

AROUND THE WORLD

Europe launches update of strategy for particle physics

by Perrine Royole-Degieux



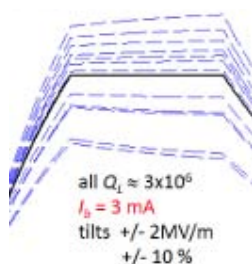
The year 2012 will be a crucial one for particle physics. Physicists expect the Large Hadron Collider and astroparticle physics experiments to draw a clearer picture of the field so that, at the end of the year, the CERN Council could vote on an update of the European strategy for particle physics and, in this way, announce Europe's top priorities for the five years to follow.

FEATURE

Good gradients in seconds flat

Fermilab scientists turn their attention to individual cavities to improve beam stability

by Leah Hesla



A stable particle beam needs a trouble-free path on its way to high energies, and that means providing it with a smooth gradient to ascend. A team of scientists at Fermilab has arrived at a way to control accelerating cavities so they can give particle beams exactly that – a tilt-free path to collision.

DIRECTOR'S CORNER

Thanks, Peter!

by Barry Barish



Peter Garbincius, a key member of the ILC Global Design Effort, has left the GDE to undertake a new assignment at Fermilab. His contributions to the ILC design effort have been truly outstanding and he will be sorely missed.



Superconductor scientists

Image: George Joch

Nearly 400 researchers gathered in Chicago last week for the SRF2011 conference.

IN THE NEWS

from ***The New York Times***

1 August 2011

Particle Accelerators Full of Spin and Fury, Signifying Something

Recently physicists have been turning over cards like crazy, most notably at a meeting in Grenoble, France. So far, the ace is still missing, and some of those potential discoveries have disappeared, but some physicists now think they may know which card the Higgs is hiding under — though they disagree on when it will finally be turned over.

from ***Physics Today***

August 2011

Particle physics, from Rutherford to the LHC

Our understanding of fundamental particles has developed in ways that were unimaginable 100 years ago, when the atomic nucleus was first glimpsed.

from ***Physics Today***

29 July 2011

House appropriators approve big cuts to DOE budget in FY 2012

The House has approved \$6 billion in cuts to the Department of Energy for 2012, but the Senate may restore much of that.

from ***Reuters***

27 July 2011

U.S. team sets end-September target in Higgs chase

Fermilab Today, its daily bulletin, said James, reported in Grenoble that researchers on the centre's Tevatron collider — friendly rival to the LHC — were stepping up their experiments in the search for the Higgs.

from ***physicsworld.com***

27 July 2011

Antiprotons pass latest symmetry test

The latest breakthrough involves antiprotonic helium and is published in *Nature* today. This exotic “atom” is formed when one electron in a helium atom is replaced with an antiproton, which is negatively charged.

from ***Discover***

27 July 2011

The LHC, the Tevatron, and the Higgs Boson

A huge raft of results has been presented at two large international conferences: the annual European Physical Society meeting on high energy physics in Grenoble, France, and the Particles and Nuclei International Conference (PANIC11) at MIT in Cambridge, MA.

CALENDAR

UPCOMING EVENTS

Meeting of the Division of Particles and Fields of the
American Physical Society (DPF 2011)

Brown University, Providence, Rhode Island, USA
09- 13 August 2011

Lepton Photon 2011 XXV International Symposium on Lepton
Photon Interactions at High Energies

Tata Institute of Fundamental Research, Mumbai, India
22- 27 August 2011

ILC positron collaboration meeting

IHEP, Beijing, China
27 August 2011

POSIPOL 2011

IHEP, Beijing, China
28- 30 August 2011

Supersymmetry 2011 (SUSY 2011)

Fermilab, Batavia, IL
28 August- 02 September 2011

XXXI Physics in Collision (PIC 2011)

Simon Fraser University, Vancouver, Canada
28 August- 01 September 2011

The 2nd International Particle Accelerator Conference
(IPAC'11)

San Sebastian, Spain
04- 09 September 2011

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PREPRINTS

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[1107.5581](#)

Hidden SUSY at the LHC: the light higgsino-world scenario
and the role of a lepton collider

AROUND THE WORLD

Europe launches update of strategy for particle physics

Perrine Royole-Degieux | 4 August 2011



*Steinar Stapnes (CERN) announced the launch of the process to update the European strategy for particle physics during an ECFA-EPS special session in Grenoble, France, on 23 July.
Image: LPSC/Tomas Jezo*

As the Large Hadron Collider at CERN, Switzerland, is delivering its first results and as neutrino particles continue to reveal their properties in experiments around the world, particle physicists discuss the future of the field. During an exceptional session of the European Committee for Future Accelerators at the [EPS-HEP2011 conference](#) on 23 July, the particle physics community launched the update of its roadmap as part of the European strategy for particle physics. The previous edition was voted on in Lisbon in 2006. The new edition is now scheduled for autumn 2012 and will be presented in Brussels, Belgium.

In Europe, the CERN Council – the governing body of CERN in which the representatives of the 20 member states decide on scientific programmes and financial resources – is the body committed to drawing the particle physics roadmap for the next twenty years. The [European strategy document](#), released in July 2006, addressed accelerator and non-accelerator-based particle physics together with R&D for new accelerator and detector technologies. At that time, the scientific community foresaw an update by the end of 2010, when they believed the LHC results on the Higgs boson and physics beyond the Standard Model would be revealed. “We changed our plans slightly, estimating that 2012 would be a better year to learn whether the Higgs boson exists or not, and by that time we expect astroparticle experiments to tell us more about dark matter or neutrinos, for example,” said Michel Spiro, president of the CERN Council. “Apart from this two-year delay for the update, we followed most of the recommendations contained in the 2006 strategy

document.”

Particle physics projects are now truly international endeavours and the CERN European Strategy group believes that a European strategy for particle physics has to be connected with other regions' visions. “Our decisions will be strongly influenced by CERN's projects but will go far beyond, at the European and international level,” said Spiro. “We would like to build our strategy with the active participation of Asia and America, and for that we nominated representatives of these regions to take part to our preparatory work and observers of many countries outside Europe will participate to the European Strategy Group meetings.”

With regard to the International Linear Collider (ILC), Michel Spiro can not judge today whether the LHC will tell the physicists enough about the Higgs and new physics so that a decision could be made by the end of 2012. “In any case, I think that we need a global effort to continue beyond 2012, and personally would like to see the ILC and CLIC [Compact Linear Collider Study] projects work more closely together in technical R&D projects management and scientific research,” said Michel Spiro.

The European Strategy will cover the European participation in particle physics projects in Europe and beyond Europe. It will also cover all specific areas of astroparticle and nuclear physics where there is overlap with particle physics research, for example in dark matter, neutrino or cosmology.

The process to update the European Strategy started at the EPS-HEP2011 conference, with an opening talk (see [slides](#) and [video](#)) from Steinar Stapnes, Scientific Secretary of the European Strategy Session of Council and also CERN's linear collider studies leader. A preparatory group is now in place and will gather information from the different proposed projects. A special meeting at CERN is foreseen in October in which the Asian and American visions of the future of particle physics will be presented. After the high-energy physics winter conferences, around April 2012, the physics community will be invited to discuss and give its opinion, the same way it was organised in Orsay, France in 2006 for the [first edition of the strategy](#) document. Then after the 2012 summer conferences, the CERN Council delegates will dedicate a full week to the analysis of the proceedings. "We will try to reach an agreement on the main priorities for the next five years," said Spiro.

Finally, at the end of 2012, the CERN Council plans to hold a special session in Brussels to mark the launch of the updated European Strategy for Particle Physics – maybe at the ministry level – devoted to the approval of their updated vision of a particle physics future.

2012 will be a crucial year for the future of particle physics in many aspects. At the same time significant results should come out of the main high-energy experiments – a study from the Organisation for Economic Cooperation and Development (OECD) about the social and economic impacts of CERN's activities should be revealed. The release of the European strategy will be also an ideal opportunity to showcase the extent of European, and indeed global collaboration in particle physics. To that end, CERN member states plan to organise outreach and educational events around this period.

[ASTROPARTICLE PHYSICS](#) | [CERN](#) | [CLIC](#) | [EUROPE](#) | [EUROPEAN STRATEGY FOR PARTICLE PHYSICS](#) | [ILC](#)

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Michel Spiro (right), President of CERN Council, presented the European Strategy for particle physics during the EPS-HEP2011 press conference on 25 July 2011. Also on this photo: Rolf Heuer, CERN's Director General and Stavros Katsanevas (CNRS), centre. Image: LPSC/Tomas Jezo

FEATURE

Good gradients in seconds flat

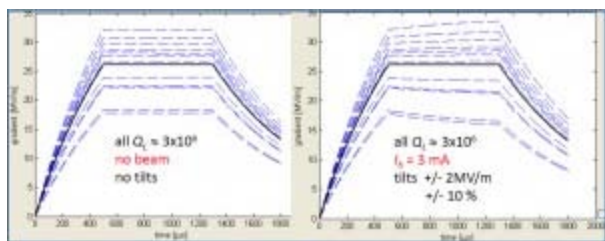
Fermilab scientists turn their attention to individual cavities to improve beam stability

Leah Hesla | 4 August 2011

A constant acceleration gradient along many thousands of particle bunches provides for a particle beam's sure-footed climb to higher energies, readying the beam for collision by providing the same acceleration for each bunch. But constant gradients don't come naturally for accelerating cavities, the elements that pave the particles' ascending path. A cavity has to be poked and prodded into maintaining a good gradient from one particle bunch to the next.

Fermilab scientists have developed a method for getting cavity gradients to stay put. Last February, as part of high-current beam experiments conducted for the ILC at DESY's FLASH facility in Germany, the team successfully modified each tested cavity to achieve constant gradients for any beam current of up to 5 milliamps (mA).

By matching individual cavity properties to the incoming power and the particle beam, they were able to achieve so-called flat gradients.



Ideally, the gradient curve is flat at its peak, as on the left, which shows gradients when no beam is loaded into the cavity. When beam is brought into the cavity, tilts appear, as on the right. Scientists were able to achieve flat gradients in cavities with beams of up to 5 mA. Image: Julien Branlard

"It went pretty smoothly," said Julien Branlard, now at DESY, who works on low-level radiofrequency technology for superconducting cavities. Their tests focused on controlling individual cavity gradients in a chain of cavities powered from a single source.

Most superconducting linacs have a separate radiofrequency power source for each cavity. For decades, said Fermilab's Gustavo Canelo, scientists regulated the power sources directly so that each cavity's gradient control was straightforward. For newer, high-gradient superconducting linacs, it's more cost-effective to power multiple cavities from a single source.

Accordingly, researchers have shifted their attention to the

challenge of controlling the overall, shared gradient of a group of cavities.

A 2010 paper by Kiyoshi Kubo reminded researchers of effects that underscored the importance of flattening individual cavity gradients.

Gradients can be flat or they can tilt along a particle bunch train. If a gradient value is sustained over time – say, a 20 megavolt-per-metre (MV/m) gradient is held over a millisecond – it reads as a flat, horizontal line. If it changes, perhaps dropping from 20 to 17 MV/m over a millisecond, it reads as a downward-tilting slope. The ideal cavity maintains a flat gradient when a particle beam passes through.

Tilts, combined with any cavity misalignment, cause the particle beam to be kicked sideways as it's accelerated. (In particular for electron-positron colliders, a one-percent gradient tilt could a significant change in the particles' orbit at the end of linac.)

"If every cavity had the same gradient, you wouldn't have to worry about this problem, because you can control the net sum to the level of all the cavities," said Canelo. But there's no getting around the truth that every cavity will have a different

gradient. “The problem is that individual cavities tilt.”

One of the keys to ridding cavities of these disturbances lies in manipulating the so-called loaded quality factor, or Q_L (pronounced Q-sub-el), which determines a cavity's gradient. Scientists control Q from the source to the cavities, so countering a cavity's particular tendency to tilt one way or the other. That tendency also depends in part on how much beam current passes through it.

Scientists set the Q_L dial according to the requirements for the current, making a one-time adjustment in the way power is fed to the cavity. Set just right, tilting gradients will level out like playing cards lining up during a shuffle.

By correctly predicting the right Q_L , the team was able to flatten tilts to within 0.5% of the constant-gradient value. This was true for any beam current between 0 and 5 mA.

The team also demonstrated that as you ramp the current up or down from a flat-gradient setting, the amount of tilting increases linearly with the change in current.

It's a useful finding, but it also highlights a problem of practicality, one that scientists hope to solve with further research: the no-tilts Q_L is particular to a single, distinct beam current value. Simply by turning the accelerator on – “Turning on the accelerator isn't like switching on a light,” says Canelo – you necessarily have to ramp through a range of currents for which the magic Q_L doesn't work at all.

Turning the knob until you get to the current you want means enduring tilting gradients along the way, possibly some that are too high for the cavity, causing it to quench. The team developed a solution to the problem that they will test soon at FLASH or at Fermilab's NML facility. It will be important to automate Q_L adjustments that take into account the ramp-up of current and any unexpected departures from the current. It's too much – not to mention too slow – to do manually.

“We need to come up with an automated process,” Canelo said. “Computers don't get tired of looking at control plots.”

The work of the Fermilab team was part of a collaboration that included KEK's and DESY's low-level radiofrequency groups, led by Shin Michizono and Holger Schlarb, respectively. John Carwardine of Argonne National Laboratory in the US and DESY's Siegfried Schreiber and Nick Walker led the ILC effort at FLASH.

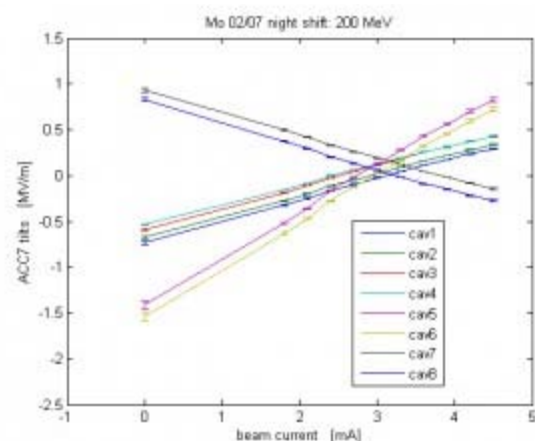
“Once they knew they could trust us, the experts at FLASH gave us *carte blanche* to play with the machine,” Branlard said.

“Maybe we got lucky, maybe we were well prepared, or a combination of both. In any case, it went really well.”

[9 MA EXPERIMENT](#) | [CAVITY GRADIENT](#) | [CAVITY TESTING](#) | [DESY](#) | [FERMILAB](#) | [FLASH](#)

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Each curve shows the change in gradient for a particular cavity as a function of the cavity beam current. Image comes from the DESY-FLASH logbook.

DIRECTOR'S CORNER

Thanks, Peter!

Barry Barish | 4 August 2011



Peter Garbincius

In 2005, I appointed three cost engineers, Wilhelm Bialowons (DESY), Tetsuo Shidara (KEK) and Peter Garbincius (Fermilab) to work together to develop the methodology and to perform an international VALUE costing of the reference design for the ILC. Peter and his cost engineering colleagues did an outstanding job of costing the ILC as a global project in a way that the costs were understandable internationally. In addition, Peter has been serving as a member of the Executive Committee of the GDE, actively participating in all organisational and policy making activities. He has recently moved to other duties within Fermilab, and though this move is a significant loss, we are very fortunate that Gerry Dugan of Cornell University has agreed to step in to take over Peter's responsibilities for the costing for the *Technical Design Report* (TDR).

The task facing the GDE cost engineers is exceptionally challenging because of the fact that a linear collider is a new type of accelerator, having many new features and challenges, and in particular because it is a global project. For example: the key technology is under development through a multi-year R&D programme; the accelerator design itself is evolving with a new baseline for the TDR; the global model for implementing construction is not well defined; the site is unknown. The list of challenges goes on.

Yet, because of the large cost of such a project, we must produce reliable costing. To succeed, the cost engineers have had to work very closely together to ensure that the costing is reliable and applicable globally, to stay connected with the designers and to develop special costing tools. Peter Garbincius has managed this juggling job with impressive skill, as evidenced by the fact that the cost estimates for the *Reference Design Report* (RDR) were reviewed with very high marks by a prestigious international committee.

Peter became so valuable to our efforts that in 2009 that I appointed him to the GDE Executive Committee, the group that functionally guides the GDE activities, sets policy and makes high-level decisions. As expected, Peter became an essential member of the committee and has participated actively in all its varied activities, from overseeing the worldwide R&D efforts to strategising future activities. Of particular note has been Peter's active involvement and role in deciding on changes to our baseline for the technical design, especially by providing timely information on cost impacts.

Peter attended his last GDE meeting last month at Caltech, where we officially transitioned his costing responsibilities to Gerry Dugan. As usual, Peter energetically participated in the many discussions of the plans and subtleties in doing our first costing since the RDR. Much has changed since the 2007 RDR costing: inflationary changes; different exchange rates; modifications to the design; different models for construction. Peter contributed both his vast knowledge and considerable insights to help us launch this new costing effort.

We are very fortunate that we have been able to convince Gerry Dugan to take over the US costing responsibility for TDR costing. He has a long history with the ILC and in doing costing, so the task is in very good hands. Nevertheless, we will badly miss Peter's vast knowledge and history and his understanding of the importance and keeping costs under control. Peter has a unique style. He truly leads by example through his great energy, dedication and hard work. Interacting with him is always interesting, because he is never shy to question others and he always 'calls a spade a spade.' We will miss Peter as part of our team, but wish him the best for the future. I am confident he will be a great asset to Fermilab in his new role as head of the Office of Program and Project Support.

Good luck, Peter!

[COST ESTIMATE](#) | [EXECUTIVE COMMITTEE](#) | [GDE](#) | [RDR](#) | [TDR](#) | [VALUE MANAGEMENT](#)

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*Peter Garbincius in discussion with Gerry Dugan during
Baseline Assessment Workshop at SLAC*