CERN Bulletin

A word from the DG

Congratulations!

At a meeting of the CERN Council a couple of weeks ago, one delegate stood up and reminded us that the LHC is not a turnkey machine. The great achievement of Tuesday is that those responsible for its construction and operation are making it look as if it is.

I'd like to congratulate them all, from those who originally conceived the project through those who turned the impossible technologies it demanded into reality, to those who brought us from the dark days of late 2008 to the position we are in today, and last but not least, to the people in the CERN Control Centre who have brought this wonder of the modern world to life in such spectacular fashion. Tuesday was their day.

(Continued on page 2)

Yes, we did it!

People in the CCC during the event.

Nearly 20 years of hard work by hundreds of people have made this machine a dream come true. On Tuesday, the LHC delivered its first high-energy collisions to the experiments. The new data will give us an unprecedented tool to understand the Universe we live in.

We did it! The first high-energy collisions were achieved at 13.06 on Tuesday 30 March at all four points of the LHC ring. Collisions occurred after a few attempts at injecting and ramping beams in the morning.

Before the collisions, there was a mixture of excitement, expectation, fear and apprehension in the CERN Control Centre. Nobody had ever attempted to make two proton beams collide at 3.5 TeV before. Only Nature produces collisions like this routinely, in the processes that yield cosmic radiation, but in a way that makes it very difficult to extract meaningful data.

The operators started to prepare the machine for collisions in the early hours of Tuesday morning: thousands of components that have to work without failing, hundreds of controls to ensure smooth operation, dozens of people standing in front of the computer screens in order to spot any anomaly as soon as possible. The LHC is such a complex machine that the operators let out a cry of relief when all the experiments confirmed the first collisions.

In this issue

Published by:
The European Organization for Nuclear Research - CERN
1211 Geneva 23, Switzerland - Tel. + 41 22 767 35 86
Printed by: *CERN Printshop*

ISSN: *Printed version: 2077-950X*
Electronic version: 2077-9518

A word from the DG

(Continued from page 1)

Congratulations!

Now it is the turn of the experimental collaborations to make their mark. Their achievement in designing and building these gargantuan, yet incredibly precise instruments is no less impressive than that of the accelerator people. The fact that they were recording and analysing data as soon as it became available last year is testimony to the work they have done, and it bodes well for the future.

The history of science is marked by periods that change our perception of the Universe and our place in it. Today could be the start of one of them.

Rolf Heuer

Yes, we did it!

(Continued from page 1)

Below we reproduce a collection of quotes from some well-known CERNois who have followed - or led - this huge endeavour over the years. We also invite you to watch the films and photos produced on Tuesday by the CERN audiovisual and photo services. They illustrate, much better than in words, what a historic moment the day was for all of us.

Today I feel very proud of my colleagues who have spent 15 hard years building the LHC. There have been many setbacks along the way and each one has been overcome with determination and commitment. It has been a privilege to have worked with them. We now know that the LHC is a beautiful machine. It behaves exactly as it was designed to do. There may be some consolidation needed in the future in order to push up to full energy but this is to be expected in a machine of such complexity. The team responsible for commissioning and running the machine has also shown great commitment and skill. Now let us get the experimental programme started and see what nature has to tell us on the new energy frontier.

Lyn Evans, former LHC Project Leader

Collisions of 3.5 TeV beams, 7 TeV total energy, at the LHC, is very good news for the particle physics community. I hope that steady running at good luminosity will be achieved and that we may learn what the cosmological "dark matter" is.

Jack Steinberger, Nobel Prize in Physics 1988

Giorgio Brianti first got me involved in the LHC in June 1988, so I've spent 22 years of my career on the project. Since 2001, when I became head of CERN's Magnets, Superconductors and Cryostats group, the LHC has been my life. What collisions at 7 TeV mean technically speaking is that we've succeeded in storing 2.5 gigajoules of magnetic energy in two thin 27 km pipes, that we're going to produce extremely hot collisions very close to the super cold temperature of 1.9 K, and that superconductivity is difficult but is allowing us to do unprecedented things. We hope that, like Galileo 400 years ago, we will see things that have never been seen before. Today, on 30 March, I'm at the KEK Laboratory in Japan with the Director-General and other physicists to discuss Japan's participation in the future LHC upgrade. The collisions at 7 TeV centre of mass give us confidence that the LHC will reach its maximum energy (14 TeV) in two years' time and that we can already start preparing for the next step, the super LHC!

Lucio Rossi, Head of the Magnets, Superconductors and Cryostats group

Seeing the first collisions at 3.5 TeV per beam is one of the landmark events in the long history of the LHC. It's the result of more than 15 years' hard work on the machine and its injectors by many teams who have had to rise to many challenges. It shows that the different systems, which were tested separately beforehand, are all working well together. I don't know of any other scientific project involving so many components that have to function all at the same time. When you're standing in the Control Room you must never forget that what you see on the screen is not a giant video game but the product of a phenomenal quantity of equipment in the tunnel, designed and maintained by hundreds of people who've given their all to the project. Every time I watch a ramp-up on one of the screens in the CCC, I can't help thinking about all that equipment and the stored energies.

This milestone bodes well for the long physics run ahead of us. I'm proud and honoured to be involved in this scientific project.

Frederick Bordry, TE Department Leader

Humanity is about to look deeper inside matter than has ever been possible before. We have many theories of what we might find, but only experiments can tell us which, if any, are right. Why do particles weigh? What is the dark matter that fills the Universe? What was the origin of the matter in the Universe? The answers provided by the discoveries of the LHC will revolutionize our understanding how the Universe works, and how it has evolved.

John Ellis, CERN Theory Group

"Today we have seen collisions for the first time in the LHC at a beam energy of 3.5 TeV. This is the culmination of many years of work to build and install the machine and detectors, but also comes remarkably quickly after beginning the commissioning of the machine with beam. The speed with which the machine has been brought to the condition that we can declare stable colliding beams at high energy is a tribute to all the people that have worked so hard on its conception, design, construction, installation and commissioning.
We are progressing in the commissioning phase in a very systematic manner, preparing each phase carefully to understand the machine and the parameters of the beam at each stage before going on. This all takes time, but the quality of the machine and its instrumentation has allowed us to make very rapid progress. After today the commissioning will continue with a progressive increase in the performance of the machine as we increase the beam intensity and the focusing of the beams around the experiments. However, today also marks an important turning point. Today the LHC started the physics programme for which it was designed."

Paul Collier, BE Department Leader

The LHC Physics Centre at CERN

As the LHC goes on line for its first exploration of the new high-energy frontier, CERN is also getting ready to enhance the support it provides for the analysis and interpretation of the emerging data.

The LHC Physics Centre at CERN (LPCC) has started up over the past couple of months, beginning with a series of initiatives ranging from workshops to lectures for students. More details about the LPCC will be featured in a forthcoming Bulletin article. In the meantime, you can consult the LPCC web page, now available at :

http://cern.ch/lpcc

This offers the high energy physics community a portal to the LPCC's activities, as well as to useful resources, tools and information about the LHC physics programme, the progress of accelerator operations, relevant workshops and events around the world, and much more. The LPCC will shortly begin issuing a weekly bulletin of its own, distributed by e-mail.

Members of the CERN physics community and subscribers to the CERN Bulletin will receive the LPCC Bulletin. To subscribe and unsubscribe, please email lpcc@mail.cern.ch.

CERN Bulletin

The particle suppliers

Particles are supplied to the LHC by six accelerators interconnected by several kilometres of transfer lines. This represents yet another complex chain of processes whereby particles are produced, bunched, synchronised and injected into the LHC at the precise moment it's ready to receive them. In other words, for collisions to be produced at the end of the chain, all the injectors must be in perfect working order.

Among all the questions asked by the many visitors to CERN, one in particular comes up time and time again: "Why don't you just connect the LHC directly to the proton source?" In other words, why do you need this whole chain of accelerators acting as an "injector" for the LHC?

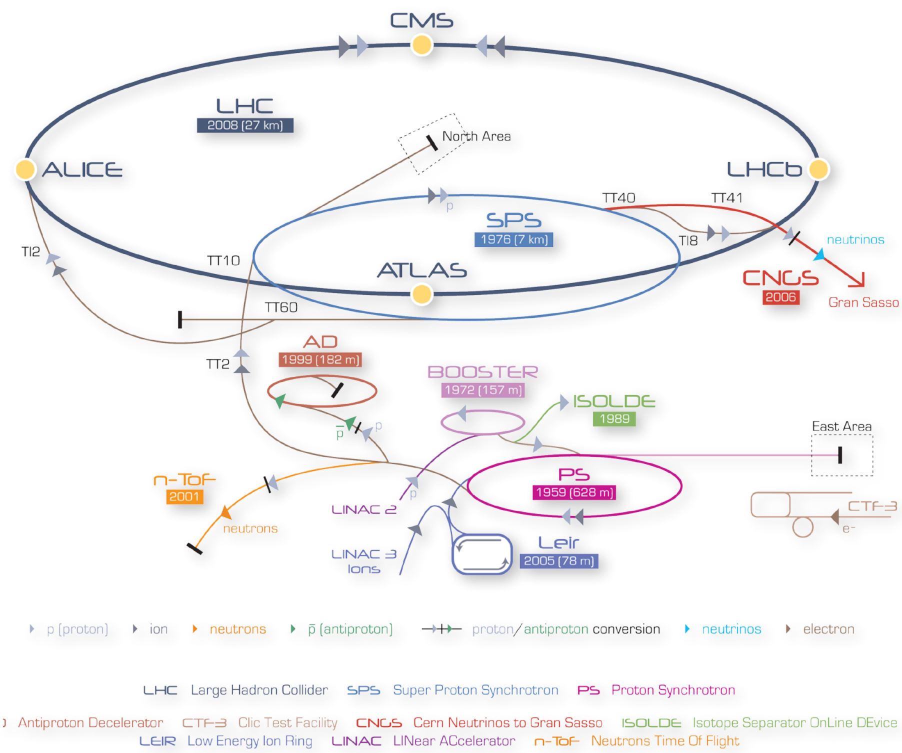
Before colliding inside the LHC, particles first have to pass through no fewer than six different accelerators: the 90 keV duoplasmatron source, the 750 keV RFQ, the 50 MeV Linac 2, the 1.4 GeV synchrotron injector ("PS Booster" or PSB), the 25 GeV Proton Synchrotron (PS) and finally the 450 GeV Super-Proton-Synchrotron (SPS).

The primary function of each of these machines is of course to accelerate the beam up to the injection energy of the next machine. For beam stability reasons, the LHC cannot receive particles at too low energies. But the various links in the LHC injector chain do have other purposes.

Take the PS Booster, for example. The meticulous adjustment of its multi-turn injection system determines the small transverse dimensions of the proton beam, thus producing a high particle density and, through that, high luminosity in the LHC, which is the only one of CERN's accelerators operating as a collider. The Proton Synchrotron is responsible for creating the bunch structure, using radiofrequency to chop the beam into successive bunches. Finally, the SPS has the delicate task of inserting the bunch trains into the LHC at just the right place to ensure that they collide in the centre of the detectors.

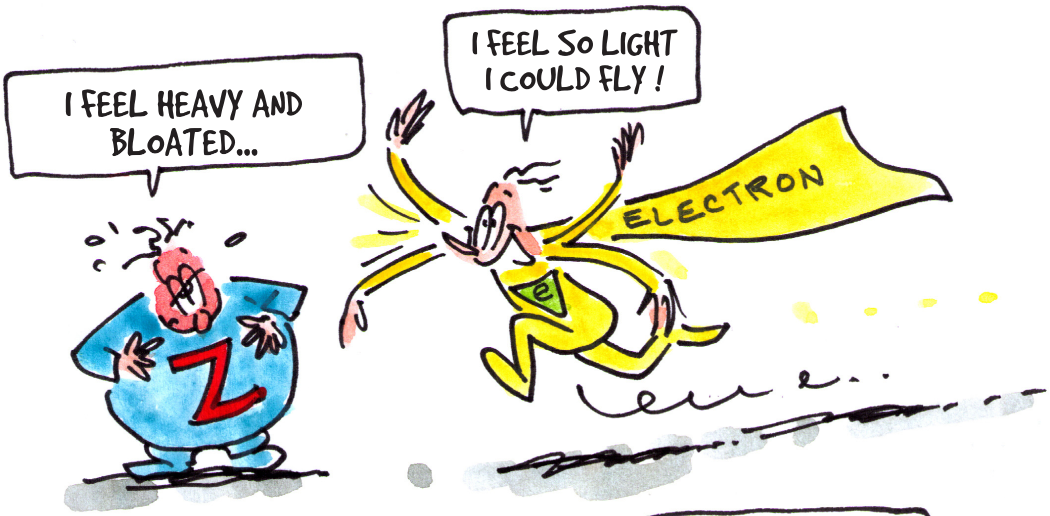
It has taken many years to prepare these various machines to supply beams to the LHC, with varying numbers of bunches, bunch spacings and intensities. And while today's collisions were of beams consisting of just four bunches each (check number of bunches), the injector chain is ready to supply the collider with nominal beams of 2,808 bunches of 10^{11} protons in each direction. This long period of preparation has finally borne fruit on this Tuesday, but the effects will only truly be felt once the LHC is ready to accept beams at their nominal intensity.

CERN Bulletin



LHC Physics

From the quarks to yet unknown particles, CERN continues to explore the new frontier in physics. Thanks to some of the most complex instruments ever made in the laboratory, Nature can reveal its inner secrets to the scientists.



Mass is the amount of material in an object. On Earth, we weigh things to figure out their mass. Despite the fact that these might appear as very familiar concepts, when it comes to elementary particles, physicists deal with a very fundamental question: where does the mass come from?

Why do particles with no known structure have mass?

→ The answer may lie in the so-called Higgs mechanism. According to this theory, a field - called the Higgs field - permeates every place in the Universe at all times. Particles acquire their mass by interacting with this field, such that those that interact strongly are heavier than those having a weaker interaction. The Higgs boson is the manifestation of the field in the form of a particle. The LHC collision energy is just right to produce such a particle.

Antimatter is routinely created in laboratories such as CERN and in nature when cosmic rays hit the atmosphere. Although matter and antimatter must have been produced in the same amounts at the time of the Big Bang, today only matter seems to have survived in our Universe.

Where has all the Big Bang antimatter gone?

→ The explanation could be a – yet unknown – difference between matter and antimatter. Tiny behavioural differences – the so-called CP violation effects – have already been observed but, according to the present theories, they can not explain the disappearance of antimatter. The LHC has some of the most advanced instruments to probe the difference between matter and antimatter.

From astronomical observations, we know that 96% of the Universe is unknown. About 70% is a new type of energy, the so-called dark energy, and 26% is dark matter. In contrast with ordinary matter, dark matter does not emit radiation and therefore can not be detected directly by today's instruments.

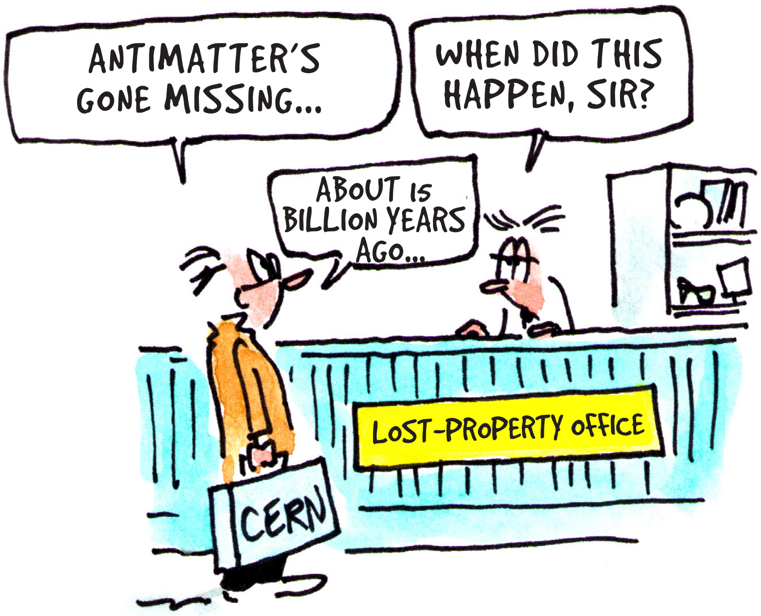
What is one-third of the Universe made of?

➔ Very massive particles, as yet undiscovered, could provide the explanation. Such 'supersymmetric' particles are predicted to solve several puzzles of the Standard Model - the theory that embodies our current understanding of nature. Thanks to the high energy available at the LHC, experiments could find the lightest supersymmetric particle, the neutralino.

Quarks are the innermost constituents of matter. Found in protons and neutrons, which, in turn, make up the atomic nucleus, they are confined in the particles they compose. At everyday temperatures they are never found free, thus making it very difficult for physicists to study them.

What are the inner properties of quarks?

➔ In the high-energy collisions between beams of lead nuclei at the LHC, the temperature will exceed 100 000 times that of the centre of the Sun. In these conditions, the quarks are set free and matter exists as a sort of extremely hot, dense soup, called quark-gluon plasma. Physicists at the LHC study this state of matter which probably existed a few moments after the Big Bang, thus probing the basic properties of quarks.



It might seem that gravity should be the best known among the four fundamental forces. After all, we have our feet on the ground because of gravity! However, while physicists have found in their experiments the particles associated with the other forces of Nature, the graviton is still undiscovered.

Could hidden dimensions disclose the graviton?

➔ The Universe could have extra dimensions beyond the four dimensions we experience - three spatial plus time as the fourth. Hidden dimensions could be curled up to be so tiny that we are not aware of them. Some theories predict that high-energy particle collisions could create gravitons that escape into the extra dimensions. The LHC experiments may provide evidence for extra dimensions, and allow the study of higher-dimensional gravitons.

LHC Highlights, from dream to reality

The idea of the Large Hadron Collider (LHC) was born in the early 1980s. Although LEP (CERN's previous large accelerator) was still under construction at that time, scientists were already starting to think about re-using the 27-kilometre ring for an even more powerful machine.

Turning this ambitious scientific plan into reality proved to be an immensely complex task. Civil engineering work, state-of-the-art technologies, a new approach to data storage and analysis: many people worked hard for many years to accomplish all this.

Here are some of the highlights:

1984 A symposium organized in Lausanne, Switzerland, is the official starting point for the LHC.

1989 The first embryonic collaborations begin.

1992 A meeting in Evian, France, marks the beginning of the LHC experiments.

1994 The CERN Council approves the construction of the LHC accelerator.

1995 Japan becomes an Observer of CERN and announces a financial contribution to the LHC. Japan makes two further major financial contributions to the LHC project in 1996 and 1998.
The LHC technical design report is published.

1996 Thanks to the contributions of non-Member States (including India, Russia, Canada and the United States), the CERN Council decides to construct the LHC in a single stage.
The CMS and ATLAS experiments are officially approved.

1997 A full-scale model of the LHC main dipole magnets, measuring 15 metres in length, is lowered into the tunnel of the future accelerator.
The ALICE experiment is officially approved.

1998 Civil engineering work begins for the ATLAS experiment. The first prototype magnet with a 15-metre nominal length is tested successfully, reaching a magnetic field of 8.3 tesla, the operating field for the LHC.
LHCb is the fourth experiment approved for the LHC.

2000 The dismantling of CERN's large accelerator, LEP, begins.

2001 The European DataGrid project (EDG) tests a networking infrastructure for the future computing grid.

2002 The last component of LEP is brought up to the surface.
The first octupole correction magnet is delivered.
The excavation of the ATLAS cavern is completed: in two years of work, one of the world's largest experimental caverns, 35 metres wide, 55 metres long and 40 metres high, has been dug!

2003 The installation of the transfer lines begins. Composed of 700 magnets, they are to transport the beams from the existing accelerator chain to the LHC.

2005 The LHC Computing Grid, which must meet enormous storage and data-processing needs, reaches more than 100 centres in 31 countries.

2006 The construction of the world's largest refrigerator is complete.
The magnet production for the LHC is also complete.
The first of the eight sectors of the LHC is ready. The sector's magnets, cryogenic distribution line and other systems and services are all interconnected.

2007 The interconnections of all the arcs of the LHC are completed. Particles circulate in the LHC for the first time.

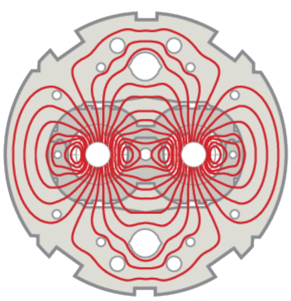
2008 The 27 kilometres of the LHC attain the –271°C needed for the experiment. In September, an incident brings the LHC to a standstill.

2009 A technical stop to prepare the LHC for restart. The machine is switched on again in November. The first collisions at a record energy of 1.18 TeV are achieved on 30 November.

19 March 2010
Beam energy is ramped to 3.5 TeV, a new world record.

30 March 2010
The first collisions at 3.5 TeV!

CERN Bulletin



For further details about the history and milestones of the LHC you can visit:

http://public.web.cern.ch/public/en/about/History-en.html

http://lhc-milestones.web.cern.ch/LHC-Milestones/

http://cerncourier.com/cws/article/cern/35869

http://cdsmedia.cern.ch/journal/CERNBulletin/2008/38/News%20 Articles/1125888?ln=en

The LHC in numbers

What makes the LHC the biggest particle accelerator in the world? Here are some of the numbers that characterise the LHC, and their equivalents in terms for us easier to imagine.

Alizée Dauvergne

Feature	Number	Equivalent
Circumference	~ 27 km	
Distance covered by beam in 10 hours	~ 10 billion km	a round trip to Neptune
Number of times a single proton travels around the ring each second	11 245	
Speed of protons first entering LHC	299 732 500 m/s	99.9998 % of the speed of light
Speed of protons when they collide	299 789 760 m/s	99.9999991 % of the speed of light
Collision temperature	~ 10^{16} °C	over one billion times as hot as the centre of the Sun
Operating temperature of the superconducting magnets	1,9 K (-271,3°C)	colder than outer space (which is 2.7 K, or 270.5˚C)
Amount of helium needed to cool down the facility	~ 120 t	
Number of leak-tight pipe junctions necessary to keep the helium cold	~ 40 000	
Volume of the insulating vacuum around the superconducting magnets	~ 9 000 m^3	the volume of the nave of a cathedral
Pressure inside the beam vacuum pipe	~ 10^{-13} atm	one tenth of the pressure at the surface of the moon
Electrical power consumption	~ 120 MW	twice the power generated by the Rolls Royce 900 engine of an Airbus A380 when the plane is at cruising speed

Cost comparisons

How much does the LHC cost? And how much does this represent in other currencies? Below we present a table showing some comparisons with the cost of other projects.

Looking at the figures, you will see that the cost of the LHC can be likened to that of three skyscrapers, or two seasons of Formula 1 racing! One year's budget of a single large F1 team is comparable to the entire materials cost of the ATLAS or CMS experiments.

Please note that all the figures are rounded for ease of reading..

	CHF	€	$
LHC	**4.6 billion**	**3 billion**	**4 billion**
Space Shuttle Endeavour (NASA)	1.9 billion	1.3 billion	1.7 billion
Hubble Space Telescope (cost at launch – NASA/ESA)	1.6 billion	1.1 billion	1.5 billion
Aircraft carrier	2.9 billion	2 billion	2.7 billion
Oresund bridge (8 km – Sweden/ Denmark)	5.7 billion	4 billion	5.3 billion
Burj Khalifa skyscraper (828 m – Dubai)	1.6 billion	1.1 billion	1.5 billion
F1 budget (per season – F1 Magazine 2003)	2.3 billion	1.6 billion	2.1 billion
F1 big team (per season – F1 Magazine 2003)	535 million	375 million	500 million

New arrivals

On Thursday 25 March 2010, during the second part of the Induction Programme, members of the CERN Management welcomed recently recruited staff members and fellows.

Official

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.

TAX DECLARATION: FOR THE ATTENTION OF MEMBERS OF THE PERSONNEL AND PENSIONERS LIVING IN FRANCE

Exchange rate for 2009

For 2009, the average annual exchange rate is 0.67 EUR for 1 CHF.

HR Department

Take note

CONFERENCE ON THE TREATMENT OF TINNITUS AND HYPERACUSIS

Monday 3 May 2010 from 2.30 p.m. to 4.30 p.m

IT Auditorium - Bldg. 31-3-004

Sylviane Chéry-Croze, Honorary Research Director at the CNRS

and Ange Bidan, Vice-President of the French Association of Tinnitus Sufferers

Do you suffer from tinnitus or hyperacusis?

The CERN Medical Service and UNIQA Assurances SA, Geneva, invite you to a conference organised by the French Association of Tinnitus Sufferers.

The conference will start with an introduction devoted to the destabilising experiences of people suffering from these symptoms and to the reactions that they induce. This introduction will be followed by a presentation of what are universally assumed in the medical research world to be the causes of the most frequently encountered forms of tinnitus (neurosensorial tinnitus). The presentation will also describe the multidisciplinary treatment that is currently regarded as the most effective means of initially managing the symptoms and then of eliminating them and that similarly targets these assumed causes.

The presentation will also survey the various clinical research protocols currently under way in Europe, which give sufferers of certain types of tinnitus hope of treatments in the short- to medium-term that will bring about a complete cure.

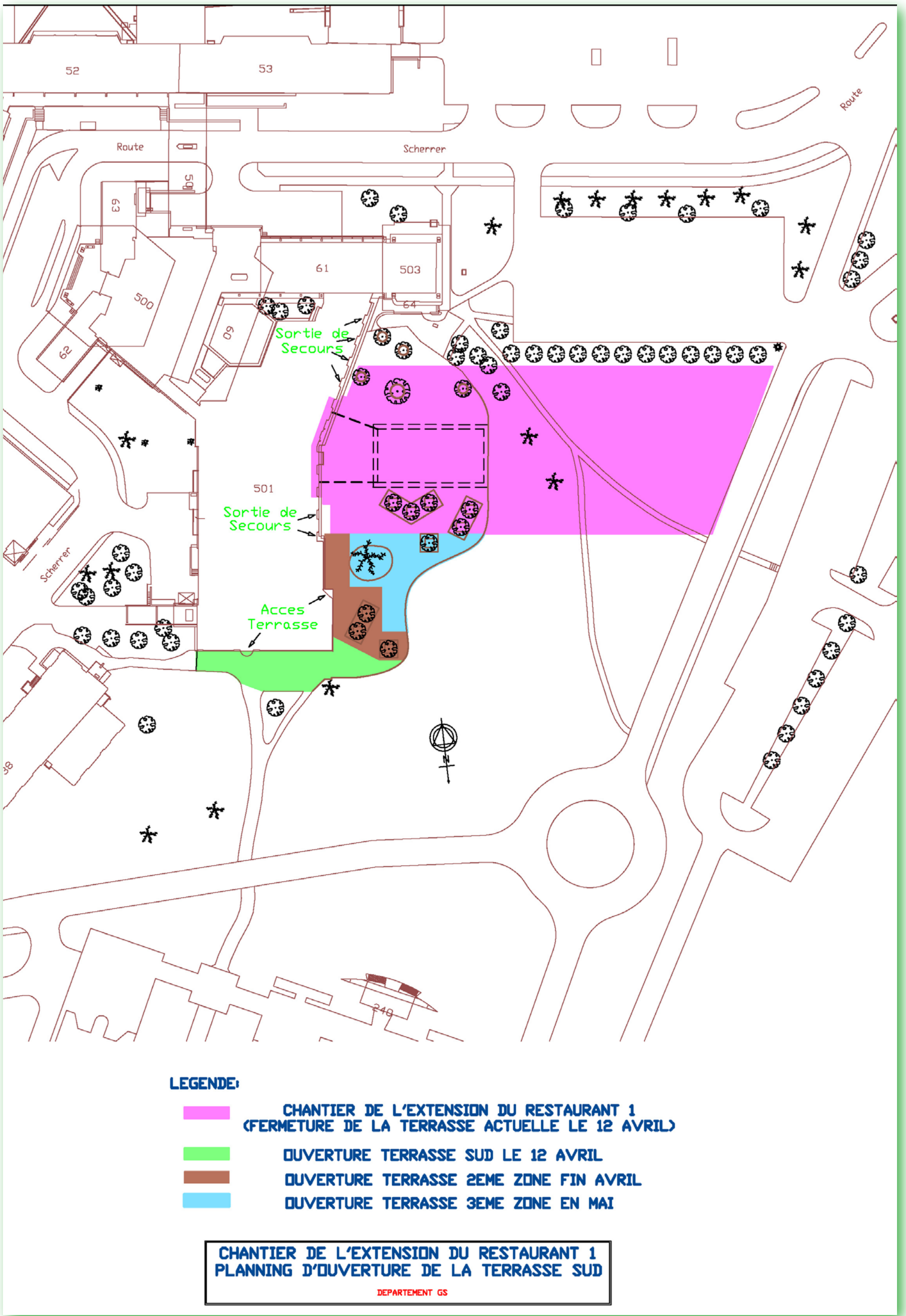
GS Department

Take note

WORK ON THE EXTENSION OF RESTAURANT NO. 1

The work on the extension of Restaurant No. 1 will start on 12 April 2010. The section of the terrace currently available will be closed from this date onwards and the south terrace (see drawing) will gradually be made available in its place.

Département GS



TO ALL MEMBERS OF THE PERSONNEL

Summer work for children of members of the personnel

During the period from 14 June to 17 September 2010 inclusive, a limited number of jobs for summer work at CERN (normally unskilled work of a routine nature) will be made available 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 allowance will be 1717 CHF for this period. Candidates should apply via the HR Department's electronic recruitment system (E-rt):

https://ert.cern.ch/browse_www/wd_pds?p_web_page_id=7716

Completed application forms must be returned by 9 April 2010 at the latest. The results of the selection will be available on 21 May 2010.

For further information, please contact:

Inger.Carriero@cern.ch

HR Department - Tel. 71372

Language training

GENERAL AND PROFESSIONAL FRENCH COURSES

The next session will take place from 26 April to 25 June 2010.

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 Mrs. Nathalie Dumeaux : Tel. 78144.

Language Training - French Training
Nathalie Dumeaux Tel. 78144
nathalie.dumeaux@cern.ch

Seminars

MONDAY 22 MARCH

ISOLDE SEMINAR
09:30 - Bldg. 304-1-001

Isolde theory course (1/2): Status of the density functionnal theory in nuclei

E. KHAN / IPN-ORSAY

TH JOURNAL CLUB ON STRING THEORY
14:00 - Bldg. 1-1-025

TBA

P. TZIVELOGLOU / CERN & CORNELL U.

CERN JOINT EP/PP SEMINARS
16:30 - Main Auditorium, Bldg. 500

Charged-particle multiplicity at LHC energies

J. F. GROSSE-OETRINGHAUS / CERN

TUESDAY 23 MARCH

ISOLDE SEMINAR
09:30 - Bldg. 304-1-001

Isolde theory course (2/2): Status of the density functionnal theory in nuclei

E. KHAN / IPN-ORSAY

CERN JOINT EP/PP SEMINARS
11:00 - Council Chamber - Bldg. 503

KLOE measurement of the σ (e+e- -->π+π-(gamma) with initial state radiation and the π π contribution to the muon anomaly

G. VENANZONI / INFN

TH STRING THEORY SEMINAR
14:00 - TH Auditorium, Bldg. 4

Modified Gravity and Supergravity

S. KETOV / TOKYO METROPOLITAN UNIVERSITY

WEDNESDAY 24 MARCH

TH COSMO COFFEE
11:00 - Bldg. 1-1-025

Standard model CP violation and baryogenesis

KONSTANDIN T. / CERN

COMPUTING SEMINAR
14:00 - Kjell Johnsen Auditorium, Bldg. 30-7-018

Cells-as-a-Service: Enterprise-Grade Cloud Infrastructure Research at HP Laboratories

P. GOLDSACK / HP LABS

ISOLDE SEMINAR
14:30 - Bldg. 304-1-001

Are there nuclear structure experiments relevant for neutron stars physics

E. KHAN / IPN-ORSAY

THURSDAY 25 MARCH

HR SEMINAR
08:30 - Bldg. 40-S2-C01

INDUCTION PROGRAMME - 2nd Part

C. GRANIER, L. LEROUX / CERN

A&T SEMINAR
14:00 - Kjell Johnsen Auditorium, Bldg. 30-7-018

Modeling, Simulation and Control of CERN cryogenic systems

B. BRADU / CNRS - LABORATOIRE DES SIGNAUX ET SYSTEMES

TH PHENCLUB
14:00 - Bldg. 1-1-025

Analyses with Fat Jets

G. SOYEZ

CERN COLLOQUIUM
16:30 - Main Auditorium, Bldg. 500

Paul Dirac and the religion of mathematical beauty

G. FARMELO

FRIDAY 26 MARCH

PARTICLE AND ASTRO-PARTICLE PHYSICS SEMINARS
14:00 - TH Auditorium, Bldg. 4

TBA

A. JUETTNER / CERN

MONDAY 29 MARCH

TH JOURNAL CLUB ON STRING THEORY
14:00 - Bldg. 1-1-025

TBA

NORIHIRO IIZUKA

TUESDAY 30 MARCH

TH STRING THEORY SEMINAR
14:00 - TH Auditorium, Bldg. 4

TBA

YUJI TACHIKAWA / IAS PRINCETON

THURSDAY 1 APRIL

TH BSM FORUM
14:00 - TH Auditorium, Bldg. 4

TBA

B. GRINSTEIN / UNIVERSITY OF CALIFORNIA SAN DIEGO