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High Energy Accelerator Research Organization

KEKの取り組み
KEK's efforts

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High Energy Accelerator Research Organization (KEK)
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Summer camp on ILC accelerator, physics and detectors 2020 [Online]

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- Recent progress in ILC project
- Update of the European Strategy for Particle Physics
- Establishment of International Development Team
- Steps forward

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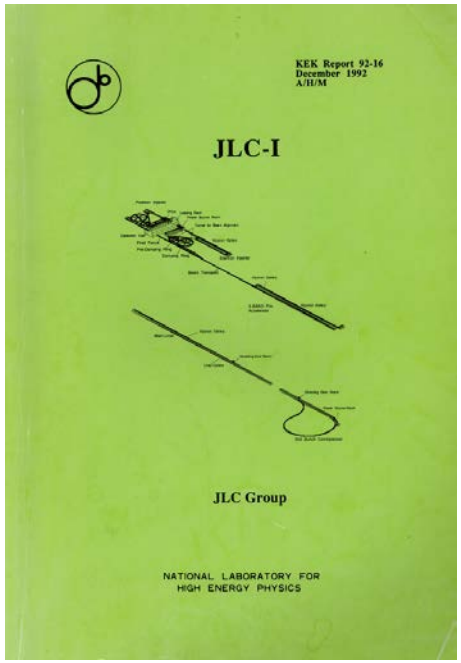
A long history of Linear Collider physics study

1.1 Physics

The main purpose of JLC-I is to discover and study the Higgs boson and the top quark, which are the two missing constituents of the Standard Model.

The most exciting possibility is the discovery of a Higgs particle with a mass less than 200 GeV. This mass range is particularly interesting from the viewpoint of grand unified models with the grand desert hypothesis, which naturally explain charge quantization, anomaly cancellation, strengths of the gauge interactions, *etc*. Moreover, the Weinberg angle $\sin^2\theta_W$, which has been precisely measured at LEP, agrees well with the prediction of its simplest supersymmetric extension originally introduced to solve the naturalness problem. Grand unified models with weak-scale supersymmetry predict at least one light Higgs boson, which cannot be missed at JLC-I with $\sqrt{s} = 300$ GeV.



JLC-I
December 1992

(before the discovery of the Top quark)

Parallel efforts for linear colliders in Asia, America, Europe up to early 2000's.

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ILC as a global effort

The ILC project has been planned and promoted in a global framework under ICFA.

2004-2013 GDE
Accelerator technology choice
(Superconducting RF technology)
Completion of ILC TDR

2013-2020 LCB/LCC
Promotion of the ILC project in Japan
ILC250 (Higgs factory) as the initial phase

2020 Aug- IDT
Establishment of IDT by ICFA
Preparation for ILC Pre-lab

LC technology choice in Aug. 2004

ILC TDR ceremony Dec. 2012

ICFA: International Committee for Future Accelerators
GDE: Global Design Effort
LCB: Linear Collider Board
LCC: Linear Collider Collaboration
IDT: International Development Team

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ILC promotion in Japan

- Japanese HEP community proposed to host ILC in Japan in October, 2012; welcomed by the HEP community across the world; ex. European Strategy for Particle Physics Update 2013, US P5 Report (2014), ICFA and ACFA statements.
- Japanese HEP community selected the Kitakami site as a preferred candidate site in Japan in August 2013; endorsed by LCC.
- MEXT Japan started serious investigations on ILC hosted in Japan.
- MEXT-US DOE discussion group on ILC was set up in 2016. ILC cost reduction R&D between KEK and FNAL has been supported in this framework. Similar discussion frameworks have been set up recently between MEXT and some European countries.
- After LHC Run 2 results, Japanese HEP community proposed to construct the ILC as a 250GeV Higgs factory as the initial step. This proposal was strongly endorsed by LCB/ICFA (November 2017).

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Statement by MEXT at LCB Meeting in March 2019

After consulting ILC Advisory Panel and Science Council of Japan ILC committee, MEXT presented its view with regard to the ILC project at the LCB meeting in Tokyo for the first time in March 2019.

https://www.kek.jp/old/ja/newsroom/2019/03/13/1830/

- MEXT has not yet reached declaration for hosting the ILC in Japan at this moment…..
- The ILC project has certain scientific significance in particle physics particularly in the precision measurements of the Higgs boson, and also has possibility in the technological advancement and in its effect on the local community….
- MEXT will continue to discuss the ILC project with other governments having an interest in the ILC project.

At a Japanese Diet session, a MEXT official expressed its hope that KEK set up a WG for discussions regarding international cos sharing, etc.

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ILC International Working Group

- KEK setup an ILC international WG in May 2019 and published its report in October 2019.
- Members: Seven members from Asia, America and Europe.
- Mandate:
  - Model of international cost-sharing for construction and operation of ILC
  - Organization and governance of the ILC Laboratory
  - International share of the remaining technical preparation

First meeting in Granada, Spain (May 17, 2019)

This report is an input for further discussions at the researcher level as well as the governmental/funding agency level .

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Outline of the KEK's recommendations

https://www.kek.jp/en/newsroom/2019/10/02/1000/

- International cost-sharing
  - Civil engineering and land acquisition are responsibility of the host state.
  - Accelerator components should be provided by all the member states as in-kind contributions
  - The operational cost should be shared among the member states.

- Organization and governance
  - An evolutionary model: ILC Pre-Lab to ILC Laboratory
  - Pre-Lab should be promptly established through laboratory-label MoU's. Its mandate is to coordinate the preparatory tasks and to assist the inter-governmental negotiations.
  - After an inter-governmental agreement, the Pre-Lab is expected to transition into a full ILC Laboratory.
  - Planning of the Pre-Lab should start as soon as possible.

- Intentional sharing of the remaining technical preparation
  - A technical preparation plan is presented with identification of potential international collaboration partners.

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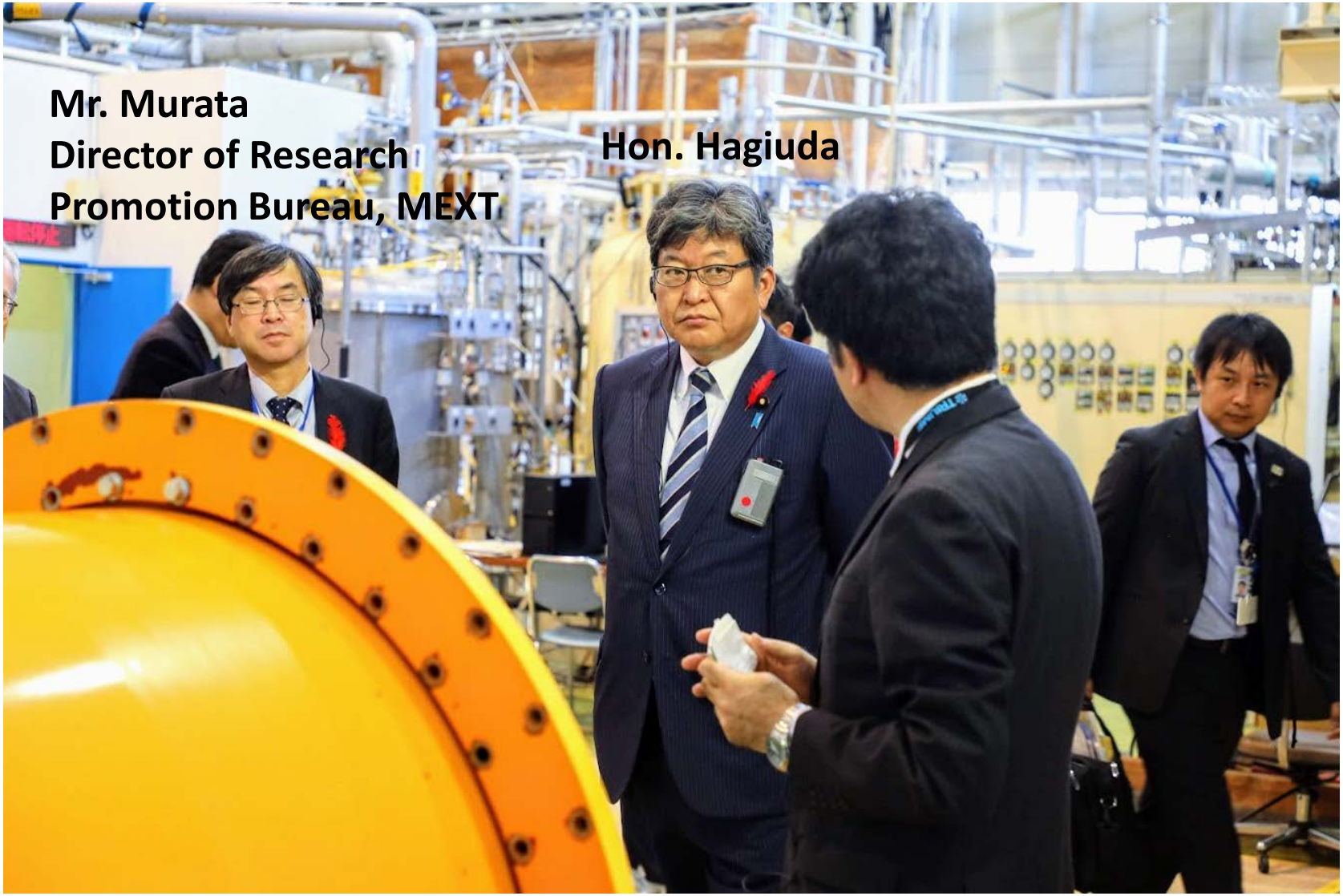
MEXT Minister, Mr. Hagiuda visited STF



October 2, 2019

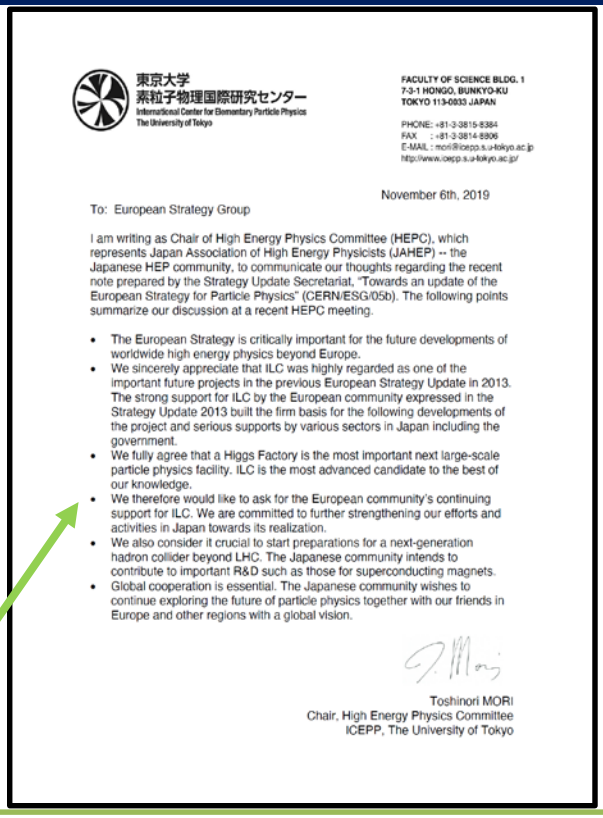
European Strategy for Particle Physics Update

- 2020 Update of the European Strategy for Particle Physics was adopted by CERN Council in June 2020.
- The update process started more then two years ago. The Japanese HEP community and KEK participated in the process by providing useful inputs.

- Participation in Granada Open Symposium in May, 2019
- A letter and a document submitted to European Strategy Group by HEPC Chair.

http://www.jahep.org/files/ESG_Japan_Nov06_signed.pdf

http://www.jahep.org/files/input_JapanHEPC_20191213.pdf



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November 6th, 2019

To: European Strategy Group

I am writing as Chair of High Energy Physics Committee (HEPC), which represents Japan Association of High Energy Physicists (JAHEP) -- the Japanese HEP community, to communicate our thoughts regarding the recent note prepared by the Strategy Update Secretariat, "Towards an update of the European Strategy for Particle Physics" (CERN/ESG/05b). The following points summarize our discussion at a recent HEPC meeting.

- The European Strategy is critically important for the future developments of worldwide high energy physics beyond Europe.
- We sincerely appreciate that ILC was highly regarded as one of the important future projects in the previous European Strategy Update in 2013. The strong support for ILC by the European community expressed in the Strategy Update 2013 built the firm basis for the following developments of the project and serious supports by various sectors in Japan including the government.
- We fully agree that a Higgs Factory is the most important next large-scale particle physics facility. ILC is the most advanced candidate to the best of our knowledge.
- We therefore would like to ask for the European community's continuing support for ILC. We are committed to further strengthening our efforts and activities in Japan towards its realization.
- We also consider it crucial to start preparations for a next-generation hadron collider beyond LHC. The Japanese community intends to contribute to important R&D such as those for superconducting magnets.
- Global cooperation is essential. The Japanese community wishes to continue exploring the future of particle physics together with our friends in Europe and other regions with a global vision.

Toshinori MORI
Chair, High Energy Physics Committee
ICEPP, The University of Tokyo

- We fully agree that a Higgs Factory is the most important next large-scale particle physics facility. ILC is the most advanced candidate to the best of our knowledge.
- We therefore would like to ask for the European community's continuing support for ILC. …

Granada Open Symposium

A consensus emerged:

A Higgs Factory is the most important next large HEP facility.

Four proposals (ILC, CLIC, FCC-ee, CEPC) have a similar physics potential for Higgs physics as a Higgs factory at the first stage of each project.

Comparisons

Project	Type	Energy [TeV]	Int. Lumi. [a^{-1}]	Oper. Time [y]	Power [MW]	Cost
ILC	ee	0.25	2	11	129 (upgr. 150-200)	4.8-5.3 GILCU + upgrade
		0.5	4	10	163 (204)	7.98 GILCU
		1.0			300	?
CLIC	ee	0.38	1	8	168	5.9 GCHF
		1.5	2.5	7	(370)	+5.1 GCHF
		3	5	8	(590)	+7.3 GCHF
CEPC	ee	0.091+0.16	16+2.6		149	5 G$
		0.24	5.6	7	266	
FCC-ee	ee	0.091+0.16	150+10	4+1	259	10.5 GCHF
		0.24	5	3	282	
		0.365 (+0.35)	1.5 (+0.2)	4 (+1)	340	+1.1 GCHF
LHeC	ep	60 / 7000	1	12	(+100)	1.75 GCHF
FCC-hh	pp	100	30	25	580 (550)	17 GCHF (+7 GCHF)
HE-LHC	pp	27	20	20		7.2 GCHF

D. Schulte Higgs Factories, Granada 2019 5

From “Accelerator Summary” at the Granada Symposium

Update of the European Strategy for Particle Physics

3. High-priority future initiatives

A. An electron-positron Higgs factory is the highest-priority next collider. For the longer term, the European particle physics community has the ambition to operate a proton-proton collider at the highest achievable energy. Accomplishing these compelling goals will require innovation and cutting-edge technology:

- ***the particle physics community should ramp up its R&D effort focused on advanced accelerator technologies, in particular that for high-field superconducting magnets, including high-temperature superconductors;***

- ***Europe, together with its international partners, should investigate the technical and financial feasibility of a future hadron collider at CERN with a centre-of-mass energy of at least 100 TeV and with an electron-positron Higgs and electroweak factory as a possible first stage. Such a feasibility study of the colliders and related infrastructure should be established as a global endeavour and be completed on the timescale of the next Strategy update.***

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

Update of the European Strategy for Particle Physics (2)

6. Organizational issues

A. An ambitious next-generation collider project will require global collaboration and a long-term commitment to construction and operations by all parties. ***CERN should initiate discussions with potential major partners as part of the feasibility study for such a project being hosted at CERN. In the case of a global facility outside Europe in which CERN participates, CERN should act as the European regional hub, providing strategic coordination and technical support. Individual Member States could provide resources to the new global facility either through additional contributions made via CERN or directly through bilateral and multilateral arrangements with the host organisation.***

It is described how Europe should participate in a global project outside Europe and what role CERN should play in such a global project.

International Development Team

- At the meeting in February 2020, ICFA released a statement.
  - The need for a preparatory phase ahead of the establishment of the ILC laboratory and the construction of the ILC in Japan.
  - Establishment of an international development team (IDT) to facilitate transition into the preparatory phase.

https://icfa.fnal.gov/wp-content/uploads/ICFA_Statement_22Feb2020.pdf

- ICFA decided to create the IDT at the TV meeting on August 2, 2020. It is headed by the Executive Board Chair, Tatsuya Nakada (Lausanne).

https://www.interactions.org/press-release/icfa-announces-new-phase-towards-preparation-international

https://www.interactions.org/press-release/icfa-appoints-members-ilc-international-development-team

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IDT activities

- Main charge of IDT is preparation for ILC Pre-Lab. Clarifying function and organization, negotiating with international partners (ex. universities. and labs), providing necessary information to the national authorities.
- Accelerator/Facility works and Physics/Detector activities are carried out by WG2 and WG3 succeeding the LCC activities.
- The work of IDT is expected to be complete in one and a half years.
- KEK provides necessary support as a host. (Most of works are done remotely at the moment.)

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Four steps of the ILC peoject

August 2020 Start of IDT under ICFA, KEK is a host

1st step IDT （1-1.5 years）

Establishment of ILC Pre-lab through MOUs among laboratories/institute worldwide.
KEK will be a host laboratory

2nd step ILC Pre-lab（about 4 years）

Establishment of ILC Laboratory by an inter-governmental agreement

3rd step Construction by ILC Laboratory (about 10 years）

4th step Operation by ILC laboratory (more than 20 years)

Steps toward realization of the ILC become clear.

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Establishing IDT and MEXT roadmap

Recent KEK announcement of withdrawal of application to MEXT Roadmap (September8)

https://www.kek.jp/en/topics-en/topic20200911-2/

In February 2020, KEK submitted an application to MEXT for adoption of the ILC project as part of the "Roadmap"; however, in March, KEK withdrew the application in light of the subsequent international development of the project. This is because the "project promotion structure through international cooperation," has changed significantly and the project plan is expected to be completely renewed with respect to the submitted application.

MEXT Minister Mr. Hagiuda's remarks at the press conference (September 11)

https://www.mext.go.jp/b_menu/daijin/detail/mext_00090.html

It is true that the High Energy Accelerator Research Organization withdrew its application for the basic concept (Roadmap) for promoting large academic research projects, but I understand the reason for withdrawing the application was that the framework of international cooperation for promoting the ILC was to be restructured as stated by the international conference on ILC in February this year, and it became necessary to readjust the application contents based on the new scheme. The Ministry of Education, Culture, Sports, Science and Technology will keep an eye on discussions by the international research community while exchanging opinions with government authorities in the United States and Europe.

(Tentative translation by researchers)

記者）
　大型加速器ILCに関してお聞きします。8日に、高エネルギー研究機構が、国の大型研究ロードマップにILCへの申請を取り下げたという発表がありました。これ、今まで文科省がずっと議論されてきた内容だと思うんですけれども、このことの受止めと、今後の取組について教えてください。
大臣）
高エネルギー加速器研究機構が、「学術研究の大型プロジェクトの推進に関する基本構想ロードマップ」への申請を取り下げたというのは事実でございますが、申請の取下げ理由はですね、本年2月にILCに関する国際会議での声明において、ILCに関する国際協力体制などの推進の枠組みを再構築することとなり、その内容を踏まえ、申請内容を見直す必要が生じたためだと伺っております。文科省としては、米欧の政府機関との意見交換を行いつつ、国際研究者コミュニティによる議論を注視してまいりたいと思っているところです。

https://www.mext.go.jp/b_menu/daijin/detail/mext_00090.html

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Steps forward

- Establishing ILC Pre-lab is the next goal. IDT activities have just started to prepare for Pre-lab.

WG1 (Chair, Tatsuya Nakada, there regional representatives, G. Taylor, A. Lankford, and S. Stapnes)
Pre-lab organization, Estimate of required resources, Timeline of Pre-lab phase, Discussions with laboratories/Institute and finding agencies.

WG2 (Chair, S. Michizono)
Accelerator and facilities works, Planning of technical preparation and engineering design work in the Pre-lab phase.

WG3 (Chair, H. Murayama)
Physics and detector activities , Guiding experimental communities to preparation for detector proposals in the Pre-lab phase.

First input from IDT: AWLC2020, https://agenda.linearcollider.org/event/8622/overview

- KEK will cooperate with IDT for preparation for Pre-lab.
- It is important that worldwide communities show strong intention to realize ILC.

For example, Snowmass 2021: https://snowmass21.org/

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Promotion of ILC in various sectors in Japan

- In order to realize ILC hosted in Japan, we need to cooperate with various sectors, industrial sector, local sector, and policy makers, etc.
- We also need understanding from academic communities and people at large.
- KEK will continue to make efforts toward this direction.

The Superconducting RF technology for the ILC
June 25, 2018

Higgs Symposium, Feb.8, 2020

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KEK's efforts

- Cooperate with the ILC-IDT to advance to the ILC Pre-Lab phase toward the realization of the ILC.
- Lead design and technical preparation activities of accelerator and facilities and physics and detector studies together with members of research communities.
- Cooperate with various sectors to realize the ILC hosted in Japan.