Hoping for the International Linear Collider (ILC) to Be Sited in Japan

Messages from the Nobel Laureates in Physics

Dr. Burton Richter (1976)
Dr. Steven Weinberg (1979)
Dr. Sheldon Lee Glashow (1979)
Dr. Jerome Isaac Friedman (1990)
Dr. Gerard ‘t Hooft (1999)
Dr. Masatoshi Koshiba (2002)
Dr. David Gross (2004)
Dr. Toshihide Maskawa (2008)
Dr. Makoto Kobayashi (2008)
Dr. Barry Barish (2017)

(winning year)

Nobel Prize in Physics 1976
Dr. Burton Richter

Burton Richter

Born	March 22, 1931
	New York City
Nationality	United States
Alma matter	Massachusetts Institute of Technology
Institutions	Stanford University
	Stanford Linear Accelerator Center

Prize Rationale

“for their pioneering work in the discovery of a heavy elementary particle of a new kind”

Massage

https://www.youtube.com/watch?v=EG7o0yoakMs

My name is Burton Richter. I'm a former Director of the SLAC National Accelerator Laboratory and maybe one of the last, if not the last of the generation that brought colliding beams into existence.

Now we're looking at what the next big machine is going to be, and the electron positron collider community got together, oh more than 10 years ago, 15 years ago, to bring in Asia, Europe and the US into the development of the technology has been developed. It's ready for the next big machine and the questions are what the next big machine is and what a competition is. So LHC is back on the air and LHC is nearly doubling its energy. We expect all sorts of good things to come out of the LHC but one thing has come out already is the Higgs boson.

But is it the Higgs everybody thinks it is ? That's a funny question because it’s light, it's in the right region and all the rest of it. But there are variants that you can think of that don't do exactly the same thing and one of the ways you tell if it's the right one is you look at the branching fractions of a Higgs and see if they agree with what the standard model tells you. That is much much easier, infinitely easier on an e +e- machine than a proton machine.

The reason is simple. Electrons and positrons are both elementary, protons are composite and in electron positron collisions of high energy, it’s kind of what I call a democracy of production, all cross sections are within an order of magnitude or so about the same, and the proton colliders the experimenters have to cope with backgrounds that are 10 to the 9th to 10th to the 10th times. The interest in cross-section it is a very difficult job and it is required tremendous ingenuity and detector design and in trigger design to make the system work.

Clearly, they made it work, because they have found the Higgs. But precision measurement of branching fractions requires that you get a lot of them and that the system be clean. And that's much easier in e+ e- when you're looking for the long-term future there's another thing that you should think about. Protons are composite and that says that the collisions that produce the things you're interested in our collisions of pieces of the proton not the proton. And those pieces share the energy and so if you build a machine like LHC 14 TeV the chances of you're actually getting a collision where you get 14 TeV into the particles that you're interested in is essentially zero. If you look at it and to tell if you want the same kind of physics then you need an e+e- machine with an energy of ten percent to twenty percent of what you get with the protons. So all of you think about this.

Look to the future that future is going, we hope, to include new accelerators. it's only going to include new accelerators if we've got a good story on the physics that we're going to get and if we do something to control the costs. The electron colliders are an important route they haven't gotten the attention they deserve.

I want to close with something that I remember when I was much younger. I was a science-fiction fan, and I remember a story, I don't remember who wrote it, I don't remember the title, but I remember the first page because the first page said, high-energy physics and ground-based astronomy are no longer done because their facilities have become too expensive. That was before the invention of colliding beams. It's only the existence of colliding beams that has made it possible to build the colliders energies that we've got today. What we can do for an encore while you're thinking about the next machine, thinks about your investment in the advanced accelerator R&D.

Good luck to all.

Nobel Prize in Physics 1979
Dr. Steven Weinberg

Steven Weinberg

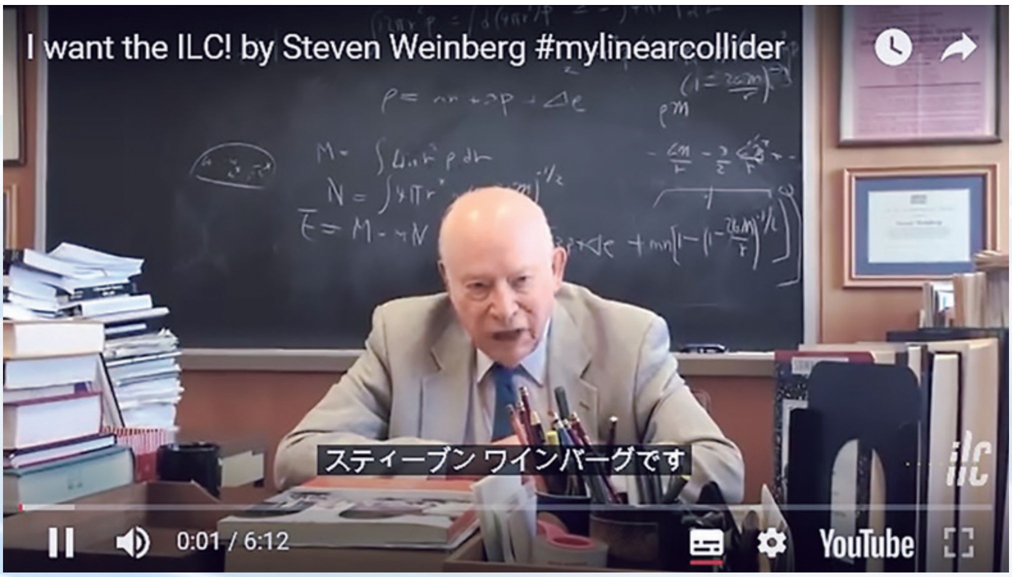
Born	May 3, 1933
	New York City
Nationality	United States
Alma matter	Princeton University
Institutions	University of Texas, Austin
	University of California, Berkeley
	Massachusetts Institute of Technology
	Harvard University
	Columbia University

Prize Rationale

"for their contributions to the theory of the unified weak and electromagnetic interaction between elementary particles, including, inter alia, the prediction of the weak neutral current"

Massage

https://www.youtube.com/watch?v=A1bRV_0j-aY



I'm Steven Weinberg, Professor of physics and astronomy at the University of Texas at Austin. Good morning I'm speaking from my office here at the University of Texas. I'm speaking on behalf of the project to build a new elementary particle accelerator known as the International Linear Collider which has special advantages

We talk about different frontiers in physics. There's a high energy frontier which is usually pursued these days by building accelerators that collide beams of protons. The clear example is the Large Hadron Collider in Europe which can go to the next generation. We hope we'll go to considerably higher energies and perhaps detect new particles that are too heavy to have been produced at the Large Hadron Collider.

But there's another frontier of high precision in which we explore physical processes with higher expectations. The theoretical expectations can be made with great precision, where the detection of even small departures from those predictions can open up a whole new world of previously unknown physics.

And this is particularly true for electron-positron colliders. Electrons and positrons are elementary particles unlike protons and the physical processes that occur when they collide, can be calculated with great accuracy so that we can detect, assuming of course that there's nothing that we don't know about the underlying physics, and by seeing whether the predictions match observations, we can tell whether there is something new like a new kind of particle or a new kind of force.

These electron-positron colliders in particular will be able to produce pairs of particles like the Higgs particle and a Z particle. We know really very well how to calculate that process, then the Higgs will decay. We know how to calculate its decay modes. If it's decaying into something that is not incorporated in our present standard model, we will know that and make a great discovery.

And even of course in that way you can't produce new particles that are heavier than the Higgs particle, but these calculations can be done so accurately because electron positron collisions are so clean. We can even detect effects of the Higgs going out of existence and producing entirely new particles, even particles heavier than the Higgs itself, violating conservation of energy briefly before the particles then disappear back into a Higgs particle or into other ordinary particles that we already know about.

In this way a linear collider that collides electrons and positrons can be a wonderful instrument for discovering new physics. The whole world of physics will benefit from the data produced by such an accelerator. But the country that hosts it will inevitably receive the greatest benefit in the training of a new generation of scientists who conveniently can work in developing accelerator and then using it. But also in technological spin-offs in which accelerator physics is particularly fruitful. I think more fruitful for example than the space program since like online computing, high magnetic field technology, cryogenics and so on.

It's very natural for this accelerator to be cited in Japan. Japan very early took an important position in fundamental elementary particle physics with the theoretical works in the 1930’s of Yukawa and in the 1940’s of Tomonaga. It has in recent decades become an important player in experimental particle physics with the large detector for rare events, the underground Kamiokande. But it has not been active in accelerator physics.

It is time for Japan to begin to play a leading role in that technology and so forth. I think it will be very wise for Japan to host this new accelerator project and I think it will be very wise for the whole world of science to support it, because of the data and the insights that this kind of accelerator will produce.

Nobel Prize in Physics 1979
Dr. Sheldon Lee Glashow

Sheldon Lee Glashow

Born	December 5, 1932
	New York City
Nationality	United States
Alma matter	Harvard University
Institutions	Boston University
	Harvard University
	University of California, Berkeley

Prize Rationale

“for their contributions to the theory of the unified weak and electromagnetic interaction between elementary particles, including, inter alia, the prediction of the weak neutral current”

Boston University College of Arts & Sciences
Department of Physics

Sheldon Lee Glashow
Arthur G.B. Metcalf Professor of Science, University Professor
590 Commonwealth Avenue
Boston, Massachusetts 02215
T: (617) 353-9099 F: 617-353-9393
Email: slg@bu.edu

BOSTON UNIVERSITY

September 11, 2017

The Honorable Shinzo Abe,
Prime Ministers Office
1-6-1 Nagata-cho
Tokyo Japan, 100-8968

Dear Prime Minister,

As a long-time friend of Japanese physics, I write to strongly encourage Japan to implement construction of the International Linear Collider (ILC) on Japanese soil. I shared the 1979 Nobel Prize in Physics for my contributions to today's 'standard theory of elementary particles'. Its central prediction is the existence of the so-called Higgs boson whose effects permeate the universe and are responsible for particle masses. It was first observed in 2012 by experiments at the Large Hadron Collider sited at the Swiss-French border. Although the Higgs was the last particle required by the standard theory, the theory remains incomplete. Additional observable structures simply must exist: to establish mathematical consistency, to explain dark matter and neutrino masses, etc. Indeed, the discovery of the Higgs boson marked the beginning of a new era of elementary particle physics.

With the first phase of ILC constructed, Japan will be poised to lead the new era. ILC can measure the Higgs' properties far more accurately than LHC and is far more likely to discover certain conjectured new particles. As a linear collider, the ILC energy can be increased in a future phase: a big advantage over circular colliders. Particle physicists worldwide eagerly await its realization as a global facility for particle physics over the decades to come. With international participation, it will promote communication and understanding among different nations and cultures.

Japan has a long and illustrious history in basic science and is now ideally situated to make a truly global contribution to the advancement of science and the promotion of world peace. Other nations discuss hypothetical future accelerators, but these — unlike the ILC — have neither been planned, designed nor sited, and are unlikely to be funded in the near future. I strongly hope that Japan will choose to assume a leadership role in basic science by initiating the international effort to construct the ILC in Japan

Respectfully,

Sheldon L. Glashow
Nobel Laureate

Nobel Prize in Physics 1990
Dr. Jerome Isaac Friedman

Jerome Isaac Friedman

Born	March 28. 1930
	Chicago, Illinois
Nationality	United States
Alma matter	University of Chicago
Institutions	Massachusetts Institute of Technology

Prize Rationale

"for their pioneering investigations concerning deep inelastic scattering of electrons on protons and bound neutrons, which have been of essential importance for the development of the quark model in particle physics"

Department of Physics
Laboratory for Nuclear Science

Massachusetts Institute of Technology
77 Massachusetts Avenue, Building 24-510
Cambridge, Massachusetts 02139–4307

Jerome I. Friedman
Institute Professor and Professor of Physics Emeritus

Phone 617–253-7585
Fax 617–253-4360
Email jif@mit.edu

The Honorable Shinzo Abe, Prime Minister
Prime Minister's Office of Japan
1-6-1 Nagata-cho,
Tokyo Japan, 100-8968

Dear Prime Minister Abe,

I would like to thank you for taking time to read this letter. Please allow me to introduce my professional credentials. I am an Institute Professor Emeritus at the Massachusetts Institute of Technology, and was jointly awarded the Nobel Prize in physics in 1990 for the experimental discovery that protons and neutrons are made of quarks. Quarks are key elements of our current theory of particle physics the so-called Standard Model of elementary particles. In this letter, I would like to write about a proposed facility to study particle physics that would advance our understanding of the fundamental structure of nature.

The Standard Model is a beautiful theory and many Nobel prizes resulted in the process of its development. Still, it has several serious problems indicating that it is not the complete theory of nature. One of the major questions concerns the Higgs boson. This particle was theoretically predicted 50 years ago and finally found in 2012 at the proton-proton collider, the Large Hadron collider (LHC), located at the CERN laboratory. This theory postulates that the Higgs particle field fills the vacuum of the universe in order for the fundamental particles to acquire tneir masses. But there is a great problem here. Because of quantum vacuum fluctuations, it is expected that the Higgs mass would have to be much greater than has actually been observed, indicating that there must be new theories beyond the Standard Model. The International Linear Collider (ILC), which collides electrons and positrons, could answer this question and others. The properties of the Higgs boson in the these new theories differ slightly from those of the Standard Model, and could be measured with very high precision at the ILC,. It will also be able to search for new particles predicted by the new theories. The ILC is uniquely suited and has been globally promoted to address these goals.

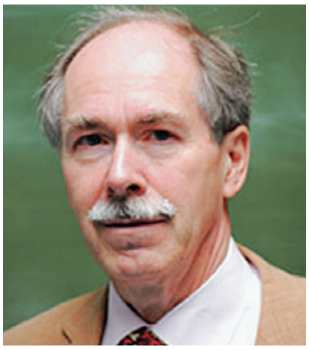
The proton collider LHC that discovered the Higgs boson will continue to run with upgraded intensity. As for the precision measurements of the Higgs properties, the ILC has sensitivity that is equivalent to about a hundred ultimate LHC's running simultaneously. With regard to the discovery of new particles, the discovery of the Higgs boson is a good example. At the LHC, about one million Higgs boson were generated over one year before the Higgs boson was discovered. At the ILC, only a handful of Higgs bosons would need to be generated to make this discovery, which would take only a few hours. Of course, the Higgs boson has already been discovered, but this demonstrates the discovery power of the ILC.

Japan has a long and illustrious history in basic science, and in particular in particle physics. For the progress of global science, I sincerely think it is very important for Japan to maintain a leadership position in particle physics by deciding to host the ILC.

Respectfully,

Jerome I. Friedman
Nobel Laureate, 1990
Institute Professor and Professor of Physics Emeritus
Massachusetts Institute of Technology

Nobel Prize in Physics 1999
Dr. Gerard ‘t Hooft



Gerard 't Hooft

Born	July 5, 1946
	Den Helder, Netherlands
Nationality	Dutch
Alma matter	Utrecht University
Institutions	Utrecht University

Prize Rationale
“for elucidating the quantum structure of electroweak interactions in physics”

Massage

https://www.youtube.com/watch?v=0S-o9h9PKQ4

My name is Gerard 't Hooft. I am a theoretical physicist, such is my interest to try to work on how laws of nature work.

Now, nature is a lot smarter than we are and definitely only thinking about nature doesn't be able to answer. We have to have experimental information

Now, a great accelerator build in Geneva, has revealed the existence of new particle, Higgs particle that we did expect, but we don't understand its details yet. And a new particle accelerator in linear particle accelerator such as the one that might be built in Japan can give us many further details.

Now figuring out how nature works has always been extremely beneficial to humanity. It actually made us what we are today.

Nobel Prize in Physics 2002
Dr. Masatoshi Koshiba

Masatoshi Koshiba

Born	September 19, 1926
	Toyohashi, Aich
Nationality	Japan
Alma matter	University of Rochester
Institutions	Tokai University
	University of Tokyo
	University of Chicago

Prize Rationale

“for pioneering contributions to astrophysics, in particular for the detection of cosmic neutrinos”

Massage

https://www.youtube.com/watch?v=NDWk6osNDTo

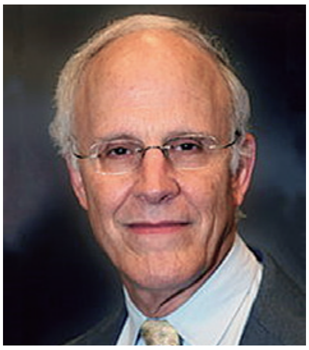
So, what exactly can we learn if we build the International Linear Collider (ILC)? Well to tell you the truth, nobody knows for sure. Try something new and at first, you'll simply be able to say, "I see, so that's what happens when I do this." However, it's not already knowing something that compels us to try something new. Knowing an answer from the outset does not necessitate experimentation. Rather, it's because we don't know that we seek to understand. As to what will come of that quest for understanding, who can say for sure?

Without going in big and pushing our capabilities to the limit, we're much less likely to be rewarded with conclusive results.

Years ago, I was very interested in the electron-positron collider at Budker's (the then director of the Nuclear Physics Institute in Novosibirsk) Institute, and thus, I applied for funding in order to conduct experiments. However, my more established colleagues in the department of physics at Tokyo University unanimously opposed this budgetary request. What was their reasoning? Quantum electrodynamics already understood the ins and outs of electron-positron collisions, they argued, dismissing any interest I might have in researching a seemingly already explainable phenomenon.

However, the department's director at the time, Dr. Kazuhiko Nishijima – a brilliant theorist who has since passed on – took a different view of the matter. Now I'm not sure whether you're aware of this or not, but here is something to understand about theorists in physics: first-rate theorists are well aware of the applicable limitations of their theories, while second-rate theorists see their theories as ideas of endless potential. Anyhow, so there I was, asking for funding to conduct preliminary experiments at the Budker Institute, with the distinguished faculty united in opposition to such a request, saying how quantum electrodynamics tells us everything that needs to be known about the matter in question. Nonetheless, as I remain adamant in my desire to experiment, then-director Dr. Nishijima chimes in saying that such an experiment has never been performed with the amount of energy I had in mind, and thus, let's fund the experiment. And so, when it comes to electron-positron collision experiments, the topic is one linked to many a personal memory.

Nobel Prize in Physics 2004
Dr. David Gross



David Gross

Born	February 19, 1941
	Washington, D.C.
Nationality	United States
Alma matter	University of California, Berkeley
Institutions	University of California, Santa Barbara
	Harvard University
	Princeton University

Prize Rationale

"for the discovery of asymptotic freedom in the theory of the strong interaction"

Massage

https://www.youtube.com/watch?v=wtLKHg2KZuE

I'm a professor David Gross from the Kavli institute for theoretical physics at the University of California in Santa Barbara.

I'd like to speak in strong support for the ILC international linear collider.
A fantastic new accelerator that the Japanese are proposing to build with the help of international collaborators. As a theorist I know very well the importance of experiment through experimental exploration of the frontiers of our field, a study of matter, study of forces, fundamental aspects of the physical reality.

When I was a young man working on the nuclear force, there was the experiment at the Stanford Linear Accelerator that was crucial in our development of the theory of the nuclear force that eventually led to the Nobel Prize in Physics.

Similarly the recent groundbreaking discovery of the Higgs particle at the Large Hadron Collider at CERN has opened up exciting new prospects for further experimental exploration of the property of the Higgs, the promise of new particles, new forces, and certainly new understanding at even higher energies.

The international linear collider: ILC is one of the most exciting prospects to make these discoveries and I applaud the Japanese government and my Japanese colleagues for leading the effort to host the ILC in Japan. I trust and hope that international community at large will join in this very important effort to build this exciting new collider

Nobel Prize in Physics 2008
Dr. Toshihide Maskawa

Toshihide Maskawa

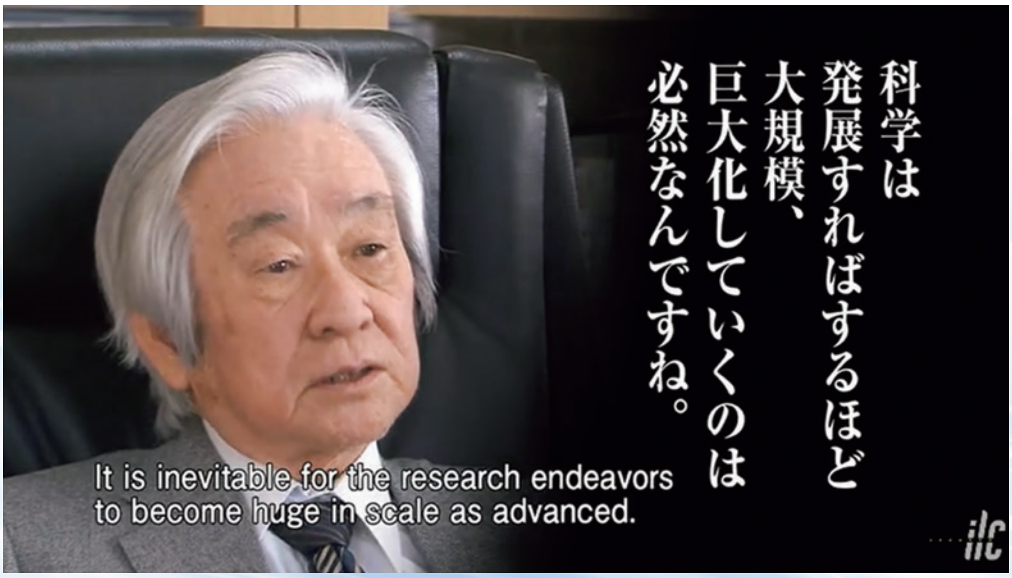
Born	February 7, 1940
	Nagoya, Aichi
Nationality	Japan
Alma matter	Nagoya University
Institutions	Kyoto Sangyo University
	Kyoto University
	Nagoya University

Prize Rationale

“for the discovery of the origin of the broken symmetry which predicts the existence of at least three families of quarks in nature”

Massage

https://www.youtube.com/watch?v=NK5T1EcZDeA



With continual scientific advancement comes the inevitable growth in both the size and scale of the science we perform.

Japan's High Energy Physics Group has received universal acclaim, and it's truly a wonderful feeling. Personally, I feel like Japanese people are suited to such scientific endeavors.

Assuming it's at all possible to bring the International Linear Collider (ILC) to Japan – a project of worldwide discussion as it is – then by all means let's make this vision a reality! I think it would be huge not only for Japan, but moreover for Asia in particular, if Japan were to house the ILC. Several countries across Asia have and continue to play invaluable roles in this effort, and as such, we must go the extra mile to seize this opportunity, lest it slip away. I feel that a more centralized Asian perspective can help lead us towards a new phase of scientific ingenuity.

Japan is indeed capable of contributing to our global society in numerous ways, yet I believe that it is science most of all where Japan can be of greatest service. Now is that time. Now is Japan's moment to show the world just how much we can do.

Nobel Prize in Physics 2008
Dr. Makoto Kobayashi

Makoto Kobayashi

Born	April 7, 1944
	Nagoya, Aichi
Nationality	Japan
Alma matter	Nagoya University
Institutions	High Energy Accelerator Research Organization
	Kyoto University

Prize Rationale

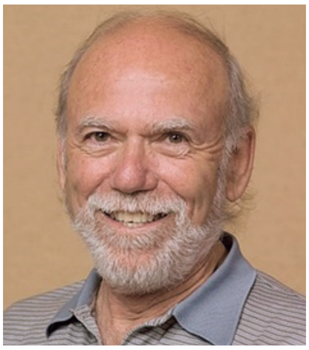
"for the discovery of the origin of the broken symmetry which predicts the existence of at least three families of quarks in nature"

The history of accelerator science dates back to the 1930s with the invention of the cyclotron, and during this period, Japan was conducting research on par with international leaders in the sciences. World War II unfortunately interrupted said efforts, causing Japan's experimental research in particle physics to fall behind that of the West. Nonetheless, the determination of those working in the field coupled with government backing allowed for the achievement of breakthrough results including but indeed not limited to B-Factory and Neutrino Oscillation.

At present, Japan is again a world leader in such research, and with the International Linear Collider (ILC) posed to pass this torch onto the next generation, there are great expectations for Japan's role in accelerator science.

Particle physics research aims to understand the natural laws of our universe at its most fundamental level, and we now stand at the cusp of a new era where we seek a unified understanding of these laws. The ILC is an electron-positron collider that allows us a precise, clean means of experimentation from which we can expect to inherit invaluable information pertinent to the direction of future research. Such studies can paint a clearer picture of the most basic mechanisms of nature, which in turn deepens our overall understanding of our world, thus allowing for greater collective consolidation of knowledge. Indeed, one of humanity's most valuable assets is access to such an evolving organization of knowledge. Building the ILC is a possibility born from years of exhaustively examining project intricacies both scientific and technological, and now here we are in the eleventh hour, so close to making this dream a reality. I hope for your support in this endeavor.

Nobel Prize in Physics 2017
Dr. Barry Barish



Barry Barish

Born	January 27, 1936
	Omaha, Nebraska
Nationality	United States
Alma matter	University of California, Berkeley
Institutions	California Institute of Technology

Prize Rationale

"for decisive contributions to the LIGO detector and the observation of gravitational waves"

CALIFORNIA INSTITUTE OF TECHNOLOGY

LASER INTERFEROMETER GRAVITATIONAL-WAVE OBSERVATORY (LIGO) PROJECT
CHARLES C. LAURITSEN LABORATORY OF HIGH ENERGY PHYSICS
21-October-2017

The Honorable Shinzo Abe, Prime Minister
Prime Minister's Office of Japan
1-6-1 Nagata-cho,
Tokyo Japan, 100-8968

Dear Prime Minister,

A few weeks ago, I was jointly awarded a Nobel Prize alongside Kip Thorne and Reiner Weiss for the detection of gravitational waves, predicted by Albert Einstein in 1916. This letter, however, is to urge Japan to take the critical positive decision to host the International Linear Collider (ILC). I served as Director of the international design group for the ILC from 2005 to 2013, during which time we completed the technical design. I understand well the great scientific potential of the ILC and I firmly believe this is the most important future particle physics project worldwide.

In elementary particle physics, we have a theory we call the Standard Model that represents the culmination of all the theoretical and experimental achievements starting from the discovery of electron. At the base of this successful theory is the Higgs particle that fills the entire universe and explains the existence of mass. In 2012, the Higgs particle was discovered at the CERN Large Hadron Collider near Geneva, resulting in a Noble Prize for Peter Higgs and another theoretical physicist. This was the last member of the Standard Model of particle physics and its the most important.

The discovery of the Higgs particle began an exciting new era for particle physics just as the discovery of gravitational waves is now opening a new dimension in the field of cosmology. The Standard Model of particle physics, however, contains serious flaws. Most importantly, it does not contain any candidate for the dark matter that we know exists, the mass of the Higgs particle itself is self-contradictory in the theory, and the theory does not explain why the Higgs particle filled the universe, to name a few fundamental problems. There are new theoretical ideas that attempt to fix these problems. However, to find the correct description of nature, we must experimentally discover the precise properties of the Higgs particle. It is also likely there are other new particles or phenomena to discover that tell us what lies beyond the Standard Model.

The ILC collider is the right instrument to resolve these questions, because the electron and its antiparticle resulting in simple events while the Large Hadron Collider collides two complex and composite particles; namely, protons, giving complicated events with many particles that mask the interactions we need to study. The ILC will measure the properties of the Higgs particle with far better sensitivities than the Large Hadron Collider, and has capability to find new particles that evade detection by the LHC.

Finally, the ILC is flexible and will have a very long-term future, because the collision energy of a linear collider can be increased by simply making it longer or using stronger accelerating force. This is a unique advantage compared to large circular colliders, like the CERN LHC. The ILC will begin as a Higgs factory and can later be upgraded straightforwardly to higher energies, if desired, giving it a decades long science life.

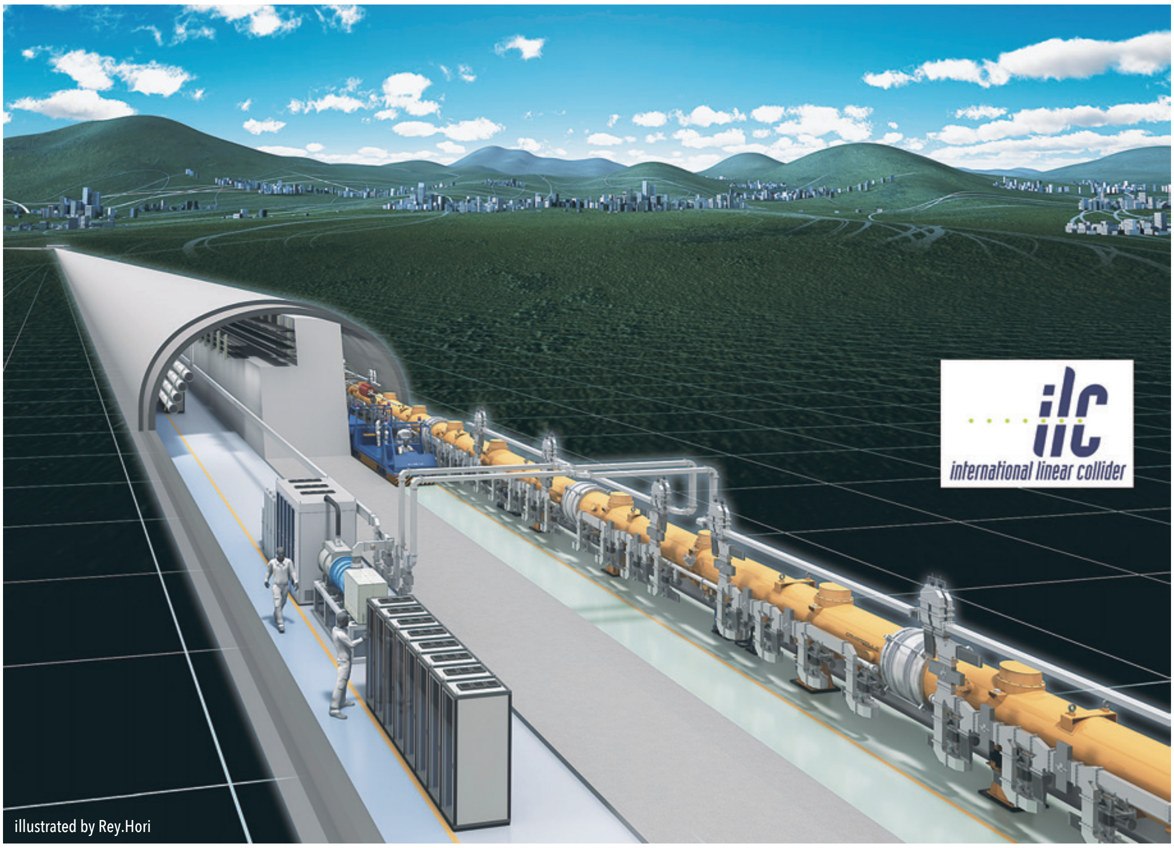
The ILC will be a centerpiece of particle physics for decades to come. We have learned from CERN that the best and brightest researchers from all over the world will converge and form a vibrant international academic community around such a facility. Therefore, the ILC will have profound cultural and economic impacts within Japan for years to come.

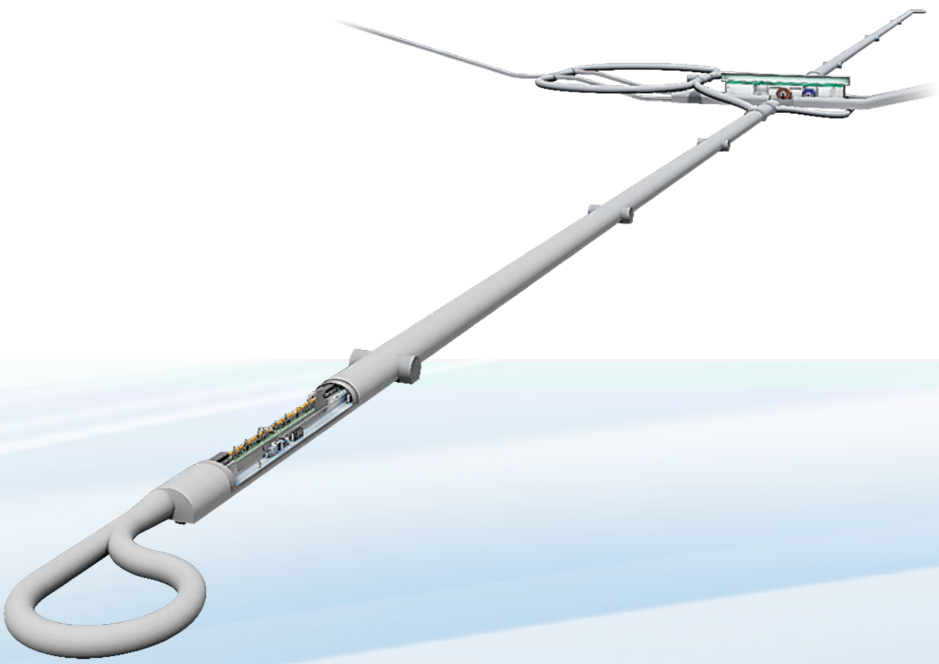
Japan has an unique opportunity at this time to host the central future facility of one of the most fundamental fields of research. I sincerely hope that Japan will seize this opportunity and take the critical decision to host this fantastic project.

Yours faithfully,

Barry C. Barish

Barry C. Barish
Linde Professor of Physics, Emeritus
Nobel Laureate 2017





Video Message : courtesy of Linear Collider Collaboration (LCC) and High Energy Accelerator Research Organization (KEK)
Nobel Laureate Data : by WIKIPEDIA