KEK ILC activities

Shin MICHIZONO
(KEK ILC R&D project leader)

- *KEK Budget*
- *ILC design work*
- *Cost reduction R&D*

LC budget at KEK

3. Research Projects Carried Out Using Mainly General Funds

3-1 Research and development for the International Linear Collider

KEK issued a KEK-ILC action plan in January 2016. In this plan it was proposed that the ILC project proceed in three phases: pre-preparation phase, preparation phase, and construction phase. The pre-preparation phase is the current phase, in which R&D in KEK has up to now been conducted mainly using general funds of KEK. As development advances, efforts need to be made to obtain external funding as well. The project will enter the main preparation phase when MEXT starts negotiations with other countries for implementing the ILC. At this

KEK Project Implementation Plan (KEK-PIP)

be set up centering around KEK to prepare for the construction over a period of approximately four years.

https://www.kek.jp/en/About/Roadmap/

- *The KEK budget (especially general funds) is limited.*
- *LC budget (JFY2016) is 20% cut from JFY2015.*
- *LC budget (JFY2017 (from April 2017)) will be similar to JFY2016.*
- *We have to start some cost reduction R&D ASAP.*

LC R&D

JFY2017 (April 2017~): No extra budget
JFY2018 (April 2018~): (maybe) extra R&D budget

- Accelerator operation (STF-2, ATF)

no STF operation, reduce ATF operation (JFY2017)

- ILC design work

no budget on JFY2017
R&D budget for "grade C" will come (?) from JFY2018
other design work will start after "green light"(?)

- SRF cost reduction R&D First priority (even in limited budget)

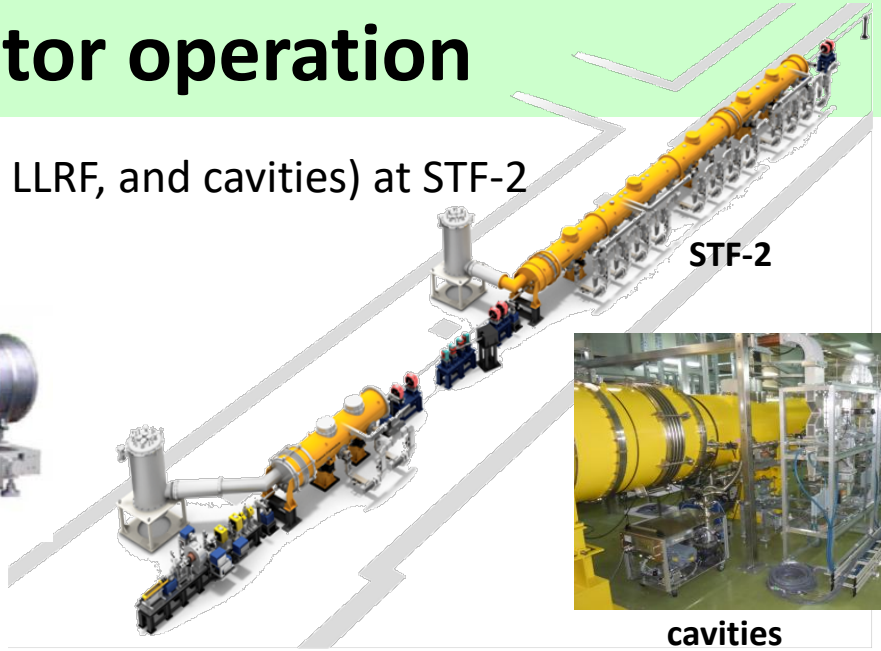
start R&D within LC-budget ASAP
main R&D works will start from JFY2018

Accelerator operation

- Long term system evaluation (rf source, LLRF, and cavities) at STF-2

MARX modulator

MBK



STF-2

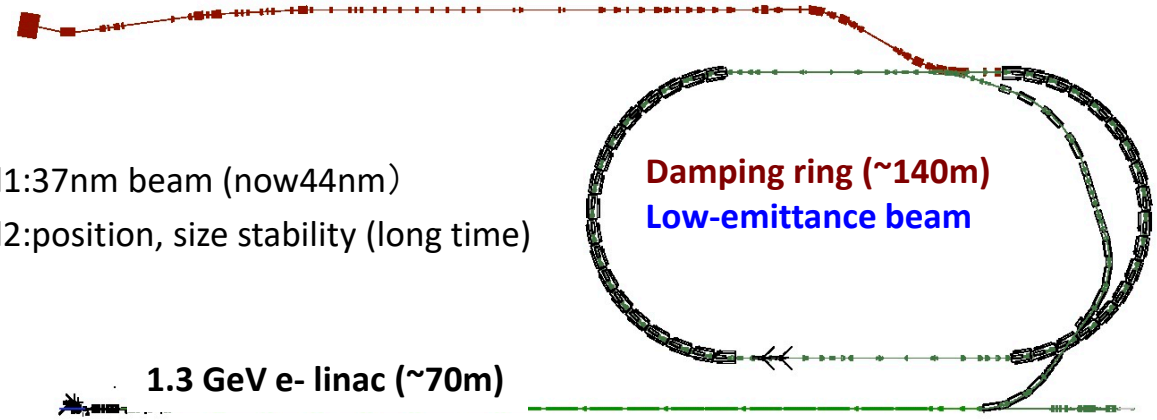
cavities

- no cryogenic operation (JFY2017)

- Nano-beam achievement at ATF-2

- (maybe) reduce operation time(JFY2017)

ATF2: final focus line same to ILC



Goal1:37nm beam (now44nm)

Goal2:position, size stability (long time)

ILC design works (grade “C”)

	Outlook rating	Definition
Grade A	◎	Prototype developed and demonstrated. Actual manufacture and mass production capable with improvements to current technology or small-scale R&D.
Grade B	○	Prototype developed and demonstrated. Actual manufacture and mass production will require certain technological advances or medium-scale R&D.
Grade C	△	Prototype not yet developed or demonstrated. Prototype development will require technological breakthroughs and large-scale R&D.
Grade D	×	Basic technology not yet established or demonstrated. Feasibility of the prototype remains unclear.

Rating at NOMURA-survey

- Main goal of ILC design works at KEK (upto JFY2018 or 2019) is to have realistic prospects (to persuade external experts) about
  - positron source
  - beam dump
  - crab cavity

  (essential parts for green light)
- Other design activities will become minimum for another 2~3 years.

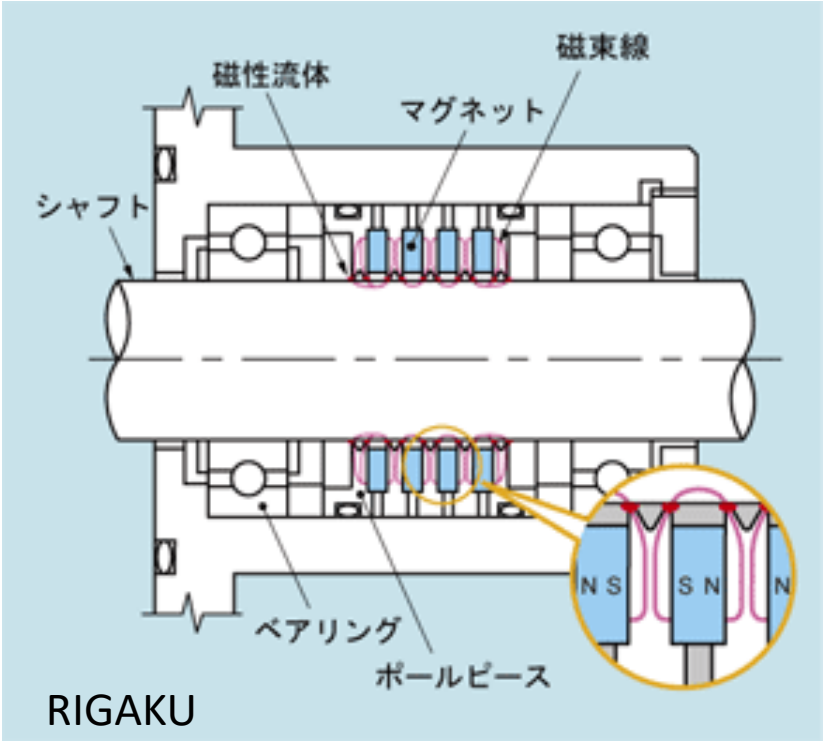
  -> We will concentrate our efforts on “ILC green light”.
- After green light, we will start the other ILC detailed design works.

Positron source (electron driven)

Positron source (backup) (electron-driven system)	■Technical issues (targets) ・Demonstration of target prototypes ・Development of model for shaft seal of rotating body (testing of radioresistance of seal on rotating body, verification of seal material degradation)	△

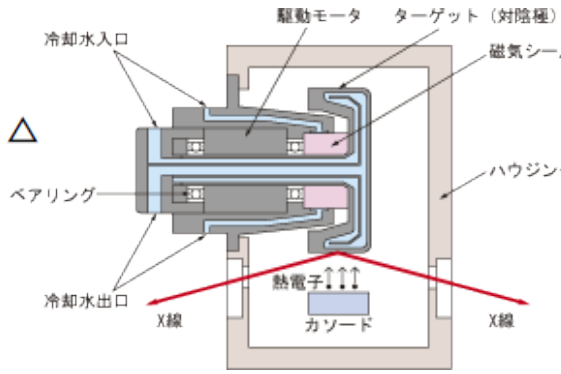
http://www.rigaku-mechatronics.com/technology/technology01.html#dokujikairo

- *We will continue to make prototype of electron-driven target (2017,2018)*
- *This will be a good basic example for undulator-based positron target.*



Positron source (undulator)

Positron source (targets)	■Technical issues (targets) ・Establishment of cooling technology and development of prototype (will be at least two years before cooling technology is ready) ・Beam testing to guarantee performance (alternatively, demonstration using laser will be necessary) ・For any of the cooling methods, development of technique for remotely replacing target modules (consumables)



http://www.rigaku-mechatronics.com/technology/technology01.html#dokujikairo

- *Continue target R&D (from electron-driven to undulator, step by step).*
- *Evaluate both radiation cooling and water-cooling with international collaboration.*

	E-driven	undulator	Existing Xray target
Cooling/seal	water/magnetic fluid	Rad. ,water/mag. levitation, fluid	water/magnetic fluid.
radius（mm）	250	500	160
weight（kg）	65	20-200*	17
speed（m/s）	5	100	160
Rotation (rpm)	200	2,000	10,000
Heating (kW)	40**	10**	90
Vacuum（Pa）	10^{-6}	10^{-6}	10^{-4}

Beam dump

Beam dump	■Technical issues ・Development of accident prevention and containment measures to be taken when window is accidentally destroyed due to concentration of beam bunch on one point of window ・Verification of corrosion resistance of window materials caused by cooling water in a highly radioactive environment ■Technical issues ・Development of safety management technologies for radioactive substances (e.g., tritium) produced by dumped beam	△

- *It is not realistic to make a proto-type of this beam dump.*
- *2 MW dump at LEP can be a good proto-type for this beam dump.*
- *Simulation results may be reliable for the detailed design.*
- *We will consider the dump system from the operational/safety points of view.*

-> We need international collaboration.

Crab cavity

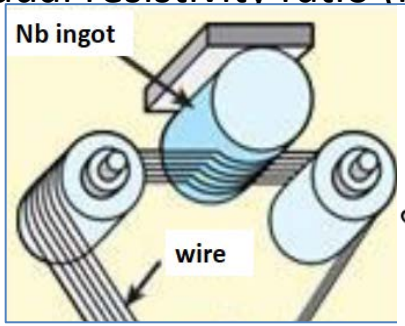
Crab cavity system	■Technical issues ・Manufacture and demonstration of prototype of superconducting nine-cell cavities with couplers ・Design of cryomodule/cryostat, manufacture and demonstration of prototype ・Redesign, manufacture, and demonstration of HOM coupler ・Synchronous operation and demonstration of two crab cavities ●Manufacturing-related issues ・Realization of commercial production of the 3.9 GHz LLRF boards necessary for synchronization of cavities	△

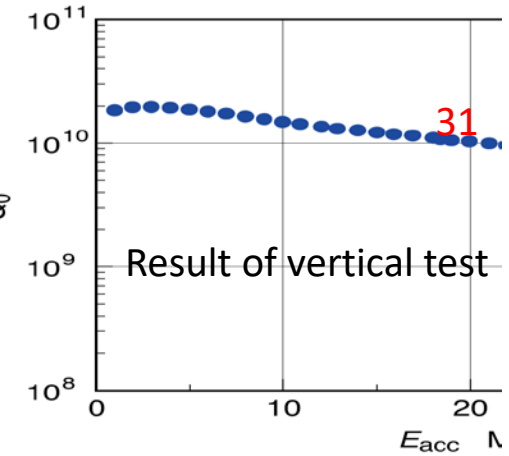
- *KEK has no activity about ILC-Crab cavity.*
- *We will start the re-design work from 2017 according to the previous English team.*
- *3.9GHz system at XFEL (jacket, tuner, rf system) will be applicable.*

-> We need international collaboration.

Niobium material preparation

- Optimize the ingot purity with a lower residual resistivity ratio (RRR) with accepting specific residual content.
  - •High-Ta middle RRR（100～200）material
  - •High-Ta high-RRR（200～300）material
- Direct ingot slicing

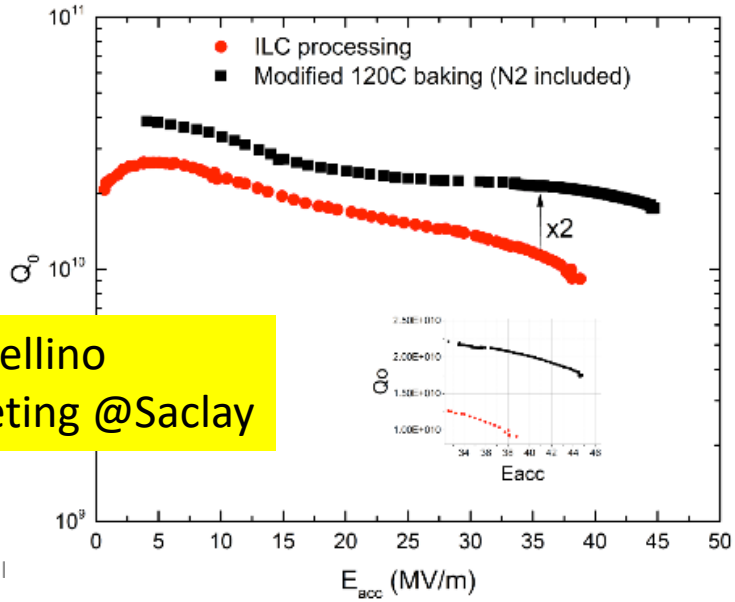




SRF cavity fabrication for high gradient and high Q

- Preparation of clean-vacuum-furnace+ N2dope
- Developed recently by FNAL
- Improve both Q value and acc. gradient.

By A. Grassellino
At TTC meeting @Saclay



LC R&D works

- After ceasing the US design activities, KEK should take over them.
- However, unfortunately due to the limitation of budget and man power, it will be difficult to take over/develop all US activities.
- *We probably have to keep all the information until "green light".*

- KEK's first priority (now) is cost reduction R&D.
- Next is to solve grade C issues (such as positron source). We need international collaboration although we are short of budget (all over the world).