Tentative Translation

Summary of Discussions on Issues

Relating to the International Linear Collider (ILC) Project

February 14, 2022

International Linear Collider (ILC) Advisory Panel (Second Phase)

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1. Background to the Study and Position of this Summary

(1) Background and History of the ILC Project up to the First Phase ILC Advisory Panel

The International Linear Collider (hereinafter referred to as “ILC”) Project, which was originally planned to deliver electron-positron collisions at 500 GeV for experiments using a 30-km long linear accelerator, has been expected to advance particle physics into a new stage and eventually elucidate how the universe was created through an in-depth investigation of the nature of the Higgs boson, a particle to generate the origin of mass, and through discovering new particles beyond the standard model.

Subsequently, the international community of particle physics researchers initiated a design effort for the ILC as a global project and completed the *Technical Design Report* (hereinafter referred to as “TDR”) in June 2013. The international community of researchers who proposed the ILC Project (hereinafter referred to “proposing researchers”) later gave their support to the ILC being constructed in Japan, and there has been a campaign in Japan inviting the ILC in the hopes of developing an international science city.

Under these circumstances, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) established the ILC Advisory Panel (hereinafter referred to as the "First Phase Advisory Panel") within MEXT in May 2014 to study the various issues relating to the ILC Project in response to the opinion of the Science Council of Japan (SCJ) given in September 2013. Several working groups were established in the First Phase Advisory Panel, to study the scientific significance matching the huge investment, costs and technical issues of the TDR and so on.

In the meantime, the First Phase Advisory Panel re-examined the revised plan to reduce the collision energy of the ILC from 500 GeV to 250 GeV, which was proposed by the international community of proposing researchers based on the experimental results of the Large Hadron Collider (LHC), and in July 2018, the First Phase Advisory Panel summarized the issues relating to the comprehensive aspects of the ILC Project in the “*Summary of the ILC Advisory Panel’s Discussions to Date after Revision”* (hereinafter referred to as the "*First Phase Advisory Panel Report*").

(2) Situation Since the First Phase Advisory Panel Report

After the First Phase Advisory Panel summarized the results, the SCJ conducted a re-deliberation at the request of MEXT and a summary, "*Assessment of the Revised Plan of International Linear Collider Project"* in December 2018. The report suggested that the government should be cautious regarding a decision to announce its commitment to host the ILC Project in Japan, since it did not reach a consensus to support hosting the ILC Project in Japan by reason of the expected scientific outcomes not being worthwhile for Japan, which was supposed to bear the major part of the huge costs required to achieve them, concerns about the technical feasibility, the prospects of appropriate international cost sharing being unclear, and so on.

In March 2019, MEXT expressed "*MEXT's view in regard to the ILC Project"*, based on the opinions of the SCJ as well. The views included were: (i) MEXT has not yet reached declaration for hosting the ILC in Japan at this moment, (ii) the ILC Project required further discussion in formal academic decision-making processes such as the SCJ Master Plan, where it has to be clarified whether the ILC Project can gain understanding and support from the domestic academic community, (iii) MEXT will pay close attention to the progress of the discussion at the European Strategy for Particle Physics Update, (iv) MEXT will continue to discuss the ILC Project with other governments while having an interest in the ILC Project, and so on.

Later, in January 2020, the SCJ formulated the "*24th Master Plan for Large-Scale Research Projects in Academia"* (Master Plan 2020), but the ILC Project was not selected as a priority large-scale research project to be implemented immediately. In September of the same year, the Council for Science, Technology and Academia of MEXT formulated the "*Basic Concept Roadmap for the Promotion of Large-Scale Projects in Academic Research"* (Roadmap 2020), but the ILC Project was not listed due to the withdrawal by the applicant.

In June 2020, *Update of The European Strategy for Particle Physics* was formulated by the European Organization for Nuclear Research (CERN). The strategy stated that an electron-positron Higgs factory "is the highest-priority next collider" and that Europe should investigate the technical and financial feasibility of a future hadron collider with an electron-positron Higgs factory as possible at the first stage. Regarding the ILC Project, as one of the Higgs factories, it was stated that "the timely

realization of the electron-positron International Linear Collider (ILC) in Japan would be compatible with this strategy and, in that case, the European particle physics community would wish to collaborate."

The international community of the proposing researchers established the ILC International Development Team (IDT) in August 2020 and published the "*Proposal for the ILC Preparatory Laboratory"* in June 2021. In addition, in Japan, the Japan Association of High Energy Physicists (JAHEP) and the High Energy Accelerator Research Organization (KEK) published a document "*Major Issues Related to the ILC Project"*, which summarized the responses to issues relating to the ILC Project that had been pointed out up until that time.

(3) Position of this summary

In response to the release of two reports from the domestic and international communities of proposing researchers mentioned above, MEXT restarted the ILC Advisory Panel (hereinafter referred to as "Second Phase Advisory Panel") in July 2021 in order to follow up on the progress of various issues pointed out by the First Phase Advisory Panel on the entire ILC Project from an expert perspective and to clarify the latest situation affecting the ILC Project as much as possible.

In the Second Phase Advisory Panel, based on the two reports from the community of proposing researchers, and referring to the latest information obtained through the exchange of opinions with the proposing researchers and additional questions, as well as the latest information on domestic and overseas trends provided by MEXT, the views of the Second Phase Advisory Panel were compiled here as *Summary of Discussions on Issues Relating to the International Linear Collider (ILC) Project*.

2. Various Issues Pointed Out Concerning the ILC Project

Based on the First Phase Advisory Panel Report (July 2018) and the assessment of the SCJ (December 2018), the main issues relating to the ILC Project were summarized as follows. An exchange of opinions was held with the proposing researchers on the progress of these issues.

(1) Prospects for International Research Cooperation and Cost Sharing

a) Realistic and sustainable international cost sharing, including sufficient contributions from non-host countries

b) Approval of the project by the science councils of the countries concerned and progress in discussions towards securing the funding from the governments of the countries concerned

c) Clear prospects for the development and securing of human resources under the premise of international cooperation

(2) Academic Significance and Support from the Public and Scientific Communities

a) Organization of the significance of hosting the ILC in Japan compared to participation in the Future Circular Collider (FCC) in Europe

b) Discussions on human resource allocation and budget allocation in the field of particle physics, and discussions on the positioning of the ILC Project, including large-scale projects in various academic fields

c) Broad support from the public and scientific communities for expected achievements

d) Technological and economic impacts

(3) Clarification of Technical Feasibility

(i) ILC Accelerator

a) Clarification of the target performance of beam dump, electron source/positron source, beam control, damping ring, measuring equipment, and consideration of process schedule

b) Improvement of yield and performance of superconducting acceleration cavities, cost validation, and quality control

c) Consideration of rising costs and countermeasures in case of failure to proceed as planned

(ii) Civil construction and environmental/safety measures

a) A plan that includes the calculation of costs for measures to deal with unforeseen situations, such as earthquakes and fires, measures to deal with groundwater flooding assuming various scenarios, and seismic design.

b) Securing methods and disposal sites for handling large amounts of excavated residual soil

c) Study of and measures to deal with the impact on construction costs and construction period in the event of a large volume of seepage

d) Environmental surveys and soil erosion countermeasures in the vicinity of mine mouths and dumping grounds for excavated soil

e) Study of radiation protection measures, long-term maintenance and management of radioactive materials, and support from local residents

f) Clarification of the environmental assessment policy that takes into account the potential for widespread groundwater level decline

(4) Appropriateness of Cost Estimates

a) Calculation of currently unaccounted costs and how they should be borne

b) Careful attention to the risk of incurring additional costs (technology, extended construction period, market, etc.)

(5) Prospects for development and Securing Human Resources

a) Leaders who are responsible for overall coordination and accelerator researchers who are responsible for total project management

b) Identifying the location of human resources in Japan and consideration of a human resource development plan

c) Consideration of amount of human resources available to supply and timely international sharing

d) Consideration of environmental improvements for foreign residents, including housing environment and support for family life

(6) Views on Proposal of the ILC Preparatory Laboratory

a) Establishment process, budget, and organization as indicated in the *"Proposal for the ILC Preparatory Laboratory"*(prospects for the development of a framework for international cooperation, discussions among KEK and researchers concerned from various countries, communication among governments and researchers in the countries concerned, etc.)

3. Current Status of Various Issues Concerning the ILC Project

Regarding the progress and domestic and overseas trends made over the past three years since the First Phase Advisory Panel Report, the current status of various issues with the ILC Project can be summarized as follows, based on the contents of the reports published by the proposing researchers, exchanges of opinions with the proposing researchers, and information on its international status obtained from MEXT.

(1) Points Discussed So far Regarding the ILC Project

(i) Prospects for International Research Cooperation and Cost Sharing

After 2019, MEXT exchanged opinions with the governments of the countries concerned, and the results were reported in the Second Phase Advisory Panel. The latest situation seems to be the governments of France, Germany, the United Kingdom, and the United States do not have any intention of hosting the ILC in their own countries, and in relation to international cooperation on the ILC Project including cost sharing, there is no information that these countries have implemented budgetary measures corresponding to the proposal of the ILC Preparatory Laboratory. Individually, France is considering no funding for the ILC Project due to its difficult financial situation, Germany and the United Kingdom say that it is difficult to discuss the ILC Project in the absence of Japan's statement of hosting the ILC Project due to its difficult financial situation as well, and the United States continues to be supportive for a Japanese initiative to advance the ILC Project under the premise that Japan hosts the ILC Project, and will determine its specific contribution during the ILC Preparatory Laboratory phase.

At the moment, France, Germany, and the United Kingdom are revising their roadmaps including the field of particle physics based on the *European Strategy for Particle Physics 2020*, but there is no prospect that the ILC Project will be part of these. As for trends in Europe as a whole, the status of CERN's *European Strategy for Particle Physics 2020* is as described above, and reflecting this, in Roadmap 2021 of the *European Strategy Forum on Research Infrastructures* (ESFRI)[1] published in December 2021, the Higgs factory has not yet been discussed much.

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[1] Consists of members nominated by the EU member states' ministers responsible for research and the representatives of the European Commission and has a role in responding to consultations from the Council of Ministers. https://www.esfri.eu/

In response to such a report by MEXT on the situation of the governments of the countries concerned, the following opinions were expressed at the meeting of the Second Phase Advisory Panel.

- It seems there has been no significant changes in the prospects for international cost sharing over the past three years.
- The countries concerned are all in a difficult financial situation. Unless Japan takes the lead in the discussions, the status quo will not move forward.
- In light of Japan's current economic situation and the situation that the world is facing with the COVID-19 crisis, global warming, and other issues, it will be difficult for Japan to make a decision unless the countries concerned come to a compromise, such as Europe and the United States bearing their appropriate share of the costs.
- The priority of this field is not high in the world. It seems that the time is not ripe for discussions among the countries.
- We should start by creating an environment for jointly developing the technology, rather than immediately discussing the hosting issue and cost sharing.
- The impression is that there is only one facility of this scale in the world, including the FCC.

From the above, it can be said that at the governmental level of the countries concerned, the situation is still unchanged with no domestic roadmap or official budgetary position for the ILC Project and no clear prospect of specific participation and cost sharing by the governments of the countries concerned as pointed out by the First Phase Advisory Panel.

About 10 years have passed since the international community of researchers first began discussing the ILC Project on the assumption that it would be hosted in Japan. In some academic international projects that have been led by the research community in the fields of particle physics and high energy physics, there are case examples of a specific country taking the initiative to build and operate the project on its own, becoming a so-called “host country” and bearing the major part of the costs. Yet, compared to previous academic international projects, the ILC Project has an unusually large scale

comparable to large-scale international joint projects, such as the ITER Project[2] in the field of fusion energy. Considering the fact that the project requires such a huge amount of budget, the fact that the hosting issue, which directly impacts the discussion of cost sharing, has already been included in the discussion of the ILC Project before the process of various technical feasibilities, consensus building, is one of the major factors that have made the discussion of the international cooperation framework, including international cost sharing, difficult.

In addition, as for the FCC, one of the future collider accelerator projects in Europe, a feasibility study (FS) has been initiated, and several Higgs factories, including the ILC project, are now being considered around the world. The scale of the budget for these proposals would be difficult to realize unless each of the participating countries were to bear a considerable amount of the cost and work together, and rather than examining multiple proposals individually, it may be necessary to examine them internationally from the perspective of academic research strategies; first how to realize a single Higgs factory in the world, and then how to further develop this field. The view presented to MEXT by the French Ministry of Higher Education, Research and Innovation (Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation/ MESRI) also states that discussions in a global context are necessary on the Higgs factory, when they discussed multiple proposals including the FCC.

As pointed out by the First Phase Advisory Panel, a large-scale international joint project requires a considerable financial burden on the countries concerned, and it is essential to obtain the approval and endorsement of the governments and parliaments of the countries concerned and broad public support. The governments of the countries concerned will be able to have discussions that include cost-sharing with a positive attitude only when such momentum and environment are cultivated within each country, and the countries concerned approach each other to realize the project.

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[2] When the construction of the ITER Project was started, it was expected that the total project cost would be 11.3 billion euros (about 1.7 trillion yen), including about 5 billion euros (about 755 billion yen) for the construction of the main unit, over a period of 35 years, including 10 years for construction and 20 years for operation.

("Launch of the International Thermonuclear Fusion Experimental Reactor Project: Establishment of the ITER Organization and "Broader Efforts" - ("Research and Information - ISSUE BRIEF-", No. 577, Research and Legislative Review Bureau, National Diet Library (March 28, 2007)))

(ii) Academic Significance and Support from the Public and Scientific Communities.

In the Second Phase Advisory Panel, the proposing researchers explained the academic significance of the ILC Project regarding the precise measurement of the Higgs boson based on the latest results obtained through the activities of domestic and overseas research organizations including CERN.

It was also reported that the activities such as lecture meetings were being implemented in the areas, mainly where the community of proposing researchers envisages as domestic candidate sites, and that the newly established ILC Japan was strengthening efforts to gain the broad support of the public and scientific communities.

Meanwhile, the ILC Project is positioned as a top-priority project by the domestic particle physics community, but there has not yet been a comprehensive discussion that goes into the prioritization of large-scale projects, including other physics fields and an even broader range of fields. In addition, as mentioned earlier, the ILC Project was not selected as a high-priority project to be implemented immediately in the SCJ's Master Plan 2020.

In response to the explanation on the above situation, the following opinions were expressed at the meeting of the Second Phase Advisory Panel:

- In the past three years, the basic academic significance of the ILC Project has not changed. It may rather increase when there is no significant progress in the world.
- As society is turning inward, the science of sharing dreams with society is important.
- There are only insufficient explanations from the point of view as to whether or not the ILC Project has academic significance worthy of a budget of over 1 trillion yen. A persuasive explanation that can be understood by the public and other scientific communities is necessary.
- Research facilities have tendency of growing in size, not limited to the field of particle physics, and the fact that research will not end there but will lead to further demands, is an issue from the perspective of the sustainability of science.

- Is there any progress in getting support from researchers in completely unrelated fields (e.g., humanities and social sciences) or from other regions than the candidate sites? Sufficient efforts have not yet been made.
- As explained by the proposing researchers, it is important to promote an understanding of the expansion of the ILC Project, including the development of technologies applicable to other fields and the possibility of constructing beamlines without compromising the original purpose of the project.
- The primary objective of the ILC Project is to perform the elementary particle experiments. It is necessary to persist in clarifying the main objective, assuming that it is not a complex facility like J-PARC.
- Evidence is needed to evaluate whether the development of two-way communication with the public is progressing.
- In visiting classes for elementary and junior high school students, consideration should be given to separating promotion of interest in science from promotion of the project.
- Giving high expectations to international communities repeatedly and making no progress will undermine confidence in Japan's particle physics community.

In light of these discussions, it has to be said that, although the basic importance of academic significance remains unchanged, the current situation is that sufficient support is not yet obtained from the public and the broader scientific communities, including the understanding of the point whether the outcomes are of considerable academic significance worth huge investments.

More improvements and efforts are required for the ILC Project to demonstrate the scientific achievements and academic significance to the public, which is the original objective of making such a huge investment.

In addition, the community of proposing researchers is required to understand the current state of society from a broad perspective, including the current situation where the world is facing urgent issues, such as the COVID-19 crisis and climate change, and develop a realistic and effective project. In addition, it would be effective to deepen communication with the public while presenting the expected technological development and ripple effects of the promotion of the ILC Project, as well as

the associated social and cultural significance of the project, such as the significance of inviting an international research institute. In doing so, it is also important to make efforts to grasp and evaluate the progress of public support through the use of questionnaires to the public and crowdfunding.

In communicating with the public, it is important not to be biased towards any particular region, and it is essential to make efforts to conduct two-way communication based on careful explanations that include academic significance, expected technological, environmental and safety issues.

(iii) Clarification of Technical Feasibility and Appropriateness of Cost Estimates

With regard to accelerator technology, the proposing researchers explained the status of their efforts to address each of the issues pointed out in the First Phase Advisory Panel Report, and a certain amount of progress was recognized in the creation of new knowledge and the organized future issues. On the other hand, according to the plan of the proposing researchers, the remaining issues of key technologies (superconducting radio frequency technology, positron source, damping ring, beam control, beam dump, etc.) that will significantly impact the design of the main accelerator unit including the experimental performance goals are to be addressed by the ILC Preparatory Laboratory.

With regard to civil engineering and environmental measures, it was reported that certain assessments regarding technical feasibility and cost estimations were being conducted under a cooperation of relevant parties in specific regions on the premise that the construction sites were not yet specified.

In response to these explanations, the following opinions were expressed by the Second Phase Advisory Panel. Note that the discussion in the meeting of the Second Phase Advisory Panel focused on the future direction of the ILC Project, including the ILC Preparatory Laboratory; hence no detailed evaluation of individual technical issues was conducted.

- Regarding the technical issues planned for the ILC Preparatory Laboratory, there may be technical developments that can be practically carried out without a framework of the ILC Preparatory Laboratory. We understand that an engineering demonstration is necessary.

- Even if an elemental technology has been developed, whether it will function as an assembled engineering system is another issue.
- It is realistic to put off issues related to the site and move forward with accelerator development first.
- The proposal of the ILC Preparatory Laboratory appears to be a hasty move. It is necessary to have a sufficient discussion in the community.
- This is a very large project, and it is important to take an appropriate step forward in order to proceed with it. If it is to proceed, it is understood that there is a part of the project that can only move forward with a technological development on a scale not possible with Grant-in-Aid for Scientific Research.

In light of these discussions and the situations relating to the issues in (i) and (ii), it is not appropriate to step into the process of the ILC Preparatory Laboratory proposed this time, although some progress is recognized on various issues regarding technical feasibility.

Although there is a shared understanding that prototype development and engineering demonstration tests will be necessary to improve the technical feasibility and accuracy of cost estimations, as described in (2) below, it has to be said that it is currently difficult to proceed with R&D in the framework of the ILC Preparatory Laboratory based on the premise that the Japanese government will express its interest in hosting the ILC in Japan. It has become necessary for the proposing researcher community to reconsider how to proceed with R&D and international research cooperation (including clarification of performance goals in experimental aspects that are closely related to academic significance) in a manner different from the process of the proposed ILC Preparatory Laboratory.

In addition, the European XFEL, which has the same type of superconducting acceleration cavity implemented, has already started operation. Although the conditions are different, it is important to conduct a detailed analysis of the operation status and achievements of the European XFEL, and to more precisely assess the technical aspect and cost risks.

(iv) Others

Regarding the prospect of development and securing of human resources, the proposing researchers explained the scale of specialized human resources expected to be necessary, the expected changes in the number of relevant human resources over time based on the ongoing accelerator construction projects, and the feasibility of securing human resources. In response to that, the following opinions were expressed by the Second Phase Advisory Panel.

- It is important that the research institutes of the countries concerned regard the ILC Project as their own project. When the ILC Project is realized, it is necessary that the research institutes of the countries concerned provide human resources who will be able to play a key role in the project.
- In terms of securing human resources for an international project, a wide range of human resources, such as international law, international logistics, civil construction, management, human affairs, and labor management, are needed, not to mention researchers and technicians.

The prospect of developing and securing human resources has a great deal to do with how the overall project is carried out as a premise, and due to large uncertainties under the situation in the absence of an overall project, it may be necessary to consider this issue in conjunction with other important issues.

(2) Views on the Proposal for the ILC Preparatory Laboratory

At the Second Phase Advisory Panel, the proposing researchers explained the background that led to the Proposal for the ILC Preparatory Laboratory, the objectives of the proposal, and the work plan and estimated costs (approximately 23 billion yen) that are envisaged for the ILC Preparatory Laboratory. In this context, a request was made by the proposing researchers that the Japanese government show a positive attitude towards hosting the ILC in Japan since the Proposal for the ILC Preparatory Laboratory states that in order to proceed to the process of the ILC Preparatory Laboratory, it is necessary that the Japanese government expresses its interest in hosting the ILC in Japan and invites partner states to discuss the processes toward the realization of the ILC Project.

In response to these explanations, the following opinions were expressed at the Second Phase Advisory Panel.

- It is understood that starting the ILC Preparatory Laboratory will maintain the interest of the countries concerned and increase the reality towards the realization of the ILC Project, but it should be done step by step, starting with small-scale projects, such as the preliminary stage of the ILC Preparatory Laboratory.
- The ILC Preparatory Laboratory itself costs a large amount, and it could happen that the results of the study may indicate that the project is not worth the cost. Is this acceptable?
- Assuming the scale of the proposed cost, it is not a bad idea from the perspective of advancing the discussion in the future.
- There is no point in discussing the appropriateness of this proposal itself now. The most important point is the question of whether the Japanese government is able to accept the proposal from the researchers, which assumes that the ILC Project will be hosted in Japan.
-In light of the MEXT minister's reply in the Diet deliberation[3], it would be better to temporarily decouple the site-related issue and focus on technological development, rather on the premise of hosting the ILC Project in Japan.
- One idea would be to establish a cooperative framework among laboratories in the countries concerned to carry out necessary technological development for the time being.

Based on these discussions, it is considered difficult to gain public support for proceeding with the process of the ILC Preparatory Laboratory, given that, as already discussed, there is still no prospect for international cost sharing for the ILC Project, and the support of the public and scientific community is not yet sufficient. Considering the MEXT minister’s reply regarding the ILC

[3] In February 2021 in the Diet deliberation, the minister of MEXT, Hagiuda (at that time) replyed, "Under the current situation that the perspective of broad internal and external cooperation for the ILC Project itself as well as its preparatory laboratory is not promised, it is difficult to obtain the Japanese citizens' understanding for investing in the preparatory laboratory. It is necessary to obtain the clear perspectives on financial contributions to the ILC Project itself by the United States and European countries prior to considering the pre-lab budget."

Preparatory Laboratory in the Diet deliberation as well, it has to be said that, regardless of the appropriateness of the individual details of the proposal, it is premature to make a decision on the transition to the ILC Preparatory Laboratory under the current circumstances, on the premise that the Japanese government will express an interest in hosting the ILC Project in Japan.

As discussed so far, it is necessary for the community of proposing researchers to reconsider how to proceed with research and development and international research cooperation in a manner different from the process of the ILC Preparatory Laboratory proposed this time, such as by proceeding from a more realistic scale, taking into account the situation of each research institute, and jointly developing the necessary technology for the realization of a future Higgs factory by the research institutes of the countries concerned.

4. Summary

Summarizing the above discussion, as for the current status of the various issues of the ILC Project, about three years after the First Phase Advisory Panel Report, there has been no significant progress that would clarify the ILC Project's future prospects although some technical progress has been made. In light of these circumstances, it has to be said that it is not currently possible to support a transition to the ILC Preparatory Laboratory phase on the premise that Japanese government will express an interest in hosting the ILC in Japan and on the proposed scale as desired by the proposing researcher community, and that it is premature to do so.

Having said the above, from the perspective of hoping for the future continuous development of this field, the Second Phase Advisory Panel would like to add the following comments:

Particle physics and accelerator science as its basis are the fundamental science fields in which Japan has a strong global presence and many Japanese Nobel laureates were produced till today. An understanding was also shared in the Second Phase Advisory Panel that Japan is expected to continuously produce world-leading research results in the future and to further promote this field. In addition, the domestic community's activities themselves should be appreciated for advocating the linear accelerator to the world, an important perspective in the development of particle physics. Looking ahead to the future of particle physics, the significance of the precise measurement of the Higgs boson, which is expected to lead to the exploration in physics beyond the standard model, will be unchanged. On the other hand, in light of the recent difficult financial situation of the countries concerned, it is time to reconsider how to proceed with the ILC Project, which is to be mainly led by the community of proposing researchers. In this reconsideration, the discussion should not be confined to the ILC Project alone; it is necessary to take into account the status of the FCC's feasibility study (FS) currently underway and to broadly consider the following matters: how to envision the future and continuous development of particle physics/accelerator science, how to restructure the international R&D strategy for the Higgs factory, including the ILC and the FCC, on a mid- to long-term time scale; and what the core issues of the strategy are.

During this reconsideration, for the ILC Project, rather than sticking to the ILC Preparatory Laboratory proposed this time, the hosting issue, which has a direct impact on the discussion of international cost sharing, should be temporarily decoupled. Taking the latest technological trends into consideration, the research organizations of the countries concerned should work out the technical issues that will be strategically important for development of next-generation accelerators through reinforced collaboration while properly sharing the roles, seek an approach that can be steadily implemented, and develop R&D step by step, reflecting various circumstances.

In order to achieve such a huge project, it is important to foster an environment in which the government officials of the countries concerned can discuss while going through the appropriate procedures within each country and sharing their respective circumstances, referring to the past consensus-building process in large international collaboration projects, such as the ITER Project.

It is also important for the community of researchers to build steady efforts for maintaining trust among the people involved and deepening mutual understanding through two-way communication in order to expand support by various stakeholders in Japan and overseas, sharing the understanding of the original objectives of the project and its ripple effects. As for building a relationship with stakeholders, we look forward to future activities of ILC Japan, which was newly established last year.

Once again, we hope that the global community of particle physics and accelerator science will undertake realistic considerations for future development, while involving young researchers who will be pioneers for the future.

Reference Materials

International Linear Collider (ILC) Advisory Panel (Second Phase) Membership

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OKAMURA Sadanori	Professor Emeritus, The University of Tokyo
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KOISO Haruyo	Professor Emeritus, High Energy Accelerator Research Organization (KEK)
SHINYO Takahiro	Trustee, Kwansei Gakuin University, Dean of Integrated Center for UN and Foreign Affairs Studies, Professor
TOJIMA Wako	Journalist
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◎ Chair, ○ Deputy Chair (as of July 2021)

Background to the Study

1st July 29, 2021

- Meeting operations of the ILC Advisory Panel
- How to proceed with the ILC Advisory Panel
- Recent trends in the ILC Project
- Perspectives on the progress check of various issues related to the ILC Project

2nd October 14, 2021

- Discussions with Proposing Researchers
  (1) The ILC Project overview and background
  (2) Technological feasibility and appropriateness of cost estimation (accelerators etc.)
  (3) About the proposal for the ILC Preparatory Laboratory

3rd October 18, 2021

- Discussions with Proposing Researchers
  (1) Technological feasibility and appropriateness of cost estimation (civil and environmental/safety measures)
  (2) Academic significance and understanding of the public and scientific community
  (3) Prospects for international research cooperation and cost sharing
  (4) Prospects for training and securing human resources, and others

4th November 29, 2021

- Additional questions
- The latest trends in Europe and the U.S.
- Discussion overall

5th December 21, 2021

- Additional questions after the fourth Advisory Panel meeting
- Summary of discussions (draft outlines)

6th January 20, 2022

- Summary of discussions (draft)