscopy applied to cultural heritage, simulation of complex systems, data simulations and reconstruction of events at LHC, nanotechnologies for the environmental monitoring and X rays spectroscopy. Some of these experiments like innovative photovoltaic systems in quantum mechanics and space-time and gravity are meant to be reproduced in the classroom context with low budget kits and materials that can be easily

available. Whereas other activities are conceived to make teachers experience the real contest of a research laboratory using cutting edge technology and softwares. The March edition was attended by 48 teachers and the November edition by 183 teachers.

http://www.lnf.infn.it/edu/incontri/2022/index.php

### 5 General public

This programme consists of public seminars given by LNF researchers, guided tours to the Bruno Touschek Visitor Centre [4], addressed to people passionate about science and people who want to discover science and the places in which it is investigated.

 $380\ {\rm people}$  attended these events.

visitorcentre.lnf.infn.it

#### 5.1 Re-OpenLABS

he LNF open day, Open Labs, represents the most important popularization of science activity carried out in the framework of the public outreach program. After two years, the 2022 edition was held in person again on Saturday, the 28th of May. The event gathers many colleagues from LNF, INFN Central Administration and other INFN units, universities (University of Ferrara, Sapienza University of Rome) and research centres (ENEA, FBK). During the day, participants had the chance to visit the electron-positron collider Dafne, the SPARCLab facility, many laboratories, the KLOE experiment's hangar, enriched by the art installation *The perfect asymmetry* and the Bruno Touschek Visitor Centre; interactive exhibits were displaced in the Maker Lab to show people cutting-edge technologies and the working principles of devices used in research; public seminars were organized to illustrate the main research topics. Moreover the program included



Figure 4: The guided tours to the Dafne acceleator during Re-OpenLabs.

a kids area where different initiatives, hands-on and science demos, were conducted by the staff of INFN Kids to engage young people with science to explore some physics phenomena and their applications in everyday life. As usual, the science show Il Wow della Fisica! was held in the main Auditorium. An escape room based on High Energy Physics, HEPscape, designed and run by the INFN Roma 1 unit's colleagues, was an interactive activity proposed to our participants to play the role of researchers in a simulated experiment. The event has been a unique opportunity to visit LNF, to discover the science conducted by INFN, universities and other research centres and a great occasion to bridge science and society. More than 2200 participants attended this edition. https://www.lnf.infn.it/edu/openlabs/2022/

5.2 European Researchers' Night

The European Researchers' Night is an initiative created in 2005 by the European Union which aims at promoting valuable occasions of meeting between science and society in enjoyable and bracing contexts. In 2022 LNF was partner of the Science Together NET project [6] in collaboration with 10 research centres and universities of the territory. In this framework between June and September, the LNF team organized:

- On September 28 guided tour the Visitor Centre and the Dafne accelerator.
- Main event in person at the Città dell'altra Economia, September 30 October 1, attended by 6000 participants.



https://edu.lnf.infn.it/notte-europea-dei-ricercatori-2022/

Figure 5: A picture taken during the NET European Researchers' Night 2022.

# 5.3 Public seminars

In 2022 we organized 3 webinars (Strong 2020 public lectures series) dedicated to modern Physics, addressed to the geneal public and broadcasted on the INFN LNF YouTube channel.

5.4 AccendiScienza - e-learning for science education

AccendiScienza is a tool for e-learning and scientific culture diffusion. The platform, financed by MIUR (Ministry of Education, Universities and Research) has been completed thanks to the collaboration with Consorzio GARR and University Marconi. Created to collect and freely make available lessons and seminars held at LNF, this web-portal contains four sections dedicated to its different targets: high school teachers, students, general public, young people. The main goal of the portal is to enhance and give more extensiveness to the activities organized every year by the Laboratory here in Frascati by enabling remote participation too. In addition, it will be a valuable support to traditional scientific teaching and education. Videos : 320

Users : 2307

accendiscienza.lnf.infn.it

## 6 Communication

The Communication office aims to create and distribute informational contents concerning the ultimate issues related to LNF experiments and collaborations, moreover it enhances the valorization of LNF scientific heritage. The principal communication activities are on the website and on socials.

6.1 Web Editorial board

The LNF Web Editorial board role is to improve the development of web content in order to keep the website constantly up to date. The Editorial Board is made of representatives of all the LNF divisions, services and the Director and provides for the collection, editing and publication of the various news, dissemination articles and other texts and communications addressed both to the general public and the LNF personnel.

cdrweb.lnf.infn.it

6.2 Social media

LNF fosters public engagement with science via social media and is currently active on Facebook, Twitter, Instagram and YouTube. Facebook @lnf.infn.it

Twitter @infn\_lnf Instagram @lnf\_infn YouTube youtube.com/user/INFNLNF

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