

UK news from CERN

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Top job for Edinburgh Professor

The next Director General of CERN will be Dr Fabiola Gianotti, the former spokesperson of the ATLAS collaboration who co-announced the discovery of the Higgs boson in July 2012.

In 2013, in addition to many other honours from universities and institutes around the world, Fabiola was appointed an Honorary Professor in the School of Physics and Astronomy at the University of Edinburgh. She is also a member of the International Advisory Committee of the [Higgs Centre for Theoretical Physics](#) at Edinburgh.



Fabiola Gianotti (centre) with colleagues from the University of Edinburgh including Peter Higgs © CERN

In 2016, Fabiola will take over from Rolf Heuer and become CERN's first female Director General.

Testing times

Safety is a serious matter at CERN. The nature of the experiments means that many gases and chemicals are used routinely, and each one has its own set of potential hazards. Chemical safety engineer, Jon Gulley is a member of the Health and Safety team. UKNFC met up with him to learn more about a typical day.



Jon Gulley (r) giving advice at the CERN Safety Day 2014 © CERN

Jon is often out and about around CERN providing on-site advice about chemicals and gases or inspecting equipment to ensure that it has been correctly installed, maintained or used. "I'll be checking risk assessments or layouts and providing advice. Sometimes the visits are with the Doctor from the CERN Medical Service. We're not the police – we want to help people comply with chemical safety rules and doing work place visits alongside the medical service



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YEARS CERN

has changed people's perceptions – our aim is to ensure that everyone is working safely.”

Of course, training people how to use gases and chemicals safely is also important and Jon oversees a range of courses including safe working with chemicals and for people who need to wear masks for protection against dusts, particles, vapours or gases.

Any new product or material that is going to be used at CERN, especially in underground areas needs to meet strict safety criteria and Jon will check the published safety sheets to check how it behaved in fire testing – he's particularly interested in the toxicity and opacity of the smoke that is produced.

“As a team, our approach is always to be pragmatic and flexible. We try to present our customer with a solution, not a problem. If someone wants to use a product that doesn't meet our safety criteria, I will try to find a compliant material, and failing that, I'll help them to overcome the non-compliance problems.”

That can mean commissioning tests to check how a material behaves in a specific environment. In fact, when we meet, Jon is part of a small group looking at a highly innovative product made by a small UK company. The product is quite unusual and has caught the attention of one of the LHC experiments. As a new product, it has very limited technical data and Jon is suggesting how CERN might be able to help. Such advice and help from a well-regarded professional in a big name organisation could have a significant effect on a small business.

Jon has been at CERN for 18 years and has seen many changes in the approach to Health and Safety, “CERN is a great place to work – the work itself is very varied and the nature of the science and engineering presents a range of challenges, unusual chemicals and products. You wouldn't find this combination of materials and installations in any other company and my role is a good balance between theory and operations.”

Spotlight on dark matter

UKNFC aims to bring you all the news about UK activities at CERN. But if you'd also like to know what's going on at other particle physics labs around the world including KEK in Japan, Fermilab in the US, IHEP in Beijing or DESY in Germany, why not take a look at www.interactions.org? The Interactions collaboration includes the world's leading particle physics labs and its website is a useful source of information about particle physics, including press releases, articles, news, event listings and images.

New to the web site is the [Dark Matter hub](#), a comprehensive list of all the experiments that are trying to find out more about this mysterious stuff that makes up around 25% of our Universe. The number of experiments reflects the size of the challenge and the range of different ways that researchers are trying to solve the mystery.

Resources for your A* LHC Project

Coronation Street Particle Physics fans will have been delighted to see 11 year old character Simon Barlow proudly telling his dad about getting an A* in his school project about the Large Hadron Collider on [Monday 10 November](#).

If you have a similar project and you're hoping for an A*, there's lots of great information available online.

[Elizabeth Cunningham](#) is STFC's particle physics and nuclear physics outreach officer, “Our '[Particle Physics for You](#)' web page is a one stop shop for everything about particle physics – you can order free leaflets and posters including my favourite – the '[tunnel to the beginning of time](#)', a stunning poster of the ATLAS experiment!”

Elizabeth is the first point of contact for anyone wanting to find out about nuclear and particle physics research funded by STFC. She supports the well-established particle physics masterclass programme offered by all the UK universities and institutes that are involved in

this area of research, and has added the option of remote masterclasses for schools where their nearest particle physics department is too far to travel. Recent remote masterclasses have included Penryn (Cornwall) and Southend (Essex).

If you're a UK teacher bringing a school group to CERN, Elizabeth will be in touch before your visit, "I want to make sure that every student is as well-prepared as possible for their visit, and I send each teacher links to resources that they can use in the classroom."

These resources include an introduction to the physics department at the school's nearest university – a local connection that can provide an extra dimension to classroom learning – as well as relevant TEDed lessons, the Lancaster Particle Physics Package, animations of the Higgs boson and Oxford University's Collider app.

As Elizabeth says, "STFC enables amazing research, and I'm here help people find out more about it."

Volcanic bread and butter physics

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CERN's most publicised discovery was that of the Higgs boson. Now, less than year before the LHC restarts in April 2015, pressure is rising. With little conclusive evidence yet found for supersymmetry, what if the Higgs boson was the high point? Will the LHC have proved an expensive white elephant?

For theoretical physicist John Ellis (KCL) this is what makes it exciting. "It's just great to have a feeling that new knowledge about nature is emerging and that this is the place where the information is coming out. It's like sitting on top of a volcano."

The Higgs boson may have captured the headlines, but for Ellis, who has been at CERN some three decades, that was just one of a string of major breakthroughs. Looking back, he picks out two other key moments: firstly, the

1983 of the massive vector bosons responsible for the weak interaction, known as the W and the Z. "That was a real technical tour de force," says Ellis, "which was first of all a great entrepreneurial idea about how an existing CERN accelerator could be turned into a high-energy collider."

Not far behind that was the 1973 discovery of neutral current weak interactions. "It's a bit esoteric," he admits, "but the thing was, in the standard model there were these new types of weak interactions."

Like analogues of radioactivity, they had been predicted but never been seen. A lot of people said that they didn't exist, but there was an experiment here using the Gargamelle bubble chamber that made a determined effort to go out and find them. In fact when they did find them, then there was a different experiment at Fermilab, ironically led by Carlo Rubbia [the same man who subsequently came to CERN, proposed this idea of turning our accelerator into a collider and used it to discover the W and Z bosons]. They said, 'this is rubbish, this is not real, this result is wrong'. But it was right. That, I think, really opened the floodgates towards experimental verification of the standard model."



Former Prime Minister Margaret Thatcher meets John Ellis during a visit to CERN in 1982 © CERN

But it is still the Higgs boson that people most associate with CERN and the LHC in particular. Did they find what they were expecting to find? "At this juncture," replies Ellis, "I like to tell the story of when Mrs Thatcher came to CERN," before the W and the Z were discovered. "I explained to her the theoretical physics and I proposed to her the experiment and the things that we might look for, but that of course I hoped we'd find something different. But Mrs Thatcher

liked things to be the way that she liked them to be, and so she said: 'Wouldn't it be better if you found what you predicted?' And I replied: 'Actually, not really, because then you wouldn't have a clue how to advance!'

The point Ellis is making is that, although the discovery of something that looks like the standard model Higgs boson is largely good news, the physicists at CERN are hoping for something more. "We're all hoping there's going to be some discrepancy with the standard model. Nothing has shown up yet, but obviously when we restart the LHC we will get much more detailed measurements and some discrepancy may well show up – we certainly hope that it does."

This is where the focus will be when the LHC restarts in April 2015. As Ellis explains: "What we want to do in general – and this is sort of bread and butter physics – would be to check the properties of the Higgs boson. But then because you've got this big increase in energy and eventually a big increase in collision rate there's lots of new prospects opening up for discovering things beyond the standard model. People are very optimistic and excited, but there's still people who are properly cautious."

Beyond April 2015, Ellis is one of the scientists responsible for looking ahead to CERN's longer-term future. As chair of the CERN committee to investigate physics opportunities for future proton accelerators, he is looking at a range of different ideas. "At the moment CERN obviously has got its hands full," he says, "in terms of upgrading the LHC and getting the full bang for the bucks being spent on it. But, equally, because of the incredibly long lead-time for future projects there is research and development for various possible options. The plan is in four or five years' time to come back to the CERN council with some specific idea of what the next project might be."

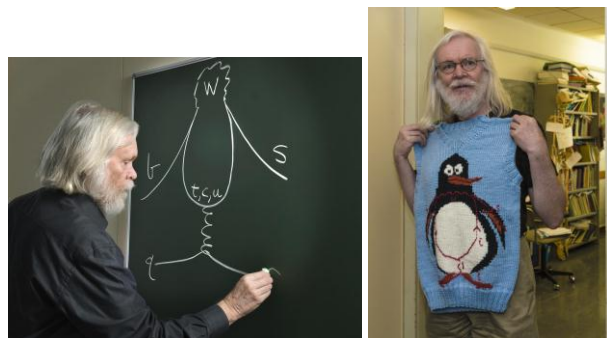
All of this, however, will depend what LHC finds once it reopens in 2015. What if it fails to make any significant new breakthroughs? As Ellis explains: "It might discover new particles that you can pair produce at a high-energy e^+e^-

machine. Or it might not, and if it doesn't that's where you might decide that's where you're going to put a premium on very precise studies of the Higgs boson. In which case a circular e^+e^- machine at lower energies might be where you want to go."

You can see John's account of what physicists do and don't know in a free online IAI Academy course: [A Brief Guide to Everything](#)

P-p-p-pick up a (woolly) penguin

And in other John Ellis-related news, we can report that John has received another hand-knitted jumper from Norway (see UKNFC 38).



Penguin double vision © CERN

The latest garment depicts the Feynman diagram that John developed more than 30 years ago to describe the decay of a bottom quark – he had been challenged to include the word penguin in a paper after losing a bet.

You can learn more about the diagram, the bet, and read a *really* bad penguin joke in [Symmetry Magazine](#).

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Diary dates

CERN Council – 14 – 18 December
[A world a particle](#) in Liverpool - until 8 January