ILC
Japanese Perspective

Toshi Mori
The University of Tokyo

- The Japanese HEP community proposes
  - to host ILC as a global project and
  - start a Higgs Factory as the first phase of the overall 500 GeV ILC project

High Energy Physics Community in Japan

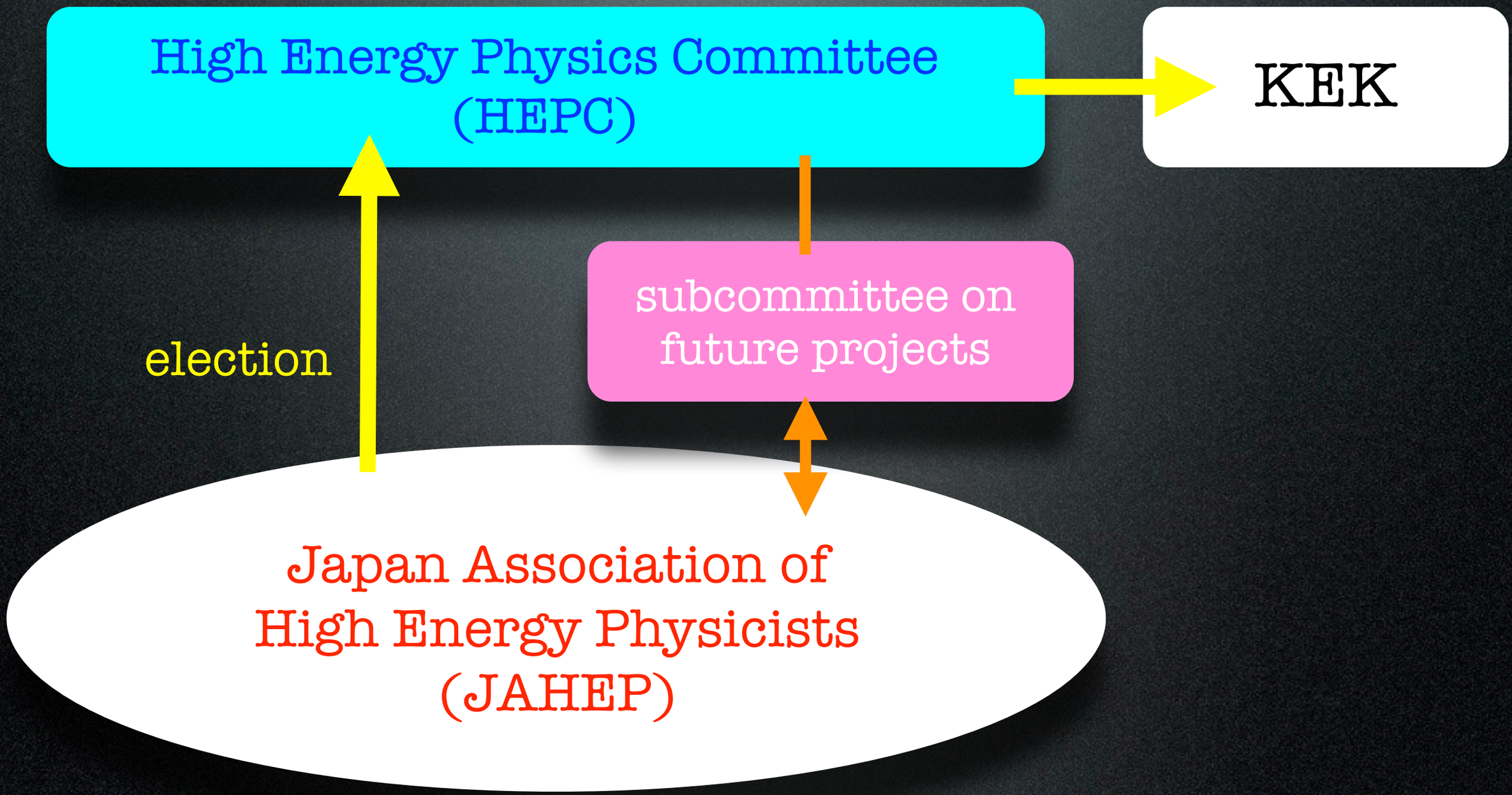
High Energy Physics Committee (HEPC)

→ KEK

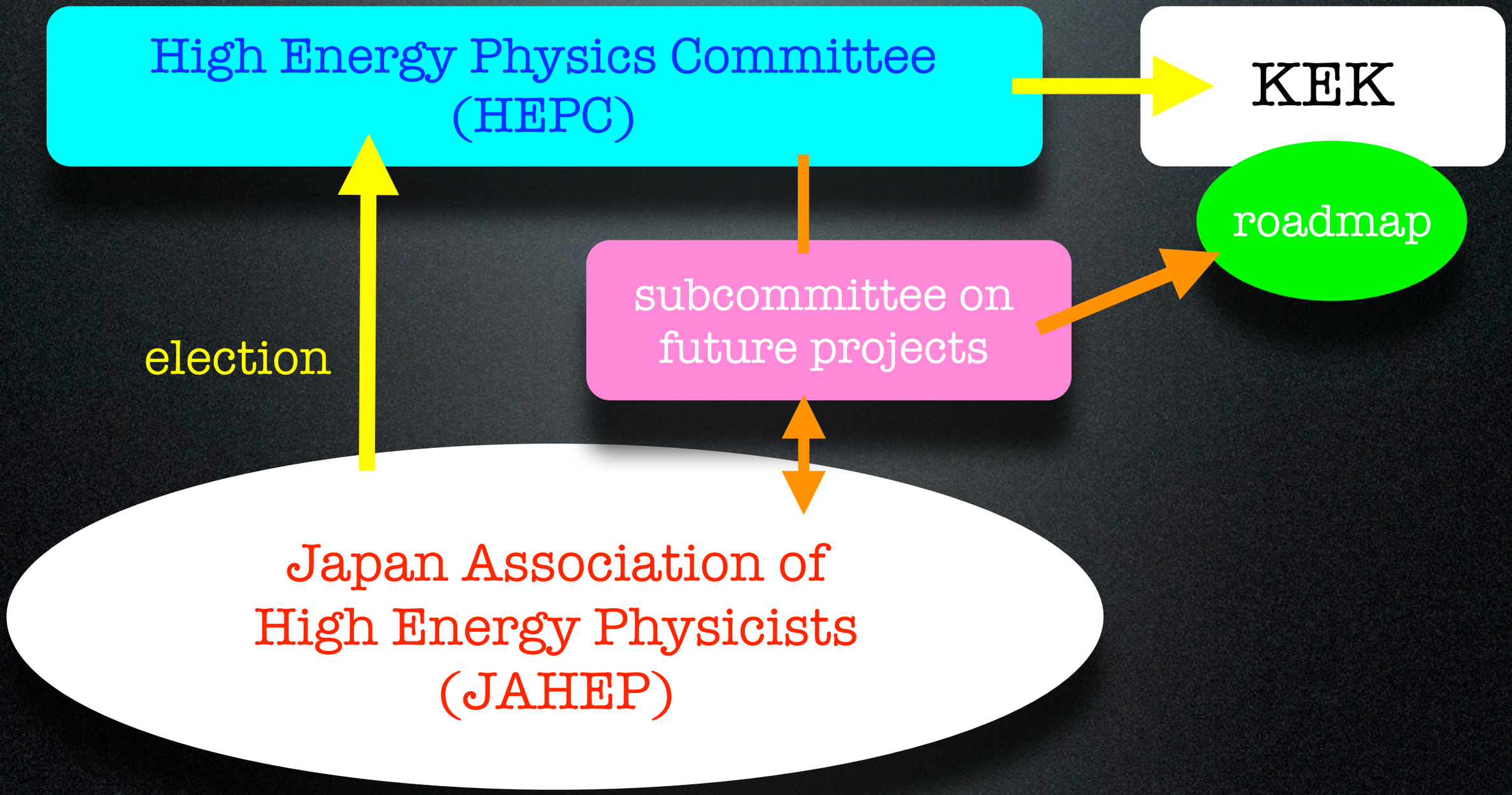
election

Japan Association of High Energy Physicists (JAHEP)

High Energy Physics Community in Japan



High Energy Physics Community in Japan



Subcommittee on Future Projects

- Appointed by HEPC after discussion at the general meeting of JAHEP in spring, 2009
- Charge:
  - Report on Japan's future projects in the time scale of more than 10 years into future
  - Based on physics importance; also consider global trends/prospects
  - Include non-accelerator experiments

http://www.icepp.s.u-tokyo.ac.jp/hecsubc/

(in Japanese)

Committee members

- S. Asai/Tokyo, T. Iijima/Nagoya, K. Ishii/KEK,
  K. Inoue/Tohoku, Y. Ushiroda/KEK,
  Y. Ohnishi/KEK, J. Hisano/Nagoya,
  M. Kuriki/Hiroshima, T. Kobayashi/KEK,
  Y. Kubota/KEK, T. Nakaya/Kyoto, M. Nojiri/KEK,
  T. Nomura(secretary)/KEK, M. Hazumi/KEK,
  K. Hanagaki(secretary)/Osaka,
  H. Murayama/Tokyo-Berkeley,
  T. Mori(chair)/Tokyo, T. Moroi/Tokyo,
  S. Yamashita/Tokyo

(in “aiueo” order)

Interim Recommendations (April 2011)

- after spending 1.5 years in reviewing the present/ future projects
- starting point for community discussion
  - Potential discoveries foreseen in the next ~5 years
  - Scenario strategies for future projects
  - Proposal to form a standing committee on future strategy for flexible & timely updates (instead of periodic updates) of strategies

The recommendations were ready in March
but was delayed by the earthquake

Road to Final Report

- 2011 4/19 Interim Recommendations
- 2011 6/25 general kick-off town meeting @Tokyo
- 2011 7/29 underground/astrophysics town meeting @Kashiwa
- 2011 8/09 J-PARC town meeting @Tokai
- 2011 9/10 collider town meeting @Nagoya
- 2011 9/17 general town meeting (JPS symposium) @Hirosaki
- 2012 2/11 Final Report submitted to HEPC
- 2012 3/05 Final Report released to public
- 2012 3/25 Discussion at general meeting of JAHEP @Osaka
- 2012 3/26 Approved by HEPC

Interim recommendations essentially supported by community

Final Report

Recommendations

The committee makes the following recommendations concerning large-scale projects, which comprise the core of future high energy physics research in Japan.

- **Should a new particle such as a Higgs boson with a mass below approximately 1 TeV be confirmed at LHC, Japan should take the leadership role in an early realization of an e^+e^- linear collider.** In particular, if the particle is light, experiments at low collision energy should be started at the earliest possible time. In parallel, continuous studies on new physics should be pursued for both LHC and the upgraded LHC version. Should the energy scale of new particles/physics be higher, accelerator R&D should be strengthened in order to realize the necessary collision energy.

- **Should the neutrino mixing angle θ_{13} be confirmed as large, Japan should aim to realize a large neutrino detector through international cooperation, accompanied by the necessary reinforcement of accelerator intensity, so allowing studies on CP symmetry through neutrino oscillations.** This new large neutrino detector should have sufficient sensitivity to allow the search for proton decays, which would be direct evidence of Grand Unified Theories.

It is expected that the Committee on Future Projects, which includes the High Energy Physics Committee members as its core, should be able to swiftly and flexibly update the strategies for these key, large scale projects according to newly obtained knowledge from LHC and other sources.

It is important to complete and start the SuperKEKB including the detector, as scheduled. Some of the medium/small scale projects currently under consideration have the implicit potential to develop into important research fields in the future, such as neutrino physics and as such, should be promoted in parallel to pursue new physics in various directions. Flavour physics experiments such as muon experiments at J-PARC, searches for dark matter and neutrinoless double beta decays or observations of CMB B-mode polarization and dark energy are considered as projects that have such potential.

Recommendations

The committee makes the following recommendations concerning large-scale projects, which comprise the core of future high energy physics research in Japan.

Large Projects

- **Should a new particle such as a Higgs boson with a mass below approximately 1 TeV be confirmed at LHC, Japan should take the leadership role in an early realization of an e^+e^- linear collider.** In particular, if the particle is light, experiments at low collision energy should be started at the earliest possible time. In parallel, continuous studies on new physics should be pursued for both LHC and the upgraded LHC version. Should the energy scale of new particles/physics be higher, accelerator R&D should be strengthened in order to realize the necessary collision energy.

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standing committee

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medium/small-scale projects

It is important to complete and start the SuperKEKB including the detector, as scheduled. Some of the medium/small scale projects currently under consideration have the implicit potential to develop into important research fields in the future, such as neutrino physics and as such, should be promoted in parallel to pursue new physics in various directions. Flavour physics experiments such as muon experiments at J-PARC, searches for dark matter and neutrinoless double beta decays or observations of CMB E-mode polarization and dark energy are considered as projects that have such potential.

Large Projects (1)

- **Should a new particle such as a Higgs boson with a mass below approximately 1 TeV be confirmed at LHC, Japan should take the leadership role in an early realization of an e^+e^- linear collider.** In particular, if the particle is light, experiments at low collision energy should be started at the earliest possible time. In parallel, continuous studies on new physics should be pursued for both LHC and the upgraded LHC version. Should the energy scale of new particles/physics be higher, accelerator R&D should be strengthened in order to realize the necessary collision energy.

Large Projects (1)

- **Should a new particle such as a Higgs boson with a mass below approximately 1 TeV be confirmed at LHC, Japan should take the leadership role in an early realization of an e^+e^- linear collider.** In particular, if the particle is light, experiments at low collision energy should be started at the earliest possible time. In parallel, continuous studies on new physics should be pursued for both LHC and the upgraded LHC version. Should the energy scale of new particles/physics be higher, accelerator R&D should be strengthened in order to realize the necessary collision energy.

↓

ILC Strategy Council formed in May

Discovery of light Higgs-like boson in July

Large Projects (2)

- **Should the neutrino mixing angle θ_{13} be confirmed as large, Japan should aim to realize a large-scale neutrino detector through international cooperation, accompanied by the necessary reinforcement of accelerator intensity, so allowing studies on CP symmetry through neutrino oscillations.** This new large-scale neutrino detector should have sufficient sensitivity to allow the search for proton decays, which would be direct evidence of Grand Unified Theories.

Large Projects (2)

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↓

Large mixing angle θ_{13} confirmed!

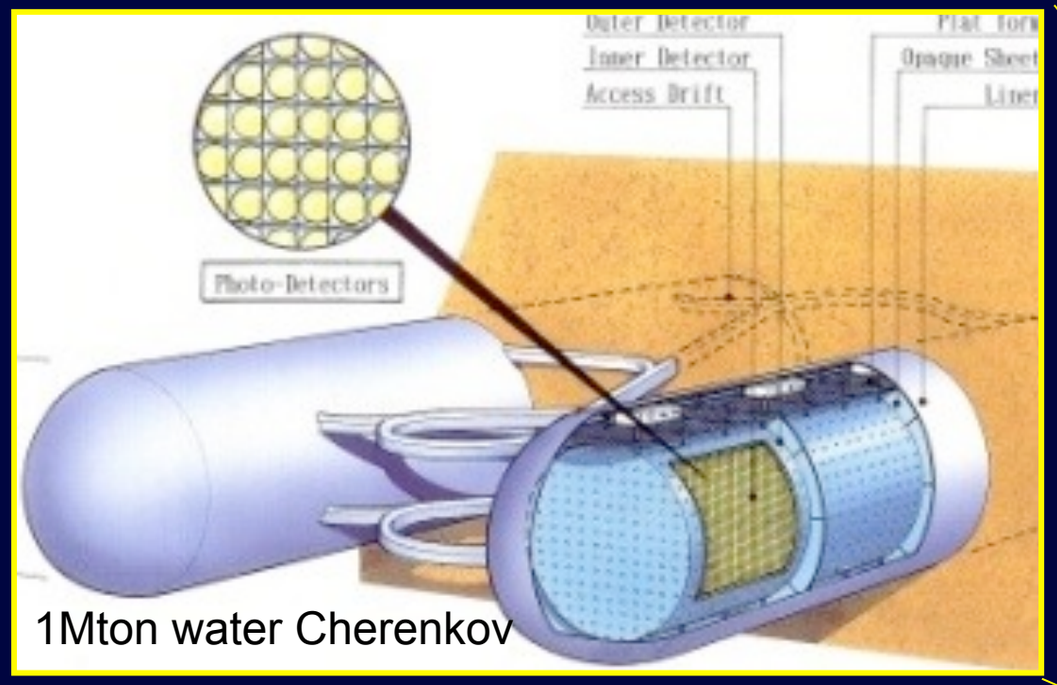
discussion by new Committee on Future Project in June

Large-Scale Neutrino Detector

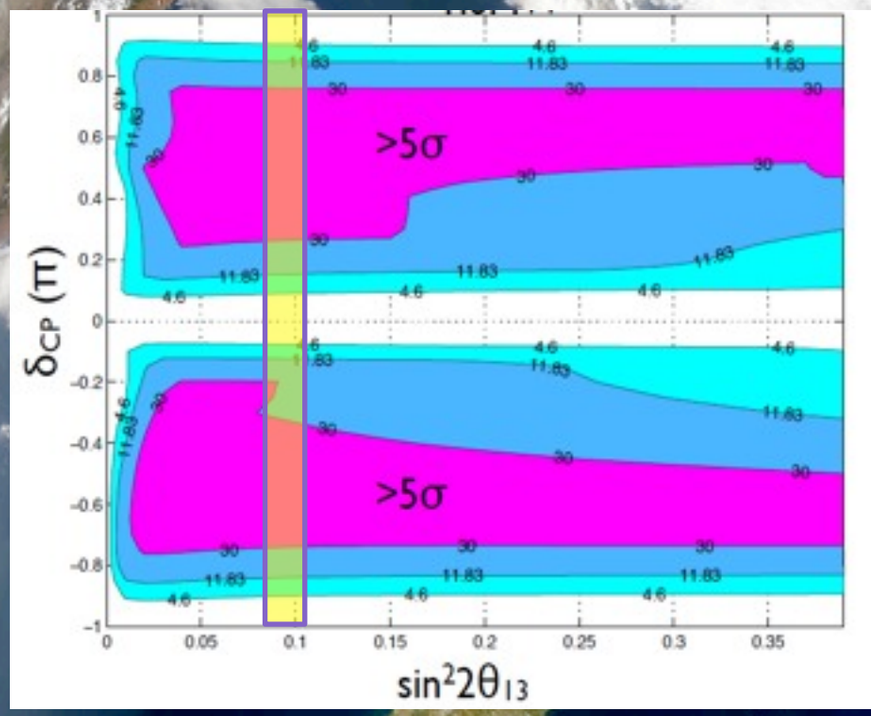
- studies on CP symmetry through neutrino oscillations by long baseline neutrino experiment
- water cherenkov vs. liquid argon TPC
- international cooperation - global planning
- reinforcement/upgrade of accelerator:
  >1 MW design still under discussion in Japan
- sufficient sensitivity for proton decays

Next ν program at J-PARC

Kamioka L=295km OA=2.5deg

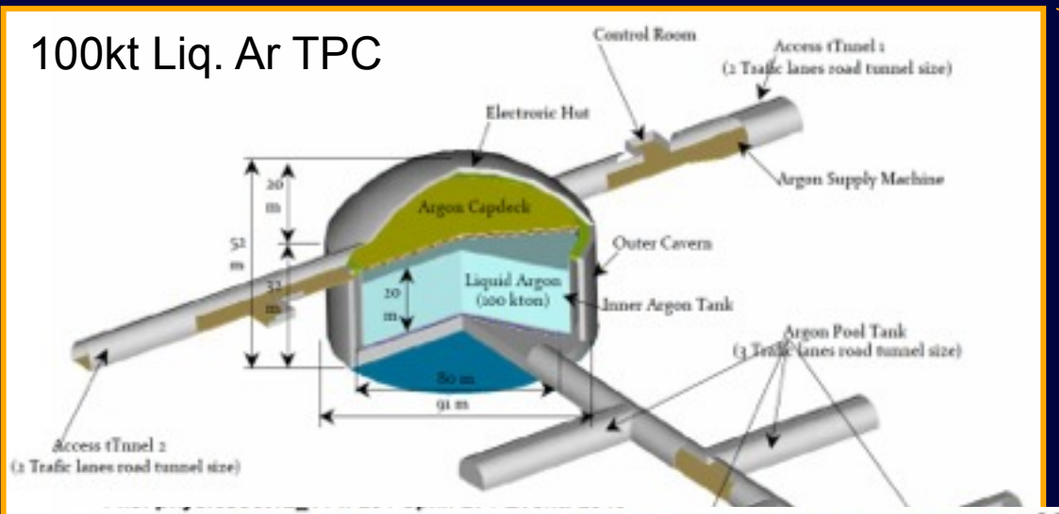


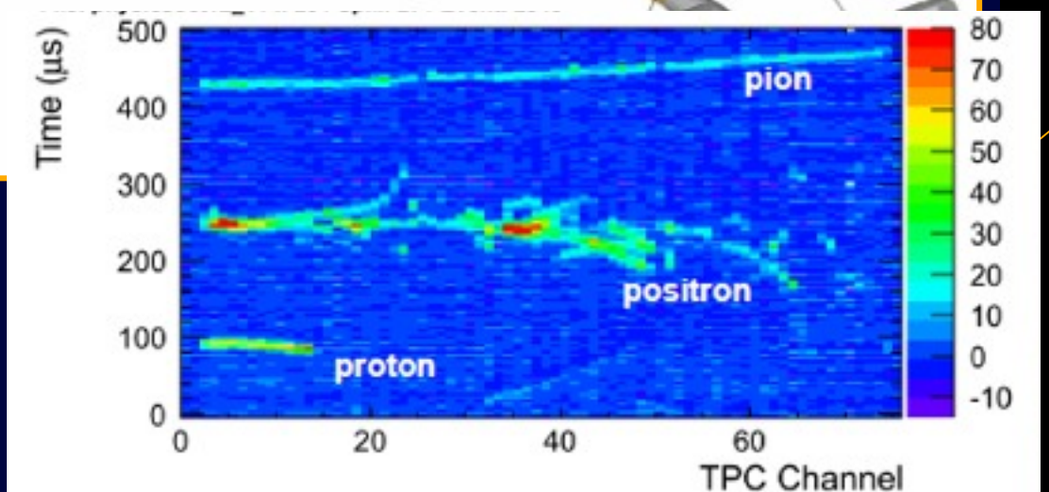
1Mton water Cherenkov



Okinoshima L=658km OA=0.78deg

100kt Liq. Ar TPC





J-PARC
→1.7MW

Hope to start construction ~2018

a standing committee

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Committee on Future Projects started

Two meetings held in June & October to discuss neutrino & ILC

other (medium/small) projects

It is important to complete and start the SuperKEKB including the detector, as scheduled. Some of the medium/small scale projects currently under consideration have the implicit potential to develop into important research fields in the future, such as neutrino physics and as such, should be promoted in parallel to pursue new physics in various directions. Flavour physics experiments such as muon experiments at J-PARC, searches for dark matter and neutrinoless double beta decays or observations of CMB B-mode polarization and dark energy are considered as projects that have such potential.

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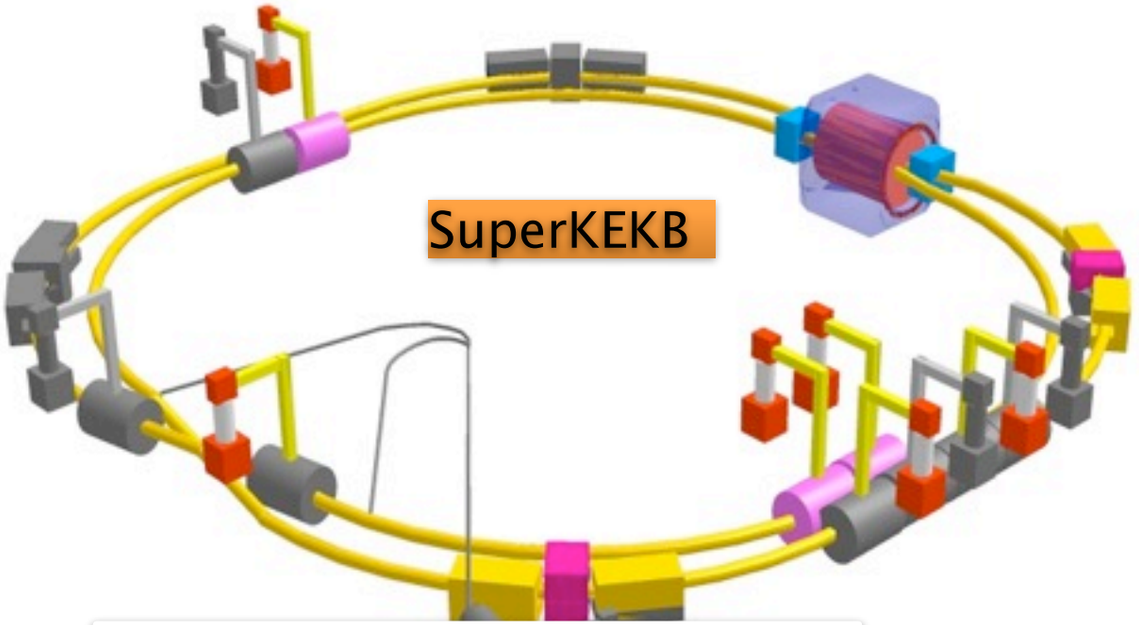
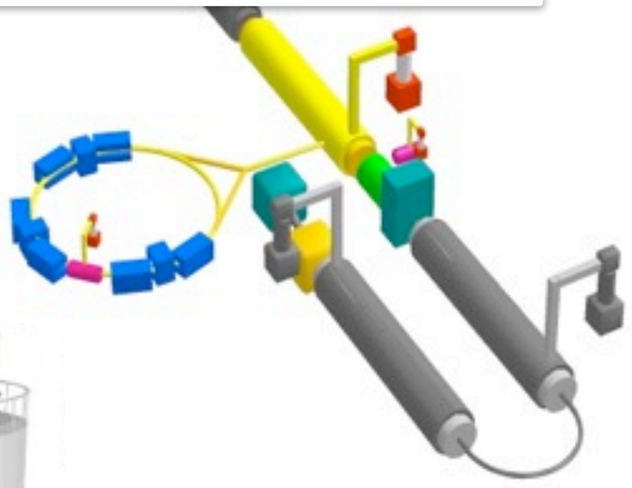
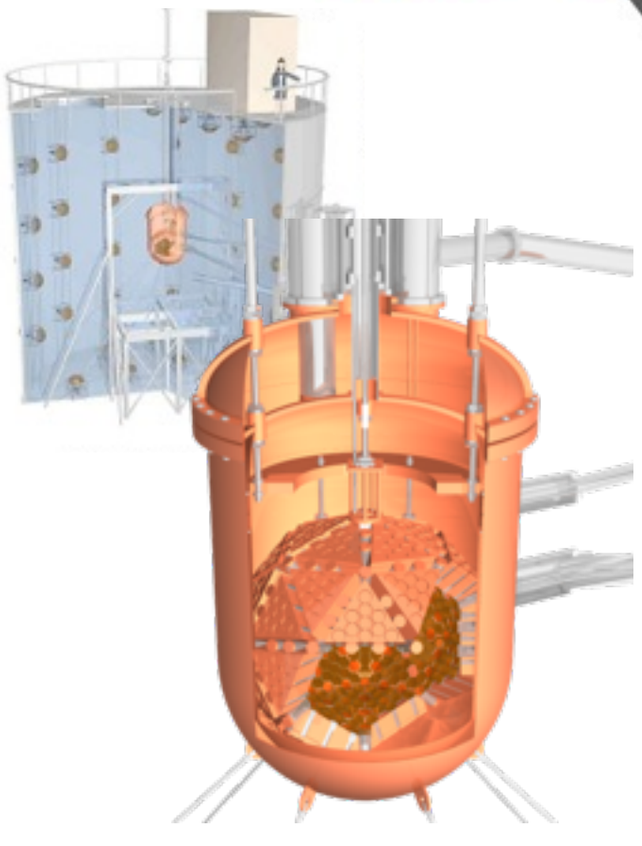
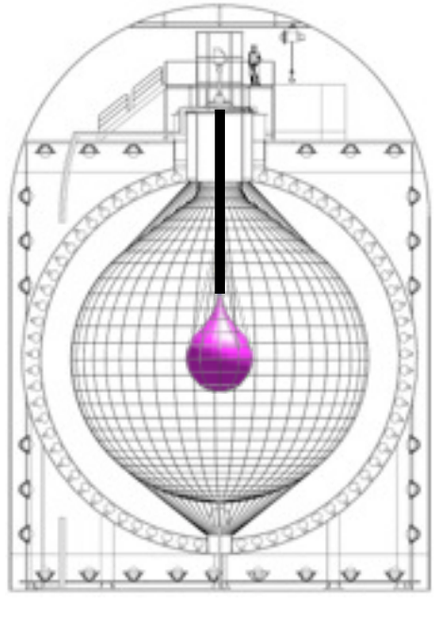
KEK budget request for COMET beam line
(mu-e conversion experiment at J-PARC)

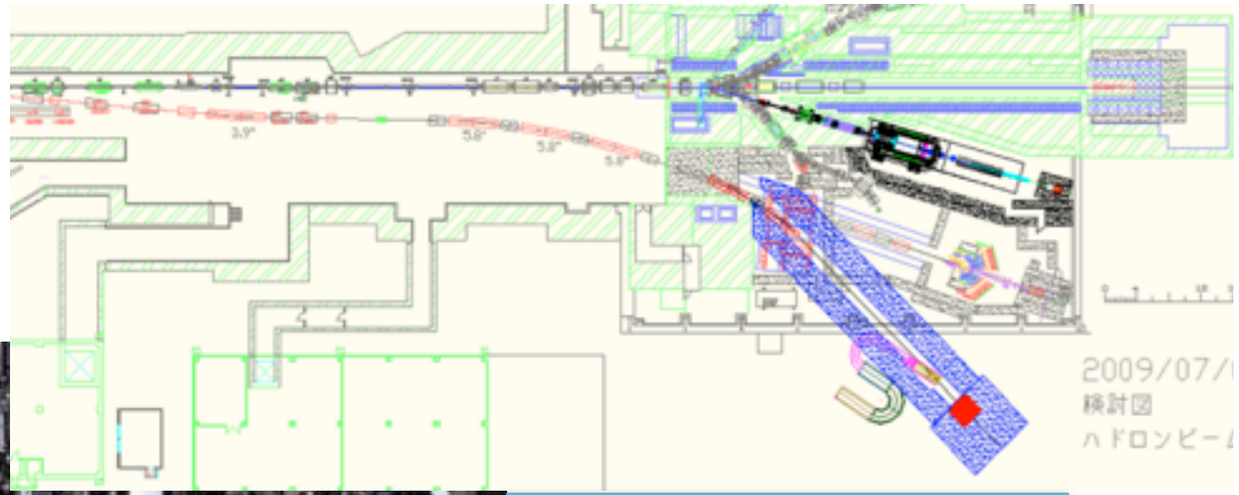


Beam commissioning scheduled in 2015

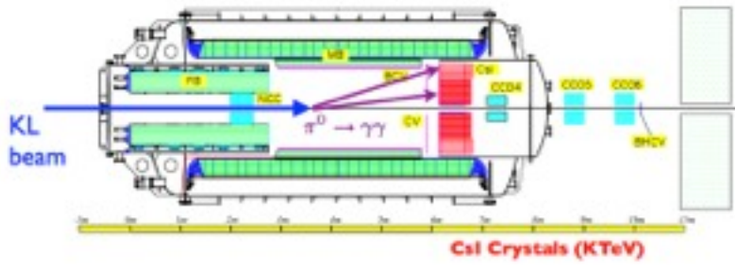


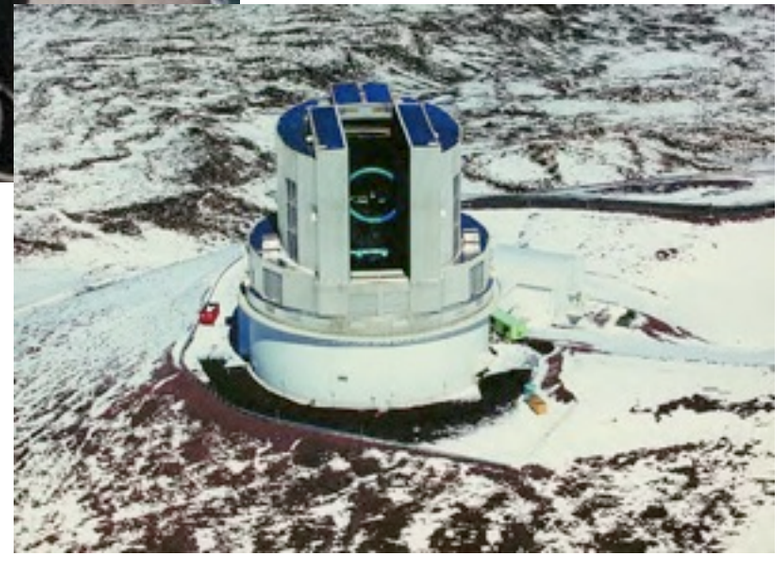






Phase-I phys run in 2017
Full COMET run in 2021-2022





Timelines of Current/Future Projects

2012 2015 2020 2025

LHC
SUSY <1TeV
SM Higgs
SUSY <2.5TeV
HL-LHC

ILC
TDR & Review
Site
Construction
Physics Run

SuperKEKB
Construction
Physics Run
50ab^{-1}

J-PARC
FX 300kW
SX 100kW
FX 750kW
>1MW

T2K
$\sin^2 2\theta_{13}$ ~0.1
~0.04
~0.02

νCP
Tech.Decision
Construction
Physics Run

MEG
O(10^{-13})
O(10^{-14})

$\mu \rightarrow$e conversion
Construction
Physics Run

Muon g-2
Construction
Physics Run

KOTO
BR~10^{-9}
10^{-11}

nEDM
Construction
10^{-27}
10^{-28}

$0\nu\beta\beta$
degenerated
inverted hierarchy

Dark Matter
10^{-45}cm^2
10^{-46}cm^2
10^{-47}cm^2

CMB B mode
r~O(0.1)
O(0.01)

CMB satellite
Construction
Observation

SuMIRe
imaging
spectroscopy

After the Recommendations

- "Committee on Future Projects" set up
  - Two meetings held on neutrino & ILC
- "ILC Strategy Council" formed under HEPC
  - Community-wide consistent efforts to promote ILC

- Proposal for "Phased Execution of ILC"
  - approved by JAHEP

- A new LDP government is soon to be formed
- "Master Plan" by Science Council of Japan
- A process to update KEK roadmap underway

Proposal for Phased Execution of the ILC Project

In March 2012, the Japan Association of High Energy Physicists (JAHEP) accepted the recommendations of the Subcommittee on Future Projects of High Energy Physics[(1)] and adopted them as JAHEP's basic strategy for future projects. In July 2012, a new particle consistent with a Higgs Boson was discovered at LHC, while in December 2012 the Technical Design Report of the International Linear Collider (ILC) will be completed by a worldwide collaboration.

a ceremony to commemorate it in Tokyo last weekend

On the basis of these developments and following the subcommittee's recommendation on ILC, JAHEP proposes that ILC be constructed in Japan as a global project with the agreement of and participation by the international community in the following scenario:

(1) Physics studies shall start with a precision study of the "Higgs Boson", and then evolve into studies of the top quark, "dark matter" particles, and Higgs self-couplings, by upgrading the accelerator. A more specific scenario is as follows:

(A) A Higgs factory with a center-of-mass energy of approximately 250 GeV shall be constructed as a first phase. Higgs factory as a first phase

(B) The machine shall be upgraded in stages up to a center-of-mass energy of ~500 GeV, which is the baseline energy of the overall project.

(C) Technical extendability to a 1 TeV region shall be secured.

(2) A guideline for contributions to the construction costs is that Japan covers 50% of the expenses (construction) of the overall project of a 500 GeV machine. The actual contributions, however, should be left to negotiations among the governments. ILC = Global Project

(a translation of the official JAHEP statement, Oct 2012)

After the Recommendations

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The campaign pledges of the Liberal Democratic Party

32　科学技術政策の強力な推進力となる真の「司令塔」機能の再構築

資源の少ないわが国にとって、今後の社会・経済をさらに発展させるため、企業の研究開発投資が激減する中、新たな成長に向けて国主導で科学技術イノベーションをリードするのが喫緊の課題です。

しかし、年間約 3.6 兆円にも及ぶ科学技術関係予算については、文部科学省を中心に、経済産業省や厚生労働省等、関係省庁に予算が配分され、各省内で同様な研究が行われている事例も見受けられ、縦割りの弊害が顕著です。また、限られた予算にも関わらず、効果的な配分が行われていないのが現状です。

そこで、産業の生命線である科学技術を国家戦略として推進し、「価値の創造拠点」とするべく、総合科学技術会議の「権限」「体制」「予算システム」を抜本的に強化し、真の「司令塔」機能へと再構築します。

具体的には、各省庁の縦割りを排し、強力な予算配分権限を集中させ、適正な評価を行うことができる人材育成とシステムの構築を行います。例えば、素粒子物理分野の大規模プロジェクトである ILC（国際リニアコライダー※研究所建設）計画等を含む国際科学イノベーション拠点作りに日本が主導的な役割を果たせるなど、再生医療※や創エネ・省エネ・蓄エネ等の重点分野を産学の知を結集した国家戦略として強力に推進

日本を

The campaign pledges of the Liberal Democratic Party

92　世界に冠たる研究開発拠点の形成

イノベーションを生み出していくためには、大学や公的研究機関、産業界等が集い、協働で研究開発に取り組む「場」の構築が必要です。特に、わが国の強みを有する分野において、地域資源等も柔軟に活用しつつ、オープン・イノベーションに対応した「競争」と「協調」による世界最先端の研究開発拠点を形成します。

わが国が世界の頭脳の獲得における中核的な地位を占めていくためには、国内のみならず海外の優れた研究者を惹きつける国際的な研究ネットワークの拠点形成が不可欠であり、「世界トップレベル研究拠点（WPI）」の大幅な拡充や、素粒子分野の大規模プロジェクトである ILC（国際リニアコライダー研究所建設）計画等を含む国際科学イノベーション拠点作りに日本が主導的な役割を果たすなど、世界水準をしのぐ優れた研究活動を行う大学や公的研究機関などに対する支援を抜本的に強化します。

After the Recommendations

- "Committee on Future Projects" set up
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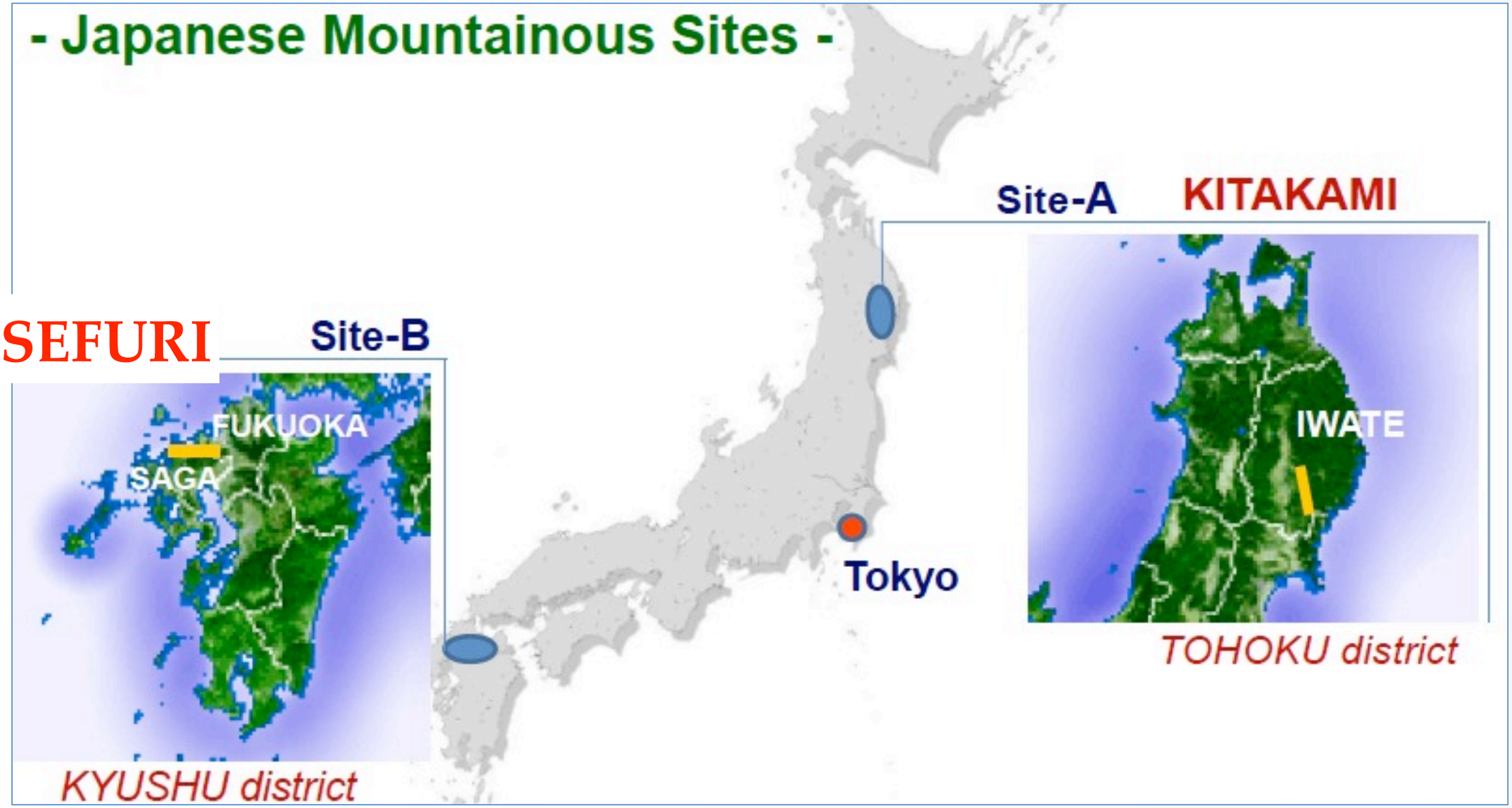
Updating KEK Roadmap

- A bottom-up process going on
  - KEK = Inter-University Research Institute Corporation
- Based on inputs from relevant scientific communities:
  - HEP, nuclear physics, synchrotron radiation research, neutron science, muon science
- Interim report is available at

  http://kds.kek.jp/conferenceDisplay.py?confId=10697
- A new roadmap “KEK Roadmap 2013” is scheduled be published in March 2013

Two Candidate Sites in Japanese mountainous locations

decision expected ~within next year



Japanese government's third supplementary budget: 5 oku-yen to ILC

Quest for Birth-Evolution of Universe

International Linear Collider（ILC）

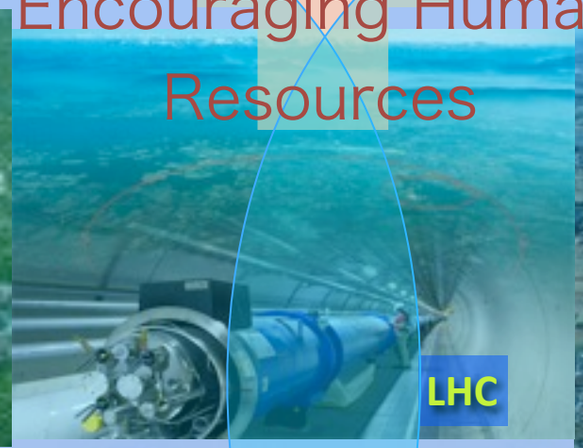
Quest for Unifying Matter and Force

(Present KEK Roadmap)

Scientific Activities
Technology Innovation
Encouraging Human Resources

Lepton CP Asymmetry

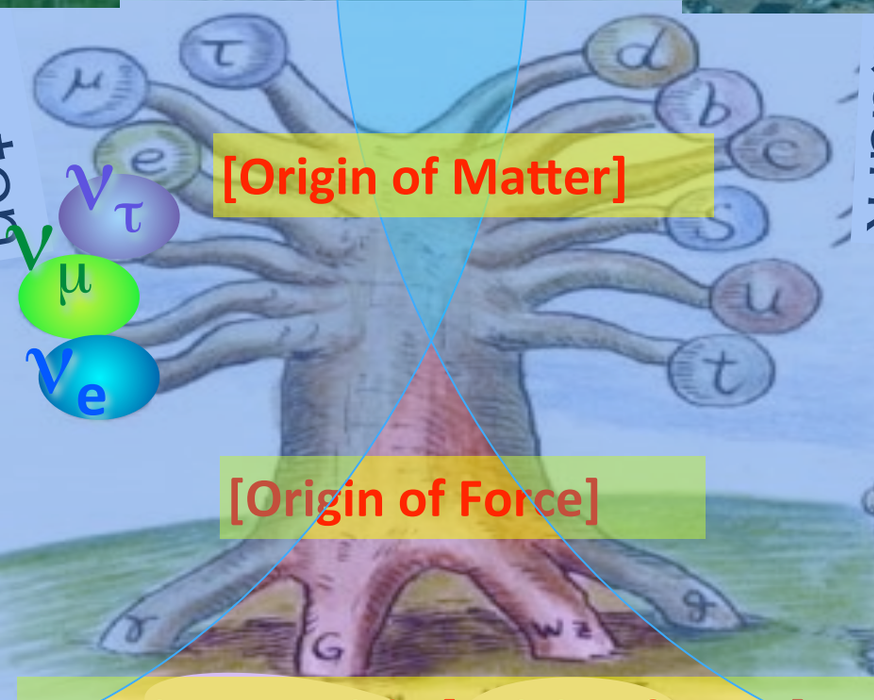
Power-Upgrade



Beyond Standard Physics

Super-KEKB

Quest for Neutrinos



Quest for 6 Quarks

Prospects - Global Strategy

- A consistent strategy of global HEP community must be formed
  - the subcommittee's Report submitted to European Strategy
    - Discussion at Krakow Open Symposium
      - Japan's proposal of phased ILC generally warmly welcomed
    - Supporting statements from France, Spain, Germany
    - Discussion at CERN SPC
  - "Snowmass 2013" process through next summer in US