All slides for ILC Advisory Panel of MEXT are in Japanese.
Then, for WG2, Kirk translated into English by Google.
But, I’m not sure how precise this translation is.

Recently, I heard “DeepL” is much better

3. Clarification of technical feasibility (SRF)

Translated by google

Comments from SCJ

[**SCRF**] The design reference value for the SCRF acceleration gradient of 35 MV/m is based on the technical level that is currently achievable. It will be necessary to achieve this reliably and with a good yield including automation techniques; further performance improvement is also desired.
[**SCRF**] It is foreseen that the bulk of the SCRF cavities will be provided through in-kind contribution from the participating countries. An important issue will be the quality assurance that maintains the compatibility among them.

Progress after FY2018 (Costdown R&D and Final design)

- Under the Japan-US discussion group, development of performance improvement and cost reduction through Japan-US cooperation is being promoted (from FY2018), and a technical outlook is obtained. Development of performance improvement and cost reduction through cooperation between Japan, Germany and France is underway (from 2020) .
- In recent years, the construction of large superconducting accelerators through international cooperation has become widespread. Specifically, the Euro-XFEL in Europe (located in Germany) has been completed and is operating smoothly. LCLS-II is almost completed in the United States. (SHINE construction is also underway in China)
- In October 2019, KEK's International WG discussed and reported on how to deal with technical issues. The International Design Team (IDT) is studying to solve these issues.
- Check the internationally shared cavities and cryomodule (CM) standards with IDT-WG2 (accelerator). In particular, we are studying the final design that conforms to "High Pressure Gas Safety Regulation" in Japan and coordinating with overseas researchers.

To do list during ILC-Prelab (from R&D to demonstration)

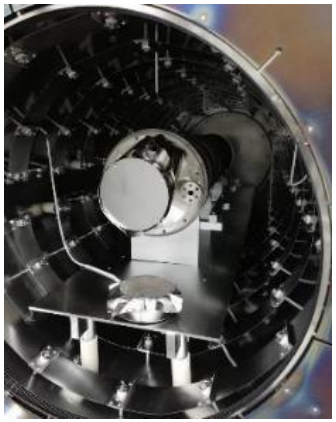
- After the launch of ILC-Prelab, we plan to proceed with two demonstrations based on the conclusions of the above efforts.
  - WP-1: Demonstration of cavity manufacturing and performance (yield) of 40 cavities each in Europe, Americas, and Asia (including Japan)
  - WP-2: Similarly, two CMs are manufactured for each, and after transportation between areas, performance maintenance is demonstrated through connection and rearrangement.
  - WP-3: Crab cavity prototyping and final design → contribution from overseas

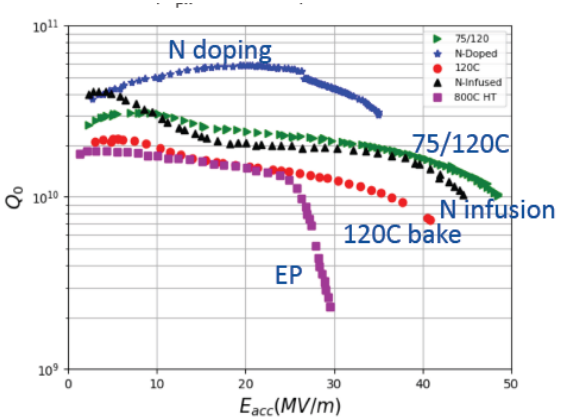
3. Clarification of technical feasibility (SRF)

Translated by google

Verification of higher performance and cost effectiveness

- Clean furnace for HT
- Cold EP
- Fast cooling
- Lower magnetic field





N-infusion cavity placed in STF module to demonstrate beam acceleration at 35 MV / m (> 31.5 MV / m (exceeding ILC-spec))

The long-term stability of cavity performance is also under investigation at STF-2 accelerator.

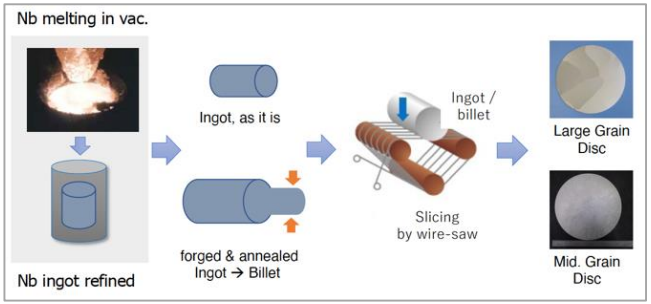
Searching new HT conditions from FY 2021

Verification of material manufacturing process and cost effectiveness

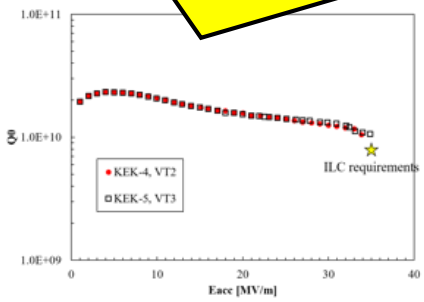
- Investigation of the effect of different Nb crystals on cavity performance
  - Conventional：Melting → Forging → Rolling (FG)
    Melting → Wire-cutting (LG)
  - **New method：Melting → Forging → Wire-cutting (MG)**

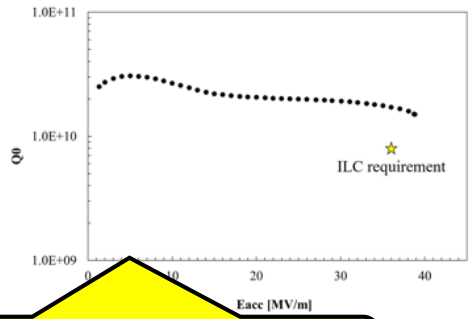
※Eliminates the need for a rolling process and avoids contamination with impurities

KEK Cavities



LG: Achieved 32 and 34 MV / m in intermediate RRR cavities



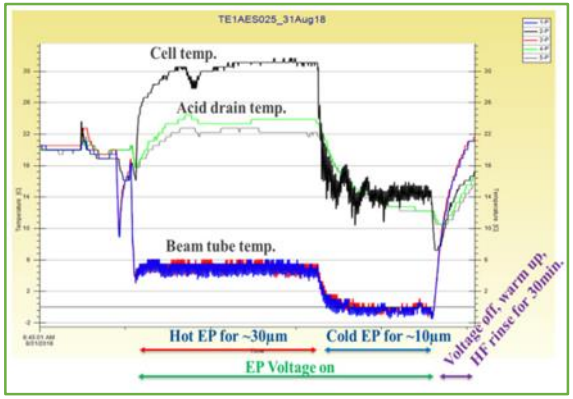


Achieved 38.8 MV / m (> ILC-spec) with single-cell cavity performance by new manufacturing method

Collaboration with overseas and the achievements

Translated by google

- In the United States, research on improving cavity performance is underway centered on FNAL
- From 2017, research aimed at improving cavity performance began with Japan-US cooperation
- To date, several promising surface treatment methods have been found and detailed research is underway
- Under international cooperation, FNAL is planning to manufacture a module that collects cavities that exceed the ILC specifications and conduct a cooling test



Changes of surface treatment in recent years

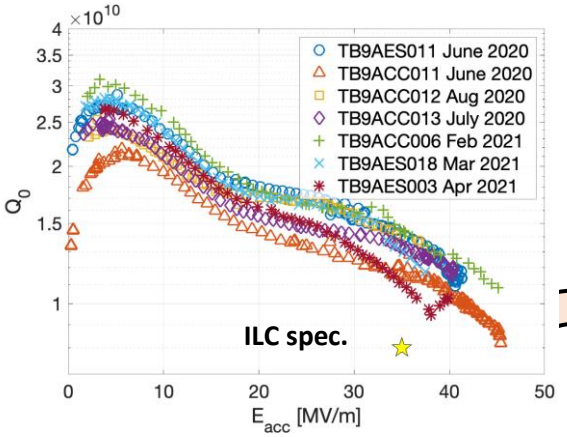
EP + HT @800 deg (conventional)

↓

EP + HT @>800 deg with nitrogen

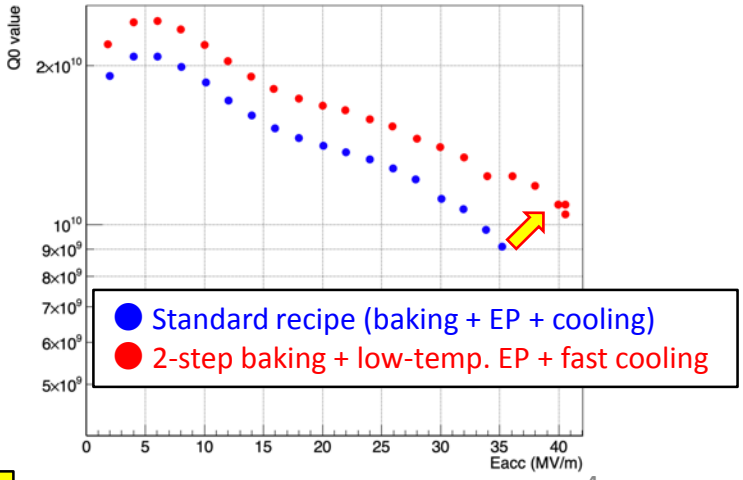
↓

Cold EP + HT @>800deg + 2-steps baking



- ≥800°C HT
- **Cold EP**
- 2-steps baking

KEK result for 2-steps baking

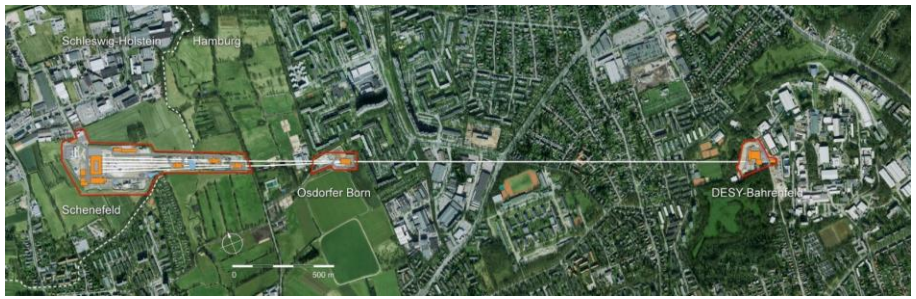


8 cavities above ILC spec. installed

Cold test with higher gradient than ILC spec. will be done

Operating and Constructing SRF accelerators (based on TESLA technology) in EU/US

- In EU, European XFEL was constructed in 2016, and operated from 2017
  - The same SRF technology as ILC is used
- The beam energy reached 17.5 GeV at nominal spec. in 2018
- Currently, the beam operation is very stable



- In US, LSLC-II is under construction from 2018
  - The same SRF technology as ILC is used
- The construction will be finished soon, and the first cool down will start

TESLA technology is already mature

“Clean” cavity connection work for cavity string

Translated by google

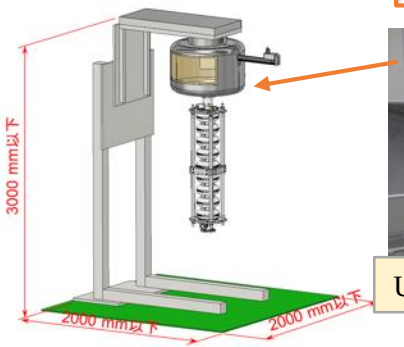
- Technology of cryomodule assembly for SRF accelerator has matured
- European XFEL accelerator has been operating stably since 2017, and LCLS-II / LCLS-II-HE in US is currently under construction
- Furthermore, new automatic assembly technology and cryomodule performance maintenance technology have been developed

Efforts of Japan

- Development of automatic cleaning system
- Under commissioning while exchanging information with overseas
- Under development of automatic cleaning system for string assembly

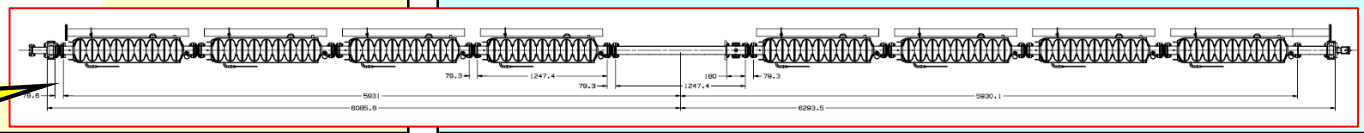
Manual cleaning for screw bolts

Aim for automation for long hours of work



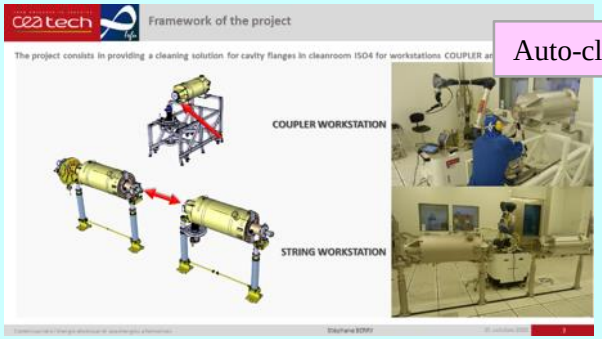
Under commissioning for prototype

Each cavity should be connected under **ultra-clean condition**

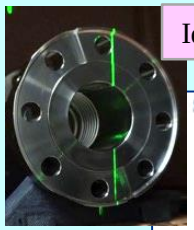


Efforts of overseas

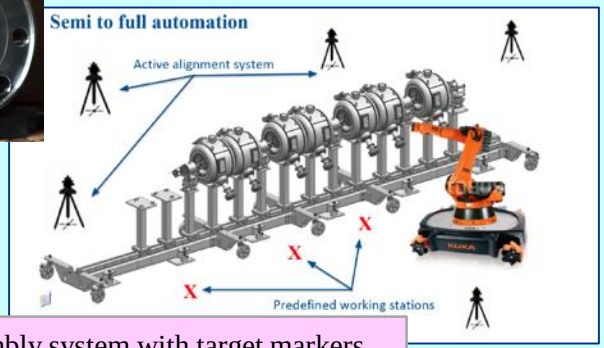
- Development and introduction of auto-cleaning system
- Under consideration of complete-auto-assembly system



Auto-cleaning system by COBOT



Identification of screw hole by laser



Complete-auto-assembly system with target markers

WP-1: Cavity Industrial-Production Readiness

Translated by google

- Demonstration of mass-production, 120 cavities
  - ~1% (total required number) → 40 cavities / region
- Higher performance and cost effectiveness after TDR
- Improved Nb sheet production
  - No contamination by direct wire-cutting as cost down
- Reconfirmation of plug-compatibility
  - Final design to be confirmed
- Confirmation of best surface treatment
- Evaluation of success yield / performance
- Establishment of HPGS for mass-production

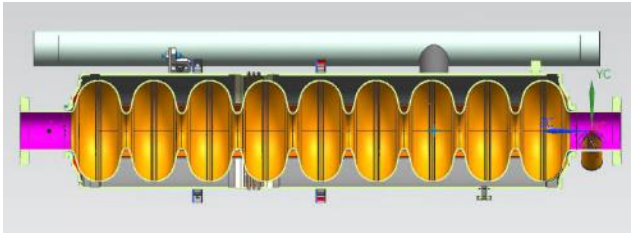
40 cavities

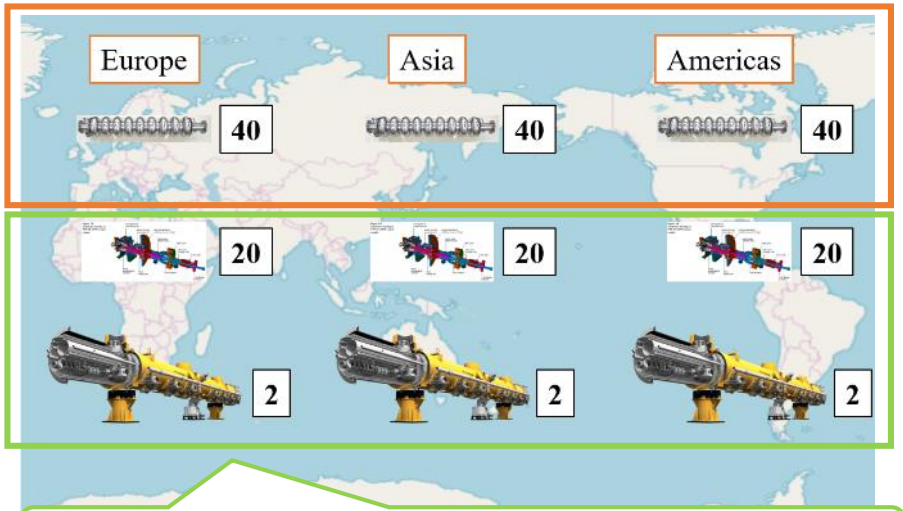
TDR baseline
Cavity production
↓
Surface treatment
↓
VT incl. success yield
↓
Installation into CM

New method for costdown
Cavity production
↓
Surface treatment
↓
VT/ performance demonstration
↓
Evaluation of success yield

Of the 40 cavities, about half will be used for CM assembly and the rest will be used for cost reduction evaluation

Baseline design in TDR





Nb sheet

EP

HT

To be confirmed the best method for mass-production

Items in green frame is related to WP-2 (next page)

WP-2: CM Assembly, Global transfer and Performance assurance

Translated by google

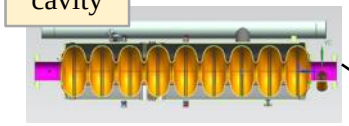
- Two CM production per region
- 48 cavities produced in WP-1 will be installed
- Satisfied with HPGS
- Incl. ancillaries (coupler, tuner, SC-Magnet)
- CM global transfer (as first case in SRF)
  - CM transfer from each region
  - Preparation for shock absorber, vacuum monitoring system
  - To be evaluated performance assurance in Japan

Two CMs production / region

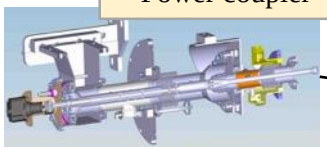
Work flow of WP-2

CM production
↓
Performance test @region
↓
CM global transfer
↓
Performance assurance in Japan

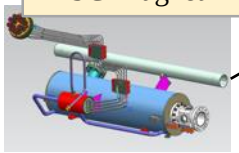
cavity



Power coupler

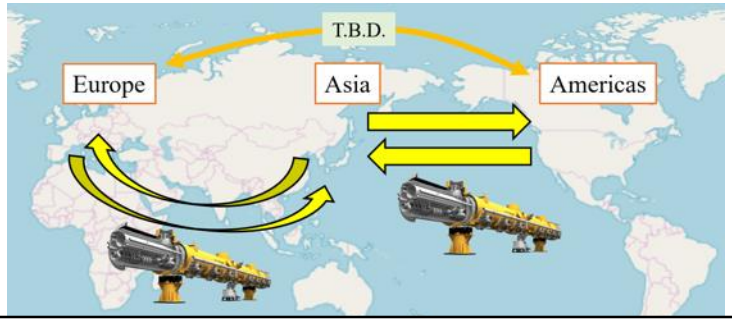


SC-Magnet



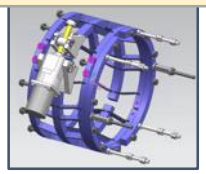
Completion of CM final design

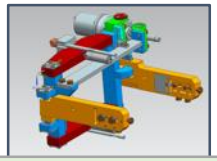
For the components that have progressed after TDR, evaluate the performance before deciding whether to use it



After performing performance tests in each area, they will be transported to Japan by sea transportation, where performance tests will be conducted again to confirm that there are no changes. Since transportation takes several months, it is necessary to monitor the impact and vacuum conditions during that period.

Tuner (TDR baseline)





Improved tuner

Cage for transfer

Shock absorber and logger

Vacuum monitoring system