

FJPPL – Japan-France workshop on computing technologies

31 Jan 2023, 09:30 → 1 Feb 2023, 22:50 Europe/Paris

202 (CC-IN2P3)

KEK and KEK-CRC general report

Tomoaki Nakamura

Computing Research Center
Applied Research Laboratory
HIGH ENERGY ACCELERATOR RESEARCH ORGANIZATION, KEK



Computing Research Center



Applied Research Laboratory



FJPPL-TYL: Comp_03/04



FJPPL Computing Workshop

chaired by Fabio Hernandez (CC-IN2P3)

from Tuesday, 10 March 2015 at 09:00 to Wednesday, 11 March 2015 at 16:20 (Europe/Paris)

2015: 23 talks

<https://indico.in2p3.fr/event/11289/>

FJPPL Computing Project Annual Workshop

chaired by Fabio Hernandez (CC-IN2P3)

from Wednesday, 10 February 2016 at 10:00 to Thursday, 11 February 2016 at 17:00 (Europe/Paris) at 202

2016: 12 talks + hands on

<https://indico.in2p3.fr/event/12701/>

FJPPL — Japan-France workshop on computing technologies for multidisciplinary science

chaired by Fabio Hernandez (CC-IN2P3)

from Tuesday, 14 February 2017 at 09:30 to Wednesday, 15 February 2017 at 22:30 (Europe/Paris) at 202

2017: 18 talks

<https://indico.in2p3.fr/event/14157/>

FJPPL — Japan-France workshop on computing technologies

13 Feb 2018, 09:00 → 14 Feb 2018, 22:00 Europe/Paris

202 (CC-IN2P3)

Fabio Hernandez (CC-IN2P3)

2018: 16 talks

<https://indico.in2p3.fr/event/16922/>

FJPPL — Japan-France workshop on computing technologies

2 Dec 2019, 09:00 → 3 Dec 2019, 22:20 Europe/Paris

202 (CC-IN2P3)

Renaud Vernet (CC-IN2P3)

2019: 12 talks

<https://indico.in2p3.fr/event/19919/>

Description The goal of this workshop is to explore relevant technologies, exchange experience and share ideas among experts of both Japan and France organisations in several scientific domains.

This is the 4th edition of this workshop, which is organized annually in the framework of and with the sponsorship of the France-Japan Particle Physics Laboratory. The agendas of previous editions are available:

- 2018
- 2017
- 2016
- 2015

Guidelines for speakers

As a speaker, you are kindly requested:

- to upload the support of your presentation (slides, videos, documents, ...) on time, that is, not later than the time your presentation is scheduled to begin. After logging into Indico with your individual identifier, you will be able to fully manage your contribution, including attaching material to it.
- to upload the slides of your presentations in PDF format. Additional formats are also accepted but please make sure at least a PDF version is provided.
- to let the chairman know if the material of your presentation is to be protected. The agenda of the meeting will be publicly available and eventually indexed by web search engines. If this is a problem for you, please let the chairman know for setting access protections accordingly.
- to allow part of the time allocated in your slot for questions and comments from the audience

Information for participants

This meeting is organized so that participants can attend partially and should feel free to attend only their talks of interest. If you want to attend, either as a speaker or as a participant, **you must register** not later than November 15 by clicking in the link below.

Participants Antoine DUBOIS, Aresh Vedae, Benjamin Guillon, Benoit DELAUNAY, David Bouvet, Fabien Wernli, Fabio Hernandez, Frederic Suzer, Ghina Rahal, Gino Marchetti, Renaud Vernet, Sébastien Gadrat

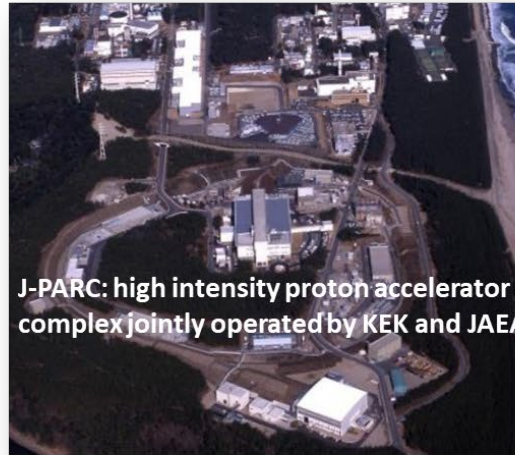
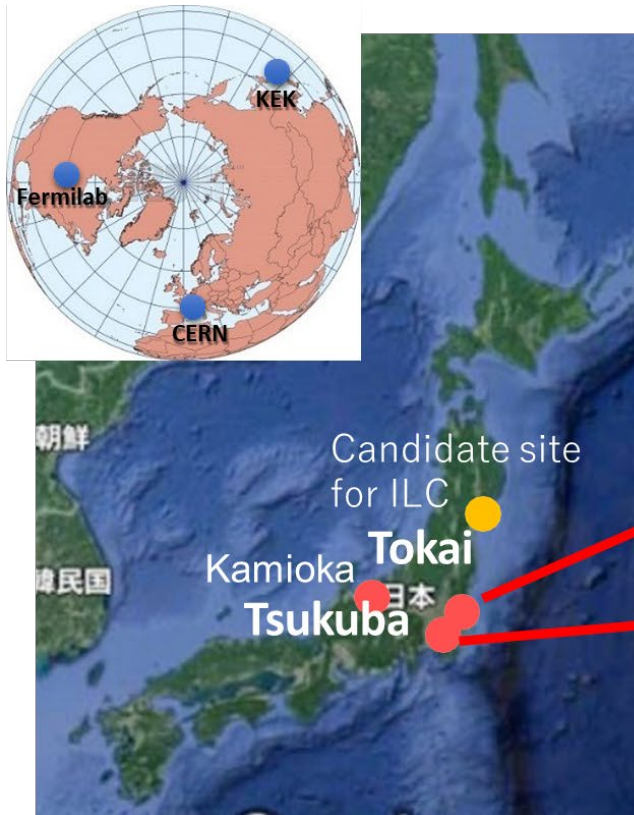
- Information exchange
- Share experience
- Common interests for both centers
- Determine the specific subjects to collaborate

More than 15 years of collaboration

2022-10-31

Tomoaki Nakamura, KEK-CRC

Mission of KEK



KEK covers diverse field of accelerator based science making full use of the electron machines in Tsukuba and the proton machines in Tokai.

J-PARC

- Hadron hall: Particle and nuclear physics experiments with fixed target.
- Neutrino facility: Neutrino beamline for T2K and upgrade program for **Hyper-Kamiokande**.
- MLF: Material and life science experiments with neutron and muon probes. **Muon g-2/EDM** experiment will be done at MLF.

SuperKEKB/Belle II

- Asymmetric e^+e^- collider at $\Upsilon(4s)$ with target $L=8 \times 10^{35}/\text{cm}^2/\text{s}$.
- $\sim 10^{11}$ B , D and t measured with vertex reconstruction and PID.
- Physics run started March 2019.
- Belle II collaboration consists of 1000 physicists from 26 countries.

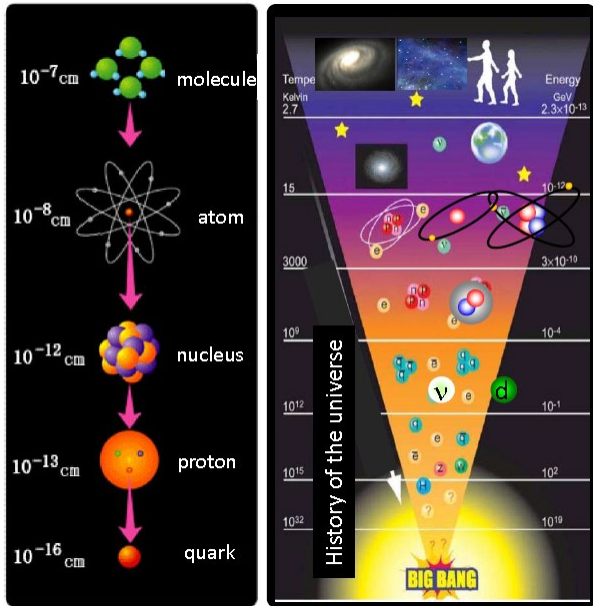
R&D

- ILC: Technical development and efforts to realize it
- Contributions to HL-LHC and ATLAS upgrade

Diversity in accelerator-based sciences



Pursuing fundamental laws of nature

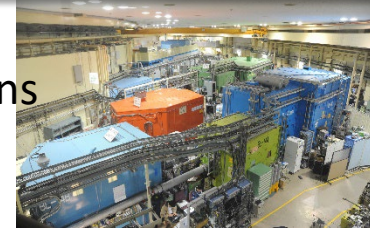


Basic science Material science and its applications

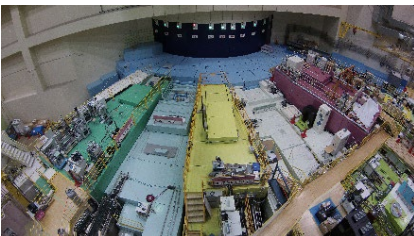
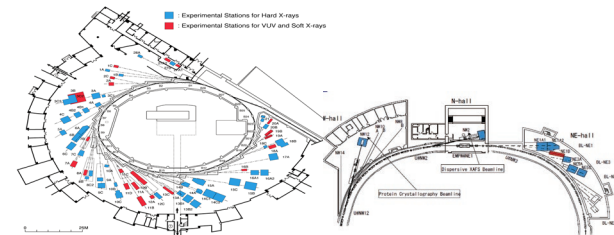
KEK

Technical development and its applications

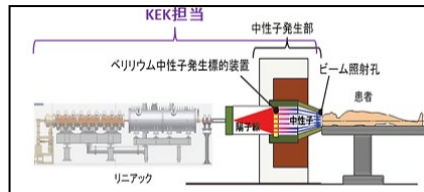
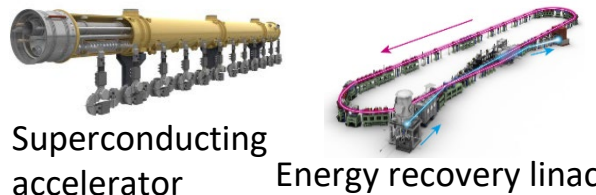
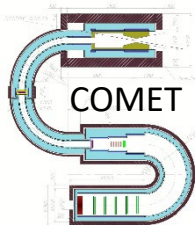
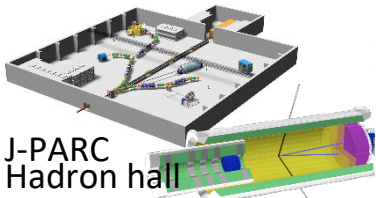
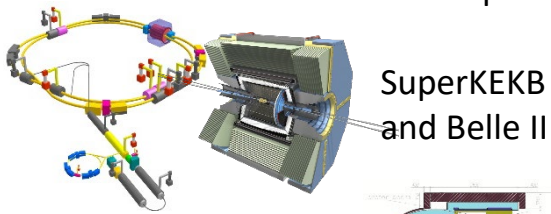
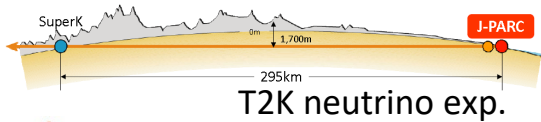
Pursuing origin of function in materials



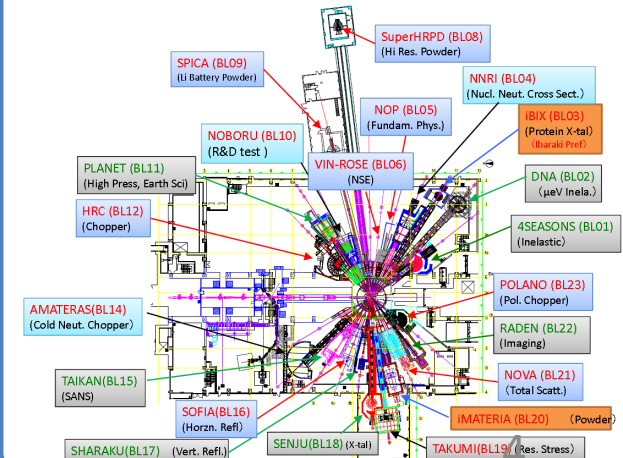
Photon factory
X-ray as a probe



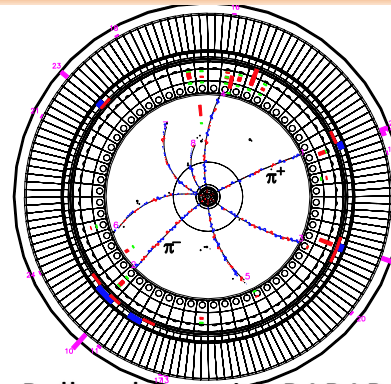
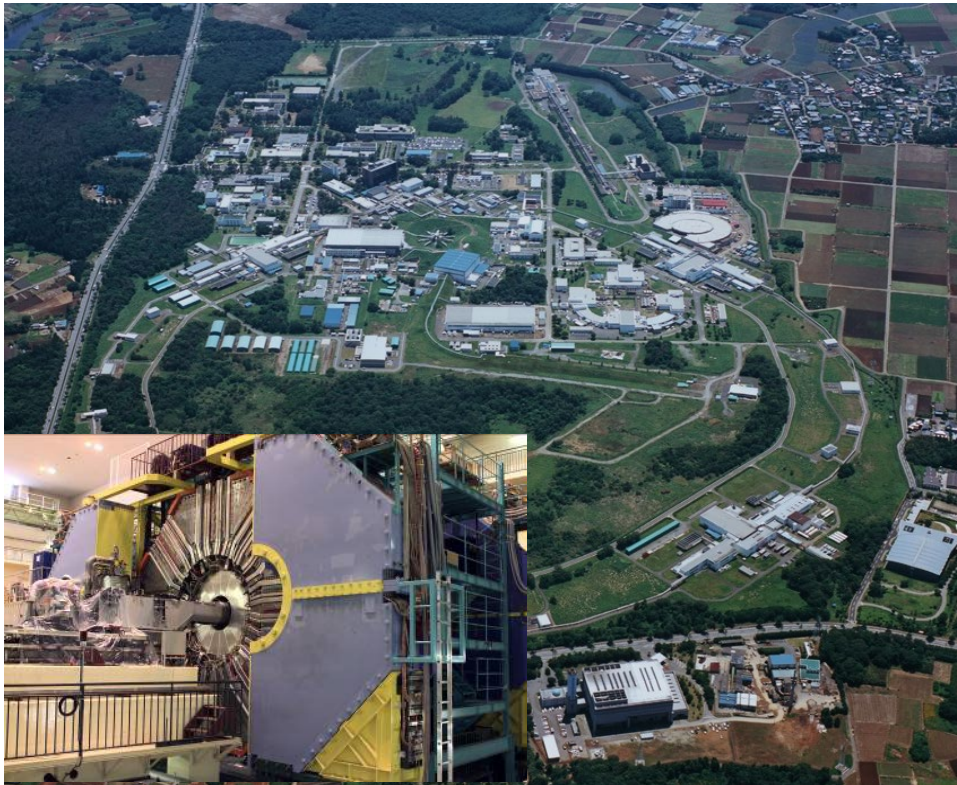
J-PARC MLF
neutron and μ as a probe



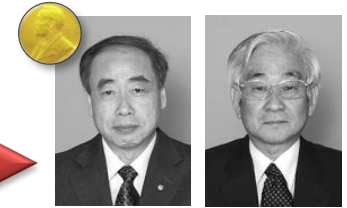
Accelerator-based BNCT



SuperKEKB and Belle II



2008 Nobel Physics prize

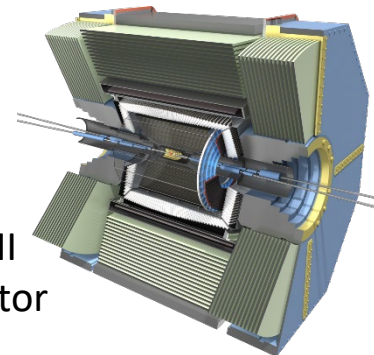


Dr. Kobayashi Dr. Maskawa

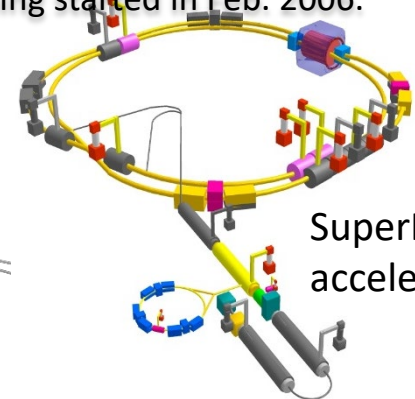
Belle, along with BABAR/SLAC, discovered CP violation in *B* mesons, and confirmed Kobayashi-Maskawa theory.

The apparatus is now being upgraded to search for new physics beyond this theory.

Accelerator commissioning started in Feb. 2006.



Belle II detector



SuperKEKB accelerator



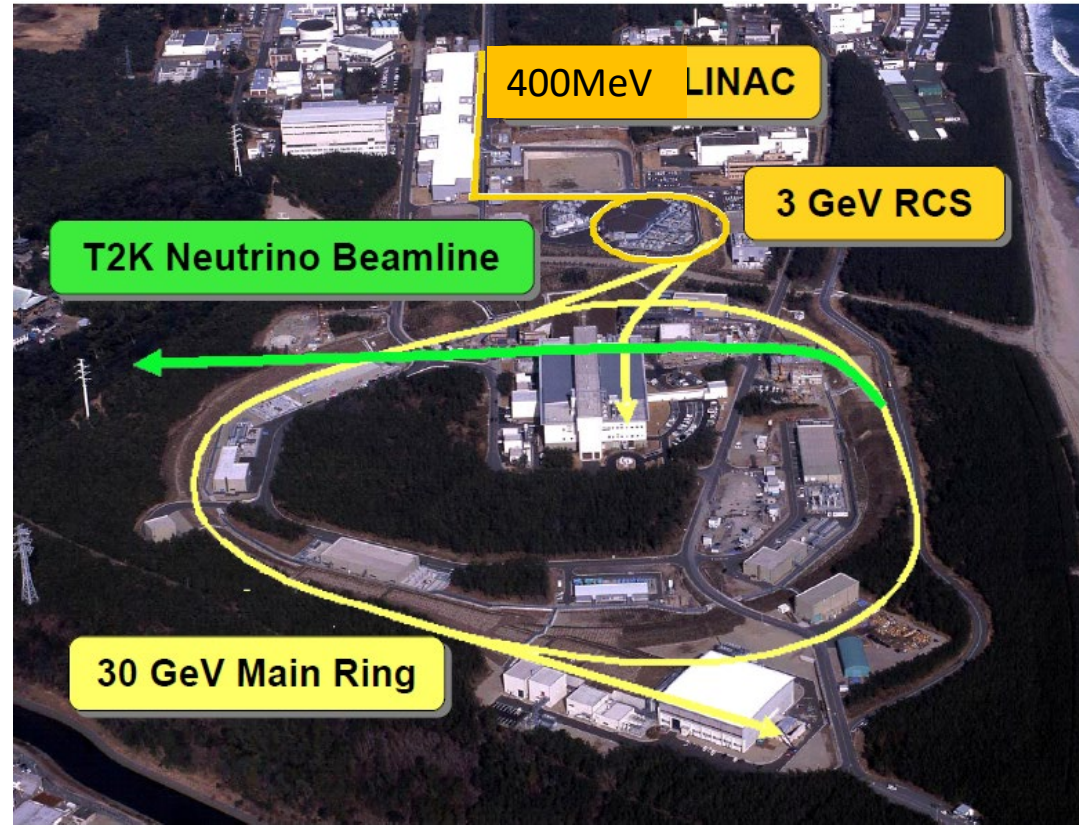
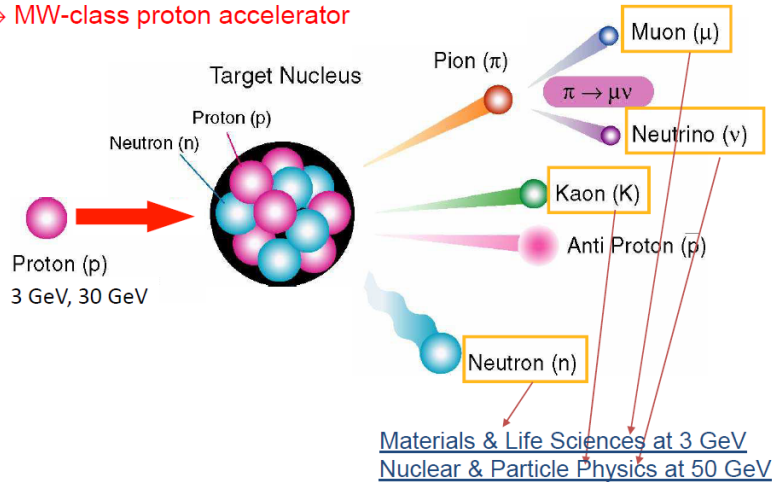
~750 scientists from 25 countries



- Located in Tokai, 60km N.E. of the KEK Tsukuba campus
- Completed in 2009
- Design goal
 - RCS: 1MW (3 GeV)
 - MR: 750kW (30 GeV)

Goal

→ MW-class proton accelerator

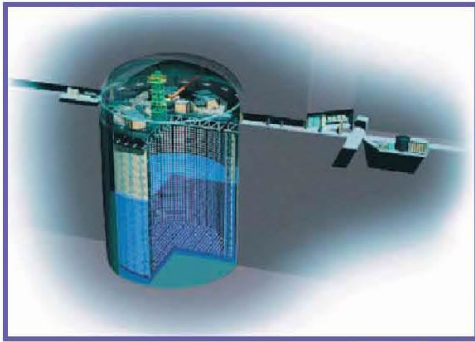


Joint project of KEK & Japan Atomic Energy Agency (JAEA)

Tokai to Kamiokande



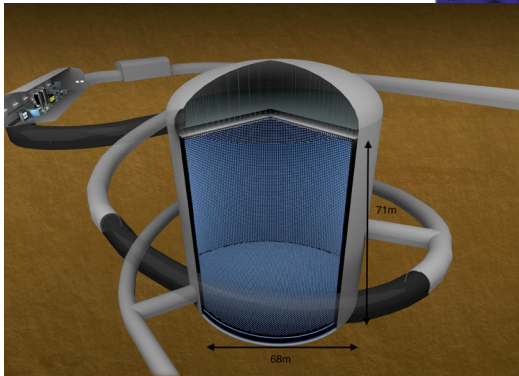
2010~ (Running)



Super-Kamiokande
(ICRR, Univ. Tokyo)



J-PARC Main Ring
(KEK-JAEA, Tokai)



Hyper-Kamiokande
x10 larger than SK
Under construction toward
physics data taking in 2027

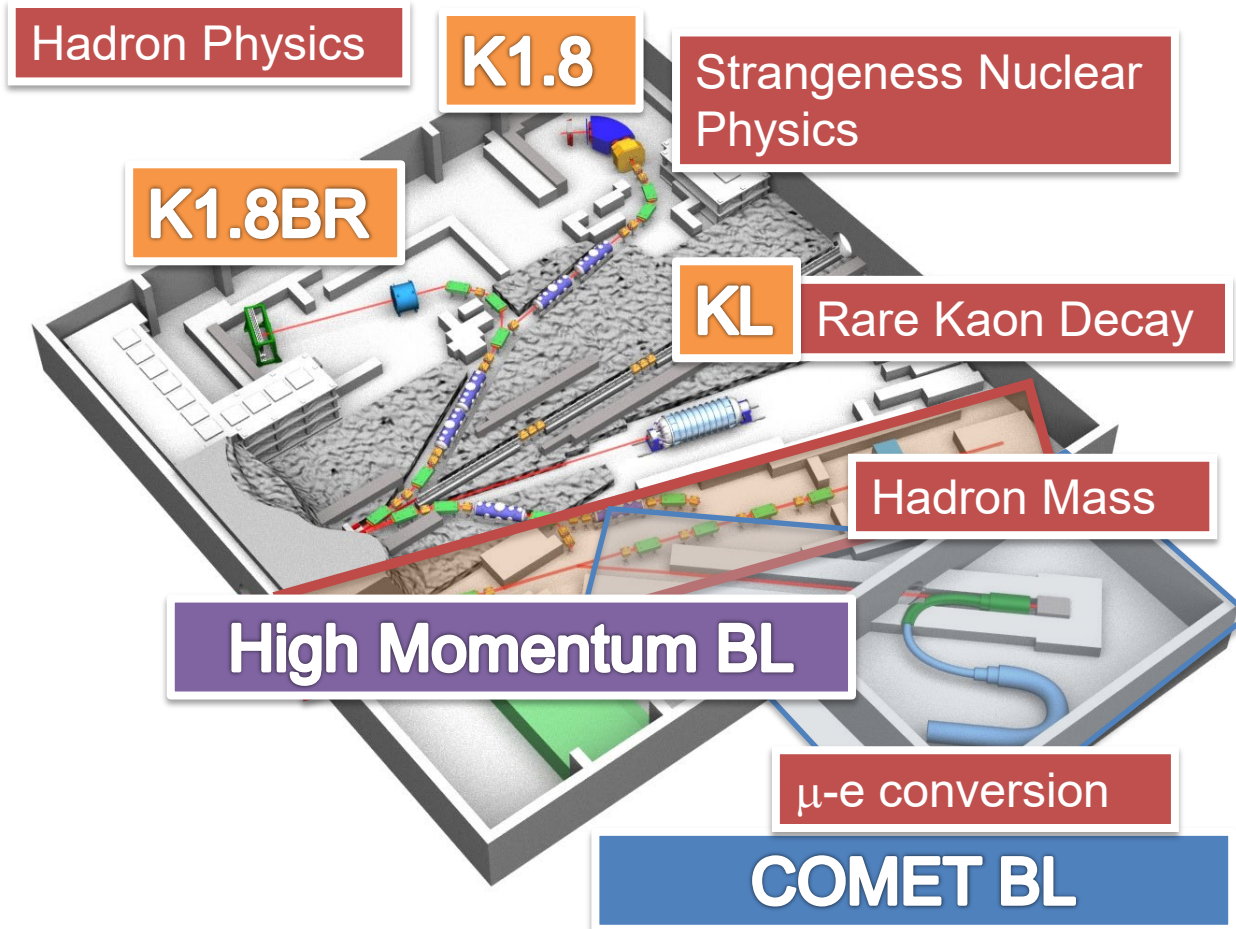
T2K collaboration
~500members from 63 institutes
in 11 countries

- High intensity ν_μ beam from J-PARC MR to Super-Kamiokande
- Observation of $\nu_\mu \rightarrow \nu_e$ (2013)
- Updated goals
 - Precise measurement of ν_e appearance
 - Precise measurement of ν_μ disappearance
 - ➔ CPV phase, contribution to mass hierarchy determination





A variety of nuclear and particle physics experiments are carried out at the hadron experimental facility.



International Collaboration Experiments

KOTO
Search for CPV in $KL \rightarrow \pi^0 \nu \bar{\nu}$
(Physics Run)

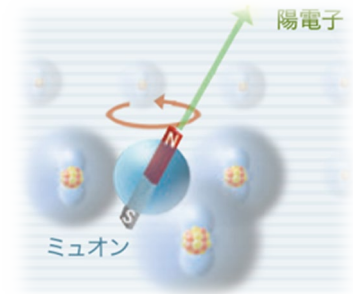
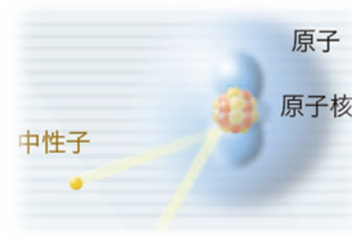
COMET
Search for Lepton Flavor Violation
(Construction phase)

Muon g-2/EDM
Measurement of magnetic moment anomaly
(Construction phase)

Material and Life Science facility at J-PARC

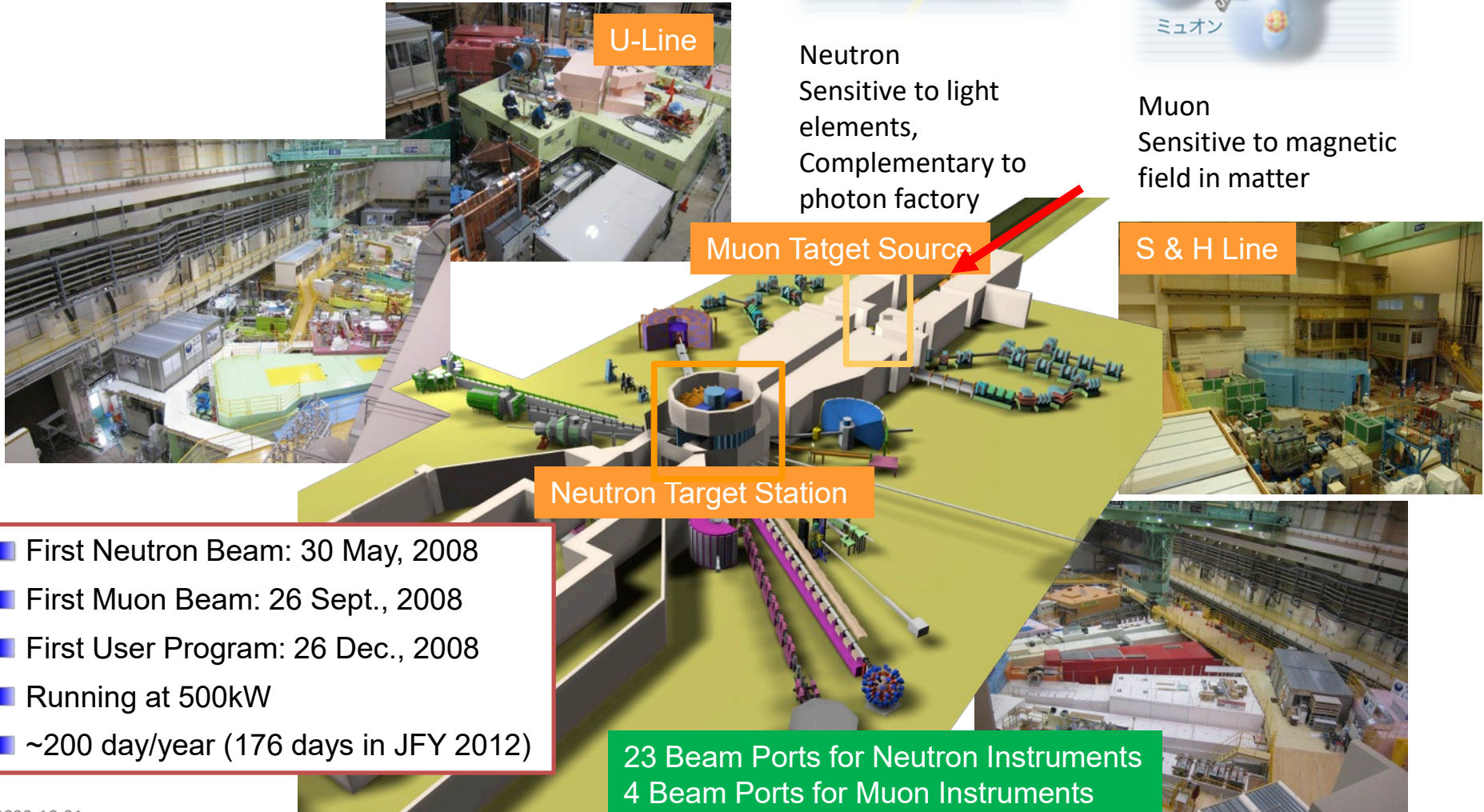


Materials and Life science using world top – class pulse neutron and muon beams



Neutron
Sensitive to light elements,
Complementary to photon factory

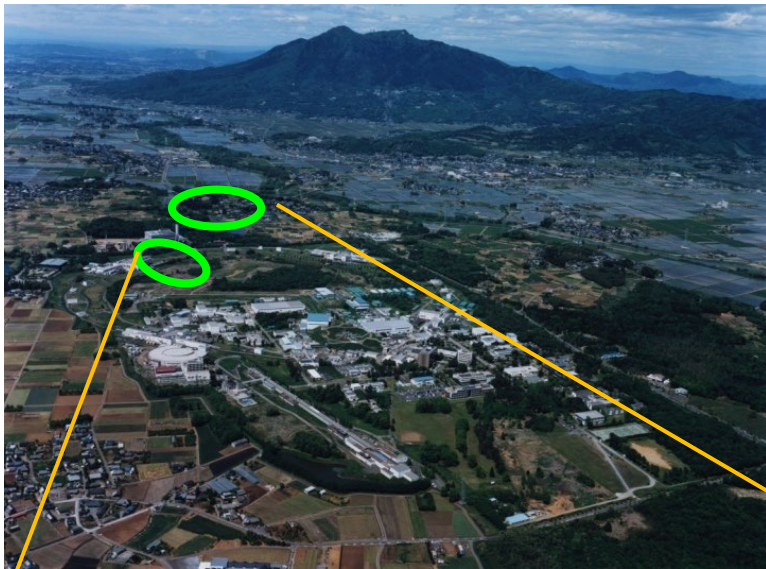
Muon
Sensitive to magnetic field in matter



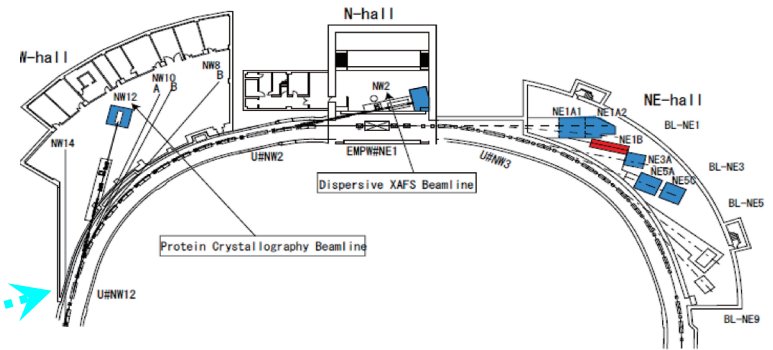
23 Beam Ports for Neutron Instruments
4 Beam Ports for Muon Instruments

- First Neutron Beam: 30 May, 2008
- First Muon Beam: 26 Sept., 2008
- First User Program: 26 Dec., 2008
- Running at 500kW
- ~200 day/year (176 days in JFY 2012)

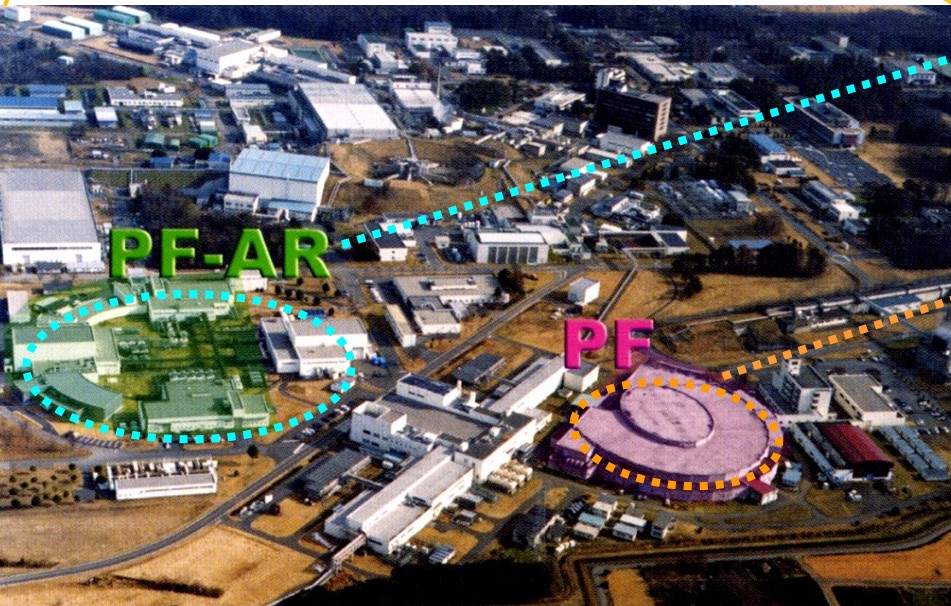
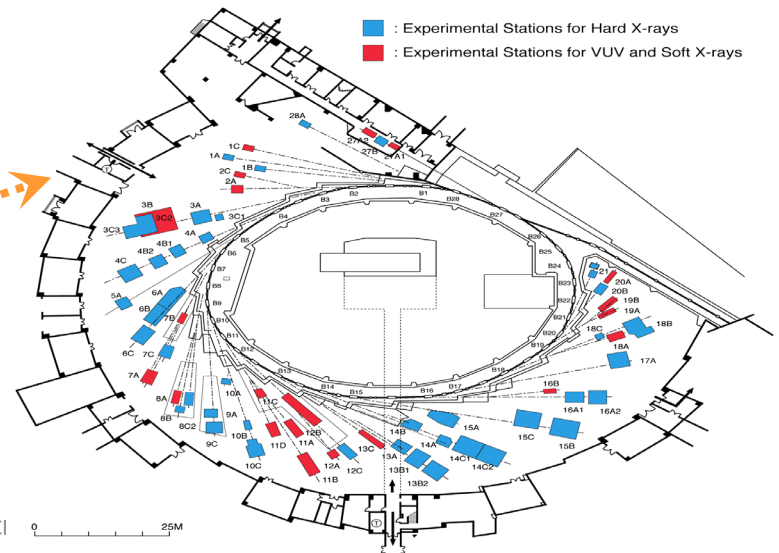
Light source facilities at KEK



PF: 2.5 GeV, 450mA e^- (since 1982)
 Material structure science
PF-AR : 6.5 GeV, 60mA e^- (since 1997)
 molecular dynamics
Exp station: ~50, Users: >3000/year



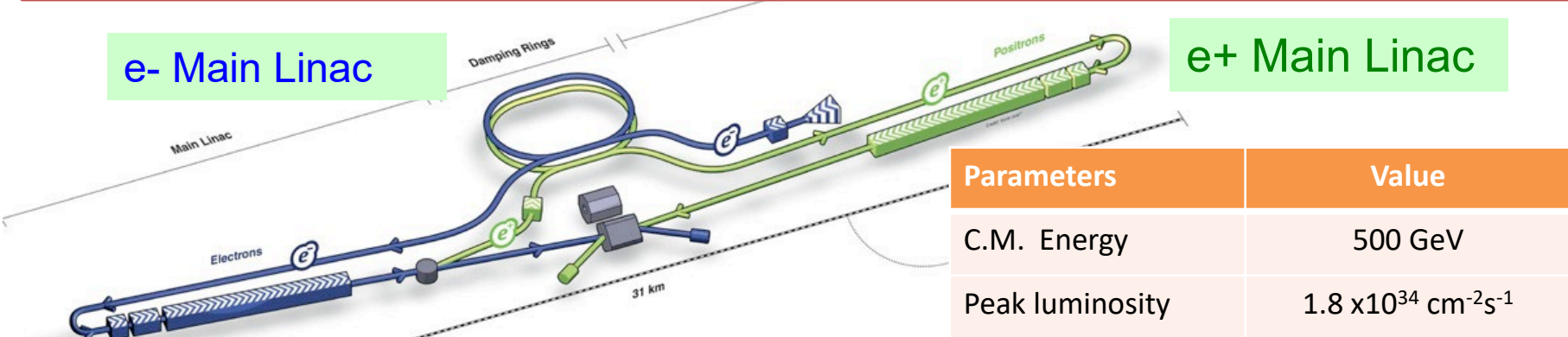
■ : Experimental Stations for Hard X-rays
■ : Experimental Stations for VUV and Soft X-rays



International Linear Collider

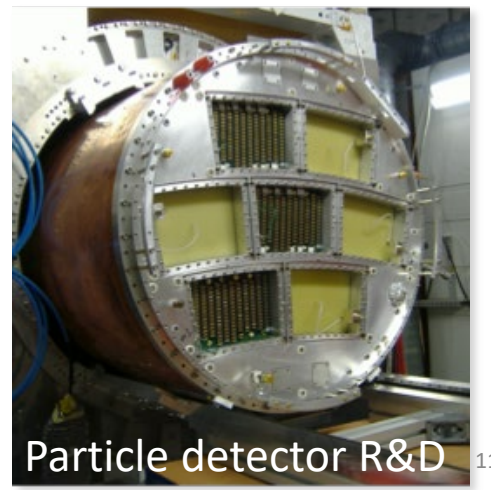


- There is a consensus among the world high energy physics community that an e^+e^- linear collider should be the next collider. The rationale is even stronger after the discovery of the Higgs particle at CERN.
- The Japanese HEP community proposed to host ILC in Japan, and this proposal was welcomed by the worldwide HEP community, ex. in Update of the European Strategy for Particle Physics, May 2013.
- MEXT, Japanese Government is investigating issues to judge hosting the ILC in Japan.
- Discussions on 250GeV ILC as a Higgs Factory are ongoing in Japan and the worldwide HEP community.



ILC Scheme | © www.form-one.de

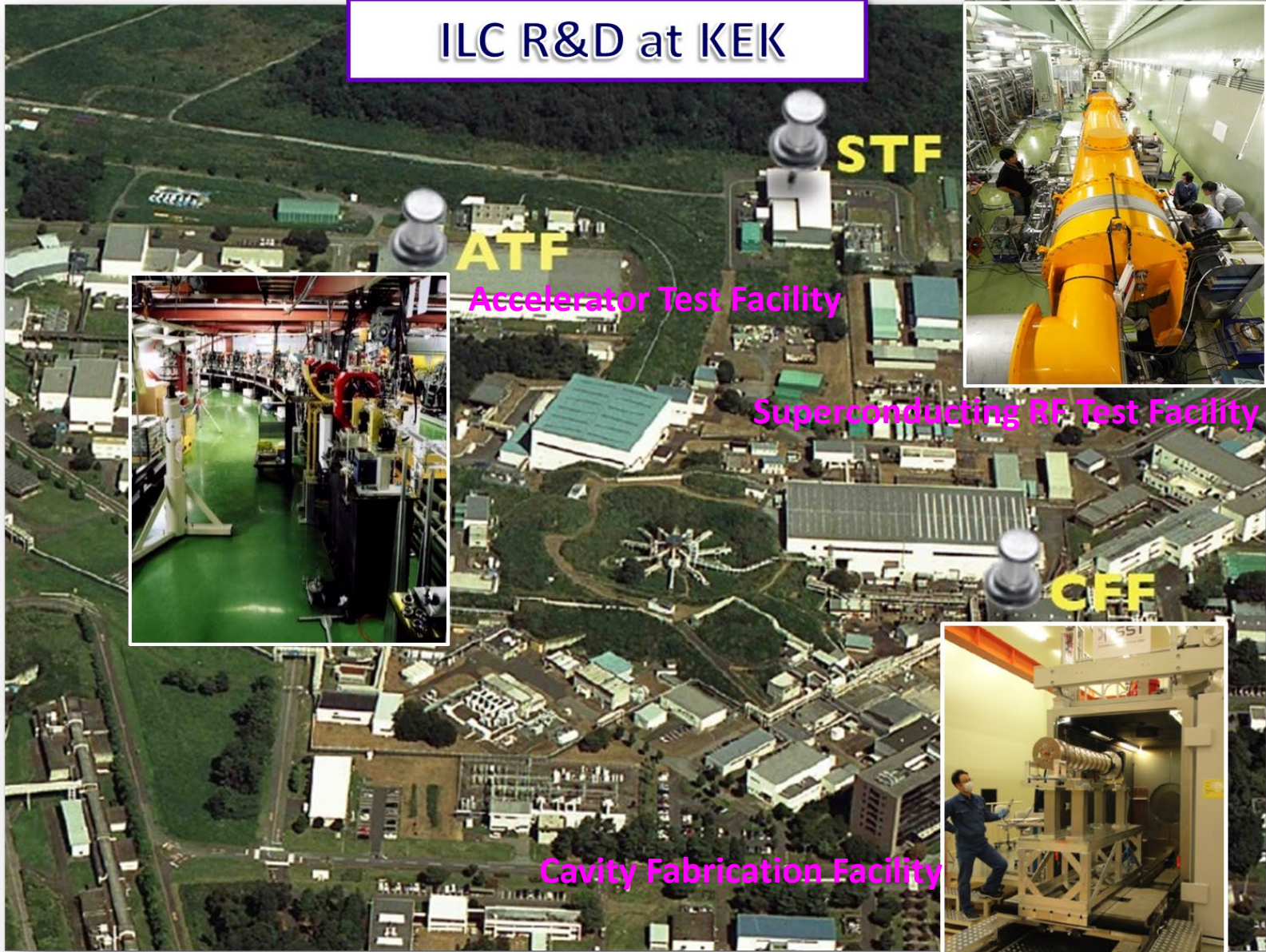
Various R&D for ILC has been conducted at KEK as an international endeavor.



Development of accelerators



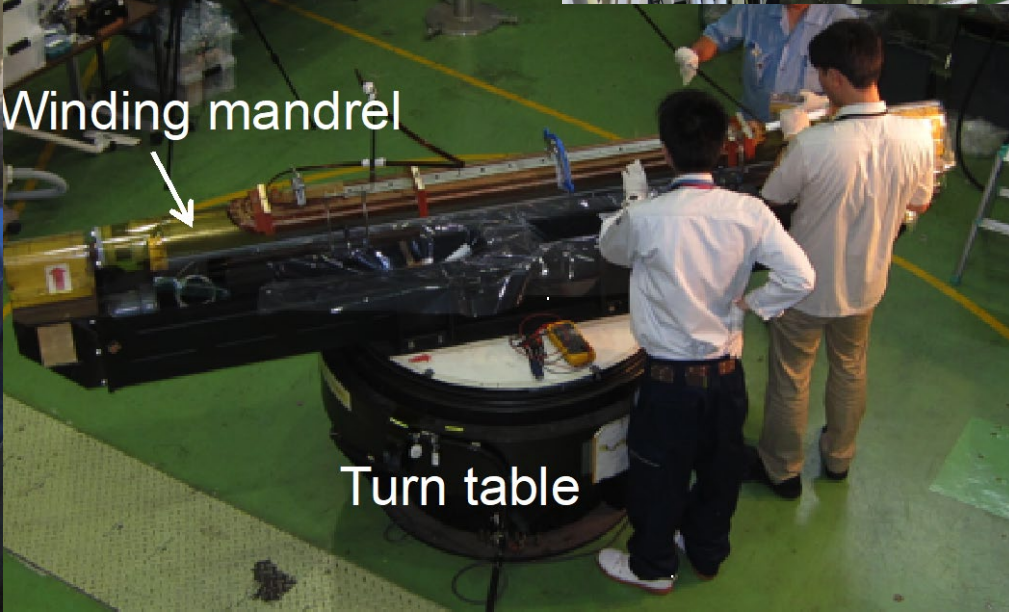
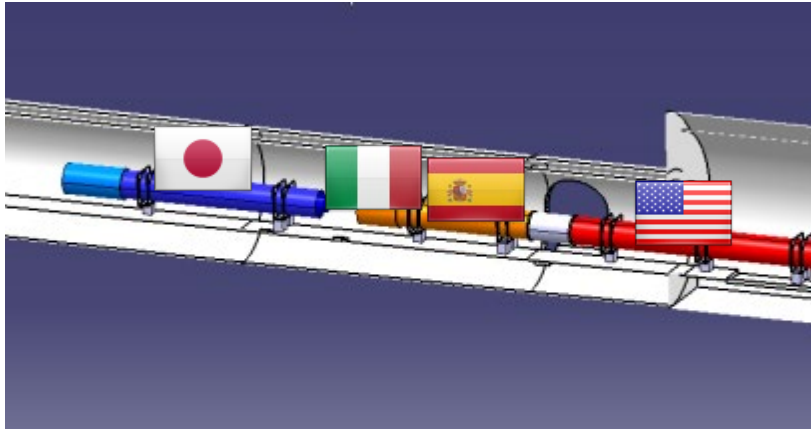
ILC R&D at KEK



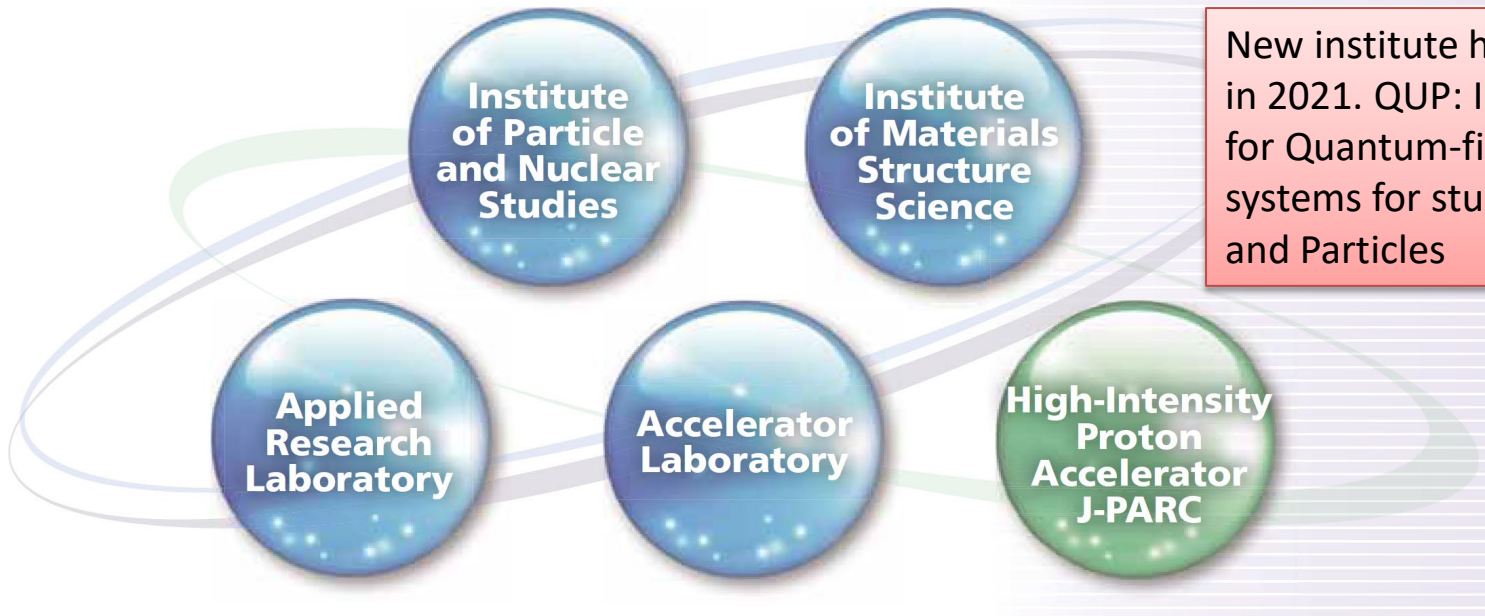
Contribution to HL-LHC



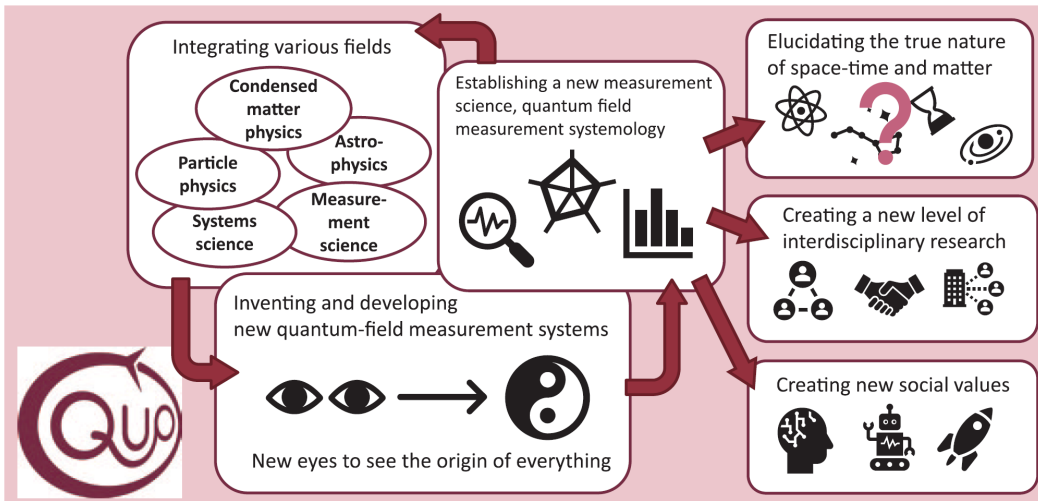
2m Model coil production and test at KEK



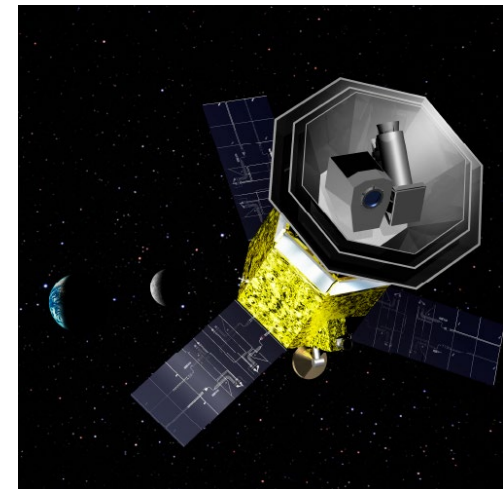
Organization of KEK



New institute has been established in 2021. QUP: International center for Quantum-field measurement systems for studies of the Universe and Particles



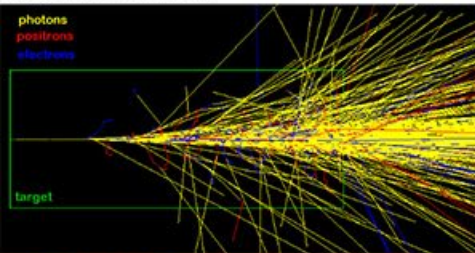
Flagship project: LiteBIRD (CMB polarization)



Applied Research Laboratory



Massive shower in a tungsten cylinder (outlined in green) produced by a single 10 GeV incident electron.



放射線科学センター
Radiation Science Center



計算科学センター
Computing Research Center



超伝導低温工学センター
Cryogenics Science Center

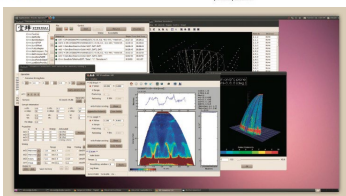
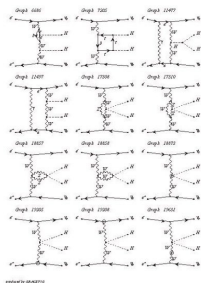
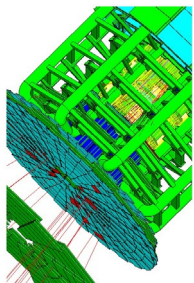


機械工学センター
Mechanical Engineering Center

The Applied Research Laboratory (ARL) conducts research and development of fundamental technologies in accelerator science, such as **radiation science and safety**, **environmental and chemical safety**, **computer and information network systems**, **superconductivity and cryogenic technology**, and **precision mechanical engineering**, which are necessary for the operation and promotion of research projects and collaborative research using the Large Accelerator Facility. It is a research institute that develops, applies, and provides technical support.

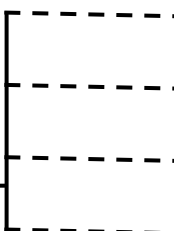
To accomplish these goals, ARL has four centers: the Radiation Science Center (RSC), the **Computing Research Center (CRC)**, the Cryogenics Science Center (CSC), and the Mechanical Engineering Center (MEC).

ARL maintains and develops its technological and R&D capabilities to meet the constant demand for new knowledge, new methods, and new technological innovations in future plans and new research projects, and to establish itself as a center for fundamental research and technological development in accelerator science.



- Procurement, deployment and operation on ICT systems
 - ✓ For research (Network, Systems for scientific computing)
- R&D
 - ✓ Geant4 (toolkit for the simulation of the passage of particles through matter)
 - ✓ GLACE (automatic program generator for particle interactions)
 - ✓ Manyo Library (data analysis framework for neutron scattering)
 - ✓ DAQ, Data Analysis
 - ✓ HPC for theoretical physics
 - ✓ Distributed computing
- ~26 people including secretaries

KEK



- Governance
 - ✓ Policy making
- Administrative computing

Staff in computing research center



ARL Director
Prof. Y. Namito
4 centers

RSC

RSC

MEC

CRC

CRC Head

Prof. A. Manabe
3 secretaries
5 res. fellows
1 student

KEKCC

Prof. T. Sasaki (Leader)
Assoc. Prof. K. Murakami
Assist. Prof. S. Okada
Lect. Prof. A. Shibata (Web)
Eng. S. Yashiro (Web)
Eng. K. Hashimoto (Mail)
Eng. S. Kaneko (Portal)

Distributed Computing

Prof. T. Nakamura (Leader)
Assoc. Prof. G. Iwai
Assist. Prof T. Kishimoto

J-PARC

Assos. Prof. J. Suzuki (Leader)
Prof. A. Manabe
Assist. Prof. T. Kishimoto

Network

Assoc. Prof. S. Suzuki (Leader)
Eng. M. Nishiguchi (Wifi)
Eng. K. Hashimoto (VPN)
Eng. K. Omori (VPN)

Security

Prof. S. Ichii (Leader)
Assist. Prof. R. Yonamine
Eng. T. Nakamura
Eng. S. Kamo

HPC

Assist. Prof. H. Matsufuru (Leader)
Assoc. Prof. T. Ishikawa

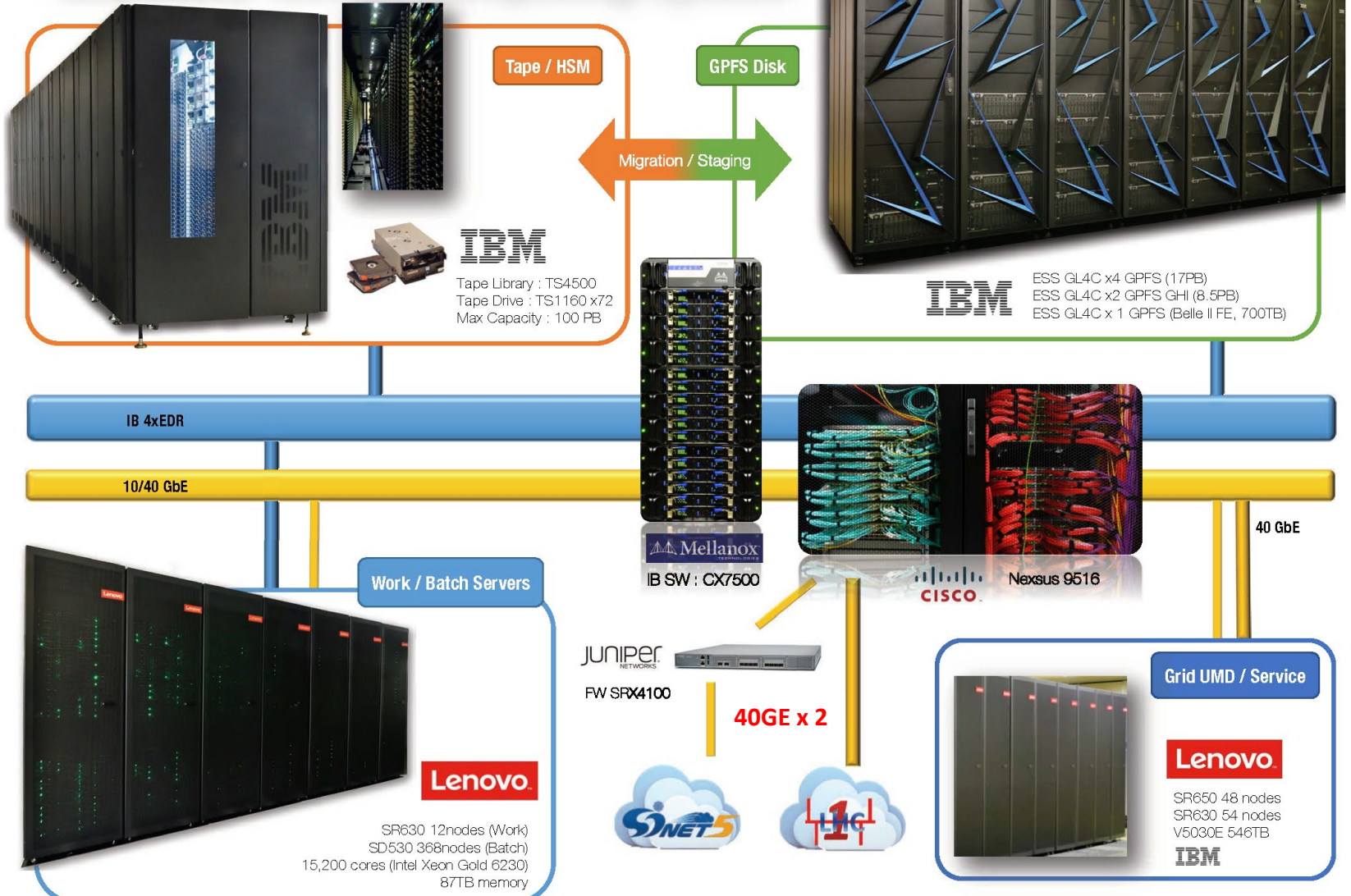
User Support, Equipment

Lect. H. Matsunaga (Leader)
Eng. H. Maeda

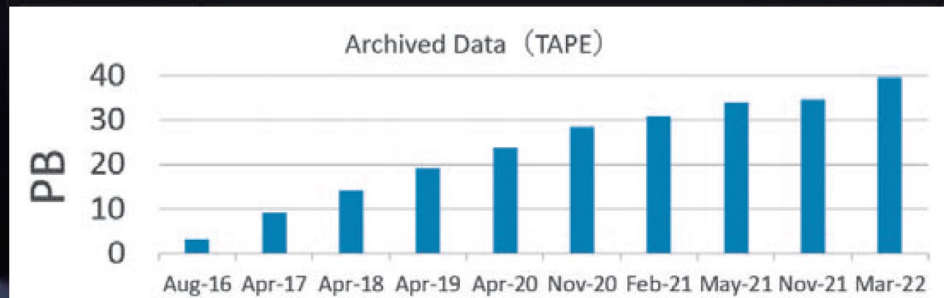


KEKCC Central Computing System

2020



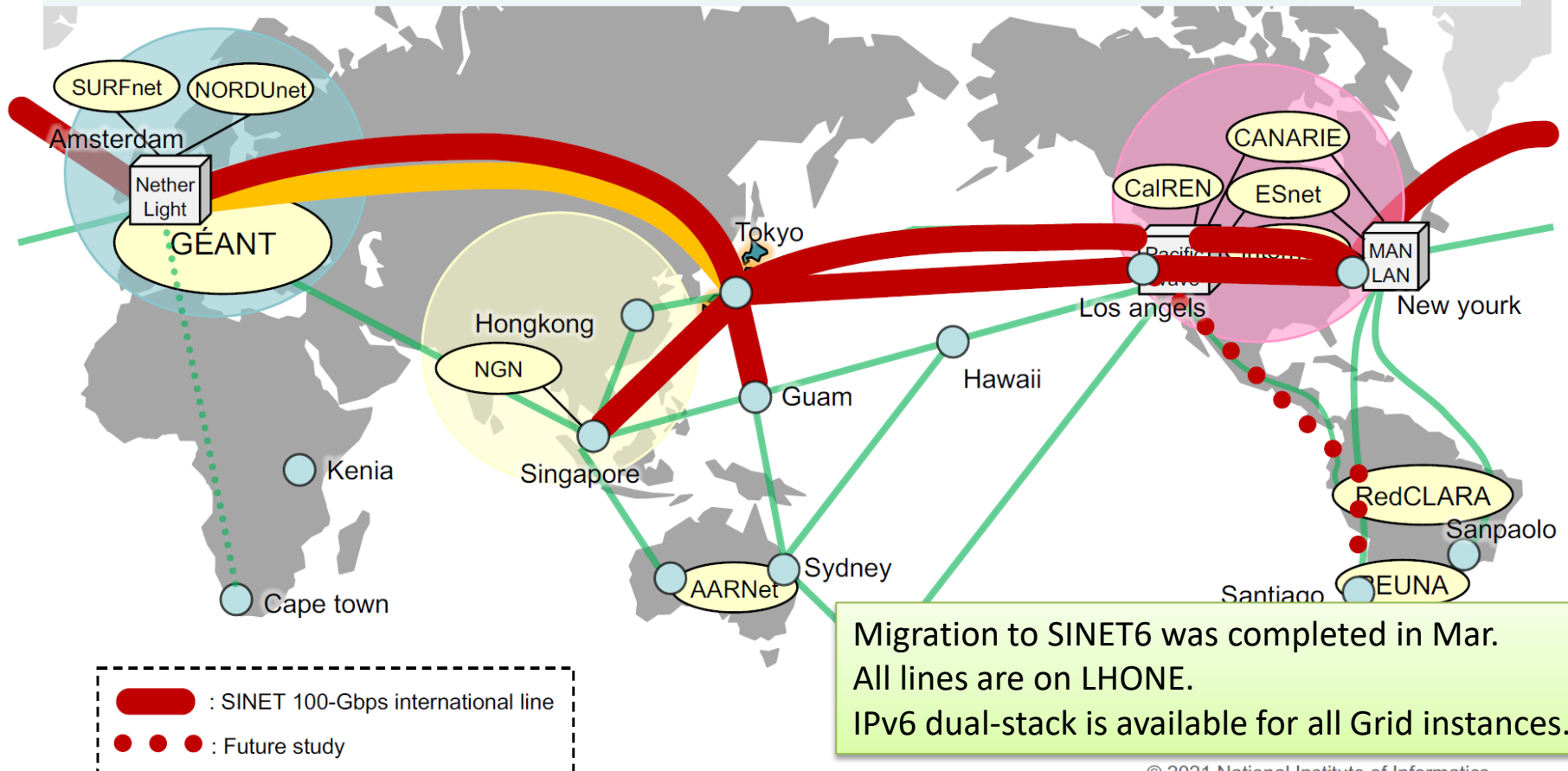
Stored data reached 40PB



International Lines of SINET6



- SINET will increase the bandwidths of USA, Europe and Asia lines.
 - USA: Los Angeles and New York, 100Gbps x 2 (in 2022)
 - Europe : Amsterdam, 100Gbps x 2 or more (around 2024)
 - Asia: Singapore and new Guam line, each 100Gbps (in 2022)
 - Other area: Oceania and south America, considering the marine cable status





A lot of projects for accelerator-based science are actively on going in parallel at KEK

- SuperKEKB, Belle II
- J-PARC, Nuclear/Hadron/Particle/Neutralino physics, Material and Life Science (neutron, muon, light source)
- R&D for HL-HLC and ILC

Services, not just hardware and software prepared by Computing Research Center

- 4-5 years and 6 years contract for KEKCC and Campus network, respectively.
- The provider is chosen in competitive tenders.
- The procedure takes 1.5 years period according to the government regulations.
- Staffs necessary for the operation are sent to KEK from the companies .

NEXT procurement for replacement in 2024

- Both KEKCC and Network systems will be replaced in 2024 by coincidence at the same time scale if everything goes according to the plan.
- It is quite challenging, but we are investigating good ideas in terms of the synergy between the both systems to enhance usability on this occasion.
- Preparation of the procurement has already started.