

AMS: From the ISS to CERN



The AMS Control Room in the newly constructed Building 946 in CERN's Prévessin site.

Unlike the detectors around the LHC ring, the Alpha Magnetic Spectrometer (AMS) does not have the luxury of a physical connection to data-processing infrastructure. Instead, cosmic events and data on AMS itself must undergo a lengthy journey before they arrive at the Payload and Operations on the Control Centre (POCC - building 946 Prévessin site) of the AMS collaboration. A joint effort between NASA and CERN makes this transmission possible. "The Space Station first sends its data to a satellite at a very high orbit," explains Sam Ting, AMS collaboration spokesperson. "The satellite sends its information to Edwards Air Force Base in

The week of 16 May 2011 saw the successful launch and installation of the Alpha Magnetic Spectrometer aboard the International Space Station. Only 4 minutes after the installation had been completed, cosmic event data started to be recorded and began its long journey from low Earth orbit to the newly constructed Payload Operations and Control Centre located on CERN's Prévessin site.

California, from where it is then sent to the Marshal Space Centre in Alabama. From there, it is sent directly to CERN."

In order to ensure that the data is not lost during this complex journey, it is stored on three separate occasions before it becomes available for analysis at CERN – onboard the ISS, at the Marshal Space Centre and upon arrival at CERN. As Ting explains, data-storing aboard the ISS is a necessary procedure because of the nature of the ISS orbit. "The Space Station orbits the Earth every 90 minutes and in some places there is no satellite

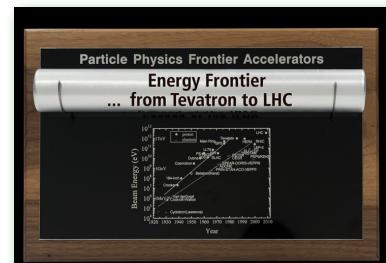
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Nos 37 & 38 – 14 & 21 September 2011



Passing the baton

It was not only in South Korea that batons were being passed last week. While the cream of the world's athletes were competing in the World Athletics Championships, the cream of the world's accelerator scientists were on their way to San Sebastian in Spain for the International Particle Accelerator Conference. One of them was carrying a rather special baton for a handover of a different kind.



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Passing the baton



On Tuesday 6 September the baton was passed from the Tevatron (left: Fermilab's Vladimir D. Shiltsev, Director for Accelerator Physics Center) to the LHC (right: Mike Lamont, LHC Operations).

When Fermilab's Vladimir Shiltsev handed the high-energy frontier baton to CERN's Mike Lamont on Tuesday, it marked the end of an era: a time to look back on the phenomenal contribution the Tevatron has made to particle physics over its 25-year operational lifetime, and the great contribution Fermilab has made over that period to global collaboration in particle physics. There's always a lot of emotion involved in passing the baton. In athletics, it's the triumph of winning or the heartbreak of losing. But for this special baton, there was none of that. Instead, there was a deep sense of friendship and collaboration. It was a time to reflect not on winning or losing, but on working together for the greater good.

When the Tevatron extracts its last beam later this month, the LHC will find itself alone at the high-energy frontier of particle physics, and as our friends at Fermilab know very well, that's a hefty responsibility. In the meantime, Fermilab will be turning its attention to Project X, an ambitious endeavour to develop ever more intense particle beams. This will be vital for the future development of our field, as we turn our attention to increasingly rare phenomena. Next year is a crucial one for the success of Project X, and as we graciously accept the baton Fermilab has passed to us, we wish the lab every success at the intensity frontier.

Rolf Heuer

AMS: from the ISS to CERN

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coverage. We record the data on the ISS until a downlink can be re-established. The most important thing is not to lose the data."

Communication between the POCC and the ISS is also very important. Each shift in the POCC includes a "Lead" – an AMS collaboration member who maintains live contact with NASA and the ISS. One significant issue that is constantly monitored and communicated by the Lead is the temperature of the AMS detector. "The only area where we can intervene is the fluctuation of temperature," explains collaboration member, Mercedes Paniccia. "We have heaters on board the AMS that we control, but NASA has also agreed a procedure with the collaboration in case the temperature fluctuations exceed operational limits." This procedure involves altering the orientation of the ISS. "The Lead waits for a band to speak directly to astronauts on the ISS," explains Mercedes Paniccia. "However we need to wait until NASA gives us permission, because it is a restricted band."

Thanks to extensive testing before the AMS was launched into space, there have been no big surprises, and after only three months the collaboration has nearly finished calibrating the detector. "Calibration is almost complete, but we still have to finalise the settings onboard before we start a physics run where clean results can be observed," explains Paniccia. Although scientific data is monitored on a computer console in the POCC, reconstruction will be done using CERN's computing power, without NASA's participation. As Paniccia explains, "The analysis of the reconstruction data will be done by CERN, not by those working in the POCC."

While physicists eagerly await AMS' first physics run, events at energies never before seen on Earth have already started being recorded in the detector. "The Cosmos is a fantastic particle accelerator," explains Roberto Battiston, Deputy AMS Spokesperson. "For the first time it is providing us with positrons and electrons detected in the several hundred TeV energy range, which is very high even compared



Did you know?

Visit the POCC!

Following the success of the recent visits to Infinity, CERN's Internal Communication service is organizing a visit to the AMS' POCC (building 946 in Prévessin site). If you wish to participate, you can sign up for a visit by sending us an email (dates to be decided depending on the number of people interested in visiting). Note that visits are open only to CERN access-card holders.

The visit will include:

- an introduction by the experts, lasting about 15 minutes,
- a tour of the equipment, lasting about 15 minutes,
- a few minutes for questions.

to the LHC." But although recording these high-energy events is very exciting, the collaboration is not in a rush to draw conclusions about dark energy, dark matter or new physics. "As I have told my collaborators, it has taken us many years to build this experiment," says Ting. "It is a very precise detector that does not have any competition. We are going to do things very slowly. We don't want to be the first to publish, we want to be the last to publish. The most important thing is to not make any mistakes – no one is able to verify our results. We have to be very careful!"

The experiment is scheduled to run for the remainder of the ISS's lifetime, now that NASA has closed its shuttle programme.

Watch the video at:

<http://cdsweb.cern.ch/record/1377398>

Jordan Juras

LHC Report: Preparing for a tighter squeeze

To obtain as many collisions as possible in the heart of the experiments, the beams are squeezed to very small beam sizes.

The beam squeezing parameter is known by experts as beta-star: the smaller the β^* , the stronger the squeezing. During the machine development period that started on 24 August, tests were made for the high-luminosity experiments ATLAS and CMS with β^* values of 1 m instead of the 1.5 m used previously. Unfortunately these tests were only partially successful, as some of the beam was lost during the squeezing process. It is thought that the beam losses were caused by the collimators, which were moved closer to the beam, and by the reduced crossing angle of the beams at the interaction points. During the same machine development period it was shown that the physical aperture

The LHC is resuming operation after a planned period of machine development followed by a technical stop. The beams returned last Friday, in the evening of 2 September, and preparations are now being made to squeeze the beams further at the collision points, aiming for new luminosity records.

of the machine is larger than assumed hitherto. Combining these two pieces of information, the decision was taken to see if β^* could be reduced to 1 m, while keeping the original collimator positions and crossing angles of the beams.

Before this could be tested a five-day technical stop took place for machine maintenance. A variety of work took place during this week, ranging from replacing an optical fibre used for the access system to upgrading software components. By 5:30 p.m. on Friday the machine was ready to resume operation, and by 10:50 p.m. the beams were circulating again. A comprehensive programme of tests was then started to

verify the aperture with the smaller β^* at point 1 (ATLAS) and point 5 (CMS). In addition, on Sunday the polarity was reversed on the ALICE solenoid and dipole magnets. Although the polarity reversal itself only took about two hours, setting up the injection protection and the collimators around the ALICE experiment took up the rest of the day, as the beam trajectory is different for the different magnet polarities.

Further tests with low beam intensities are required before one can be absolutely sure that the machine is ready to again safely receive 100 megajoule beams. After these verifications the number of bunches will be increased in four steps from 264 bunches per beam to the 1380 used previously, hopefully this time with 50 % more luminosity for the ATLAS and CMS experiments.

Jan Uythoven for the LHC Team

John Ellis discusses the Higgs, the lack of the Higgs, and extra dimensions

So, let's start from the Higgs boson: does it exist and where is it? The million-dollar question...

Sometime in the next few months, I think we will finally get clarity on the Higgs boson. While it has been with us as a hypothesis since 1964, I think we are finally closing in on it now. However, in every possible discovery scenario, clarity on the Higgs will lead to new physics. Let me explain...

Experiments have left only three possible mass ranges where the Higgs – or a Higgs-like particle – could be: between 114 GeV and 135 GeV, over 500 GeV, or between 135 GeV and 500 GeV.

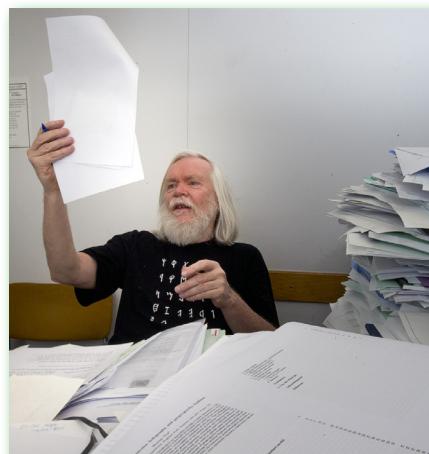
In the first scenario (114–135 GeV), we could be looking at a Standard Model Higgs boson. This range has been refined experimentally: recent LHC results presented in Mumbai excluded the Standard Model Higgs from about 135 GeV to about 500 GeV, while LEP had previously excluded it up to 114 GeV. That leaves a narrow low-mass range of about 20 GeV where it could lie. But if found in this range, the Standard Model theory would still be incomplete; the present electroweak vacuum would be unstable for such a light Higgs in the Standard Model, so we would have to come up with new physics to stabilise it.

The second option is that the Higgs boson is found to be heavier than 500 GeV, in which case it could also be a Standard Model Higgs. However, the theory defining it would become so strongly coupled that we wouldn't be able to calculate it reliably. In that case, I believe we would need some new physics in order to "domesticate" or "tame" this heavy Higgs.

The third option is that the Higgs boson lies somewhere between 135 GeV and 500 GeV. In that case, we would not have the Standard Model Higgs couplings – they would have to be weaker by some amount. And if such a "Higgs" were weaker, then it would not do the same job as the Standard Model Higgs and, again, we would need some sort of new physics.

I think that there is every chance that within the next few months, at most one year, we will know which of these possibilities is the case. Of course, there is also a fourth option: that there is no Higgs!

On 13 September, CERN will be hosting a colloquium to mark John Ellis' 65th birthday. The colloquium comes as John ends his long career as a distinguished CERN staff member and makes a transition to Clerk Maxwell Professor of Theoretical Physics at King's College London. The Bulletin took the opportunity to ask John to share his expectations from the LHC during this long-awaited data-taking phase...



John Ellis in his office (July 2011).

What if the LHC finds nothing at all?

Well, that might mean that there is nothing like a Standard Model Higgs boson, or that it is so heavy that it has to behave in a way that we cannot calculate (at the moment, of course!). I have always said that the most exciting result for theorists would be if there were no Higgs boson at all. It would really force us to throw away the ideas we have been playing with for the last 47 years.

And if there is no Higgs, what else should we expect?

There are already some ideas out there exploring the possibility that there is no Higgs boson. One of the most appealing, for me, is the extra dimension theory. The job of the Higgs boson is often explained as giving mass to particles. But another way of thinking about it is that it has to give masses to some particles and not to others, it has to discriminate between different types of particles. In the language of a particle physicist that means it has to break the symmetry between, say, a W boson on the one hand, and a photon on the other.

So how do you break this symmetry? We can try writing equations that are not symmetric – that have never had the symmetry to break in the first place. But that would leave us with a theory that is, literally, incalculable. The only possibility is to have symmetrical

equations that somehow give different results for different particles.

But how do you force symmetric equations to have such asymmetric solutions? One option is to put the Higgs field into the vacuum, what we naively think of as "empty space". The Higgs field will break the symmetry, discriminating between different types of particles depending on how strongly those particles interact with it. That is the option chosen in the Standard Model.

But there is another way, potentially, of breaking symmetry: by using boundary conditions. When you solve a differential equation, the solution depends on what boundary conditions you impose on the calculation at the edge of space. In the three-dimensional universe we see around us, space seems to extend to infinity, and there are no edges where different boundary conditions could be imposed for different particles. But if space had small additional dimensions, at their edges we could impose different boundary conditions for different types of particles, giving us different masses for different particles. I think that would be the most exciting alternative: to discover that there is no Higgs, but that there are more dimensions of space.

How will we be able to test all these options?

In principle, there are several ways of testing such a theory: by looking for deviations from Standard Model predictions in the scattering of W particles, for example. There are a couple of experimental options you might want to follow if there turns out to be no Higgs. In such a scenario, there will be a premium on exploring even higher energies. In order to look at W-particle scattering, for example, we could increase the intensity of the energy in the LHC or we could build a very high-energy positron-electron collider, like the CLIC accelerator that is currently on the drawing board.

The second part of the John Ellis interview, in which he discusses the future of CERN and particle physics, will be published in the 23 September, 2011 issue of the Bulletin.

Information about the Colloquium to celebrate John Ellis' Birthday is available at:

indico.cern.ch/conferenceDisplay.py?confId=147519

Katarina Anthony

CERN inspires 2011 edition of the ARS Electronica Digital Arts Festival

The CERN cultural policy project, announced at the beginning of 2011 has started to gain momentum. Ariane Koek, art specialist for the Communication Group, received confirmation in May that ARS Electronica had chosen her proposal to use CERN as the primary source of inspiration for their annual ARS Electronica Festival. This marks the first of the cultural policy's arts partnerships.

The world-renowned celebration for the digital arts is held annually in Linz, Austria, where, amongst the incredible collection of displays and productions, the Prix ARS Electronica – the Oscars of the digital arts world - are presented. During this year's festival (31 August - 6 September), Koek had the opportunity to announce and open the competition for an additional Prix Electronica: the Collide@CERN Artist in Residency Digital Arts Award. "ARS and CERN have both conducted extensive external fundraising in order to create and support the digital award," says Koek. "We've worked very closely and I am excited to see what we can create together."

The Collide@CERN project has also recently received funding for a dance and performance award, which will not be announced until November. "Now with the funding for a dance and performance award from the City and Canton of Geneva, which will open later this year, the festival will be a fantastic international launch for the Collide@CERN project."

This year's annual ARS Electronica Digital Arts Festival featured CERN as the springboard for its theme, ORIGIN – How it All Begins. The prestigious digital arts festival also served as the perfect venue to launch the Collide@CERN project.

An artist winning the Collide@CERN award will be granted a residency of up to three months with the opportunity to integrate into the CERN community and truly become a resident. "Integration is part of the criteria for the prize – along with excellence in the arts, the artists must be interested in integrating and communicating," says Koek. A free and open exchange between the artist and the scientists and engineers at CERN is what Koek envisions. "The artist will be paired up with a science mentor who is appropriate for what the artist hopes to accomplish, and together they will give two lectures: the first at the beginning to explain what they do and what they plan to do over the course of the residency, and the second at the end, when the artist will return with his or her final work."

In addition to the residency at CERN, ARS Electronica has committed to offering the digital arts award winner a creative space in Linz for a month to produce his or her work. "The digital artists will research and plan their work at CERN, but the physical work will be created with an ARS mentor back in Linz, at FutureLab," explains Koek (see box).

The CERN-inspired festival also saw the participation of Rolf Heuer, Director General and Sergio Bertolucci, Director of Research and Computing, who led a two-day symposium on Friday 2 and Saturday 3, September about the physics at CERN. Ariane Koek also



Did you know?

ARS Electronica

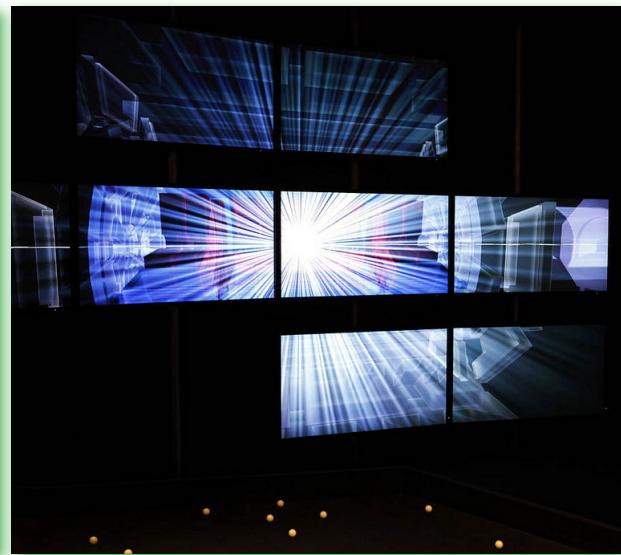
ARS Electronica is an international digital arts organisation that was founded around the annual eponymous festival in Linz, Austria. Over the course of the last three decades, the digital arts festival has risen to international acclaim, and includes the presentation of the prestigious Prix Electronica. Today, the ARS organisation is composed of two more elements: the physical space, featuring a world-class museum for digital arts that is open all year round, and FutureLab, a newly constructed space attached to the ARS Museum, where an inter-disciplinary team of architects, artists and digital artists works together to produce incredible displays for virtually anything, from museums to airports.

For more information, visit:

<http://new.aec.at/origin/en/about/>



Colours and Lights at the ARS Electronica Digital Arts Festival in Linz (Austria).



(Photo by Claudia Marcelloni)

featured in the symposium, where she led a session on the art of physics on Saturday 3 September and explained the Collide@CERN Artists in Residency programme in detail.

Jordan Juras

Science comic-strips on display at Microcosm

It's no easy task, presenting the history of science to the general public in a light-hearted way. As part of the various events organised in the Fête de la Science and the Europeans

Researchers Night, CERN will be hosting an exhibition entirely devoted to the comic-strips created by Fiami. The artist describes his comics as "a relaxed way of looking at serious and apparently highly complex subjects."

Fiami's very latest creation, *Les Vies de Marie Curie*, published in June 2011, celebrates the Year of Chemistry and the hundredth

To mark the publication of his new comic-strip "Les Vies de Marie Curie", the Genevan artist Fiami will be placing some of his previous creations on the theme "women and science" on display at CERN. The new comic-strip pays tribute to the illustrious Nobel prize-winner by taking a light-hearted look at the history of chemistry and how the role of women scientists in society has evolved through the ages.

anniversary of Marie Curie's Nobel Prize for Chemistry. After his depictions of Einstein (*The Lives of Einstein*, published in the Year of Physics, 2005) and Galileo (*The Lives of Galileo*, published in the Year of Astronomy, 2009), this is the first time Fiami has placed a female character in the spotlight. Following the tried-and-tested formula of his previous books, the author retraces the major discoveries in the field of chemistry and illustrates

women's fight to gain access to knowledge through six major periods of history.

From 21 September to 20 December 2011, nineteen panels taken from the Genevan artist's repertoire will be on display at Microcosm. "Even in the age of digitalisation and computerisation, the cartoon remains as effective a tool for communication and culture as ever," says Fiami. "It's a great honour for me to exhibit my work at CERN, which is at the very heart of world science. Microcosm is the ideal place to put science-inspired cartoons on public display."

"Among the many ways of establishing a dialogue between science and society, the comic-strip is a highly popular medium which can be understood by all, in particular the young," adds Bernard Pellequer, member of the Education Group and organiser of the exhibition. "Fiami excels in this field; here he paints the portraits of three women from history, reminding us that science cannot be reduced to the isolated work of a few brilliant minds but is also the product of the culture and society in which those people lived. What better way to tell the history of science than through jokes and puns?"

Whether you're a novice, an aficionado or simply interested in finding out more about Marie Curie, Mileva Einstein or Marie-Anne Lavoisier, don't miss this exhibition at the Microcosm, Mondays to Saturdays, from 9.00 a.m. to 5.00 p.m. The vernissage will take place on 21 September at 5.00 p.m.

Alix Marcastel



CERN firefighters win medals in New York

Everybody has heard of the Olympic Games, but did you know that every two years firefighters and police officers from around the world hold their own version, which is second in size only to the Olympics? Since the mid-1980s, the World Police and Fire Games have taken place on three different continents, making waves in the cities that have hosted them. This year, the CERN Fire Brigade was part of a 10-day sports extravaganza in the city that never sleeps.

Five CERN firefighters, two from Britain and three from Finland, participated in the Games in their chosen disciplines of triple jump, open water swim, bench press and dead lift, as well as an event called "Toughest Competitor Alive", a kind of cross between decathlon and army boot camp, with eight events over four days, including long and short distance running, swimming, shot putt, rope climbing and an obstacle course. "We expect to come back with some medals," said Craig Stevenson, one of the competitors, before the event (see their score!). "As the events go by age/weight categories, I think we have a good chance. The Finns are lifting weights of up to 200kg." They would be lifting more, he explained, but they were already using all the weights the CERN gym had to offer.

This year CERN's firefighters have taken part for the first time in the World Police and Fire Games, held in New York at the end of August. After an intensive training programme and some glorious achievements, the members of the CERN Fire Brigade taking part in the event enthusiastically share their experience with us.

Over 15,000 athletes from more than 70 different countries descended on New York between 26 August and 5 September. Staying in an athletes' Village or in hotels nearby, they were living, competing and partying together for 10 days. "It's going to be such a massive event and we're all going to come back if not with medals, then at least with the memories of such a huge event on such an occasion (10th anniversary of 9/11)," Craig said before setting off.

The poignancy of firefighters and police officers congregating in New York almost exactly 10 years after the 9/11 attacks on the World Trade Centre, where the members of the emergency services showed incredible bravery and lost many colleagues, is not lost on Craig. He and his fellow CERN competitors see the Games as a memorial to the 343 firefighters who died, and of course attended the official remembrance service. "We all accept that it could have been us walking up the stairs of the tower whilst everyone else was coming the other way. There's a kind of camaraderie with all firefighters from all over the world," Craig said.

A glorious score

Craig Stevenson got a bronze medal in the triple jump category with a personal record of 11.37 metres; Toni Salmi won a gold medal in the push and pull (weights); Tomi Rasanen won a silver medal in the same event but a different weight category. Martin Lancaster came 12th of 42 swimmers in the open water swim of 3.2 km, in a time of 61 minutes (at Coney Island). Janne Kauppinen was in a weight group of 'monsters', so although he didn't get a medal he did have a personal best dead lift!

Congratulations to all of them!

You can follow the training and participation of the CERN firefighters in the World Police and Fire Games on YouTube at:

www.youtube.com/wpfgcern

Joannah Caborn Wengler



Craig Stevenson with his bronze medal in the triple jump category (11.37 m).



Tomi Salmi (left) and Toni Rasanen (next to him) with their medals.



The Games

The 65 different disciplines included in the Games range from traditional sporting events, such as golf and soccer, to more profession-specific challenges. For example, firefighters can compete in the "Ultimate Firefighter" event, which involves speed hosepipe rolling, an obstacle course and negotiating a high-rise building at speed in full firefighting gear. For those with less physical stamina, there is also a horse-shoe throwing event, a wrist wrestling competition and a variety of shooting events.

A very special visit from India

Everything was triggered by an electrical engineering course that some of the students were following at their school in Varanasi (India). Eeshan Jaiswal and his friend were involved in a project on electric charges and kept asking me about fundamental particles and how the subatomic world works", says Dr. Raka Ray Mondal, a physics teacher at the Rajghat Besant High School, who organised the trip. "They were very keen on the project and we all started to get enthusiastic".

From India to Europe with a single destination in mind: CERN. This was the dream of five young students who convinced their parents to fund their travel costs and their school to organise the trip. Now, of course, they all plan to come back here as physicists. We have no doubt that they'll succeed!

The next step was to find a contact person here at CERN but this came quite naturally as Archana Sharma from the CMS Collaboration was a batchmate of a biology teacher at the same school and also the mother of one of the students involved in the initiative. "We made sure that their days at CERN would be very busy! They visited ATLAS, the Computing Centre and LINAC



Students, parents and teachers from Varanasi (India) are photographed here with CERN's Mick Storr and John Ellis.

and met several scientists and talked to them about various topics", says Archana, who took care that the visit programme was sufficiently intense and impactful.

The feedback from the students confirms that the visit was a fantastic experience for them. "I will take back all my enthusiasm to India and will try to share it with my classmates as much as I can", says Eshan. And Isha, a student approaching the age of seventeen, adds: "I will tell all the students I know how exciting a scientific organisation can be!" Shanu, who is from a different school but heard about the programme from his friends, says: "Everything has now changed in my life, I now understand the world of particle physics better. Before I came to CERN my knowledge was only superficial but now I have seen the experiments with my own eyes. I hope we will be able to stay connected with CERN and possibly organise video-conferences with my school". Shivangi, 15, the youngest student in the group, says: "I had to face and overcome several problems in order to be able to take part in the trip but the experience made it all worthwhile! The exposure to knowledge and technology I've had was just fantastic. I initially had some doubts but now that I've met scientists I just want to come back here during my university course!" Aditi's dream was to "explore" the subatomic world and she is very happy about what she learned at CERN and the "amazing level of inspiration" she was exposed to.

The four days at CERN turned out to be a fascinating experience for the parents as well. "Eshan's father is a businessman and he had to close his business during the visit here but he is so happy! He has been cooking good food for everybody every morning," says the teacher.

Students, we look forward to your next visit here as distinguished physicists!

CERN Bulletin

Pauline Gagnon's blog post: I'm a Higgs gatherer, not a Higgs hunter!

The way it works is purely based on statistics. With the ATLAS and CMS detectors, we collect millions of "events" every day, each event

being a snapshot of what happened after two protons collided in the Large Hadron Collider (LHC). All sorts of particles are created out of the highly concentrated energy coming from these head-on collisions, some more often than others. Whatever happens often, we know very well by now, having had plenty of opportunities to study them in the past. What's left now is everything that is hard to do, like catching rare events such as those containing Higgs bosons. And for this, we have to sort through huge numbers of events to find them.

The heavy particles created out of these collisions are highly unstable and soon decay into smaller, stable particles. Each event looks very much like a mini firework with debris flying out in all directions. If a Higgs boson is created, it will readily decay into smaller particles. To identify it, we need to reconstruct it from its decay products.

The Higgs boson has been rather elusive so far and no one really knows what it will look like. But if the Higgs boson exists, and if it is the one predicted by the Standard Model, then we know how to set traps to catch some. Each trap, or "analysis" in our jargon, is a set of selection criteria based on what

Ever since four theorists published their "Higgs hunter's guide" in 1990, people have been referring to the Higgs hunt, as if we were a bunch of bloodthirsty physicists out for a kill. I'd say, if the search for the Higgs is a safari, at most it's going to be a photo safari!

is unique in the "signal" events, namely a specific decay of a Higgs boson.

For example, a Higgs boson could decay into two Z bosons, and those could each produce a pair of electrons or muons. We would then look for events containing two pairs of electrons or muons. But it is also possible to just produce a pair of Z bosons directly, and these events would look just like the decay of a Higgs boson. Or sometimes, decay products are mis-identified as electrons or muons, mimicking an event similar to those we are interested in.

The difficulty is to catch as many events corresponding to the decay of a Higgs boson as possible while rejecting the vast majority of other types of events that are produced more abundantly, what we call the background. It is as if we want to take a photo of a small flash of light in bright daylight! We need to set special filters to minimise the amount of background light coming through, while still allowing the tiny flash to be seen.

Fortunately, we know quite well what the Standard Model predicts. So in the end, all we do is count the number of selected

events to see if we find more than what is expected solely from the background.

In the end, we take all selected events and look at the distributions of some of their attributes. The distribution we most often use is the value of the mass reconstructed from all the decay products. Events coming from the background will not have a particular mass but if the decay products all come from the same particle, a Higgs boson for instance, they will start clustering in one spot. And that would be the clear sign that we have found it.

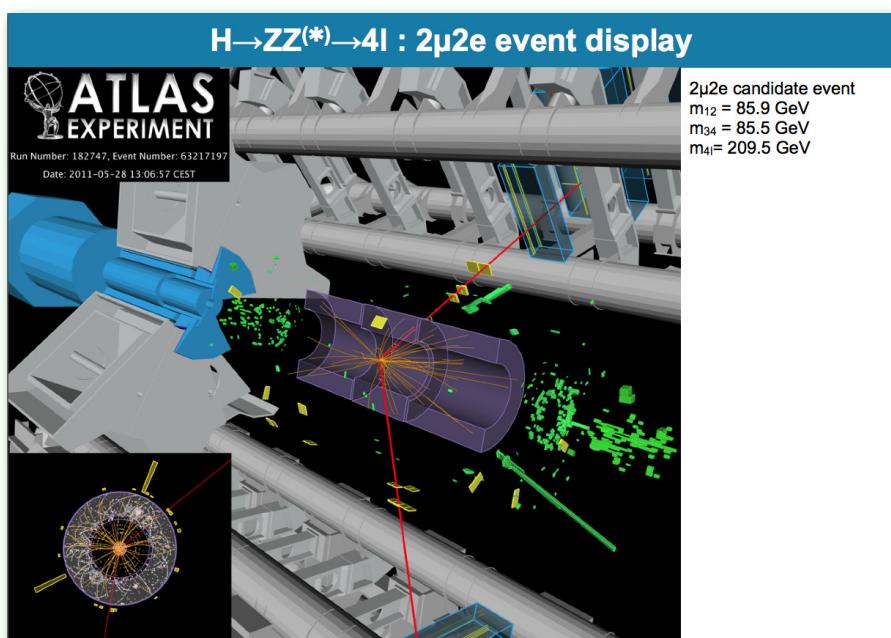
But even if one day we claim to have found the Higgs, we will never be able to tell with complete certainty if one particular event (taken from all those we selected) came from a Higgs boson decay or from some background process. It is only when looking at all the collected events that we can see the excess, and not for any particular event.

So just as with blueberry picking, you need to gather many of them before it starts making a bump at the bottom of your pail. Having grown up in the northern part of Quebec in Canada, I know a great deal about blueberry picking. Hopefully, this will give me an edge in the Higgs gathering race!

To be alerted of Pauline's new postings on Quantum Diaries, follow her on Twitter:

@GagnonPauline

Pauline Gagnon



An event captured by the ATLAS detector in the search for a Higgs boson decaying into two Z bosons, one of which goes into a pair of electrons (shown in yellow in the small picture at the bottom left corner) and two muons (the two tracks shown in red). There is no way to tell if this particular event comes from a Higgs decay or simply from a background event such as one containing two Z bosons. Only after gathering many such events and studying their properties will we be able to tell if some of them came from a Higgs boson decay.



... An example of flawed code

We were wondering how well written the following code was:

```
1 /* Safely Exec program: drop privileges to user uid and group
2 * gid, and use chroot to restrict file system access to jail
3 * directory. Also, don't allow program to run as a
4 * privileged user or group */
5 void ExecUid(int uid, int gid, char *jailDir, char *prog, char *const argv[])
6 {
7 if (uid == 0 || gid == 0) {
8 FailExit("ExecUid: root uid or gid not allowed");
9 }
10
11 chroot(jailDir); /* restrict access to this dir */
12
13 setuid(uid); /* drop privs */
14 setgid(gid);
15
16 fprintf(LOGFILE, "Execvp of %s as
uid=%d gid=%d\n", prog, uid, gid);
17 fflush(LOGFILE);
18
19 execvp(prog, argv);
20}
```

(Courtesy of Barton Miller, University of Wisconsin, Madison, US)

Do you recall our small exercise in the last issue of the Bulletin?

Indeed, it was not so well written since it contained at least 13 flaws:

1. Line 1: Incomplete specification: Does it run *arbitrary* commands or just a few selected ones? Who checks for errors? The function or the caller? Does it run on *arbitrary* chroot jails? What about thread-safety? Is this expected to run in a multithreaded environment?
2. Line 5: Depending on the platform, there may be integer-related issues.
3. Line 5: No sanitization of "jailDir". For example "/" will do nothing.
4. Line 11: No check for errors on "chroot". chroot("lkjhkjlhkh") or chroot(NULL) would bypass the jail.
5. Line 11: Missing "chdir(jailDir)" before the chroot, or chroot("/") after it.
6. Line 11: No checks for errors.
7. Lines 13/14: setuid & setgid run in the wrong order.
8. Lines 13/14: No checks for errors, so the attacker may choose some random number for uid and gid and run the program as root.
9. Line 16: Is LOGFILE actually open? This may crash the program, or may make it exploitable.
10. Line 19: No sanitization of prog, it may cause NULL pointer dereferences, crashes, etc. and make the code exploitable.
11. Line 19: No environment sanitization.
12. Line 19: No error handling: if execvp() returns it means there is some error to be handled. The specification is weak in this case.
13. If the program runs in a multithreaded environment, sanitization will have to make private copies of jailDir, prog and argv[] and perform the checks on them.

The winners of the three marvellous books on software security are Bertrand Lefort (BE/OP), Paolo Torelli (extern) and Remi Mommsen (CMS). Congratulations!!!

You think this is not easy? True --- and this is the advantage for any attacker. He just has to find a few flaws to exploit that code and take over the corresponding server. Thus, please check basic rules for good programming as well as essential books on proper software development in the section for software developers on our security web page (<https://cern.ch/security/recommendations/en/index.shtml>). Also, you can also easily test your software yourself. Check thoroughly the warnings of your compiler and run on of our suggest static code analysers (https://cern.ch/security/recommendations/en/checklist_for_coders.shtml). In addition, the HR technical training provides excellent course on secure programming in Java, C++, Python, Perl and web languages (<https://cern.ch/security/training/en/index.shtml>). Next one day hands-on courses are on securing PHP, Java and Web applications (September 27th, 28th, and 29th, respectively) as well as for secure programming in Python (October 28th). There are still places available!!!

Finally, do not hesitate to contact Computer.Security@cern.ch if you prefer an external review of your software!

Of course, if you have questions, suggestions or comments, please contact Computer.Security@cern.ch or visit us at <http://cern.ch/security>.

Computer Security Team



Ombuds' Corner Le coin de l'Ombuds

In this series, the Bulletin aims to explain the role of the Ombuds at CERN by presenting practical examples of misunderstandings that could have been resolved by the Ombuds if he had been contacted earlier. Please note that, in all the situations we present, the names are fictitious and used only to improve clarity.

Confidentiality concerning boards

Phil* was a candidate to a position in a different group as the one he had been working for. After the board had taken place, Phil asked for an appointment with the Ombuds.

To his perception the interview went reasonably. However Phil had some doubts as he had heard that actually there would be no point for him to apply as another candidate will get the position. But he had decided to apply anyway, encouraged by other people, in the hope to get a good rating which could help him in getting a possible future position, if not the present one. During the interview he was asked some questions which could only be answered by the candidates who had some experience related to this specific group; he missed these points, but his concern was different.

Later, Phil did not appreciate to learn in advance the result of the board from a

colleague who got the information from another colleague: the position had been given to someone else. In addition he learned by rumors that some comments were made concerning him in the discussions leading to the decision. This was a shock and Phil started to reflect about a possible negative influence of some of his past history, could not prevent himself to envisage that some unknown considerations within the board could have influenced the decision. He could not stop to have all these thoughts, even if unreal, invading his mind.

The mandate of the Ombuds forbids him to start entering challenging a managerial decision, especially when taken after several discussions as in the case of a board. Although Phil understood and accepted that he could not change the situation as he had no knowledge of what really happened, he was staying with a bad feeling, a vague impression that the decision could have been twisted in his disfavor even if it would not have been the case.

Conclusion

Such a situation is annoying and leaves a bad feeling on the candidates who have not been taken. It is most important that the confidentiality of the debates concerning the decisions leading to grant a position, whether a Limited Duration or Indefinite Contract, be respected. Only the Human Resources Adviser present in the board should forward first information to the candidates who ask for it.

Contact the Ombuds early!

<http://cern.ch/ombuds>

Vincent Vuillemin

* Names and story are purely fictitious.

NEW ARRIVALS

On Tuesday 6 September 2011, at the second part of the Induction Programme, members of CERN Management welcomed recently-recruited staff members and fellows (photographed here with Jean-Marc Saint-Viteux, Deputy Head of HR Department and Vincent Vuillemin, CERN Ombuds).





News from the Library

Key publishers will present a selection of titles in physics, technology, mathematics, engineering, computing and popular science.

You are welcome to come along and meet the publishers' representatives or simply have a look to the books on sale.

The Fair will take place in the Main Building (bldg. 500) on the ground floor near the Restaurant 1 on Wednesday 14th and Thursday 15th September. Participating or represented publishers include: Cambridge University Press, Elsevier, EPFL Press – PPUR, Oxford University Press, Princeton University Press, Springer, Taylor & Francis, Wiley, World Scientific-Imperial College Press.

The CERN Bookshop and CERN Library invite you to attend the 2011 CERN Book Fair, a two-day scientific event offering you the opportunity to meet key publishers and to browse and purchase books at significant discounts.

Fair opening times:

- **Wednesday 14 September 9:00 – 18:00**
- **Thursday 15 September 9:00 – 18:00**

Three book presentations are scheduled during the two days. They will all take place in the Library:

- **Wed. 14 September at 3.30pm:**

"Knowledge Management in an International Research Centre: A study of technology transfers and benefits to society in a scientific organization, CERN" by Beatrice Bressan

<http://indico.cern.ch/conferenceDisplay.py?confId=153266>

- **Wed. 14 September at 4.30pm:**

"You Are Wrong, Mr. Einstein: Newton, Einstein, Heisenberg and Feynman Discussing Quantum Mechanics" by Harald Fritzsch

<http://indico.cern.ch/conferenceDisplay.py?confId=152457>

- **Thu. 15 September at 3.30pm:**

"Matter Antimatter Fluctuations: Search, discovery and analysis of Bs flavor oscillations" by Nuno Leonardo

<http://indico.cern.ch/conferenceDisplay.py?confId=153504>

CERN Library



Official news

Members of the personnel shall be deemed to have taken note of the news under this heading. Reproduction of all or part of this information by persons or institutions external to the Organization requires the prior approval of the CERN Management.

ANNUAL PENSION FUND UPDATE

All members and beneficiaries of the Pension Fund are invited to attend the

**Annual Pension Fund Update
to be held in the CERN Council
Chamber
on Tuesday 20 September 2011
from 10-00 to 12-00 a.m.**

Copies of the 2010 Financial Statements are available from departmental secretariats.

Coffee and croissants will be served prior to the meeting as of 9-30 a.m.

CERN Pension Fund



Take note



Workshop Energy for Sustainable Science

Energy Management for Large-Scale Research Infrastructures

FIRST JOINT WORKSHOP ON ENERGY MANAGEMENT FOR LARGE-SCALE RESEARCH INFRASTRUCTURES

CERN, ERF (European Association of National Research Facilities) and ESS (European Spallation Source) announce the first Joint Workshop on Energy Management for Large-Scale Research Infrastructures.

**The event will take place
on 13-14 October 2011 at the ESS office
in Sparta - Lund, Sweden**

The workshop will bring together international experts on energy and representatives from laboratories and future projects all over the world in order to identify the challenges and best practice in respect

of energy efficiency and optimization, solutions and implementation as well as to review the challenges represented by potential future technical solutions and the tools for effective collaboration.

Further information at:

<http://ess-scandinavia.eu/general-information>



Safety Training Course

SAFETY TRAINING: SCHEDULED SESSIONS IN SEPTEMBER AND OCTOBER 2011

The following training courses are scheduled in September – October. You can find the full Safety Training programme on the Safety Training online catalogue.

If you are interested in attending any of the below courses, please talk to your supervisor, then apply electronically via EDH from the course description pages, by clicking on SIGN-UP.

Registration for all courses is always open – sessions for the less-requested courses are organized on a demand-basis only. Depending on the demand, a session will be organised later in the year.

Alphabetical order (original course titles are maintained)

Conduite de chariots élévateurs

17-OCT-11 au 18-OCT-11, 8h00 – 17h30, en français*

Ergonomie - Sensibilisation à l'ergonomie bureautique

15-SEP-11, 9h00 – 12h30, en français

15-SEP-11, 14h00 – 17h30, en anglais

Laser Users

28-OCT-11, 9h00 – 12h30, en anglais

Masque autosauveteur

15-SEP-11, 8h30 – 10h00, en anglais

15-SEP-11, 10h30 – 12h00, en français

27-SEP-11, 10h30 – 12h00, en anglais

Radiological Protection

20-SEP-11, 8h30 – 12h30, en anglais

20-SEP-11, 13h30 – 17h30, en français

30-SEP-11, 13h30 – 17h30, en anglais

07-OCT-11, 8h30 – 12h30, en anglais

07-OCT-11, 13h30 – 17h30, en français

11-OCT-11, 13h30 – 17h30, en anglais

18-OCT-11, 8h30 – 12h30, en anglais

18-OCT-11, 13h30 – 17h30, en français

28-OCT-11, 13h30 – 17h30, en anglais

Recyclage Habilitation - Personnel électrique effectuant des opérations du domaine de tension BTA

14-OCT-11, 9h00 – 17h30, en français

Risques liés aux interventions en espace confiné

20-SEP-11, 9h00 – 17h30, en français

Secourisme - Cours de base

22-SEP-11 au 23-SEP-11 (1 jour et demi), 8h30 – 17h30, en français

Secourisme - Cours de recyclage

23-SEP-11, 13h30 – 17h30, en français

Sensibilisation aux gestes et postures de travail

30-SEP-11, 9h00 – 17h30, en français

Sécurité chimique – Introduction

27-SEP-11, 9h00 – 11h30, en français

(*) Session in French with possibility to have the documentation in English.

Isabelle Cusato (HSE Unit)



Language training

ENGLISH COURSE

General and Professional English Courses

The next sessions will take place:

From 3rd October 2011 to beginning of February 2012 (break at Christmas).

These courses are open to all persons working on the CERN site, and to their spouses.

For registration and further information on the courses, please consult our Web pages:

<http://cern.ch/Training> or contact Kerstin Fuhrmeister, tel. 70896.

Oral Expression

The next sessions will take place from 3rd October 2011 to beginning of February 2012 (break at Christmas).

This course is intended for people with a good knowledge of English who want to enhance their speaking skills.

There will be on average of 8 participants in a class.

Speaking activities will include discussions, meeting simulations, role-plays etc. depending on the needs of the students.

For registration and further information on the courses, please consult our Web pages: <http://cern.ch/Training> or contact Kerstin Fuhrmeister, tel. 70896.

Writing Professional Documents in English - Administrative

Writing Professional Documents in English – Technical

The next sessions will take place from 3rd of October 2011 to beginning of February 2012 (break at Christmas).

These courses are designed for people with a good level of spoken English who wish to improve their writing skills.

There will be an average of 8 participants in a class.

For registration and further information on the courses, please consult our Web pages or contact Kerstin Fuhrmeister, tel. 70896.

Cambridge FCE examination course

We are offering a course in preparation for Cambridge 1st certificate examination. This would consist of two 15-week sessions of 4 hours a week leading to the examination in June.

We need a minimum of 7 participants to open this course. If you think you might be a suitable candidate please contact Kerstin Fuhrmeister or Tessa Osborne in order to arrange an appointment for a test.

For registration and further information on these courses, please consult our Web pages: <http://cern.ch/Training> or contact Kerstin Fuhrmeister: Tel. 70896. or Tessa Osborne: Tel. 72957



Seminars

MONDAY 12 SEPTEMBER

LHC SEMINAR

11:00 - Main Auditorium, Bldg. 500

Higgs searches with CMS

M. ZANETTI / MASSACHUSETTS INST. OF TECHNOLOGY (US)

WEDNESDAY 14 SEPTEMBER

TH COSMO COFFEE

11:00 - TH Auditorium, Bldg. 4

Universe acceleration from bulk viscosit

J. LESGOURGES / ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (CH)

TH THEORETICAL SEMINAR

14:00 - TH Auditorium, Bldg. 4

Problems of quantum cosmology

J. HARTLE (UCSB)

THURSDAY 15 SEPTEMBER

COLLIDER CROSS TALK

11:00 - TH Auditorium, Bldg. 4

Angular analysis of $B^0 \rightarrow K^* 0 \mu^+ \mu^-$ at LHCb

T. BLAKE / IMPERIAL COLLEGE SCI., TECH. & MED.

FRIDAY 16 SEPTEMBER

DETECTOR SEMINAR

11:00 - Salle Andersson, Bldg. 40-S2-A01

A high-performance tracking system for the LHCb spectrometer

A. PELLEGRINO / NIKHEF

MONDAY 19 SEPTEMBER

ISOLDE SEMINAR

14:00 - Bldg. 26-1-022

Shape coexistence in the lead region investigated using a multitude of experimental probes (1/3)

P. VAN DUPPEN / INST. VOOR KERN- EN STRALINGS-FYSICA-KATHOLIEKE UNIVERSITEIT LEU

TUESDAY 20 AUGUST

LHC SEMINAR

11:00 - Main Auditorium, Bldg. 500

Diboson production and Standard Model Higgs searches with the ATLAS Detector at the Large Hadron Collider

J. BARREIRO GUIMARAES DA COSTA / HARVARD UNIVERSITY (US)

TH STRING THEORY SEMINAR

14:00 - TH Auditorium, Bldg. 4

TH Institute on Quantum Gravity

ISOLDE SEMINAR

14:00 - Bldg. 26-1-022

Shape coexistence in the lead region investigated using a multitude of experimental probes (2/3)

P. VAN DUPPEN / INST. VOOR KERN- EN STRALINGS-FYSICA-KATHOLIEKE UNIVERSITEIT LEU

WEDNESDAY 21 SEPTEMBER

LHCC / LHCC MEETINGS

09:00 - Main Auditorium, Bldg. 500

Open and Closed Sessions

107th LHCC Meeting AGENDA

OPEN Session

E. ELSEN / DEUTSCHES ELEKTRONEN-SYNCHROTRON (DE)

TH THEORETICAL SEMINAR

14:00 - TH Auditorium, Bldg. 4

Where do we stand in Quantum Gravity

H. NICOLAI / II. INSTITUT FÜR EXPERIMENTALPHYSIK

ISOLDE SEMINAR

14:00 - Bldg. 26-1-022

Shape coexistence in the lead region investigated using a multitude of experimental probes (3/3)

P. VAN DUPPEN / INST. VOOR KERN- EN STRALINGS-FYSICA-KATHOLIEKE UNIVERSITEIT LEU

THURSDAY 22 SEPTEMBER

COLLIDER CROSS TALK

11:00 - TH Auditorium, Bldg. 4

TBA

C. GORHAM LESTER / CAVENDISH LABORATORY, UNIVERSITY OF CAMBRIDGE

FRIDAY SEPTEMBER 23, 2011

DETECTOR SEMINAR

11:00 - 40-S2-B01 - SALLE BOHR

Particle Flow in CMS : The Data Challenge

C. BERNET / CERN