

Asian Perspective

M. Nozaki
(KEK/ACFA)



ACFA (Asian Committee for Future Accelerators)

established in 1996



AsiaHEP (Asia-Oceania HEP Panel)

established in 2012



Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image Landsat

Image JRC AO

Australia

A satellite map of Asia and Oceania. Two yellow ovals are placed over East Asia: one over China labeled 'IHEP' and one over Japan labeled 'KEK'. A black horizontal band with white text 'HEP accelerators in Asia-Oceania' is centered across the map. At the bottom, white text reads 'Data SIO, NOAA, U.S. Navy, NGA, GEBCO', 'Image Landsat', and 'Image JRC/AO'.

IHEP

KEK

HEP accelerators in Asia-Oceania

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image Landsat

Image JRC/AO



KEK

IHEP

HEP accelerators on the globe

3 is the minimum number of legs for a stable table

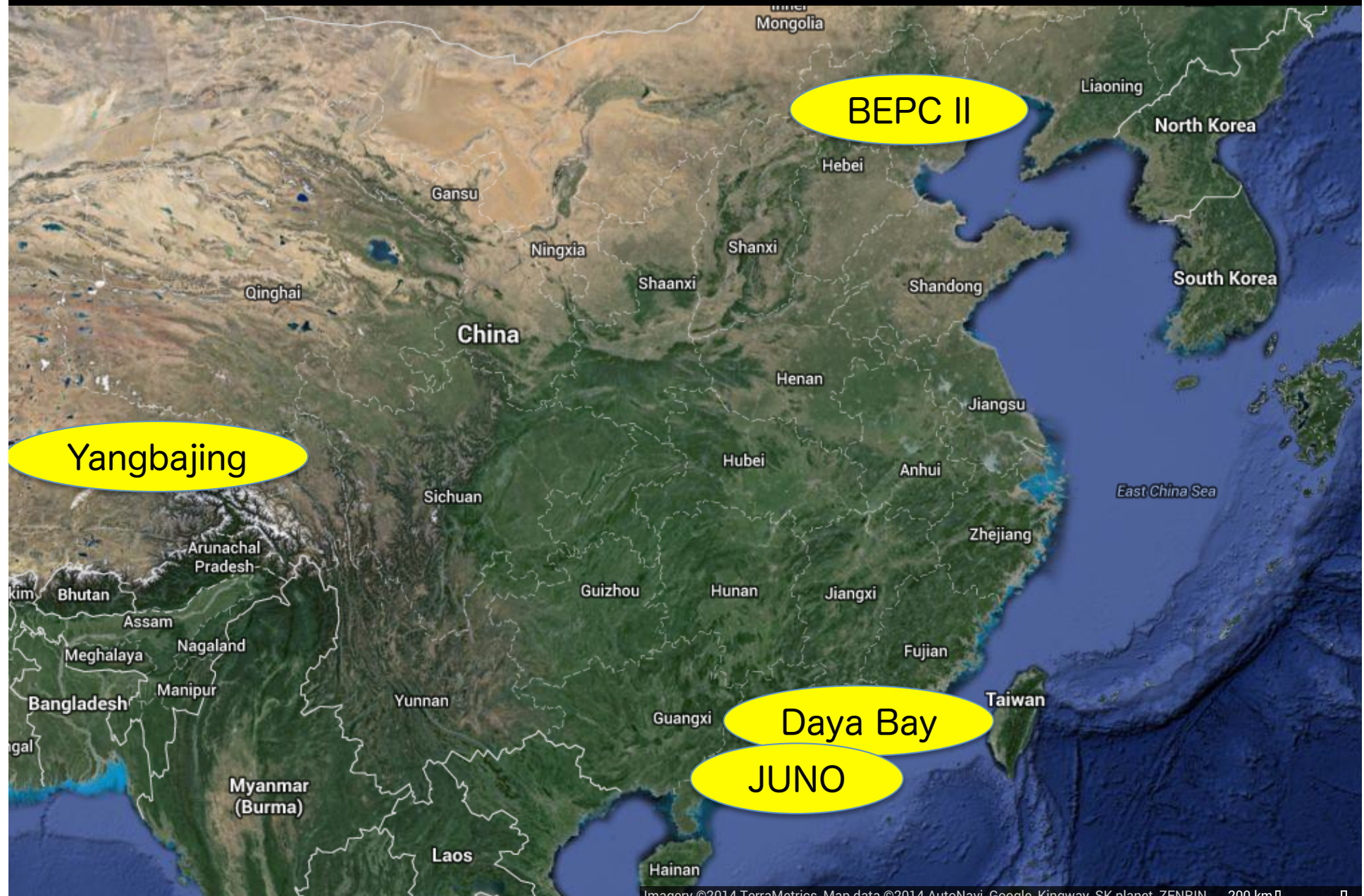
Fermilab

CERN

Prepared by Yifang Wang (IHEP)

IHEP-CHINA

IHEP is operating an e^+e^- collider (BEPC II), reactor neutrino experiments (Daya Bay & JUNO) and cosmic ray observatory in Tibet.



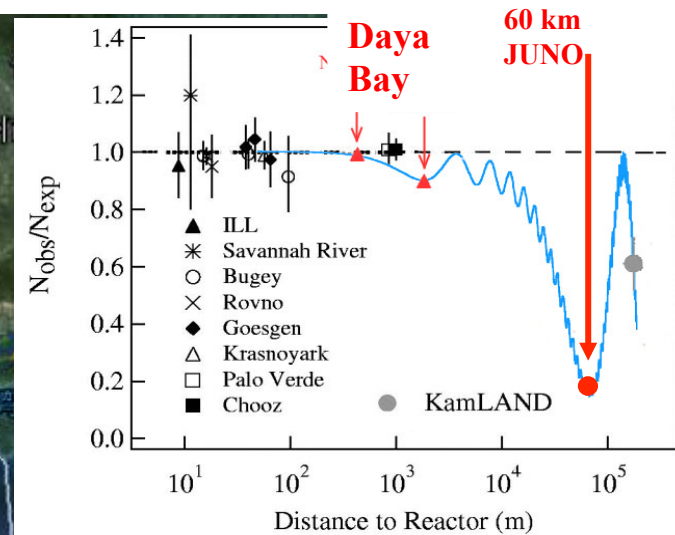
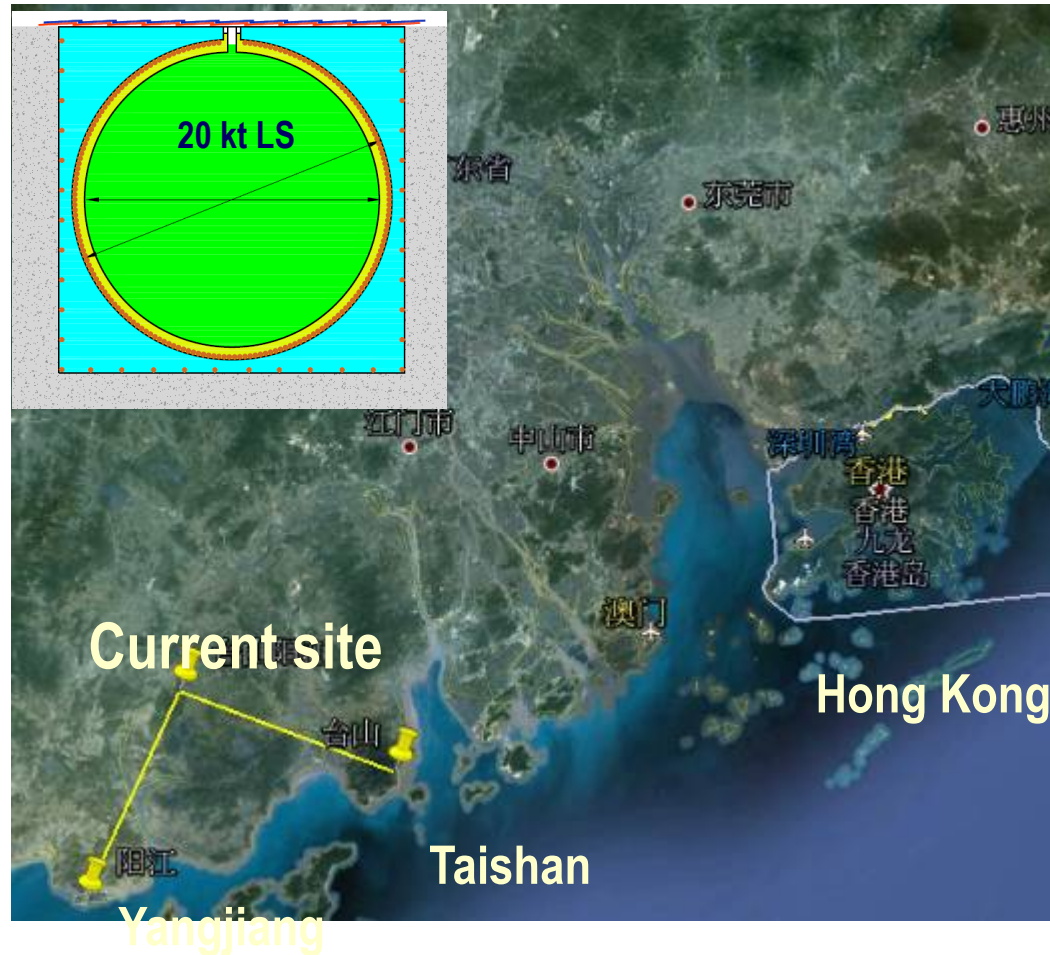
Main Considerations of the Roadmap

- Based on existing capabilities with “aggressive” extrapolations:
 - BEPCII/BESIII, Daya Bay, ASg/ARGO, HXMT, ...
 - Not able to cover everything, but try to catch up on some (scientifically important) issues(directions)
 - Mainly based on the existing manpower
- Balanced domestic and international programs
- Try to be aggressive at this rapidly expanding environment in China
- Taking into account constraints:
 - Funding:
 - total(as a reasonable fraction of GDP);
 - individual: competitiveness with respect to other projects(disciplines),
 - Manpower:
 - Technological capabilities

Roadmap

- Explore the full potential of BESIII
- Continue the flavor physics & QCD studies: PANDA, BELLE II
- Actively involved in the energy frontier: LHC & ILC
- Thinking about the future machine in China after BEPCII/ BESIII: Circular Higgs Factory + pp Collider
- Continue the reactor neutrino physics: Daya Bay → JUNO
- Neutrino oscillation → flavor changing process → COMET
- Start to explore neutrino-less $\beta\beta$ decay: EXO → nEXO
- Maintain the possibility for the future: Jinping lab & exp. there
- High altitude cosmic-ray physics: AS γ & ARGO → LHAASO
- Explore in space: AMS/HXMT → HERD/XTP

Next Step: JUNO for Mass Hierarchy



- Mass hierarchy
- Precision mixing parameters
- Supernova neutrinos
- Geoneutrinos
- Sterile neutrinos
- ...

- The only one based on reactor: independent of CP phase

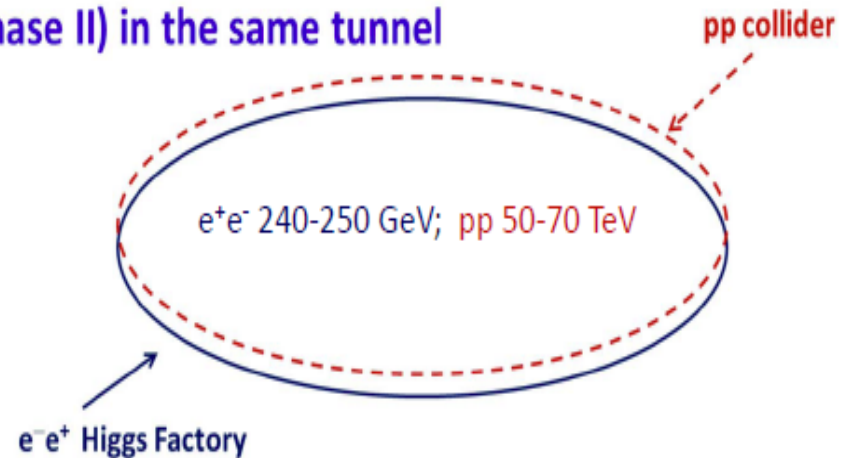
China's Perspective on e^+e^- colliders

- 464th Xiangshan Science Conference in June 2013
 - A series of academic symposium organized by MOST
 - discussed “the electron-positron colliders – present and future-”
- High energy electron-positron collider is a natural choice after LHC.
- China should play a significant role in the ILC, both preparatory R&D and construction.
- CEPC-SPPC is an important option and chance for the development of HEP in China.

CEPC+SppC

- We are looking for a machine after BEPCII
- A circular Higgs factory fits our strategic needs in terms of timing, science goal, technological & economical scale, manpower reality, etc.
- Its life can be extended to a pp collider: great for the future

- Circular Higgs factory (phase I) + super pp collider (phase II) in the same tunnel



- Circular Higgs factory is complementary to ILC
 - Push-pull option
 - Low energy vs high energy

We hope to collaborate with anyone who is willing to host this machine. Even if the machine is not built in China, the process will help us to build the HEP in China

KEK-JAPAN

Decision Making Process in Japan

- KEK: an Inter-University Research Institute Corporation
 - to promote national and international collaborative research activities by providing advanced research facilities and opportunities.
 - Similar organizations in Japan: NAOJ, NIFS, NII etc.
- KEK's roadmap is based on the community's strategy
 - The latest roadmap is published in May 2013.
- HEP community = JAHEP (~800 researchers)
 - Experimental physicists, collaborating with theorists
 - Represented by JHEPC, elected from among JAHEP
- Future plan is discussed and periodically revised by JAHEP/JHEPC

A Report from the HEP Community in Japan, published in February 2012

JHEPC issued “A Report on Future Projects of High Energy Physics.”

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-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.

Length of cycles of experiments: high energy physics experiments become larger and take a longer time. **It is difficult for even a competent student or young researcher to experience the whole process of the experiment** from project design, R&D and construction of detectors, commissioning and operation, to data collection and physics analysis. More and more young researchers miss opportunities to work on technological developments and it could prevent smooth inheritance of technology.

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.

KEK Roadmap at a glance

- J-PARC with nominal intensity (750kW)
 - to answer remaining questions of ν together with other experiments
 - Different baselines, ν & anti- ν , reactor
 - Mass hierarchy, lepton CP, maximal θ_{23}
 - Medium/small size experiments such as KOTO, LFV, EDM, g-2 etc.
 - Next generation ν facility: HK & liq. Ar TPC R&D
- SuperKEKB with 40xKEKB luminosity
 - Physics goal shifts from CP violation by direct B-quark production to search for BSM via indirect processes.
- ATLAS/LHC upgrade
- ILC
 - A central role in R&D, engineering, organizational design toward the ILC hosted in Japan
- Accelerator/detector technologies
 - Collaboration with other science area such as astroparticle physics
 - Industrial and medical applications

Statements from Outside

- AsiaHEP

- AsiaHEP/ACFA welcomes the proposal by the Japanese HEP community for the ILC to be hosted in Japan. AsiaHEP/ACFA looks forward to a proposal from the Japanese Government to initiate the ILC project. (Aug. 2013)

- From Science Council of Japan to the Ministry (MEXT)

- SCJ pointed out obvious issues with international projects, such as cost sharing, its governance model, and availability of leadership and personnel. Therefore, the report recommends the government to allocate the funds necessary to study risks and discuss with potential partners in the next two to three years. (Sep. 2013)

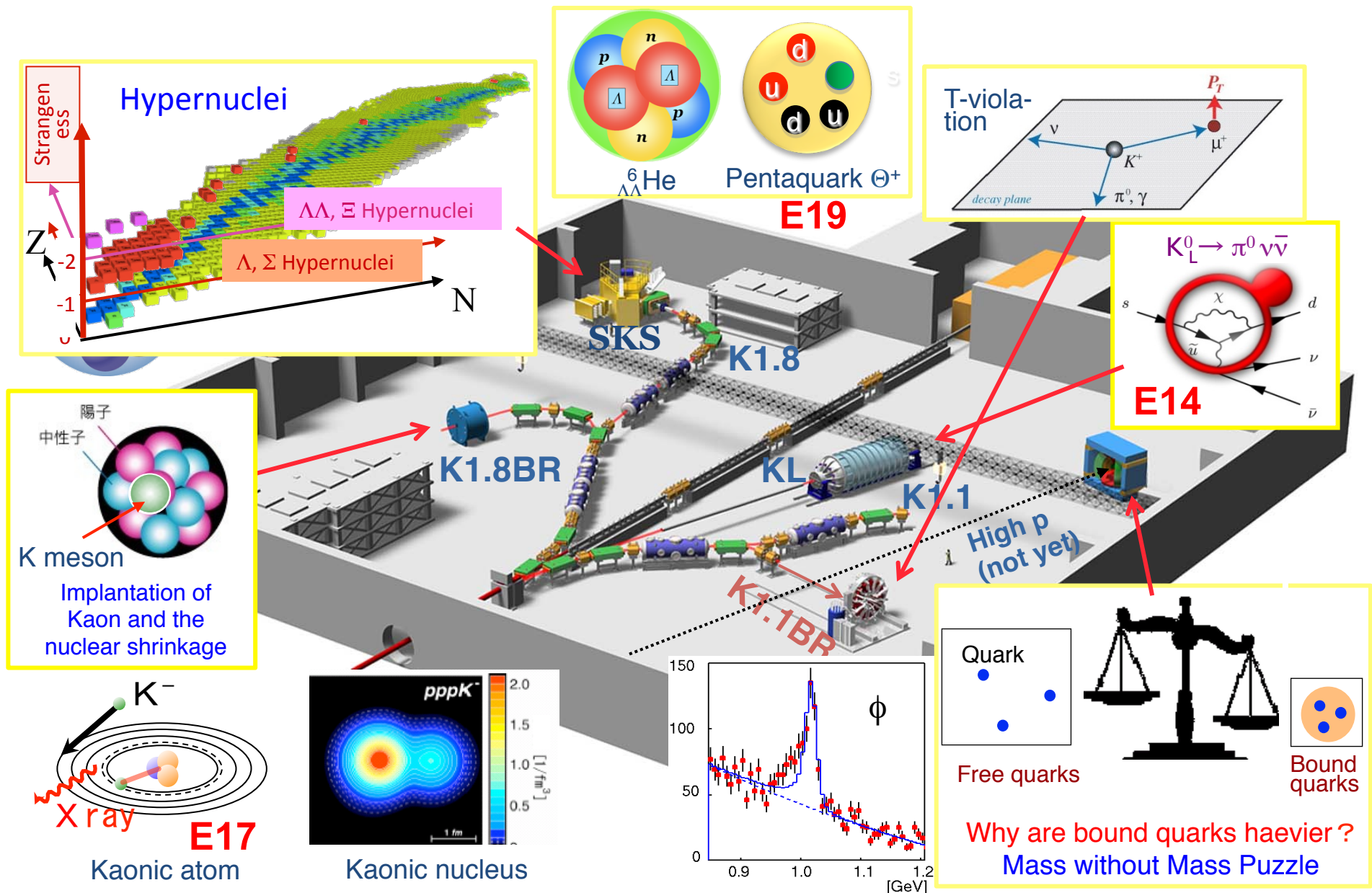
- SCJ selected 27 priority projects

- Including J-PARC upgrade, HK, LiteBIRD. (Feb. 2014)

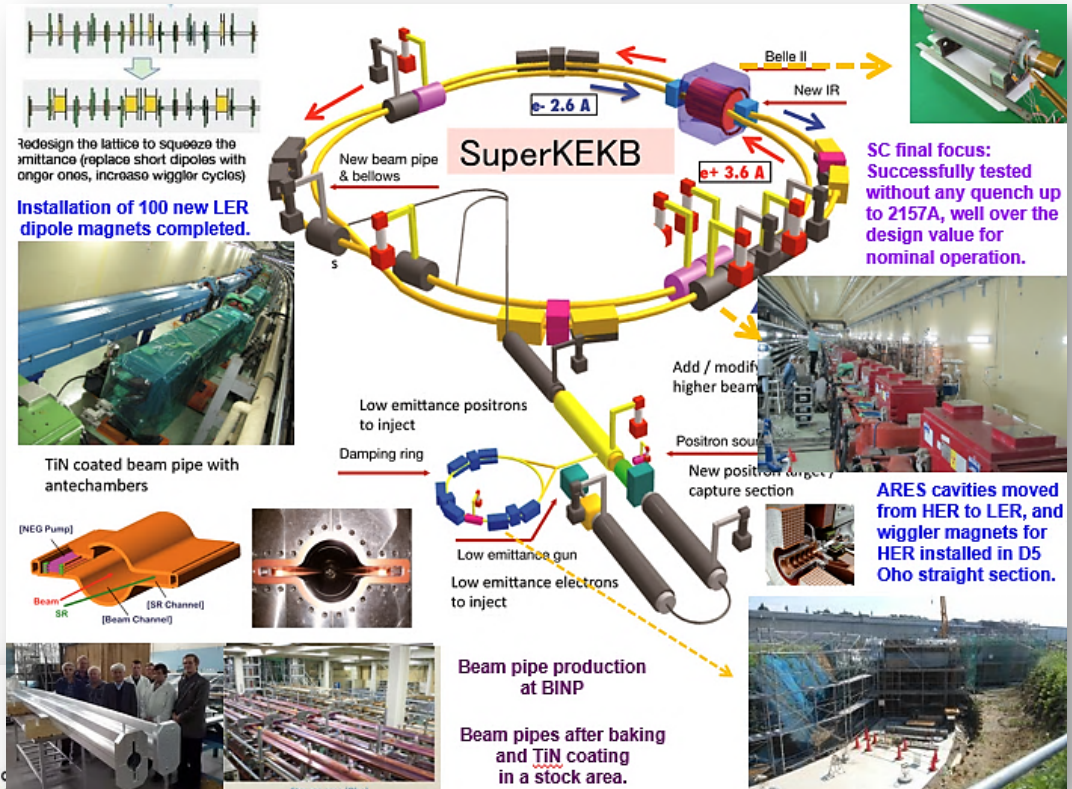
- MEXT is periodically selecting priority big projects

- SuperKEKB and J-PARC have been funded based on this selection.
- The next selection is scheduled in June 2014.

Nuclear & Particle Physics with J-PARC Hadron Beam

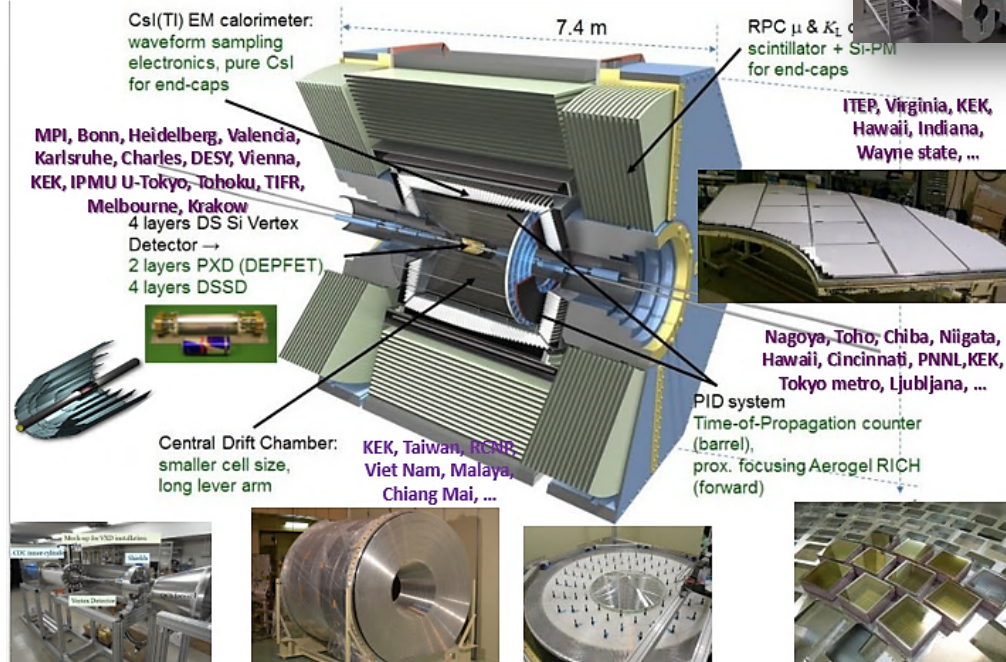


SuperKEKB/Belle II

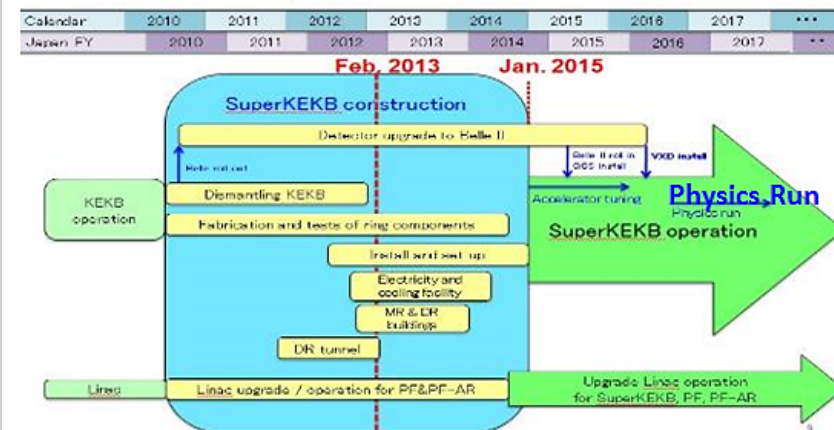


BINP, KEK, Nara
Taiwan, Hanyang, ...

Belle II Detector Upgrade



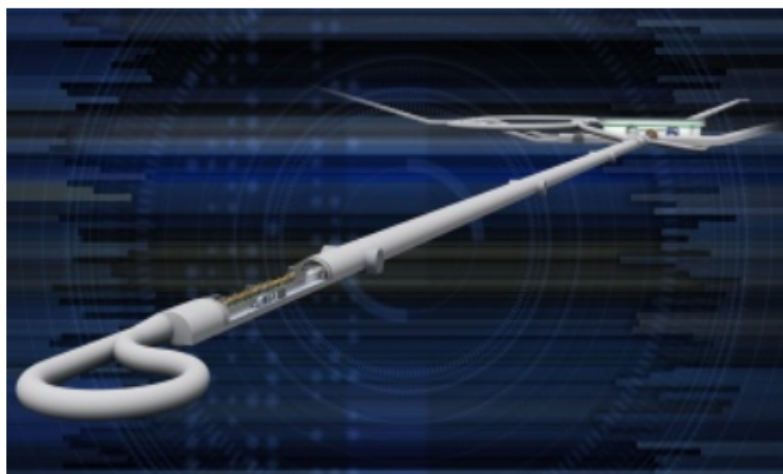
SuperKEKB Schedule



Preparation Office for promoting the ILC project was set up in KEK (February 2014)

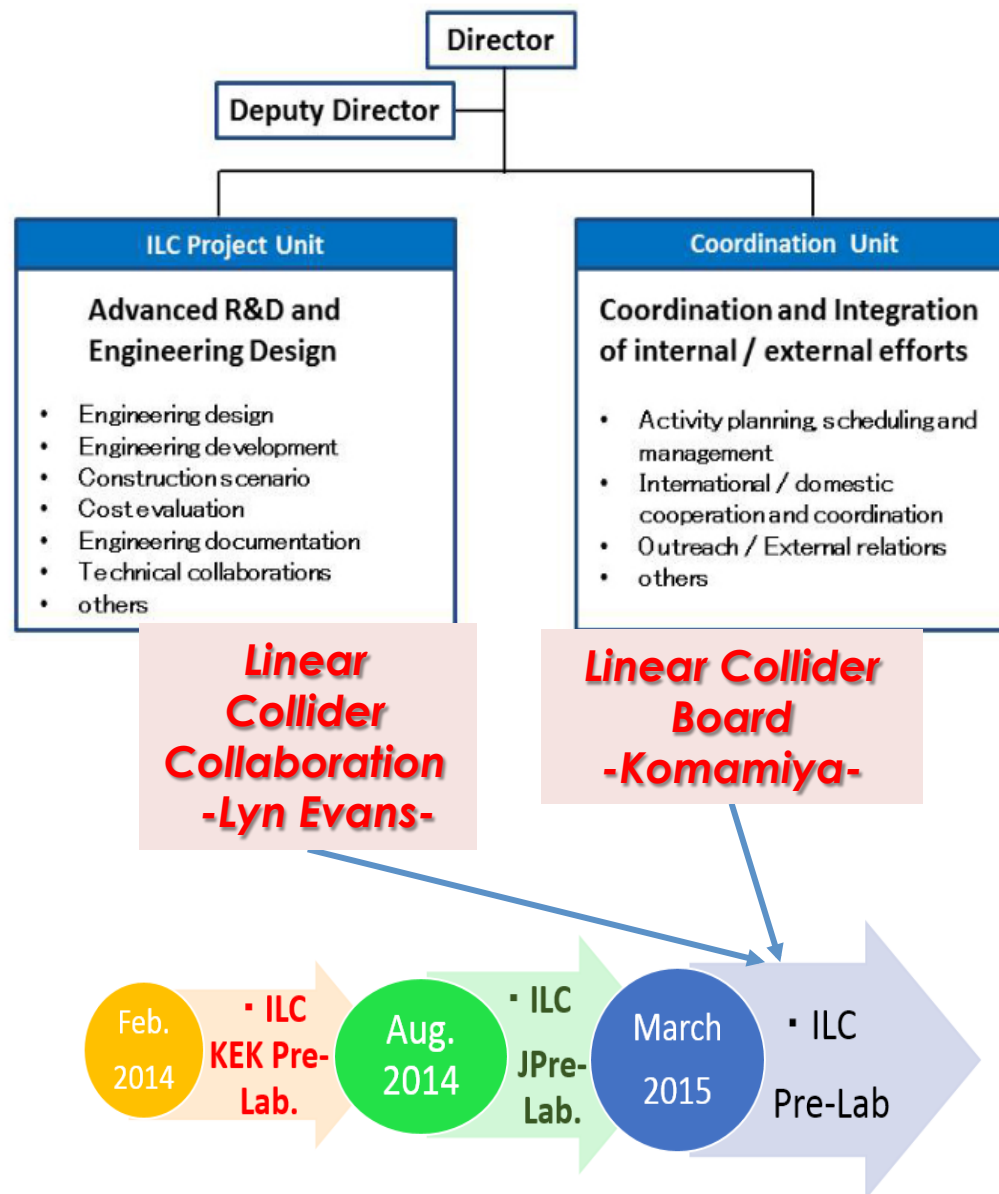
AROUND THE WORLD

*From KEK: KEK sets up Planning
Office for the International Linear
Collider*



February

Tsukuba, 6 January 2014. KEK, Japan's High Energy Accelerator Research Organization, has set up a Planning Office for the International Linear Collider. The office will be headed by Atsuto Suzuki, Director General of KEK, and will oversee a broad range of activities required for realisation of the ILC, in addition to the ongoing efforts.

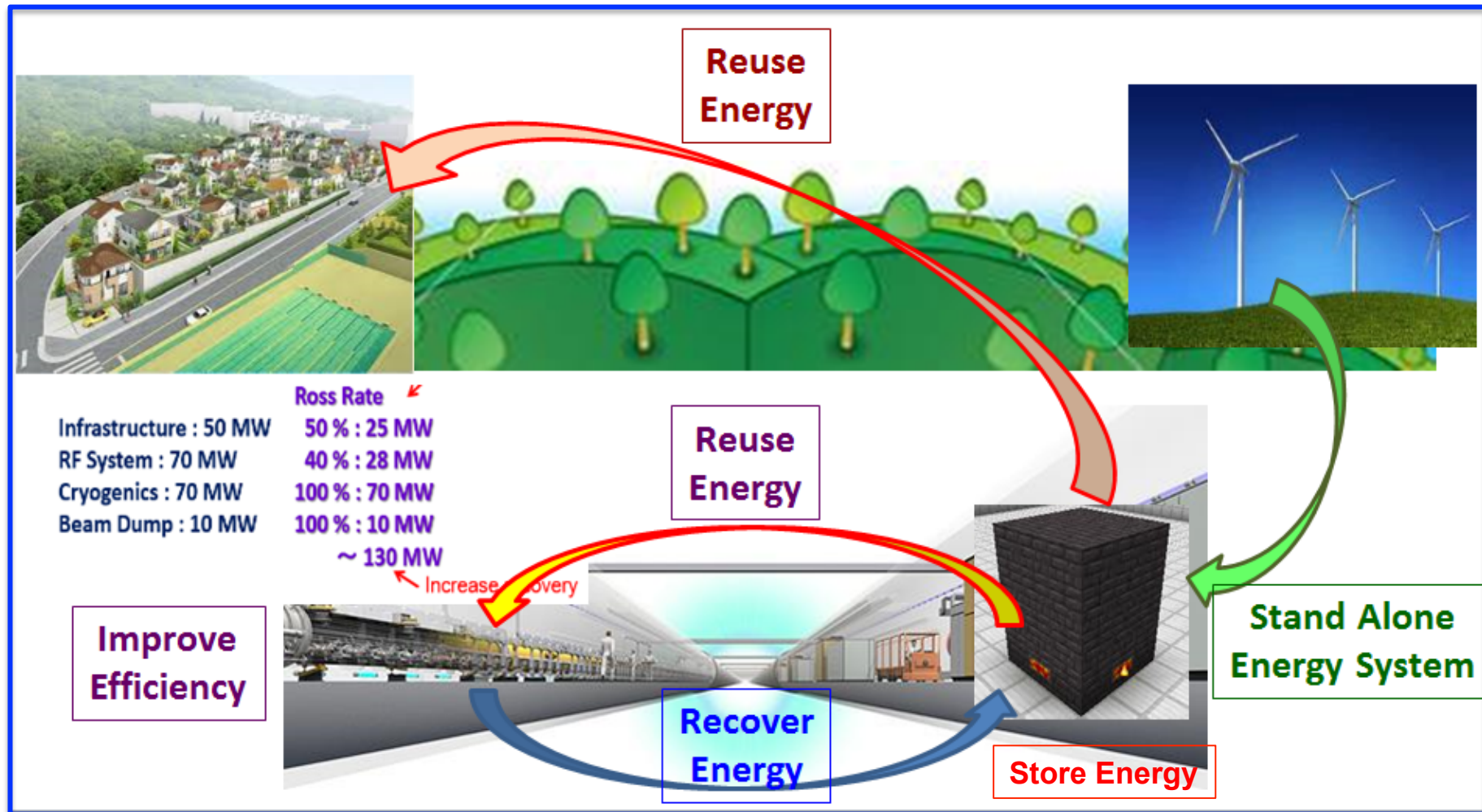




GREEN ILC

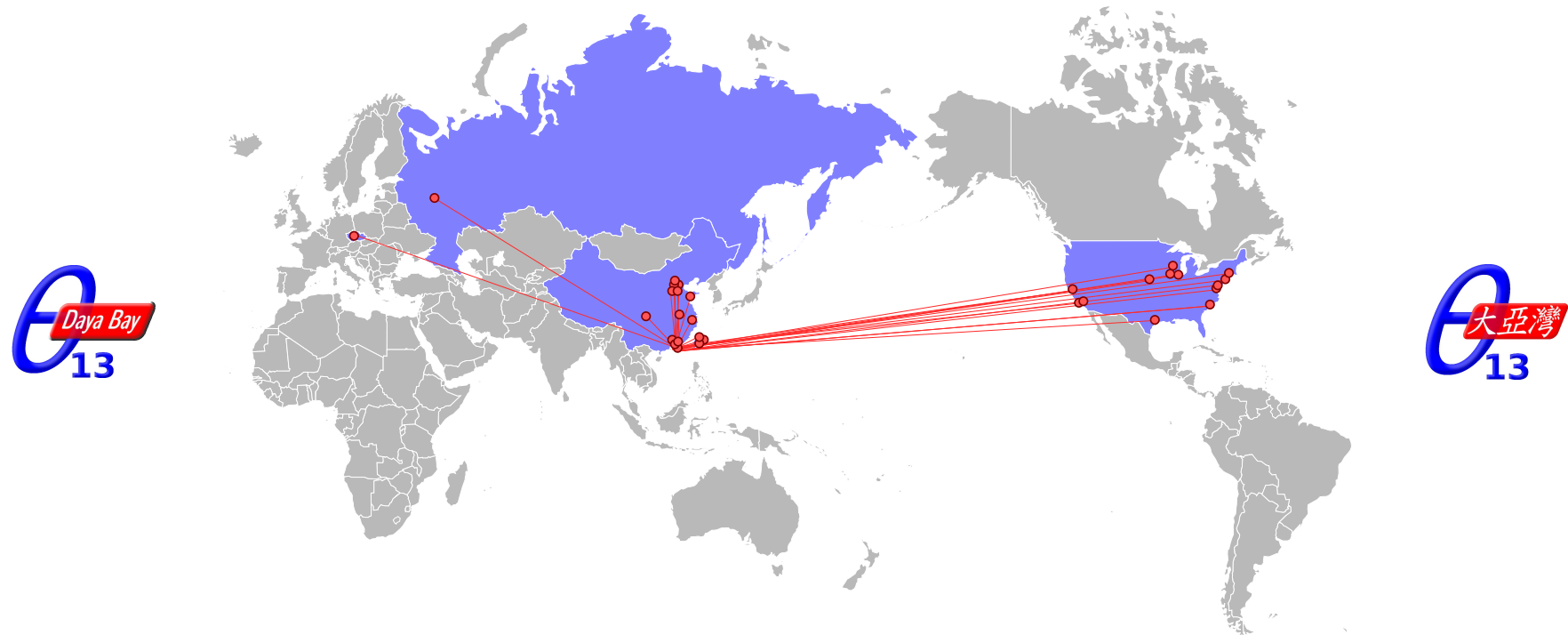


Collaboration with industry



INTERNATIONAL COOPERATION

An International Effort: 230 Collaborators from 40 Institutions



North America (17)

Brookhaven Natl Lab, CalTech, Illinois Institute of Technology, Iowa State, Lawrence Berkeley Natl Lab, Princeton, Rensselaer Polytechnic, Siena College, UC Berkeley, UCLA, Univ. of Cincinnati, Univ. of Houston, UIUC, Univ. of Wisconsin, Virginia Tech, William & Mary, Yale

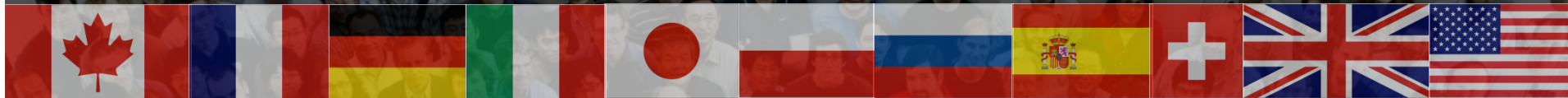
Europe (2)

Charles University, JINR Dubna

Asia (21)

Beijing Normal Univ., CGNPG, CIAE, Dongguan Polytechnic, ECUST, IHEP, Nanjing Univ., Nankai Univ., NCEPU, Shandong Univ., Shanghai Jiao Tong Univ., Shenzhen Univ., Tsinghua Univ., USTC, Xian Jiaotong Univ., Zhongshan Univ., Chinese Univ. of Hong Kong, Univ. of Hong Kong, National Chiao Tung Univ., National Taiwan Univ., National United Univ.

The T2K Collaboration



~500 members (337 authors), 59 Institutes, 11 countries

Canada

TRIUMF
U. Alberta
U. B. Columbia
U. Regina
U. Toronto
U. Victoria
U. Winnipeg
York U.

France

CEA Saclay
IPN Lyon
LLR E. Poly.
LPNHE Paris

Germany

U. Aachen

Italy

INFN, U. Roma
INFN, U. Napoli
INFN, U. Padova
INFN, U. Bari

Japan

ICRR Kamioka
ICRR RCCN
Kavli-IPMU
KEK
Kobe U.
Kyoto U.
Miyagi U. Edu.
Okayama U.
Osaka City U.
Tokyo Metropolitan U.
U. Tokyo

Poland

IFJ PAN, Cracow
NJBC, Warsaw
U. Silesia, Katowice
U. Warsaw
Warsaw U.T.
U. Wroclaw

Russia

INR

Spain

IFIC, Valencia
U. A. Barcelona

Switzerland

U. Bern
U. Geneva
ETH Zurich

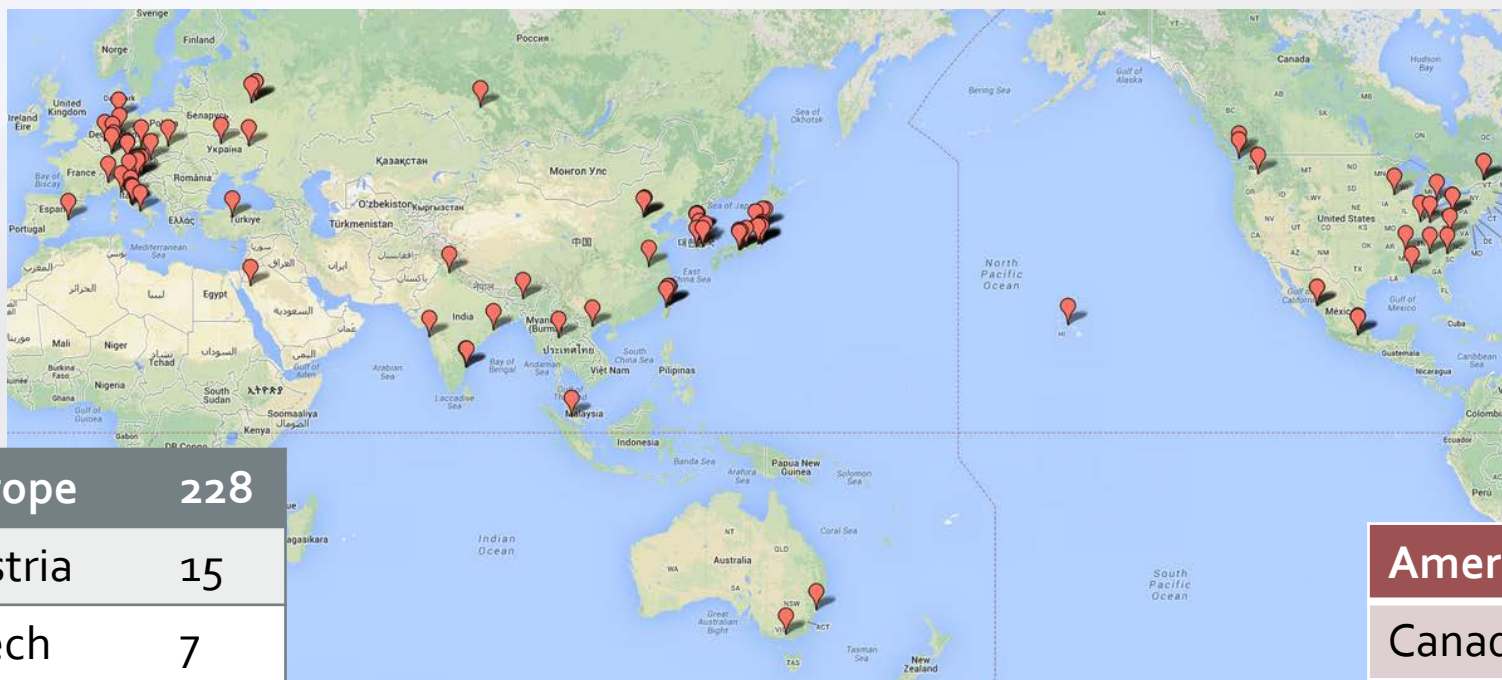
United Kingdom

Imperial C. London
Queen Mary U. L.
Lancaster U.
Liverpool U.
Oxford U.
Sheffield U.
STFC/Daresbury
STFC/RAL
Warwick U.

USA

Boston U.
Colorado S. U.
Duke U.
Louisiana S. U.
Stony Brook U.
U. C. Irvine
U. Colorado
U. Pittsburgh
U. Rochester
U. Washington

Belle II collaboration



Europe	228
Austria	15
Czech	7
Germany	83
Italy	48
Poland	11
Russia	38
Slovenia	16
Spain	4
Ukraine	6

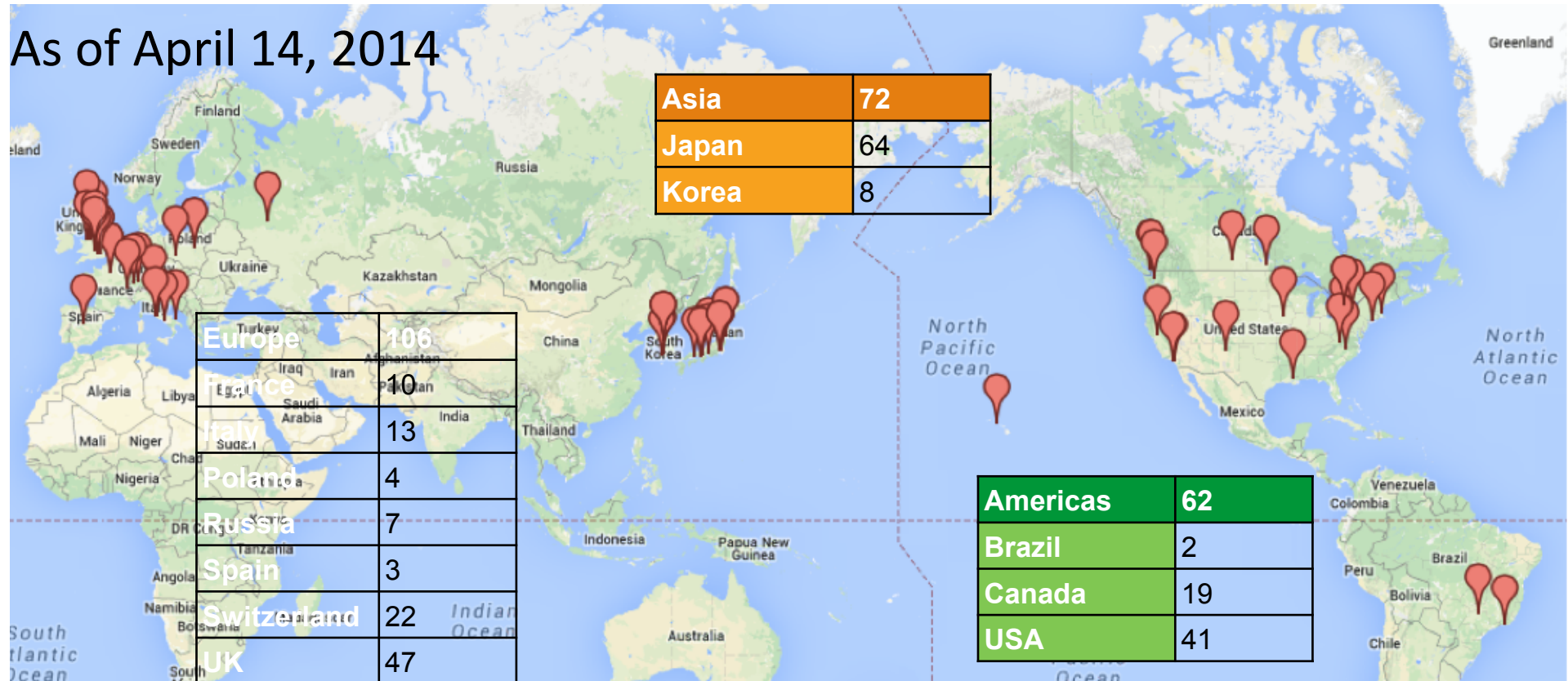
Asia	283		
Saudi Arabia	4	Korea	38
Australia	16	Malaysia	6
China	18	Viet Nam	3
India	22	Taiwan	24
Japan	145	Thailand	4
		Turkey	3

America	92
Canada	17
Mexico	6
U.S.A	69

23ヶ国・地域
約600名

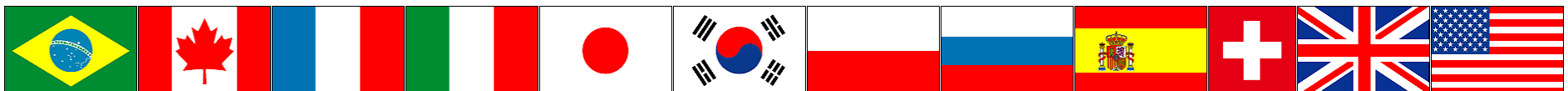
Hyper-Kamiokande International Working Group

As of April 14, 2014



12 countries, 67 institutes, 240 people

Submitted a proposal to J-PARC PAC in Apr. 2014



Summary

- Ample research opportunities in Asia.
 - T2K, KOTO, COMET etc. @J-PARC
 - e^+e^- : Belle II @SuperKEKB and BES III @BEPC II
 - Neutrino: JUNO @Taishan and HK @Kamioka + RENO in Korea and INO in India
- Future colliders have been proposed.
 - Linear e^+e^- collider in Japan
 - TDR completed, technically ready to go.
 - Circular e^+e^- (pp) collider in China
 - Design study started.
- Asian lab/community is accumulating experience in hosting large international projects.

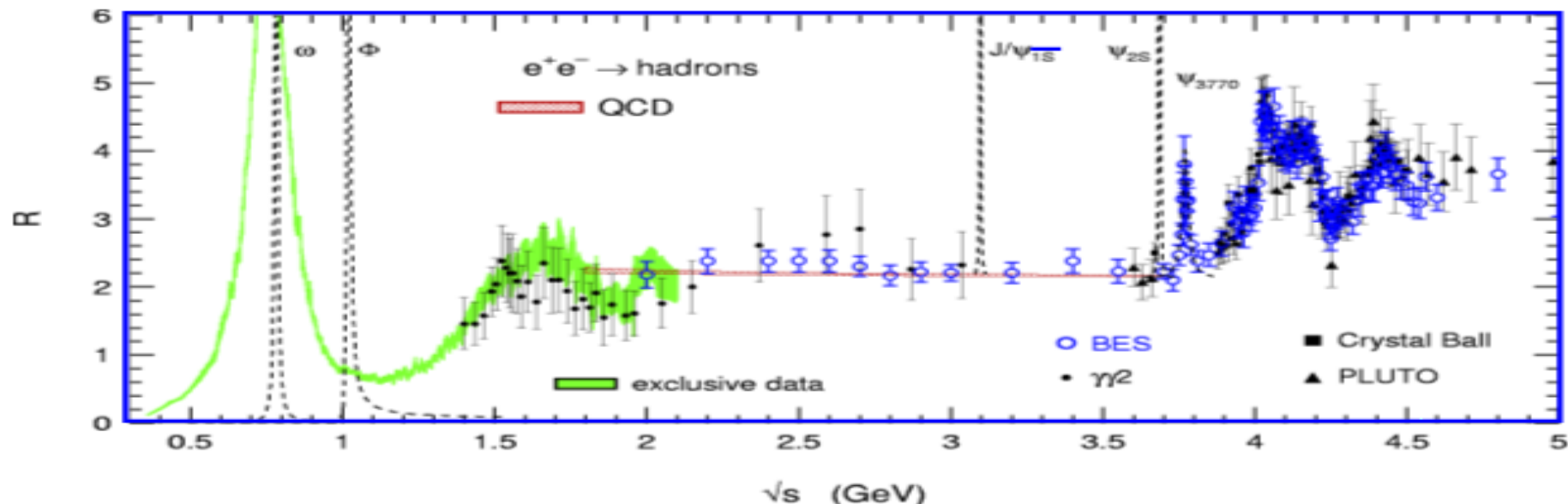
Acknowledgement to Y. Wang, J. Gao (IHEP),
T. Kobayashi, A. Suzuki, M. Yamauchi (KEK), and
M. Yokoyama (Univ. Tokyo)

THANK YOU

BACKUP

BESIII Data Taking Status & Plan

	Previous Data set	BESIII Near future
J/psi	BESII 58M	2009: 200M, 2012: 1 B
Psi'	CLEO: 28 M	2009: 100M, 2012: 0.4 B
Psi''	CLEO: 0.8 /fb	2010: 0.9/fb, 2011: 2.6/fb
$\psi(4040)/\psi(4160)$ & scan	CLEO: 0.6/fb @ $\psi(4160)$	2011: 0.4/fb @ $\psi(4040)$ 2013: 2.0/fb (4260), 0.5/fb (4360)



BESIII will continue for the next 8-10 years: Unique in the world

The Daya Bay Experiment

Far Hall

1615 m from Ling Ao I
1985 m from Daya Bay
350 m overburden

Ling Ao Near Hall

481 m from Ling Ao I
526 m from Ling Ao II
112 m overburden

Tunnels

3 Underground
Experimental Halls

Entrance

Daya Bay Near Hall

363 m from Daya Bay
98 m overburden

Ling Ao II Cores

Ling Ao I Cores

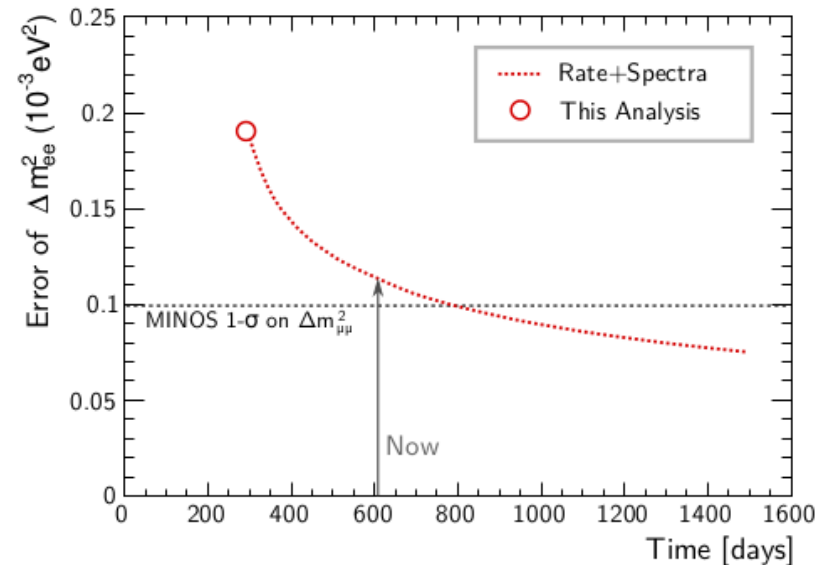
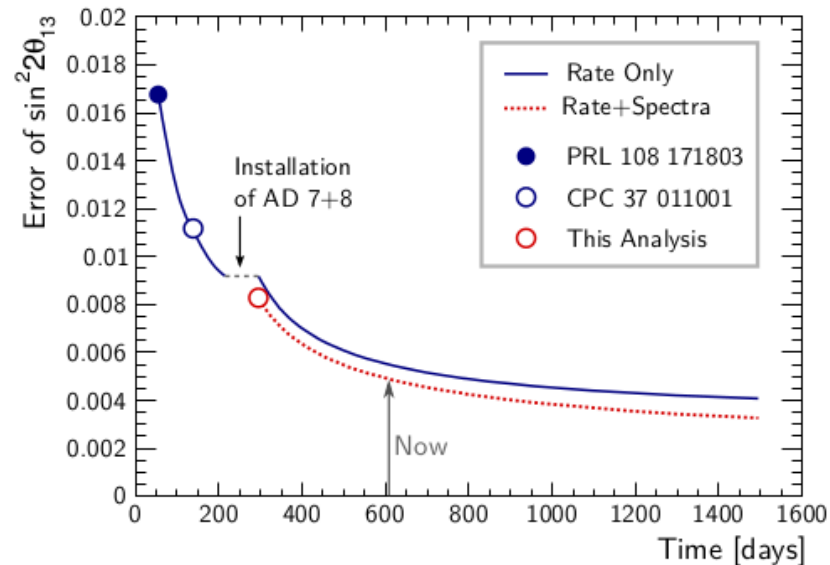
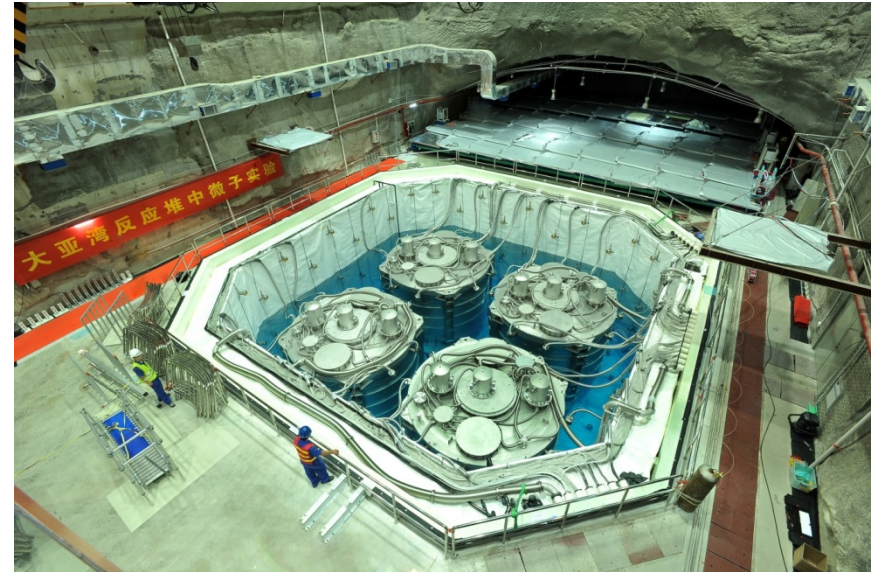
Daya Bay Cores

- 17.4 GW_{th} power
- 8 operating detectors
- 160 t total target mass

Daya Bay: Future plan

- Summer(2012) maintenance & calibration completed
- Data taking with 8AD in Oct.
- Results in three years: $\Delta(\sin^2 2\theta_{13}) \sim 3\text{-}4\%$

The most precise measurement of $\sin^2 2\theta_{13}$ in the next decades.

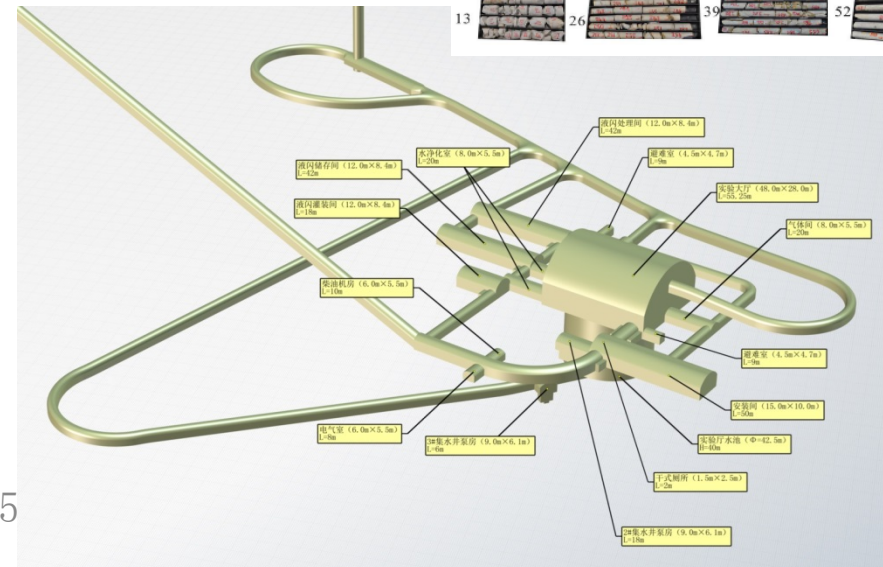
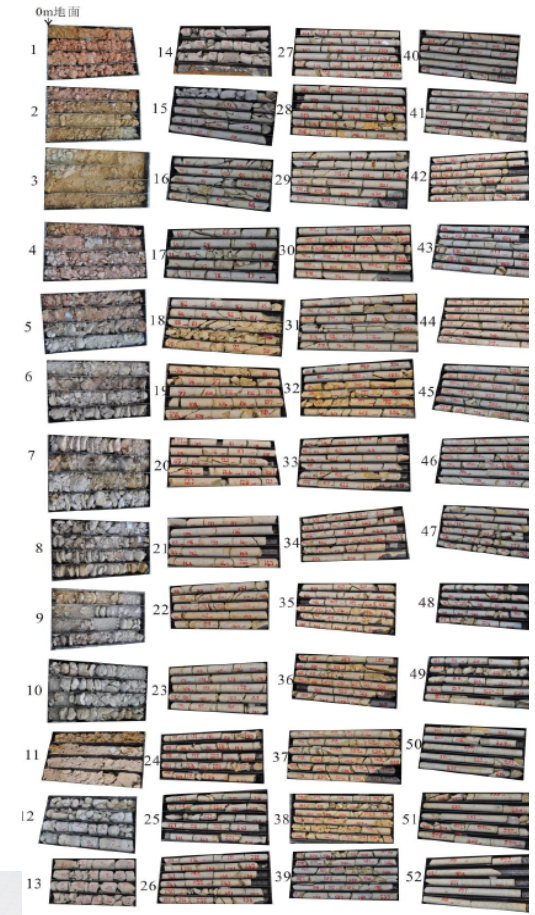


Status of the project

- Conceptual design & R&D approved in China
- Site determined, geological survey completed
- Detailed civil design underway
- Paper work to start construction underway
- Detector design and R&D underway
- Collaboration will be established soon
 - Interested parties: US, Italy, France, Germany, Russia, Czech, ...
- Welcome new collaborators

Schedule:

Civil preparation: 2013-2014
 Civil construction: 2015-2017
 Detector R&D: 2012-2016
 Production: 2016-2018
 Installation: 2018-2019
 Filling & data taking: 2020



Tsukuba: e^+e^- collider (B-factory)
and ATF (Accelerator Test Facility)

Tokai: J-PARC
(proton accelerator complex)
secondary particles p, n, π, μ, ν



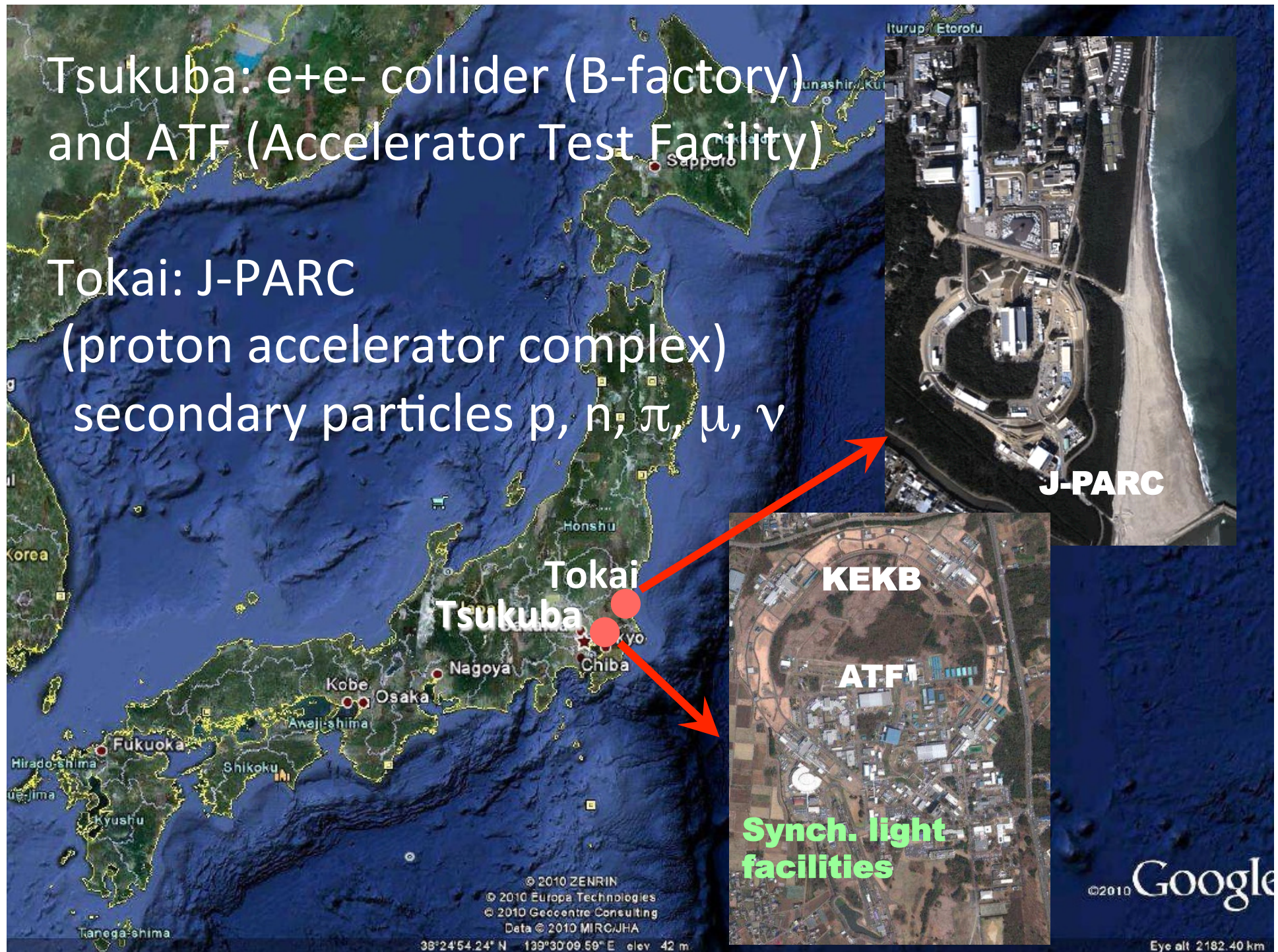
J-PARC



KEKB

ATF

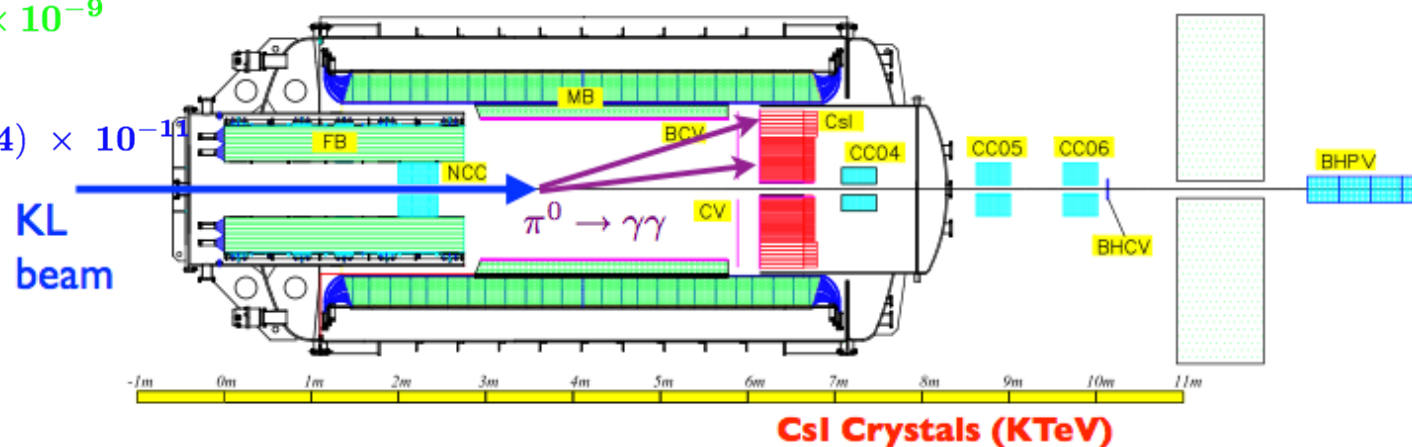
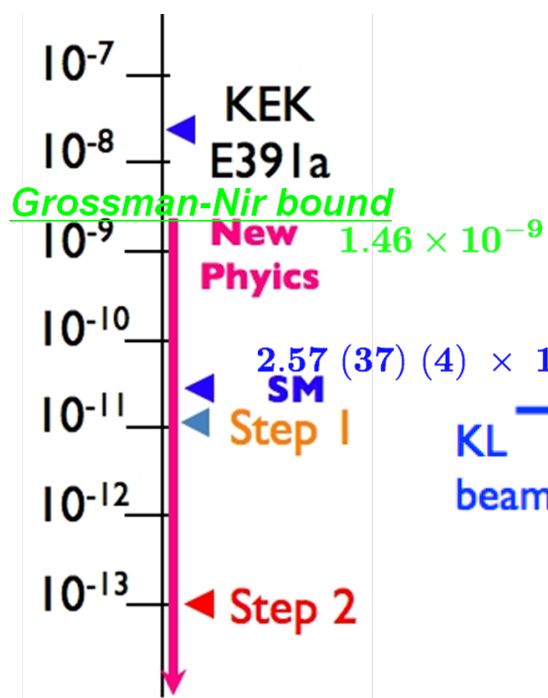
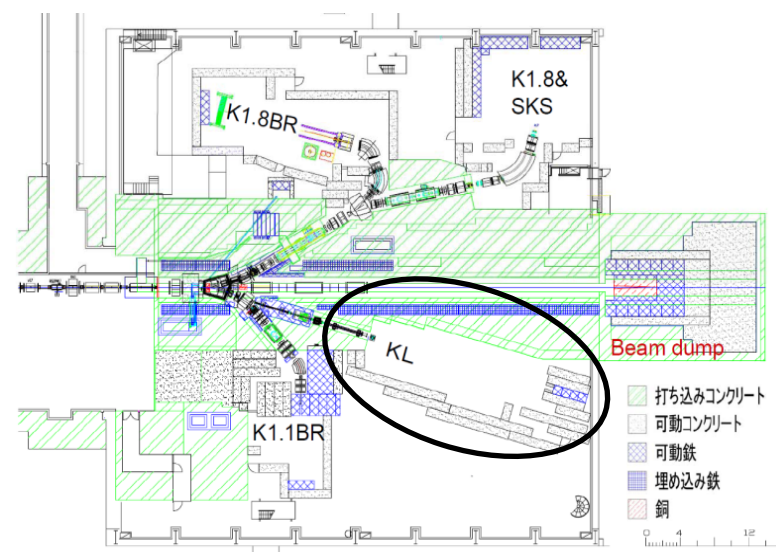
**Synch. light
facilities**



KOTO experiment

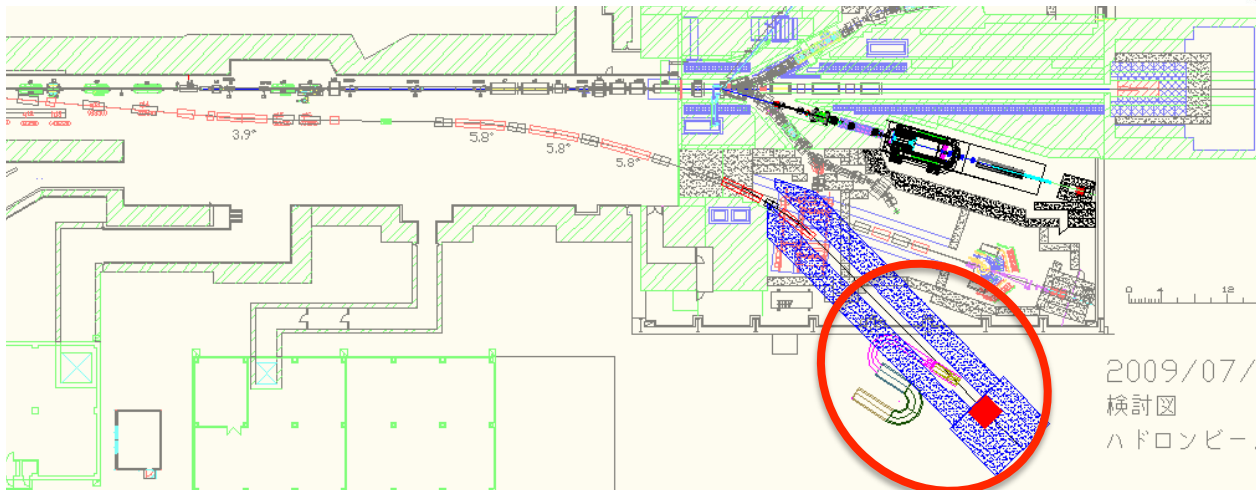
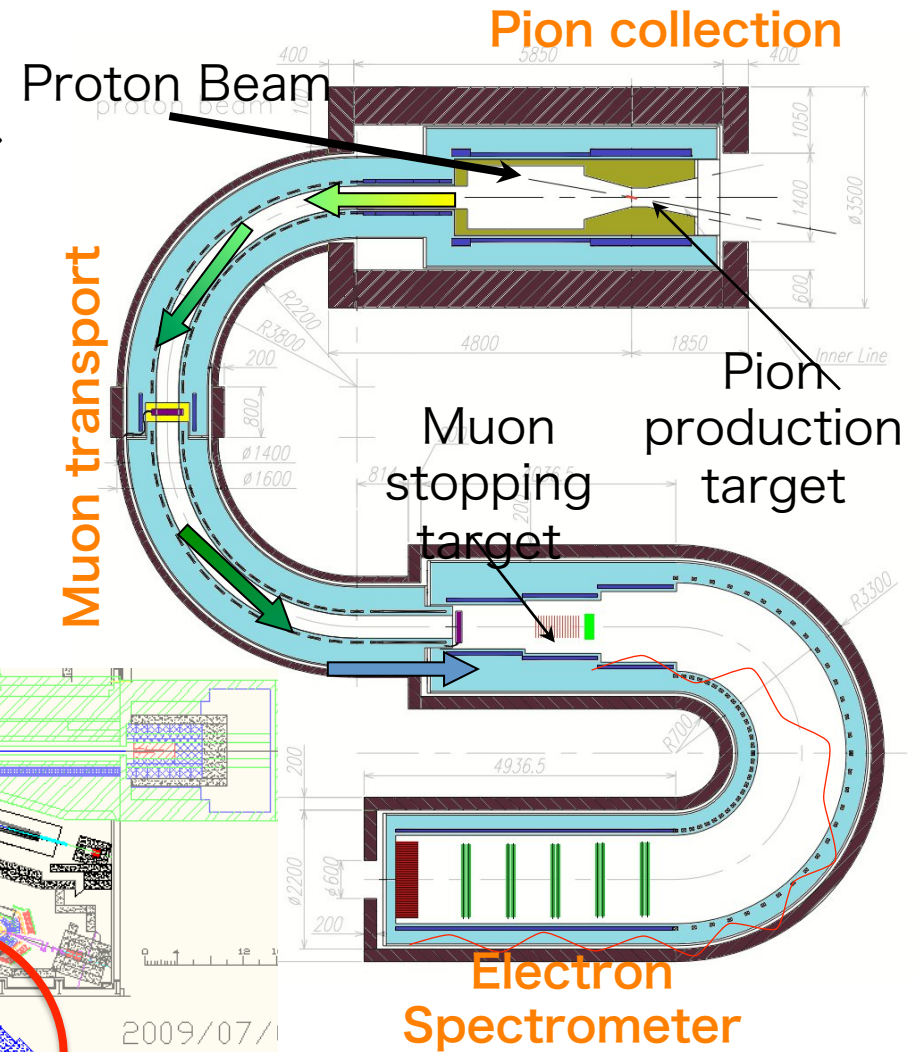
- Direct CPV rare decay for physics beyond the standard model
- Milestones
 - Before Summer 2013: Exceed GN limit ($\sim 10^{-9}$)
 - **10~30kW x 4weeks**
 - Final goal : 290kWx3SNyr $\rightarrow 1 \times 10^{-11}$
 - **Critical to have >100kW**
- Requirement for duty factor (rough estimate)
 - Duty [%] > 100% x (Power[kW]/300kW)

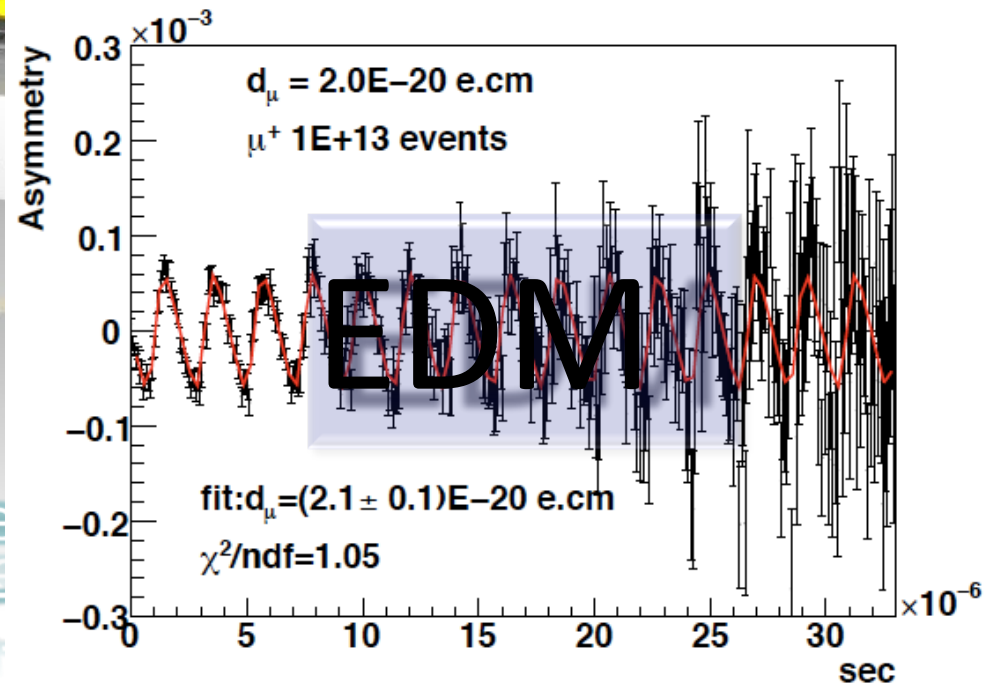
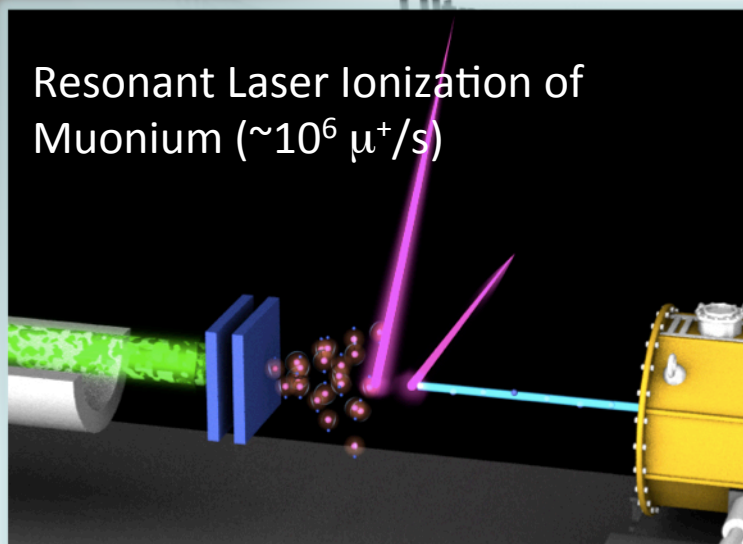
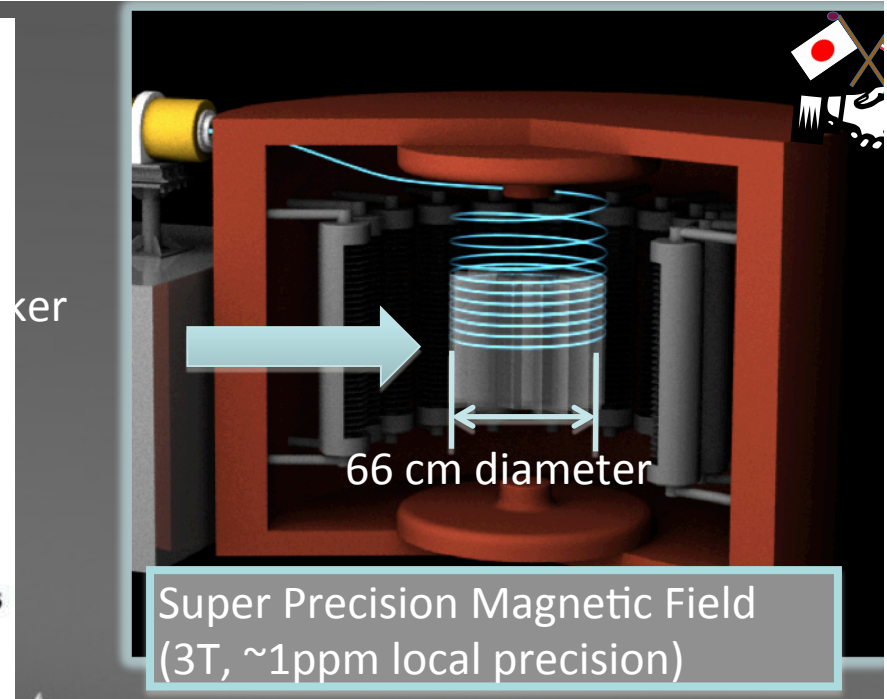
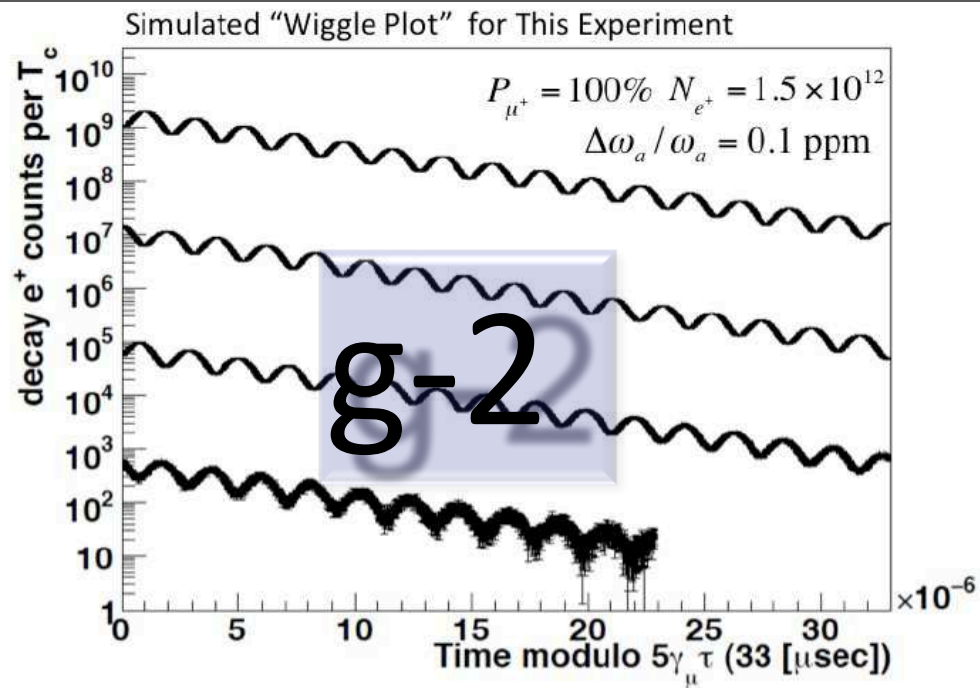
$$K_L^0 \rightarrow \pi^0 \nu \bar{\nu}$$



COMET μ -e conv. search

- Search for cLFV mu-e conv.
 - 10^{-16} sensitivity (Target S.E.S. 2.6×10^{-17})
 - Improve $O(10^4)$ than present upper bound such as SINDRUM-II $BR[\mu^- + Au \rightarrow e^- + Au] < 7 \times 10^{-13}$
- Signature: 105MeV monochromatic electron
- Beam requirement
 - 8GeV bunched slow extraction
 - 8.5×10^{20} pot needed to reach goal
 - 7 uA (56kW) x 2 years (2×10^7 sec)
 - Extinction $< 10^{-9}$





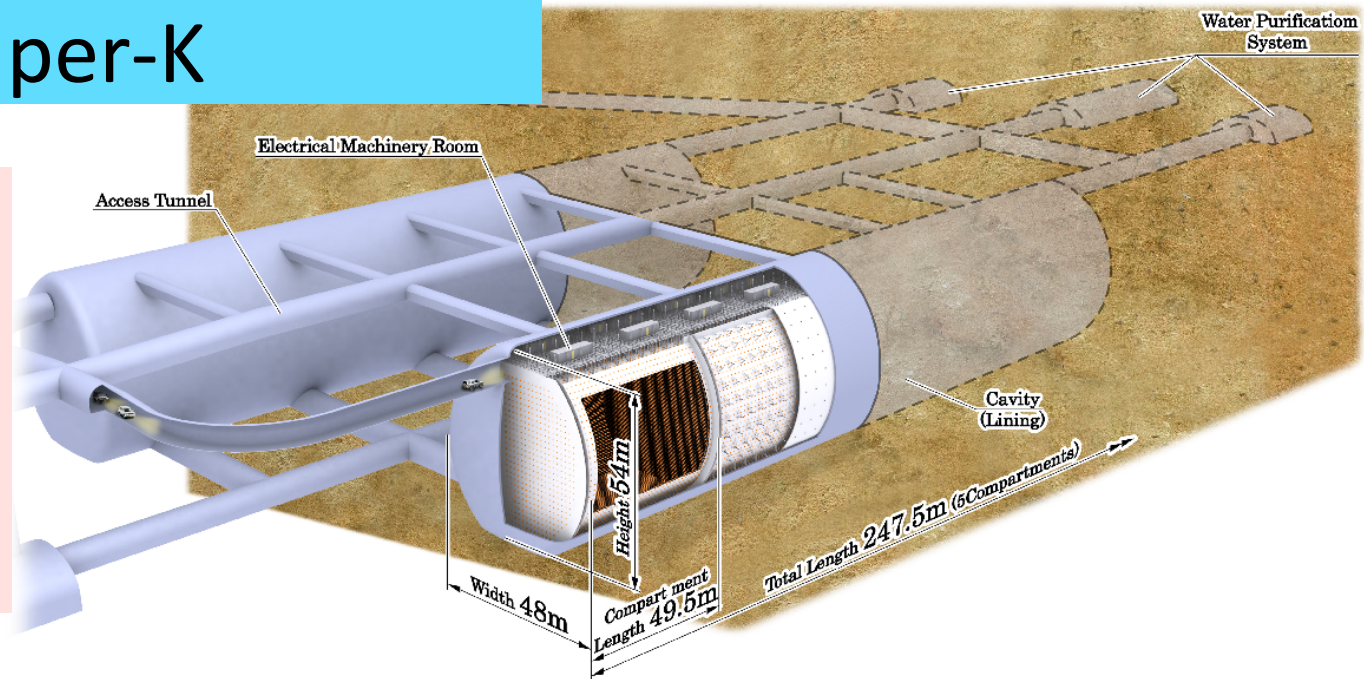
Hyper-Kamiokande

Total volume: 0.99 Mton
Inner volume: 0.74 Mton
Outer volume: 0.2 Mton
Fiducial volume: 0.56 Mton
(0.056 Mton \times 10 compartments)
x25 of Super-K

LoI by Hyper-K WG,
arXiv:1109.3262 [hep-ex]

Snowmass whitepaper
arXiv:1309.0184 [hep-ex]

- 99,000 20" PMT for inner-det.
(20% coverage)
- 25,000 8" PMT for outr-det.



提 言

第 22 期学術の大型研究計画に関する

マスタープラン

(マスタープラン 2014)



平成 26 年 (2014 年) 2 月 28 日

日 本 学 術 会 議

科学者委員会

学術の大型研究計画検討分科会

Selected as one of 27 top projects in Japanese Master Plan for Large Scale Research Projects by Science Council of Japan (Feb. 2014)

No.	Scientific Field No.	Project Name	Project Summary	Scientific Significance	Social Value	Project Duration	Financial Requirement (1 billion yen)	Implementing Institution, or Affiliation of Proposer
85	23-2	Nucleon decay and neutrino oscillation experiment with an advanced large detector	The project aims to construct a one million ton-scale water Cherenkov detector, Hyper-Kamiokande, to succeed Super-Kamiokande and to perform world-leading neutrino and nucleon decay research in conjunction with the J-PARC accelerator facility.	The project will explore CP violation (matter-antimatter asymmetry) in neutrinos in order to help understand the evolution of the universe. Additionally, with the world's best nucleon decay searches it also aims to establish the unification of elementary particles and their forces.	Addressing profound questions concerning the elementary structure and evolution of the universe appeals directly to the inherent intellectual curiosity mankind harbors for comprehension of its origins and future. Additionally, dramatic advances in neutrino research with a world-leading project in Japan represent society's dreams for a rich program in basic science.	2015 to 2038	Total: 1,880 Construction of Hyper-Kamiokande 800, Operating cost of Hyper-Kamiokande 450, Operating cost of J-PARC 600, Neutrino monitor 30	Lead by the Institute for Cosmic Ray Research, University of Tokyo and the High Energy Accelerator Research Organization. Participation from domestic and foreign universities and research institutions is anticipated.

A Report from Science Council to Ministry



AROUND THE WORLD

ILC moves forward in Japan

Hitoshi Murayama and Satoru Yamashita | 10 October 2013

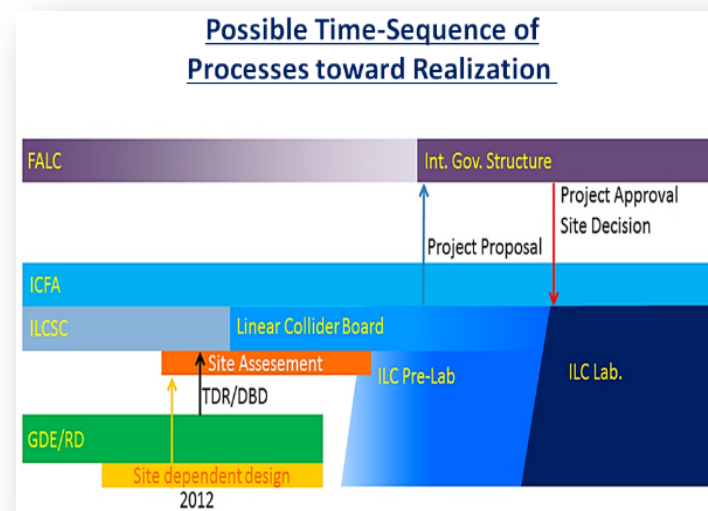
On 30 September, the Science Council of Japan (SCJ) submitted the report on the study of the International Linear Collider to the Ministry for Education, Culture, Sports, Science and Technology (MEXT). This was a response to the



SCJ pointed out obvious issues with international projects, such as cost sharing, its governance model, and availability of leadership and personnel. Therefore, the report recommends the government to allocate the funds necessary to study risks and discuss with potential partners in the next two to three years. This is exactly what the chair of Linear Collider Board, Sachio Komamiya expected (see, e.g., [presentation at EPS2013](#)).

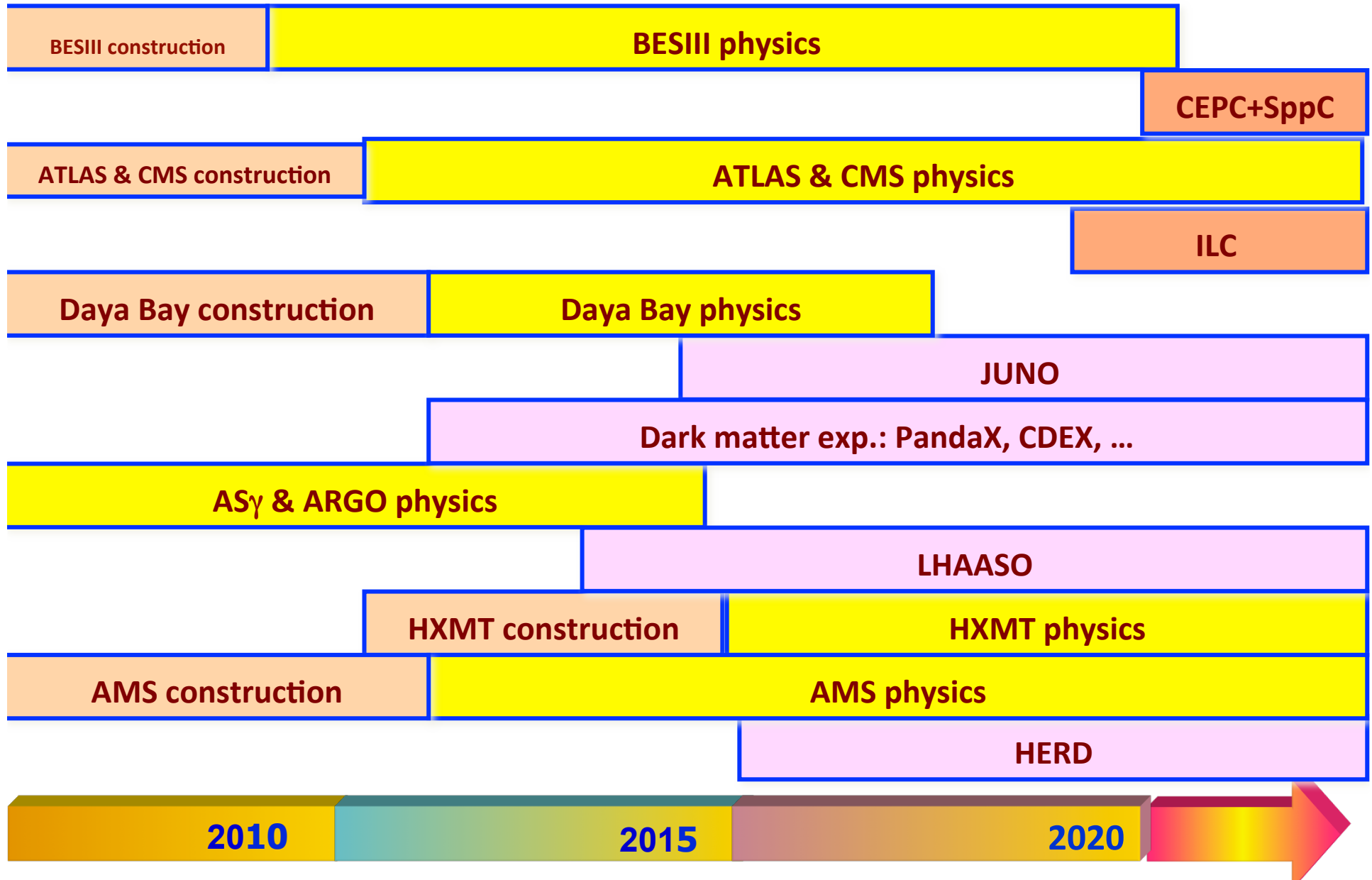
In the report, the council recommends the creation of a budget to make an extensive review on the ILC project. The government quickly followed up. MEXT has requested about 50 million yen (about half a million US dollars) to study the ILC project as a line item in the fiscal 2014 budget. Even though the amount is small, it is symbolic that the Japanese government for the first time allocates a “preparatory budget” for ILC as an official project. Namely, ILC is moving *forward* in Japan as a result of the SCJ report.

The report also recommended that a council of advisers to study the ILC further should be established. On 2 October, Minister of MEXT, Hakubun Shimomura said in the general press conference that the government will create a working group of advisors with specialists from various fields as soon as possible. A task force exclusively set up to study the ILC at MEXT has been working since February, deepening the understanding of the project in the ministry. A new working group will be set up under the task force, which will review the possible issues on the realisation of the ILC in Japan.



SCHEDULES

Summary



Timelines of Current/Future Projects



Elucidation of the origin of matter with an upgrade of J-PARC experimental facility

Intended Schedule (JFY2017-)

年次計画	H24 (2012)	H25 (2013)	H26 (2014)	H27 (2015)	H28 (2016)	H29 (2017)	H30 (2018)	H31 (2019)	H32 (2020)	H33 (2021)	H34 (2022)
Accelerator (Main Ring)		Beam Intensity Upgrades					Further Intensity Improvements				
Neutrino Exp.							Next Generation Neutrino Experiment				
		Neutrino Oscillation and a hint of CPV									
Hadron Exp.		Hi-momentum beamline					Hadron Hall Extension				
Muon Particle Physics Exp.		COMET phase-I					COMET phase-II g _μ -2/μEDM				
							(※) Accelerate to compete with US projects				
Neutron and Muon at MLF		Polarized neutron /muon S&H lines					Advance beamlines				

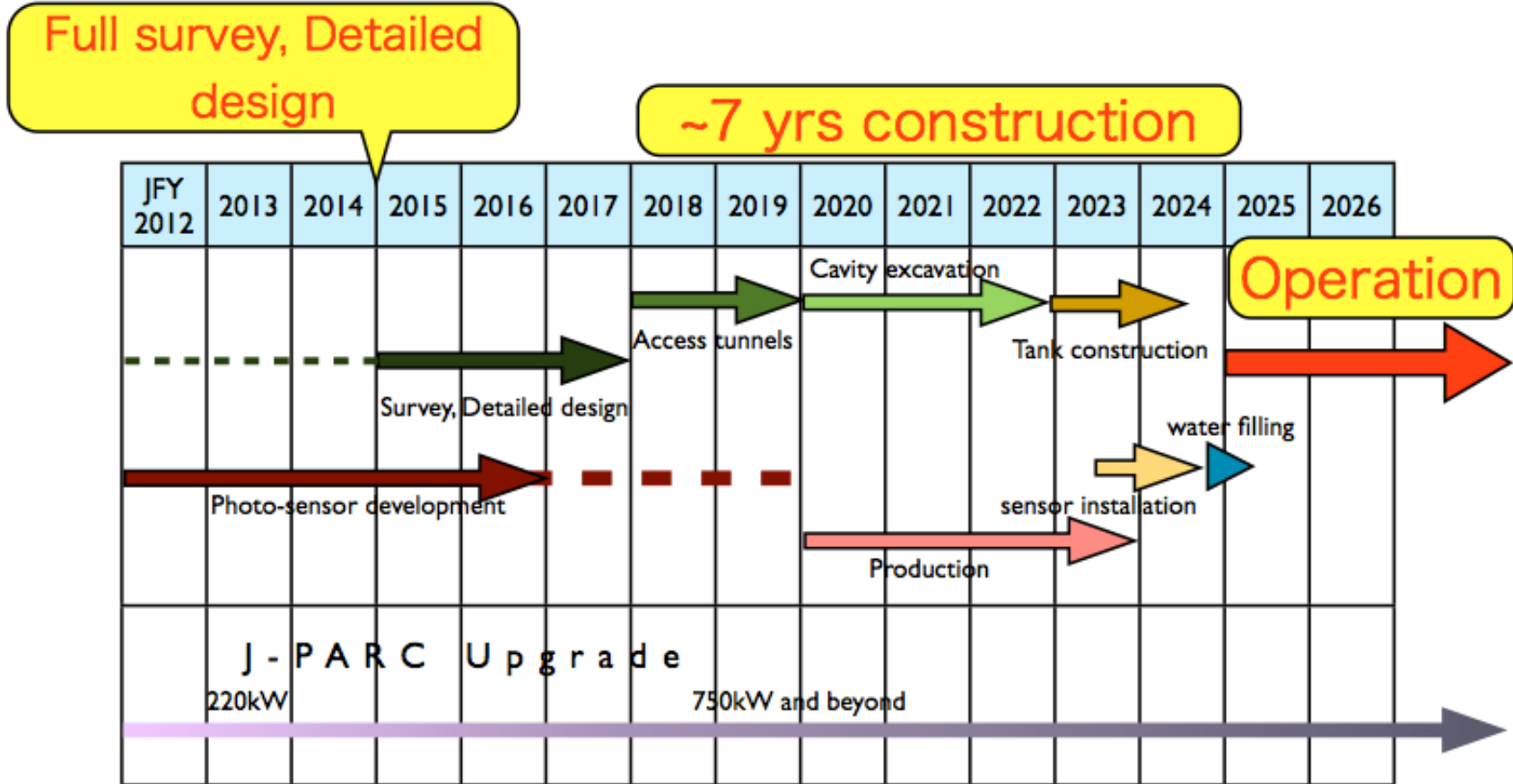
Overseas Projects

g-2 at Fermilab
(~2016)

GSI-FAIR (Hadron Experiments)
(~2018)

Mu2e at
Fermilab
(2021)

Notional Timeline



- 2015 Full survey, Detailed design (3 years)
- 2018 Excavation start (7 years)
- 2025 Start operation

SuperKEKB Schedule

