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THE BRIL LUMINOSITY SUB-DETECTORS PREPARE CMS FOR A BRIGHT RUN 3

Calabrese, Capricciosa, Diavola and Margherita – the four modules of the BRIL sub-system – were mounted on the CMS experiment in July 2021

Joanna Wanczyk (left) and Georg Auzinger (right) work on the -Z side bulkhead platform of the BRIL sub-system (Image: CERN)

After long months of preparation, the Beam Radiation, Instrumentation and Luminosity (BRIL) group has completed the installation of three instruments dedicated to the measurement of luminosity and beam conditions: the Beam Condition Monitor "Fast" (BCM1F), the Beam Condition Monitor for Losses (BCM1L) and the Pixel Luminosity Telescope (PLT). These three of the BRIL sub-detectors make up the BRIL subsystem which is segmented into 4 modules. They represent a new "generation" in their respective design history. Both PLT and BCM1F rely on silicon sensors, while BCM1L uses poly-crystalline diamond sensors.

Measuring the real-time rate of collisions at CMS is key to optimising both the trigger rates and the quality of the beams delivered by the Large Hadron Collider (LHC). Continuously assessing the beam conditions is also essential to the protection of the LHC machine and the sensitive CMS sub-detectors. Finally, the aggregated luminosity measurements need to be meticulously understood to determine the expected frequency of interactions in the analysis of data collected at CMS.

(Continued on page 2)

A WORD FROM BENOÎT DELILLE

A REMINDER OF THE COVID-19 MEASURES IN PLACE

As the summer holidays come to an end and school classes resume, it's a good time to remind ourselves of the measures in place to protect us all from COVID-19. Huge progress has been made since the pandemic began, allowing measures to be relaxed to some extent, in way that recognises that the virus that is still with us.

(Continued on page 2)

In this issue

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A WORD FROM BENOÎT DELILLE

A REMINDER OF THE COVID-19 MEASURES IN PLACE

CERN's approach to handling the pandemic has been, unsurprisingly, driven by science. The range of measures we have applied from the start has been very diverse and based on the evidence available at the time. We've continuously monitored the facts, and adjusted our measures accordingly. For much of the pandemic, CERN's measures have been stricter than those of the Host States, and when we have relaxed them, we have done so only after a thorough analysis of the prevailing conditions in the region, or because the growing body of epidemiological evidence has allowed us to do so. For example, when studies appeared indicating that distancing of 1.5 metres is as safe as 2 metres, we relaxed that requirement.

In parallel to the application of now well-known measures, we've developed tools, like CARA, that help us to assess the level of risk in shared spaces, and apply appropriate preventative measures. CARA has also raised much interest outside CERN, and its use has been deployed by other organisations. CARA has contributed to a number of academic papers, and allowed CERN to be part of a working group convened by the WHO with the aim of developing an algorithm and methodology to quantify airborne risk transmission. We are also trialling the use of CO_2monitors as a means to verify the quality and renewal of air, and to help substantiate the results of the CARA tool.

This summer we moved our COVID level to 2 – Yellow, allowing people to come back on site. Throughout the summer, the overall number of people coming on site has remained stable at around 4500 people per day, just slightly higher than when CERN was at level 3 – Orange. Throughout this period, the positivity rate has remained low among the CERN community, and in line with the rate in the local region. Many of those coming back on site were grateful of the opportunity to see colleagues in the flesh, instead of on zoom. For those who are vulnerable or are uncomfortable about coming on site, flexibility has been the key word, along with specific protection plans where appropriate.

Many of us, naturally, keep a close eye on the incidence rate. It is an important factor in determining which level CERN applies, but it is just one factor out of many. We have also taken into account factors including the conditions applying in the Host States, the strong evidence concerning the impact of vaccination programmes, the spread of new variants, the capacity of the site and the desire of many to come back on site under safe conditions.

Our approach going forward is to acknowledge that the virus will be with us for some considerable time, and to keep CERN as open as possible in this new normality while maintaining strict measures to safeguard everyone's health. For that reason, we strongly encourage vaccination, coupled with regular testing provided free of charge to everyone on site, the application of health and safety measures and the mandatory use of Proximeters while on site. This approach allows us to keep coming on site, and to prevent spread by identifying those carrying the virus, and those they have been in contact with.

Keeping the community informed through the regular COVID-19 emails is an important part of CERN's approach. These mails not only include information necessary for us all to carry out our work, and live our daily lives in both Host States, but also links to some of the studies that guide our actions as the situation and our knowledge of the virus evolve. Success relies on everyone making an effort: read the regular COVID-19 emails carefully, get vaccinated if you can, if you are coming on site, test regularly, respect the measures in place, and do not come on site if you have even the most minor symptoms. We are all looking forward to a return to normality, although things will never be quite as they were before, and it requires all of us to get there.

Benoît Delille
Head of the HSE Unit

THE BRIL LUMINOSITY SUB-DETECTORS PREPARE CMS FOR A BRIGHT RUN 3

The design and production of new components, sensor characterisation, assembly, stress-testing under thermal cycles, troubleshooting, repairs and other tasks spanned a few years of challenging work, which ramped up as Long Shutdown 2 came to a close. The transport activities began before sunrise on 5 July 2021.

Each module of the sub-system was carefully loaded onto a special transport vehicle and dry air was circulated inside their transport boxes. Only days before, each module had been delicately readied for its journey, which included labelling them with their affectionately selected aliases: Calabrese, Capricciosa, Diavola and Margherita. After being lowered down the pit to the CMS experimental cavern, each module was craned up to the tracker sub-detector plat-

form. The BRIL sub-detectors now lie at the heart of the CMS detector, about 1.8 m from the interaction point, just beside the forward pixel tracking sub-detector.

One of the most significant changes in the design of the instruments has been the implementation of a new active cooling circuit for BCM1F, which is essential for a silicon-based detector. The PLT cooling loop has been modified to include a new section for BCM1F. The design of the BCM1F cooling circuit follows the approach implemented for the PLT during Run 2: the cooling structure has been 3D printed in a titanium alloy using the selective laser melting technique.

The silicon sensors used for BCM1F and three of those used in one of the PLT channels were sourced from a batch currently being developed for the CMS Phase II upgrade for the High-Luminosity LHC. “This is the first time that these prototype Phase II silicon pixel sensors will be installed in CMS, so the whole community is eager to see how this material behaves,” says Anne Dabrowski, CMS BRIL project manager.

The installation of the BRIL sub-detectors was closely followed by the sealing of the bulkhead, which encloses them with the CMS silicon pixel and strip tracker sub-detectors. The work is now focused on the full commissioning of all BRIL systems in anticipation of the first beams of Run 3 of the LHC.

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This story was originally published on the CMS website.

CERN'S SCIENCE GATEWAY TAKES (TUBULAR) SHAPE

Two months on from the first-stone ceremony, one of Science Gateway's tubular structures has been installed

A new architectural feature – in the form of a tube – has been installed this week on the Esplanade des Particules. (Image: CERN)

Construction of Science Gateway, CERN's new scientific education and communication hub designed by the Renzo Piano Building Workshop in collaboration with Brodbeck-Roulet *architectes associés*, is proceeding apace.

A new architectural feature – in the form of a tube – has been installed this week on the *Esplanade des Particules*. This is the first of two large steel cylinders measuring 10 metres in diameter and 80 metres in length that will house CERN's permanent and temporary exhibitions. In these structures, visitors will be immersed in an environment representing the underground tunnels of the LHC.

The tubes, which appear to be suspended in space, evoke the pioneering technology that underpins the cutting-edge research carried out at CERN and elsewhere in order to push the boundaries of our knowledge of the origins of the universe. Science Gateway's architecture is therefore a celebration of the inventiveness and creativity that characterise the world of research and engineering.

Three other features will soon be added to the architectural complex: the bridge, the solar collectors and the forest.

The bridge, passing over the *Route de Meyrin* at a height of 6 metres, will connect the tubes, symbolising the enduring link between science and society. Several spaces dedicated to exhibitions and educational activities will branch off from this main artery. The solar collectors – three square solar panels measuring 40 metres by 40 metres – will be installed on three pavilions that will house a large 900-seat amphitheatre, labs, an exhibition space, the reception area, the shop and the restaurant. The forest will provide a wonderful experience for people exploring the area on foot. With more than 400 trees, it will remind us that all our explorations, at every scale, are ultimately about nature.

Through its exhibitions and hands-on educational activities, Science Gateway will give people of all ages and from all walks of life the chance to find out about CERN's discoveries, scientific research and technologies. It will also set the bar for efforts to encourage young people to pursue careers in science and technology. Science Gateway is due to open to the public in 2023.

ENVIRONMENTAL AWARENESS: TAKE ACTION ON WASTE BY RESPECTING THE THREE RS

(Image: CERN)

For information on CERN's electronics pool, please visit this page (*https://ep-ese.web.cern.ch/content/electronics-pool*).

For information on CERN's Storage, Recuperation and Sales service, please visit this page (*http://recuperation-sales.web.cern.ch*).

More information on CERN's e-learning module on waste management can be found here (*https://lms.cern.ch/ekp/servlet/ekp?CID=EKP000043174&TX=FORMAT1&BACKTOCATALOG=Y&DECORATEPAGE=N#*).

Share your best tips for waste reduction on our dedicated Mattermost channel (*https://mattermost.web.cern.ch/hse-unit/channels/environment-cern*).

HACKING FOR HUMANITY AT CERN'S GLOBAL WEBFEST

The second online edition of the Webfest brought together people from 63 countries to tackle challenges like wildfires, domestic violence and educational inequality

(Image: CERN)

The Webfest is CERN's annual hackathon based on open web technologies. This year, on the weekend of 21-22 August, participants from 63 countries formed small teams online and used their combined skills and knowledge to develop innovative prototype apps, hardware and other tools.

The theme for this year's Webfest was "science, society, sustainability", with participants encouraged to work on projects that address the UN Sustainable Development Goals. To this end, teams at the Webfest created an application to warn of wildfires, a concealed alarm system for victims of domestic violence, a directory for online learning materials, a website providing clear and accurate information about nuclear energy, a health app that identifies nutrient deficiencies, an AI system to aid with studying and much more. Information on all 22 innovative projects can be found on the Webfest website.

"Focusing on the Sustainable Development Goals, the participants in this year's CERN Webfest showed a great commitment to using their skills to improve our world," says Charlotte Warakaulle, Director for International Relations at CERN. "Their creativity and innovation has not only generated new practical solutions to societal challenges, but also inspired new ways of working together."

Each year, one project is selected as the overall Webfest winner. The eight judges at this year's event selected a project that uses crowdsourced designs and 3D printing to create tools for disabled people. These tools are particularly aimed at helping people with conditions like ectrodactyly and syndactyly (malformations of the hands and feet) to use everyday objects. During the Webfest, the team was able to create a prototype attachment that helps those with these conditions to pick up drinking bottles.

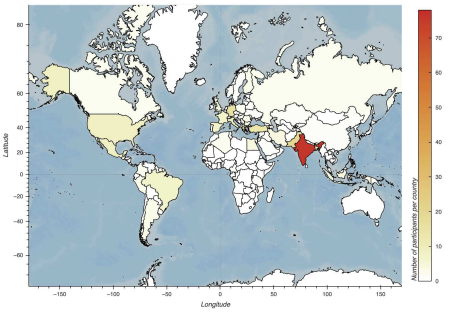
"For me, the Webfest was more than a hackathon; it was a portal for meeting new people from various backgrounds and learning about their journeys," says Komal Kedarnath, a mechanical engineering student from India and a member of the winning team. "I had the best time during the networking sessions, where I talked to people from 10 different time zones about how they got here. It was amazing!"

Noor Afshan Fathima, a technical student in the CERN IT department, presented the winning idea at the end of the Webfest. Her teammates were Komal Kedarnath, Mehdi Golbaz and Noor K. Kubra, all from India. Mehdi Golbaz is currently a CERN openlab summer student.

In addition to these networking sessions, the Webfest offered a fun CERN-themed quiz, an online exercise session and several how-to workshops focused on practical skills, such as how to give good presentations and how to create short videos. This diverse programme was made possible thanks to the Webfest's supporters: CERN openlab, gluoNNet, RemotelyGreen, Veertly, Citizen Cyberlab, Crowd4SDG, THE Port, CERN Alumni, Quantum FutureX, AI Crowd and CERN Fitness Club.

Given the global interest once again shown in the event, the organisers plan to run the hackathon online again next year.

To find out more, read the full version of this article on the CERN openlab website (https://openlab.cern/hacking-humanity-wildfire-alerts-tackling-domestic-violence-reducing-educational-inequality-and) . Also, you can still watch all the public Webfest sessions – including the closing awards ceremony (https://www.youtube.com/watch?v=Jmtsu4SniaE) – on YouTube.



Participants from 63 countries across the globe joined the hackathon. (Image: CERN)

Noor Afshan Fathima, a technical student in the CERN IT department, presented the winning idea at the end of the Webfest. Her teammates were Komal Kedarnath, Mehdi Golbaz and Noor K. Kubra, all from India. Mehdi Golbaz is currently a CERN openlab summer student. (Image: CERN)

Andrew Purcell

FIRST EUROPEAN HOSPITAL RECEIVES 3D COLOUR X-RAY SCANNER USING CERN TECHNOLOGY

MARS Bioimaging's 3D colour X-ray scanner has arrived in Europe for clinical trials that will lead to medical use of a CERN technology

MARS Bioimaging scanner at Lausanne University Hospital (CHUV). (Image: CHUV)

Since 2008, CERN and the New Zealand company MARS Bioimaging have teamed up to develop a 3D colour X-ray scanner based on the Medipix3 technology, developed by the Medipix3 collaboration. Inspired by particle physics detectors, Medipix3 and Timepix3 chips are now used for medical applications, in space and for art authentication.

The scanner has now arrived in Europe, at Lausanne University Hospital (CHUV) in Switzerland. This marks the first step towards the European part of the international clinical trials being undertaken by MARS Bioimaging to get the technology certified for medical use.

With the potential to monitor bone healing following a fracture, MARS Bioimaging's scanner makes high-resolution imaging around metal implants possible and can distinguish between many different types of tissue without any use of contrast agents. Images of such precision will lead to significant progress in diagnosing hand and wrist fractures and monitoring the healing process.

The team of radiologists and medical physicists at CHUV is eager to start clinical use of the scanner. "The MARS scanner will allow us to improve our understanding of arthritis: how it develops and how to diagnose it. It should also help us develop the targeted therapies we are currently lacking for calcium crystal deposition diseases," explains Dr Fabio Becce, Associate Physician and Senior Lecturer at CHUV.

"Trials of this technology in a Swiss hospital clearly demonstrate the pathway from experiments performed in a physics research laboratory to making a difference to patient healthcare," adds Professor Anthony Butler, President of MARS Bioimaging.

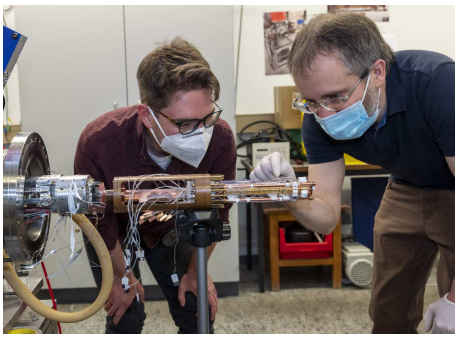
"In June 2021, CERN and MARS Bioimaging extended their current contract by five years, thus supporting MARS Bioimaging on their way to obtaining US Food and Drug Administration and European Union approval," explains Aurélie Pezous, from CERN's Knowledge Transfer group. "The partnership between CERN, the Medipix3 collaboration and MARS Bioimaging shows how teaming up with health professionals is critical to fostering medical innovation."

Beyond knowledge transfer, this cooperation highlights the potential of CERN alumni, several of whom have been involved in ensuring the scanner's radiological safety. Among them is Lucia Gallego Manzano, a former CERN fellow in radiation protection who now works at the *Institut de radiophysique* (IRA) of CHUV.

Antoine Le Gall

TWO-TRAP COOLING PROMISES ANTIMATTER PRECISION

The BASE collaboration has performed the first demonstration of two-trap sympathetic cooling, promising substantial improvements to studies of antiprotons



Cool experiment — Matthew Bohman (left) and Christian Smorra point out the location of the Penning trap where individual protons are cooled in the new two-trap cooling apparatus at the University of Mainz. (Image: Stefan F. Sämmer/JGU)

Picture two children playing on swings in a playground. One is a daredevil, launching themselves high off the ground in big arcs. The other daydreams, swinging gently.

Now picture the children holding either end of a long spring. Tension in the spring now accelerates the daydreaming child forwards and backwards to follow their friend, whose swings are slowed and shortened.

This is the principle behind a groundbreaking new technological demonstration reported today in Nature by the BASE collaboration – an international particle-physics collaboration based at CERN's antimatter factory. The energetic child represents a single proton oscillating inside the magnetic and electric fields of a Penning trap. The daydreamer represents a laser-cooled cloud of beryllium ions inside a second trap. The spring represents a unique innovation by the BASE collaboration: a superconducting resonant electric circuit that transfers energy from the proton to the ions, just as the spring transfers energy from one swing to the other. Smaller

swings mean a lower temperature proton and greater precision in experimental studies.

“This is an important milestone in precision Penning trap spectroscopy,” says BASE deputy spokesperson Christian Smorra of RIKEN and the University of Mainz, where the demonstration was performed. “With optimised procedures we should be able to reach particle temperatures of the order of 20 to 50 mK, ideally in cooling times of the order of 10 seconds. Previous methods allowed us to reach 100 mK in 10 hours.”

The speedy new two-trap cooling procedure promises a huge increase in the statistics that are available to experimenters. It is also a game-changing development for the study of BASE's main particle of interest: the antiproton. Conventional cooling techniques are difficult to apply to antimatter because it is highly challenging to put matter and antimatter in the same trap. Applying the new technique should allow a significant improvement on BASE's already world-leading measurements of fundamental properties of antiprotons. Such measurements have the potential to shed light on one of the biggest unanswered questions in fundamental physics: the unexplained surfeit of matter over antimatter in the universe.

“Our vision is to continually improve the precision of our matter–antimatter comparisons to develop a better understanding of the cosmological matter–antimatter asymmetry,” says BASE spokesperson Stefan Ulmer of RIKEN. “The newly developed technique will become a key method in these experiments, which aim to measure fundamental antimatter constants at the sub-parts-per-trillion level.”

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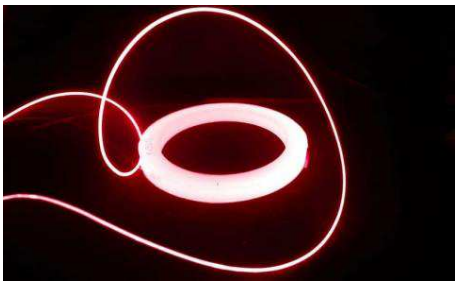
For more details check out the full report in CERN Courier *magazine.*

Mark Rayner

CERN-TESTED OPTICAL FIBRES NOW ON THE INTERNATIONAL SPACE STATION

Astronaut Thomas Pesquet has activated Lumina, an optical fibre-based dosimetry experiment on board the International Space Station



Lumina is an optical fibre-based dosimetry experiment developed by CNES, iXBlue, UJM and CERN. (Image credit: iXblue/CNES/G. Le Bras)

In a spacecraft, in order to protect both crew and electronics from radiation, it is mandatory to invest in effective radiation monitoring systems. The International Space Station (ISS), just like the Large Hadron Collider at CERN, is a complex radiation environment that requires bespoke dosimetry devices. Optical-fibre-based technologies can provide both distributed and point radiation dose measurements with high precision.

On 18 August, ESA astronaut Thomas Pesquet activated the Lumina experiment inside the ISS as part of the ALPHA mission. Developed under the coordination of the French Space Agency, CNES, and with the involvement of CERN, the Laboratoire Hubert Curien at the Université Jean-Monnet-Saint-Étienne, and iXblue, this project uses two several-kilometre-long optical fibres as active dosimeters to measure ionising radiation in the ISS with very high sensitivity.

Daniel Ricci, leader of the Fibre Optics section of the Engineering department at CERN, explains: “When exposed to the space radiative environment, the optical fibres experience a partial loss of transmitted power, which we call radiation-induced attenuation.” Diego Di Francesca, fibre-dosimetry project leader in the team, describes in detail how the dosimeter works: “Using a reference control channel, the radiation-induced attenuation of some special optical fibres can be accurately measured and put in relation with the total ionising dose. The sensitivity of the device is mostly governed by the length of the fibre. Depending on the dosimeter design, the longer the optical fibre dosimeter, the more sensitive it is.”

In order to prevent radiation-induced damage to the electronics inside the accelerators, CERN has been working with radiation sensors based on optical fibres for six years. Building on this experience, CERN has made a technical contribution to Lumina by helping with the theoretical analysis of the optimised architecture of the dosimeters and by carrying out the low- and high-dose irradiation tests needed to calibrate the instrument. Once the experiment is fully installed by Thomas Pesquet, CERN will also contribute to the analysis of the experiment's ground and flight data during its one to five years of operation.

“A challenge of Lumina is to be sensitive enough to measure low radiation rate variations, considering the shielding provided by the ISS shell. The calibration performed at CERN, on a ground reference model, will enable us to post-process the measurements and will lead to accurate results,” explains Florence Clément, project manager of the Lumina experiment at CNES/CADMOS. “We are convinced that the ISS is only a first step for fibre-optic dosimeters as we venture further into space. As we move away from Earth, the radiation levels increase, and so does the need for reliable dose monitoring.”

By contributing to this experiment, CERN continues to demonstrate its added value for the space sector. “This joint experience in space is an important result of the framework collaboration agreement established between CERN and CNES a few years ago, with special focus on radiation issues,” highlights Enrico Chesta, Aerospace Applications Coordinator in CERN's Knowledge Transfer group. “To monitor radiation damage to electronics, CERN has developed instruments that can

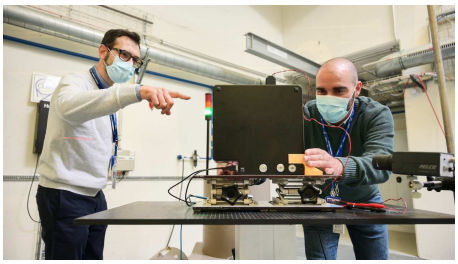
also be used on satellites. In the field of irradiation testing, our unique technical facilities are able to reproduce a variety of environments representative of the most extreme radiation space conditions."

The optical fibre dosimetry activity at CERN is part of the Radiation to Electronics (R2E) project, responsible for ensuring a successful operation of the CERN accelerator complex in view of adverse effects on critical electronic systems exposed to radiation.

For more information:

- Find out more about CERN's impact on aerospace here (*https://kt.cern/aerospace*).
- Article by CNES: *Lumina : Top départ pour la mesure des radiations dans l'ISS* (in French).

ESA astronaut Thomas Pesquet installing the Lumina experiment inside the Colombus science laboratory of the International Space Station. (Image credit: CNES)

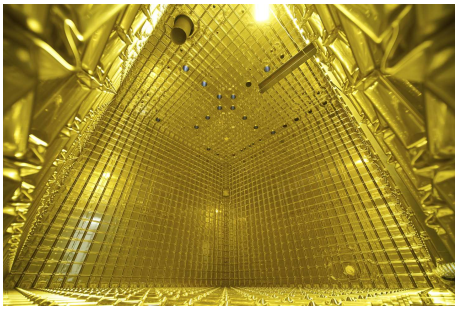


Calibration tests of the Lumina dosimeter in the irradiation facilities at CERN. (Image: CERN)

Antoine Le Gall

CERN TO PROVIDE SECOND DUNE CRYOSTAT

The Laboratory deepens its collaboration with the US-based neutrino experiment with the provision of two enormous stainless-steel vessels for DUNE's cutting-edge liquid-argon detectors



Inside a prototype liquid-argon time-projection chamber for the DUNE experiment. (Image: CERN)

Neutrinos are tricky beasts. Alone among known fundamental particles, they suffer from an identity crisis – if it were possible to put them on a weighing scale, you would unpredictably measure one of three possible masses. As a result, the three neutrino "flavours" merge into each other as they race through space and matter, opening up the potential for matter–antimatter asymmetries relevant to open questions in cosmology. Neutrinos are today the subject of a vibrant worldwide research programme in particle physics, astrophysics and multi-messenger astronomy.

In an eye-catching example of international collaboration in particle physics, CERN has now agreed to produce a second cryostat for the detectors of the international Deep Underground Neutrino Experiment (DUNE) in the US. Cryostats are huge stainless-steel vessels that will eventually hold and cool 70 000 tonnes of liquid argon inside the DUNE experiment's detectors. The large size and low temperatures of the cryostats needed for the DUNE detectors necessitated innovation in collaboration with the liquefied-natural-gas shipping industry. CERN had already committed to build the first of four DUNE cryostats. Following approval by the CERN Council, the Organization has now also agreed to provide a second.

The collaboration exploits CERN's expertise with a technology that neutrino physicists have dreamed of deploying on such a scale for decades. Neutrinos are notoriously difficult to detect. They stream through matter with a minuscule chance of interacting. And when they do interact, it's often with one of the least well understood objects in physics, the atomic nucleus, and a spray of particles and excitations emerges from the swirling mess of hadronic matter. To get enough of these ghostly particles to interact with nuclei in the first place, you need a dense target material; however, that is a terrible starting point for building a detector sensitive enough to reconstruct these sprays of particles in detail.

Former CERN Director-General and Nobel laureate Carlo Rubbia proposed a solution in 1977: neutrinos could interact in tanks of liquid argon, and electric fields could amplify tiny signals caused by the gentle ionisation of neighbouring argon atoms by charged particles created in the collision, allowing the event to be reconstructed like a three-dimensional photograph, with exquisite resolution that would be unprecedented for a neutrino experiment. Such a liquid-argon time-projection chamber was first realised on a large scale by the ICARUS experiment at Gran Sasso, which was built by INFN in Italy, refurbished at CERN and shipped to Fermilab's short-baseline neutrino facility in 2017. Each DUNE detector module will be 20 times bigger. Work on these groundbreaking designs has been under way at CERN for several years already in the preparation and testing of two ProtoDUNE detectors, which have successfully demonstrated the operational principles of the technology.

For more details, read the full story in CERN Courier *magazine.*

Mark Rayner

LS2 REPORT: ACCELERATED BEAMS IN THE SPS

The SPS accelerated its first LHC-type beam in May and is now sending beams to the North Area, where the physics season has started

The SPS's new RF system. (Image: CERN)

The Super Proton Synchrotron (SPS) is now sending accelerated beams to the North Area (NA), where the physics season has started. As well as being a key element of the LHC's acceleration chain, the SPS provides beams to the fixed-target experiments located in the North Area, as well as to the AWAKE experiment and the HiRadMat facility.

First acceleration

On 12 April 2021, the first beam was injected from the Proton Synchrotron (PS) into the SPS and, three weeks later, on 4 May, the first acceleration took place in the SPS, using the accelerator's brand-new radiofrequency (RF) acceleration system. "We first accelerated what we call 'LHC beams', which are different from the beams needed for the North Area," explains Verena Kain, head of SPS operation. "LHC beams are made of up to 288 high-intensity bunches with 25-ns spacing, while the NA beams fill almost the entire circumference of the SPS with many more bunches of lower intensity with a spacing of 5 ns."

Indeed, because of the production scheme in the SPS injectors, the fixed-target beams are injected into the SPS at a lower energy than the LHC beams. Because of this lower injection energy, the fixed-target beams have to be accelerated through what is called "transition energy". "The radial beam position needs to be controlled by feedback while accelerating through transition; the beams easily become unstable around transition," explains Verena Kain. "Adjusting the relevant parameters for crossing transition with the new RF controls took a considerable amount of time until good beam transmission could be achieved."

A brand-new RF system

" The SPS's new RF system uses solid-state amplifier technology. It is revolutionary, to say the least! It's the result of five years of research and development in collaboration with the French firm Thales," explains Éric Montesinos, deputy group leader of SY-RF. The system has been in operation since November 2020 and reached the peak power of 1.6 megawatts – a world first – earlier this year.

"This is a huge success for CERN, which has been possible thanks to the close cooperation between our group and Thales experts," continues Éric Montesinos. "It has not been an easy path – we developed as many as 28 prototypes! But we are now fully operational, with a failure rate below the calculated one and an availability rate of almost 100% for the SPS."

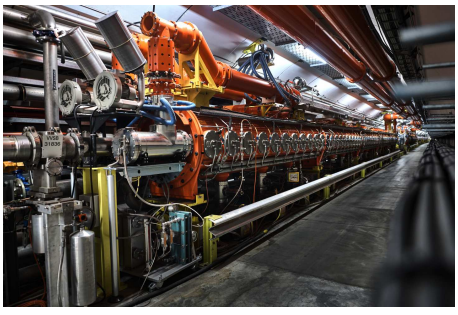
The SPS teams are now preparing the intensity ramp-up, with the eventual goal of achieving HL-LHC parameters. The beams extracted from the SPS are "brighter" now – in other words, there are more particles in a given volume, which will increase the number of collisions in the LHC. It will, however, still take several years for the designed HL-LHC parameters to be achieved in the SPS.

Watch or re-watch the live broadcast of the first beam acceleration in the SPS on 4 May 2021: https://www.youtube.com/watch?v=pJI-AgbA050

Anaïs Schaeffer

SPS EXPERIMENTS ARE BACK IN ACTION

Experiments restart at the Super Proton Synchrotron, CERN's second-largest accelerator



The Super Proton Synchrotron, CERN's second-largest accelerator. (Image: CERN)

The Super Proton Synchrotron (SPS) lives up to its superlative designation. It's CERN's second-largest accelerator and is the last link in the accelerator chain that feeds particle beams to the Large Hadron Collider (LHC). What's more, it supplies beams to a range of non-LHC experiments that address an impressive array of topics, from precision tests of the Standard Model of particle physics to studies of the quark–gluon plasma, a state of matter believed to have existed shortly after the Big Bang.

Following hot on the heels of the restart of the Proton Synchrotron Booster and the Proton Synchrotron after the second long shutdown of CERN's accelerator complex, the SPS and its experiments are now also back in action.

The SPS delivers particle beams to all of CERN's North Area (NA) experiments, to the associated test beam areas, as well as to the AWAKE experiment, which investigates the use of a wakefield created by pro-

tons zipping through a plasma to accelerate charged particles, and to the HiRadMat facility, which tests materials and accelerator components in extreme conditions.

The NA experiments are an essential strand of the Laboratory's experimental programme. NA58/COMPASS studies how quarks and gluons form composite particles such as protons and pions. NA61/SHINE investigates the quark–gluon plasma and takes particle measurements for neutrino and cosmic-ray experiments. NA62 studies rare kaon decays and searches for new heavy neutral leptons. NA63 investigates radiation processes in strong electromagnetic fields. NA64 searches for new particles that could carry a new force between visible matter and dark matter, or that could make up dark matter themselves. Last but not least, NA65, a new experiment that was approved in 2019, will take measurements of tau neutrinos for neutrino experiments and for tests of the Standard Model.

NA62 has just restarted taking data for physics studies, and the remaining experiments will start doing so in the coming weeks and months. Highlights include the start of NA65 in September and the first pilot runs in October for experiments proposed in the Physics Beyond Colliders initiative, such as AMBER (the successor of COMPASS) and NA64m (NA64 running with beams of muons).

“It's always a thrill to witness the restart of the experiments, as is to see the fresh data that they deliver, not least after the extensive upgrades they have undergone over the past two years,” says Johannes Bernhard, the leader of the Liaison to Experiments section at CERN. “And if the past seasons of data-taking are any indication, there will be plenty of new physics results to digest and to direct future studies.”

Ana Lopes

COMPUTER SECURITY: “CHECK ME” COMES BEFORE “SCAN ME”

Like with any other malicious URL, letting one malicious QR code through can put your digital life at risk

Remember our article on “ The truth lies in the URL ” about our latest phishing campaign and the risk to your device, your account and your digital life when clicking on the wrong – malicious – URL, the wrong “link”? Unfortunately, in this “Covidised” world, URLs now come more and more frequently in another form – as QR codes (see images below).

QR codes are used to access a dedicated webpage, e.g. to make a restaurant reservation or to provide personal details for COVID-19 tracking. Taking a photo of a QR code with your smartphone opens the intended webpage in your browser. Easy as pie.

But wait! While it's easy for your smartphone to tell what those patterns ought to be, our human eye is innocent and fails. Is this a good QR code? Is this a malicious one? Like with “standard” URLs embedded in emails, attachments, WhatsApp or Facebook messages or even text messages, you have to make the final call. You have to (try to) judge whether the URL embedded in the QR code is reasonable, expected and non-malicious. Like when you hover your mouse over a “standard” URL when using a laptop/PC, your smartphone should display at least the beginning of the URL (for the examples above, “cern.ch” and “cern.cg”). Check this URL and continue only if it looks right to you. Admittedly, it's often hard to tell, but it's still better to be safe than sorry. Otherwise, like with any other malicious URL, letting one malicious QR code through can put your smartphone and, hence, your account and subsequently your digital life at risk. So, please, watch out, be vigilant and STOP – THINK – DON'T CLICK!

For those who want to create their own QR code, e.g. to direct people to a website or as a link to a conference paper or other supporting material, make sure that the embedded QR is “pure” and only contains the URL you intended to provide. Some online QR generators embed additional information in the URL such as webpage redirection or id tokens that are used for tracking purposes. Please refrain from doing so*. Thanks!

** https://zxing.appspot.com/generator, for example, generates pure QR codes.*

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.

Colours are arbitrary and used here just to distinguish the good from the evil.

Computer Security team

Official communications

OPERATIONAL CIRCULAR NO. 7 (REV. 2) – TELEWORK

Operational Circular No. 7 (Rev. 2) entitled “Telework”, approved by the Director-General, is now available via the following link (*https://cds.cern.ch/record/2779005/files/Operational_circular%20no7_Rev.2_EN.pdf*).

This revision cancels and replaces Operational Circular No. 7 (Rev. 1) entitled "Telework dated November 2016.

This circular is an evolution of our current framework, incorporating lessons learned from the COVID19 pandemic and implementing the principles endorsed at the Extended Directorate of 9 March 2021, which simplify, streamline and increase flexibility whilst maintaining the focus of work on the CERN site.

The main modifications are:

- The introduction of telework opportunities also for Associated Members of the Personnel;
- The setting up of one single procedure for both regular and occasional telework;
- The introduction of a new general limit for telework of 40% of the contractual working time, in any two-week period.

The revised Circular will enter into force on **1 September 2021** and will be implemented taking into account the COVID 19 measures in place (https://hse.cern/content/scales-all).

Members of the personnel are invited to consult the CERN Admin e-guide for more details on implementation, including an FAQ and support for supervisors, at link (*https://admin-eguide.web.cern.ch/en/procedure/telework*).

HR department

133RD ACCU MEETING

Agenda for the meeting to be held on Tuesday, 7 September 2021 at 9:15 a.m. by video-only (no in-person meeting)

1. Chairperson's remarks
2. Adoption of the agenda
3. Minutes of the previous meeting
4. News from the CERN Management
5. Working Group on Strengthening the Support for Users at CERN
6. Report on services from SCE department
7. The CERN Ombud
8. Report on services from IT department
9. Users' Office news
10. Matters arising
11. Any Other Business
12. Agenda for the next meeting

The **Advisory Committee of CERN Users (ACCU)** is the forum for discussion between the CERN Management and the representatives of CERN Users to review the practical means taken by CERN for the work of Users of the Laboratory. The mandate of ACCU is available on: https://accu.web.cern.ch/node/31

There are one or two Delegates from each Member State (two Delegates from the large Member States), one Delegate from each of the Associate Members, four Delegates from non-Member States (NMS), and two from CERN. The list of ACCU members is available on: https://accu.web.cern.ch/accu-members

ACCU meetings are attended by the Director-General and members of the Directorate, other members of the CERN management and departmental representatives, the Head of Users' Support and a representative of the CERN Staff Association. Other members of the CERN Staff attend as necessary for specific agenda items.

Chairperson: Cristina Biino (Cristina.Biino@cern.ch)
Secretary: Michael Hauschild (ACCU.Secretary@cern.ch)

Anyone wishing to raise any points under “Any Other Business” at the upcoming ACCU meeting is invited to contact the appropriate User representative, or the Chairperson or the Secretary.

Announcements

ICHEP ANNOUNCEMENT – A CAVEAT

The "International Conference on High Energy Physics" happening in Paris on 20-21 September is unrelated to CERN and to the regular ICHEP conferences

The Scientific Information Service has recently been made aware of an "International Conference on High Energy Physics (ICHEP001 - 15.)", which is scheduled to take place in Paris on 20-21 September 2021.

According to information available on the conference website, the proceedings of the conference will be published in a special issue of a periodical named "World Academy of Science, Engineering and Technology - Physical and Mathematical Sciences" (ISSN : 1307-6892) .

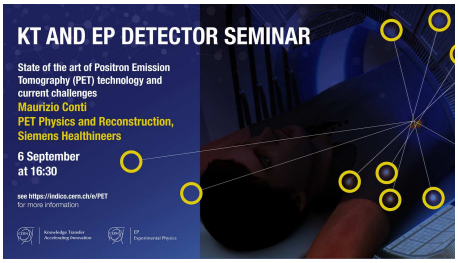
Please note that this conference should not be confused with the International Conference on Particle Physics (ICHEP) many of you know and enjoy every two years, organised by the International Union of Pure and Applied Physics (IUPAP).

The 41st ICHEP, organised by IUPAP and hosted by INFN (*Istituto Nazionale di Fisica Nucleare*, will take place on 6-13 July 2022 in Bologna. No ICHEP conference is scheduled in 2021.

The publisher "World Academy of Science, Engineering and Technology" and its journals appear on the Beall's list as a "potentially predatory" publisher. For a definition of "predatory journal" please refer to this *Nature* article (*https://www.nature.com/articles/d41586-019-03759-y*).

If you are ever in doubt whether a publisher or journal is a legitimate outlet for your publication, please do not hesitate to contact us at: open-access-questions@cern.ch

KT AND EP SEMINAR: STATE OF THE ART OF POSITRON EMISSION TOMOGRAPHY (PET) TECHNOLOGY AND CURRENT CHALLENGES



(Image: CERN)

When: 6 September 16:30
Speaker: Maurizio Conti, PET Physics and Reconstruction, Siemens Healthineers
Where: The seminar will take place on Zoom
For more information, please visit: https://indico.cern.ch/e/PET

A brief historical review of time-of-flight (TOF) positron emission tomography (PET) will be presented, including the recent developments in silicon photomultipliers (SiPM), which have resulted in improved TOF performance. The principles of TOF PET physics and a discussion of the technical and clinical advantages of TOF PET compared to conventional PET will be presented, including the concept of time resolution and its effect on TOF gain in signal-to-noise ratio (SNR), as well as properties such as reconstruction robustness to inconsistent data, convergence, and convergence speed. Other advanced reconstruction methods and innovations will be discussed, such as resolution recovery methods, data-driven methods for motion correction and the recent introduction of deep learning in various aspects of PET.

From the hardware point of view, we will review the most recent and exciting developments towards long axial field-of-view – or total-body – PET/CT scanners: design trade-off, characteristics and performance, challenges and advantages, including new applications enabled by very high-performance TOF PET scanners in the field of low-count imaging, theranostics and monoclonal antibody imaging, and dynamic and parametric imaging with simultaneous coverage of multiple organs.

Finally, we will briefly comment on the near future of PET and TOF PET in terms of possible technology developments and the need for fundamental research to push the field forward.

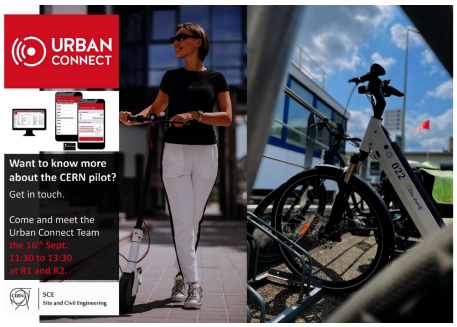
Knowledge transfer at CERN could not happen without the knowledge exchange between experts in science, technology and industry. The Knowledge Transfer Seminars, launched in 2016, are a series

of events showcasing how the novel technology and know-how developed at CERN translates into positive impact on society, by creating concrete solutions for industry across a wide range of fields: from medical technologies to aerospace, industry 4.0 and cultural heritage.

For information about the next Knowledge Transfer Seminar, sign up to our e-group at http://cern.ch/go/F9cX.

CERN Knowledge Transfer group

ON 16 SEPTEMBER, COME AND MEET URBAN CONNECT, OUR E-SCOOTER AND E-BIKE SERVICE PARTNER



(Image: CERN)

As you're probably aware, the SCE department is conducting an electric bike and scooter pilot scheme in partnership with Urban Connect, which has developed a dedicated mobile app.

All the information, including the terms of use and the locations of the docking stations, can be found at the CERN Mobility Centre, in the conditions of use and on the bike sharing webpage.

In case you missed the pilot scheme's launch in July, the Urban Connect team will be holding another event on the CERN site on 16 September. They'll be at Restaurants 1 and 2 from 11.30 a.m. to 1.30 p.m. to talk about the pilot scheme and explain how to get hold of the electric vehicles.

The more users the pilot scheme attracts, the more effective it will be. So don't miss out on this opportunity to go green!

SCE department

JOIN INDIA@CERN 2021: CONNECTING TECHNOLOGY EXPERTS WITH INDIAN COMPANIES

CERN will welcome representatives of Indian industry from 13 to 15 September 2021 in a digital format

The event will see a wide variety of Indian companies, working in a diverse range of fields of interest to researchers, engineers and technicians at CERN.

Anyone at CERN is welcome to attend the event.

“The objective is to develop contacts and match Indian companies with the relevant CERN technical counterparts and procurement officers, to address the upcoming challenging requirements at CERN.” – *CERN Procurement Service*

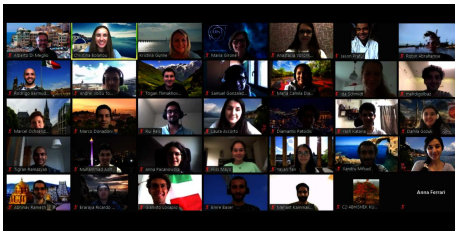
Consult the complete programme here: https://indiacern.cern.b2match.io/

If you are not already considered as a CERN Contact Person for Industrial Events@CERN and wish to make appointments with the representatives of Indian industry, please send an email to in-at-cern-contacts@cern.ch in order to receive an invitation.

While the global situation is not exactly the same as it was during the previous iteration, the purpose of the event remains the same: to develop the commercial relationship between CERN and leading companies in its Member States. Procurement remains a fundamental aspect of CERN's economic impact in its Member States and, reciprocally, advancements in accelerators, detectors and computing take shape through successful business collaborations with a variety of industries.

ONLINE “LIGHTNING TALKS” FROM THE 2021 CERN OPENLAB SUMMER STUDENTS

On Monday, 6 and Tuesday, 7 September, the 2021 CERN openlab summer students will present their work at dedicated public “lighting talk” sessions



Students from 16 countries are taking part in this year's online programme. (Image: CERN)

On Monday, 6 and Tuesday, 7 September, the 2021 CERN openlab summer students will present their work at dedicated public “lighting talk” sessions (session 1 (*https://indico.cern.ch/event/1054527/*), session 2 (*https://indico.cern.ch/event/1054531/*)).

In five-minute presentations, each student will introduce the audience to their project, explain the technical challenges they have faced and describe the results of their investigations. It will be a great opportunity for the students to showcase the progress they have made so far and for members of the audience to be informed about these cutting-edge IT projects, the solutions that the students have come up with, and the potential future challenges they have identified.

Due to the pandemic, this year's CERN openlab Summer Student programme is taking place online, with the selected students participating remotely from their homes across the globe. Over nine weeks (June–August 2021), the CERN openlab summer students have been working – via remote connection – with some of the latest hardware and software technologies, as well as learning about how advanced IT solutions are used in high-energy physics. This year, 28 students from 16 different countries were selected for the programme. They have also participated in a series of lectures given by IT experts on advanced CERN-related topics.

Join us on 6 and 7 September to discover the exciting work the students have carried out, bringing innovative ideas and fresh perspectives to the IT challenges faced at CERN. The presentations are free and open to all. On both days, the sessions will begin at 4.00 p.m. CEST and will last under two hours. Follow the live webcasts via the links below:

- Session 1 (*https://indico.cern.ch/event/1054527/*)
- Session 2 (*https://indico.cern.ch/event/1054531/*)

CERN openlab

PRINTING OF VISITOR CARDS NOW POSSIBLE ON THE PRÉVESSIN SITE

In addition to Building 33 and Gate B in Meyrin, you can now print the approved visitor cards at the entrance of the Prévessin site in Building 880.

A desk to enter your access code and a printer are available from the security officer in charge of access control.

As a reminder, staff members can request access to CERN for visitors by filling in the ticket below: *https://cern.service-now.com/service-portal?id=sc_cat_item&name=cern-visitor-card&fe=visitor-access-card*

SCE department

Ombud's corner

DON'T SWEEP CONFLICTS UNDER THE CARPET

Conflicts are a normal part of workplace life. They are unavoidable and inescapable because we all have different expectations and needs. However, depending on how a conflict is managed, it may be either constructive or destructive, hence the importance of understanding how a conflict evolves.

The earliest stage of a conflict relates predominantly to the underlying causes. There are many and varied causes of conflicts, including – and the list is far from exhaustive – the difficulty to adapt to change, poor communication, cultural factors, distribution of resources, confusion over responsibilities, and inappropriate leadership.

As divergence between the parties' needs, goals or expectations starts to emerge, positions become entrenched and communication becomes limited. The parties usually seek to make alliances and attempt to isolate one another. They start to lose sight of common ground and objectives, and rather focus on whatever has driven them apart.

At this stage, it is possible to encourage the parties to "let off steam", take a step back and talk through the issue. Very often, when open and honest dialogue is given a chance, positions may be softened and attitudes realigned for a successful collaboration. Managers should not miss this opportunity to "nip the conflict in the bud".

If the conflict is left to escalate, rational communication and mutual respect may be rapidly replaced by emotional confrontation. The parties' focus shifts to winning, and their ability to demonstrate empathy for each other is seriously undermined. At this stage, both parties feel that their values and needs are threatened and see backing down as a loss of face and a failure. In their view, any further discussion is unlikely to resolve anything.

At the late conflict stage, the conflict spreads to the team, as the parties seek to damage their opponent's reputation. Previously well-performing teams are drawn into the conflict and may lose motivation and productivity. Both parties experience high levels of stress.

After the conflict explodes and has to be managed – very often in a lose-lose settlement – it is often up to the managers to pick up the pieces. With both parties clinging to the view that they are right and everyone else is wrong, it is even more difficult for managers to balance the needs of the parties with those of the extended team and those of the business.

Whenever you experience or have to manage conflict, do not sweep it under the carpet: address it at its earliest stage. A conflict that is left unmanaged will create an increasingly toxic work environment.

I would like to leave you with a quote from Carl Jung that reminds us that conflicts, when properly and promptly addressed, may actually strengthen a work relationship:

"Conflicts create the fire of affects and emotions; and like every fire it has two aspects: that of burning and that of giving light."

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.