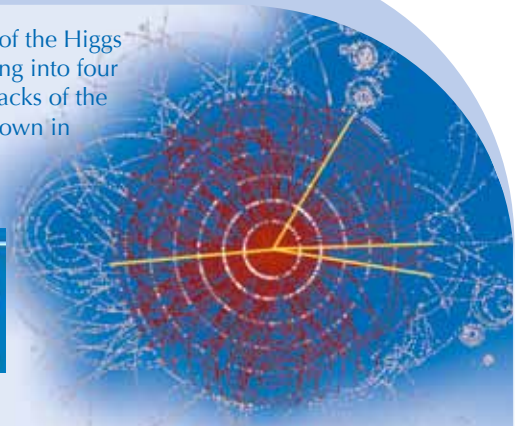
Black holes, magnetism and cancer

Image courtesy of CERN



A simulation of the Higgs boson decaying into four muons; the tracks of the muons are shown in yellow

CERN:
Tantalising hints of Higgs

The hunt for the Higgs boson has entered its decisive phase, as announced in a seminar on 13 December 2011. If they exist, Higgs bosons are short-lived and decay in many different ways. Both ATLAS and CMS, the two largest experiments at CERN's Large Hadron Collider (LHC), have observed an excess of gamma rays (highly energetic photons) in the mass region where the Higgs boson would be expected to register.

However, even the 500 trillion proton–proton collisions observed in each experiment – thanks to a brilliant performance of the LHC during 2011 – are not enough. With a statistical significance between two and three standard deviations, the signals do not yet allow the scientists to claim that they have finally discovered the long sought-after particle.

About four times more collisions will be needed to finally conclude whether the Higgs boson exists. If all goes well, the LHC will provide these data by the end of 2012, when it will become clear if the standard model of particle physics can be considered complete.

To learn more, see the press release:
http://press.web.cern.ch/press/PressReleases/Releases2011/PR25.11E.html

To find out more about the LHC, see:
Landua R, Rau M (2008) The LHC: a step closer to the Big Bang. *Science in School* **10**: 26-33. www.scienceinschool.org/2008/issue10/lhcwhy

Landua, R (2008) The LHC: a look inside. *Science in School* **10**: 34-45. www.scienceinschool.org/2008/issue10/lhchow

Based in Geneva, Switzerland, CERN is the world's largest particle physics laboratory. To learn more, see: www.cern.ch

For a list of CERN-related articles in *Science in School*, see:
www.scienceinschool.org/cern

EFDA-JET:
A snowball in hell

During the recommissioning of the Joint European Torus (JET) after an 18-month refurbishment period, scientists have injected the proverbial snowball into hell. The snowball in question is a 3 millimetre pellet of frozen deuterium, at approximately -260 degrees Celsius. Hell is the plasma inside JET, ionised deuterium gas at about 100 million degrees Celsius. These experiments are part of the quest for nuclear fusion, an energy source based on nuclei colliding and coalescing into heavier elements.

Surprisingly, contrary to popular legend, the 'snowball' has a significant effect on 'hell'. The pellet injection system is designed to prevent plasma instabilities in which the hot gas momentarily escapes its magnetic cage, diffusing a lot of energy and many of its constituent particles. The injection of a cold pellet actually triggers instabilities as well, but if pellets are injected at regular intervals, scientists have found that the many small instabilities produced reduce the number of large instabilities, thereby allowing the plasma pulses to operate for longer.

The way is now clear to begin the process of slowly turning up the new heating systems to test the many other new components.

To find out more, see:
Rüth C (2012) Harnessing the power of the Sun: fusion reactors. *Science in School* **22**: 42-48. www.scienceinschool.org/2012/issue22/fusion

Situated in Culham, UK, JET is Europe's fusion device. Scientific exploitation of JET is undertaken through the European Fusion Development Agreement (EFDA). To learn more, see: www.efda.org

For a list of EFDA-JET-related articles in *Science in School*, see:
www.scienceinschool.org/efdajet

Image courtesy of EFDA-JET

Essentially, this equipment is a gas-powered machine gun capable of firing up to 50 small frozen pellets of deuterium fuel per second into the hot plasma

Science in School is published by EIROforum, a collaboration between eight of Europe's largest inter-governmental scientific research organisations. This article reviews some of the latest news from the EIROforum members (EIROs).

Tumour formation

Image courtesy of André-Pierre Olivier

EMBL: Cancer research for schools

On 9 December 2011, more than 200 enthusiastic pupils and teachers gathered at the European Molecular Biology Laboratory (EMBL) for the EMBL Insight Lecture 2011. To celebrate the International Year of Chemistry, Maja Köhn, who works in the highly interdisciplinary field of chemical biology, gave a lecture on 'Chemistry and biology – strong allies in the fight against cancer'.

Her cross-disciplinary team of organic chemists and molecular biologists works on designing molecules that inhibit proteins involved in disease mechanisms. The scientists want to understand the role of phosphatases in cancer metastasis, the molecular mechanisms leading to disease and how the activity of these proteins can be modulated. During her lecture, Maja demonstrated how inhibitors of phosphatases are designed by combining molecular biology, biochemistry and synthetic chemistry.

The EMBL Insight Lectures series is produced by EMBL's European Learning Laboratory for the Life Sciences (ELLS) to inform young people about current trends in life-science research and how this research influences our everyday lives. Maja's lecture is one of a growing list of EMBL Insight Lectures available at: www.embl.org/ells/insightlectures

EMBL is Europe's leading laboratory for basic research in molecular biology, with its headquarters in Heidelberg, Germany. To learn more, see: www.embl.org

For a list of EMBL-related articles in *Science in School*, see: www.scienceinschool.org/embl

ESA: Take your classroom into space

PromISSe is the fourth European long-duration mission to the International Space Station (ISS), which began on 23 December 2011 with the arrival at the ISS of the European Space Agency's astronaut André Kuipers and his Russian-American colleagues. André and his colleagues will remain in space until mid-May 2012.

During this 148-day mission André is taking part in experiments on human research, fluid physics, materials science, radiation and solar research, mostly in the European space laboratory Columbus. School students can join in too, taking part in many science activities being transmitted from space to classrooms across Europe.

André is also encouraging a new generation of space explorers to stay fit and 'Train Like an Astronaut', with a NASA-led educational programme for 8- to 12-year-olds. Thousands of pupils are invited to perform physical exercises and classroom lessons, competing with teams from around the world.

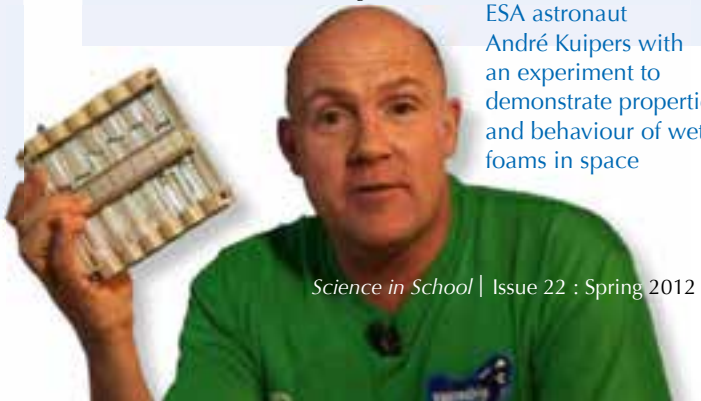
To learn more about the Columbus laboratory, see: Wegener A-L (2008) Laboratory in space: interview with Bernardo Patti. *Science in School* **8**: 8-12. www.scienceinschool.org/2008/issue8/bernardopatti

For more details of the in-orbit demonstration for children, see: www.esa.int/SPECIALS/PromISSe/SEMU1FJ37SG_0.html or use the direct link: http://tinyurl.com/7y7ahy9

To find out more about the 'Train Like an Astronaut' project, see: www.esa.int/SPECIALS/PromISSe/SEMK0FJ37SG_0.html or use the direct link: http://tinyurl.com/76hk2vy

ESA is Europe's gateway to space, with its headquarters in Paris, France. For more information, see: www.esa.int

For a list of ESA-related articles in *Science in School*, see: www.scienceinschool.org/esa



ESA astronaut André Kuipers with an experiment to demonstrate properties and behaviour of wet foams in space

Image courtesy of ESA

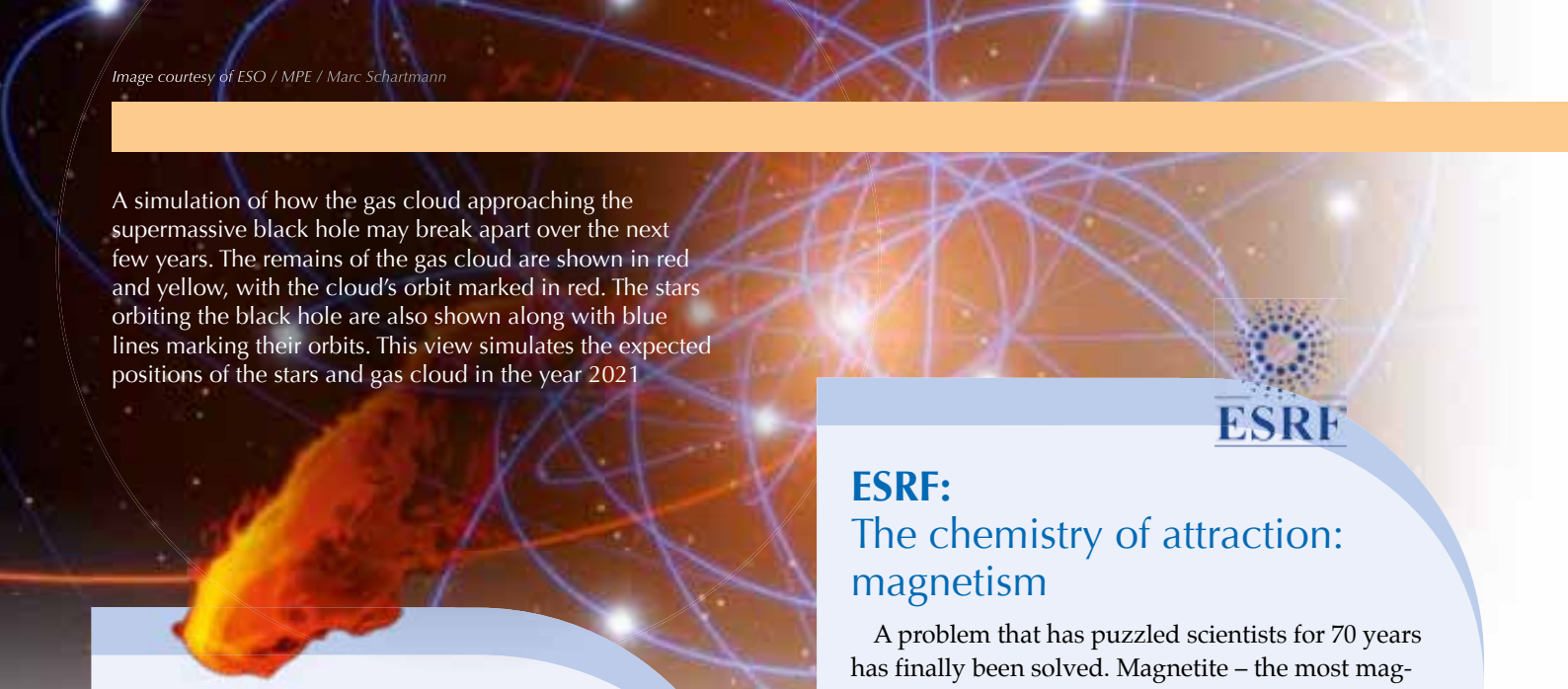


Image courtesy of ESO / MPE / Marc Schartmann

A simulation of how the gas cloud approaching the supermassive black hole may break apart over the next few years. The remains of the gas cloud are shown in red and yellow, with the cloud's orbit marked in red. The stars orbiting the black hole are also shown along with blue lines marking their orbits. This view simulates the expected positions of the stars and gas cloud in the year 2021

ESO:
Doomed cloud approaches black hole

Astronomers using the European Southern Observatory's Very Large Telescope have discovered a gas cloud with several times the mass of Earth accelerating fast towards the black hole at the centre of the Milky Way. This is the first time ever that the approach of such a doomed cloud to a supermassive black hole has been observed.

Over the past seven years, the speed of this gas cloud has nearly doubled, reaching more than 8 million kilometres per hour. In mid-2013 it will pass at a distance of only about 40 billion kilometres from the event horizon of the black hole. In astronomical terms, this is an extremely close encounter with a supermassive black hole. The cloud's edges are already starting to shred and disrupt and it is expected to break up completely over the next few years.

"The idea of an astronaut close to a black hole being stretched out to resemble spaghetti is familiar from science fiction. But we can now see this happening for real to the newly discovered cloud. It is not going to survive the experience," explains Stefan Gillessen of the Max-Planck Institute for Extraterrestrial Physics, the lead author of the paper describing the discovery.

To find out more, see the press release (www.eso.org/public/news/eso1151) or the research paper:

Gillessen S et al. (2012) A gas cloud on its way towards the supermassive black hole at the Galactic Centre. *Nature* **481**: 51-54. doi: 10.1038/nature10652

Download the article free of charge on the *Science in School* website (www.scienceinschool.org/2012/issue22/eiroforum#resources), or subscribe to *Nature* today: www.nature.com/subscribe

ESO is the world's most productive astronomical observatory, with its headquarters in Garching near Munich, Germany, and its telescopes in Chile. For more information, see: www.eso.org

For a list of ESO-related articles in *Science in School*, see: www.scienceinschool.org/eso

ESRF:
The chemistry of attraction: magnetism

A problem that has puzzled scientists for 70 years has finally been solved. Magnetite – the most magnetic of all minerals – stops conducting electric currents at low temperatures, a discovery made in 1939 by Dutchman Evert Verwey. The reasons remained controversial until a group of scientists working at the European Synchrotron Radiation Facility (ESRF) fired an intense X-ray beam at a tiny, perfect crystal of magnetite at very low temperature. They observed a subtle rearrangement of the mineral's chemical structure, trapping electrons within groups of three iron atoms, inhibiting them from transporting an electrical current.

Magnetite (Fe_3O_4) was discovered more than 2000 years ago. It gave rise to the original concept of magnetism and was used to build the first magnetic compass. When it crystallises from volcanic magma, magnetite conserves the direction of Earth's magnetic field, which was key to the discovery that this field had reversed direction in the past. Tiny crystals of magnetite are also found in insect and pigeon brains and are thought to play a role in these animals' ability to fly back home over long distances.

To find out more, see:

Attfield JP (2011) Condensed-matter physics: A fresh twist on shrinking materials. *Nature* **480**: 465–466. doi: 10.1038/480465a

Download the article free of charge on the *Science in School* website (www.scienceinschool.org/2012/issue22/eiroforum#resources), or subscribe to *Nature* today: www.nature.com/subscribe

Situated in Grenoble, France, ESRF operates the most powerful synchrotron radiation source in Europe. To learn more, see: www.esrf.eu

For a list of ESRF-related articles in *Science in School*, see: www.scienceinschool.org/esrf

The scientists watching magnetite crystals

Image courtesy of Ana Wright

The ongoing tunnel floor installations

Images courtesy of European XFEL

European XFEL: Building the world's largest X-ray laser

The year 2011 has shown good progress on the construction and development of what will be the world's most brilliant source of ultra-short X-ray pulses. The European XFEL will offer new insights into the nano-world, revealing the structures of biomolecules and allowing chemical reactions to be 'filmed'.

With most of the tunnel boring completed, tunnel builders have started to put in the concrete floor elements. All told, the facility is 3.4 kilometres long and has 5.7 kilometres of underground tunnels. The tunnel for the linear accelerator, which will speed electrons up to very high energies, is now ready for the installation of technical equipment.

At the far end of the accelerator, the tunnel splits into a number of smaller tunnels, where X-ray light flashes will be generated by forcing the electrons on a tight slalom course through a line of magnets called undulators. The first prototypes of the undulator segments have been delivered. Significant milestones have been reached in the development of the instruments that scientists will use to carry out their experiments and of other technical equipment. European XFEL expects to start operation in 2015.

European XFEL is a research facility currently under construction in the Hamburg area in Germany. It will generate extremely intense X-ray flashes for use by researchers from all over the world. To learn more, see: www.xfel.eu

ILL: Symmetry in quasicrystals

Discovery of colloidal quasicrystals with small-angle neutron scattering: the 12-fold diffraction symmetry of a quasicrystalline micellar phase and the corresponding tiling pattern showing the position of the micelles

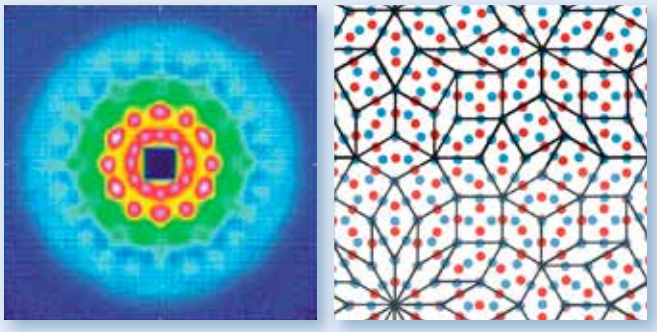


Image courtesy of instrument D11 / ILL and Stephan Förster / Universität Bayreuth

ILL is an international research centre at the leading edge of neutron science and technology, based in Grenoble, France. To learn more, see: www.ill.eu

For a list of ILL-related articles in *Science in School*, see: www.scienceinschool.org/ill

EIROforum

EIROforum combines the resources, facilities and expertise of its member organisations to support European science in reaching its full potential. To learn more, see: www.eiroforum.org

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To browse the other EIRO news articles, see: www.scienceinschool.org/eironews

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