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26 JULY 2012

RESEARCH DIRECTOR'S REPORT

In front of the door to a new world

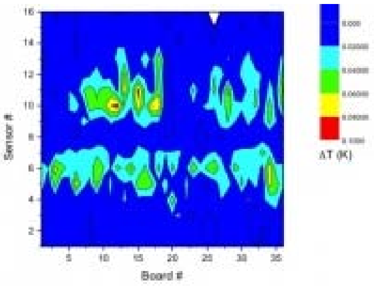
by Sakue Yamada

The discovery of the Higgs-like particle at the LHC is exciting news for the whole community. The physics-and-detetor Detailed Baseline Design report, along with a sound physics case that allows studies of and beyond the Standard Model, is on the to-do list and must be finished when more definite news about the particle come out.

AROUND THE WORLD

From Fermilab Today: Fermilab’s new cavity temperature mapping system commissioned

by Leah Hesla



Fermilab scientists have a new diagnostic tool that could lead to far more efficient accelerator cavities. The temperature mapping system, fitted with 576 sensors, reads the temperature of every square centimetre of cavity surface and might thus help scientists get to the bottom of the problem of why superconducting cavities dissipate much more energy than theory predicts.

DIRECTOR'S CORNER

Quantity, quality and keeping the resources

Today's issue features a Director's Corner from Kaoru Yokoya, Global Design Effort Asian Regional Director.

by Kaoru Yokoya

With the news of the Higgs, public interest in particle physics in general and the ILC in particular is at an all-time high. Kaoru Yokoya, Asian Regional Director, says that now is the time to foster this interest and find the next generation of particle physicists in Japan.

IN THE NEWS

from ***China Daily***
25 July 2012
The ‘fashion front’ of high energy physics
But the role of LHC is likely to be challenged soon. Some 2,000 accelerator and particle physicists, engineers, theorists, technicians, students, software experts and others, from all corners of the world, are working on the design and technologies for the next-generation particle accelerator International Linear Collider.

from ***Kahoku Shinpo***
19 July 2012
誘致、復興の象徴に 盛岡で推進協講演会
国際プロジェクトで建設する超大型加速器「国際リニアコライダー 」の岩手県南部、北上山地への誘致を目指し、県内の経済団体などでつくる推進協議会は 日、盛岡市で講演会を開いた。(Aiming for the bid of ILC to Kitakami hill, the promotion association consisting of industrial bodies in Iwate prefecture hosted the lecture in Morioka city.)

from ***The Economist***
19 July 2012
Life after the Higgs
If you could design a dream machine to succeed the LHC, what would it be?
The natural next step is to build what is known as a linear collider, as opposed to a circular one like the LHC.

from ***Saga Shimbun***
17 July 2012
ヒッグス粒子存在で講演 県内誘致へ期待膨らむ
宇宙誕生を読み解く鍵とされる「ヒッグス粒子」と、県が誘致を目指す 国際リニアコライダー をテーマにした講演会が 日、武雄市であった。(The lecture on the ILC and Higgs particle was held in Kakeo city, Saga prefecture. Saga is interested in inviting the ILC to the area.)

from ***SankeiBiz***
13 July 2012
「ヒッグス粒子」で注目の加速器、日本誘致で地方活性化 創成会議提言
民間企業の労使や学識者で構成する政策発信組織の「日本創成会議」 座長・増田寛也元総務相 は 日、「ヒッグス粒子」研究で注目されたジュネーブ郊外の大型加速器の後継器を国内に誘致すべきだとの提言を発表した。(Japan Policy Council, founded by business and labor leaders and scholars, aims to create a grand design, issued the recommendation to invite next generation accelerator to Japan)

CALENDAR

UPCOMING EVENTS

SiD Workshop
SLAC
21- 23 August 2012

6th International Workshop on Semiconductor Pixel Detectors for Particles and Imaging (PIXEL2012)
Inawashiro, Japan
03- 07 September 2012

POSIPOL 2012
DESY, Zeuthen
04- 06 September 2012

XXVI International Linear Accelerator Conference (LINAC 12)

Tel-Aviv, Israel
09- 14 September 2012

CERN Council Open Symposium on European Strategy for Particle Physics
Crakow, Poland
10- 13 September 2012

12th International Workshop on Accelerator Alignment (IWAA 2012)
Fermilab
10- 14 September 2012

View complete calendar

PREPRINTS

ARXIV PREPRINTS

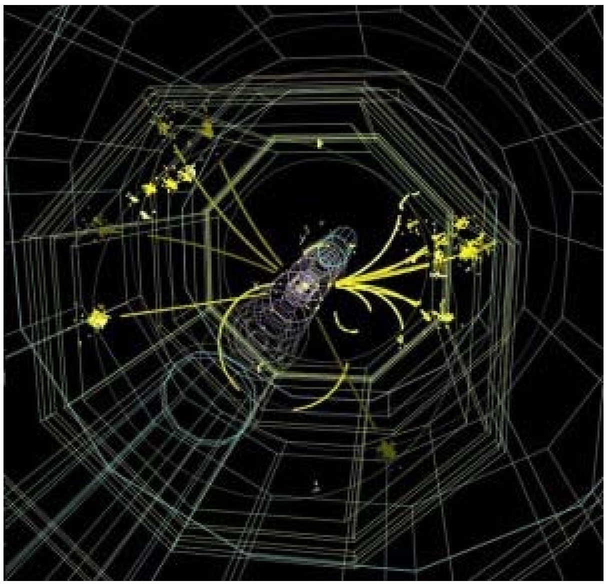
1207.4994
Assessing Risk in Costing High-energy Accelerators: from Existing Projects to the Future Linear Collider

1207.4758
Submicron multi-bunch BPM for CLIC

RESEARCH DIRECTOR'S REPORT

In front of the door to a new world

Sakue Yamada | 26 July 2012



Fully simulated and reconstructed Higgs event in the ILD detector. Image: DESY, Frank Gaede

Since the big news of the discovery of Higgs-like particle at LHC, we have been talking about it with enthusiasm a lot and at various occasions. I'm sure every particle physicist has been asked questions from families, friends or neighbours what the discovery means. The news stimulated big excitement about the Higgs particle in the media as the many TV programmes and press articles indicate. It is wonderful that people know what particle physicists are questing for and how we do it. The excitement should be shared with many people who supported this success through paying their taxes.

The discovery gave us, the ILC physics and detector community, solid ground to plan for the next actions both in the short term and longer term. The immediate one is that we must keep our schedule to complete the *Detailed Baseline Design* (DBD) report. This is straightforward as well as important. The report is a summary of our R&D studies during the Letter-of-Intent (LOI) period since 2007. The report will become a key document together with the accelerator's *Technical Design Report* to propose the ILC. It is crucial that our DBD is completed at the same time as the properties of the new Higgs(-like) particle are better determined. When the HEP community considers the longer-term programme based on the discovery, our documents can be good materials to take into account. During the last meeting of International Linear Collider Steering Committee, the chair, Jon Bagger, was very clear that we must complete it as scheduled.

We are proceeding to keep this target. Already early this year several milestone dates were agreed with the detector groups on how to complete the detector and simulation volume. The first milestone was that the outlines of the content were monitored by International Detector Advisory Group (IDAG) last April. The groups are working hard now to complete their drafts by 21 September. A complete set of the draft will be reviewed by IDAG in October during the LCWS12 in Arlington, USA. The other volume of the DBD, the physics volume of the detailed physics case for the ILC, is about to be completed now so that it can be referred to in the European strategy discussions in September. Following the development of LHC experiments, this volume may be updated through the end of the year.

Knowing the mass of the Higgs-like particle helps us decide where to set the ILC energy to study the new world. The discovery excites us not only because it may fill the last hole of the particle chart of the Standard Model but because of this possibility. The Higgs particle is totally different from other members and opens the door to the next development. The mass tells where the door is. The Standard Model of particle physics describes almost all of the existing observations comprehensively. If the last hole is filled, the Model would be complete. This would be a great accomplishment. However, we also know that the Standard Model is not perfect because there are a few but very important questions it can't answer. For instance, there is no room for dark matter, which dominates the universe over the known matter that makes up stars, planets and galaxies. The mass spectrum of the elementary particles can't be explained either. It can be interpreted as the coupling to the Higgs particle but without further explanation on the observed structure provided. Therefore, theorists are proposing various ideas for beyond the Standard Model to solve remaining questions and to understand Nature deeper. The precise investigation of the Higgs-like particle is a promising approach to find the correct idea. Experiments at the ILC are designed to pursue such investigations. While they begin with the identification of the new particle to tell whether it is really the Higgs particle of the Standard Model, they mark the beginning of richer programmes possibly by observing some deviations or even other new particles expected in the ideas beyond the Standard Model.

High precision measurements can give a clue for the higher-energy phenomenon with the help of theoretical considerations. A good example is the prediction of the Higgs particle mass. From the precise data of the W and Z bosons and the top quark, accumulated with the previous colliders, the most likely mass of the Standard-Model Higgs particle was estimated to be around 120 GeV. This number was used in many simulations of our R&D studies. Now the observed mass of the candidate shows that the estimation is right. This demonstrates the capability of the theoretical analyses. Similarly, the precise measurements of the Higgs particle itself will enable us to survey the higher energy world and to find which model to take.

The ILC is the best facility for these studies and we have been preparing to demonstrate it. Now we know that we are standing in front of the door to a new world and this is why we are so excited.

DBD | HIGGS | PRECISION MEASUREMENTS | STANDARD MODEL

Fermilab Today

Feature

Fermilab's new cavity temperature mapping system commissioned

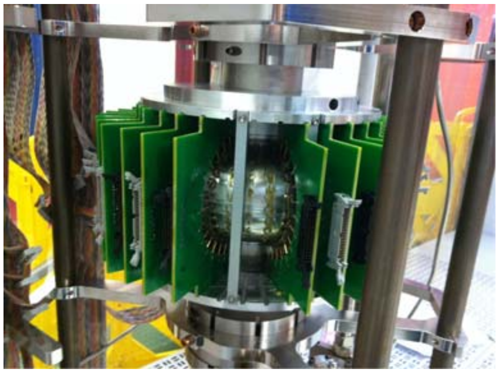


Image caption: Temperature-mapping sensors are placed around a single-cell niobium cavity to spots where energy is dissipated. *Photo: Alexander Romanenko*

Fermilab scientists have a new diagnostic tool that could lead to far more efficient accelerator cavities.

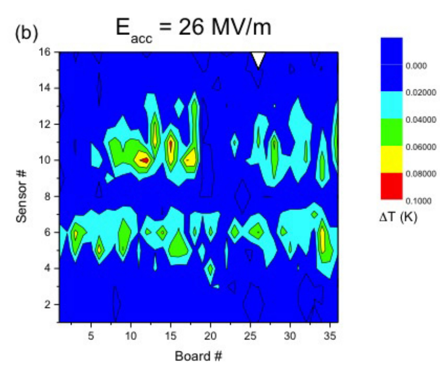
A team in the laboratory's Technical Division, led by scientist Alexander Romanenko, recently completed and commissioned a custom-made temperature-mapping system to be used on superconducting cavities. With the new tool, one of only three such in the world, scientists may be able to get to the bottom of the problem of why superconducting cavities dissipate much more energy than theory predicts.

It's a problem that researchers have addressed largely using trial-and-error methods. But by measuring the varying temperature over the surface of the cavity, the new system can pinpoint hot spots in the cavity wall, culprit sites that cause anomalous energy dissipation. Understanding how and why the dissipation happens provides an invaluable insight into the governing physics, which is still not understood.

"Before, we couldn't do the same level, or even a comparable level, of fundamental research on cavities as places such as Cornell or Jefferson Lab because, without a system like this, the cavity's basically a black box," Romanenko said.

"You'd see from the data that there was energy loss, but you wouldn't know where," said TD scientist Anna Grassellino. "Now we can detect the heating patterns in the cavity walls and use them to identify the different loss mechanisms."

The system comprises 576 sensors placed closely together all around a 1.3-gigahertz cavity cell. Each sensor takes the temperature reading for a square centimeter of cavity wall. An exceptionally high reading points to the site of energy dissipation. Scientists can then remove the lossy piece of cavity wall and try to learn how that particular area is different from the rest.



Red spots in the temperature readout of a single-cell niobium cavity indicate places on the cavity where energy was dissipated. Temperature mapping was developed in the 1970s at Cornell University, where Romanenko completed his dissertation on a related topic in 2008. Last year he and his team learned how to build their own system from researchers at Jefferson Lab. They spent one year custom-building each sensor, finally commissioning the system last April.

The project is part of an effort to raise superconducting cavities' so-called quality factor, or Q. The higher the Q, the less energy the cavity loses, the less power it needs to propel particles.

Tests show that the quality factor increases or decreases depending on the cavity's electromagnetic field strengths, though in principle it shouldn't. Researchers don't fully understand the reason for the sloping Q, or more importantly, how they can prevent Q from sloping downward, leading to energy loss.

Some methods for processing cavities seem to have increased their Q, but again, the reasons they worked are poorly understood.

"We often 'accidentally' find a cure for something, but we still don't fully understand why it works" Grassellino said.

With temperature mapping, scientists are now armed with a way to target the problem and push for higher performances.

Superconducting radio-frequency cavities are the technology of choice for the proposed International Linear Collider and

Fermilab's Project X.

Romanenko credits the work of Rob Schuessler, Roman Pilipenko, TD, and former TD researcher Joe Ozelis, now at Michigan State University, for the project's success.

"In using this tool on one single test of the cavity, you can extract more information from it than you would from testing tens of cavities without it," Romanenko said.

—*Leah Hesla*

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DIRECTOR'S CORNER

Quantity, quality and keeping the resources

Today's issue features a Director's Corner from Kaoru Yokoya, Global Design Effort Asian Regional Director.

Kaoru Yokoya | 26 July 2012

Yokoya on KEK caravan, giving an ILC lecture for elementary school students in Saga prefecture. Image: Tashiro Elementary School

Recently, public interest in the International Linear Collider in Japan has rocketed sky high, almost as if it keeps in step with the activity of the Global Design Effort: we are in the final stage of completing the Technical Design Report.

One might have noticed that the amount of ILC-related media coverage is increasing in an exponential fashion since 2010, especially after the positive remark made by the Prime Minister Yoshihiko Noda at the ILC symposium hosted by the Advance Accelerator Association promoting Science and Technology (AAA) last December, which is still fresh in our minds. Right after the symposium, some members of GDE executive committee visited candidate sites in Japan. It was also publicised in the media in a big way.

The public interest is not limited to the ILC. The news from CERN on 4 July about the discovery of the Higgs-like boson made extensive headlines in Japanese media every day. Several days ago, I had the chance to meet some old friends at a high-school reunion. There, I faced a barrage of questions from them. It seems like everyone wants to know about particle physics now. These are certainly extraordinary reactions towards basic science activities, and I would say that it is a little overenthusiastic. But this did not happen overnight. These developments are the fruit of longstanding activities to reach out to every stakeholder in political, governmental, and industrial communities. I would say that in this regard, we are one step ahead of other regions in the world.

Nevertheless, this is just “one step.” There is still much that needs to be done. The most important thing is to receive the understanding and support of the people.

Japanese history in modern science is short. With over 400 years of history, science has continuously been upheld by European scientists since the time of Copernicus and Galileo. In contrast, Japan bears merely 150 years of history in the field, and for only half of it, Japanese scientists have been able to contribute to the scientific advancement.

European science had a deep influence on the way Japanese people view things, and fundamentally changed the way we live. Science is regarded as beneficial, however the true value of scientific knowledge has not been digested by Japanese people, and science remained to be an “imported idea”. Even though the Higgs particle or dark matter are attracting lots of attention, the value of having knowledge of particle physics gets ignored. Also, there is an undeniable sense that the nuclear accident at Fukushima last year had a significant negative impact on the perception of science in general.

To overcome these situations, we must continuously make an effort to gain as much understanding and support of our activities as possible. Targeting university students and officials is working very well, for example through organising periodic workshops at the university. We are now in our second run for this activity.

Two years ago, KEK kicked off an outreach project called “KEK caravan” following the proposal of Atsuto Suzuki, the director general of KEK. Scientists and other staff of KEK are being dispatched to different places in Japan by request from many different bodies, such as schools, local governments or senior study groups. The topics vary from general physics studies, radiation, to, of course, the ILC. The total numbers of the lectures have exceeded 100 already, and I believe that this activity will help changing the idea of science in Japanese minds.

We are responsible for another thing: fostering of human resources. We are not quite sure yet, but we estimate that the ILC host country will cover the half of the construction cost. So, how about the share of human resources? We have not discussed it yet. If the ILC would be realised in Japan, unprecedented numbers of scientists and engineers will be needed. It’s not only the quantity, but we will also need the human resources with qualities who can lead the project. Fostering the necessary human resources for both construction and operation of the ILC is our prime task.

Still, Japan now seems to enjoy an atmosphere of going for the ILC. We need to keep working hard not to lose this momentum.

JAPAN | KEK | OUTREACH