

MEMBER REPORT

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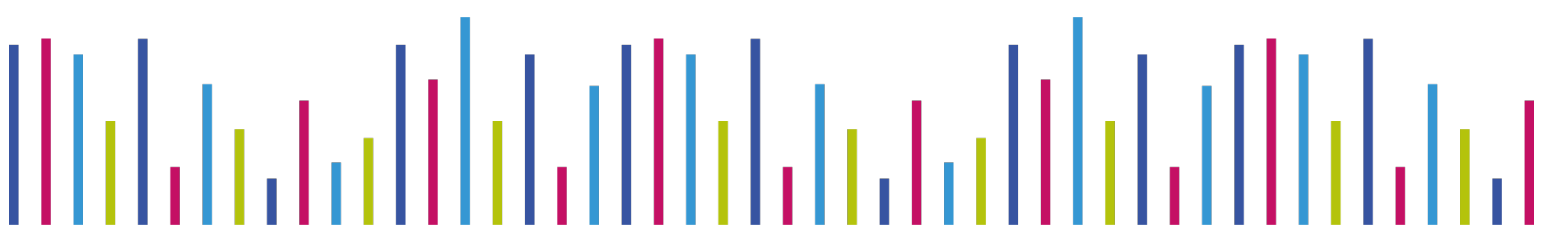


Member Reports

In this section, we present a comprehensive overview of the IPPOG-related activities conducted by our Members and Associate Members. The information has been provided by their respective representatives. Due to various reasons, some member countries, laboratories, or experiments were unable to carry out outreach activities in 2023. In such cases, we have included activities from the 2022 reports to provide a glimpse into their typical initiatives. This distinction is clearly indicated in the title.

While reading these reports, one will notice a distinctiveness in style that reflects the diverse collaboration. Each member employs methodologies that are tailored to the cultural, social, historical, and pedagogical aspects of their respective regions. However, there are common threads that unite us, such as the ongoing commitment to enhance global educational standards, the drive to expand our programmes to new audiences worldwide, and the unwavering dedication of all members to inspire a sense of wonder in fundamental research and foster a profound appreciation for science and evidence-based decision-making among the younger generation.

We hope you find these reports enjoyable to read and gain a comprehensive understanding of the work and efforts undertaken by IPPOG collaborators. Their efforts aim to improve scientific literacy in society, motivate students to pursue STEM careers, promote the widespread knowledge of particle physics, and disseminate the values of peaceful and international collaboration.





Member Reports

Below is the list of available reports divided by years. Please note that some members do not have reports to display for 2023, which is why they have chosen to include reports from the previous two years. You will find reports from 2022 and 2010 as well as an illustration of the type of activities carried out in the countries.

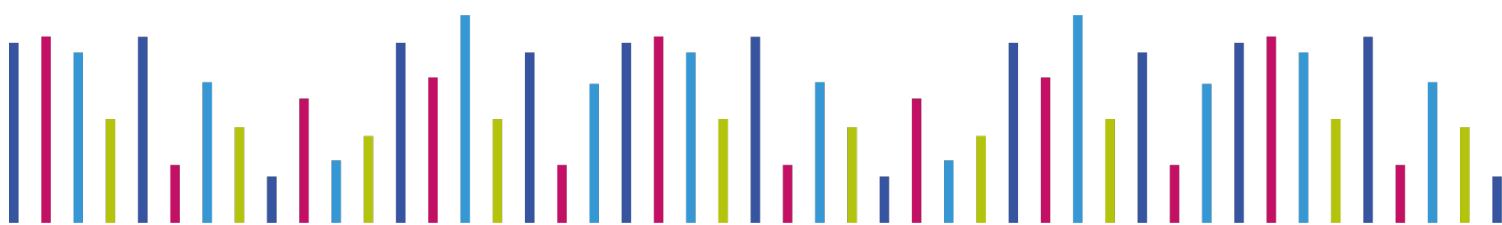
2023

ALICE COLLABORATION
ATLAS COLLABORATION
AUSTRALIA
BRAZIL
BULGARIA
CERN
CZECH REPUBLIC
FINLAND
FRANCE
GEORGIA
GERMANY
GREECE
GSI
HUNGARY
INDIA
ITALY
LHCb COLLABORATION
MONTENEGRO
NORWAY
PIERRE AUGER OBSERVATORY
POLAND
PORTUGAL

ROMANIA
SLOVAK REPUBLIC
SLOVENIA
SOUTH AFRICA
SPAIN
SWITZERLAND
USA

2022

AUSTRIA
BELLE II EXPERIMENT
CMS COLLABORATION
DESY
HAWC





Visits to the ALICE exhibition have been taking place all year round; visits to the underground installations were done when there were no beams. Among the visitors there were many artists from the arts@CERN programme.



More than 20 virtual visits to the ALICE cavern and control room were done via zoom, often combined with masterclasses or European Researchers' Night. In December, a first Instagram Live from the ALICE cavern took place.

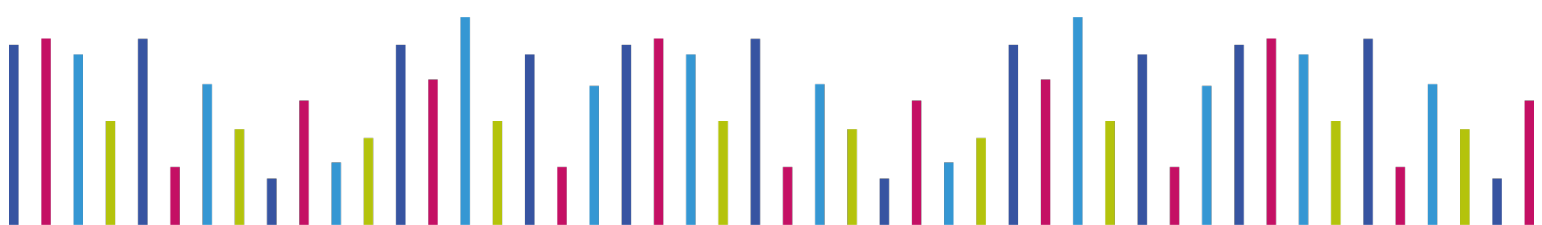
During International Masterclasses 2023, 33 sessions of ALICE masterclasses took place; these included 3 sessions of special masterclasses for girls on the International Day of Women and Girls in Science (11th February). ALICE contributed also to the National High-School Teachers programmes at CERN with masterclasses for the Swedish teachers and the Greek teachers.

ALICE members organised a week-long internship at CERN in July for 15 students from Liceo Gandini, Lodi, Italy and a three-week-long internship at CERN for 15 students from Liceo Pacinotti, Cagliari, Italy.

Members from ALICE, ATLAS, CMS and LHCb took part in a "Live" from the CERN Control Centre after the end of the heavy-ion run and answered questions from the public.



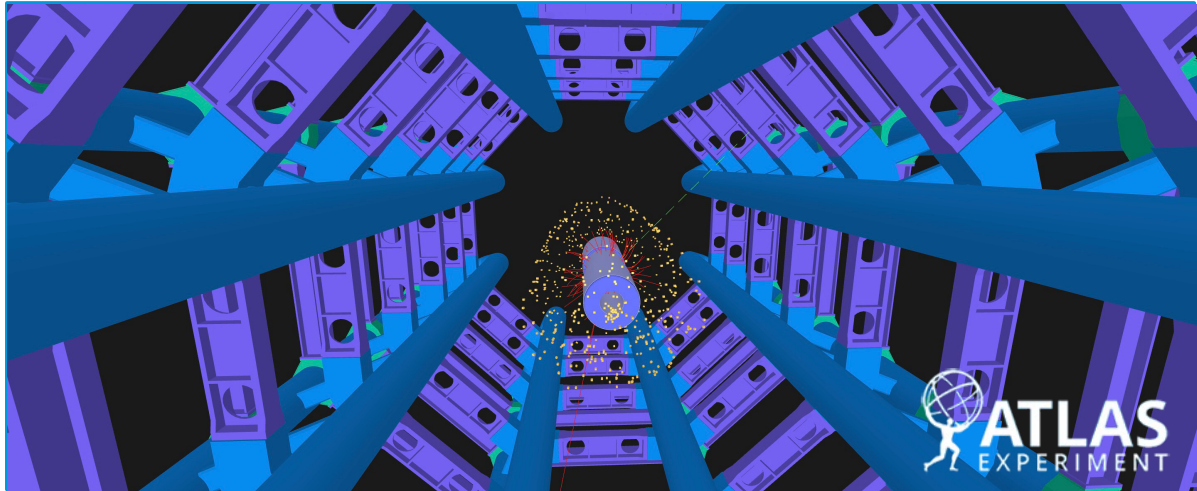
An ALICE-themed escape room was created at the University of Jyväskylä in Finland and was visited by high-school students.





ATLAS Collaboration - 2023

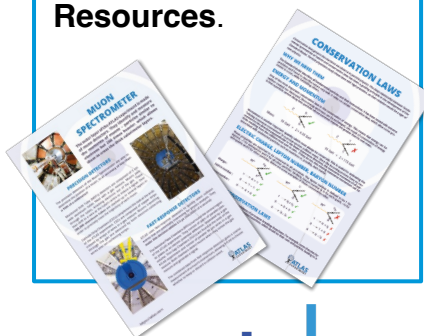
ATLAS Collaboration Representative in IPPOG – Steven Goldfarb



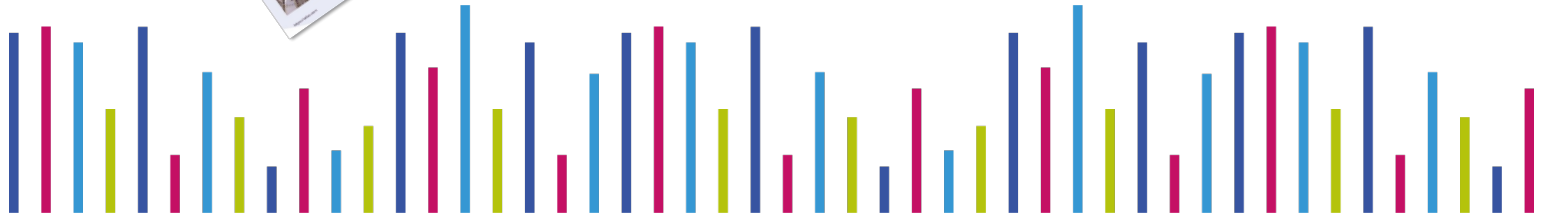
In **2023** CERN celebrated the **50th anniversary** of the discovery of the **Weak Nuclear** force. **ATLAS** contributed to its growing wealth of LHC electroweak physics results with a world-record measurement of the **W-boson mass**, a key, sensitive parameter of the Standard Model. The year also featured the highest-energy measurement of **Quantum Entanglement** and a plethora of results from abundant **LHC Heavy Ion collisions**. More than **30 physics and experimental briefings** were published on our public website **atlas.cern**.

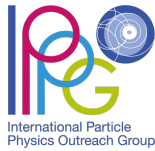
6 + 10

The number of **Cheat Sheets** (physics) and **Fact Sheets** (detector components, software, computing, trigger, data acquisition, etc.) now downloadable as **ATLAS Printables**, in up to 7 different languages from the **ATLAS Educational Resources**.



Masterclasses resumed in **Ukraine** after being halted in 2022 due to the Russian invasion. Above, Ukrainian students meet with a class in **Karkhiv** during an underground Virtual Visit. ATLAS organized over **80 Virtual Visits in 2023** from 31 countries in 6 continents **around the world**. Complementing this was a **YouTube Live** co-hosted with CERN from the ATLAS Control Room.





Australia - 2023

Australia Representative in IPPOG – Jackie Bondell

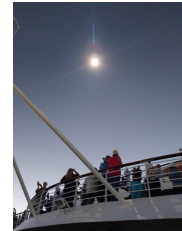
In 2023, Australia's activities aligned with IPPOG goals revolved around four areas:

- 1. Student Engagement:** Delivery of school partnership programs schools in regional and rural locales.
- 2. Teacher Programs:** Leading of workshops about particle physics at national education conferences.
- 3. Public Outreach:** Major public events such as the National QDM Road Trip, the Exmouth Eclipse, and public talks.
- 4. IPPOG Awareness:** IPPOG updates at the Lepton-Photon Conference.

Public Outreach:

Below Right: As part of the education program for a total solar eclipse cruise in Western Australia, CDMPP hosted talks on Dark Matter and Diversity in Science.

Below Left: CDMPP's Renee Key gives a talk as part of the Spooktacular Space event on Halloween.



A major outreach initiative aligned with the mission of IPPOG is the **National Quantum and Dark Matter Road Trip** as part of Australia's National Science Week. The 2023 road trip visited 18 schools and delivering 12 public events across remote and regional Australia. By the end of the event, road trippers had reached more than 1,600 people at schools, universities, pubs and community hubs across the country.



Left: The QDM Road Trip Team with students at Winton State School in the Queensland Outback

Right: IPPOG's Bondell leading a gravity demo with students from Djarragun College in Far North Queensland



Education Programs:

Bottom Left: Uni Melbourne's Han Ng leads a lesson on Dark Matter for students at the regional Stawell Secondary School in Victoria.

Bottom Right: Students and teachers learn using CERN Mystery Boxes as part of a STEM workshop in Queensland).

Right: Article published in the SA Teachers Association Journal About Dark Matter Lessons



Centre of Excellence for Dark Matter Particle Physics (CDMPP), based at the University of Melbourne, supports IPPOG in Australia.





Wiener Forschungsfest 2022

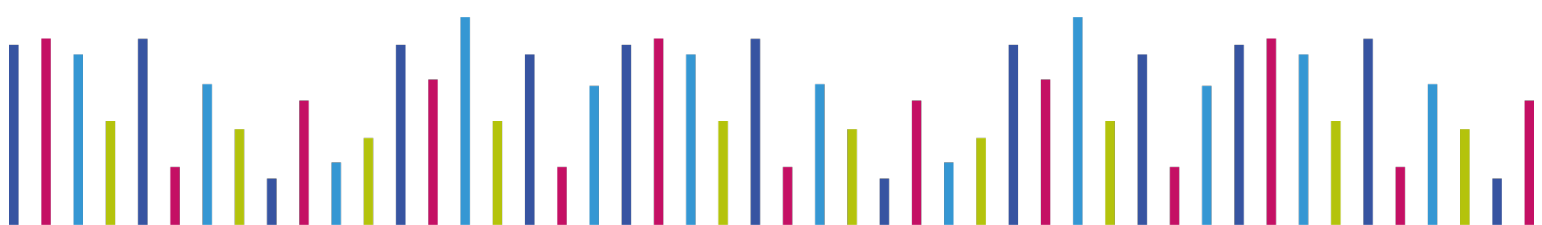
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Kinderuni 175 ÖAW

© ÖAW/APA-Fotoservice/Hörmandinger

- Belle II International Masterclasses for students (HEPHY Vienna: 23 March 2022 online)
- Pint of Science, different pubs in Vienna, outreach event within the Identification of Dark Matter conference 2022 in Vienna
- KinderUni Wien for school classes at the Campus of the Austrian Academy of Sciences (17 – 19 May 2022)
- Lange Nacht der Forschung 2022 at the Austrian Academy of Sciences (20 May 2022)
- Wiener Forschungsfest 2022 at the Vienna City Hall (9 – 11 September 2022)
- ÖAW Studienstiftung at CERN (15 – 16 September 2022)
- Open Day at the Federal Ministry of Education, Science and Research (26 October 2022)
- Dark Matter Day 2022 at the Statt-Beisl WUK (31 October 2022)
- Public talks for the general public and at schools (as a part of the initiative “Akademie im Klassenzimmer”)





In 2022, the outreach activities of the Belle II Collaboration were gradually recovering from the impact of COVID-related measures. Nearly half of the institutions involved were able to successfully organize live events. The online infrastructure played a crucial role in facilitating these activities, as participants could utilize their own equipment and connect to the dedicated online app. This technological advancement has significantly expanded the possibilities for hands-on activities to be organized.

We hosted three Belle II International Masterclasses events, where participants had the opportunity to reconstruct B meson decays using a sizable data sample of 5 million events. Additionally, a new exercise was specifically designed to focus on measuring quark colors and was deployed by several institutions. Both of these exercises have been made available online, enabling citizen engagement in the research process.

In addition to the aforementioned events, the Belle II Collaboration also organized outreach activities at notable gatherings such as the Flavor Physics and CP Violation 2022 Conference, the University of Mississippi, and the Physics Summer School at the University of Ljubljana. Furthermore, we actively participated in the European Researchers Night at multiple locations, further promoting our outreach efforts and fostering public interest in our research endeavors.

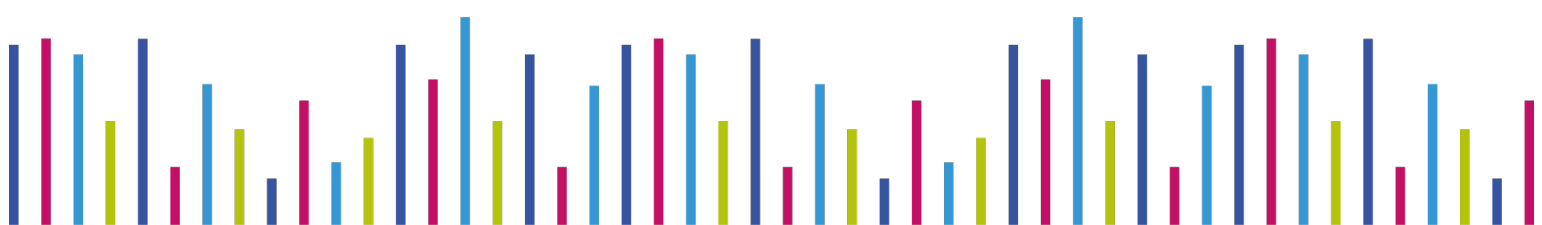


Belle II International masterclasses:

- 3 full day events
- 11 institutions
- 216 participants

- Additional 5 satellite half day events

We have maintained a consistent flow of communication by sharing our latest news and updates with our social media audience across multiple platforms, including Facebook, Twitter, and Instagram..



Masterclasses Hands On Particle Physics

In 2023, the Masterclasses Hands On Particle Physics was organized in all Brazilian regions, present in the following states: Amazonas and Pará (North region); Mato Grosso (Center region); Bahia, Ceará and Rio Grande do Norte (Northeast); Rio de Janeiro, São Paulo and Minas Gerais (Southeast); Paraná and Rio Grande do Sul (South). In the whole country, around 900 students participated in the events.

In Brasilia, the country capital, Masterclasses had its place in the Nacional Week of Science and Technology Fair, hosted in the Ministry of Science and Technology booth.



During 2023, there were

900 students

participating in Masterclasses events in all Brazilian regions

700 students

participating in the ATLAS Virtual visits

7000

visualizations of the IPPOG-Brasil portal hosted by the Brazilian Physical Society

International Day of Women and Girls in Science

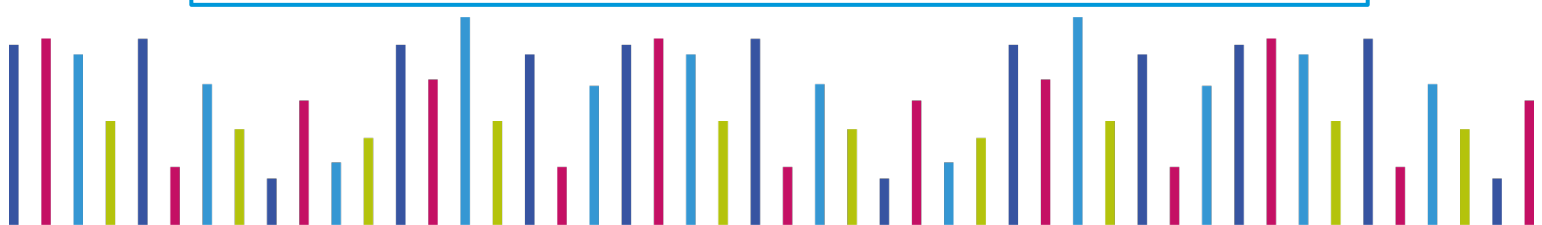
Special events dedicated to women and girls in Science were organized again in 2023

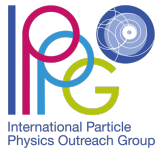
In São Paulo and Rio de Janeiro, 2 events gathered more than 70 girls to participate in special editions of the Masterclasses.



Art and Science

In Resende (city of Rio de Janeiro), an Art and Science project with high school students was inspired by the ATLAS Virtual visits. The paintings about Particle Physics made by the students beautified the school and awakened the students curiosity.

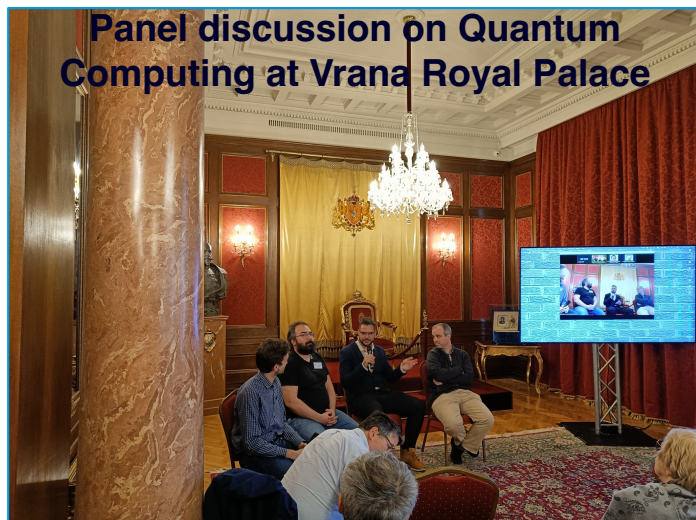
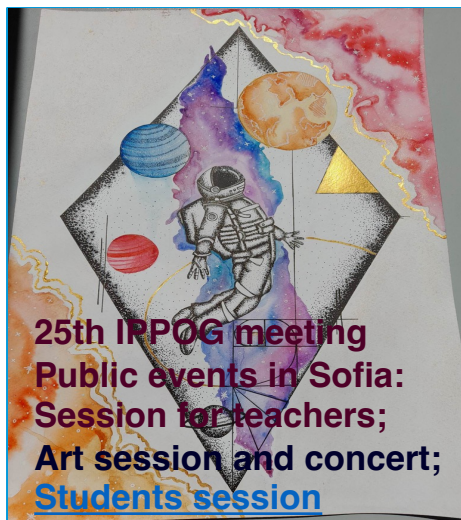




Bulgaria - 2023

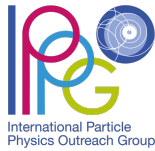
Bulgaria Representative in IPPOG – Roumyana Hadjiiska

IPPOG Spring Collaboration Meeting at Sofia Tech Park 9 - 13 May



In 2023 Bulgarian students participated in 5 International masterclasses: First ALICE class in Bulgaria in town of Vratsa, a Particle Therapy class in Sofia and 3 CMS classes in Sofia, Varna and Pazardzhik.





CERN - 2023

CERN Representative in IPPOG – Ana Godinho

WELCOMING VISITORS IN THE ICONIC CERN SCIENCE GATEWAY

Since opening to the public on 8 October and until the end of 2023, close to 72 000 visitors of all ages and from more than 120 countries enjoyed the remarkable range of activities that CERN's new flagship education and outreach centre offers: three different universes in the exhibitions, enquiry-based laboratory workshops, science shows, public events. The emblematic guided tours of CERN now start at Science Gateway, connecting to the other visitor offers.



INCREASING DIGITAL ENGAGEMENT

CERN's community of followers on social media increased to 4.7 million, with posts being viewed 117 million times. Beyond reach, social media users also engaged with CERN posts, with 3.7 million actions (likes, shares, etc) taken in response to the posts over several campaigns.

ENGAGING LOCALLY AND GLOBALLY

For the International Day of Women and Girls in Science, around 100 female scientists and engineers from CERN, EPFL, the University of Geneva and the Anecy Particle Physics Laboratory (LAPP), visited over 200 classrooms in the local region to talk to some 5100 pupils about their careers as women in science and engineering.

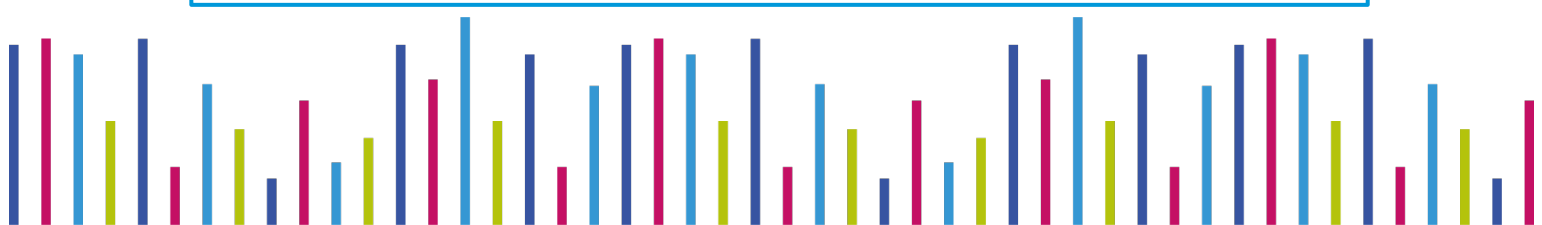
CERN's travelling exhibitions visited three cities in Germany, reaching an estimated 53 000 visitors.

EMPOWERING TEACHERS AND STUDENTS

After 25 years, CERN's teacher programmes have reached 14 600 teachers from 107 countries. In 2023, 27 national and international programmes welcomed 801 teachers, from 55 countries. The Ukrainian teacher programme remained online, reaching 70 teachers.

The Beamline for Schools competition completed 10 editions, with another record-breaking participation: 379 proposals from teams representing 68 countries. As in the past three editions the winning teams conducted their winning proposals at CERN and DESY (Germany).

The CERN Solvay Education Programme, established between CERN and the science company Solvay, produced 12 new education videos, with 2.2 million online views. The student camp received over 600 applications from more than 60 countries, and 30 students were selected for the first camp held in October.



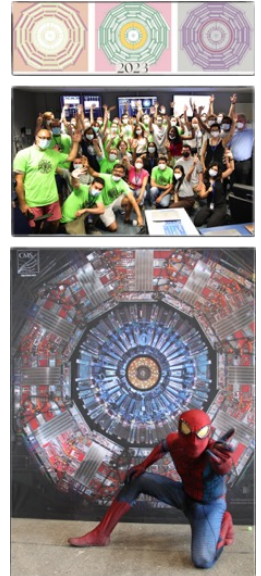


CMS Collaboration - 2022

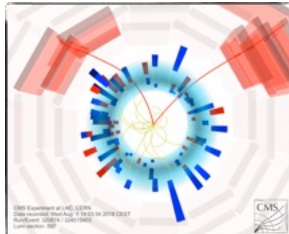
CMS Collaboration representative - Freya Blekman

Live & International Events have been a lot of fun over 2022!

- CMS was part of the **CERN live** events marking the start of **Run 3** and **Dark Matter Day**, and the **Higgs' 10 year** anniversary celebrations.
- Virtual visits** and **guided tours** to the detector continued throughout the year, with **over 2700** online visitors and **over 7400** in person visitors underground.
- CMS set up an expo area at the **GeekTouch** convention in Lyon, including games and a VR station. There was a huge amount of enthusiasm from colourfully dressed people!
- CMS continues to contribute to the IPPOG particle physics **Masterclasses** throughout the year



Physics Briefings continue to be a priority, and in 2022 we published 28 including **5 key results** as highlights.



Open Data sets CMS apart - it is unique for sharing all its proton-proton data from Run 1 with the public.

A **dedicated Open Data workshop** was set up and run at CMS, including **high school students and teachers!**

Online Presence

Continued presence on social media platforms

NEW accounts on **LinkedIn & Mastodon**

11 blog posts on the Cylindrical Onion

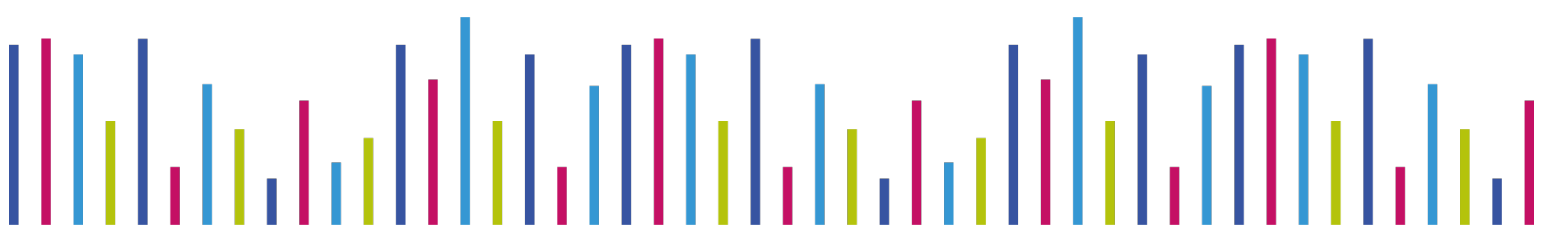
18 detector and collaboration **news stories**

CMS Social Media
& Website Links!



Videos

CMS produced **14 new** YouTube videos, including **explanations** of the CMS upgrades and the **expectations** for Run 3, as well as **fun videos** such as showing the strength of the magnet through paperclips, chains, keys, and a variety of other objects



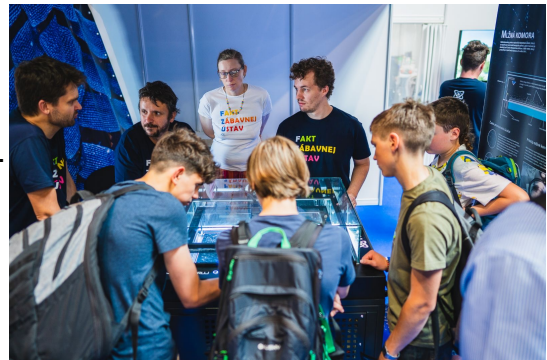
The Big Bang Stage at the Colours of Ostrava music festival offered 28 hours of programme about particle and nuclear physics. Besides music, the festival visitors had the opportunity to learn about physics engagingly. They enjoyed the unique experience very much!



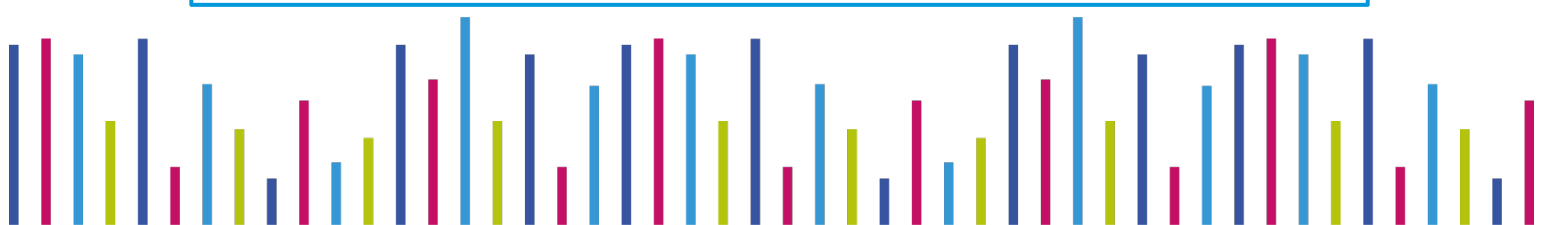
3000

people visited talks, science shows, discussions and workshops at The Big Bang Stage in 4 days.

Science Fair 2023, organized by the Czech Academy of Sciences, presented cloud chamber, particle physics, cosmic rays and CERN to its 30,000 visitors.



International Masterclasses form a key element of the Czech Particle physics outreach dedicated to high-school students. In 2023 alone, the Czech physicists organized 8 Masterclasses events attended by hundreds of excited students. ATLAS, LHCb and AUGER experiments were presented this way.



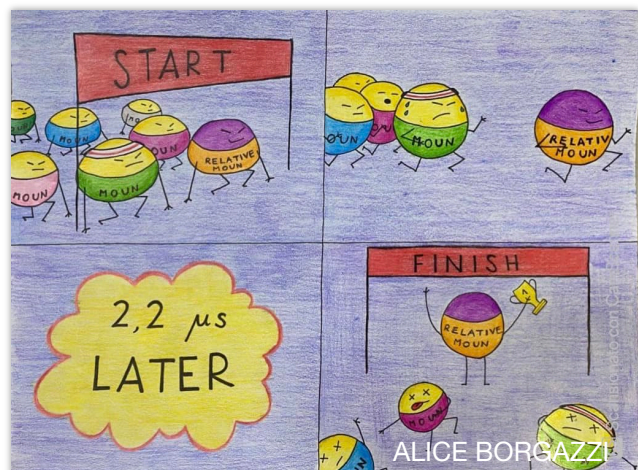
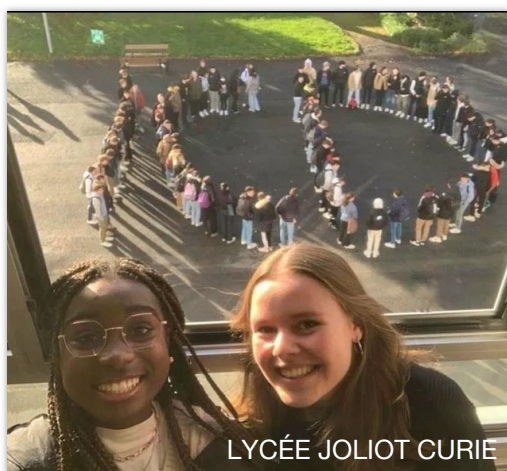
Since 2012, **DESY** initiates and coordinates the International Cosmic Day (**ICD**) in cooperation with **IPPOG** and many national networks and partners. The ICD2022 took place on November 22. The day is dedicated to the unnoticed cosmic particles that flood our universe and constantly surround us on Earth.

On this day the students get the chance to become a part of the science community. Participants from various institutions all over the globe such as schools, universities, and research institutes perform experiments and attend lectures. Students listen to scientists and to other students who present their results and discuss their research. A special guest and supporter of this year's **ICD** was Rebecca Smethurst, astrophysicist at Oxford University, known on YouTube as Dr Becky.

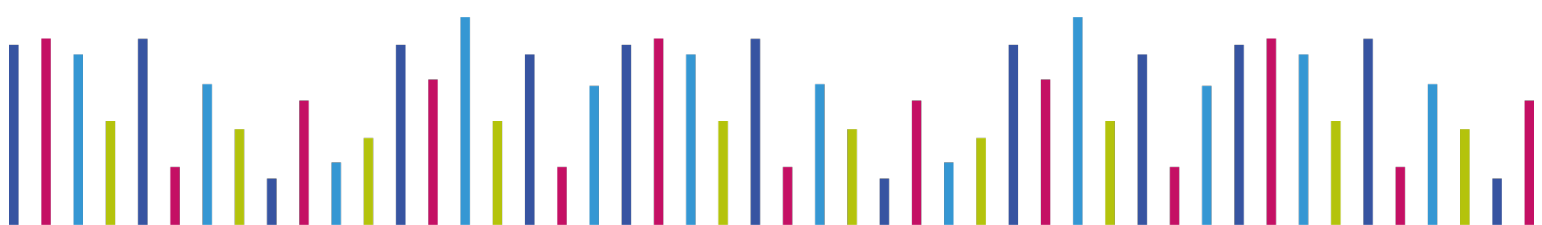
DESY provides material and organizes the communication between the groups. The team consisting of scientists, students and event experts came up with some new highlights: activities for anyone who wants to spontaneously join in on the day, including a quiz on astroparticle physics and a drawing and selfie competition on social media. Those who do not live near a venue could also participate without conducting their own experiments. The Cosmic@Web website provides data from long-term experiments and tools for evaluation.

Another special feature was the online masterclass for Ukrainian students in Ukraine. This was held in cooperation with the organisation Astrosandboxers and young scientists at **DESY** in Zeuthen.

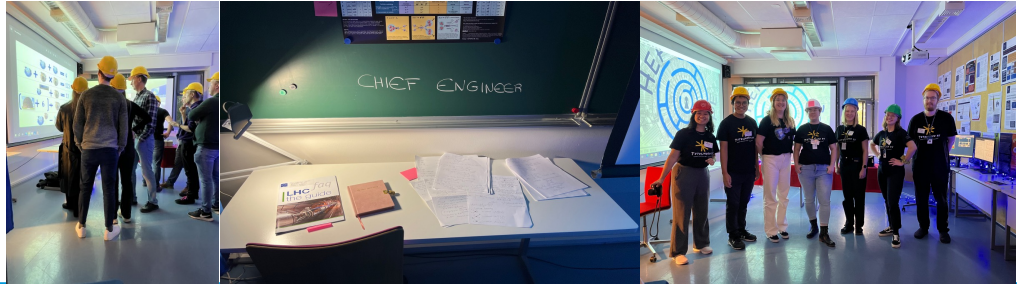
<https://icd.desy.de> | <http://globalcosmics.org> | <http://cosmicatweb.desy.de>



Winners of the Cosmic Selfie and Drawing Contests.



The highlight for outreach in Finland in 2023 is the creation of a 'HEPScapeRoom' – an escape room with a HEP theme. A. Önnerstad and her team in the University of Jyväskylä created the room for 'escaping from the ALICE experimental cavern', following the example of the INFN Rome where such an escape room was first created for CMS. The escape room was well received by the public during the Researchers' Night. Photos A.Önnerstad and L.Huhta.



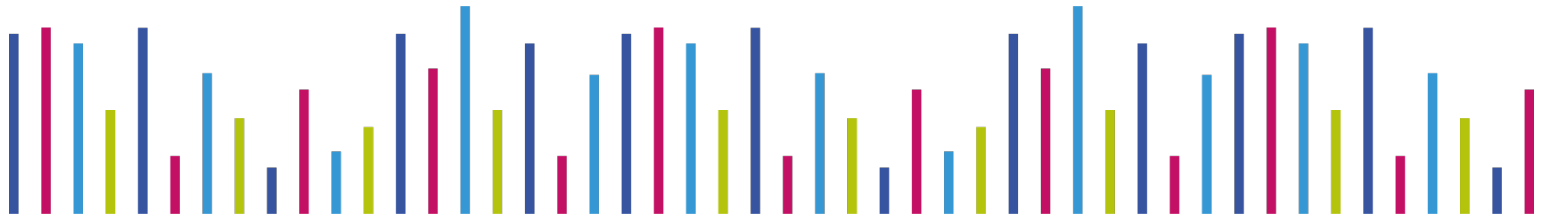
The Researchers' Night in the Observatory of Helsinki with the traditional quiz (modified from Masterclasses, very popular), cloud chamber, magnetic accelerator (huge success for children under school-age), particle detectors made of beer/soda cans etc.

Photo J.Aaltonen



High school students participating the Physics Masterclasses studying the collision events in the CMS detector. Is it a Z or a W boson.. or a Higgs!

Photo T.Lindén



Introducing **young people** and the **general public** to **basic science** (nuclear physics, particle physics, cosmology and astrophysics), the **technological advances** required (accelerators, detectors, computer science) and the related **applications** (energy, health, etc.), is a key mission for the **31 CNRS/IN2P3 laboratories, infrastructures and national platforms**, and the **CEA/IRFU**.

Educational and outreach activities are carried out in close collaboration to teachers and take many forms: in-person, online, virtual, websites, exhibitions, educational detectors, printed and media resources, training courses, etc.

Our goal: to give people a taste for science and physics

In 2023 we have had a mix of continuing, long-established, outreach and educational activities, some one-time events well-covered on social medias, and the first opportunities provided by the special “2023-2024 schoolyear of physics”.



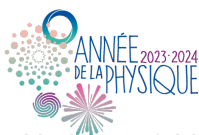
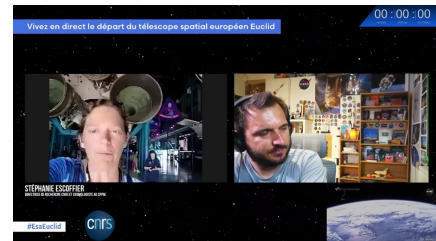
45 happy teachers & organizers (CERN, CNRS/IN2P3, Sciences à l'École) during the 2023 **French Teacher Programme**: a doubled group for the year of physics!



On July 1st, the successful launch of the **Euclid space telescope** targeting the dark side of the Universe has been **viewed live** or

in replay by 150k people connected to a happening with scientists from all aspects from the project

and animated by a YouTuber. This has been among the climax of our **social media** activity for the whole year 2023.



The French Ministry of National Education, the CNRS, the CEA, “France Universités”, the French Physical Society and other partners have dedicated the **2023-2024 schoolyear** to **physics**. This outreach and education event targets both the schools and the general public, with the twofold goal to **promote** this field and to **bridge the growing gap** between science and society. 120+ actions organized across the country have been certified,

including the **Masterclasses** and the French Teacher Programme.

These, and many other resources, can be found on the website anneedelaphysique.cnrs.fr, created for the occasion. As shown

on the right, a project permitted by this action has been the rejuvenation of **primary school lessons** given by **Marie Curie** a

century ago: a modern and inclusive layout, in accordance with the spirit with which these lessons, still relevant today, were created!



IPPOG MASTERCLASSES








9th of March

- University of Debrecen, Debrecen, Hungary
- Helsinki University, Helsinki, Finland
- INFN, Perugia, Italy
- Kharkiv National University, Kharkiv, Ukraine
- Georgian Technical University, Tbilisi, Georgia
- Constantine University, Constantine, Algeria


13th of March

- TU Dresden, Dresden, Germany
- Georgian Technical University, Tbilisi, Georgia
- University Mohammed Firs, Oujda, Morocco

9th of March
Georgian Technical University



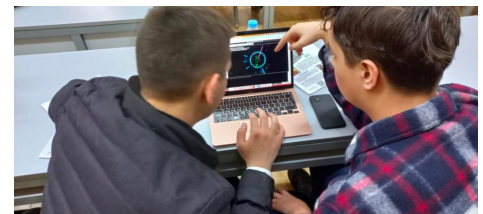
Georgian Technical University




Universities:

- University of Debrecen, Debrecen, Hungary
- Helsinki University, Helsinki, Finland
- INFN, Perugia, Italy
- Kharkiv National University, Kharkiv, Ukraine
- Georgian Technical University, Tbilisi, Georgia
- Constantine University, Constantine, Algeria

Participants: 26 students from Tbilisi region
9 State schools



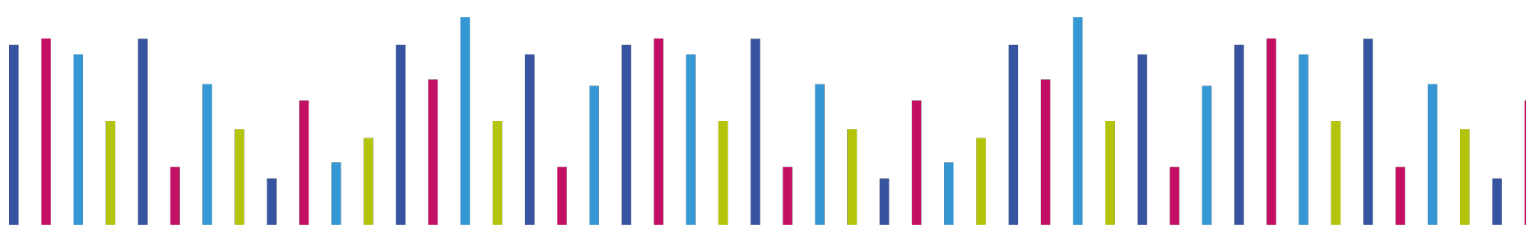
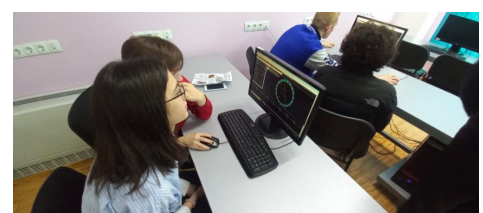
Georgian Technical University




Universities:

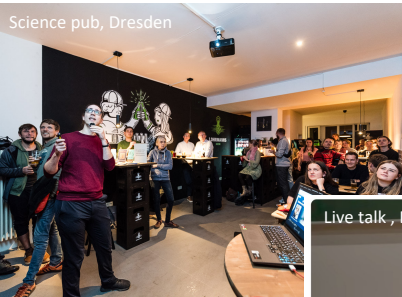
- TU Dresden, Dresden, Germany
- Georgian Technical University, Tbilisi, Georgia
- University Mohammed Firs, Oujda, Morocco

Participants: 22 students from Tbilisi region
7 State schools







Accelerator tour, Bochum



Science pub, Dresden



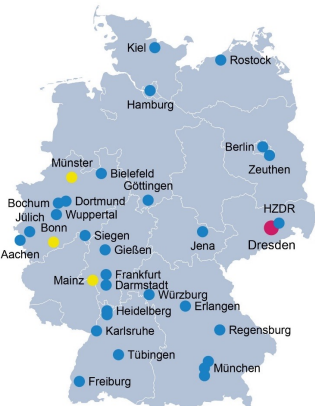
WOCHE DER
TEILCHENWELT
06.11. – 12.11.2023
Landing page



Live talk, Dresden and YouTube

Abendvortrag: Besteht die Dunkle Materie aus Schwarzen Löchern?
Netzwerk Teilchenwelt
419 subscribers
41K views Streamed 4 months ago

Topical Week on Smallest Particles
30 events at 15 places over Germany from masterclasses to lectures and guided tours (more than 1100 people) plus Online events and virtual visits to all 4 LHC experiments (350 people live, more than 40 000 YouTube streams)



Collaboration 136 groups in nuclear and (astro)particle physics at 34 universities and research centers signed LOI for Netzwerk Teilchenwelt






Public places and fairs
Mobile exhibition *Urknall Unterwegs* (13 stops), activity items at fairs and events attract broad audience (Virtual reality, dry ice, LEGO models and puzzles)




Hard Probes, Aschaffenburg


Multi-Step Program of Netzwerk Teilchenwelt – Cloud chamber workshops and masterclasses in high schools, own research at CERN, Germany-wide fellow program.




Cloud chambers, Münster



ATLAS MC, Mainz

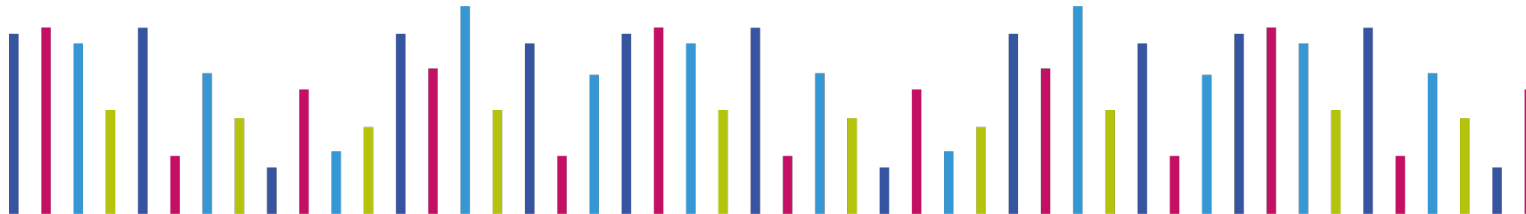


Detector workshop, Bonn



Fellow meeting 2023

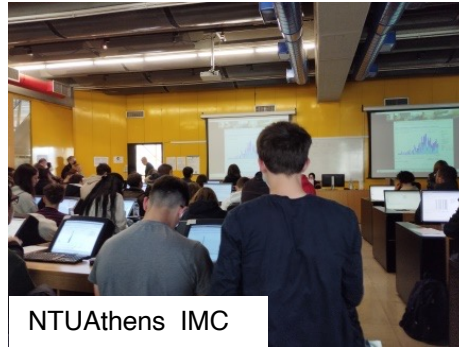
133 active fellows (50% female)
12 students @ CERN, 2 week project
42 students @ CERN, 3 day workshop
46 CERN@ home workshop
122 Masterclasses



In 2023 nine Masterclasses took place in Athens, Crete, Thessaloniki and Patras (new) with a total of about 580 high-school students and 40 teachers. Also two masterclass, for the International Day for Women and Girls in Science and a Particle Therapy one, took place in Thessaloniki.



UoAthens IMC



NTUAthens IMC

In winter, spring and autumn 2023, a number of mini-masterclasses took place in local schools. These included lectures by HEP scientists, hands-on at the school's PC labs and a Virtual Visit to a LHC experiment.

After the CERN group visits were resumed in May 2022, a large number of schools visited CERN (5.5% of all visits)!



Mini-masterclass in Chalkida



Mini-masterclass in Avlonari

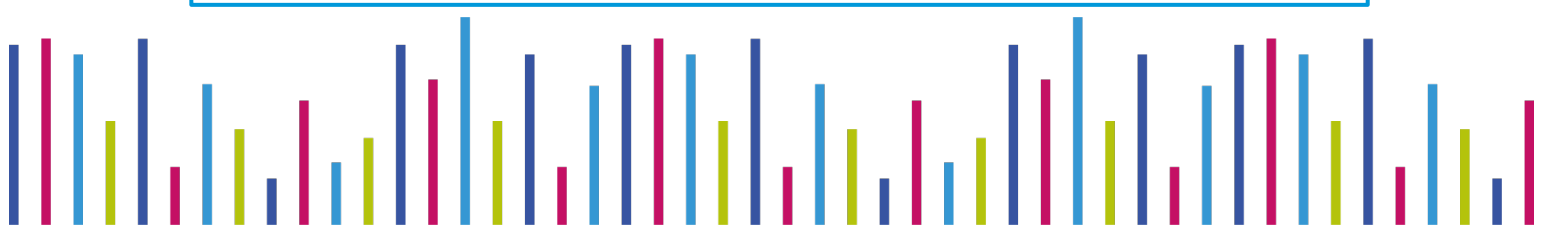


Greek Teacher Programme

27–30 Aug 2023
CERN

30 August 2023 to 2 September 2023
CERN

The Greek teacher program coordinated by Prof. E.Tsesmelis took place at the end of August-beginning September 2023. The four-day seminars take place at CERN for 75 selected Greek science teachers from every prefecture of Greece. The annual event includes lectures, on-site visits, exhibitions, and hands-on workshops in order to introduce its participants to the cutting-edge particle physics. They in turn, upon their return, are hoped to serve as HEP ambassadors in their schools and pass on the subject to the next generation of physicists and engineers.

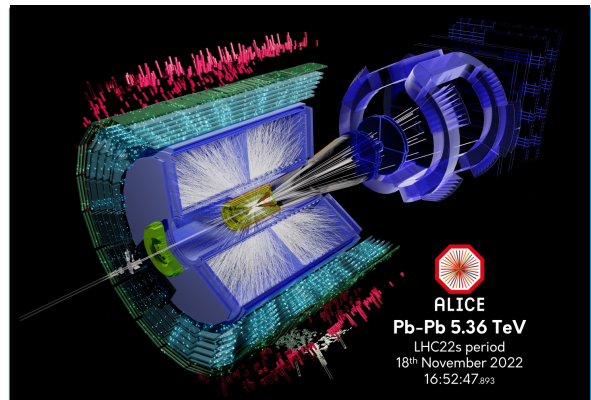




GSI Helmholtzzentrum für Schwerionenforschung - 2023

GSI Representative in IPPOG – Ralf Averbeck

GSI is an IPPOG Associate Member since 2020, with a significant impact on the Masterclass program already since 2010. A Masterclass on the suppression of jets in the quark-gluon plasma produced in heavy-ion collisions has been developed for the ALICE experiment at the LHC. This Masterclass and regular cloud-chamber workshops are the working horses for IPPOG activities at GSI related to particle detectors and heavy-ion physics and ultra-relativistic energies.



Event display of a collision of two lead nuclei recorded with ALICE in Run 3 at the LHC.

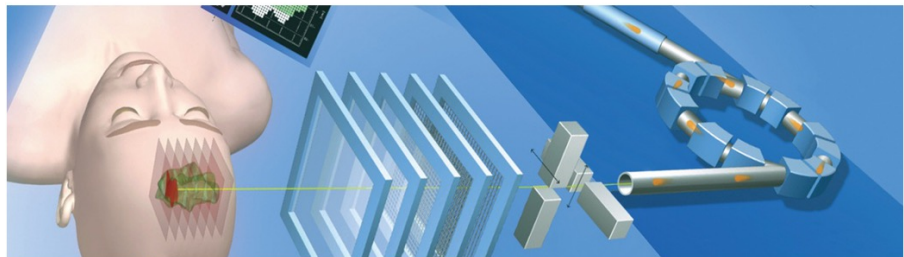


Impression from GSI Open House.

One of the highlight events for the public at GSI/FAIR was the Open House on July 15, 2023. On that day more than 3500 guests visited the GSI/FAIR campus in Darmstadt where, among other attractions, also IPPOG supported activities related to tumor therapy with relativistic hadron beams as well as heavy-ion physics with ALICE were presented.

The second cornerstone of IPPOG activities at GSI is the Particle Therapy Masterclass (PTMC). This program was initiated and is coordinated by GSI scientists since 2020. It has become a very successful world-wide activity in which pupils get an in-depth insight into cancer therapy with particle beams.

In 2023, Particle Therapy Masterclass sessions took place online but also in person at various institutions distributed all over the globe.





HAWC was presented during the Child's day at UNAM campus. The visitors enjoyed more than 40 activities including the HAWC virtual visits, or the cloud chambers



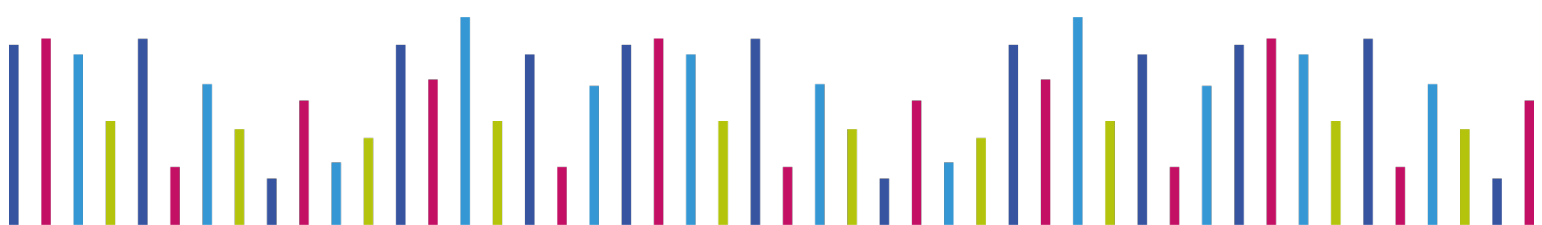
IFUNAM Open Door Days is a well-known event among High School Teachers and students. HAWC was one of the favourites sections of this virtual event.

In 2022, it became possible to start hosting science festivals, and Children's Day provided the first opportunity. On April 30th, at the UNAM esplanade, parents and children had the chance to delve into various scientific subjects, in particular, they could learn about the HAWC and witness the passage of cosmic rays through the installed cloud chambers. On December 3rd, "La noche de las Estrellas" took place in Mexico City's Zocalo Square. This is Mexico's most significant science outreach event, which offers to people of all ages, the opportunity to spend an afternoon exploring and marveling at the Universe. HAWC made its presence felt with virtual tours, an electronic event simulator, and the cloud chambers, which allowed children and adults to gain insights into and observe cosmic rays reaching Earth. The "Bingo HAWC" game was designed and executed with resounding success among the attendees. In addition to these events, in November, the IFUNAM open doors have consistently provided an excellent opportunity for high school students to delve into various physics topics. Particularly with HAWC, they could learn about the most energetic events in our Universe.



Noche de las Estrellas

More than 200,000 visitors enjoyed "La noche de las Estrella" in Mexico City Downtown. HAWC presented a photograph exposition besides activities as; virtual tours, cloud chambers and Bingo HAWC.



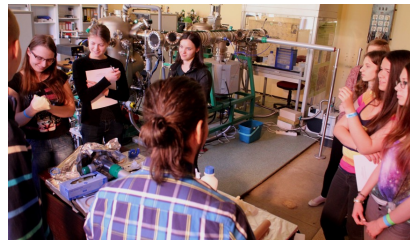
Popular lectures, hands-on masterclasses, researcher's nights, student science camps, detector building for high-school students at Eötvös Loránd University and the Wigner Research Centre for Physics in Budapest, at the Óbuda University in Székesfehérvár, and at the University of Debrecen.

Hungarian Teachers Programme at CERN (19-26 August) with 20 physics teachers attending and its post-meeting in December organized by the Wigner RCP (<https://indico.cern.ch/event/1294242/timetable/>).

From the Atoms to the Stars: popular lecture series at Eötvös Loránd University (<http://atomcsill.elte.hu/>)



Particle hunting for high-school girls in Debrecen and in Budapest



Hungarian Teacher Programme at CERN:
Wire chamber building



High-school masterclass at Eötvös University





- 84 students participated
- Lectures on Introduction to Particle Therapy and Particle accelerators
- Hands-on training session: Treatment planning software



PTMC-2024 Poster

<https://indico.cern.ch/event/1381832/>

Particle Therapy MasterClass (PTMC) – 2024 was conducted on 15th March, 2024 at NISER campus, Jatni, Odisha, India



Students busy in MatRad hands-on session



Programme ended with quiz competition and winners awarded with prize by their teacher



In 2023 INFN joined many science festivals, organizing numerous live shows. Several of them had a special focus on the research in gravitational waves and AI. The 2022-2024 edition of “Art&Science across Italy” saw the participation of 9000 students from 200 schools and 19 cities. The Italian science literature price “Asimov” involved 200 schools and 14,000 students. In February-March the 2023 IPPOG Masterclasses saw the participation of 3000 students and so did the Italian edition of the “International Cosmic Day” in November. In May INFN’s researchers took part in “Pint of science” in the pubs across Italy and INFN’s escape room called “HEPscape!” was featured at the Modena Play Festival. In July the video-mapping “Shapes and colours of a discovery” was at the visual arts festival Videocittà in Rome. In October “INFN-Kids” (a project for 5-12 years old kids) participated at “Quantum 2023” in Gardone Val Trompia. In December INFN inaugurated a new national exhibition about quantum mechanics called “Quantum. The revolution in one leap” at the Science Museum Muse of Trento.

Podcast

- “Radici” (Roots)
(10 episodes)

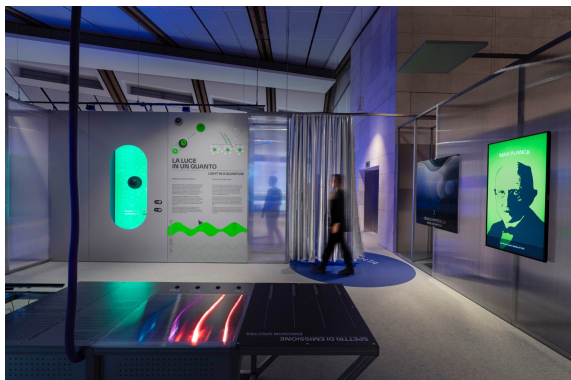
Secondary school students narrate the stories of 10 scientists.

- “Traiettorie” (Pathways)
(6 episodes)

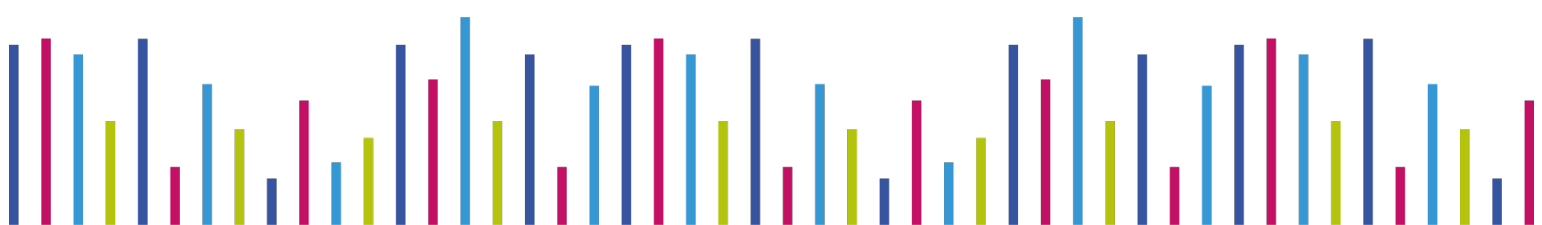
The course of studies of six laureates in physics or other STEM disciplines is at the heart of this podcast to give secondary school students an orientation for their future



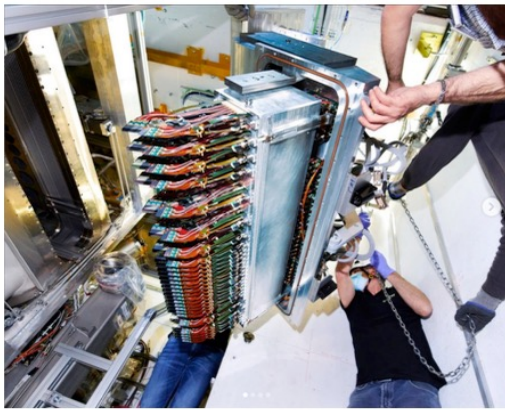
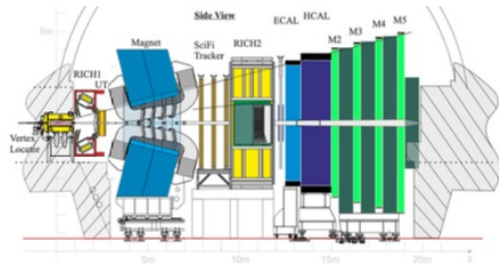
“Ideas and images of art and science”, a live show with Massimiliano Fuksas and Giorgio Parisi at the Science Festival of Rome (18th April).



The exhibition “Quantum. The revolution in one leap” can be visited in Trento at the Muse museum till 15th June 2024.



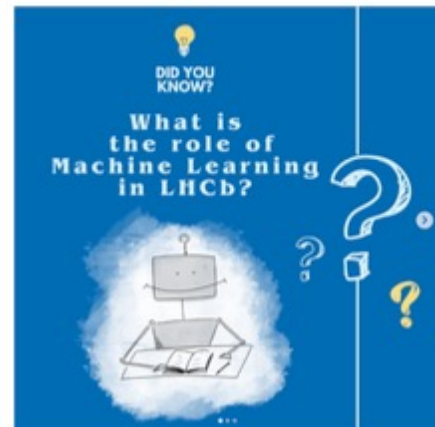
LHCb underwent a complete rework with most of the detector components replaced. The new incarnation of LHCb, Upgrade I, started taking data in 2022



The surface exhibition at LHC P8 also received a massive upgrade, with interactive cinema room and exhibits of the new subdetectors

Growing Online Community

Work towards a consistent brand identity on social media



 30800 followers

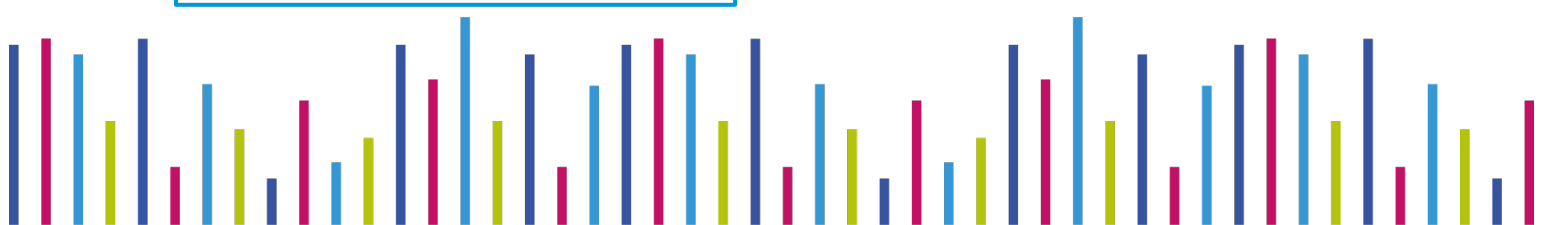
 20600 followers

 17300 followers

Also on:   

Many Outreach activities:

- Masterclasses for hundreds of students worldwide
- **3554** underground visitors
- Masterclasses for hundreds of students worldwide
- Over **850** virtual visitors
- Coverage of Upgrade and commissioning activities
- LHCb VR experience



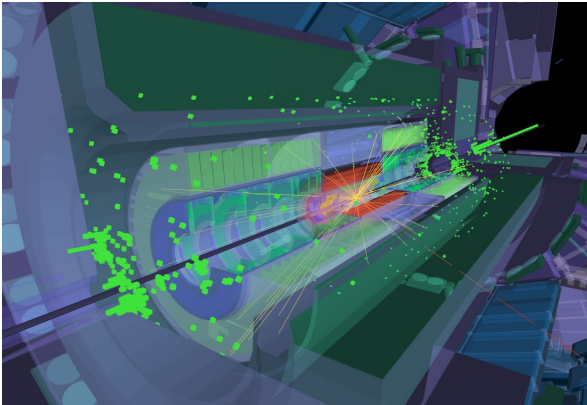


IPPOG activities in 2023

- ❑ International Particle Physics Masterclass organised at University of Montenegro at Faculty of Science and Mathematics in Podgorica on 24th of February. The best student from schools all over Montenegro participated.
- ❑ Days of Science in Montenegro 2023 (September, 27 – 30)
 - Short particle therapy masterclass
 - Particle detectives show by Michael Gregory
- ❑ European Researchers Night 2023 (29th of September)
 - Popular videos of CERN, collisions, particle production explained to visitors
 - Visitors learnt how we reconstruct particles at LHC through the “LHC: Connect the dots”

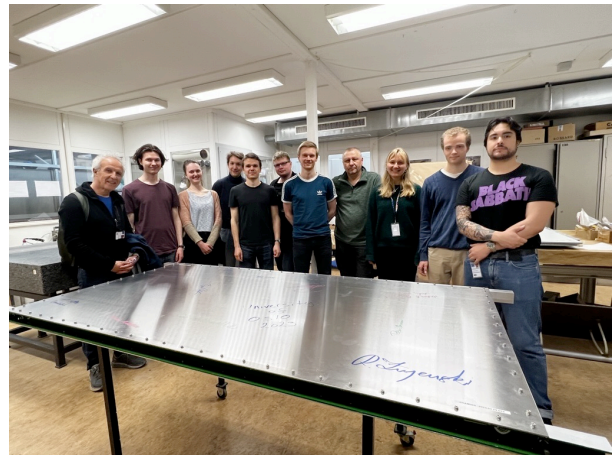
The Oslo-developed Z-path confirmed in 2023 its position as the most popular of the international masterclasses with more than 80 participating institutes world-wide.

Several developments of the Z-path are being worked on. A collaboration with the Georgian Technical University to enable use of the 3D Tracer event display app in Z-path has started. There is also work ongoing to include the planned release of ATLAS Open Data for Education into Z-path.



The international masterclasses were arranged twice in Oslo in 2023, gathering in total **345** pupils from **20 high schools** all over Norway.

In 2023, ten students from Oslo took part in a trip to CERN to build a particle detector as part of a course, *Research-based particle physics*, at the University of Oslo. The students built a multigap resistive plate chamber (MRPC), from scratch, guided by an engineer and physicist from the EEE network.



The efforts of bringing hands-on activities continues through further development and exploitation of the **Zpath Galaxy portal**. This is a web-based interface where anyone can get access to computing resources and research data (e.g. the ATLAS Open Data) for performing simple analyses using Jupyter Notebooks. This is already being used in several courses at the University of Oslo.



Pierre Auger Observatory - 2023

Pierre Auger Collaboration Representative in IPPOG – Raul Sarmento

The Pierre Auger Observatory, the world's largest experiment dedicated to the measurement of ultra-high-energy cosmic rays, formally **joined IPPOG in 2023**. During this year, the Auger Masterclasses made a **successful debut at the IMC2023** with 3 sessions of high and enthusiastic participation. The visitors center, open to the public at the observatory facilities in Malargue, Argentina, was renewed and has received **a record >10000 visitors** during 2023. Female Auger scientists shared experiences and artworks to celebrate the International Day of Women and Girls in Science. Other initiatives took place, such as the program of virtual visits to the observatory and the participation at the International Cosmic Day. The outreach activities have been advertised via the observatory social network accounts and presented at the CSSP, ICRC and TAUP 2023 conferences.

Auger International Masterclasses

Premier @ IMC2023

- 3 full-day events
- 550 high-school students
- 12 institutions
- 5 countries

@ ICD2023

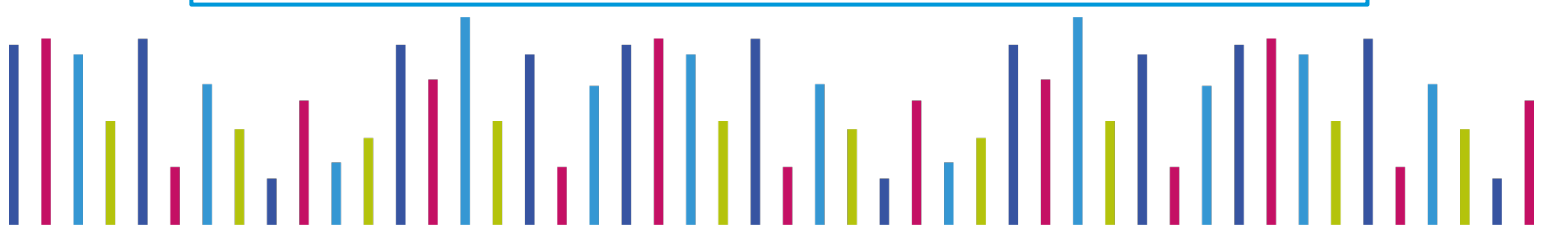
- Germany and Ukraine

@ local institutions

- 3 events

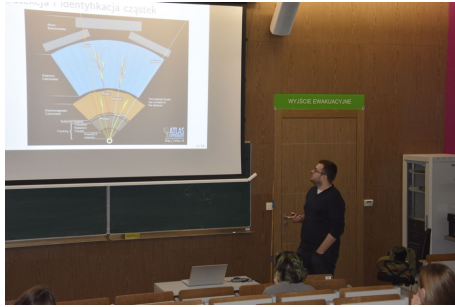


Virtual visits to the observatory are arranged online, with scientists showing the observatory facilities and the detector workings, or provided by a virtual-reality tour to the field.



International Masterclasses in Poland

at schools and universities:
Katowice, Kielce, Kraków, Tarnów,
Warszawa - 370 participants



remote Masterclasses
282 participants from 16 schools

Interviews (at YouTube)

AGH science meetings
spotkania.agh.edu.pl
*Higgs particle, Internet, and
lightsabers*



www.copernicuscenter.edu.pl
*Fizyka cząstek elementarnych –
przekraczanie granic poznania*
(352k views)



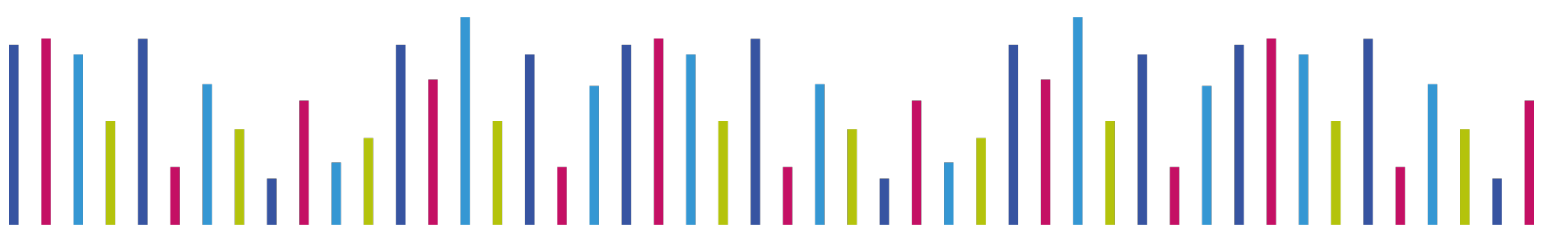
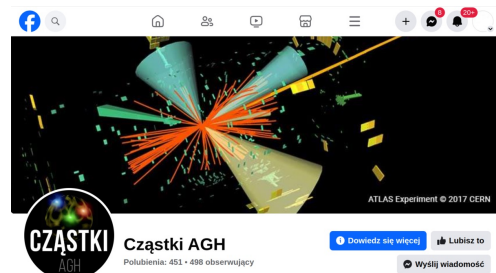
Fizyka jest prosta

(Physics is easy - YouTube)
Time dilatation
(63k views)



Facebook

news on elementary particles
www.facebook.com/CzastkiAGH





Masterclasses based on data from the Pierre Auger Observ. developed at LIP and implemented in the IMC programme (@Lisbon-IST with 180 partic.)



R-ECFA Meeting in Lisboa (September 14th-15th), associated with a fully packed public session featuring CERN's DG (Fabiola Giannotti) talking about "The Higgs boson and our lives".

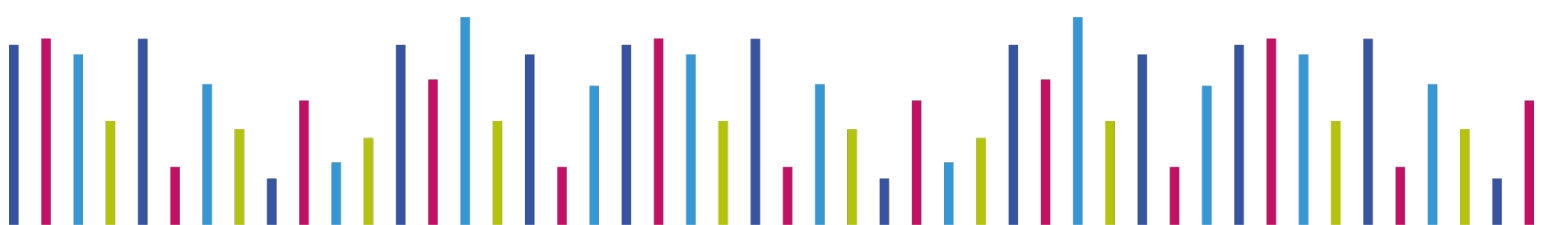
Apart from these highlights we held more than 50 outreach talks at secondary schools and several other events. Some of the most noteworthy of these were:

- Celebration of the International Day of Women and Girls in Science.
- International Masterclasses in Particle Physics, organized again in presence for a total of 1000 students in 13 sessions.
- Development and implementation of Virtual Reality software for "3D Goggles", featuring the Pierre Auger Observatory.
- Two-week internship for high school students with 9 participants.
- CERN Portuguese Language Teachers Programme had its 15th edition, again with teachers from all Portuguese speaking countries, thanks to the support from Instituto Camões (M.N.E./PT) to the African and East-Timor teachers.
- European Researchers Night 2023: in-person public demonstrations and dialogues with researchers in Braga, Coimbra and Lisboa.



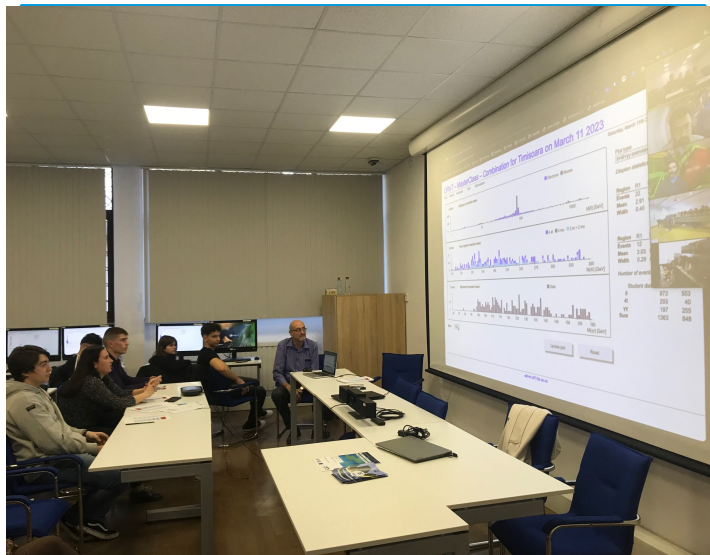
200 visitors
50 researchers
involved

on the second LIP Open Day (Dec.7th,2023), six years after the first, profiting of an inauguration of a new University building close to LIP's premises.





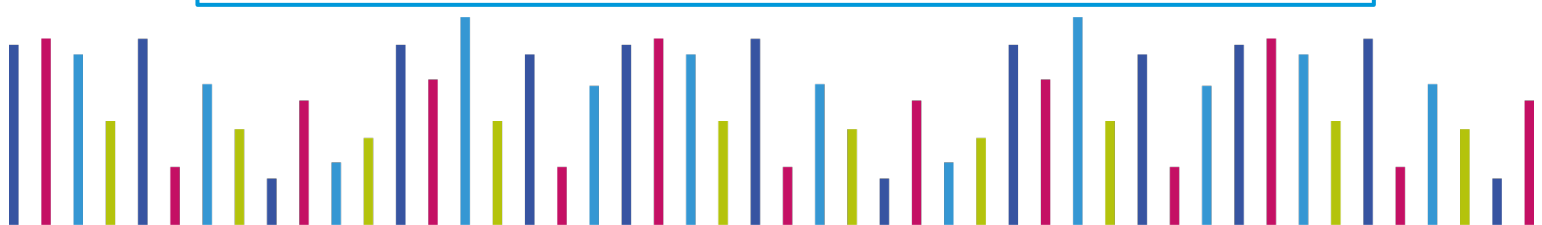
International Masterclasses are taking place every year at major Romanian Universities in Bucharest, Iasi, Timisoara (ATLAS W- and Z-path) and Suceava (LHCb). Also, European Researchers Night and Open Gates events at the same universities include presentations of CERN.

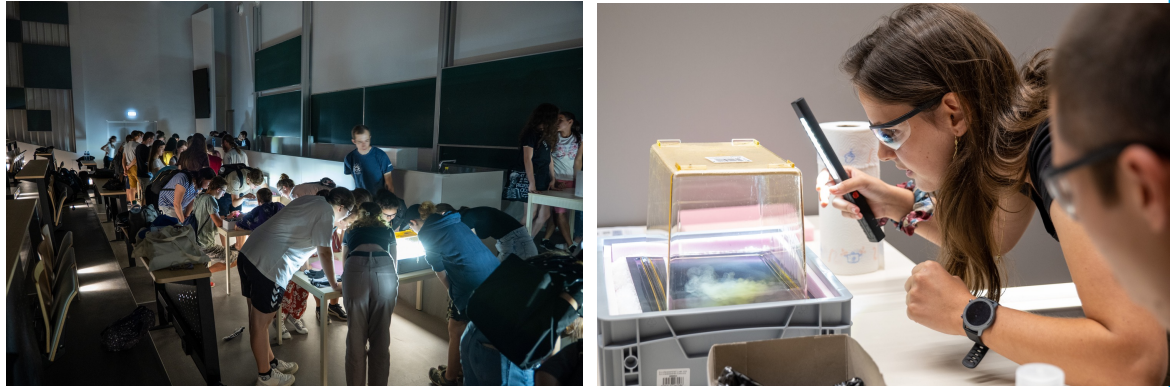


- "Romania@CERN – Open Symposium 2023", Măgurele, January 11, 2023 organized by the Institute of Atomic Physics and the University of Bucharest. The event coincided with the meeting of the International Scientific Advisory Board (ISAB) on the occasion of the 10th anniversary of ISAB's founding. The symposium was attended by students and pupils, teaching staff from the university and pre-university environment, together with government representatives, directors of research and development institutes.

- "Romanian Students Internship Program 2023 (SIP - RO)", CERN, November 2023 offered the opportunity to a group of 12 nationally selected Romanian students to participate for two weeks in dedicated activities within CERN: courses; visits to experiments, projects in international research teams, etc.

- The "Discover the Universe with Romania@CERN" conference, December 15, 2023, Rectorate of the University of Bucharest, dedicated to disseminating the results of the SIP-RO programme.





The cloud chamber workshop during the celebrations of 30 years of the Slovak Republic at CERN



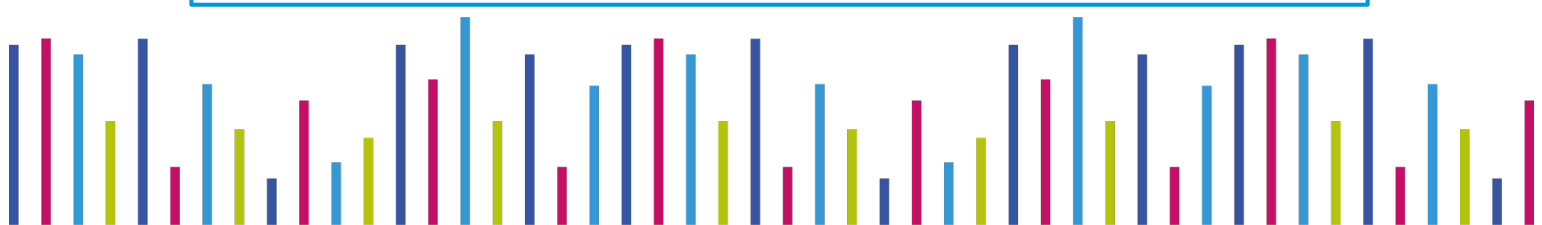
Charlotte Warakaulle presents the award to the winner of the Cascade competition



International Particle Physics Masterclasses (13.2. - 1.4. 2023): masterclasses were organized at five universities: Bratislava, Košice, Banská Bystrica, Žilina, and Nitra with hundreds of students participating.

Cascade projects competition for high schools (March-Jun 2023): students competed with 5 min video presentations on physics topics. Videos were uploaded on a Youtube channel and judged by the jury. The winners were awarded the prizes during the celebrations of 30 years of Slovakia at CERN.

Slovakia@30 celebrations: 100 high school students participated in the programme held in **FMFI UK** Bratislava 27.6. 2023. The programme included lectures, ATLAS virtual visit and the cloud chamber workshop. A similar event was held in Košice 15.6. 2023.



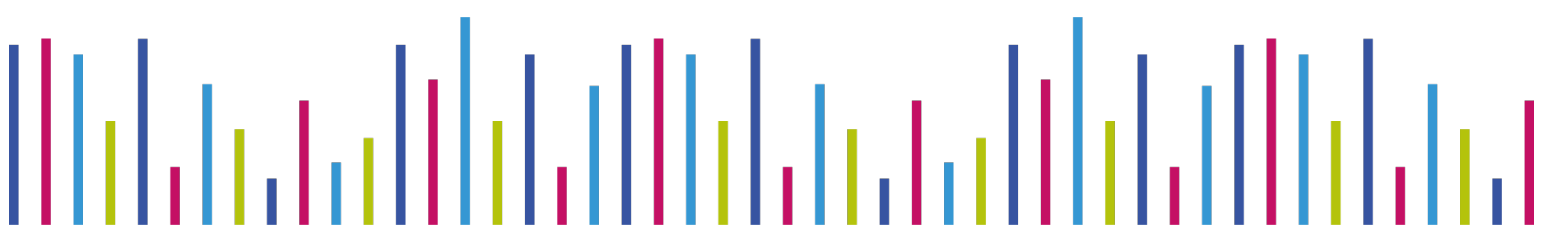
Masterclass March 23

- ATLAS, Belle II and, for the first time, particle therapy IMC
- Virtual visit to Belle II
- 40 students from around the country



CERN Teacher Programme September 2023

- 11 teachers and a very intense programme
- Included a taste of ATLAS IMC



International Masterclass returns to iThemba LABS

The International Masterclass creates an opportunity for high school learners to experience the world of particle physics through a day-long immersive intervention. The learners interacted with particle physicists in person, and through online platforms, to analyse and interpret recent data measured at the Large Hadron Collider (LHC) at CERN, located near Geneva, Switzerland. The masterclass that was coordinated by the International Particle Physics Outreach Group, introduced the participants to the physics after the Big Bang, as they mined data in search of elusive forms of matter. Through their interactions with their tutors and fellow learners they were not only learning NEW science, but they were also introduced to role-models. These engagements are needed to shift perceptions related to the fact that science is only accessible to certain groups, or that science is boring and unattractive. The day was finished off by participating in an international videoconference with peers in Greece and Germany, and particle physicists based at CERN. This was the 8th event of its kind being hosted at iThemba LABS and another is planned at the end of March. The event hosted on **Friday, 10 February 2023**, created an opportunity for iThemba LABS to celebrate the International Day of Women and Girls in Science as proclaimed by UNESCO. The event was attended by 20 female learners from 10 different schools. A special word of thanks to the principal investigators linked to ALICE and their postgraduate students for making this a reality. It is clear that teachers and learners are excited by the return of this immersive experience after the restrictions endured during the pandemic.

African Conference of Fundamental and Applied Physics

The 3rd African Conference of Fundamental and Applied Physics, ACP2023, took place from 25 – 29 September 2023 in George, South Africa. The event was organized jointly by the African School of Physics, the South African Institute of Physics and Nelson Mandela University. The chair of the organizing committee was Prof Azwinnidini Muronga and the programme included invited and contributed talks, poster sessions, and discussions in:

- Particles and related applications: particle accelerators, detectors and instrumentation, computing, particle physics, nuclear physics, medical, fluid and plasma physics, complex systems;
- Light sources and applications: light sources, condensed matter and materials physics, atomic and molecular physics, laser physics;
- Physics engagements: physics education, early career physicists, women in physics, community engagement.

Here is a link to an article written by Prof Muronga:

<https://news.mandela.ac.za/news/media/Store/documents/2023/Science%20Supplement/Shaping-the-Future-of-Science-for-Society.pdf>



Spanish HEP institutions continuously dedicate a remarkable effort in science promotion. In 2023 a new national network for particle physics was launched in order to serve as forum for information exchange and sharing of experiences.

The Spanish community celebrated the 50th anniversary of the International Meeting of Fundamental Physics in Santander with several outreach events, such as an encounter with high school students called 'A morning among scientists' and public conferences.



'A morning among scientists' - Santander



Science Week - Santiago de Compostela

Most Spanish institutions have a regular participation in different programmes of talks in schools, seminars and educational programmes, as well as the IPPOG Masterclasses. There's also a continuous participation in large events such as the Science Week, Dark Matter Day, Day of Women and Girls in Science and European Researchers' Night.



Science fest - Barcelona



European Researchers Night - Palma de Mallorca



Dare to investigate - Madrid

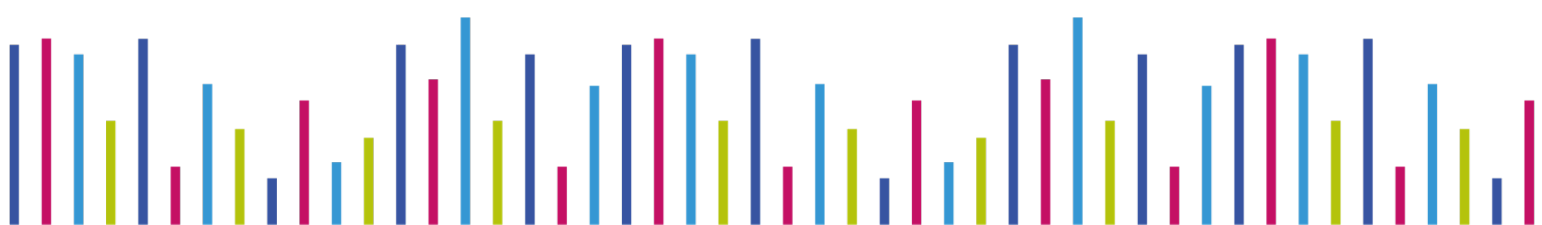
Moreover, our presence in mass media is steady, as well as the creation of multimedia material. Last, there have been several initiatives linking art and science, as well as numerous special educational initiatives.



Quantum Harmony - Valencia



MEDRA Project - Santiago de Compostela





Scientifica

Zurich Science days with 20'000 visitors

Booth on particle physics with cloud chamber and scattering experiment

Guided tours

(UZH/ Katharina Müller)

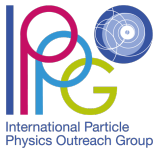
Open your eyes
open-air photo festival:

World-class science
meets world-class
photography
the code of the universe
photo exhibition, guided
tours, talks



(ETHZ / Alessandro Della Bella)

- Many workshops for high-school students in particle physics and cosmology
- International Day of Women and Girls in Science:
Special workshops from female researchers
Female scientist present their work to school classes
Interviews with and portraits from women in research
Special activities/workshops for girls
- Masterclasses with about 250 participants
- Women in Physics Career Symposium
- Guided tours through the physics exhibitions
- Exhibition on Gravitational Waves at the Science Pavilion UZH
- Open Days



United States of America - 2023

United States of America Representative in IPPOG – Spencer Pasero



Visitors explore activities at the reopening of Fermilab's Wilson Hall



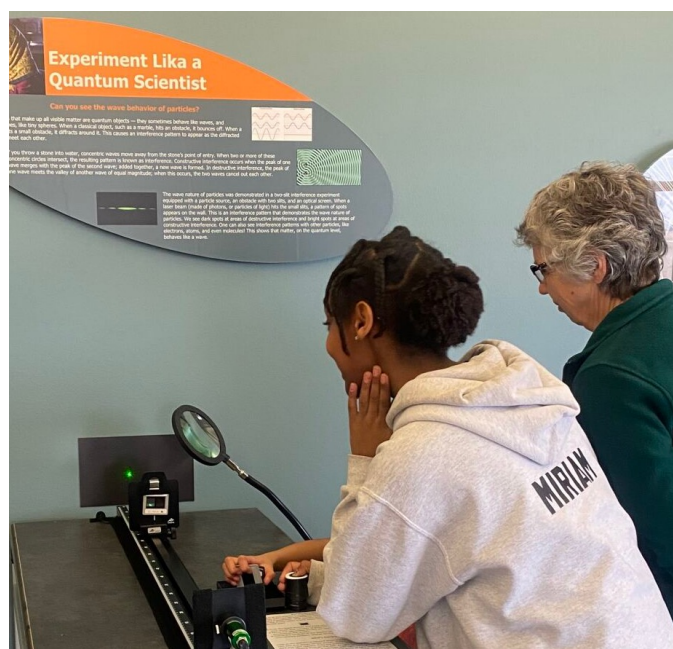
A Fermilab Education Facilitator gives a tour to a public group

QuarkNet and Fermilab continued to lead the way for United States particle physics outreach in 2023. QuarkNet is the leading U. S. professional development program for high school physics teachers interested in particle physics, and Fermilab is the home for QuarkNet's cosmic ray program and the lead institution for DUNE and the U. S. neutrino program.

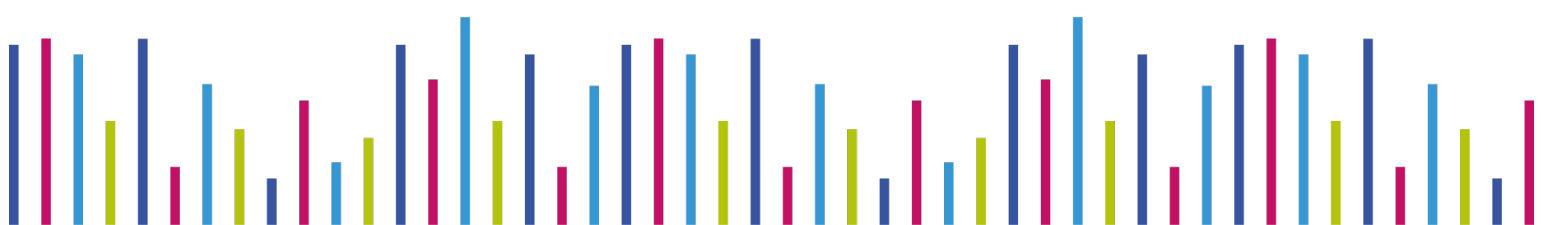
QuarkNet has continued to be a major partner in IPPOG's International Masterclasses, continuing work with the LHC and MINERvA masterclasses, and piloting the NOvA masterclass in preparation for the official 2024 launch. Fermilab supported 33 videoconferences for a total of 53 centers serving a total of more than 1,000 students in 2023. Fermilab and QuarkNet were also active in supporting IPPOG's cosmic ray efforts through participation in International Muon Week and International Cosmic Day.

QuarkNet continued hosting national workshops for high school teachers, including Data Camp and three levels of Coding Camp. In Data Camp 24 teachers come together from across the country to work with LHC data and develop ideas for conducting particle physics analysis in their classrooms. QuarkNet's Coding Camps support high school physics teachers in incorporating coding and computer science activities into their physics classes.

Fermilab welcomed more than 6,000 public visitors to the site in 2023, hosting a major public event in October blending physics and ecology educational activities, and welcoming the public back for regular tours in addition to their extensive school field trip program.



A student explores the new double-slit experiment at Fermilab's Lederman Science Center





International Particle
Physics Outreach Group

ippog.org

