# CERN Bulletin

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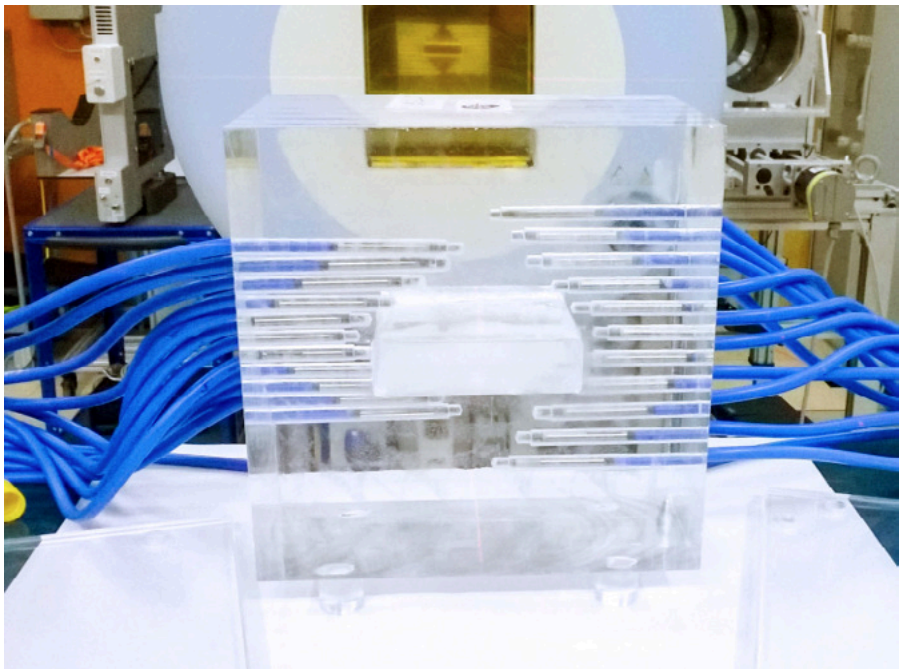
# DO YOU BELIEVE IN PHANTOMS?

**"Phantoms" are tools that simulate a therapy's response by mimicking the conditions of the human body. They are required in hadron therapy in order to optimise and verify the therapy before performing it on the patient. The better the phantom, the more accurate the treatment plan and the more effective the therapy. In the framework of the EU-funded project ENTERVISION*, a team of CERN researchers has designed an innovative piece of equipment able to evaluate radiobiology-related parameters in a very accurate way.**



*The ENTERVISION phantom being tested at HIT.*

A key challenge in hadron therapy – i.e. the medical use of hadrons to treat cancer – is to evaluate the biological effect of the delivered radiation. This can be achieved by using accurate dosimetry techniques to study the biological response in terms of the dose deposited and other physical parameters of the beam, such as the Linear Energy Transfer (LET). The job of the "phantom" is to allow this accurate assessment of the deposited dose versus the dose response that a given cell culture shows to different types of particle beams. In this way, the oncologist can evaluate in advance the right dose to guarantee the best results of the treatment.

Thiago Viana Miranda Lima joined CERN in 2012 as a member of the ENTERVISION project team with the task of designing a new phantom in the context of improving digital medical imaging for radiotherapy. The ENTERVISION team works in close collaboration with CNAO, HIT and INFN Torino. "I spent the first year of my fellowship studying the phantoms already available and, eventually, providing the first design of the new one. Thanks to the joint efforts of a multidisciplinary team, we produced the earliest prototype in the first half of 2013," explains Thiago. The phantom is a box connected to particle detectors. It is made

(Continued on page 2)


## INTRODUCING INTERNATIONAL GENEVA

**Geneva is variously known as the city of peace, the world's smallest metropolis and a place where great ideas have taken form. It has been the home to philosophers such as Rousseau and Voltaire. It was the centre of the Calvinist reformation and birthplace of the Red Cross.**

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## In this issue

### NEWS




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# A word from the DG

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## INTRODUCING INTERNATIONAL GENEVA

**I hardly need to tell you that it is also a city of great international collaboration in science. Little wonder, then, that over the years, Geneva has developed into the world's capital of internationalism in the broadest sense of the word. Yet while we all know of the existence of modern day International Geneva, how many of us really know what it does?**

**Here at CERN, we're about to find out. Next week sees the first in a series of talks at the Laboratory from the heads of some of the institutions that make up International Geneva. On Friday, 20 February, it will be my pleasure to introduce you to Michael Møller, Acting Director-General of the United Nations Office at Geneva (UNOG), who will be kicking off the series with an overview of the vital role International Geneva plays on the world stage. As the series progresses, I'll be returning the compliment, presenting CERN to the personnel of other international organisations.**

**It's been said that as far as the UN is concerned, while New York is the table, Geneva is the kitchen. But what does it actually cook? Michael Møller's talk at CERN forms part of his initiative to answer this question and make International Geneva better known. As head of UNOG, he's uniquely placed to see that while the missions of the International Labour Organization, the United Nations High Commissioner for Refugees or, for that matter, CERN may differ widely, we all share the spirit of international collaboration over nationalism, of pooling our resources for the greater good. History demonstrates that it is no accident that international organisations have gravitated to Geneva, and there's a tangible added value in the fact that there are so many of them here.**

**Over the coming weeks and months, as we hear from the heads of other organisations such as the World Meteorological Organization and the World Intellectual Property Organization, we'll be learning more about what makes International Geneva tick, and how vital a part of it CERN is. Do come along next Friday. You might be surprised by what you learn, and I've no doubt that you'll leave the talk with greater respect for Geneva and the region that hosts our Laboratory.**

***Rolf Heuer***

# DO YOU BELIEVE IN PHANTOMS?

(Continued from page 1)

out of polymethyl methacrylate (PMMA), a material with a density close to that of water, the main component of the human body.

The main advantage of the ENTERVISION phantom is that it uses pre-sterilised commercia l cell plates, thereby avoiding the risk of contamination. "Using commercial cell plates also enables us to perform as many tests as we want, obtaining much better statistics concerning the biological response of the tissues and reducing uncertainties that arise from delayed cell preparation," says Thiago. The current phantom is the result of several stages of development and testing. "The box evolved from having a single-cell-flask plate to the current 12-cell-flask plate, and in the next model the number of cell flasks will be increased to 96 in order to enhance the spatial resolution and statistics of the phantom performance.

"The final goal of the project is to evaluate precisely the difference between irradiating cells with protons and with other charged particles so that we'll be able to work out their biological effect on human tissues, which will aid radiobiologists in the development of different biological models," concludes Thiago. The ENTERVISION team is now in the process of finalising the analysis and gathering all the results in order to study the reproducibility of the phantom so that it can be used by both radiobiologists and medical physicists.

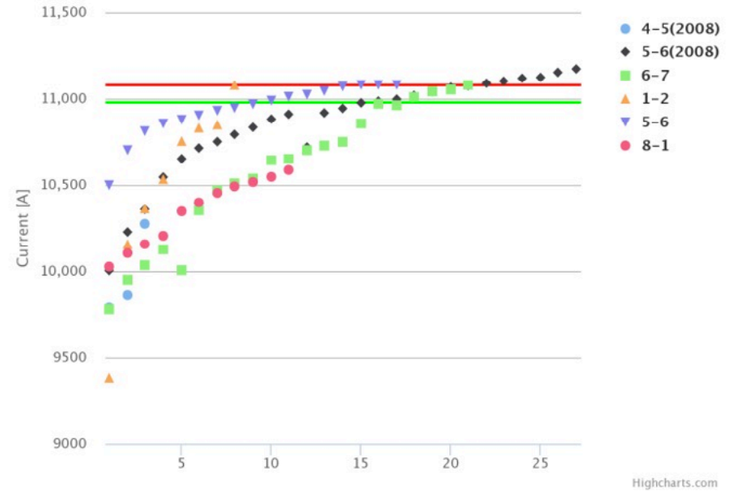
**ENTERVISION is a Marie Curie Initial Training Network project composed of 16 researchers, three of whom are based at CERN, in the field of online medical imaging and dose delivery for hadron therapy. The project was established in response to the clinical need for further research into online imaging and to train highly skilled professionals. You can find additional information about the ENTERVISION project at* ***http://entervision.web.cern.ch/ENTERVISION/***

*Rosaria Marraffino*



# LHC REPORT: GETTING IN SHAPE FOR THE RUN 2 MARATHON

**The buzzword you'll hear most both inside and outside the CCC is "training". Rather than preparation for an athletic competition, it actually refers to the way the LHC is trying to get in shape for the long Run 2 marathon at 6.5 TeV.**




*Picture 1 : Training quenches of the LHC Dipoles*


*On Wednesday, 11 February at point 4 (sector 3-4), the teams in charge of the ELQA tests performed the final high-voltage qualification of an LHC main dipole insulation as part of an extensive series of LS1 interventions and upgrades. They applied 1500 V to the circuit and observed no significant leakage of current, which concludes the scheduled campaign of electrical tests positively.*

In the previous edition of the Bulletin, we discussed the lengthy process of commissioning LHC superconducting circuits and the phenomenon of repetitive quenches accompanying the progressive increase in their performance. This is typical for superconducting magnets, but it is particularly intriguing for the LHC dipole magnets. Not only because each and every one of the 1,232 dipoles has to reach the same current target in order for beams to circulate at a certain energy (the weakest link of the chain determining or compromising the performance of all the others), but also because we know that every additional quench brings us closer to our 2015 objective. All the dipole magnets have been tested - one by one - in SM18, but this is the first time that they will all be trained together up to the current that corresponds to 6.5 TeV energy (namely 10,980 A) in the tunnel.

Every morning, people arriving at the CCC ask "where are we with the training in sector XY?", and they look at the colourful plot (see picture 1) to try and guess how long it will take to complete the full training of that sector.

Aside from the guesswork, people are continuing to work hard to prepare the machine in time and the powering tests are now very much in the ramp-up phase. Currently, more than half of the test steps have been executed. Also, importantly, the dipole circuits in three out of eight sectors have been trained to the 6.5-TeV-equivalent current, with the total number of quenches confirming the initial prediction of about 100 quenches for all the dipoles in the machine. An additional fourth sector is now in the training stage. Among the already-trained sectors, sector 5-6 is reaching the target energy for a second time: in 2008, tests were conducted in that sector, bringing it above 6.6 TeV.

Testing of all other magnet circuits has progressed well and an entire sector has been fully commissioned, with all its circuits having been brought up to 6.5 TeV at the same time.

Powering tests are ongoing on six different fronts, with the last two sectors arriving at the beginning of next week. The tremendous effort of the many teams that worked tirelessly during LS1 to prepare the circuits is almost over. The Electrical Quality Assurance (ELQA) team is one of the last; it has been an integral part of the process since the very beginning of LS1, guaranteeing the quality of the extensive consolidation and ensuring that the cool-down of all elements was done correctly and didn't generate any issues. They recently completed their last planned verification, although their expertise will undoubtedly be required to address inevitable non-conformities.

The whole machine will be soon in the hands of the beam commissioning team for one last sprint. The preparation for the marathon is entering its final stage.

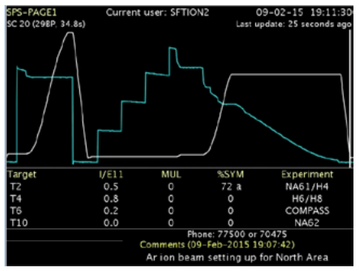
*Mirko Pojer, Matteo Solfaroli*

# ARGON IN ACTION

**Over the past few days, the SPS has been accelerating argon ions, which have started to be sent to the NA61/SHINE experiment. This operating mode, using a new type of ion, required a number of modifications to the accelerator.**

Today, the accelerators are once again juggling particles and even performing completely new tricks. The SPS is supplying beams of argon ions for the first time, at energies never before achieved for this type of beam. They are destined for the NA61/SHINE experiment (see box) located in the North Area, which began receiving the beams on 11 February.

Argon ions have a relatively large mass, as they consist of 40 nucleons, so they can be used in a similar way to lead ions. The main difficulty in accelerating them lies in the SPS, where the variation in acceleration frequency is limited. "The SPS was designed for accelerating protons," explains Django Manglunki, who is responsible for the project, "but argon ions are injected at a relatively slow speed compared to protons, and their revolution frequency during acceleration varies considerably. It's beyond the usual operating range of the machine." The radiofrequency specialists must therefore use the acceleration method known as "fixed frequency", which resynchronises the phasing during acceleration, as in the case of lead ions.




*Picture 1: a "super-cycle" of the SPS, featuring a proton cycle for the LHC, followed by an argon ion cycle for the North Area.*

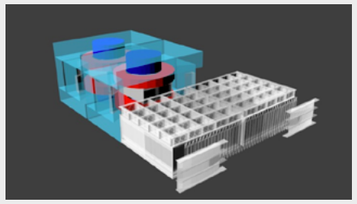
Another difficulty arises from the range of energies required by the experiment: beams of six different momenta, between 13 and 150 GeV/c per nucleon, will be produced over the course of eight weeks in 2015. So as not to monopolise the SPS during argon operation, the argon beams will alternate with beams of protons being sent to the LHC. A "super-cycle" of the SPS will therefore include both proton and argon cycles (see picture 1). This double operation required the installation of a safety system to ensure that proton beams cannot accidentally be sent to the North Area.

Operation with argon ions was originally proposed six years ago, and the accelerator teams have been planning for it for the past two years. In 2013, the source, the radio-frequency quadrupole and Linac 3 were commissioned using argon. Over the past year, as the LS1 work on them was completed, LEIR, the PS and the SPS received their first ions. "We restarted LEIR with a new power supply control system and a new type of ion all at once," explains Django.

The start-up of the SPS with argon ions at the end of January was a new challenge as the machine's components are more difficult to adjust with low intensity beams of this kind. Nevertheless, after just two weeks of warming up, the accelerator had already extracted ions at three different energies.

CERN's accelerators occasionally juggle particles other than protons. Aside from lead ions, the complex has also accelerated electrons, positrons, antiprotons, deuterons and α particles, as well as oxygen, sulphur and indium ions. The teams are already preparing for operation with other types of ions, lead and xenon, which will also be used by NA61/SHINE and other experiments in the North Area.

### Exploring the phase transitions of hadronic matter



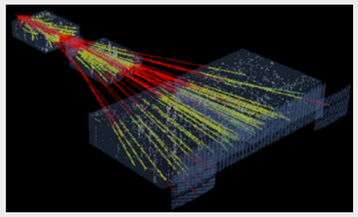
*Mock-up of the NA61/SHINE detector.*

NA61/SHINE is part of a series of experiments using heavy ions that began in the late 1980s at the SPS, continuing at the RHIC collider at Brookhaven and then at the LHC. By studying heavy ion collisions, these experiments are exploring the phenomenon of "deconfinement", whereby quarks, bound by strong interaction, are subjected to very high energies and are set free for a fleeting period of time. They have gathered evidence of the existence of quark-gluon plasma, a state that is thought to have existed at the very beginning of the Universe and in which quarks moved around freely, unconfined by the strong force in protons and neutrons. NA61/SHINE is the direct successor of one of these experiments, NA49.

NA61/SHINE is concerned with the phase transition to quark-gluon plasma. We know that the properties of the transition between liquid water and water vapour vary with temperature and pressure. In the same way, the properties of the transition between the confined state of hadrons (where quarks are bound in hadrons) and quark-gluon plasma should change with temperature and the density of the baryons. Physicists can play with these two parameters by varying the type of nuclei and the energy of the collision.

More specifically, NA61/SHINE is interested in the "deconfinement" point, a collision energy threshold above which the creation of quark-gluon plasma would be possible. The experiment is also searching for a hypothetical critical point, beyond which the two phases would transform between each other seamlessly. "The theory of strong interactions, quantum chromodynamics, does not predict the values for phase changes and the critical point precisely," explains Marek Gazdzicki, spokesperson for NA61/SHINE. "Their discovery by an experiment would therefore be of huge importance."

NA61/SHINE is thus systematically testing many collision energies using ions of different masses. This research complements work at the LHC, where collisions at much higher energies are being studied. Between 2009 and 2013, NA61/SHINE studied proton-proton, then beryllium-beryllium interactions. "We're pinning a lot of hope on the collision of argon ions, as they are much lighter than lead ions and should allow us to find the infamous critical point. That would be a huge leap forward in our knowledge of the properties of matter subjected to the strong interaction," explains Marek, who can hardly wait for the first data.



**Last update!** On Thursday, 12 February, the NA61/SHINE team recorded the first collisions of argon ions with a momentum of 150 GeV/c per nucleon with scandium nuclei. This picture shows one of these events as reconstructed by the NA61/SHINE team.

*Corinne Pralavorio*



# KICAD CHALLENGES THE BIG ONES

**Printed Circuit Boards (PCB) are the heart of any electronic device, including your toaster and your smartphone. Designing PCBs is the job of electronic engineers who, so far, have often had no option but to use proprietary tools to design complex circuits. Thanks to the efforts that CERN experts have put in to improve the free KiCad software, that situation is about to change.**

KiCad's development started in 1992 as a way to design PCBs, the units that control how an electronic device works. Since 2013, experts in the Beams department have made important contributions to KiCad as part of the Open Hardware Initiative (OHI), which provides a framework to facilitate knowledge exchange across the electronic design community. "Our vision is to allow the hardware developers to share as easily as their software colleagues," says Javier Serrano, head of the BE-CO-HT section and OHI initiator. "Software sources are easily shared online because they are text files and everyone has access to editors and compilers that turn the sources into a program. On the other hand, in the case of hardware design, most of the time this is done using proprietary tools. Therefore, in order for people to modify the sources, they need to use those proprietary tools."

When the CERN KiCAD project started at CERN, a lot of free tools were already available to hardware designers but none was easy enough to use when designing a complex circuit. Among them, KiCad showed the best potential. "We started by cleaning the basic code and introducing a new graphical engine," explains Tomasz Wlostowski, a member of the BE-CO-HT section who, among other things, is in charge of supervising the development of new features for KiCad. "With our contribution, we aim to develop KiCad up to a point where it becomes the *de facto* standard for sharing, and more and more users, including corporate ones, start working with it."

Next week, the team is going to release two new features that many in the free/Open Source EDA community have been asking for: differential pair routing and trace length matching. "Thanks to the new differential pair routing, you can more easily design PCBs that support fast signals over a long distance and with less noise. This is particularly important for devices that deal with great amounts of data," explains Tomasz. "The second tool – length matching – automatically ensures that two signals take exactly the same time to cross the PCB. When the feature is selected, the tool automatically adds meanders to adjust the delay. This is very useful when timing and synchronisation become important parameters to take into account."

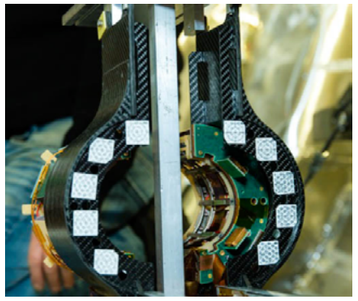
The recent developments are giving KiCad a considerable boost. "KiCad is also becoming interesting for specialised companies, which can use it to develop new electronic components. They could also be potential donors for the project," says Javier. Indeed, the Raspberry Pi Foundation and Arduino have already donated to the CERN KiCad initiative through the "Giving to CERN" portal. But the dream of Javier and his colleagues is to develop KiCad so well that CERN's electronic design office starts using it to draw their circuit boards!

*Antonella Del Rosso*

# DIAMONDS AT THE GOLDEN POINT

**Alongside the CMS Pixel Luminosity Telescope (PLT) – installed last month (see *Bulletin* 06-07/2015) – lie diamond detectors. No ordinary gems, these lab-grown diamonds will be playing a vital role in Run 2: differentiating signals from collision products with those from the beam background.**

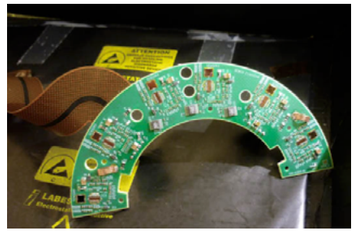
Earlier this year, the CMS BRIL project installed beam condition monitors (BCM) at the heart of the CMS detector. Designed to measure the online luminosity and beam background as close as possible to the LHC beam pipe, the BCMs use radiation-hard diamonds to differentiate between background and collision signals. The BCM also protects the CMS silicon trackers from damaging beam losses, by aborting the beam if the signal currents measured are above an acceptable threshold.



*The BCM detector's green "c-shaped" printed circuit board is mounted on the PLT/BCM carbon-fibre carriage ready for installation.*

These new BCMs are designed with Run 2 bunches in mind. "The new system has improved radiation hardness, faster front-end electronics, a higher granularity and a larger surface area - making the BCM more sensitive to the beam background in the higher particle-rate conditions expected in Run 2," says Anne Dabrowski, BRIL deputy project leader and technical coordinator. "The upgraded triggerless back-end electronics ensure that every passing charged particle will be counted."

To distinguish collision products from background, the detector has been placed at a very special location. "The BCM needs to be in a golden location for Run 2, some 6.25 ns away from the interaction point," says David Stickland, BRIL project leader. "Imagine a background particle comes along - typically at the same time as the beam itself - and they both pass the BCM. When the beams collide at the interaction point, that collision can result in particles returning to give signals in the BCM. Given its golden location - a return path of 12.5 ns from the interaction point - the BCM has the optimal window before the next bunch comes along the beam pipe."

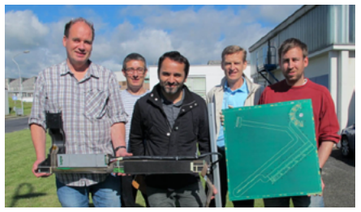


*Six metalized diamond sensors are located on the outer part of the rigid BCM "c-shape" printed circuit board.*

At the core of a faster BCM detector is a new micro-electronic chip designed by the PH-ESE department and the University of Science and Technology AGH Krakow. The novel design was the brainchild of a Polish PhD student, Dominik Przyborowski, working side-by-side with Jan Kaplon and Vladimir Ryjov from CERN.

These chips have an excellent time resolution, allowing the team to differentiate multiple hits in a 25-ns bunch crossing.

Finding space for all the BCM elements and connections was a challenge. "PH-DT came up with a clever design that brought all the elements into one piece," says Anne. "We placed the diamond sensors, signal converters and connections on a single circuit board, using a flexible circuit board for the wires between these elements and the optical converters that send the signals to the readout."



*Engineers from PH-ESE and PH-DT involved in the design and production of the integrated BCM printed circuit board mounted on a carbon-fibre carriage (from left to right: Robert Loos, William Billereau, Rui De Oliveira, Vladimir Ryjov and Bertrand Mehl).*

"The circuit board serves two masters, providing both mechanical structure and data connections," concludes David. "Its design was just one of many accomplishments that led to the successful construction of the BCMs. An essential ingredient was the dedication of physicist Wolfgang Lange and the DESY Zeuthen team in the meticulous art of detector assembly and qualification. Now that installation is complete, we are looking forward to seeing the BCMs in action in less than two months' time."

*Katarina Anthony*

# THE ALPHABET OF THE UNIVERSE

**One of the most culturally inspiring – yet unexpected – venues where you can find an exhibition about CERN and particle physics these days is the *Bibliotheca Alexandrina* in Egypt. Discover *The Alphabet of the Universe: from CERN to North Africa and the Middle East* in the cradle of knowledge *par excellence*.**

*The Alphabet of the Universe exhibition in Alexandria. (Image credit: Bibliotheca Alexandrina)*

With its 400 square metres surface area, about 40 exhibits and more than 50 people involved, *The Alphabet of the Universe* exhibition was inaugurated on 19 January in the Planetarium Science Centre (PSC), one of the main attractions of the New Library of Alexandria. "The exhibition has been designed to cover four main themes related to particle physics and CERN: what we know; open issues; accelerators and detectors; computing and applications," explains Barbara Gallavotti, curator of the exhibition. "The exhibits were designed by CERN and the Library of Alexandria and were handmade in Egypt".

The endeavour started with the signing of a collaboration agreement with CERN in May 2012. Thanks to very successful cooperation with the Bibliotheca Alexandrina, it only took a few months (and a limited budget) to make the exhibits and set up the exhibition. "Some exhibits were inspired by and based on existing CERN exhibitions but most of them were created from scratch in collaboration with the PSC," says Gallavotti. Thus, the Higgs field is explained using pistons (one representing the photon, one the electron and the last one the muon) that can be pushed in order to feel the difference in resistance (thus, "mass"); the principle of detection is shown using a magnetic pendulous leaving different traces on the soil; mesons and hadrons are explained with black and white magnetic pieces that can be put together only according to the allowed combinations.

In addition to the more technical and explanatory part, the exhibition includes a presentation of CERN as the world's largest particle physics laboratory, where different cultures work together to do cutting-edge science. "CERN is a model for peace and collaboration," says Sergio Bertolucci, CERN's Director for Research and Computing, who also contributed to the design of the exhibition. "We hope that, after Alexandria, the exhibition will travel to other Middle Eastern countries and will spread the positive message of fundamental science everywhere."

The whole production of this exhibition has relied on Egyptian hands trained by experts from the Library of Alexandria, in collaboration with renowned CERN scientists. "*The Alphabet of the Universe* is a real breakthrough," says Ayman El Sayed, director of the Planetarium Science Centre. "The Library will build on it to produce more exhibitions that will tour the Near East and North Africa region, including all of Egypt. This is an essential cornerstone for building national and regional knowledge communities."

Do you fancy a culturally interesting detour from the Egyptian beaches? The exhibition will remain in Alexandria until the end of the year. For more information, please visit the PSC webpages: **http://cern.ch/go/7FTm**

*Antonella Del Rosso*



# CERN OPENLAB ENTERS FIFTH PHASE

**CERN openlab is a unique public-private partnership between CERN and leading ICT companies. At the start of this year, openlab officially entered its fifth phase, which will run until the end of 2017. For the first time in its history, it has extended beyond the CERN community to include other major European and international research laboratories.**

Founded in 2001 to develop the innovative ICT systems needed to cope with the unprecedented computing challenges of the LHC, CERN openlab unites science and industry at the cutting edge of research and innovation. In a white paper published last year, CERN openlab set out the main ICT challenges it will tackle during its fifth phase, namely data acquisition, computing platforms, data storage architectures, computer management and provisioning, networks and connectivity, and data analytics.

As it enters its fifth phase, CERN openlab is expanding to include other research laboratories. "Today, research centres in other disciplines are also starting to produce very high quantities of data at a very high speed," says Alberto Di Meglio, head of CERN openlab. "The idea with the new phase of CERN openlab is to understand together — across disciplines — what are the challenges we all face and how can we collectively address them?"

To a certain extent, all 'big science' research follows the same basic pattern of data acquisition, analysis, computing, etc. However, as new research centres join the team, they bring new requirements to those typically considered by CERN openlab. "Things are very centralised in the high-energy physics community: data is generated by the experiments at CERN and then distributed across the world for analysis," says Alberto. "By contrast, the model often used in biomedical research is almost the exact opposite of this: data is generated by thousands of distributed instruments and is then brought together for analysis. It's important to understand how the technologies developed by ICT companies can cope with such wildly varying models." These differences will have to be thoroughly considered when developing data-management infrastructures.

CERN openlab is not only expanding on the public research side, it is also looking for new industrial partners. "We're currently developing new ways for smaller companies — those with innovative, disruptive ideas — to participate," says Alberto. "It is absolutely vital for Europe that there is a continuous exchange of information and expertise between research and industry. CERN openlab plays a central role in this vision."

*Andrew Purcell*

# INTERNATIONAL GENEVA COMES TO CERN

**To strengthen even more its links with the United Nations and the world of multilateral diplomacy, CERN is launching a new series of seminars aiming to introduce other international organisations to CERN's internal audience. The Director-General of the United Nations Office at Geneva (UNOG) will lead the way with a seminar on 20 February. You are all invited to take part.**

Although everybody knows where the Palais des Nations is, not everybody has visited it and even fewer people know about the complex mechanisms that make the UN work. On 20 February, Mr Michael Møller, Acting Director-General of UNOG, will discuss the topics that the international organisation *par excellence* deals with every day, its relationship with the headquarters in New York and the challenges that lie ahead, as well as the cooperation between UNOG and CERN.

Since 2010, CERN has considerably strengthened its relationships with the other international organisations in Geneva and beyond. Cooperation Agreements have been signed with various agencies including, of course, those belonging to the UN system. In December 2012, CERN was granted Observer status at the UN General Assembly. "Despite the intense exchanges that have marked the recent history of the two organisations, this will be the first time that the Director-General of the UN Office at Geneva has come to meet with CERN people at large," says Maurizio Bona, advisor to the Director-General of CERN and responsible for relations with international organisations. "The seminar will also be an opportunity to present the past, present, and future collaborations and exchanges between the two organisations."

In addition to introducing UNOG to CERN people, Møller will reply to questions from the audience. The presence of CERN's DG at the seminar will give those attending the opportunity - should they so wish - to discuss topics related to CERN/UN relations and "international Geneva" with both leaders in a unique and open exchange of views.

Put 20 February in your diary: the seminar will be held in the Main Auditorium and will start at 11.00 a.m. The event will be webcast and a recording will be made available shortly after the live event.

*The second seminar of this series will take place on Thursday, 7 May 2015 and will feature Michel Jarraud, the Secretary-General of the World Meteorological Organization (WMO). Later in the year it will be the turn of Mr Francis Gurry, Director-General of the World Intellectual Property Organization (WIPO).*

*Antonella Del Rosso*

# ERC REWARDS CERN RESEARCHERS

**The European Research Council (ERC) has awarded starting grants to Magdalena Kowalska, a member of the ISOLDE physics team, and Claude Duhr, CERN Theory Division. The funding will enable them to build their own research teams at CERN, engaging postdocs and PhD students.**

*Magdalena Kowalska and Claude Duhr.*

The ERC fosters scientific excellence in Europe through competitive funding. Its grants are awarded to projects headed by researchers – both beginning-of-career and established – via an open, peer-reviewed competition. In December 2014, Magdalena Kowalska and Claude Duhr were awarded grants to pursue research in ultra-sensitive nuclear magnetic resonance (NMR) in liquids and mathematical structures in scattering amplitudes, respectively.

"Our research project aims to apply an ultra-sensitive NMR technique using radioisotopes to liquids in order to study the interaction of metal ions with biological molecules such as proteins, DNA or RNA," says Magdalena. "Most of the project cost will be covered by the ERC grant, and the rest will be covered by CERN."

Claude Duhr received his grant to perform high precision computation. "We want to study the properties of the quantities appearing in our computation by looking at them from the angle of number theory," explains Claude. "These mathematical methods will be used to make very concrete predictions for the LHC and might also be useful in other fields, such as string theory."

Thanks to the ERC funding, both research fields will be further developed, with the participation of postdocs and PhD students.

*Rosaria Marraffino*

# Computer Security

## IT OR NOT IT, THAT IS THE QUESTION

**Following on from our recent Bulletin article on "How to succeed in software deployment" (see *Bulletin* 41-42/2014), we repeatedly face the problem that "standard" IT services are replicated within CERN or even outsourced to external companies.**

Past experience has shown that such non-centrally managed systems are more prone to security risks and, in the long run, are less well managed – that is, if they're not eventually orphaned completely. If hosted outside CERN, there is also the risk that sensitive data from the Organization could be leaked and that CERN would not be able to intervene in the event of a security problem.

Imagine, for example, a slide show created by an external consultant and hosted in the cloud… While this might have been convenient for the consultant, a regular user of that cloud service, the content was lost once the consultant's job was done and nobody at CERN took responsibility for the slide show. Or imagine a web page developed by a summer student using an external web-hosting company. It turned out that the website was flawed and leaked data but neither the student nor the web host were able or motivated to get this fixed. Or a questionnaire sent to colleagues asking personal questions, only for their answers to be disclosed to the general public. Or the development of a web application by an ex-colleague, who was later reimbursed by CERN.

CERN is in the comfortable situation of having many different centres of expertise: the medical service for our health, the fire brigade for safety, the RP group for radiation issues, the FP department for contracts and purchasing, the cooling, ventilation and electricity groups, the metrology section for measurements, technical groups knowledgeable in PCB design, the legal service, the HR department for personnel matters, etc.

Luckily, the same applies to IT matters, and the IT department is there to support you in this. Of course, the commodities of modern life – Facebook, Twitter, smartphones and so on – have brought us closer to IT, but this doesn't mean that we are all IT experts. While today it is easy enough to open another Dropbox folder, create a SurveyMonkey questionnaire or set up a Wordpress or Joomla webpage, this is not always to the overall benefit of CERN.

So, just as you would consult the FP or HR departments, the medical or legal services or the radiation protection group for their respective expertise, shouldn't we draw on the expertise and knowledge of our colleagues in the IT department?

If you plan to start a project employing IT technologies (websites, standalone servers, disk storage, external cloud services, etc.) or are already in the development process, may we propose that you consult either us at **Computer.Security@cern.ch** or our colleagues in the IT department?

This would allow you to focus on the core of your project while we ensure that the IT technologies employed are fully supported and secured, kept up-to-date and fully backed up, and that the CERN Data Protection Policy is properly respected.

In the long run, you can (and should) benefit! Some examples can be found at **http://information-technology.web.cern.ch/services/cern-commercial**.

Check out our website **https://security.web.cern.ch** for further information, answers to your questions and help, or e-mail:
**Computer.Security@cern.ch**

If you want to learn more about computer security incidents and issues at CERN, just follow our Monthly Report: **https://cern.ch/security/reports/fr/monthly-reports.shtml**

*Stefan Lueders, Computer Security Team*



# Official news

## TAXATION IN SWITZERLAND

**Memorandum concerning the 2014 internal taxation certificate and the 2014 income tax declaration forms issued by the Swiss cantonal tax administrations.**

You are reminded that the Organization levies an internal tax on the financial and family benefits that it pays to the members of its personnel (see Chapter V, Section 2 of the Staff Rules and Regulations) and that the members of the personnel are exempt from federal, cantonal and communal taxation on salaries and emoluments paid by CERN.

**I - Annual internal taxation certificate for 2014**

The annual certificate of internal taxation for 2014, issued by the Finance, Procurement and Knowledge Transfer Department, will be available on 20 February 2015. **It is intended exclusively for the tax authorities.**

- If you are currently a member of the CERN personnel you will receive an e-mail containing a link to your annual certificate, which you can print out if necessary.
- If you are no longer a member of the CERN personnel or are unable to access your annual certificate as indicated above, you will find information explaining how to obtain one at the following link **http://admin-eguide.web.cern.ch/en/procedure/annual-internal-taxation-certificate**

If you encounter any difficulties in obtaining your annual certificate, send an e-mail explaining the problem to **service-desk@cern.ch**.

**II - 2014 income tax declaration forms issued by the Swiss cantonal tax administrations**

The 2014 income tax declaration form must be completed in accordance with the general instructions available at the following address: **http://admin-eguide.web.cern.ch/en/procedure/income-tax-declaration-switzerland**

**IF YOU HAVE ANY SPECIFIC QUESTIONS, PLEASE CONTACT YOUR TAX OFFICE DIRECTLY**

This information does not concern CERN pensioners, as they are no longer members of the CERN personnel and are therefore subject to the standard national legal provisions relating to taxation.

*HR Department*
*Tel.: 73903*

## SUMMER WORK FOR CHILDREN OF MEMBERS OF THE PERSONNEL

**During the period from 15 June to 11 September 2015 inclusive, there will be a limited number of summer jobs at CERN (normally unskilled work of a routine nature) will be offered to children of members of the personnel (i.e. anyone holding an employment or association contract with the Organization).**

Candidates must be aged between 18 and 24 inclusive on the first day of the contract, and must have insurance coverage for both illness and accident. The duration of all contracts will be 4 weeks and the subsistence allowance will be 1500 CHF for this period. Candidates should apply via the HR Department's electronic recruitment system: **https://jobs.web.cern.ch/job/11323.**

Completed application forms must be returned by 5 April 2015 at the latest. The results of the selection will be available by the end of May 2015.

For further information, please contact:
**Virginie.Galvin@cern.ch**, tel. 72855
**(Geraldine.Ballet@cern.ch**, tel. 74151)

*HR Department*

# Take note

## SAFETY DURING MARS EXERCISE

**It is MARS[1] time again! All employed members of the CERN personnel are currently undergoing the annual MARS evaluations.**

This is also a good occasion for supervisors and their supervisees to fill in or update the OHS-0-0-3 form[2] **"Identification of occupational hazards"**.

Filling in the OHS-0-0-3 form is an opportunity to assess any safety issues related to the supervisee's activities. Each of us should, together with our supervisor, regularly identify and assess the hazards we may be exposed to in the course of our professional activities and reflect on how to control and mitigate them.

When filling in the OHS form for the first time, it is important to determine any potential hazards as well as the corresponding preventive measures, in particular training and protective equipment.

When updating the form, please review the available information to ensure that it still corresponds to the current activities. The form should be updated whenever the activities of the supervisee change. We also recommend keeping an inventory of any safety training courses followed over the past year. Thus the supervisor and the supervisee will be able to identify the most suitable preventive measures and any safety training courses to be followed in the coming year.

Once the necessary safety training has been identified, do not forget to register for the corresponding courses!

For any questions, please contact:

Safety Training: **safety-training@cern.ch**
Safety and working conditions: **hse.secretariat@cern.ch**

Medical aspects and occupational health: **medical.service@cern.ch**

*[1] Merit Appraisal and Recognition Scheme:* ***https://admin-eguide.web.cern.ch/procedure/reconnaissance-du-merite-mars***

*[2] Form available via EDH.*

## CHANGE OF MOBILE TELEPHONY OPERATOR

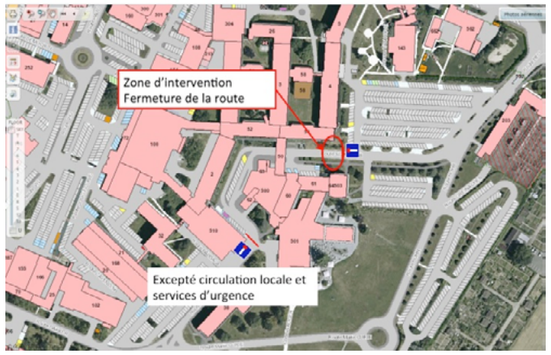
**Following a call for tenders issued in 2014, CERN has agreed a contract with Swisscom for the provision of mobile telephony services from 1 July 2015.**

The Sunrise equipment on CERN sites will therefore be switched off from this date and people with a CERN mobile subscription will need to exchange their Sunrise SIM card for a new one from Swisscom, with a new mobile number (the last 4 digits will remain the same). We cannot give further details at present as we are still finalising arrangements for the deployment of the new network with Swisscom, but detailed information on the steps to be followed will be given well in advance of the changeover.

## ROUTE SCHERRER AND ROUTE EINSTEIN CLOSED FOR CONSTRUCTION WORK

**Please note that Route Scherrer will be inaccessible for two and a half months from the beginning of March and that part of Route Einstein will be closed for two weeks from the end of February.**

Fermeture de la route Scherrer




- The part of Route Scherrer between Building 510 and Building 53 will be closed from the **beginning of March until mid-May for civil engineering works.**

The superheated water pipes supplying the buildings in this area date back to 1959 and therefore present a significant risk of leakage. In order to ensure the reliable supply of superheated water, and, by extension, heating, to all premises near the Main Building (i.e. Buildings 500, 501, 503, 60, 62, 63 and 64), a new buried service duct will be installed between the basements of Buildings 53 and 61 to house a new superheated water pipe.

The following car parks will, however, remain **accessible** for the duration of the works: the Cèdres car park, the car park for Buildings 4 and 5, and the car park situated between Buildings 32, 38 and 168.

Fermeture de la route Einstein

- Route Einstein will also be closed in the vicinity of Building 119 for two weeks from the end of February owing to the installation of a waste water collector beneath the road.

Traffic will be diverted via Route Démocrite.



## 2015 CERN-FERMILAB HCP SUMMER SCHOOL

CERN and Fermilab are jointly offering a series of "Hadron Collider Physics Summer Schools", to prepare young researchers for these exciting times. The school has alternated between CERN and Fermilab, and will return to CERN for the tenth edition, from 24 June to 3 July 2015. The CERN-Fermilab Hadron Collider Physics Summer School is an advanced school targeted particularly at young postdocs and senior PhD students working towards the completion of their thesis project, in both Experimental High Energy Physics (HEP) and phenomenology.

Lecture Topics include: Statistics in HEP, Heavy Flavour, Heavy Ion, Standard Model, Higgs searches and measurements, BSM theory, BSM searches, Top physics, QCD and Monte Carlos, Accelerators, Detectors for the future, Trigger and DAQ, Dark Matter Astroparticle, and two special lectures on Future Colliders, and 20 years after the top discovery.

**Calendar and Details**: Mark your calendar for 24 June - 3 July 2015, when CERN will welcome students to the tenth CERN-Fermilab Hadron Collider Physics Summer School. The School will include nine days of lectures and discussions, and one free day in the middle of the period. Limited scholarship funds will be available to support some participants.

The **deadline** for applications and reference letters is **28 February 2015**.
More info: **http://cern.ch/hcpss/2015**

**Lecturers**

- Vincent CROFT National Institute for Subatomic Physics (NIKHEF), RU-Nijmegen, Netherland
- Helvi HARTMANN Frankfurt Institute for Advanced Studies, Germany
- André PEREIRA LIP-Minho, Braga, Portugal
- Pawel SZOSTEK CERN, Geneva, Switzerland
- Helga TIMKO CERN, Geneva, Switzerland

**Programme overview**

**Monday 23 February 2015**

| | |
|---|---|
| 09:00-09:15 | Welcome |
| 09:15-09:30 | Introduction to the inverted CSC |
| 09:30-10:30 | Basic concepts in computer architectures - Pawel Szostek |
| 11:00-12:00 | Numerical Methods of Longitudinal Beam Dynamics - Helga Timko |
| 13:30-14:30 | Exploring EDA - Vincent Alexander Croft |
| 14:30-15:30 | Multi-core processors and multithreading - Pawel Szostek |
| 16:00-17:00 | Numerical Challenges & Limitations of Longitudinal Beam Dynamics - Helga Timko |

**Tuesday 24 February 2015**

| | |
|---|---|
| 10:00-11:00 | Taking Raw Data Towards Analysis - Vincent Alexander Croft |
| 11:00-12:00 | Challenges of Modern High Performance Computing - Helvi Hartmann |
| 13:30-14:30 | Scalable Parallel Computing - Andre Pereira |
| 14:30-15:30 | Message Passing - Helvi Hartmann |
| 16:00-17:00 | Frameworks to Aid Code Development and Performance Portability - Andre Pereira |

*Alberto Pace, Director,*
*CERN School of Computing*

## WHERE STUDENTS TURN INTO TEACHERS: THE EIGHTH INVERTED CERN SCHOOL OF COMPUTING

**For the eighth time since 2005, the CERN School of Computing (CSC) has organised its inverted school, which will take place at CERN on 23 and 24 February 2015, in the IT Auditorium (Room 31/3-004).**

The idea for inverted CSCs stemmed from the observation that at regular CSCs it is common to find students in the room who know more on a particular (advanced) topic than the lecturer. So why not try and exploit this and turn the students into teachers?

CSC2014 students made proposals via an electronic discussion forum, from which a programme was designed. This year's programme focuses on challenging and innovative topics, including: the evolution of processor architectures, the growing complexity of CPUs and its impact on the software landscape, exploring clustering and data processing, the importance of message passing in high-performance computing, the development of applications across heterogeneous systems. There will be also lectures on applied computing used in the simulation of longitudinal beam dynamics problems typical of the accelerator sector.

**Attendance is free and open to everyone.** Though most of the lectures are part of a series, the programme is designed so that lectures can be followed independently. Registration is not mandatory, but will allow you to obtain a copy of the full printed booklet (first registered, first served).

The inverted schools are one key step in a process that's been in place for several years to identify and train young new lecturers for the main School. This year's main school will take place in September in Kavala, Greece and the thematic school in Split, Croatia, next May.

For further information on the CERN School of Computing, see **http://cern.ch/csc** or contact **computing.school@cern.ch**.

## UNIVERSITÉ DE GENÈVE | PHYSICS COLLOQUIUM | 27 FEBRUARY

**Vendredi 27 février 2015, 11h00**
Ecole de Physique, Auditoire Stueckelberg

**"A quantum memory for twisted photons"**

by

Elisabeth GIACOBINO
Laboratoire Kastler-Brossel, Ecole Normale Supérieure,
Université Pierre et Marie Curie, 75005 Paris

Résumé :

A quantum memory relies on an efficient coupling between light and matter, in order to achieve reversible mapping of quantum photonic information in and out of the material system. Our system involves the transfer of quantum information from light to atoms (writing) and back from atoms to light (retrieval), using electromagnetically induced transparency (EIT) in three-level transitions in a cold cesium atomic ensemble.
With this set-up we have shown efficient storage of pulses carrying orbital angular momentum (OAM) at the single photon level. Laguerre-Gauss LG+1 and LG-1 modes were imprinted on the signal pulse, using a spatial light modulator. Then superpositions of LG modes, i.e. Hermite-Gauss modes, were stored and retrieved. A full memory characterization (process tomography) over the Bloch sphere was performed and allowed us to demonstrate quantum fidelity. We thus demonstrated a quantum memory for orbital angular momentum photonic qubits.
Single photons carrying OAM are promising for the implementation of qubits and qudits since OAM constitutes a quantized and infinite space. Interfacing them with quantum memories opens the way to their use in quantum networks.

Une verrée en compagnie du conférencier sera offerte après le colloque.

Professeure Ruth Durrer

# Training

## SAFETY TRAINING: PLACES AVAILABLE IN JANUARY AND FEBRUARY 2015

**Places are available in the forthcoming Safety courses. For updates and registrations, please refer to the Safety Training Catalogue: cta.cern.ch.**

*Safety Training, HSE Unit*
***safety-training@cern.ch***

# Seminars

### FRIDAY FEBRUARY 20, 2015

11:00 **Detector Seminar The Story of the NA62 Straw Spectrometer** Salle Anderson
11:00 **International Geneva Director General of UNOG presents the UN world and the relations with CERN** Main Auditorium
14:00 **Particle and Astro-Particle Physics Seminars TBA** TH Conference Room

### MONDAY FEBRUARY 23, 2015

08:00 **European School in Instrumentation for Particle and Astroparticle Physics (ESIPAP)**
09:00 **Inverted CSC inverted CERN School of Computing 2015** IT Amphitheatre

### TUESDAY FEBRUARY 24, 2015

20:30 **Globe LHC superconductive technology at the service of energy for mankind** 80-1-001

### WEDNESDAY FEBRUARY 25, 2015

14:00 **Legal aspects of Joint Pre-Commercial Procurements: from modeling to implementation** IT Amphitheatre
14:30 **ISOLDE Seminar Selective laser photodetachment in an RFQ ion beam cooler for AMS**

### TUESDAY MARCH 03, 2015

11:00 **EP Seminar CERN's strategy for neutrino physics** Main Auditorium