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DIRECTOR'S CORNER

An ILC Higgs factory – is it enough?

by Nick Walker

GDE Project Manager Nick Walker reports from a focused, positive and lively meeting in Cracow and the impact the discussions can have on the ILC. Would a staged approach - starting at 250 GeV to make the ILC a Higgs factory and ramping up to 500 GeV later - make for a cheaper machine? Where are the potential savings, and how long would it take to build an ILC Higgs factory?

AROUND THE WORLD

Japan's key figures back the ILC

by Rika Takahashi

A week after the CERN's announcement of the discovery of the Higgs-like particle, a group of experts in various field in Japan issued recommendations entitled Creation of Global Cities by hosting the International Linear Collider.

FEATURE

Grassroots master plan includes a Higgs factory

Particle physics community from Europe and beyond discusses future strategy

by Barbara Warmbein

Some 500 particle physicists from Europe and beyond met in Cracow, Poland, in September to kick-start the update of the European Strategy for Particle Physics, an initiative by the CERN Council that sets the European pace for global planning and cooperation on future projects in particle physics around the world. With the recent discovery of the Higgs-like particle at the LHC, a Higgs factory is high up on the wish list.

IMAGE OF THE WEEK

Chancellor Merkel's first cavity

Image: DESY, Marco Urban

Chancellor Angela Merkel visited DESY on 19 September for a hall baptism: the experimental hall of DESY's light source PETRA III is now officially named Max von Laue, after the discoverer of diffraction of X-rays. DESY DG Helmut Dosch presents the German chancellor (who was a physicist before she became a politician) with a miniature accelerator cavity. In her speech, Merkel stressed the importance of fundamental research, freedom of science and the importance to communicate results. Check DESY's press release for more links, the chancellor's full speech (in German) and images.

IN THE NEWS

from ***Vision Systems***
25 September 2012
Vision robot inspects accelerator cavities
The International Linear Collider is a proposed electron-positron collider that will complement the Large Hadron Collider (LHC), a proton-proton collider at the European Center for Nuclear Research (CERN) in Geneva, Switzerland. Inside the collider, superconducting accelerator cavities operating at temperatures near absolute zero provide the particles with an increasing amount of energy until they collide at the centre of the machine.

from ***Livedoor.com/ Wired.jp***
25 September 2012
日本の東北地方が主役に!? ヒッグス粒子発見以降の物理学研究の未来
まったく異なる解決策だが、非常に進んだ計画段階にあるのが、国際リニアコライダー　International Linear Collider　のような電子・陽電子リニア線形衝突型加速器だ。この計画のために以前から物理学者の国際的なコンソーシアムが働いていて、いまのところ予想されるコストは67億ドルだ。(google translation)

from ***SLAC***
24 September 2012
Small X-band Photoinjector Packs Powerful Punch
Accelerator physicists at SLAC have started commissioning the world's most compact photoinjector – a device that spits out electrons when hit by light.

from ***Star-telegram.com***
24 September 2012
Notable and quotable
They study tiny things…

from ***Iwate Nippo***
23 September 2012
来夏までにILC候補地を一本化へ 本県誘致が正念場 (Aim to have sole ILC candidate site in Japan)
本県の北上山地　北上高地　と脊振　せふり　山地　福岡、佐賀両県　が国内候補地となっている大型線形加速器国際リニアコライダー　　について、研究者や候補地域の関係者らは来年夏までに国内候補地を一つに絞る方向だ。(There are two ILC candidate sites in Japan: Kitakami and Sefuri. Scientists and involved parties aims to choose one candidate site by next summer.)

from ***Nikkei Online***
22 September 2012

九大、素粒子物理学の新拠点を10月開設 (Kyusyu University opens new particle physics research center)
新センターには、　　での実験に引き続き参加する部門のほか、　　の九州誘致を進めるため、脊振山地の地質調査や　　を中心とした学術都市計画を検討する部門を設ける。(The new center will have a department to promote the research at CERN's experiment, and a department to study the geological survey at Sefuri mountains, one of the ILC candidate site, and to discuss about urban planning centering the ILC as a core laboratory.)

from ***CERN***
20 September 2012
Professor Agnieszka Zalewska Elected President of CERN Council
Geneva, 20 September 2012. CERN[1] Council today elected Professor Agnieszka Zalewska as its 21st President for a period of one year renewable twice, with a mandate starting on 1 January 2013. Professor Zalewska takes over from Michel Spiro who comes to the conclusion of his three-year term at the end of December.

CALENDAR

UPCOMING EVENTS

2012 International Workshop on Future Linear Colliders (LCWS12)
University of Texas at Arlington, Texas, USA
22- 26 October 2012

Special Linear Collider Event at the 2012 IEEE NSS/MIC
Disney Hotel, Anaheim, California
29- 30 October 2012

2012 IEEE Nuclear Science Symposium and Medical Imaging Conference
Disney Hotel, Anaheim, California
29 October- 03 November 2012

UPCOMING SCHOOLS

The first Asia-Europe-Pacific School of High-Energy Physics (AEPSHEP2012)
Fukuoka, Japan
14- 27 October 2012

CERN Accelerator School: Introduction to Accelerator Physics

University of Granada, Granada, Spain
28 October- 09 November 2012

View complete calendar

ANNOUNCEMENTS

Calling all LCWS12 participants
The international workshop on future linear colliders, LCWS12, is only four weeks away, and many of the hotels' specially arranged conference rates are expiring. Please register for the conference and make your hotel reservations. We now have a draft scientific programme, and Steven Weinberg will give a public lecture titled "The Standard Model, Higgs Boson, Who Cares?" on the night of Wednesday, 24 October. We hope to see many of you in Arlington, Texas, USA, in a few weeks!

Jae and Andy, Co-chairs of the LCWS12 Local Organizing Committee

PREPRINTS

ARXIV PREPRINTS

1209.4569
High Resolution BPM Upgrade for the ATF Damping Ring at KEK

1209.4052
Status and Plans for an SRF Accelerator Test Facility at Fermilab

1209.4039
Performance of Particle Flow Calorimetry at CLIC

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DIRECTOR'S CORNER

An ILC Higgs factory – is it enough?

Nick Walker | 27 September 2012

The ILC can be turned into a Higgs factory - but what are the pros and cons?

The announcement of the discovery at the LHC in July of "that new boson" at approximately 125 GeV has everybody excited (and I'm sure more than a few quite relieved). As a humble accelerator builder I stood in wonder as I observed the world media event that followed. Following my particle physics colleagues to Cracow for the recent European Strategy Preparation Group open symposium, I was also caught up in the excitement of this process; compared to its predecessor five years ago in Orsay, this meeting was focused, positive and lively: the LHC was here! And that new boson does look awfully like the H thing.

The linear collider physics community is at least as invigorated, and possibly more so. This piece of the jigsaw adds real weight to the physics case for the ILC which is an excellent precision tool for pulling apart the intricacies of this new particle, its quantum numbers and its couplings.

Perhaps inevitably then, there is suddenly a lot of attention being paid to the concept of a Higgs Factory. Indeed accelerator physicists the world over seem to be opening that bottom drawer and pulling out designs for just such a machine based on all sorts of concepts: storage rings that fit in the LHC tunnel; storage rings that sit in a very big tunnel; all variants of gamma-gamma colliders; and not forgetting the muon collider.

What does this all mean for the ILC, and in particular for the *Technical Design Report* (TDR) which is close to completion?

The GDE's mandate was to produce a cost-effective and mature design for an electron-positron linear collider in the centre-of-mass energy range from 200 to 500 GeV, with a possible upgrade to 1 TeV. Understandably, the primary focus of the design and costing work has been on the more demanding scope of the initial 500-GeV centre-of-mass machine, for which we believe we have a realistic and defendable design, with a reliable cost estimate and few remaining technical issues. As per the mandate, however, running at low centre-of-mass energies is included in the baseline: at 250 GeV centre-of-mass energy the TDR baseline parameter tables quote a luminosity of approximately 7×10^{33} $cm^{-2}s^{-1}$ (as opposed to 1.8×10^{34} $cm^{-2}s^{-1}$ at 500 GeV). To turn the beam energy down, one simple turns down the voltage in the linacs.

But much of the discussion in the physics community appears to be on a possible 250-GeV machine as a first stage, or indeed as a standalone "Light Higgs Factory". This is a slightly different question to the one the GDE has answered. There is fundamentally no reason why we cannot construct a machine with half the length of linac – the technology is the same, and there is no difference to the other accelerator subsystems such as damping rings. There are certainly "beyond current baseline" concepts that could be considered, such as an increase of the luminosity by a factor of two by increasing the number of bunches per pulse (a scenario already included in the TDR baseline as a possible luminosity upgrade). Or indeed one could revisit the parameter space in the hope of optimising the "Higgs physics". But I expect that these things would be small perturbations to the overall design and cost of the machine. The only real questions are "how much money do you save?" "what's the reduction in construction time?" and —

probably most important – “is it worth just to consider a light Higgs factory?” While I leave the last question to my particle physics colleagues, the GDE can at least make some ball-park estimates on the first two questions, although a thorough design study at this point is beyond our means, and will need to be left to the post-TDR organisation.

Based on some rather simplistic scaling, the cost of a dedicated 250-GeV machine would be ~70% of the cost of the 500-GeV machine. This may seem surprising until you realise that only about 60% of the total baseline cost is actually the linacs; the remaining 40% is for the sources, damping ring, beam delivery system and IR hall. A first look at the construction schedule also shows a relatively modest saving, possibly 12 to 18 months. This is because the main tunnel is constructed in parallel segments, so reducing the length saves little time. In addition, the central region and detector halls, sized for two detectors in a push-pull arrangement, drive the schedule and the detectors themselves need many years for construction.

However, much of the discussion within the GDE is not focused on a limited 250-GeV centre-of-mass machine, but more on this energy as a first stage of the 500-GeV project. The preferred scenario is to construct the tunnels and infrastructure required for the entire 500-GeV baseline machine, but to initially only install half the linacs. This scenario comes in at about 75% of the TDR baseline cost. Increasing the centre-of-mass energy up to the maximum 500 GeV is then relatively straightforward, by simply adding more cryomodules, RF and cryogenics to the tunnel. Such an approach lends itself to a rather more adiabatic upgrade over several years. Furthermore, we can imagine scenarios where after the initial construction cryomodule production would ramp down to a lower rate rather than stopping altogether, thus avoiding the issue of shutting down production lines, only to having to start them up again at a later date.

There are still may details that need to be considered in such a staged approach, and the relative cost figures are likely to change slightly as further technical studies are made. Nonetheless they can be taken as a very good indication of the scope.

Finally, a comment on the final question that I left to my physics colleagues: “is it worth it just to consider a light Higgs factory?” My personal opinion is that it makes little sense to discuss an ILC just as a Higgs factory, since one of the most attractive features of a linear machine is its inherent extendibility in energy, compared to the “dead end” inherent in a storage ring solution. Indeed it was primarily this reason and the associated cost scaling that lead to the suggestion of a linear collider in the first place. Whether we start at 250 GeV or 500 GeV, the same mature technology is available and will work at either energy. We can — and probably should — start at 250 GeV, but there is a strong case all the way up to ~500 GeV. And of course we don’t need to stop there: if it looks like there is interesting physics above 500 GeV, we can just make it longer — at least until the space runs out …

COST | EUROPEAN STRATEGY FOR PARTICLE PHYSICS | HIGGS FACTORY | TECHNICAL DESIGN REPORT

AROUND THE WORLD

Japan's key figures back the ILC

Rika Takahashi | 27 September 2012

A week after the CERN's announcement of the discovery of the Higgs-like particle, Japan Policy Council (JPC) issued recommendations entitled *Creation of Global Cities by hosting the International Linear Collider*. Now the English version is available online.

Hiroya Masuda, the chair of the JPC explains their 2nd recommendations at the press conference

Composed of members who are Japan's foremost leaders in various fields such as policy making, economics, labour or sociology, the JPC aims to formulate a grand design for Japan for the next decade and to develop a strategy towards its realisation. Concerning Japan's loss of social vitality due to the declining birthrate and aging population, JPC issues its recommendations to revitalise the country and to reform it to create a "New Japan." JPC's recommendation, written from the point of view of the general public, will be disseminated to Japan's key personalities to spark the national debate over the proposed issues.

The recommendations consist of the following two articles:

Recommendation 1: Japan should transform a regional city into a global city that attracts talent and investment from around the world; the growth of the nation should be led by local leadership.

Recommendation 2: Build a role model for the creation of a global city by reforming a local city through founding an international organisation for the International Linear Collider (ILC), for which Japan is the most probable host.

"On writing up the recommendations, we took particular note on the anticipation that the ILC site will turn into a city which attracts highly intellectual people from around the world, who are devoted to state-of-the-art research activities. The global city will be created in Japan only if the ILC is realised here. This is a chance of lifetime," said Hiroya Masuda, the chair of the JPC and former Minister of Public Management, Home Affairs, Posts and Telecommunications. "We would like to build the ILC in Japan. That will be a first step to create a global city," Masuda said.

The key word of this recommendation is "Domestic Globalisation." The idea is that Japan should revitalise its provincial cities to revitalise Japan itself, with a global viewpoint. If the ILC were built in Japan, it is most likely constructed in a rural area, where new global city will then emerge. "Japan's central and local governments are now inactive in lack of future strategy. We should take advantage of the opportunity of country's possible bid to host the ILC," Masuda said.

The recommendations are based on numerous lessons learned from previous projects in Japan. One of the examples was Tsukuba Science City, the city where the KEK laboratory and its KEKB accelerator is located. Masuda says that Tsukuba failed to develop from a city into a place where people wished to live during the urban development process. The recommendation states "*the biggest cause is the lack in the resident point of view*." For the ILC city, it states "*It is important to not only to realize international facilities and organizations, but also to design a city that caters to different lifestyles of different countries to allow foreigners to spend their everyday life at ease, which eventually leads to improved quality of life for the local residents*".

Now Tsukuba Science City is gradually becoming the city of increasing population, with infrastructures such as the Tsukuba Express that connects Tsukuba and Akihabara, Tokyo in 45 minutes. The image of a highly educated environment also attracts people as a favourable place to raise their children. But it took almost half a century for Tsukuba to become such a city – this should be avoided for the ILC.

The recommendations received a great response. “I received numerous positive comments from key figures including the top of the economic circle, politicians keen on the science and technology policy, and local governments. They all expressed their backups on the project and many of them said Japan should promote it as one of the national policies,” Masuda said.

Masuda expects that the science community will reinforce their activity by explaining the value of the research to be done at the ILC with lay language. “We were pretty lucky to have CERN’s announcement right before the release of our recommendations,” said Masuda. The level of recognisability of the ILC in Japan is not so high yet. But thanks to the attention given to the discovery of the Higgs-like particle, the significance of the next-generation accelerator following the Large Hadron Collider was easier to explain.

“Still, we need additional effort to gain more public understanding. I expect the world’s scientists to put out the message what and why you want to explore, and how the research at ILC will benefit human beings at large, hopefully in an easy-to-understand way.”

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FEATURE

Grassroots master plan includes a Higgs factory

Particle physics community from Europe and beyond discusses future strategy

Barbara Warmbein | 27 September 2012

When scientists make plans or want to show the results of their work, they write a paper. Nearly 170 such papers recently landed on the desks of the members of the European Strategy Preparatory Group, a part of the European Strategy Group that is charged by the CERN Council to come up with recommendations for a strategy for particle physics in Europe. Every five or six years the strategy process starts anew, in the light of new results or political developments. The first step of the new strategy process was taken in Cracow, Poland, in September, and the CERN Council will take the recommendations to update its Strategy in March 2013.

The first step is always to consult the community, and this is what the recent Cracow meeting was all about. The European particle physics community had submitted project plans and proposals to categories including Accelerator Science and Technology, Physics at the High-Energy Frontier, Physics of Neutrinos or Instrumentation, Computing and General infrastructure. The submissions are available for all to read, and in the meeting in Cracow concise summaries of these papers were presented, followed by long and detailed (as well as very structured) discussions among the almost 500 participants.

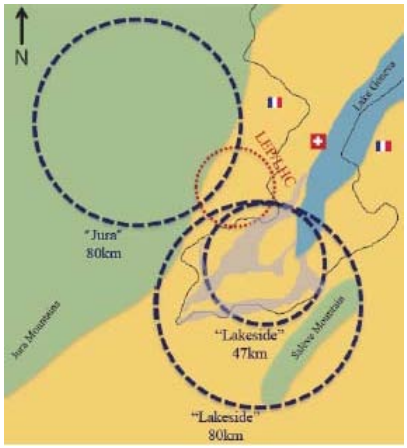
e^+e^- collider summary

	ILC	ILC	ILC	CLIC	CLIC	CLIC	LEP3
√s [GeV]	250	500	1000	500	1500	3000	240
Luminosity [10^{34} $cm^{-1}s^{-1}$]	0.75	1.8	4.9	1.3	3.7	5.9	1 per IP
>0.99 √s fraction	87%	58%	45%	54%	38%	34%	100%
polarization e^-	80%	80%	80%	80%	80%	80%	-
polarization e^+	30%	30%	20%	>50%?	>50%?	>50%?	-
beam size σ_x [nm]	729	474	335	100	60	40	71000
beam size σ_y [nm]	7.7	5.9	2.7	2.6	1.5	1	320
Power [MW]	128	162	300	235	364	589	200

- Both ILC and circular e^+e^- machines offer the option of "GigaZ"
  - Collect 10^9 (ILC) to 10^{11} (LEP3, with 80% $e^\pm$ polarization) Z events in one year at E_{cm} = 91 GeV
  - Improve by an order of magnitude or more on the precision of the LEP/SLC measurements of Z couplings
- Also running at WW threshold to improve m_W

8

A slide from one of the summary talks comparing electron-positron collider features. Slide: Terry Wyatt



Ideas for new proton-proton collider options at CERN.

It's nearly impossible to summarise two and a half days of intense talks and discussions on a multitude of different projects, plans and proposals. What emerged, however, mirrors the recommendations from the last Strategy round that give highest priority to the full exploitation of the science potential of the Large Hadron Collider including its upgrades, complemented by a electron-positron precision tool. Accelerator and detector R&D as well as active participation in the global neutrino programme also featured on the list.

However, a new aspect in the discussions was the discovery of the Higgs-like particle at CERN. This new particle led to strong support for a so-called Higgs factory, meaning an accelerator that can study all possible decay channels of the Higgs at an energy in the region of the Higgs particle. Several options were discussed, including a staged ILC or a new proposal for an electron-positron collider in the LHC tunnel, and even a completely new, 80-kilometre ring tunnel was on the discussion table.

Günther Dissertori from ETH Zurich, who summarised the experimental status at the high-energy frontier, pointed out that “at the LHC, we are only at the beginning of the high-energy frontier exploration” – an estimated 95% or more of the LHC’s physics potential is still in the future. While a number of participants pressed for a Higgs factory today rather than tomorrow, a number of others called for caution in planning a new machine – there might be more precision studies in store from LHC results, so a more versatile machine would be more desirable.

The fact that particle physics is not a regional undertaking was made clear by relatively large number of participants from the US and Asia and the understanding that future large-scale projects will be global from the start. Masanori Yamauchi from KEK, who reported on the physics programme in Asia , presented the plans of the Japanese high-energy physics community to host the ILC. With a staged approach of a Higgs-factory ILC at 250 to be upgraded to 500 GeV and later 1 TeV, data taking could start around 2030, he said. He pointed out, however, that “it is essential that we have strong European support from the beginning”.

The community can still submit updated proposals or further input until 15 October. The next step will be a briefing booklet, based on submissions and discussions, that the Strategy Group will use to put together its recommendation proposal in January next year. This also follow a very clear structure, defined by the mandate: “The proposal shall comprise a series of ordered and concise statements of 1-2 lines each, or 1-2 pages in total followed by more detailed presentations that shall not exceed 25 pages.” The Strategy Group submits its proposal to the CERN Council, which will finalise an updated Strategy in March 2013. This is then scheduled to be adopted in a special session of the CERN Council in Brussels in May or June 2013.

The symposium auditorium was packed and discussions were very structured and constructive.

Further reading:

- The website of the Open Symposium in Cracow
- An overview over future facilites in high-energy frontier and flavour physics by Terry Wyatt from the University of Manchester

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