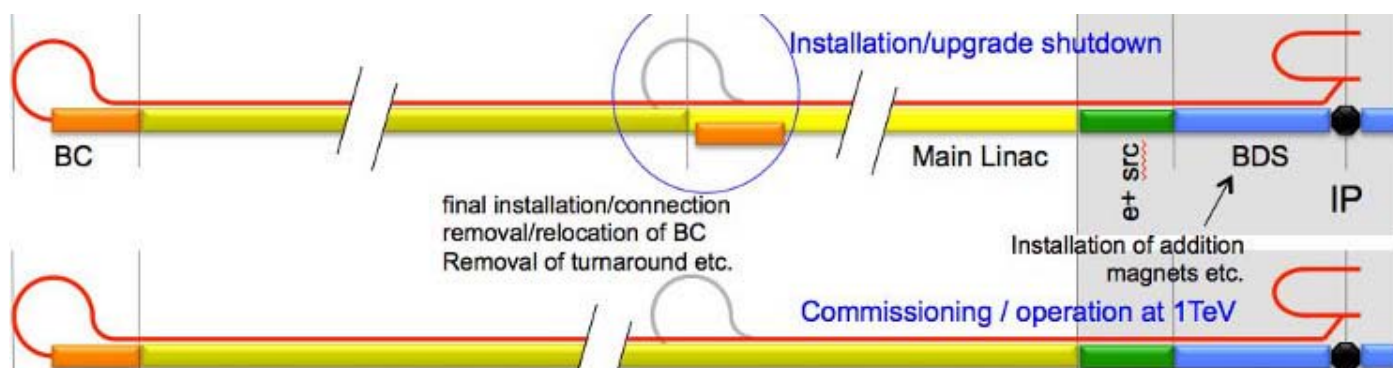


FEATURE

Onward and upward into the terascale

The 1-TeV upgrade challenges scientists develop better beams at lower rates of power

by Leah Hesla



Until the Large Hadron Collider tells scientists where in the energy frontier to dig for new physics, ILC researchers are preparing for eventualities. Should new physics be found to reside in a range higher than the ILC's current reach, scientists have a energy-boosting plan in their back pocket.

RESEARCH DIRECTOR'S REPORT

Progress made during LCWS11 in Granada

by Sakue Yamada



This year's linear collider workshop was a time of fruitful discussion and planning. Key discussions helped shape the near future in the period before the release of the detailed baseline design.

DIRECTOR'S CORNER

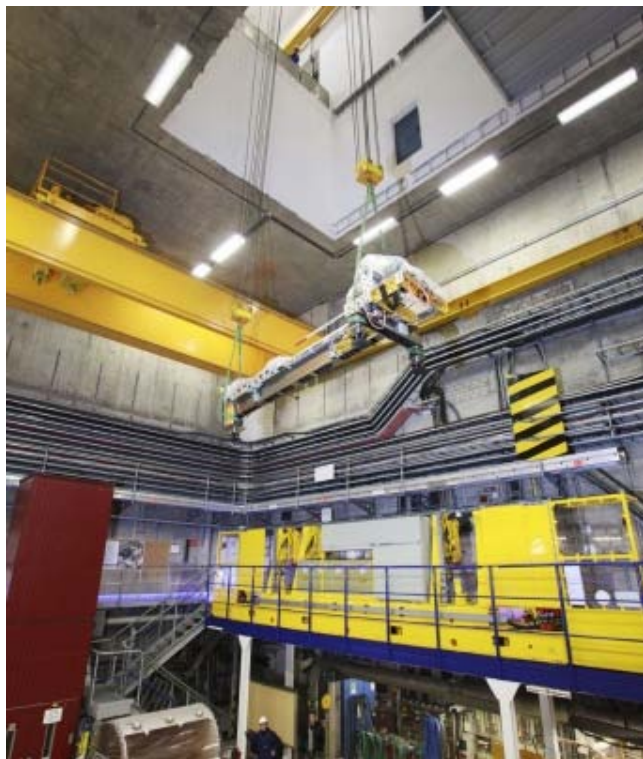
Japan Society for Promotion of Science supports ILC detector R&D

by Barry Barish



The Japan Society for the Promotion of Science has made a new five-year award for ILC detector R&D. A kickoff meeting was held at Tohoku University in Sendai, Japan in September. The new award will support critical R&D on advanced particle detector techniques that are both central to ILC needs and have broader implications for science, technology and medicine.

IMAGE OF THE WEEK



A new lodger at HERA

Image: DESY

The optical inspection system OBACHT at DESY moved to a new lab roughly 25 metres below the surface in one of the former experimental halls of the HERA accelerator. Becoming good neighbours - OBACHT and HERA!

IN THE NEWS

from ***New Scientist***

19 October 2011

Neutrino watch: Speed claim baffles CERN theoryfest

a paper on the speeding neutrinos has been accepted for publication and the first preliminary results from a comparable experiment are out.

from ***Hamburger Abendblatt***

18 October 2011

Gesichter der Wissenschaft

In dieser weltweit größten Anlage sollen in Zukunft zwei je 15 Kilometer lange Teilchenkanonen Elektronen und Positronen aufeinanderfeuern und eine große Anzahl neuer, bisher unbekannter Teilchen freisetzen.

from ***Science 2.0***

18 October 2011

ICARUS Refutes Opera's Superluminal Neutrinos

The saga of the superluminal neutrinos took a dramatic turn today, with the publication of a very simple yet definitive study by ICARUS, another neutrino experiment at the Gran Sasso Laboratories, who has looked at the neutrinos shot from CERN since 2010.

from ***Interactions***

18 October 2011

A further step in the design of the LAGUNA large neutrino observatory is launched

The principal goal of LAGUNA (Large Apparatus for Grand Unification and Neutrino Astrophysics) is to assess the feasibility of a new pan-European research infrastructure able to host the next generation, very large volume, deep underground neutrino observatory.

from ***symmetry breaking***

12 October 2011

[Future of deep underground science discussed at congressional roundtable](#)

Oddone and others emphasized that the Long Baseline Neutrino Experiment (LBNE) will edge out a lead for the U.S. in the neutrino field, while taking advantage of the unique opportunity of having the perfect deep underground mine available in South Dakota.

CALENDAR

UPCOMING EVENTS

[50th ICFA Advanced Beam Dynamics Workshop On Energy Recovery Linacs \(ERL 2011\)](#)

KEK, Tsukuba, Japan
16- 21 October 2011

[2011 Low-Level Radio Frequency Workshop \(LLRF 2011\)](#)

DESY, Hamburg, Germany
17- 20 October 2011

[2011 IEEE Nuclear Science Symposium and Medical Imaging Conference](#)

Valencia, Spain
23- 29 October 2011

[ILC Source/RTML/BDS+MDI Technical Baseline Review](#)

DESY, Hamburg, Germany
24- 27 October 2011

UPCOMING SCHOOLS

[Sixth International Accelerator School for Linear Colliders](#)

Pacific Grove, California, USA
06- 17 November 2011

[View complete calendar](#)

PREPRINTS

ARXIV PREPRINTS

[1110.4327](#)

Development of Large Area GEM Chambers

[1110.4326](#)

Application of Large Scale GEM for Digital Hadron Calorimetry

[1110.4151](#)

Signatures of Exotic Hadrons

[1110.3220](#)

Four-jet final state in same-sign lepton colliders and neutrinoless double beta decay mechanisms

FEATURE

Onward and upward into the terascale

The 1-TeV upgrade challenges scientists develop better beams at lower rates of power

Leah Hesla | 20 October 2011

The technical design of the International Linear Collider is nearing completion, and it comes with a stipulation: If the Large Hadron Collider should direct scientists to an energy range beyond what the ILC accommodates, they should refer to its 1-teraelectronvolt contingency plan.

Over the next several months, researchers will complete a [preliminary study of the 1-TeV ILC](#) as an energy-doubling upgrade of the current 500-gigaelectronvolt (GeV) technical design. Having developed the outline for a possible upgrade from day one, researchers are now conceptually defining the elements of a higher-energy machine.

		Straw-man TeV	
		300MW 5% BS	300MW 10% BS
Ecm	GeV	1000	1000
gamma		9.78E+05	9.78E+05
N	e10	2.0	2.0
sigz	mm	0.25	0.15
sigx	nm	553.7	428.9
sigy	nm	2.8	2.1
Dy		18.7	18.7
Ngamma		1.4	1.7
deltaB		5%	11%
HD		1.5	1.5
Ngamma		1.4	1.8
deltaB(%)		5.3	9.8
L		2.8E+34	4.8E+34
L(1%)		62%	50%
Travelling focus			
Ngamma		1.4	1.8
deltaB(%)		5.3	9.8
L		3.4E+34	5.6E+34
L(1%)		61%	49%

Straw man beam parameters for a 1-TeV upgrade

“Our focus has been very strongly on designing the best 500-GeV machine we can,” said Global Design Effort (GDE) Project Manager Nicholas Walker. “At the same time, we do have to do a little more work on the TeV upgrade than we did for it in the *Reference Design Report*,” he said, referring to the 2007 document.

Upgrade parameters are largely based on a cavity gradient goal of 45 megavolts per metre (MV/m) and a power consumption limit of 300 megawatts (MW) for operating the collider. Using these straw man parameters as a foundation, scientists will continue to develop them for the forthcoming ILC *Technical Design Report* (TDR) using LHC results, cost studies and technical reviews as guides.

The toughest challenges lie in developing accelerator technology befitting one teraelectronvolt of linearly directed collision energy.

ILC scientists are focused on developing superconducting accelerator cavities with a 45-MV/m cavity gradient, up almost one-and-a-half times the 31.5 MV/m specification for the 500-GeV accelerator. These higher-gradient cavities would be developed during the ILC’s initial 500-GeV run. If there were an upgrade, they would be added to those already operating in the collider.

“The linac technology is the jewel in the crown of the machine,” Walker said. “It’s the high-tech element and the cost driver. We take the view that we should always use state-of-the-art technology whenever we do anything there.”

Scientists are also chasing higher cavity quality factors to help cut down on power losses as the beam is propelled towards collision.

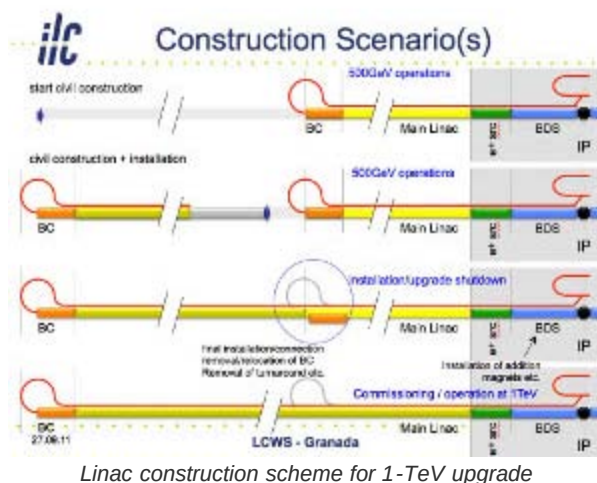
Conserving power, even as the beam energy is hiked up, is a goal unto itself. By setting a power consumption ceiling of 300 MW to for collider operation, ILC scientists compel themselves to find a different way to reach higher luminosities without drawing it from the wall plug.

"We're trying to be greener," Walker said.

The path to a greener machine and luminous beam involves hitting on the right beam structure: reducing bunch repetition rate, taming Beamstrahlung, squeezing the beam size. Scientists are currently deciding on the beam's working parameters based on the straw man limits. The parameters will also be used in simulations for the detector community's detailed baseline design.

While enforcing technological rigour in certain aspects of the 1-TeV design, ILC researchers are necessarily flexible about the future machine's collision energy.

"One has to bear in mind that the LHC results are rewriting the textbooks, so in the backs of our minds is the potential to react to whatever comes out of the LHC," Walker said. Having borne this in mind from the time of the GDE mandate in 2003, ILC scientists pursue the current 1-TeV design in accordance with the original charge of designing an upgradeable machine that begins its life as a 500-GeV collider. Though resources aren't available to do a full-fledged 1-TeV design, parameters are expected to be specific enough that the upgrade from the TDR 500-GeV collider will merit a summarising chapter in the report.



At the same time, the likelihood that the LHC will come out with meaningful results as early as 2012 requires researchers to be even more nimble, ready to build, from the get-go, a machine whose centre-of-mass energy may be lower or higher than 500 GeV. The 1-TeV study, in addition to prescribing a set of upgrade changes, also gives scientists a means to explore the design of a machine engineered for a different energy, one they may tackle in the post-TDR era should the LHC guide them elsewhere.

In contrast, other factors specific to the 1-TeV scheme have long been established, built into the original 500-GeV programme at minor cost. The beam delivery system includes room for the installation of longer bending magnets to take care of the increased beam energy. The current beam dumps can handle up to 18 megawatts of cast-off power – more than enough for a 1-TeV beam – precluding the need to weather a radioactive environment to change them later.

And, of course, doubling the energy would mean adding about 20 kilometres of linac to the present design.

Other technology architecture remains much the same. Damping rings, positron and electron sources and injection won't fundamentally change for the 1-TeV scenario, though provisions are made for improvements.

Most are optimistic that they can design a 1-TeV machine within reasonable environmental, scientific and cost limits.

"It drives a lot of the R&D, keeps everyone excited – the whole technology and everything that goes with it," Walker said. After the final report is delivered, the realisation of a 1-TeV design and the challenges of its attendant hurdles will encourage researchers to maintain their momentum. "The R&D in this technology will not stop."

1 TEV | ENERGY UPGRADE | TDR

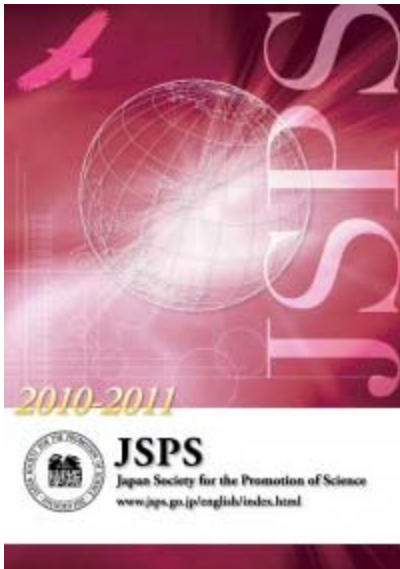
Copyright © 2011 ILC GDE

Printed from <http://newsline.linearcollider.org>

DIRECTOR'S CORNER

Japan Society for Promotion of Science supports ILC detector R&D

Barry Barish | 20 October 2011



The Japan Society for the Promotion of Science. Image: JSPS bulletin

The Japan Society for the Promotion of Science (JSPS) has awarded a new five-year award for ILC detector R&D. A [kickoff meeting for this grant](#) was held at Tohoku University in Sendai, Japan from 12-14 September. The new programme is descriptively entitled “a global R&D program of a state-of-the-art detector system for ILC.” The research will focus on critical R&D on advanced particle detector techniques central to ILC needs, but that also have much broader implications for science, technology and medicine.

JSPS was founded in 1932 as a non-profit foundation through an endowment by Emperor Showa. It became a quasi-government organisation in 1967 under the Ministry of Education, Science, Sports and Culture (Monbusho) and now under the Ministry of Education, Culture, Sports, Science and Technology (MEXT). JSPS promotes Japanese science by initiating and carrying out a wide range of programmes to advance scientific research, including research grants, researcher cultivation and international exchange and cooperation. JSPS promotes Japanese science as an independent administrative institution supported primarily through subsidies from the Japanese government. Its stated main functions are “to foster young researchers; to promote international scientific cooperation; to award grants-in-aid for scientific research; to support scientific cooperation between the academic community and industry; and to collect and distribute information

on scientific research activities.”

ILC detector R&D in Japan has been traditionally supported by grants to individuals without explicit coordination. The JSPS award is for approximately 500 million yen over 5 years (100 yen is roughly equal to \$1.30), including funds for indirect costs and salaries. The new JSPS award has an increase of about 40 percent over the past award and is the first successful funding of a bundled proposal. The ILC detector researchers in Japan also have submitted a second independent proposal of similar size and scope to MEXT.

The list of research efforts that will be supported by the JSPS grant includes the central ILC detector technologies: high-speed, low-power and radiation hard vertex detector; end plates for time projection chamber tracking; silicon pad / scintillator hybrid system for calorimetry; physics studies guided by LHC results; and expansion of the grid computing effort to use in data analysis. The workshop at Tohoku University reviewed advanced detector technologies and basically set out the goals for the new programme.

The JSPS kickoff meeting was held exactly six months after the Great East Japan Earthquake, as it is called in Japan. The recovery is truly impressive. Sendai was badly damaged by the tsunami resulting from the earthquake, including flooding of the Sendai airport. The airport is back open and most services are back to normal.

A highlight of the meeting was a visit by workshop participants to one of the two Japanese sites under consideration for the ILC.



Hitoshi Yamamoto, Tohoku University, introducing the JSPS kickoff workshop

The Tohoku site is in the Kitakami Mountains not far from Sendai, while the other Japanese site is in the Sefuri Mountains in Kyushu. Both sites have strong support from local industry, universities and government. In addition, Iwate prefecture proposed to make the ILC a pillar of the earthquake recovery programme.

The JSPS detector R&D award is very welcome in the ILC community. The results coming from this research will further crucial ILC detector development efforts in very important ways and will have broad impacts on practical uses of particle detection for other science research, industry and medicine. I was happy to participate in the kickoff meeting.

DETECTOR R&D | JAPAN

Copyright © 2011 ILC GDE

Printed from <http://newsline.linearcollider.org>

RESEARCH DIRECTOR'S REPORT

Progress made during LCWS11 in Granada

Sakue Yamada | 20 October 2011



Sakue Yamada gives a talk at LCWS11. Image: Perrine Royole-Degieux

In Granada, Spain from 26-30 September, [LCWS11](#) was held jointly between ILC and CLIC for the second time following the Geneva workshop last year. Regarding ILC physics and detector activity, good progress was made and a number of steps were taken for the completion of the detailed baseline design report (DBD). There were many meetings of different types. I wish to introduce some of them, which required cooperation with the wide community beyond the detector groups.

First, there was much discussion about the possible physics cases based on the updated knowledge of LHC result, which narrowed down the allowed mass band of the Standard Model Higgs boson. Theorists may have become more confident about their global analysis in the frame of the Standard Model, which is consistent with this observation. It was stressed repeatedly in different ways how important the particle

is. For instance, in his concluding talk for the future prospect of high-energy physics, ILC Steering Committee Chair Jon Bagger said: "It is not a quark, not a lepton or a gauge boson. It is a fundamental spin-zero boson that fills the universe, and was last seen in the very early universe." When a Higgs-like candidate is found at the LHC, we have to study it precisely to examine whether it is really the Higgs particle. Its firm confirmation will be a historical event in particle physics, and a linear collider will be an ideal facility for that. If, on the contrary, the Standard Model Higgs is excluded, "it will also be a big discovery", as was emphasised by CERN Director General Rolf Heuer. That will disclose, after many years of experimental effort, the clear deviation from the prediction of the Standard Model. It is an extremely challenging new problem. A whole bunch of theoretical works must be revisited and new ones will be proposed. Also very precise new data will be required to find what can cause the contradiction. It is expected that the LHC will make it clear by end 2012 which case is real.

There was a panel discussion on the first day to discuss such physics prospects, and many views and opinions were exchanged among participants. It was organised by Michael Peskin, the convener of the Physics Common Task Group, who also convenes a group to prepare for the physics volume of the DBD, to present the activity of the group and invite more to join. This was the first open meeting of the group, and the group will continue to study the consequence of the LHC result as it improves.

Second, the International Detector Advisory Group (IDAG) interviewed the two detector groups following their previous meeting several months earlier at the [workshop of Americas Linear Collider Physics Group](#) (ALCPG11) in Eugene, US, to hear their status and planning for the DBD. IDAG acknowledged their more refined planning. Apparently this interview helped the groups examine themselves their schedule and strategy for the DBD.

We wished IDAG to give us further advice on the preparation of the DBD. Since it will meet two more times before the completion of the DBD (during the Asian Committee for Future Accelerators linear collider workshop in Korea next spring and LCWS12 in Arlington, US in October 2012), we set a concrete schedule on how IDAG can monitor progress. Each detector group will provide an outline of its DBD by the end of February 2012 and the first draft of the DBD by September 2012. This plan allows IDAG to study the materials and to meet each group with concrete suggestions.

IDAG also heard a report by Marcel Demarteau, the convener of the detector R&D Common Task Group, about the group's investigation of ILC detector R&D spin-off cases. This attempt was recommended by IDAG last year during its interview, and the group paid much effort for the investigation. A detailed report document, which is nearly finalised, will be made public soon online.

Third, the workshop was timely for the two groups to talk with CLIC colleagues, who completed their Conceptual Design Report recently, about the themes where cooperation can be enhanced. I am informed from both groups that fruitful discussions were made in particular about the collaboration for 1 TeV benchmark simulations.

Last but not least, we concluded together with the accelerator community about which beam parameters are to be used for the benchmark simulations at 1 TeV. The joint plenary session for this purpose was successful. The SB2009 working group, which further worked on this matter, had made necessary studies to prepare for this session. During the session a new idea of the bunch shape was introduced, which will reduce the angular spread of the background. A consensus was reached. We hope event generation will be started soon, after some technical checks, using a parameter set based on this one. By this progress and with the enhanced cooperation with CLIC researchers, the simulation for 1 TeV benchmarks will soon be in full swing.

DBD | LCWS11

Copyright © 2011 ILC GDE

Printed from <http://newsline.linearcollider.org>



Scene of an IDAG interview with detector groups during LCWS11. Image: Sakue Yamada