CERN Bulletin

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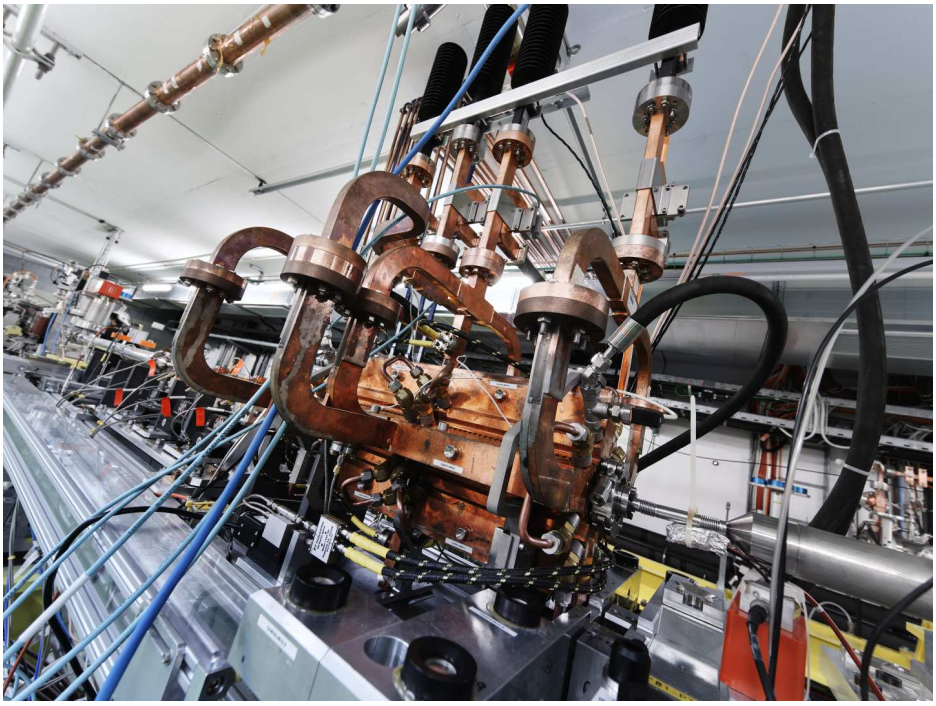
CLEAR STUDY PAVES THE WAY FOR NOVEL ELECTRON-BASED CANCER THERAPY

The study, conducted at CERN's CLEAR test facility, demonstrates how very high-energy electron beams can be focused onto deep-seated cancerous tumours



CERN's CLEAR facility, where tests on very high-energy electron beams were carried out (Image: CERN)

There are some cancer tumours that not even surgery, chemotherapy or traditional radiation therapy can cure. These resistant tumours contribute to making the disease one of the main causes of mortality worldwide, but the scientific community is teeming with ideas to make cancer fatalities a thing of the past. Among the latest medical and technological innovations, progress in **particle therapy** – the process of irradiating tumours using highly energetic particle beams generated by a particle accelerator – allows the treatment of tumours that would otherwise have been fatal.

More than 10 000 small electron linear accelerators (linacs) are currently used for cancer treatment worldwide. Most of these machines rely on **photon beams generated by electrons** to irradiate their target. Some, however, use the electron beam itself for direct **low-energy electron irradiation**, although this can only reach superficial tumours. These methods differ from **hadron therapy**, a technique based on irradiation with protons or heavy ion beams.

A possible complement to hadron and low-energy electron therapy is the use of **high-energy electron beams** within the 50-200 MeV range, which can penetrate deep into tissues.

(Continued on page 2)

A WORD FROM CHARLOTTE LINDBERG WARAKAULLE

A WARM WELCOME BACK TO OUR VISITORS

"The visit has been cancelled." For many of us working on CERN's public engagement, that phrase has become emblematic of the past 15 months as thousands of visits to the Laboratory had to be cancelled or postponed. But, hopefully, we can now consign this phrase to the past.

(Continued on page 2)

In this issue

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A WORD FROM CHARLOTTE LINDBERG WARAKAULLE

A WARM WELCOME BACK TO OUR VISITORS

On 1 June 2021, CERN restarted a number of activities for the public after having had the doors closed for visits and events due to the COVID-19 pandemic. Openness, engagement and sharing of knowledge with the public are part of our CERN DNA, and it was difficult to have to disappoint the many people who had planned to visit us during the pandemic. We are therefore delighted to welcome our first visitors back on site, although the reopening is of course gradual – initially just the Microcosm exhibition, CERN Shop and events at the Globe – and highly dependent on the health situation, in line with CERN's COVID-19 scale and measures.

I say "on site" because the pandemic did not prevent CERN from welcoming many visitors, virtually. Our disappointment at the many cancelled visits was transformed into a burst of creativity and innovation in the way that we engage with the public.

The Visitor and Events Operations and the Teacher and Student Programmes sections deployed a wide range of online activities, giving people locally and worldwide the chance to learn about CERN, its facilities and its research from their schools and their homes.

Since April 2020, no less than 450 virtual talks have been organised for over 12 000 visitors from 27 countries, for which 40 CERN guides were trained. In recent months, the Visitor and Events Operations section has also conducted virtual tours with guides on site, and has integrated virtual tours of ATLAS and ALICE in its platform, alongside a compilation of CERN's most popular online resources for discovering the Laboratory.

Two online science shows – "It's just a phase!" and "Superconductors take off!" – have been developed by the Teacher and Student Programmes section. In total, 50 shows have been held for over 2300 students aged from 6 to 19 in 15 different countries.

In September 2020, the final stage of the Beamline for Schools competition took place in a hybrid format, with one team on site at the DESY laboratory (Germany) and the other team running its experiments remotely from CERN. For the 2021 edition, two online events were organised for all the pre-registered teams, leading to record participation.

And from October 2020 to June 2021, some 1800 teachers from 40 different countries participated in 13 online teacher programmes, ranging from half-day events to six-week training courses. This represents an undeniable success that could well transform CERN's Teacher Programmes in the long run.

The Protocol Service, with the support of colleagues across the Laboratory, also developed a virtual-visit concept that will provide new opportunities for engagement with decision-makers who wish to know more about CERN but may not be able to visit in person.

These are just a few examples of the many initiatives that saw the light of day during the pandemic. Together with the strong digital storytelling we put in place (engagement with CERN on social media increased by 107%, for example), they are helping help CERN reach an ever-wider public. All initiatives were very positively received, encouraging us to continue innovating. They will not replace the on-site engagement, which will be expanded with the opening in 2023 of the CERN Science Gateway, but provide an important complement to our exhibitions and guided tours, many of which have also been upgraded during the pandemic.

We are thrilled to reopen CERN's doors to our visitors – and to maintain the online engagement that is opening science up to many, many more.

Charlotte Lindberg Warakaulle
Director for International Relations

CLEAR STUDY PAVES THE WAY FOR NOVEL ELECTRON-BASED CANCER THERAPY

However, this technique is rarely used due to the higher **cost** and larger **size** of the accelerator needed to produce them compared to photon facilities. In addition, their depth profile is less well defined than that achieved with hadron beams. Recent developments in high-gradient acceleration for compact linear accelerators, mainly driven by the CLIC study at CERN, have started to change the story.

A recent finding might constitute a further step towards the use of high-energy electron beams. Two studies involving the universities of Strathclyde and Manchester were carried out at CERN's linear electron accelerator for research (CLEAR), a test facility that serves research and development efforts on accelerator technology. Researchers tested a **new irradiation technique involving** very high-energy electron (VHEE) beams focused on a small spot in order to achieve higher beam density. By focusing a VHEE beam

with a large aperture electromagnetic lens, they established that the particles could travel several centimetres deep into a water phantom (a large bucket of water used for studies on radiation) without significant scattering – that is, while remaining focused on a well-defined, targeted volume. Such a beam could thus **theoretically be used to treat deep-seated cancerous cells** with limited harm to the surrounding tissues.

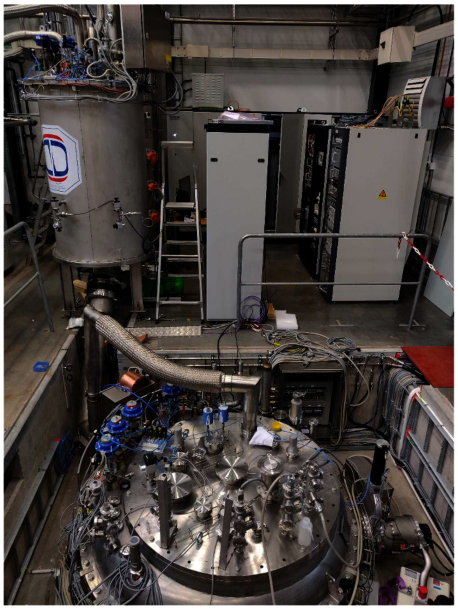
This is promising news for the medical technology community for a variety of reasons: VHEE beams produced by compact linacs in clinical settings would not only offer a **more cost-effective alternative to other particle beam therapies** but would also provide doctors with a **highly reliable medium**, as their scattering in inhomogeneous tissue is limited. These factors **could drastically expand the pool of patients eligible for electron therapy**. Additionally, VHEE beams would be compatible with **FLASH radiotherapy**, a technique for delivering highly energetic particles to tissues almost instantaneously (in less than a second). CERN and the Lausanne University Hospital (CHUV) recently joined forces with the aim of building a high-energy clinical facility for FLASH therapy, with preliminary tests to be conducted at the CLEAR facility.

The ultra-focused VHEE beam is the direct fruit of advances in linear acceleration technology achieved by the CLIC study at CERN. It attests to the relevance of this field of research not only for particle physics but for society as a whole. Although VHEE beams require more research before practical applications in a clinical setting are found, the CLEAR results contribute to widening the field of possibilities for cancer treatment.

Thomas Hortala

QUALIFYING HL-LHC MAGNETS AND CAVITIES AT UPPSALA UNIVERSITY

Uppsala University is upgrading its FREIA Laboratory, initially constructed for the ESS project, to test superconducting magnets and crab cavities for the HL-LHC



The Gersemi vertical cryostat. (Image: CERN)

Uppsala University in Sweden has been a valuable partner to CERN since the Laboratory's foundation. In the 1950s, Uppsala, having just constructed its own cyclotron, contributed to the development of the very first accelerator at CERN, the Synchrocyclotron. In the 1980s, CERN assisted Uppsala in constructing a proton and heavy-ion accelerator and cooler-storage ring named CELSIUS and, in the mid-2000s, Uppsala assisted in the development and operation of the CLIC CTF3 test facility at CERN. Now, Uppsala University is upgrading its FREIA Laboratory, initially constructed for the ESS project, to test superconducting magnets and crab cavities for the HL-LHC.

Uppsala University established the FREIA Laboratory for instrumentation and accelerator development in 2011. It is equipped with a horizontal cryostat called Hnoss, a cryomodule test stand for superconducting cavities, and a vertical cryostat called Gersemi. In Nordic mythology, Hnoss and Gersemi are daughters of the goddess Freia.

A unique feature of Gersemi is its double functionality for both cavity and magnet testing. Cavities are tested in liquid helium at 2 K and sub-atmospheric pressure, while magnets are tested at 2 K and atmospheric pressure. Magnets create a magnetic field that can magnetise any metallic parts around the cryostat, such as reinforced concrete. Since superconducting cavities are very sensitive to magnetic fields, this puts substantially different requirements on the functionality of the cryostat in its two modes of operation.

Gersemi uses different inserts for cavity and magnet testing, and has an active earth-magnetic-field compensation system to shield superconducting cavities, monitored by a prototype 3-axis magnetic sensor produced in collaboration with UK company Bartington Instruments Ltd.

The Gersemi vertical cryostat was installed and commissioned during 2019. During the summer of 2020, a first HL-LHC prototype crab cavity was sent from CERN, installed into Gersemi and cooled down to 2 K. An extensive testing period followed, supported under the EU-funded ARIES project Transnational Access scheme, in which the cavity reached an electric field of 4.6 MV. This was more than 1.2 MV above the nominal design value.

“We overcame a lot of issues and passed plenty of milestones, including mechanical, vacuum, cryogenics and radiation shielding issues,” said Akira Miyazaki, the Superconducting Radio Frequency (SRF) researcher responsible for the test. “We are now firmly on the starting line of the cavity business!”

Simultaneously, preparations for testing an HL-LHC orbit corrector magnet were ongoing. Two power converters and energy extraction units developed by CERN were sent to Uppsala and, on 23 June 2020, the first positive results were announced.

After completing the crab cavity test, the magnet was installed into Gersemi and cooled down, first to 4 K and then to 2 K.

An extensive testing period was performed at both temperatures to commission the complete set-up for superconducting magnet testing. Many small and not-so-small problems had to be fixed, both on the cryostat hardware and on the testing hardware and software. On 1 April 2021, the system was finally ready for the first powering of the cold magnet at 4 K. Two weeks later, the magnet was cooled down to 2 K and successfully powered again. “After encountering difficulties for a few weeks, even months, I am happy to announce that a superconducting magnet has been powered for the first time in the FREIA lab,” said magnet test engineer Kévin Pepitone. “All systems responded as expected.” The LHC superconducting orbit corrector magnet was powered to a current close to the nominal current, and a field of 2.4 T was produced in Gersemi.

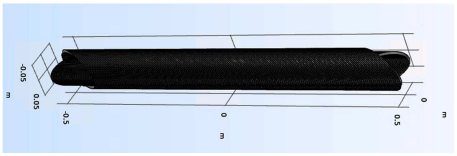
The successful commissioning of the new equipment at Uppsala establishes the FREIA Laboratory as an important complement to the SM18 test facility at CERN, in time for the testing of new HL-LHC components.

In addition to the current tests of superconducting magnets at Gersemi, Uppsala and CERN have started a new collaboration project that will use new manufacturing technologies to produce an innovative new type of magnet, a so-called canted-cosine-theta design. The basic idea, which consists of combining two solenoids slightly canted in opposite directions, originated in the 1960s. It is only nowadays with accurate computer-aided manufacturing that it has become feasible to industrialise it. Uppsala University and Linnaeus University will provide skills development to three participating companies in Sweden to develop the technology to manufacture the magnet. The goal is to develop a prototype magnet that, in the future, can replace existing dipole orbit corrector magnets in the LHC when they reach the end of their lives. A major requirement is to make it plug-in compatible with the existing orbit correctors, limiting the design choices of current, quench protection, overall dimensions and connections. The design work on the superconducting cable and magnetic layout has started. The powering tests of the magnet will be performed at Gersemi.

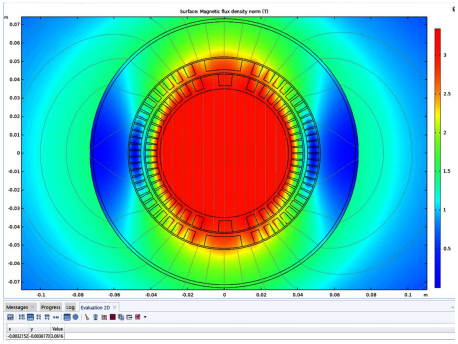
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under GA No. 730871.

An HL-LHC crab cavity being prepared for testing. (Image: CERN)

An LHC superconducting orbit corrector magnet being prepared for testing. (Image: CERN)



Preliminary design of the canted-cosine-theta magnet. Above, the winding of the superconducting wire. Below, the magnetic field strength, maximum 3.1 T. (Image: CERN)



Preliminary design of the canted-cosine-theta magnet. Above, the winding of the superconducting wire. Below, the magnetic field strength, maximum 3.1 T. (Image: CERN)

Roger Ruber, Kevin Pepitone, Akira Miyazaki

TWO HIGH-SCHOOL TEAMS FROM ITALY AND MEXICO WIN THE CERN BEAMLINE FOR SCHOOLS COMPETITION

Two teams of high-school students from the Liceo Scientifico Statale "A. Scacchi" (Bari, Italy) and the Escuela Nacional Preparatoria "Plantel 2" (Mexico City, Mexico) have won the 2021 edition of the Beamline for Schools competition.

Winners of the CERN Beamline for Schools 2021: Team Teomiztli (above) from the Escuela Nacional Preparatoria Plantel 2 (Mexico City, Mexico / Image: Escuela Nacional Preparatoria Plantel 2); and Team EXTRA (below) from the Liceo Scientifico Statale A. Scacchi (Bari, Italy / Image: Liceo Scientifico Statale A. Scacchi)

Geneva and Hamburg, 23 June 2021. Two teams of high-school students from the Liceo Scientifico Statale "A. Scacchi" (Bari, Italy) and from the Esculea Nacional Preparatoria "Plantel 2" (Mexico City, Mexico) have won the prestigious CERN Beamline for Schools competition. The prize this year is a trip to the DESY research centre in Hamburg, Germany, in autumn 2021, to carry out their proposed experiments with the support of scientists from CERN and DESY.

Beamline for Schools (BL4S) is a global physics competition for high-school students. Teams are invited to submit a proposal for an experiment that uses a beamline. Beamlines, operated at laboratories like CERN and DESY, provide fluxes of subatomic particles that can be used for diverse scientific experiments in different disciplines. During the second Long Shutdown of CERN's accelerators for maintenance and upgrades, the partnership with DESY allowed the competition to continue. After the success of the 2019 and 2020 editions, the German laboratory will host the winning teams again in September 2021.

"DESY is very pleased to welcome the Beamline for Schools competition," says Ties Behnke, DESY's Director in charge of Particle Physics. "The initiative clearly shows how attractivefundamental research can be to young people.I am very much looking forward to welcoming the winning teams to DESY this autumn, and to observe the experiments take shape."

Since the competition was launched in 2014, more than 12 000 students from 91 countries have participated. This year, despite the difficulties faced by schools during the COVID-19 pandemic, a record number of 289 teams representing 57 countries submitted a proposal. From the applicants, 26 teams from 22 countries were shortlisted, eight teams from eight countries were selected for a Special Mention, and one team, representing India and Sweden, was awarded for the most creative video proposal. "Some of the winners of the first editions of BL4S have come back to CERN as members of the experimental collaborations after their studies," says Margherita Boselli, BL4S project manager. "We hope that we can continue contributing to training the next generation of scientists."

"I am impressed by the number of participants this year," says Joachim Mnich, Director for Research and Computing at CERN. "The students' increasing interest in the competition over the past editions clearly shows that it is getting more and more attractive every year."

The experiments proposed by the winners of the eighth edition show the deep understanding that high-school students can have of modern particle physics. The Italian team "EXTRA" proposes to investigate the transition radiation effect, where X-ray photons are produced when a beam of high-energy electrons crosses the interface between materials with different optical properties. To study this phenomenon, the students will need to find a smart way to discriminate the signals produced by the particles in the beam from those produced by the X-ray photons.

"Thanks to BL4S, we are involved in a real research experiment that taught us the value of everyone's contribution to a common project and gave us a purpose during the pandemic," state Domenico Soriano and Vittorio Zupo from the EXTRA team in their proposal. "We are grateful and honoured for this opportunity."

The experiment proposed by the Mexican team "Teomiztli" focuses on Cherenkov radiation: the production of electromagnetic radiation when high-energy particles travel through certain materials. The goal of the Teomiztli team is to compare the production of Cherenkov radiation in different materials and contribute to applying this phenomenon in the development of particle detectors.

"Winning the first prize is a great achievement because it will help us promote science in Mexico and help younger people get interested in particle physics and science in general," says Ilse Buendía from the Teomiztli team.

Beamline for Schools is an education and outreach project funded by the CERN & Society Foundation and supported by individual donors, foundations and private enterprises. The eighth edition is partly supported by the Wilhelm and Else Heraeus Foundation, with additional contributions from the Arconic Foundation, the Amgen Switzerland, and the Ernest Solvay Fund, managed by the King Baudouin Foundation.

"What makes BL4S special among student competitions is that the students carry out their own research projects at a research institute such as CERN or DESY. This undoubtedly leads to greater motivation towards scientific careers and a sustained interest in physics and, therefore, the initiative perfectly fits our goals as a foundation," says Dr Stefan Jorda, Managing Director of the Wilhelm und Else Heraeus Foundation.

Further information:

- BL4S website: https://beamlineforschools.cer

- 2021 edition: https://beamlineforschools.cern/editions/2021-edition
- Shortlisted and special mention teams 2021: https://beamlineforschools.cern/results-2021
- Previous winners: https://beamlineforschools.cern/bl4s-competition/winners

About CERN:

CERN, the European Organization for Nuclear Research, is one of the world's leading laboratories for particle physics. The Organization is located on the French-Swiss border, with its headquarters in Geneva. Its Member States are: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Spain, Sweden, Switzerland and the United Kingdom. Cyprus, Estonia and Slovenia are Associate Member States in the pre-stage to Membership. Croatia, India, Lithuania, Pakistan, Turkey and Ukraine are Associate Member States. The European Union, Japan, JINR, the Russian Federation, UNESCO and the United States of America currently have Observer status.

About the CERN & Society Foundation:

The CERN & Society Foundation is a charitable foundation established by CERN to fund a programme of projects. These projects, in the areas of education and outreach, innovation and knowledge exchange, and culture and creativity, are inspired or enabled by CERN, but lie outside of its specific research mandate. The Foundation seeks the support of individuals, trusts, foundations and commercial companies to help make these projects happen, and spread the CERN spirit of scientific curiosity for the inspiration and benefit of society.

About DESY:

DESY is one of the world's leading particle accelerator centres. Researchers use the large scale facilities at DESY to explore the microcosm in all its variety – ranging from the interaction of tiny elementary particles to the behaviour of innovative nanomaterials, the vital processes that take place between biomolecules and the great mysteries of the universe. The accelerators and detectors that DESY develops and builds at its locations in Hamburg and Zeuthen are unique research tools. DESY is a member of the Helmholtz Association, and receives its funding from the German Federal Ministry of Education and Research (BMBF) (90 per cent) and the German federal states of Hamburg and Brandenburg (10 per cent).

Extra info:

- Countries represented by the shortlisted teams: Argentina, Austria, Bangladesh, Cambodia, Canada, Chile, Croatia, Czech Republic, Germany, Hong Kong SAR China, Italy, Japan, Mexico, Morocco, Nepal, Netherlands, Poland, Portugal, Switzerland, Turkey, United Kingdom, United States.

- Countries represented in the Special Mention teams: Canada, Cyprus, Italy, Pakistan, Peru, Turkey, United Kingdom, and United States.

SLEEP, NUTRITION AND EXERCISE: YOUR MENTAL HEALTH'S BEST FRIENDS

Because mental health is about more than just our minds, it's vital that we pay attention to our sleep, nutrition and exercise: the golden triangle of good physical and mental health

Because mental health is about more than just our minds, it's vital that we pay attention to our sleep, nutrition and exercise: the golden triangle of good physical and mental health.

Sleep

Sleep is crucial to keep us functioning properly: it helps us to learn, improves our memory, strengthens our immunity, promotes the elimination of toxins and encourages healing. It also has a positive impact on our moods and emotions.

An adult needs between 7 and 9 hours of sleep per night. When you don't get enough sleep at night, a 20-minute nap during the day can help.

Tips for a good night's sleep:

- Wind down before bedtime: avoid vigorous exercise in the 2 hours before going to bed and avoid the use of screens in the last hour (their blue light inhibits the production of melatonin – the sleep hormone – so it takes longer to fall asleep).
- Develop a routine: practise a calming activity at least 30-45 minutes before bedtime to condition your brain for sleep.

- Keep to a regular sleep pattern: the production of cortisol, which is at its lowest in the first part of the night and at its highest early in the morning, is inversely proportional to that of melatonin. Cortisol is a stimulant that causes our energy levels to peak between 6 and 8 a.m. That's why getting up at the same time every day helps to stabilise the cortisol cycle and puts us in better shape.

Nutrition

Nutrition has an impact on our mental health and well-being. Our brains need nutrients to function; the food we eat affects factors linked to mood, hormones and cognition (memory, reasoning, learning, etc.).

Some important points to note:

- A healthy, balanced diet is vital for our physical and mental health. Although **there is no single diet that suits everyone**, researchers have observed that people who increase their daily intake of fruit and vegetables feel greater life satisfaction.
- By taking the time to eat proper meals, at regular times, you will enjoy your food and be less likely to snack.
- Avoid eating too late in the evening: our metabolism slows down when we're asleep, making digestion harder and sleep less restorative.

Exercise

It's well known that physical activity has a positive effect on health in general. The World Health Organization (WHO) recommends 150 minutes of moderate to vigorous physical activity every week.

Any exercise is good for you: use your bicycle instead of the car for short journeys, get off the tram one stop before your destination and walk for 5 minutes, or climb the stairs instead of taking the lift.

Some of the benefits of regular physical activity:

- A healthy heart, a healthy weight and lower “bad” cholesterol, better circulation and stronger bones, protection against osteoporosis.
- Higher levels of serotonin, the precursor to melatonin, also known as the sleep hormone – that's why exercising makes you sleep better!
- A better mood and general mental state: physical activity produces dopamine, the neurotransmitter of reward and pleasure, as well as endorphins, which have a painkilling and euphoric effect.

Let's not forget that our mental health is crucial to our overall health.

If you feel that you would benefit from talking professional or personal matters through with a professional, don't hesitate to contact us. The Medical Service offers all members of the personnel (MPE and MPA) first-line psychological counselling. Appointments with our psychologists, Katia Schenkel and Sébastien Tubau, are free of charge and strictly confidential: https://hse.cern/content/psychologist.

The next article in this series will cover ways of looking after our mental health – check out the next Bulletin.

Medical Service

CMS HONOURS ITS 2020 THESIS AWARD WINNERS

(Image: CERN)

The winners of the 2020 CMS Thesis Award are **Matteo Defranchis** (University of Hamburg), **Cristina Martín Pérez** (*Institut Polytechnique de Paris*) and **Thorben Quast** (RWTH Aachen).

Every year since 2000, the CMS Thesis Award Committee has recognised and rewarded excellence in research by CMS PhD students. Any thesis written on a CMS-related topic is eligible for nomination; this includes physics analysis, simulation, computing, detector development and engineering. This year's selection committee (28 CMS scientists appointed by the CMS Collaboration Board) faced the difficult task of choosing the three winners from a total of 24 nominations. The theses were judged on clarity of presentation, originality and impact of the research work.

The award includes a plaque of recognition and a proposal to have the thesis endorsed by CMS for publication in the Springer Theses series, which recognises exceptional PhD theses in the physical sciences.

For more information on the laureates and their theses, visit the CMS website.

CERN LAYS FIRST STONE OF SCIENCE GATEWAY

Today, CERN held a first stone ceremony for Science Gateway, the Laboratory's new flagship project for science education and outreach

The first stone with the newly unveiled logo of the CERN Science Gateway. Its underlying concept is to anchor the project and its mission to CERN. At the core is a collision, from which the architecture of the iconic building rises. From left to right: Renzo Piano, Fabiola Gianotti, Antonio Hodgers and John Elkann. (Image: CERN)

Today, CERN held a first stone ceremony for Science Gateway, the Laboratory's new flagship project for science education and outreach. Fabiola Gianotti, CERN's Director-General, John Elkann, Chairman of Stellantis and the FCA Foundation, the main donor, Renzo Piano, architect and founder of Renzo Piano Building Workshop, and Geneva State Co uncillor Antonio Hodgers, speaking on behalf of the Swiss host authorities, were present to mark the successful start of its construction. Ursula Bassler, President of the CERN Council, contributed to the ceremony remotely. Representatives from CERN Member and Associate Member States, Host States and many other partners were also in attendance at the ceremony.

When the Laboratory opened in 1954, its Convention already promoted openness and commitment to education and outreach. Almost seventy years and over two million visitors later, CERN is increasing its capacity to welcome visitors of all ages, from near and far and extending its educational portfolio with a view to increasingly inspiring future generations towards science and research. Hundreds of thousands of visitors per year will have the opportunity to go on a captivating journey through the science, the discoveries and the technology at CERN, guided by the people who make it all possible.

Scheduled to open in 2023, the CERN Science Gateway has environmental sustainability at its core. It will be an iconic, carbon-neutral building and a local landmark, surrounded by a 400-tree freshly-planted forest. Closely connected to the CERN campus, the Science Gateway will also feature a modular 900-seat auditorium, immersive spaces, laboratories for hands-on activities for visitors from age 5 up, and many other interactive learning opportunities.

An exhibition on the Esplanade des Particules details the project and its connection to CERN.

“I would like to express my deepest gratitude to the many partners in our Member and Associate Member States and beyond who are making the CERN Science Gateway possible, in particular to our generous donors. The challenging times we've been through over the past 18 months have demonstrated the enduring value and the necessity of science and the need for cooperation across borders. Science brings people together and shows what humanity can achieve when we put our differences aside and focus on the common good. Science gives hope and trust in a better future. We want the CERN Science Gateway to inspire all those who come to visit with the beauty and the values of science,” said CERN Director-General Fabiola Gianotti during her opening speech.

“It is with joy and pride that we are launching today this ambitious project where, thanks to the collaboration of different skills, nationalities and languages, we will build a place of exchange and knowledge. A bridge, forever bridges! A glass bridge, which links the different themes and parts of Science Gateway while also allowing a physical encounter between researchers and children, visitors and physicists, tourists and scientists, all driven by curiosity and the thirst for knowledge,” said Renzo Piano, the internationally renowned architect, whose notable buildings include the Zentrum Paul Klee in Bern, the Pompidou Centre in Paris, and the Shard in London.

“At Stellantis we strongly believe in the importance of education, with an emphasis in the fields of science and technology.” said John Elkann, Chairman of Stellantis and the FCA Foundation. “Supporting STEM education has proven to be the most effective way to keep our societies open and safe as we have learned this last year by overcoming the Covid-19 crisis.”

“CERN Science Gateway is a great way to democratise scientific research and a spectacular entrance gate to Geneva,” said Antonio Hodgers, Geneva State Councillor in charge of Territorial Planning, speaking on behalf of the Swiss host authorities.

“We will do our best, not only in the construction and operation of the Science Gateway, but also more widely, to ensure that science maintains a place of integrity and trustworthiness, of international collaboration aiming for peace”, said Ursula Bassler, President of the CERN Council.

Audiovisual material:

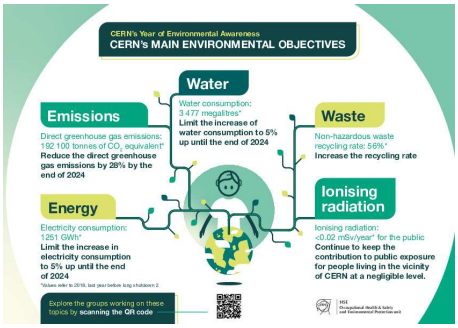
Webcast record of the ceremony (for the CERN community): https://webcast.web.cern.ch/event/i1046896

Video (download): https://videos.cern.ch/record/2773601

Short “highlights” video (download): https://videos.cern.ch/record/2773686

Photos: https://cds.cern.ch/record/2773478?ln=en https://home.cern/resources/image/cern/cern-science-gateway

CERN'S MAIN ENVIRONMENTAL OBJECTIVES



(Image: CERN)

These five topics are CERN's main priorities in terms of environmental protection. They will be further explained in this series of articles, together with other environmental subjects that the Organization deems important.

The figures in this graphic were originally published in the CERN Environment Report 2017-2018 (*https://hse.cern/environment-report-2017-2018*), in which you can find more detailed information.

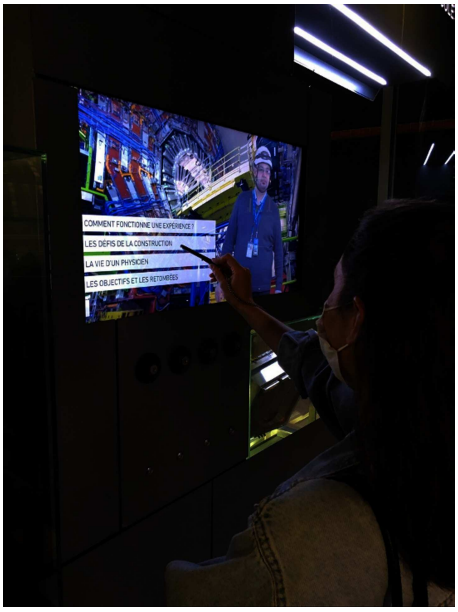
Can't find an environmental subject you'd like to discuss? Join the conversation on Mattermost (*https://mattermost.web.cern.ch/hse-unit/channels/environment-cern*)!

This infographic is part of the series CERN's Year of Environmental Awareness.

HSE Unit

CERN IS GRADUALLY REOPENING TO VISITORS

After being closed to the public for nearly 15 months due to the COVID-19 pandemic, CERN is delighted to gradually reopen its doors to visitors as of 1 June 2021



Visitors discover the Microcosm exhibition, under strict sanitary measures. (Image: CERN)

The Microcosm exhibition and CERN shop are now accessible, with strict sanitary measures in place. In these first weeks of reopening, almost 400 visitors (re)discovered the Microcosm exhibition and had the opportunity to watch Discover CERN, a movie usually reserved for guided tours.

The programme of public events at the Globe of Science and Innovation will also resume in a few weeks, with a series of science shows scheduled during the summer months. Registration is already open for the first dates at visit.cern/events.

In addition, from the end of June onwards, the Esplanade des Particles will host an exhibition dedicated to the CERN Science Gateway, the Laboratory's future visitor centre, which will open to the public in early 2023 (see https://sciencegateway.cern).

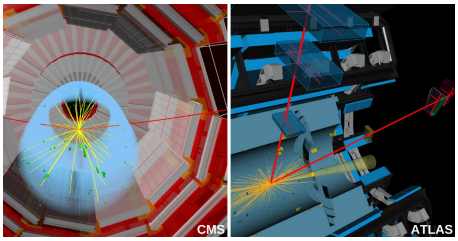
Pending further easing of the sanitary measures, the Universe of Particles exhibition and guided tours of the site remain cancelled until further notice. The situation will be reassessed regularly during the summer. In the meantime, requests can be submitted for guided tours taking place after September 2021.

As of 1 June 2021, the sanitary measures in place on the CERN sites, including access for visitors, are determined by the Organization's new four-level COVID-19 scale. For visitors and guests unable to access the CERN sites, our virtual tours and talks offered during the pandemic remain available.

Further information regarding visits is available at https://visit.cern/.

LEPTOQUARKS, THE HIGGS BOSON AND THE MUON'S MAGNETISM

A new study shows that a class of new unknown particles that could account for the muon's magnetism, known as leptoquarks, also affects the Higgs boson's transformation into muons



Displays of candidate events for a Higgs boson decaying into two muons, as recorded by CMS (left) and ATLAS (right). (Image: CERN)

Zoom into an online particle physics conference, and the chances are you'll hear the term muon anomaly. This is a long-

standing tension with the Standard Model of particle physics, seen in the magnetism of a heavier cousin of the electron called a muon, that has recently been strengthened by measurements made at Fermilab in the US.

In a paper accepted for publication in *Physical Review Letters*, a trio of theorists including Andreas Crivellin of CERN shows that a class of new unknown particles that could account for the muon anomaly, known as leptoquarks, also affects the transformation, or "decay", of the Higgs boson into muons.

Leptoquarks are hypothetical particles that connect quarks and leptons, the two types of particles that make up matter at the most fundamental level. They are a popular explanation for the muon anomaly and other anomalies seen in certain decays of particles called B mesons.

In their new study, Crivellin and his colleagues explored how two kinds of leptoquarks that could explain the muon anomaly would affect the rare decay of the Higgs boson into muons, of which the ATLAS and CMS experiments recently obtained the first indications.

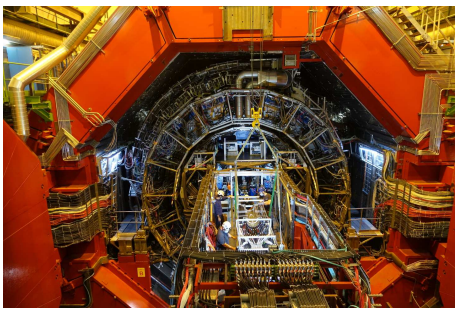
They found that one of the two kinds of leptoquarks increases the rate at which this Higgs decay takes place, while the other one decreases it.

"The current measurements of the Higgs decay to muons are not sufficient to see this increase or decrease, and the muon anomaly has yet to be confirmed," says Crivellin. "But if future measurements, at the LHC or future colliders, display such a change, and the muon anomaly is confirmed, it will be possible to pick out which of the two kinds of leptoquarks would be more likely to explain the muon anomaly."

Ana Lopes

ALICE FINDS THAT CHARM HADRONISATION DIFFERS AT THE LHC

New measurements by the ALICE collaboration show that the way charm quarks form hadrons in proton-proton collisions differs significantly from expectations based on electron collider measurements



A view of the ALICE experiment during the installation of new components. (Image: CERN)

Quarks are among the elementary particles of the Standard Model of Particle Physics. Besides up and down quarks, which are the basic building blocks of ordinary matter in the Universe, four other quark flavours exist and are also abundantly produced in collisions at particle accelerators like the CERN Large Hadron Collider. Quarks are not observed in isolation due to a fundamental aspect of the strong interaction, known as colour charge confinement. Confinement requires particles that carry the charge of the strong interaction, called colour, to form states that are colour-neutral. This in turn forces quarks to undergo a process of hadronisation, i.e. to form hadrons, which are composite particles mostly made of a quark and an antiquark (mesons) or of three quarks (baryons). The only exception is the heaviest quark, the top, which decays before it has time to hadronise.

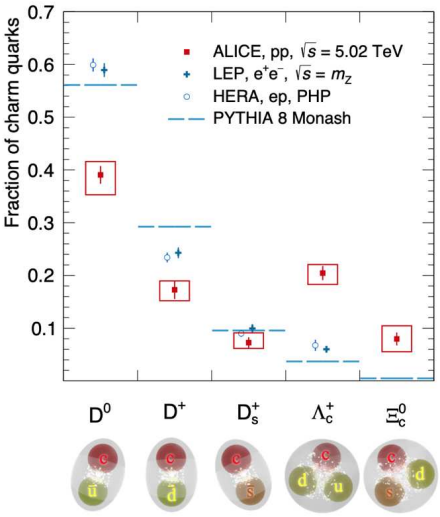
At particle accelerators, quarks with a large mass, such as the charm quark, are produced only in the initial interactions between the colliding particles. Depending on the type of beam used, these can be electron-positron, electron-proton or proton-proton collisions (as at the LHC). The subsequent hadronisation of charm quarks into mesons (D^0, D^+, D_s) or baryons (Λ_c, Ξ_c, ...) occurs on a long space-time scale and was considered to be universal - that is, independent of the species of the colliding particles - until the recent findings by the ALICE collaboration.

The large data samples collected during Run 2 of the LHC allowed ALICE to count the vast majority of charm quarks produced in the proton-proton collisions by reconstructing the decays of all charm meson species and of the most abundant charm baryons ($\Lambda_c$and Ξ_c). The charm quarks were found to form baryons almost 40% of the time, which is four times more often than what was expected based on measurements previously made at colliders with electron beams ($e^+e^-$and ep in the figure below).

These measurements show that the process of colour-charge confinement and hadron formation is still a poorly understood aspect of the strong interaction. Current theoretical explanations of baryon enhancement include the combination of multiple quarks produced in proton-proton collisions and new mechanisms in the neutralisation of the colour charge. Additional measurements during the next run of the LHC will allow these theories to be scrutinised and further our knowledge of the strong interaction.

Read more in the article (https://arxiv.org/abs/2105.06335) by ALICE and on the ALICE website.

Andrea Dainese



Fraction of charm quarks that hadronise to form each species of mesons (quark-antiquark) or baryons (three quarks). The ALICE measurements in proton-proton collisions show a larger fraction of baryons than those at colliders using electron beams. (Image: CERN)

COMPUTER SECURITY: THE TRUTH LIES IN THE URL

Like last year, every CERN staff member and user received a fake message posing as a malicious attempt to convince them to click on the embedded link...

Failed. We all failed spectacularly! We're talking about the latest annual phishing campaign conducted by the CERN Computer Security team. Like last year, every CERN staff member and user received a fake message posing as a malicious attempt to convince them to click on the embedded link. Already clicking – and about 22% of recipients clicked! – put the corresponding device (and CERN) at risk, and the subsequently displayed fake login pages would have done the rest – more than 7% of recipients tried to provide their password (fortunately that fake login page didn't accept passwords for privacy reasons). If it had been for real: device gone, password gone, CERN gone – see our *Bulletin* articles on “Ransomware” and the risks for CERN: “ What do accelerators and pipelines have in common? ”, “ Blackmailing Academia: Back to pen and paper(?) ” and “ Blackmailing Enterprises: You are Patient Zero ”.

On the plus side, hundreds of colleagues spotted the trap and reported their fake phishing email to the Computer Security team. Many more simply ignored the email, as the contents (“Contract amendment”, “COVID-19 internal report”, “Fund balance – confidential”, “X has shared a file with you”, “Teleworking Reminder”, “Updated vaccine schedule”, or “Your travel arrangements”) did not concern them. Some people cross-checked the sender names in the CERN Phonebook where, indeed, Sean Luggers, Sebastien Lodevinski, Luigi Valnese, Ramon Warze, Anne Longshire, Nikolae Fridilidis, Adriana Do Montes and Danielle Pecheur do not appear and, hence, do not seem to work for CERN (some of their namesakes, however, work for the Computer Security team). Others wondered about the embedded link that, while being labelled with “documentstore.cern.ch”, “hr.cern.ch”, “pf.cern.ch” or “covid-cern.ch”, actually pointed to either the domain cern.CG of the Republic of the Congo, or to the IP address 192.91.245.24. And there we go. The truth lies in the URL!

While judging the relevance of the email itself based on typos or any other anomaly, or checking for names in the address book, is good practice (see our recommendations (*https://security.web.cern.ch/recommendations/en/malicious_email.shtml*)), these methods aren't foolproof. Attackers are trying their very best to perfect the spoofing of their malicious emails. Given that lots of information about CERN, CERN projects and current news is public, it's easy to come up with increasingly targeted and sophisticated email messages – messages that anyone who isn't vigilant would fall for*. And given that many of our names are published on one webpage or another, sending malicious emails using real CERN names would not have been a problem for attackers. The email protocol allows for that – just as you can write any sender name on the paper envelope of your letter, you can fake any email sender address you wish. Easy-peasy.

So, the best way to spot malicious emails is to check the web address that a link would lead you to. The truth lies in the URL, the uniform resource locator, pointing to the real internet contents. The displayed text is all hollow words. “documentstore.cern.ch”, “hr.cern.ch”, “pf.cern.ch” or “covid-cern.ch” are just inventions. The truth lies beneath. In the URL. STOP—THINK—DON'T CLICK!!! Hover your mouse pointer over those hollow words, those duplicitous links, and the pop-up tooltip will reveal their truth, reveal the true destination.

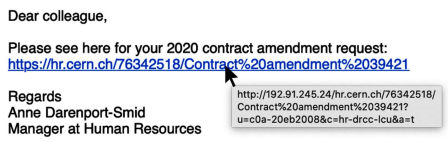
The same holds true of any embedded link in WhatsApp messages, tweets, Facebook posts and Instagram threads. STOP—

THINK—DON'T CLICK!!! It's hard, but it's still better than getting your device infected and compromised. Only if it's cern.CH (for Switzerland) or home.CERN, is it us. If the pop-up looks dodgy, weird or unexpected or has contents differing from the displayed text, hold fire. Be vigilant, be sceptical. Better check with us first at Computer.Security@cern.ch. For the sake of your device's security, and for the security of the Organization!

Finally, and in particular, check the CERN login page before typing your password. The two valid Single Sign-On (SSO) pages for CERN are “login.cern.ch” for the old and “auth.cern.ch” for the new SSO webpage. Every other URL is fake, bad, malicious and should be reported!!! Alternatively, use a password manager. It will prompt you to fill in your password ONLY on the CERN domain, so if the password manager suddenly refuses to enter your password, something may be majorly off...

**Even we could have done better with our campaign. But it's a slippery slope, as some companies discovered with their tests (see here (https://www.theguardian.com/uk-news/2021/may/10/train-firms-worker-bonus-email-is-actually-cyber-security-test) and here (https://www.cbsnews.com/news/tribune-bonus-email-hoax-cybersecurity-test/)).*

Do you want to learn more about computer security incidents and issues at CERN? Follow our Monthly Report. For further information, questions or help, check our website or contact us at Computer.Security@cern.ch.



Computer Security Team

Official communications

CERN HEALTH INSURANCE SCHEME: OPENING OF UNIQA OFFICES IN TOWN

We inform you that the UNIQA offices in town are now open to the public from Monday to Friday, from 8:00 am to 5:00 pm, at **the following new address** :

UNIQA GlobalCare SA
Avenue de la Praille, 26
1227 Carouge
Switzerland

You can still contact UNIQA services in Geneva by phone at the following numbers: 72730 (CERN Office) or +41 22 718 63 00 and by sending a message to: uniqa@cern.ch.

The blue UNIQA envelopes with the old address are still valid and can be used for sending your claims.

Announcements

CERN SERVICES GRADUALLY REOPEN FOR BUSINESS

(Image: CERN)

Since the beginning of the pandemic, the CERN services have all been required to demonstrate their creativity and flexibility in order to adapt to the health restrictions and continue to serve their customers.

Now that infection rates are falling and the COVID-19 scale has come into effect, we're looking forward to a gradual return to normal of all the on-site services: restaurants, hostels, mobility, showers, shops, etc.

In recent months, the restaurants have reinvented themselves. The suppliers have brought in new ranges, new distribution methods have been introduced (e.g. click & collect, take-away meal jars) and the outside eating areas have been completely overhauled to allow people to eat together in compliance with the rules.

Restaurant No. 2 reopened on 31 May, meaning that there are now four places to eat on the Meyrin and Prévessin sites, five days a week:

- Restaurant No. 1: 7.00 a.m.-4.00 p.m. (meals served 11.30 a.m.-2.00 p.m.) – five days a week
- Restaurant No. 2: 7.00 a.m.-2.30 p.m. (meals served 11.30 a.m.-1.45 p.m.) – five days a week
- Restaurant No. 3: 7.00 a.m.-2.30 p.m. (meals served 11.30 a.m.-1.30 p.m.) – five days a week
- O'Delices – Building 774: 7.00 a.m.-5 p.m. – five days a week.

For the moment, the cafeteria, the kiosk and the Grab'n Go remain closed, but we're optimistic that they'll be able to reopen soon. In Building 40, new tables will soon be installed and the terrace will be rearranged to increase seating capacity.

Since 10 May, a dedicated shuttle service has been operating to make it easier for people to come to the restaurants at lunchtime. Every effort is being made to accommodate those of us who are gradually getting back to on-site work in the best possible conditions.

For our safety, the stores continue to deliver the personal protective equipment (PPE) required for on-site work quickly and efficiently.

A mobile app for reserving and starting up CERN vehicles is being piloted by the Car Sharing service with a view to minimising the use of keys. A larger-scale trial phase will soon begin, during which the system will be further adjusted to the needs of users. Bikes are available as usual and are increasingly in demand as the weather improves and more people come onto the site.

The showers have been reopened in the following buildings: 5, 21, 35, 104, 112, 124, 162, 513, 570 and 676 in Meyrin, and 774, 865, 867, 892 and 927 in Prévessin.

Refurbishments have been carried out in the CERN hostels. Building 38 will reopen at the end of the summer, following a complete overhaul of the facilities and the health and safety measures: repainting, sanitary facilities, electrics, heating, the creation of three extra single rooms, renovation of the studio for people with reduced mobility, refurbishment of several other rooms to accommodate people with reduced mobility, all bedding replaced and furniture renewed beyond the scope of the original project (desks, chairs, wardrobes, mirrors, coat racks, luggage stands, etc.).

Throughout the pandemic guests have been accommodated in the CERN hostels (Buildings 39 and 41 and the Schumann Residence) in accordance with the changing rules. A guide has been produced to help people who have to leave their hostel room because they are obliged to quarantine or self-isolate. The housing service reception is open from 8.00 a.m. to 8.00 p.m. during the week and from 8.00 a.m. to 5.00 p.m. at the weekend.

Lastly, the Access Management service can now open CERN's doors to a wider public as the age and status restrictions are gradually being eased.

As the CERN services gradually get back to business as usual, they are taking on board the lessons learned this past year. You will be kept regularly informed about several initiatives that are being considered and implemented to improve life on site. And aside from the ongoing health crisis, the SCE department as a whole is doing its utmost to create a welcoming environment for CERN's scientific community.

SCE department

THE 2020 CERN ANNUAL REPORT IS AVAILABLE

You can read it online or get a paper copy at the Library

(Image: CERN)

The 2020 CERN Annual Report, which highlights CERN's main achievements and activities from last year, was presented to the CERN Council in their June meeting.

This report includes a special section to account for the diverse actions taken by CERN's community in the fight against COVID-19: more information on pages 12-15!

You can read this, and previous, Annual Reports online here (*https://cds.cern.ch/collection/CERN%20Annual%20Reports?ln=en*) – paper copies are also available at the CERN Library.

2021 CERN-JINR EUROPEAN SCHOOL OF HIGH-ENERGY PHYSICS

The 2021 CERN-JINR European School of High-Energy Physics (ESHEP2021) will take place in Israel, 17-30 November 2021.

The School is targeted particularly at students in experimental HEP who are in the final years of work towards their PhDs, although candidates at an earlier or later stage in their studies may be considered.

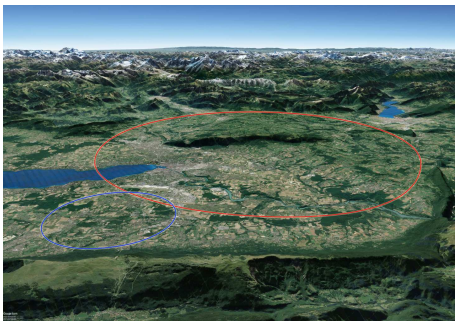
The deadline for applications is 23 July 2021. Sponsorship may be available for a few students from developing countries.

Further details are available on the Indico page (*https://indico.cern.ch/event/940219/*).

The School will take place in 2021 provided sufficient progress has been achieved in containing the COVID-19 pandemic by then in the countries from which participants will be traveling. The school will be subject to Covid-related regulations in Israel.

Nick Ellis and Martijn Mulders, on behalf of the Organising Committee

CERN COURIER WEBINAR: "FUTURE CIRCULAR COLLIDER: WHAT, WHY AND HOW?" – 30 JUNE 2021



The FCC study prepared a conceptual design of a 100km long ring accelerator, that uses CERN's existing accelerator infrastructure. (Image: CERN)

Join the audience for a live *CERN Courier* webinar at 18:00 Central European Time on Wednesday 30 June 2021 and put your questions about future colliders directly to an expert panel of accelerator, experimental and theoretical physicists.

By clicking the "Join the audience" button you will be taken to our third-party webinar provider in order to register your details.

Our three panellists will introduce the motivation for and status of a proposed Future Circular Collider (FCC) at CERN, followed by a discussion and live questions from the audience moderated by *CERN Courier* editor Matthew Chalmers.

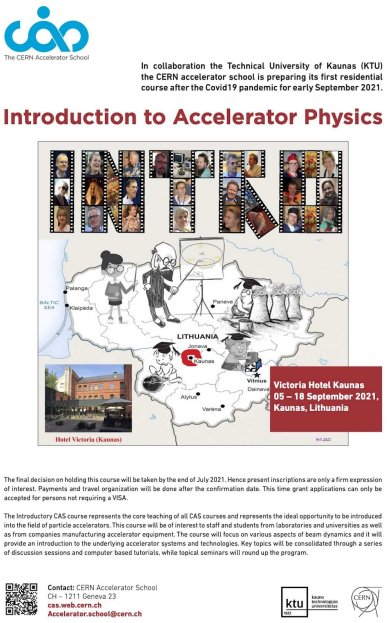
Accelerator physicist and FCC study leader **Michael Benedikt** (CERN/Vienna University of Technology) will report on the status and scope of the FCC Innovation Study, a European Union-funded project to assess the technical and financial feasibility of a 100 km electron-positron and proton-proton collider in the Geneva region.

Experimental particle physicist **Beate Heinemann** (DESY/Albert-Ludwigs-Universität Freiburg) will explain how the Higgs boson opens a new window on fundamental physics, and why a post-LHC collider is essential to explore this and other hot topics such as flavour physics.

Theoretical physicist **Matthew McCullough** (CERN) will explore the potential of a future circular collider to address the dark sector of the universe, and explain the importance of striving for the highest energies possible.

CERN ACCELERATOR SCHOOL: INTRODUCTION TO ACCELERATOR PHYSICS | 5-18 SEPTEMBER 2021

Registration is now open for the CERN Accelerator School's course "Introduction to Accelerator Physics", 5-18 September 2021, Kaunas (Lithuania)



(Image: CERN)

In collaboration with the Technical University of Kaunas (KTU), the CERN Accelerator School is preparing its first residential course after the COVID-19 pandemic for early September 2021.

The introductory CAS course is the core teaching of all CAS courses and represents the ideal opportunity to be introduced into the field of particle accelerators. This course will be of interest to staff and students from laboratories and universities as well as from companies manufacturing accelerator equipment. The course will focus on various aspects of beam dynamics and will provide an introduction to the underlying accelerator systems and technologies. Key topics will be consolidated through a series of discussion sessions and computer-based tutorials, while topical seminars will round up the programme.

The final decision on holding this course will be taken by the end of July 2021. Hence present inscriptions are only a firm expression of interest. Payments and travel organisation will be done after the confirmation date. This time, grant applications can only be accepted for persons not requiring a VISA.

For more information and application, please visit the school website: https://cas.web.cern.ch/schools/kaunas-2021

CERN Accelerator School

Ombud's corner

THE THIRD CHAIR IN THE OMBUD'S OFFICE: THE PRINCIPLE OF IMPARTIALITY

The code of ethics of the ombud profession consists of a shared set of professional ethical principles: independence, neutrality, impartiality, confidentiality and informality. Of course, these principles, which are set out on the Ombud's website, must be rigorously put into practice.

Today, I'd like to talk to you about the principles of **neutrality** and **impartiality** *.

- The Ombud is *neutral* – indeed, is often referred to as a "designated neutral" – and must therefore avoid expressing personal opinions.
- The Ombud is *impartial*, approaching all cases without any hint, whether real or perceived, of prejudice or preconceptions and working without fear, favouritism or bias.

Visitors to the Ombud's office give their own account of the conflict situation in which they find themselves, setting out the information they have, their own perceptions, the emotions the situation triggers and the impact it's having on them. They receive the Ombud's full attention and empathy.

However, the Ombud never forgets that **only one side of the story is being told**. To remind me of this, I always place a third chair at the table to represent the absent party, whether it's a person, a group of people or an entity.

Neutral and impartial, **the Ombud does not seek to determine who's right and who's wrong** or to establish the facts. The Ombud's main role is to listen actively to you and gain a full understanding of your situation.

The Ombud then endeavours to describe the situation to you from a different point of view – that of the "occupant" of the third chair – and helps you to see your concerns as part of a bigger picture by suggesting possibilities that you may no longer be able to see if the conflict looms too large in your daily life.

Finally, so that you can make progress, the Ombud explores with you **all the possible ways in which you might solve the problem**, examining the advantages and disadvantages of each option with you without expressing a personal preference for any of them. It's up to you to decide what you want to do. This may take some time and require another visit to the Ombud.

When you've decided what to do, the Ombud can help you by providing all information on the procedures you'll need to follow. At your request, the Ombud can also contact a third party to help you to clarify a situation, but will not plead your case.

Visiting the Ombud requires a lot of trust on your part. In return, the Ombud offers a neutral and impartial point of view – the **main value** of a visit to the Ombud's office – which facilitates conversations that might otherwise not happen.

The principle of neutrality and impartiality is one of the greatest challenges for the Ombud, who is, after all, only human and has personal values, sensitivities and history. But **the Ombud is everyone's Ombud** and must consider the points of view and concerns of all parties, whoever they may be.

It's by being neutral and impartial that the Ombud can be most helpful to you.

**These are the definitions (translated from the French) of neutrality and impartiality provided by the* Association des Ombudsmans et Médiateurs de la Francophonie *(Association of Ombuds and Mediators of the French-speaking World, AOMF).*

Laure Esteveny

I want to hear from you – feel free to email ombud@cern.ch with any feedback or suggestions for topics you'd like me to address.