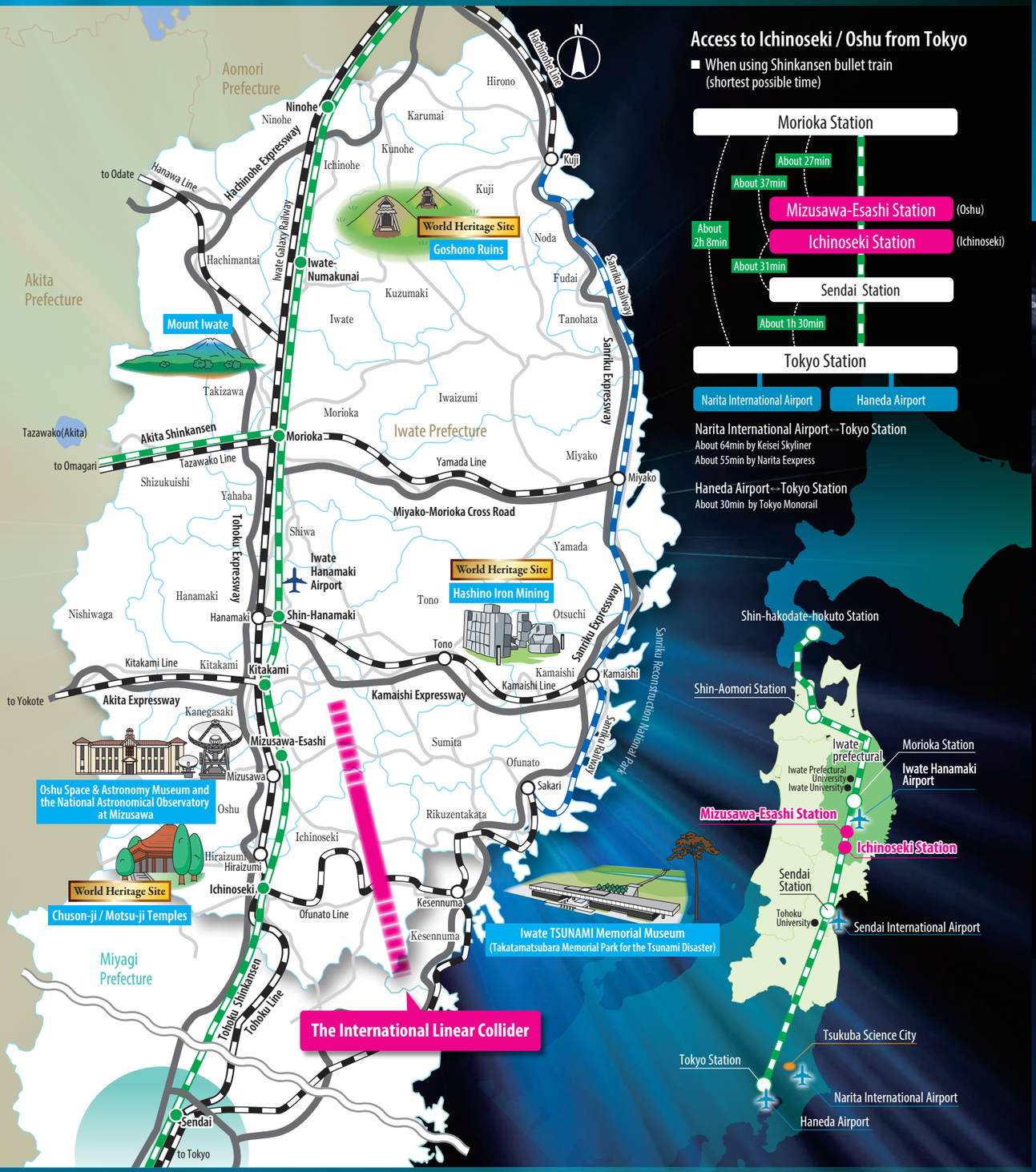
ACCESS



Access to Ichinoseki / Oshu from Tokyo

■ When using Shinkansen bullet train (shortest possible time)

Narita International Airport↔Tokyo Station
About 64min by Keisei Skyliner
About 55min by Narita Exepress

Haneda Airport↔Tokyo Station
About 30min by Tokyo Monorail

Bureau of ILC Promotion, Iwate Prefectural Government

(020-8507) 10-1, Uchimaru, Morioka City, Iwate Prefecture TEL 019-629-5203

E-mail AB0009@pref.iwate.jp

Twitter

March 2023

We support the ILC

Blazing a trail for science in the 21st century.
Connecting Tohoku and the world.

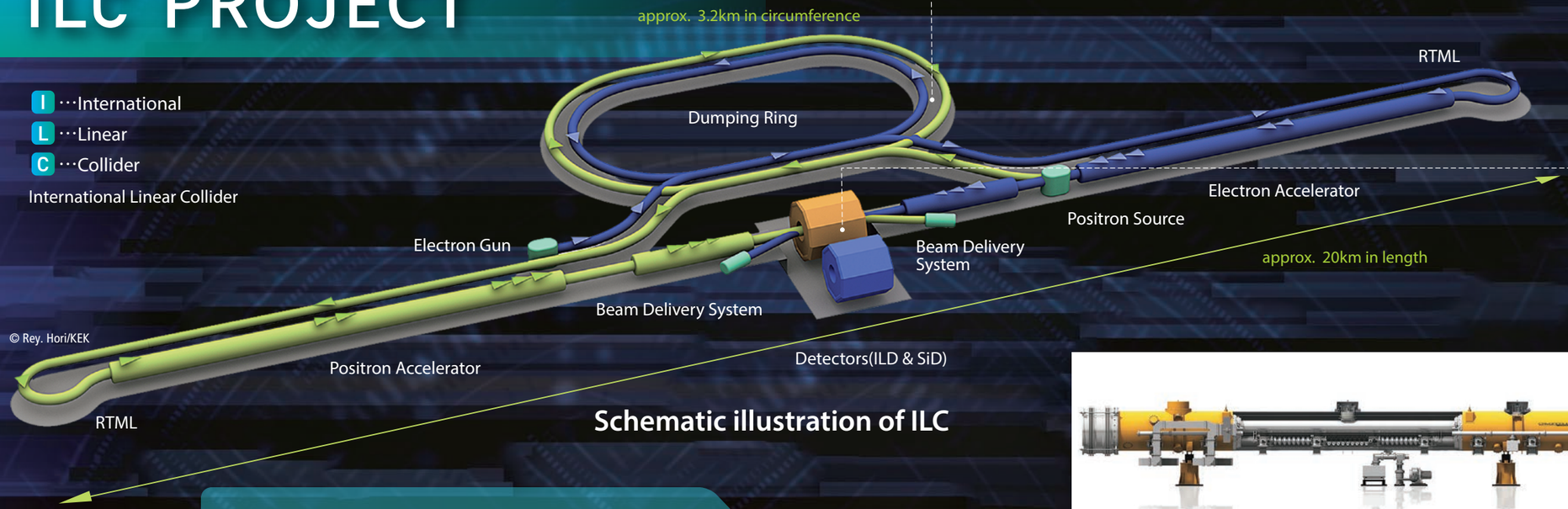
The International Linear Collider

© Rey. Hori/KEK

We're ready for the ILC!

ILC PROJECT

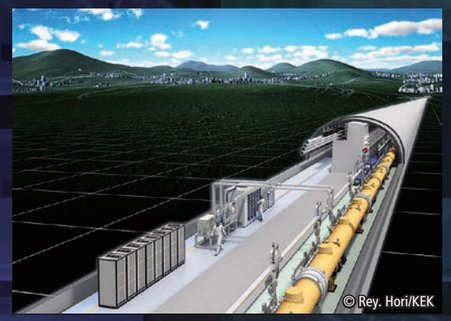
I ···International
L ···Linear
C ···Collider
International Linear Collider



Schematic illustration of ILC

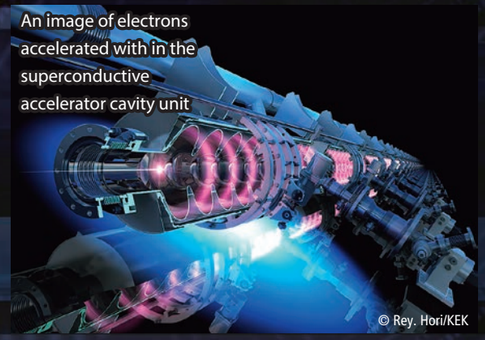
What is an accelerator?

Accelerator : This device accelerates electrons, positrons, and other particles to close to the speed of light, and then smashes them together.



Accelerator Tunnel

The accelerator tunnel will have two rooms; one for the main linac (right), and the other for klystrons (left),the device that supplies the accelerator with the electricity it needs.

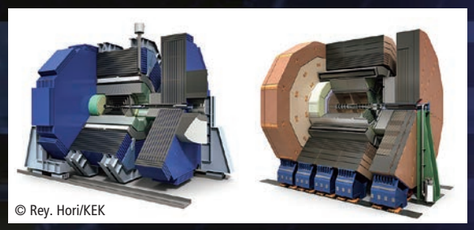


Damping Ring

A damping ring is a closed storage ring that decreases the volume of the particle bunches making up a beam, creating bunches that are denser and more compact. The ILC design has two damping rings, one for the electron beam and one for the positron beam.

Particle Detector

The particle detectors will record the electron-positron collisions. ILC will have two detectors, ILD and SiD, installed in the center of the accelerator tunnel. Having these two detectors will allow vital cross-checking of the experiments.



Main Linac

Here are some of the components that go into the main linear particle collider inside of the massive tunnel.

Cryomodules

These cooled containers are like giant thermoses (12m long and 1m in diameter). They link to each other in the collider tunnel to house the super-conductive accelerator cavities. A beam of electrons or positrons is run through the cavity units at an extremely high speed - 99.99999999% the speed of light. Liquid helium is used to cool these cavity units to a temperature of -271℃.

Super-conductive Accelerator Cavity Units

These important devices could be called the heart of the ILC. They're made with a metal called niobium.

Super-conductive Accelerator Cavity Units

photo : KEK

What is the ILC?

The International Linear Collider is a next-generation particle collider that is currently being designed and developed through international cooperation.

Within a long, straight tunnel ranging tens of kilometers long (currently planned for a 20km length at an elevation of 110m), electrons and positrons will be accelerated to near the speed of light and then smashed together. This experimental facility will observe and record those reactions.

World-class researchers and scientists will gather from universities and laboratories around the world to the Tohoku region and the Kitakami mountains. It is expected that this will be a hub for international research for 10 to 20 years.

Experiments at the ILC

The ILC will be a massive particle collider around 20 kilometers long.

It will collide electrons (particles with a negative charge) and positrons (particles with a positive charge; the antimatter counterpart to the electron) at close to the speed of light.

This collision annihilates both particles, releasing energy that will create other various particles.

The ILC will observe these new particles, in particular the Higgs boson particle, and look into their makeup.

What are the requirements for the construction site of the ILC?

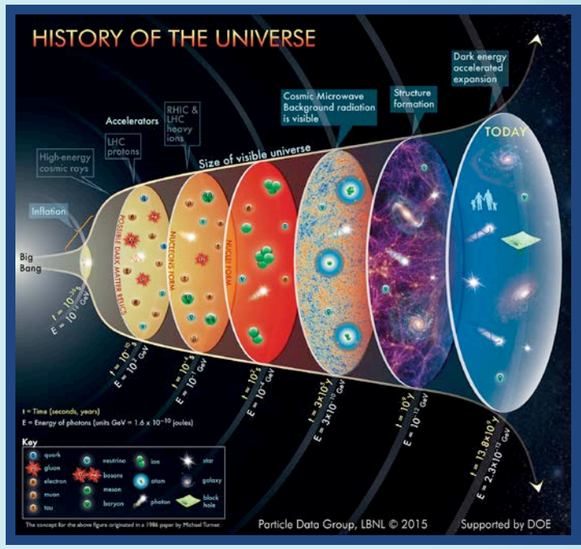
The site needs to be a place where an accelerator tunnel can be built up to 50km long in a straight line. It also needs to be able to house all of the access tunnels and underground halls that store the particle detectors.

The collision of electrons and positrons requires precision, so the ILC must also be in a place with few manmade vibrations; a place where the bedrock is stable with no fault lines. This is why the Kitakami mountain area of the Tohoku region of Japan has been deemed to be site for constructing the ILC.

How much will the ILC cost?

According to the estimates of the scientific community, the construction costs for the ILC (including civil engineering, the collider, detectors, and labor) will cost around 735.5-803.3 billion yen, and the operating costs will be 36.6-39.2 billion yen per year.

However, as the ILC will be a research facility for joint international research, it is surmised that construction costs will be shared by the international community, with the host country being responsible for around half of the cost.

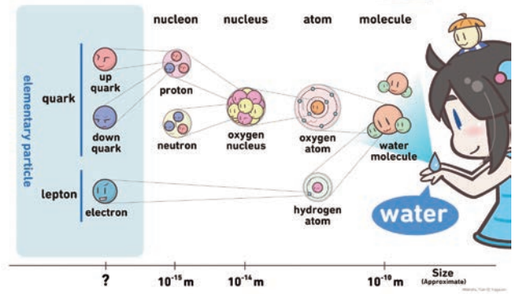


What will we learn from the ILC?

The ILC will accelerate electrons and positrons to near the speed of light and collide them together head-on. That will annihilate the two particles, creating a pulse of energy that will resemble the conditions that took place one trillionth of a second after the birth of the universe. This will release the Higgs boson particle and many other particles, along with other phenomena that no one has ever recreated before. By observing these particles, we can begin to unlock mysteries that have long since plagued humanity, like how the universe and matter were created.

What are elementary particles?

These are the smallest portions of matter and forces; particles that cannot be divided any further. There are particles like quarks (which make up protons and neutrons), leptons like electrons and neutrinos, and gauge bosons which act as force carriers.



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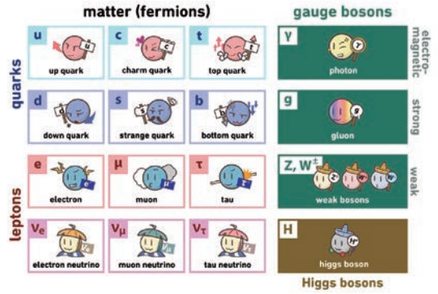

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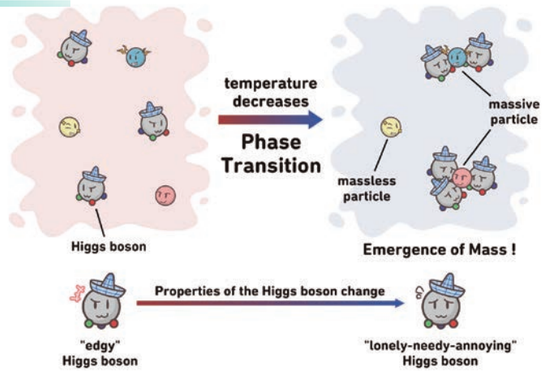
What is the Higgs boson particle?

The Higgs boson was discovered in July 2012 at the CERN laboratory in Geneva, Switzerland.

The Higgs boson fills the entire universe like water fills the ocean, and is thought to give mass to elementary particles.

Immediately after the Big Bang, elementary particles had no mass. As the universe expanded and cooled down, the nature of the Higgs boson changed, with elementary particles receiving resistance from Higgs bosons, making it difficult to move. This difficulty is thought to have led to mass.



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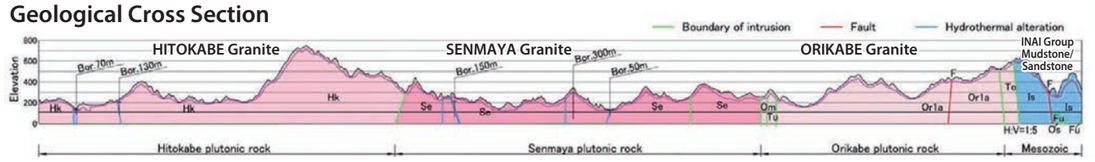
The potential of the Kitakami Mountain Region

Strong granite rock is distributed over a 50km area, with no fault lines

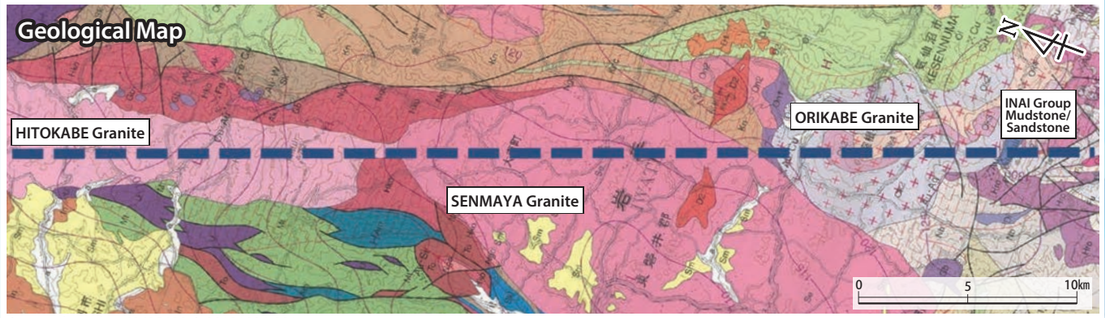
The electrons and positrons used in experiments are extremely small. Colliding these particles together requires precision, so the ILC needs to be in an area with a strong bedrock and few vibrations. Plus, the area needs to range from 20km to 50km long. Building the ILC in the Kitakami mountains of the Tohoku region of Japan means that we have found one of the best spots in the world for the ILC, fulfilling all of its requirements. The underground of the Kitakami mountains stretches from Oshu City to Ichinoseki in Iwate Prefecture, and possesses very strong granite layer of bedrock, stretching from north to south. Its northern region is called the Hitokabe Granite layer, and the southern region is called the Senmaya Granite layer. From December 2012 to spring 2013, Tohoku University and the Iwate Prefectural Government performed a joint, detailed geological survey of the area, and it was confirmed that the Kitakami mountains were an ideal spot for the ILC.

Additionally, while the Tohoku region of Japan suffered great damage from 2011's Tohoku earthquake and tsunami disaster, we also learned that the land was extremely stable. There is already a facility built under the Kitakami mountains called the Esashi Earthtides Observation Station (National Astronomical Observatory), and that facility suffered no effects from the earthquake.

Geological Cross Section



Geological Map

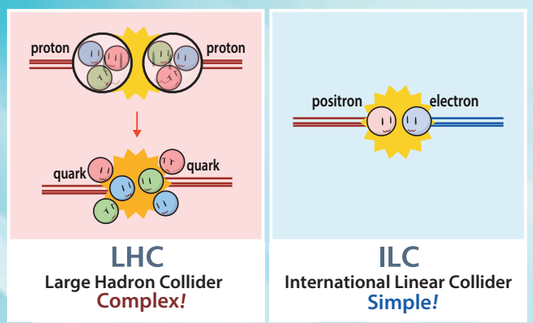


Approval number 60635130-A-20131024-001

The Large-Scale Circular Collider that will be a Model for the ILC

The European Organization for Nuclear Research (CERN)

CERN was built in Switzerland in 1954. The Large Hadron Collider (LHC), with a circumference of 27km, was installed underground on the outskirts of the international city of Geneva. Nobel Prize-winning research is conducted here, including the discovery of the Higgs boson in 2012.



LHC
Large Hadron Collider
Complex!

ILC
International Linear Collider
Simple!

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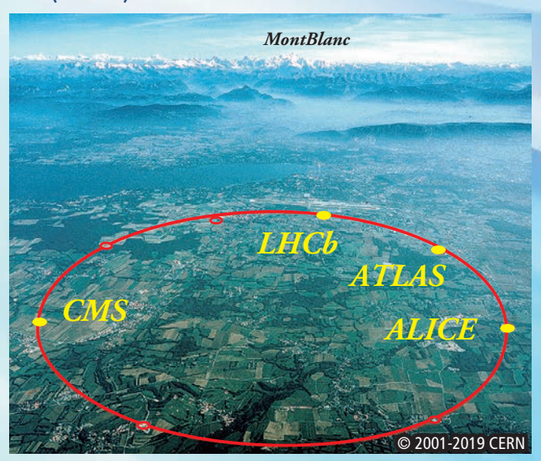

Aerial photograph of the LHC (The collider lies underneath the red circle; the yellow indicates the location of each particle detector)

The ILC in Japan: Creating Value and Leading a New Future

International Trust and Diplomacy through Science and Technology in Japan

To become a country that will contribute to and lead the world

By hosting the ILC, Japan will have a fantastic chance to lead international society through hosting the ILC, with science at the core of its leadership. The ILC will be a way to develop Japan as a country based on science and technology.

Science for Peace

The ILC will serve as the first large scale international hub for science and technology in Asia. Scientists from around the world will work together on the same challenges, making the ILC a place that will contribute to international society and encourage peace through science.

Developing International Science and Cultivating Human Resources

Discovering new paths that will lead to core truths of the universe

Through experiments at the ILC, we will discover new paths that will help us solve the mysteries of elementary particle science, and greatly contribute to the development of science as a whole.

Cultivating human resources to go from a "braindrain" to a "braingain" society

The ILC will be a world-class research facility. By having such an amazing facility in their back yard, the people of the region will see researchers challenge themselves and gain opportunities for exchange in their daily lives. Through this, children will gain new hopes and dreams, giving them the motivation to challenge themselves. It will greatly contribute to the fostering of global human talent that will go on to be not just the next-generation of scientists, but also experts in a variety of other fields.

ILC

Fostering Innovation and Developing Industry

Fostering innovation through new frontiers of knowledge and the accumulation of technology

Cutting-edge technology and scientists at the top of their game will gather at the ILC, along with related companies. This accumulation will create new value, and bring a diversity of change as it fosters innovation that will ripple outward from Japan to the rest of the world.

The Development and Accumulation of a Wide Range of Industries

The ILC will serve as a source of base technology for healthcare, biological sciences, environment, energy, advanced materials, and other industries. Through the accumulation of related companies and the growth of local companies, the area is expected to rapidly develop as a place for advanced science and technology industries.

A New Form of Regional Revitalization and Reconstruction from the 2011 Disaster

A new form of regional revitalization that will link us to the world

Because so many scientists and researchers from around the world will gather with their families in the area, the region will see effects like a population increase, promotion of industry, creation of employment opportunities, and an increase in foreign tourism.

The plan is to create a "Green ILC" through energy reuse and the usage of waste heat, as well as building the research facilities out of wood. It will foster a regional circular economy that will be a new model for regional revitalization, linking us to the world.

A True Reconstruction from the Great East Japan Earthquake and Tsunami

The ILC will work to solve the mysteries of the universe, and give hope, dreams, and motivation to children. Not only is the research important, but the ILC will allows us to share information on our construction, tourism assets, culture, and food to the world, and increase our communication with the world. The ILC will be a source of pride to the survivors in the disaster area, and will greatly contribute to realizing a true reconstruction from the 2011 disaster and the creation of a new Tohoku.