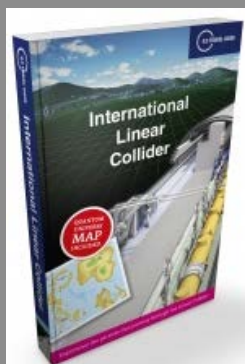


NEWSLINE

THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY



Special issue: The ILC guide to Kitakami

How do foreigners get around in Japan? What are the problems they encounter and what are the experiences that they make? And what can be done to make lives easier for scientists from around the world who come to settle in Japan when (if) the ILC is being built and operated? The European LC communicators inspected the Kitakami ILC site while being filmed by Japanese communicator Rika Takahashi.

AROUND THE WORLD

The road to Kitakami

by Barbara Warmbein



Our mission was clear: we were the tasters, the vanguard. In early February, the two European LC communicators travelled to Japan for three days to a. find our way around the Japanese transport system, b. be filmed doing so, c. find entry points of improvement potential for foreigners about to make the same experience, and d. start a communication model for the future multi-national laboratory. Here is how it all played out.

FEATURE

The Big ILC Kitakami Iwate Tohoku Glossary

by Barbara Warmbein



Are you confused yet? Is Kitakami a mountain or a town, a river or a region? What's "Iwate" and what does it have in common with Sendai? Here's a glossary to help you understand all those new words and look them up before you go.

Oh, and by the way: Kitakami is all of the above and Iwate and Sendai are all in the Tohoku region of Japan...

FEATURE

A day in the life of a particle physicist in Kitakami

by Perrine Royole-Degieux



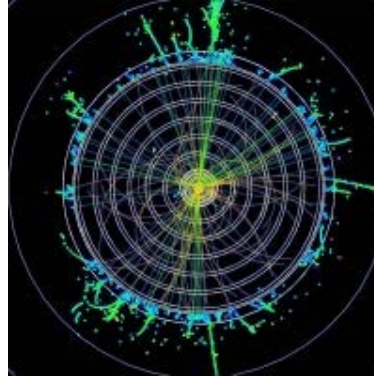
The life of a particle physicist is the same everywhere in the world one might say. It's true that the physicist's work life at the future ILC is easily predictable. Computing and data taking or analysis,

meeting with colleagues, tons of coffee and tea, short lunch breaks at the cafeteria (with "electron" and "positron" menus?), preparing for future meetings in the afternoon, plus, for the lucky ones, night shifts for a detector or machine survey. I'm not going to tell you anything new about what you know already. Let me tell you the other side of the story, regarding your afterwork life at the Kitakami site. Put on your most comfy easy-to-take-off shoes – there is much to visit here - and follow me to the Tohoku region.

DIRECTOR'S CORNER

Future Colliders: A strategic perspective

by Harry Weerts



Over the past decades, colliders have defined the energy frontier in particle physics. Currently there are four studies worldwide: ILC, CLIC, FCC and a muon collider. Each high-energy physicist can argue about which one of these should be pursued and have his/her own preference.

However, considering the strategic aspect and the time scale involved in realising these machines, the ILC is the natural next energy frontier machine. Harry Weerts, Americas Regional Director for the Linear Collider Collaboration, explains why.

SLIDESHOW



Kitakami slideshow

Images: ILC/Barbara Warmbein, ILC/Perrine Royole-Degieux and Oshu City

We're ending this travel diary with a few of the hundreds of pictures we took during this trip to Tohoku. Have a glance, and discover what the region looks like, as if you were there.

IN THE NEWS

from *Futura Science*

14 February 2014

Le Cern envisage la construction d'un LHC de 100 kilomètres

ela explique aussi pourquoi parallèlement à la mise en service du LHC, des études ont été menées pour l'ILC. Un tel accélérateur permet de bien connaître les propriétés physiques du boson de BEH, notamment les couplages de Yukawa. Si l'on découvrirait malgré tout des particules supersymétriques à partir de 2015, avec le redémarrage du LHC, l'ILC pourrait là aussi permettre de mesurer précisément bien des propriétés de ces particules.

from Kahku Shinpo

12 February 2014

関連産業 アドバイザー設置 一関市、地元企業参入促す

岩手県一関市は 日、 年度当初予算案を発表した。「国際リニアコライダー」の建設実現を見据え、関連産業への地元企業の参入促進を図る科学技術アドバイザーの設置事業を盛り込んだ。(Ichinoseki city announced city's budget plan for fiscal year 2014 on 12 February. It includes the new project to staff the science technology advisers to encourage the local industries to enter into the accelerator business, to take advantage of the prospective of the ILC to be build in the area)

from Der Tagesspiegel

11 February 2014

Gigant im Untergrund

Das Vorhaben namens ILC (International Linear Collider), bisher vom Cern unterstützt, bekommt jetzt mächtig Konkurrenz. Denn die FCC-Verfechter haben noch einen Trumpf: Um Entwicklungszeit zu gewinnen, schlagen sie vor, dass der künftige Beschleuniger zunächst für einige Jahre mit Elektronen und Positronen beschickt wird, berichtet der Cern-Physiker Jörg Wenninger. „Das kommt dem Forschungsansatz des ILC schon sehr nahe.“ Es liege auf der Hand, dass nicht zwei Großgeräte gebaut werden, die dann ähnliche Fragen bearbeiten, meint er. Insofern setzt das erweiterte FCC-Konzept das ohnehin schon stockende Unternehmen ILC weiter unter Druck.

from livescience.com

11 February 2014

Future Colliders May Dwarf Today's Largest Atom Smasher

Another suggestion for a next high-energy particle collider is to build a linear machine, provisionally titled the International Linear Collider (ILC). It is not yet clear where it would be housed, but some researchers in Japan have proposed to build it there. Instead of moving particles in a circle, the machine would be a straight accelerator some 19 miles (31 km) long. It would no longer be colliding protons but instead lighter-mass particles — electrons and their antimatter partners called positrons — sent from either end of the tunnel.

from Le Monde

10 February 2014

Discussions sur un nouvel accélérateur de particules géant

Il existe un tel projet au Japon, baptisé International Linear Collider (ILC), et un autre au CERN, le Collisionneur linéaire compact (CLIC), d'une technologie un peu différente. Ne pouvant jouer sur tous les tableaux, l'Europe se verrait bien soutenir l'initiative du Japon si celui-ci, qui voit là une possibilité de relance après l'accident de Fukushima, se décide. Mais pour étudier cette physique inédite dont rêvent les savants, il faudra bien davantage...

from ANA-MPA

8 February 2014

Νέος επιταχυντής από το CERN

Ο σχεδιαζόμενος γιγάντιος FCC έχει όμως να ανταγωνιστεί μια πιο «ώριμη» και φθηνότερη εναλλακτική πρόταση για τη δημιουργία ενός γραμμικού -όχι κυκλικού- επιταχυντή, είτε του Compact Linear Collider (CLIC) μήκους 80 χλμ., είτε του International Linear Collider (ILC) μήκους 31 χλμ. Το μεγάλο δίλημμα είναι αν ο επόμενος μεγάλος επιταχυντής θα είναι κυκλικός ή γραμμικός και, στη συνέχεια, αφού αποφασιστεί αυτό, θα πρέπει να οριστικοποιηθεί το ακριβές σχέδιο του επιταχυντή. Οι δύο μελέτες σκοπιμότητας θα συγκρίνουν κόστη και οφέλη για τον κυκλικό και τον γραμμικό επιταχυντή.

from physicsworld.com

6 February 2014

CERN kicks off plans for LHC successor

One leading design effort is the International Linear Collider (ILC), which would accelerate electrons and positrons to about 250 GeV and smash them together at a rate of five times per second. Funding for the \$8bn, 31 km-long collider has yet to be found, but Japanese particle physicists are already making moves to host this next-generation particle smasher.

from Science

6 February 2014

Mega-Doughnuts: CERN to Study Plan for 100-Kilometer Atom-Smashers

The plan would offer an alternative to the current widely held vision for the global future of particle physics, in which the next great collider would be an arrow-straight linear collider, not a circular one. "We have to make a choice at some point," says Patrick Janot, a physicist at CERN, located near Geneva, Switzerland. "Either we have to go linear or we have to go circular."

from *i-mash.ru*

6 February 2014

[ЦЕРН: один ускоритель мало – надо больше](#)

Одним из “наследников” БАКа станет Международный линейный коллайдер ILC, который планируется построить в Японии. Параллельно с этим проектом обсуждается план создания линейного коллайдера CLIC (Compact Linear Collider).

from *CERN*

6 February 2014

[CERN prepares its long-term future](#)

The FCC will thus run in parallel with another study that has already been under way for a number of years, the Compact Linear Collider, or “CLIC”, another option for a future accelerator at CERN. The aim of the CLIC study is to investigate the potential of a linear collider based on a novel accelerating technology.

from *FNN Local News*

4 February 2014

[ILC広報担当者、北上山地の建設候補地などを視察 \(video\)](#)

ILC(国際リニアコライダー)の広報活動をしているヨーロッパと日本の担当者が、北上山地の建設候補地を視察した。

ANNOUNCEMENTS

The English version of the *Report on the International Linear Collider Project* by the Science Council of Japan has just been released. [Read the report](#)

CALENDAR

Upcoming events

[Workshop on Top physics at the LC](#)

LPNHE, Paris

05- 06 March 2014

[CALICE collaboration meeting](#)

Argonne, Chicago, IL

19- 21 March 2014

Upcoming schools

[Joint Universities Accelerator School \(JUAS\)](#)

Archamps, France

06 January- 14 March 2014

[View complete calendar](#)

PREPRINTS

ARXIV PREPRINTS

[1402.3112](#)

Study of anomalous quartic $WW\gamma\gamma$ couplings at the Compact Linear Collider

[1402.2780](#)

Detector Optimization Studies and Light Higgs Decay into Muons at CLIC

[1402.2692](#)

Initial Results of a Silicon Sensor Irradiation Study for ILC Extreme Forward Calorimetry

[1402.2515](#)

Backgrounds at future linear colliders

[1402.2251](#)

Status of the Zee-Babu model for neutrino mass and possible tests at a like-sign linear collider

[1402.1904](#)

Comparison of Electron Cloud Mitigating Coatings Using Retarding Field Analyzers

[1402.1426](#)

Lepton flavour violation at high energies: the LHC and a Linear Collider

[1402.1187](#)

Observables for model-independent detections of Z' boson at the ILC

ILC NEWSLINE

THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

AROUND THE WORLD

The road to Kitakami

Barbara Warmbein | [20 February 2014](#)



ILC candidate site in Kitakami. The accelerator is shown with a blue line.

Our mission was clear: we were the tasters, the vanguard. In early February, the two European LC communicators travelled to Japan for three days to a. find our way around the Japanese transport system, b. be filmed doing so, c. find entry points of improvement potential for foreigners about to make the same experience, and d. start a communication model for the future multi-national laboratory. Our itinerary: land at Haneda International Airport, take Monorail and local train to Tokyo train station for a Shinkansen high-speed train to Ichinoseki, some 450 kilometres further north. In and around Ichinoseki we were to visit various sites and sights – sites for the ILC if it was built there, and sights of the area to explore the leisure potential of Kitakami. Please see our "[Kitakami glossary](#)" for explanations of terms.

Here is how it all played out.

Our Japanese colleague Rika Takahashi asked us to fly to Haneda airport as it is supposed to become more of an international hub for the Tokyo

Olympics in 2020 and might thus be a main entry port for ILC scientists in the future. (There is an airport closer to the Kitakami site, in Sendai and Hanamaki, which are serviced by flights from Osaka, so that's another viable option next to Tokyo's Narita airport) Detail for geeks: you get to ride downtown on the Tokyo Monorail!

One minor Tokyo public transport system culture shock later, we were zooming northwards on the Tohoku Shinkansen bullet train. Another treat for train geeks: the Hayabusa E5 Shinkansen runs on this line, and as of March the new E7 will take up operation. Look it all up [here](#). But that's enough about passenger trains – let's move on to bunch trains.

The ILC, if built in the Kitakami region, would stretch from a part of Oshu called Esashi (one end of the linac) to a part of Ichinoseki called Morone (the other end of the linac), crossing under the rolling hills of Kitakami for beams to collide near the town of Ohara, under a mountain called Hayamayama. For the 1-TeV 50-kilometre option it would almost stretch out to the coast, to a town called Kesennuma – one of the towns that was severely hit by the March 2011 earthquake and tsunami. So the kind people from the prefecture office drove us around to places in the area where the international ILC lab could be established, showing us points for access tunnels, campuses, even the granite core probes that were taken to examine the [exact geological situation of the area](#) and are being evaluated now.



European LC communicators in Tokyo, trying to find their way in the Japan Rail (JR) system. Image: ILC/ Barbara Warmbein.



Panorama of the Kikami mountains. Image: Oshu City

We also met with local officials and discussed how ILC scientists and the ILC could be attracted to the area, heard about their plans to open the region up to a massive new science project, visited local sights and admired the support for the ILC that can be spotted at many different places. The taxi driver who took us to our hotel, for example, said the ILC was “talk of the town”; [shops had banners and pins, roads had signs](#). It was almost touching and certainly very exiting to see so much enthusiasm and support. As always, discussions led to more questions and things that would need to be investigated and done and conclusions are hard to draw, but we can conclude this: that the trip was an eye-opener for this area of Japan, that regional support should meet global support, and that foreigners – even plagued by jetlag – can easily find their way up to Kitakami.

バーバラ・ワームベイン (Barbara Warmbein)

[COMMUNICATION](#) | [ICHINOSEKI](#) | [JAPAN](#) | [KITAKAMI SITE](#) | [OSHU](#) | [SENDAI](#)

Copyright © 2014 LCC

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

LC NEWSLINE

THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

FEATURE

The Big ILC Kitakami Iwate Tohoku Glossary

Barbara Warmbein | [20 February 2014](#)

ICHINOSEKI

Ichinoseki would be one of the main hubs of ILC life. It's a city with a major train station, hospitals, shopping centres, and nearly 130 000 inhabitants, spread over a rather large area – over 1200 square kilometres, which is nearly 10 times the size of Geneva (Switzerland). This is because it was merged into one big city from many smaller communes in 2005. One of its most outstanding features: one of the biggest ILC fans in the area also happens to be the mayor, Osamu Katsube. Even before the ILC existed or he became mayor, during times when the Japan Linear Collider or JLC was being considered, he was part of a linear collider planning office in Iwate prefecture government. He has a 30-centimetre mascot of himself which also features on his business card – a grand man with a grand plan.

IWATE

Iwate is a prefecture of Japan. After Hokkaido it is the second largest prefecture and forms the Tohoku region together with Akita, Aomori, Fukushima, Miyagi and Yamagata. Its largest and capital city is Morioka, roughly an hour's train ride north of the designated ILC site. The cities of Ichinoseki and Oshu are all in Iwate Prefecture. The Iwate Prefecture Government runs its own ILC office and coordinates activities with the ILC offices of Ichinoseki and Oshu.

KITAKAMI



Frozen ricefield near the ILC candidate site in Kitakami region. Image: ILC/Barbara Warmbein

Kitakami is the name for many things. LC NewsLine readers will know it as the name for the northern site. Kitakami can refer to the Kitakami river – the 5th largest river in Japan, by the way, and very important for the prefecture because its river plain is home to much of the agriculture, which in majority are rice paddies. It can refer to the city, which is slightly smaller than Oshu and Ichinoseki and slightly further north.

And it is the name of a soft, rolling mountain range that runs through the prefecture from north to south, parallel to



The candidate interaction region could be under Hayama mountain, near Ohara City. Image: ILC/ Barbara Warmbein

Kitakami river. Many access tunnels would be created under and into the Kitakami hills and mountains, and the interaction region would be under a mountain called Hayamayama near the town of Ohara. By the way, there's some good hiking, paragliding and even skiing in the area. Town, river and mountains together make the place the "Kitakami region".

OSHU

Oshu, like Ichinoseki, is a neighbouring city of the ILC if it was built in Iwate. It is the second largest city in Iwate Prefecture, and like Ichinoseki it is the result of a 2006 merger of several smaller communes. It has a gigantic sports stadium, a branch of the National Astronomical Observatory of Japan, all the amenities of a large city, famous cherry orchards, tasty cows and a high-tech Shinkansen station. What is more, it is the home of the International ILC Support Committee, a group of non-Japanese ILC fans who live in Iwate. The mayor of Oshu city and a group of officials came to visit CERN last year to explore the ways of an international lab.

TOHOKU



This pine tree was the only survivor of its forest after the big 2011 Tsunami in Rikuzen Takata. Image: ILC/Barbara Warmbein

Many ILC researchers know the name Tohoku thanks to colleagues from Tohoku university situated in Sendai, notably Hitoshi Yamamoto, the LCC's Associate Director for Physics and Detectors. Tohoku (Japanese for "northeast") is the name for the northeastern region of Japan's main island and comprises six prefectures, including Iwate (see above) and Miyagi, Sendai's prefecture. It is also the name of the Shinkansen line that links Tokyo with the north east, so if you're in Tokyo station looking for the right platform find the JREast Tohoku line. People from Tokyo are likely to tell you that "there be dragons" – that Tohoku is very, very cold and quite rural. As for the cold, yes, it was cold when we were there, but not much colder than Tsukuba or Tokyo, so it's all a matter of perspective. And in comparison to Tokyo, everything will appear rural...

Tohoku is also the region that was most hit by the Great Earthquake and Tsunami of March 2011. One of its seaside towns, Kesenuma-port, would be very close to the 50-kilometre ILC end point. It is one of the towns most destroyed by the tsunami, and the reconstruction work that is going on in the area is impressive to say the least. A new highway is being built to link all towns along the coast, and the town of Rikuzentakata is even levelling out surrounding hills to rebuild it on higher ground and fill lower ground with the rubble from the hills to make it all more tsunami-safe. All communes have regular tsunami drills.

バーバラ・ワームベイン (Barbara Wamubein)

[ICHINOSEKI](#) | [IWATE](#) | [KITAKAMI](#) | [OSHU](#) | [TOHOKU](#)

Copyright © 2014 LCC

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

NEWSLINE

THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

FEATURE

A day in the life of a particle physicist in Kitakami

Perrine Royole-Degieux | [20 February 2014](#)

The life of a particle physicist is the same everywhere in the world one might say. It's true that the physicist's work life at the future ILC is easily predictable. Computing and data taking or analysis, meeting with colleagues, tons of coffee and tea, short lunch breaks at the cafeteria (with "electron" and "positron" menus?), preparing for future meetings in the afternoon, plus, for the lucky ones, night shifts for a detector or machine survey. I'm not going to tell you anything new about what you know already. Let me tell you the other side of the story, regarding your afterwork life at the Kitakami site. Put on your most comfy easy-to-take-off shoes – there is much to visit here – and follow me to the Tohoku region.

Please see our "[Kitakami glossary](#)" for explanations of terms.



Ekiben (railway bento box). Image: [Luke Lai](#)

Welcome onboard!

If you're coming from abroad, you'll probably land in Tokyo in the first place. You're not arrived yet, but the experience begins here. To reach the candidate ILC campus, you'll have to come onboard a Shinkansen "bullet" train, which will give you the opportunity to discover – at the peak speed of 320 km/h – the charms of the Tohoku region. By the time the ILC is constructed, the nearest station to the ILC campus will probably have become a main station of the Tohoku Shinkansen line, so you'll arrive with an express train, 400 to 430 km later (and for those of my French colleagues who cherish their [TGV](#), the Japanese train is way more comfortable!) Don't forget to treat yourself to one of the bento boxes, sold on board or at the station of you departure. They're all delicious!

Talking of food... Bento boxes might become your best friends. Surely, in an international lab's canteen you'll probably have the choice between many kind of snacks and sandwiches, but bento boxes should be at your top list whether you consider to skip a proper lunch. They exist in many various kinds and often fit the local specialties, which are many... In Kitakami, you'll be eating lots of different kinds of fish in various sorts of cooking of course, but you may be surprised to read that Iwate Prefecture is famous for its Maesawa Beef (to be tried in steaks and sukiyaki or shabu-shabu fondues), for dairies (from the [Koiwai Farm](#)) for its local Esashi apples and its sweet Nanbu Ichiro pumpkins (you may be lucky enough to try pumpkin sake — no kidding). Another very popular dish from the region are the mochi dishes (rice cakes), which are served as small bites in a nearly three hundred combinations of preparations, from mushrooms and fish to sweet green tea. Although mochi are famous all over Japan, there's a special "mochi culture" in southern Iwate, where they are eaten at various special events. You may also try the Nambu Sembei (delicious crackers) or all kinds of noodles from soba (which Iwate people like so much that they organise Soba eating contests) to jajamen and Morioka reimen .



Hiraizumi. Image [noshadows](#)

If you stay a few more days at the lab or live there, you should know that there is a must-see sight in Japan about 30 km from the future ILC detector halls: Hiraizumi, classified World Heritage Site by UNESCO in 2011. At its apogee during the XII century, Hiraizumi was a rich and prosperous town which could compete with Kyoto. From that ancient time survived a few treasures. Among those are the marvellous Golden Hall, a gold and lacquer covered structure at the Buddhist temple Chuson-ji, and the almost completely preserved garden of the Motsu-ji temple, known as one of the

most beautiful gardens from that era. Culture-wise, you'd probably like to discover more about the famous writer Kenji Miyazawa, whose hometown was Hanamaki, Iwate Prefecture. He wrote in 1927, in the *Night on the Galactic Railroad* "if you study hard so that by experiment you can divide true thoughts from false thoughts—if you can just figure out how to set up the experiment—why then, Giovanni, faith will become just like science."

Whenever you come to Kitakami, you'll be enjoying the region's nature all year long. During winter, ski resorts at Himekayu (to the west of the Oshu city centre) or at Esashi (at the northeastern end) will welcome you. In spring, you'll enjoy the cherry blossoms. In August the rice fields will reveal all their poetic beauty. Outdoor sports like fishing, hiking (on Mt Murone or Mt Kurikoma for example) or golf are well appreciated by locals.



Deer dance festival. Image: Iwate Prefecture

For leisure, you'll also appreciate the closeness of tourist spots like the Geibikei gorge outside of Hiraizumi, which you can discover by gondola-like boat all year long (approved by the writer of this article during the freezing winter!). Don't forget also a visit to the National Astronomical Observatory of Mizusawa (a district within Oshu), which hosts one of the four very-long-baseline interferometry VERA stations. All year long, you may participate in



Winter boat trip through Geibikei gorge. Image: ILC/Perrine Royole-Degieux

local festivals, among them is the popular local Japan beer festival of Ichinoseki City, the Kawasaki summer fireworks festival, the Daito Ohara Mizu-kake Matsuri (Water Pouring Festival at Ohara) or the Snow Festival of Shizukuishi Town in February, and the Shishi-Odori (Deer Dance) in August, just to name a few.

Your trip to Kitakami is now almost ending and you may worry about what to take back home. Don't show this post to your family and friends since they are many things you may pick. You may for instance choose your souvenir among thousands sorts of kokeshi dolls, originally from the Tohoku region, teapots from the world-famous Iwate Nambu Tekki ironware (save some weight in your luggage though, there are quite heavy), lacquerware or amber jewelry (Iwate is the only place where you will find it).

Now it's time to go back home. Let's hope you'll come back soon to Iwate... with the ILC this time.

ペリン・ロワイヤドゥジュ (Perrine Royole-Degieux)

RECOMMENDED LINKS AND READING

Images

For Further images, don't miss our [slideshow](#) for a best overview of the region.

Local ILC support websites and brochures

ILC Pamphlet: [Ray of Hope – Tohoku is ready to welcome the ILC](#)

[Iwate International Association webpage about the ILC](#)

[Oshu International Linear Collider website](#)

Tourism in the area

[A Trip to Iwate](#): Iwate Prefecture Tourism Portal Site

[Travel to Tohoku](#): Tohoku's Tourism Web Portal

[Ichinoseki WIKI travel](#)

Historic Monuments and Sites of Hiraizumi

[Chuson-ji Temple](#)

[Motsu-ji Temple](#)

[Other sites of Hiraizumi](#)

[COMMUNICATION](#) | [HIRAIZUMI](#) | [ICHINOSEKI CITY](#) | [INTERNATIONAL LABORATORY](#) | [IWATE PREFECTURE](#) | [KIKAMI](#) | [OSHU CITY](#) | [SOCIAL LIFE](#)

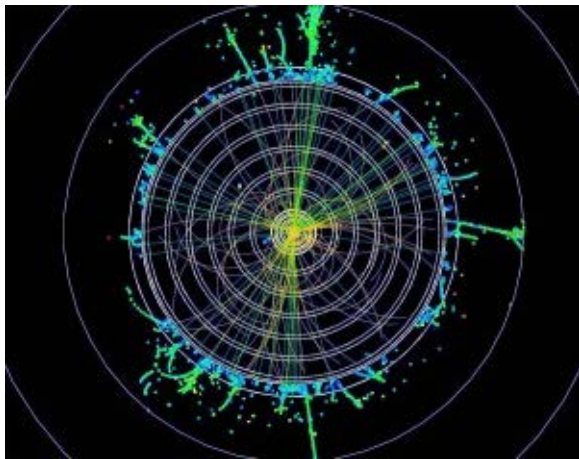
Copyright © 2014 LCC

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

DIRECTOR'S CORNER

Future Colliders: A strategic perspective

Harry Weerts | [20 February 2014](#)



Particle collisions could reveal new physics territories. Image: Norman Graf, SLAC

Over the past decades, colliders have defined the energy frontier in particle physics. Both electron-positron, proton-(anti)proton as well as electron-proton colliders have played complementary roles in fully mapping out the constituents and forces in the Standard Model (SM). We are now at a point where all predicted SM constituents have been found at colliders. Currently only one collider, the Large Hadron Collider (LHC) is running and will run for a while. The last remaining, predicted field/particle in the SM was found at the LHC in 2012 and with increased luminosity and raising the energy to 14 teraelectronvolts (TeV), the LHC will be the field's only tool to study the Higgs boson. Especially raising the energy will also enable extending the reach for searching for new physics beyond the SM (BSM).

Trying to explain the SM and its features and parameters leads us to expect new physics and therefore new particles. There are theoretical expectations that such particles are at the TeV-level energy scale, but in principle they could be at any scale above one TeV and even that depends on their

interaction strength. In an ideal world the only way to directly produce such particles/fields in our labs is in colliders. Assuming that we need to go beyond the LHC, we would like a collider or colliders that can reach from a few hundred GeV to very high energies, ultimately if one is allowed to dream the Planck scale of 10^{19} giga-electronvolts (GeV).

The above reasoning has led to many studies of future colliders at rather different stages of completion or maturity. It is also the driving scientific force behind a worldwide accelerator R&D programme trying to achieve higher accelerating gradients, especially for linear colliders and to achieve higher magnetic fields, for circular colliders. This programme driven by the high-energy physics (HEP) community which needs to build ever higher energy colliders at affordable cost, has led to technologies that enabled other fields of science in obtaining their goals (the European XFEL at DESY, Germany and LCLS II at SLAC, US). These fields often industrialise those technologies before HEP can do it and in that way contribute to possible future machines for HEP. In that way all participating fields of science benefit and contribute.

The studies of future HEP colliders mentioned above are very important aspects of HEP. Over the last two decades several of these studies have been undertaken and some are just being started now. They all aim at proposing a future collider and requiring the development of new technologies to be able to reach the energies aimed at. Typically these technologies do not exist at the start of the study, but are anticipated to be within reach, given sufficient research, development and funding. These studies are also on extremely different time scales of possible realisation of concepts. Currently there are four studies worldwide: ILC, CLIC, FCC and a muon collider. The International Linear Collider (ILC), an electron-positron collider at 500 GeV and possibly upgraded to 1 TeV is the most mature with a *Technical Design Report* (TDR) and the most established superconducting RF technology. A candidate site has also been identified in Japan to possibly locate the machine. CLIC (Compact Linear Collider) is an electron-positron collider concept based on two beam acceleration aiming to reach about 3 TeV and with a completed *Conceptual Design Report* (CDR), aiming for a TDR around 2019. A multi-TeV muon collider is under discussion and an active R&D programme of how to cool muons, an essential ingredient, is in

progress. Recently the study of a Future Circular Collider (FCC) aiming at about 100TeV centre-of-mass energy for proton-proton collisions has started. It is being pursued both in Europe and in China and will require the development of new superconducting high field magnets (of about 16-20 teslas). The FCC study at least in Europe aims for a CDR around 2018. From a HEP perspective, one can argue about which one of these should be pursued and each of us in HEP has their preference. However there is a strategic aspect associated with this conundrum that cannot be ignored and that is the time scale involved in realising any of these machines. In the most optimistic scenario, the LHC will have a high luminosity run and will run until sometime in the 2030's. The only option mentioned above that has any chance of some overlap with LHC and/or be accumulating data around that time is the ILC. Even that assumes that the ILC will be realised in Japan on a technically limited schedule without financial or political delays.

So it seems that if HEP wants to continue energy frontier physics with complementary to the LHC, precision exploration of the Higgs and explore BSM physics at weak scales above about 200 GeV, unexplored by the LHC, then the ILC is the natural next energy frontier machine for HEP. Any other option will take at least another decade beyond 2030 before it could be realised. That would result in an extended period of time without a running energy frontier machine in HEP.

[CLIC](#) | [ENERGY FRONTIER](#) | [FCC](#) | [HIGGS BOSON](#) | [HIGH ENERGY PHYSICS](#) | [ILC](#) | [LHC](#) | [MUON COLLIDER](#) | [NEW PHYSICS](#)

Copyright © 2014 LCC

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

NEWSLINE

THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

SLIDESHOW

Kitakami slideshow

Images: ILC/Barbara Warmbein, ILC/Perrine Royole-Degieux and Oshu City | [20 February 2014](#)

We're ending this travel diary with a few of the hundreds of pictures we took during this trip to Tohoku. Have a glance, and discover what the region looks like, as if you were there.

[\[Show as slideshow\]](#)

