ilc newsline

19 JANUARY 2012

RESEARCH DIRECTOR'S REPORT

Design report in the making: drafting the DBD

by Sakue Yamada

The year 2012 will be very busy and exciting. The main task for the ILC physics and detector community is to complete Detailed Baseline Design report summarising our effort since 2007. To achieve this goal, coordination between the detector groups and with the Global Design Effort is essential, and we are fulfilling this mission.

FEATURE

From Fermilab Today: Origins of mass: It's not what you think

If you have even the faintest interest in particle physics, you've heard about the Higgs boson. The Higgs boson is the leading candidate explanation for the origin of the masses of point-like subatomic particles. By extension, the Higgs boson is the origin of mass in the universe, right? There's only one problem with that statement—it's totally wrong.

Read the full article in *Fermilab Today*.

View videos about the Higgs boson from the author, Don Lincoln:

What is the Higgs Boson? | Higgs Boson: How do you search for it? (and latest news)

DIRECTOR'S CORNER

Linear Collider Accelerator School

by Barry Barish

The Sixth International Accelerator School for Linear Colliders was held from 6 to 17 November at the Asilomar Conference Center in Pacific Grove, California, US. The Global Design Effort has co-sponsored this successful school from inception and we are proud of the fact that many graduates have gone on to careers in accelerator science, including at the ILC.

IMAGE OF THE WEEK

Mapping the ILC

Image: ILC
Map implementation: Jeffrey Clark (GDE)

The ‘international’ in ‘International Linear Collider’ isn’t just a part of a name. The ILC is demonstrably global, involving thousands of scientists from the Americas, Asia and Europe in accelerator activity, detector research and physics pursuits. The map is a picture of ILC activity around the world.

Visit the map webpage and click around.

And if you notice any inaccuracies or see that an institution is missing, please don’t hesitate to notify us. We can make corrections.

Enjoy exploring the world of the ILC!

IN THE NEWS

from ***NHK News***
18 January 2012
“宇宙の解明”施設候補地視察
GDE director visits ILC candidate site in Northern Japan. (in Japanese)

from ***Southeast European Times***
17 January 2012
CERN, a new chance for Serbian science
Serbia’s scientific community received a boost this month as the country became an associate member of the European Organization for Nuclear Research (CERN).

from ***DESY***
13 January 2012
The world’s smallest magnetic data storage unit
For the first time, the researchers have managed to employ a special form of magnetism for data storage purposes, called antiferromagnetism. Different from ferromagnetism, which is used in conventional hard drives, the spins of neighbouring atoms within antiferromagnetic material are oppositely aligned, rendering the material magnetically neutral on a bulk level. This means that antiferromagnetic atom rows can be spaced much more closely without magnetically interfering with each other. Thus, the scientist managed to pack bits only one nanometre apart.

from ***CNRS/IN2P3***
12 January 2012
GUINEVERE : towards cleaner nuclear energy
GUINEVERE is a reactor entirely composed of nuclear fuel, lead and a particle accelerator that controls the reactor. It is a demonstration model of an ADS (Accelerator Driven System).

from ***BBC News***
6 January 2012
Cash grants allow real experiments in school science
Another grant will go to Trinity Catholic School in Nottingham, where pupils will build their own atom smasher. They will construct a model linear particle accelerator and investigate particle collisions similar to those under way at the Large Hadron Collider at Cern in Switzerland.

CALENDAR

UPCOMING EVENTS

ILC ML & SCRF Baseline Technical Review
KEK, Tsukuba, Japan
19- 20 January 2012

3rd LC FORUM meeting
DESY, Hamburg
07- 09 February 2012

UPCOMING SCHOOLS

Physics and Technology of Particle Accelerators (JUAS 2012)
Geneva, Switzerland
09 January- 16 March 2012

USPAS sponsored by the University of Texas at Austin
Austin, Texas
16- 27 January 2012

Excellence in Detectors and Instrumentation Technologies (EDIT 2012)
Fermilab, Batavia, IL, USA
13- 24 February 2012

View complete calendar

PREPRINTS

ILC REPORT

2012-035
Report of the seventh meeting of the ILC Project Advisory Committee (PAC)

ARXIV PREPRINTS

1201.3472
Recent advances in Ti and Nb explosion welding with stainless steel for 2K operating (ILC Program)- To the proceedings of LCWS11

1201.2643
Recent progress for Linear Collider SM/BSM Higgs/Electroweak Symmetry Breaking Calculations

1201.2092
Physics performances for Scalar Electrons, Scalar Muons and Scalar Neutrinos searches at CLIC

RESEARCH DIRECTOR'S REPORT

Design report in the making: drafting the DBD

Sakue Yamada | 19 January 2012

Year 2012 will be a busy and exciting year for particle physics, especially for the International Linear Collider, under the sign of the dragon. Image: Bibliothèque des Arts décoratifs, Paris

The year 2012 will be very busy and exciting. The main task for the ILC physics and detector community is to complete Detailed Baseline Design (DBD) report summarising our effort since 2007. It will consist of two volumes: the physics volume and the detector and simulation volume. The recent news from CERN's Large Hadron Collider (LHC) is extremely interesting. The clarification of the long-standing question about the Standard Model Higgs particle will create much excitement. The LHC experiments' smooth progress over the last year suggests that the answer to the Higgs question could be answered by the time we finish the DBD. This development is being followed by the physics group in detail and will be reflected in the physics volume, as was reported by Michael Peskin last November.

For the detector and simulation volume of the DBD, some preparatory steps were made before the change of the year. First, the one-teraelectronvolt beam parameters for benchmark simulation were stamped by the Global Design Effort (GDE). The straw man baseline 2009 (SB2009) working group has kept up discussions with the accelerator experts since LCWS11 in Granada. The new collision scheme, which was introduced and agreed to tentatively in Granada, was replaced with another idea, the shifted-waist technology, which is less challenging technically and produces similar luminosity. We decided to use this latest set of parameters for simulation. By now the software group has finished the first preprocesses with it and is ready for the mass production of simulated events. The two detector groups will be able to start simulations soon.

Second, we formed a subgroup to coordinate the format of the detector and simulation volume of the DBD. Since the two detector groups will write their own detector and simulation sections, it is desirable that they follow a common format. Further, since the DBD will be combined with the GDE's *Technical Design Report* for the accelerator, certain coordination with the TDR is also desirable. The subgroup consists of two members from each detector group, T. Behnke and Y. Sugimoto (ILD), P. Burrows and M. Stanitzki (SiD) and the four members from the management, J. Brau, J. Fuster, H. Yamamoto and myself. Phil Burrows is also a member of the TDR editorial group and will serve as a link between TDR and DBD format consideration.

This subgroup met last year to discuss basic questions of the format. They agreed on many key points, particularly those that are needed to be fixed rather soon so that the detector groups can start shaping their sections.

1. The detector and simulation volume of the DBD will have three sections, an introductory section and two group sections. The introduction will cover topics common to both detectors and will be about 50 pages long. Each detector part can concentrate on its own specific items and will be up to 150 pages long for the main text.
2. First-round ideas on the content and on topic selections for the introduction were exchanged. The subgroup worked also as an editor group and will continue to work that way.
3. The content of the detector and simulation sections can be designed by each group. It is natural that they will cover relevant topics included in the Letter of Intent documents. There are differences in their concepts and where emphases are placed may differ accordingly. Such contrast will be welcome since it enhances the strength of the physics capability of the project as a whole. The outline of each section will be submitted to the International Detector Advisory Group (IDAG) in March to be checked during the next IDAG meeting in April.

I wish the details of the subgroup discussions to be shared in each detector group. Although each group has the freedom to organise its part, it is desirable that each section takes a coherent format for a better understanding and comparison for the readers. We learned a lesson through editing the interim report: it is time-consuming to achieve coherence later. Our plan is to make the minutes of the subgroup meetings accessible in our webpages, too. In the meantime there will be further coordination with the TDR editorial board, and tools for drafting, like templates, will also be fixed soon. We will do our best to arrange all the necessary frameworks for the detector groups as soon as possible so that they can start drafting the DBD sections.

DETAILED BASELINE DESIGN | IDAG | ILD | LHC | SID | TECHNICAL DESIGN REPORT

Fermilab Today

Friday, Jan. 13, 2012

Physics in a Nutshell

Origins of mass: It's not what you think

The origin of mass in the universe has been worked out. Luckily it's not just the much-maligned donut.

If you have even the faintest interest in particle physics, you've heard about the Higgs boson. The Higgs boson is the leading candidate explanation for the origin of the masses of point-like subatomic particles. By extension, the Higgs boson is the origin of mass in the universe, right? There's only one problem with that statement--it's totally wrong.

To clarify, I'm now talking only about ordinary matter. Ordinary matter is the kind that makes up everything familiar to you: you, your mom, the Earth, the stars that seem to twinkle so gently in the clear night sky, but are actually raging thermonuclear furnaces… everything. I'm explicitly not talking about dark matter, which is necessary to explain some astronomical mysteries, but it is totally irrelevant in your day-to-day life.

Ordinary matter is made of atoms. Atoms are made of protons, neutrons and electrons. The protons and neutrons sit in a nucleus, which resides in the center of atoms. Electrons swirl around the nucleus, on the periphery, like a little solar system. Protons and neutrons have about the same mass, so we won't distinguish between them. We'll refer to them by the generic term nucleon, as they are found in the nucleus of the atom. So, if matter is made of atoms, where is the mass located in atoms?

The electrons are extremely light. One nucleon weighs as much as 2,000 electrons. For all practical purposes, the mass of atoms is located in the nucleons.

It is commonly said that nucleons are made of three quarks, which is true to a point. It is logical to think that each quark has one third the mass of the nucleon, but that's not actually true. The mass of the three quarks in the nucleons make up only about one to two percent of the mass of the nucleons. What makes up the other 98 percent?

This is where things get cool. First, you need to know that a nucleon is not a static object with three ingredients. A nucleon consists of three very light quarks held together by the strong nuclear force. Those three quarks are moving at high velocities inside the nucleon. To picture this, imagine three ping pong balls in a lottery machine. Those ping pong balls aren't the most important thing; rather, you should focus on what's forcing them into motion. Think of nucleons as three quark flecks, tossed furiously inside a little subatomic tornado. The tornado is far more important than the tiny flecks.

This is related to mass through Einstein's familiar equation, $E = mc^2$. This equation says that mass and energy are one and the same. From what we know about the mass of nucleons, we see that approximately 98 percent of the mass of the universe isn't mass in the usual way we think about it. Rather, the mass is stored in the energy of tiny subatomic energy dust devils.

How does the Higgs boson fit into all this? While the mass of the nucleons (and, by extension, most of the visible universe) is caused by the energy stored up in the force field of the strong nuclear force, the mass of the quarks themselves comes from a different source. The mass of the quarks and the leptons is thought to be caused by the Higgs boson. It's important to remember that "is thought to be caused" merely means that this is the most popular theoretical proposal. In fact, we don't really know why the quarks and leptons have the masses that they do. That's why the search for the Higgs boson is so interesting. Trying to solve a mystery is always great fun.

However, no matter how interesting the question of the Higgs boson, it's not the dominant source of mass in the universe. Well-understood physics, governed by strong nuclear force is why you have the mass you do.

Well, that and donuts, of course.

Want a phrase defined? Have a question? Email [Fermilab Today](#).

—Don Lincoln

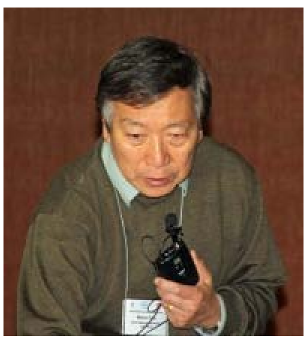
DIRECTOR'S CORNER

Linear Collider Accelerator School

Barry Barish | 19 January 2012

Students in the lecture hall at Asilomar Conference Center in Pacific Grove, California, US. Image: ILC

The Sixth International Accelerator School for Linear Colliders was held from 6 to 17 November last year at the Asilomar Conference Center in Pacific Grove, California, US. This highly selective and successful school series began in 2006 in Japan and has rotated between America, Europe and Asia in subsequent years. The school has an in-depth approach, concentrating on topical areas at the forefront of the field in developing future-generation linear colliders, especially those involved for the ILC. A significant number of students have gone on to work in the field.



Weiren Chou, Fermilab. Image: ILC

In 2006, Weiren Chou of Fermilab approached me with the idea of organising an advanced accelerator school based on linear collider accelerator science. He argued that most universities do not have a PhD programme in accelerator physics, so that when accelerator physicists make a career switch, they usually receive in-field mentoring at a large accelerator laboratory. Although there are already other very good accelerator schools that provide additional academic instruction, Weiren suggested that our school should be rigourous and focus on real leading-edge issues for a linear collider, especially the ILC, and be taught by the experts dealing with those problems.

I bought into this idea, not without some selfish hope that this would help facilitate bringing new very good young physicists into the challenging problems we face in developing a linear collider that can achieve our challenging and ambitious goals. The rest is history.

Vinod Bharadwaj (SLAC), chair of the local organising committee. Image: ILC

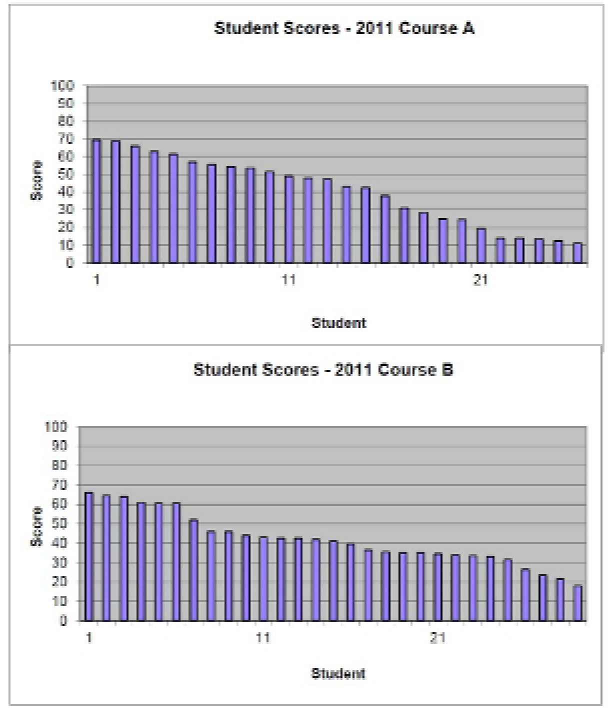
The school has been very popular, bringing in hundreds of qualified applicants each year for our limited capacity of 60 to 70 students, enabling us to be highly selective. We have evolved the school over the six years to include related topics, such as the Compact Linear Collider Study (CLIC) and a muon collider, while at the same time keeping our in-depth philosophy by dividing the curriculum into two tracks.

Weiren Chou and Alex Chao (SLAC) have, along with the local organisers and very capable administrative support from Fermilab, worked together as a team to oversee and organise the school. This year the local organisers were Vinod Bharadwaj (SLAC, chair), Naomi Nagahashi (SLAC, administration) and Nick Arias (SLAC), who provided technical support. The facilities at Asilomar are excellent, not to mention a beautiful venue.

I was pleased to again give the opening day lectures, kicking off with a general introduction to particle physics and the role of particle accelerators in the morning, followed by an introduction to the International Linear Collider, including the physics motivation and goals and related accelerator and detector concepts. On the second day were excellent introductions to CLIC by Frank Tecker

(CERN) and to muon colliders by Robert Palmer (BNL). The third day, Daniel Schulte (CERN) gave a lecture on linac basics and Herman Schmickler (CERN) on beam instrumentation.

Once students received their three-day survey of future colliders, the school was broken up into two tracks: 1) accelerator physics and 2) radiofrequency technology. Finally, at the conclusion of the eleven-day school, the students took a final examination, which gave them and us a picture of what they had learned in the school. The top students were given awards.



The distribution of final exam scores for both tracks

Our sponsorship of and participation in this series of accelerator schools is something we are proud of and that has lasting value. Accelerators have many applications to society and pushing the forefront of accelerator development is an extremely important byproduct of our efforts in developing the technologies and design of the ILC. Helping talented young scientists recognise the opportunities in this field and facilitating their transition to becoming practicing accelerator scientists makes this accelerator school one of our most important activities. Next year the school location will return to Asia, hosted this time by RRCAT in India. The dates are still to be decided.

CLIC | LINEAR COLLIDER ACCELERATOR SCHOOL | LINEAR COLLIDER SCHOOL | MUON COLLIDER