CERN Bulletin

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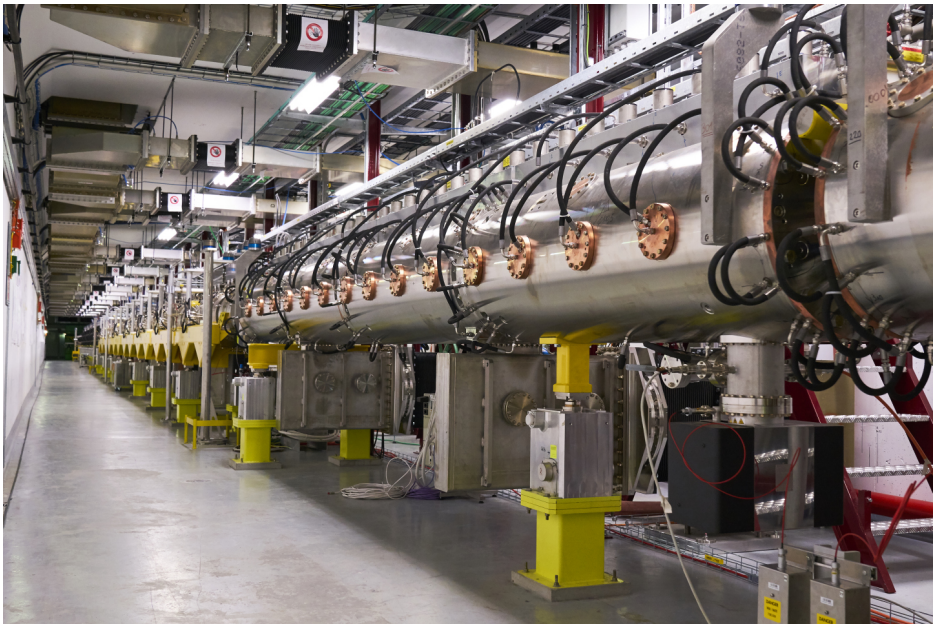
LS2 REPORT: LINAC4 KNOCKING AT THE DOOR OF THE PS BOOSTER

During a two-month test run that started at the end of September, Linac4 will send negative hydrogen ions up to the door of the PS Booster



The linear accelerator 4 (Linac4) will be the new source of proton beams for the Large Hadron Collider (LHC) after the second long shutdown of CERN's accelerator complex (LS2) (Image: CERN)

Busy activity has returned to the CERN Control Centre (CCC), where the Operation group coordinates the current Linac4 test run, supported by the Accelerators and Beam Physics (ABP) group and all the involved equipment groups. As we write, the nominal 160 MeV beam has already reached the Linac4 dump.

After the ongoing second long shutdown of CERN's accelerator complex (LS2), Linac4 will replace the retired Linac2 to provide protons to the LHC and all the CERN experiments that are served by CERN's proton-accelerator chain. "For this purpose, Linac4 has by now been connected to the LHC injectors chain through its new transfer line to the PS tunnel and the existing transfer lines to the PS Booster (PSB)," says Bettina Mikulec, who coordinates the test run.

In order to prepare Linac4 for the challenge of delivering reliably high-quality beam to the PSB from its first day of post-LS2 operation in 2020, a special beam run started on 30 September to measure its beam parameters in the completely renovated 15-m-long emittance-measurement line (LBE), only 50 m away from the PSB injection point.

(Continued on page 2)

A WORD FROM JAMES PURVIS

THE FIVE-YEARLY REVIEW BEGINS

Intergovernmental organisations periodically review the financial and social conditions they provide to ensure they correspond to their needs. At CERN, the applicable procedure is defined in Annex A1 of the Staff Rules and Regulations: *"In accordance with Article S V 1.02 of the Staff Rules and Regulations, the periodic reviews of the financial and social conditions of members of the personnel consist of a five-yearly general review of financial and social conditions (...) and an annual review of basic salaries, stipends, subsistence allowances and family benefits (...). In the framework of the five-yearly review, the Council may also decide to review any of the procedures defined for application at subsequent reviews."*

(Continued on page 2)

In this issue

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A WORD FROM JAMES PURVIS

THE FIVE-YEARLY REVIEW BEGINS

In respect of staff members, the purpose of the five-yearly review is to ensure that the financial and social conditions offered by the Organization allow it to recruit and retain the staff required for the execution of its mission from all its Member States. For fellows, it is to ensure that the financial and social conditions offered to them remain attractive compared to those in comparable research institutions.

Insofar as associated members of the personnel (MPAs) are concerned, the purpose of the five-yearly review is to ensure that the financial and social conditions offered by the Organization allow it to host MPAs in its research facilities, taking into account the highest cost-of-living level in the local region.

The five-yearly review procedure, which is driven and coordinated by the Human Resources (HR) Department, normally lasts no less than two years from initial data collection to approval by the Council of the Management's proposals, following which the implementation phase formally begins.

The Management's proposals are elaborated after consideration of input from various services across the Organization. They are then subject to concertation with the Staff Association at the Standing Concertation Committee (SCC) before being discussed within the TRripartite Employment Forum (TREF) and subsequently submitted for approval by the Finance Committee (Staff Regulations) or the Council (Staff Rules).

The five-yearly review will formally begin on 1 January 2020, following the last meeting of TREF in 2019, which took place on 22 October and brought together Member State delegates, the Management and the Staff Association. At that meeting, an overview of the five-yearly review procedure and a summary of the main decisions taken in the framework of the last review were presented.

We will then look ahead at the needs and priorities of the Organization, based on input from a variety of sources and benchmarks, and define the approach and timescale. You will find information and regular updates on https://hr-dep.web.cern.ch/content/5yr-2021.

As the main interested parties, we will keep you duly informed and updated through the webpages and dedicated public meetings. Watch this space!

James Purvis
Head of the Human Resources department

LS2 REPORT: LINAC4 KNOCKING AT THE DOOR OF THE PS BOOSTER

“In this line, we can of course measure the emittance of the beam – the transverse dimensions of the beam and its energy spread – but also its longitudinal parameters in the transfer line,” adds Bettina Mikulec. “The LBE line is also very close to the PSB entrance, so everything we measure there should not be far off from the final characteristics at the PSB injection point.”

Until 6 December, negative hydrogen ions* will cover the 86 m of the Linac4 to be sent along the new and renovated transfer lines (160 m in total) into the new LBE line, before terminating their flight in a dump located just at the wall of the PSB.

“During this run, hardware and software changes deployed since the last Linac4 reliability run, which took place in 2018, will be commissioned, with the aim of solving some remaining issues and enhance the beam quality,” says Alessandra Lombardi, Linac4 project leader in the ABP group.

In addition, the required operational beam configurations for the 2020 start-up will be prepared as much as possible in advance to allow a rapid Linac4 start in April 2020, when various beams will be set up for the PSB, so that the PSB can restart with beam under optimum conditions in September 2020.

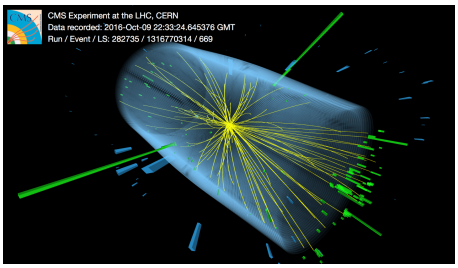
** Hydrogen atoms with an additional electron, giving it a net negative charge. Both electrons are stripped during injection from Linac4 into the PS Booster to leave only protons.*

Follow the progress of the LBE run on the online Vistar (https://op-webtools.web.cern.ch/vistar/vistars.php?usr=Linac4).

The new LBE line. At the end of this line, we can see the LBE dump (green shielding blocks) located just at the wall of the PSB (Image: CERN)

CMS MEASURES HIGGS BOSON'S MASS WITH UNPRECEDENTED PRECISION

The CMS collaboration reported the Higgs boson's mass with a precision of about 0.1%



A candidate from CMS of a Higgs boson transforming into two photons; the two large green towers show energy deposits from the photons (Image: Thomas McCauley, CMS/CERN)

The Higgs boson is a special particle. It is the manifestation of a field that gives mass to elementary particles. But this field also gives mass to the Higgs boson itself. A precise measurement of the Higgs boson's mass not only furthers our knowledge of physics but also sheds new light on searches planned at future colliders.

Since discovering this unique particle in 2012, the ATLAS and CMS collaborations at CERN's Large Hadron Collider have been busy determining its properties. In the Standard Model of particle physics, the Higgs boson's mass is closely related to the strength of the particle's interaction with itself. Comparing precise measurements of these two properties is a crucial means of testing the predictions of the Standard Model and helps search for physics beyond the predictions of this theory. In addition to probing its "self-interaction" strength, the researchers have also paid careful attention to the exact mass of the Higgs boson.

When it was first discovered, the particle's mass was measured to be around 125 gigaelectronvolts (GeV) but it wasn't known with high precision. Analysis of much more data was needed before reducing the errors in such a measurement. Indeed, ATLAS and CMS have been improving this precision with their respective measurements over the years. Last year, ATLAS measured the Higgs mass to be 124.97 GeV with a precision of 0.24 GeV or 0.19%. Now, the CMS collaboration has announced the most precise measurement so far of this property: 125.35 GeV with a precision of 0.15 GeV, or 0.12%.

Like most members of the zoo of known particles, the Higgs boson is unstable and transforms – or "decays" – nearly instantaneously into lighter particles. The mass measurement was based on two very different transformations of the Higgs boson, namely decays to four leptons via two intermediate Z bosons and decays to pairs of photons. To arrive at the mass value, the scientists combined CMS results of these two decays from two datasets: the first was recorded in 2011 and 2012 while the second came from 2016.

This measurement adds another piece to the puzzle of the exciting world of subatomic particles.

More details on the CMS website.

BROADENING TUNNEL VISION FOR FUTURE ACCELERATORS

CERN's civil engineers are tackling the tunnelling challenges of a post-LHC collider

Tunnels and underground galleries are currently being excavated to prepare for an upgrade of the Large Hadron Collider (Image: Julien Ordan/CERN)

What could the next generation of particle accelerators look like? With current technology, the bigger an accelerator, the higher the energy of the collisions it produces and the greater the likelihood of discovering new physics phenomena. Particle physicists and accelerator engineers therefore dream of machines that are even bigger than the Large Hadron Collider (LHC), with its 27-km circumference.

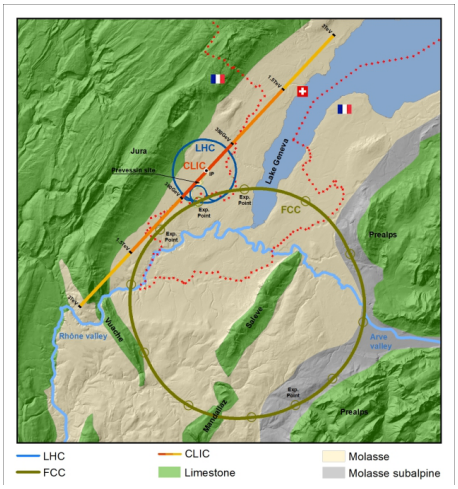
For CERN's civil engineers, a new accelerator requires a bespoke deep-underground tunnel, and the tunnel's shape, depth and orientation as well as its access shafts are largely constrained by the local geography. Such an accelerator built at CERN would be bound by mountains, and, if circular, would need to go under Lake Geneva and completely enclose the Salève mountain of the Prealps.

The two largest projects under consideration for a post-LHC collider at CERN are the Compact Linear Collider (CLIC) and the Future Circular Collider (FCC). Their scale would dwarf CERN's existing infrastructure, making them some of the largest tunnelling projects in the world. Civil engineers therefore need to survey the geological, environmental and technical constraints of these machines.

A tunnelling workshop that took place last week at CERN brought together civil-engineering experts from industry and academia to examine how new technologies and methods could optimise tunnel design and asset management. It is part of ongoing collaborations that have already seen CERN and the engineering consultancy Arup develop a first-of-its-kind tun-

nel optimisation tool to provide the best design when fed all the required parameters. The tool has already shown the feasibility of tunnels for either the FCC or CLIC in the local area, to help support the ongoing update for the European Strategy of Particle Physics that will guide the direction of particle physics and related fields to the mid-2020s and beyond.

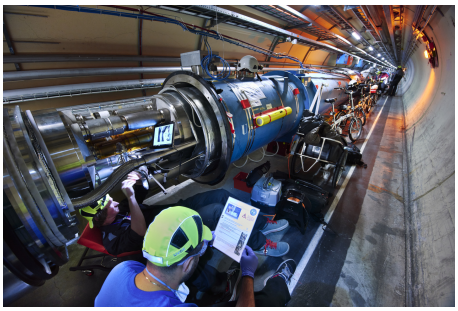
Find out more about the tunnelling challenges of CERN's civil engineers for the next-generation of particle accelerators in “Tunnelling for Physics” on the *CERN Courier* 's website.



Two proposed post-LHC accelerators – CLIC and the FCC – present unique challenges to CERN's civil engineers (Image: CERN)

HALFWAY TOWARDS LHC CONSOLIDATION

One hundred and fifty people are hard at work upgrading the Large Hadron Collider's superconducting magnets



Two members of the LHC consolidation team inspect and clean a diode enclosure of the dipole magnets before improving the electrical isolation (Image: Maximilien Brice and Julien Ordan/CERN)

The Large Hadron Collider is such a huge and sophisticated machine that the slightest alteration requires an enormous amount of work. During the second long shutdown (LS2), teams are hard at work reinforcing the electrical insulation of the accelerator's superconducting dipole diodes. The LHC contains not one, not two, but 1232 superconducting dipole magnets, each with a diode system to upgrade. That's why no fewer than 150 people are needed to carry out the 70 000 tasks involved in this work.

The project is now halfway to completion. One of the machine's eight sectors, containing 154 magnets, is now closed and the final leak tests are under way. Work is ongoing in the seven other sectors and the teams are working at a rate of ten interconnections consolidated per day.

The work is part of a broader project called DISMAC (“Diodes Insulation and Superconducting Magnets Consolidation”), which also includes the replacement of magnets and maintenance operations on the current leads, the devices that supply the LHC with electricity. Twenty-two magnets have already been replaced and two others have been removed from the machine in order to replace their beam screens, which are components located in the vacuum chamber.

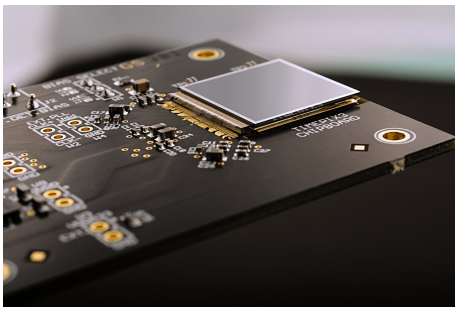
A plethora of upgrade and maintenance work is also being carried out in the tunnel on all the equipment, from the cryogenics system to the vacuum, beam instrumentation and technical infrastructures.

Replacement of one of the LHC superconducting dipole magnets during the accelerator consolidation campaign. (Image: Maximilien Brice and Julien Ordan/CERN)

Corinne Pralavorio

MEDIPIX: TWO DECADES OF TURNING TECHNOLOGY INTO APPLICATIONS

The story of how detector components ended up in medical imaging, in art restoration and even in space



The Timepix3 chip developed by the Medipix3 collaboration (Image: CERN)

How could microchips developed for detectors at the Large Hadron Collider (LHC) be used beyond high-energy physics? This was a question that led to the Medipix and Timepix families of pixel-sensor chips. Researchers saw many possible applications for this technology, and for the last 20 years these chips have been used in medical imaging, in spotting forgeries in the art world, in detecting radioactive material and more. A recent CERN symposium commemorated the two decades since the Medipix2 collaboration was established, in 1999.

Pixel-sensor chips are used in detectors at the LHC to trace the paths of electrically charged particles. When a particle hits the sensor, it deposits a charge that is processed by the electronics. This is similar to light hitting pixels in a digital camera, but instead they register particles up to 40 million times a second.

In the late 1990s, engineers and physicists at CERN were developing integrated circuits for pixel technologies. They realised that adding a counter to each pixel and counting the number of particles hitting the sensors could allow the chips to be used for medical imaging. The Medipix2 chip was born. Later, the Timepix chip added the ability to record either the arrival time of the particles or the energy deposited within a pixel.

As the chips evolved from Medipix2 to Medipix3, their growing use in medical imaging led to the first colour X-ray of parts of the human body in 2018, with the first clinical trials now beginning in New Zealand. In addition, the versatile chips have gone beyond medicine, for example, a start-up called InsightART allows researchers to use Medipix3 chips to peer through the layers of works of art and study the composition of materials to determine the authenticity of pieces attributed to renowned artists.

The team behind InsightART, based in Prague, recently scanned an alleged Van Gogh, concluding that the work was most likely to have been produced by the Dutch master, having observed an underlying sketch very similar to other figures Van Gogh painted at the time. The work will be sent to the Van Gogh Museum to be vetted with this evidence, and it might be that not one but two Van Goghs have been found in the same piece.

Timepix-based detectors have been aboard the International Space Station since 2012 to measure the radiation dose to which astronauts and equipment are exposed, and in 2015, high-school students from the UK sent their own Timepix-based detector to the ISS with astronaut Tim Peake. The ability of the chips to detect gamma rays has been exploited to help with the decommissioning of nuclear reactors and is being evaluated for the detection of thyroid cancer with greater resolution than before and with a lower radiation dose to the patient.

The Medipix and Timepix chips, developed by three collaborations involving 32 institutes in total, have been remarkable examples of knowledge transfer from CERN to wider society. You can learn more about the history of Medipix and their many applications in this talk (*https://cds.cern.ch/video/2678560?showTitle=true*) by Medipix spokesperson Michael Campbell, given in June 2019.

COMPUTER SECURITY: A NEW TWIST FOR THOSE WHO RELY ON EXTERNAL SOFTWARE

If you take advantage of the plethora of software snippets, code excerpts, libraries and the like circulating on the Internet, don't forget that there's a risk: is the code safe? Bug-free? Maintained? And free of any malicious components?

Are you a programmer? Software developer? Someone who codes regularly? Or just from time to time? Then you no doubt take advantage of the plethora of software snippets, code excerpts, libraries and the like circulating on the Internet, on Github, Stack Overflow, SourceForge, or others. Nice, but there's a risk: is the code safe? Bug-free? Maintained? And free of any malicious components?

A few months ago, we discussed the inherent risk and implications for CERN's computer security of any use of external libraries (see our *Bulletin* article on “Fatal dependencies”). In the past, several public and open source libraries were found to contain malicious code for extracting credentials or misusing local computing power for crypto-currency mining or other evil deeds. So, all that glitters is not gold. External software libraries and external code snippets should be used with diligence and care. A variety of static code checkers can help you with this. Or consider using a centralised software

repository manager like Sonatype Nexus or Apache Maven. But that is not the only risk.

What if the code you depend on is simply withdrawn from your source? In an interesting new twist, a software developer decided to pull all his code from Github after he learned that it was being used by a US agency whose work he did not appreciate at all. His software, "Chef Sugar", is a Ruby library for simplifying work with "Chef", a platform for configuration management. Removing the software from the public domain impacted negatively on several customers of that US agency using "Chef"*. And they might not be the only ones being affected...

Another example is the recent change of Oracle's terms and conditions for the usage of Java JRE. While any support for Java as part of a commercial software package is still included in that package, updates and support for in-house development might need a paid subscription. Previously free usage has become restricted behind a paywall... While the OpenJDK toolkit (for Java version 11) provided and supported by RedHat until 2023 might still fit certain use cases, other software might run into nasty dependency issues...

So, what are the chances of something like this happening to you? Do you have a full copy of the software you rely on in source code format? Can you freely and independently compile it? Have you assessed the impact in case the original publication location goes bust? Share your experiences with us via Computer.Security@cern.ch.

**The full story can be found on Slashdot.*

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.

The Computer Security Team

Official communications

CHANGE OF ADDRESS IN SWITZERLAND AND SWISS "ATTESTATION DE DÉPART"

1. Change of address in Switzerland
Although the Permanent Mission of Switzerland in Geneva directly informs the services concerned via a monthly list, the Swiss authorities recommend that members of the personnel inform the relevant service below of their arrival in Switzerland and any change of address within 14 days:

a) for people living in the Canton of Geneva, the *Office cantonal de la population et des migrations* (OCPM) should be informed (see here (*https://www.ge.ch/annoncer-mon-arrivee-office-cantonal-population-migrations/annonce-arrivee-geneve-detenteurs-carte-legitimation*) and here (*https://www.ge.ch/annoncer-changement-adresse-geneve*));

b) for people living in the Canton of Vaud, the *Contrôle de l'habitant* for the commune in which they live should be informed.

2. Swiss "Attestation de départ"
An a *ttestation de départ* (departure certificate) is an essential document for certain formalities that arise upon departure from Switzerland (customs, insurance companies, etc.). It is valid for two months and can be issued one month prior to departure at the earliest.

a) Procedure to follow for people living in the Canton of Geneva:

- you are strongly advised to apply by post by sending the form *"Annonce de départ"*, enclosing a photocopy of your *carte de légitimation* (Swiss card) issued by the Federal Department of Foreign Affairs, to

Office cantonal de la population et des migrations,
Case postale 2652,
1211 Genève 2
(see here (*https://www.ge.ch/annoncer-mon-depart-office-cantonal-population-migrations*)), or

- you can also go in person, bringing your *carte de légitimation* (Swiss card) issued by the Federal Department of Foreign Affairs to

OCPM,
Route de Chancy 88,
1213 Onex
(open Monday, Tuesday, Thursday and Friday from 7.30 a.m. to 1.30 p.m. nonstop, and Wednesday from 9.00 a.m. to 4.30 p.m., tel. 022 546 47 95);

b) Procedure to follow for people living in the Canton of Vaud: go in person to the *Contrôle de l'habitant* for the commune where you live, bringing your *carte de légitimation* (Swiss card) issued by the Federal Department of Foreign Affairs.

Relations with the Host-States Service
www.cern.ch/relations
relations.secretariat@cern.ch
Tel. : 72848 / 75152

Announcements

ESCALADE RUNNERS TO TRAIN AT CERN

A run in preparation for the Escalade race will take place on Sunday, 17 November on the CERN site

CERN, the CERN Clubs Committee and the Running Club are organising one of six training runs for the Escalade race, in conjunction with the event's organisers. This training run will take place on Sunday, 17 November from 10 a.m. Runners can choose from three routes, from 2.1 km to 8.9 km, on the Meyrin site and through the vineyards of Satigny. The starting and finishing lines will be on the Esplanade des Particules.

1500 runners, adults as well as children, are expected to participate in the training run.

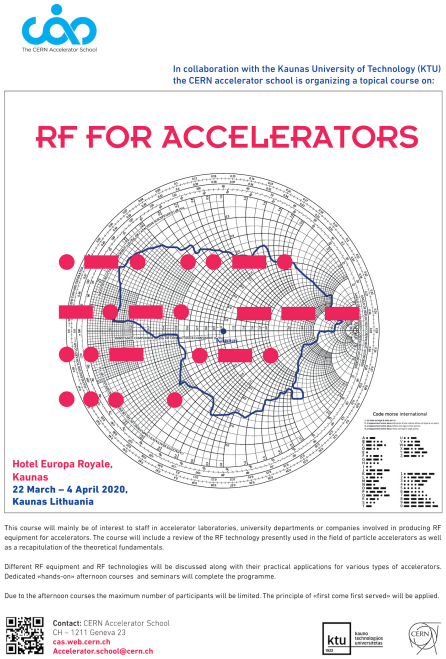
There is no need to register if you want to take part. However, please use public transport where possible, or if you are coming by car, please park within the CERN site.

To facilitate the organisation of the event, **the Globe car park will be closed** and access to it will be limited to runners only, **from 8 p.m. on Saturday, 16 November to midday on Sunday, 17 November**.

More information here: http://escalade.ch/santescalade/dimanche

CERN ACCELERATOR SCHOOL: RF FOR ACCELERATORS 22 MARCH – 4 APRIL 2020

Registration is now open for the CERN Accelerator School's course on RF for Accelerators, to be held in Kaunas, Lithuania, from 22 March to 4 April 2020



(Image: CERN)

Registration is now open for the CERN Accelerator School's course on RF for Accelerators, to be held in Kaunas, Lithuania, from 22 March to 4 April 2020.

This course will mainly be of interest to staff in accelerator laboratories, university departments or companies involved in producing RF equipment for accelerators.

The course will include a review of the RF technology presently used in the field of particle accelerators as well as a recapitulation of the theoretical fundamentals. Different RF equipment and RF technologies will be discussed along with their practical applications for various types of accelerators. Dedicated “hands-on” afternoon courses and seminars will complete the programme.

For more information and application, please visit the school website (*https://cas.web.cern.ch/schools/kaunas-2020*).

“SCIENCE MEETS FICTION” CONFERENCE

A conference in collaboration with Arts at CERN will take place on Wednesday 30 October from 2.00 p.m. to 6.30 p.m. at the HEAD in Geneva

(Image: CERN)

Does science need fiction? Does fiction still need science? What kind of fictional spaces, and fictional scenarios emerge when scientists and artists collaborate? From bio-design to particle physics, this conference, in collaboration with Arts at CERN, will focus on the mutual influences between science and fiction.

Wednesday 30 October
From 2.00 p.m. to 6.30 p.m.
CUBE, HEAD, Building H
Free entrance

For more information, please visit this website (*https://www.hesge.ch/head/en/event/2019/science-meets-fiction-conference-collaboration-arts-cern*) or the Facebook event.

FLU: PROTECT YOURSELF AND OTHERS

The World Health Organization (WHO) maintains that influenza vaccinations are effective and safe. “Worldwide, these annual epidemics are estimated to result in about 5 million cases of severe illness and around 290 000 to 650 000 deaths.”

By choosing to get vaccinated, you are protecting not only yourself, but also your family, friends and colleagues as well as people who are vulnerable and at risk.

How to get vaccinated at CERN?

From now until the end of the vaccination period, all people working at CERN can come and collect a prescription for an influenza vaccine from CERN's medical service, building 57.

Once you have bought the vaccine, CERN's medical service will welcome you in order to administer it.

Please ensure that the vaccine is kept cool in the fridge if you cannot come immediately!

Friday 8th November 2019 is the Swiss national flu vaccination day.

To mark this event, CERN's Medical Service will exceptionally be open the whole day from 8am to 5.30pm in order to vaccinate you against influenza.

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For more information regarding influenza:

- *WHO*
- *OFSP*
- *Santé Publique France*

CERN Medical Service