SC RF Activities in Asia

Eiji Kako (KEK, Japan)

Outline

Activities in Japan

- Progress in KEK-STF
  - . Cryomodule Tests in STF Phase-1.0
  - . Cavity Tests at STF
- ERL Cavities for Injector Linac
- ERL Cavities for Main Linac
- Crab Cavities for KEKB Factory
- Accelerating Cavities for KEKB Factory
- LL Cavities for ILC
- ADS Cavities for J-PARC

Outline

Activities in Korea

- KNU, PAL, KAERI

Activities in China

- IHEP, PKU

Activities in India

- RRCAT
- (IUAC, BARC, TIFR, VECC)

Acknowledgements

I would like to thank my colleagues in Asia for giving me many information.

- K. Umemori (KEK, Japan)
- H. Nakai (KEK, Japan)
- T. Furuya (KEK, Japan)
- F. Furuta (KEK, Japan)
- Kim H.- S. (KNU, Korea)
- Zhang Baocheng (PKU, China)
- Gao Jie (IHEP, China)
- S.C. Joshi (RRCAT, India)
- Members of KEK-STF Group

Cryomodule Tests in STF Phase-1.0 (1)



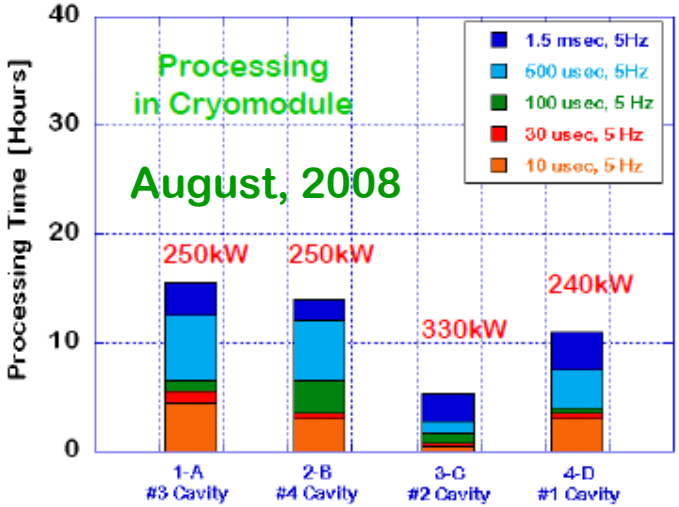

String assembly of four cavities and cryomodule assembly were carried out in January ~ March, 2008.



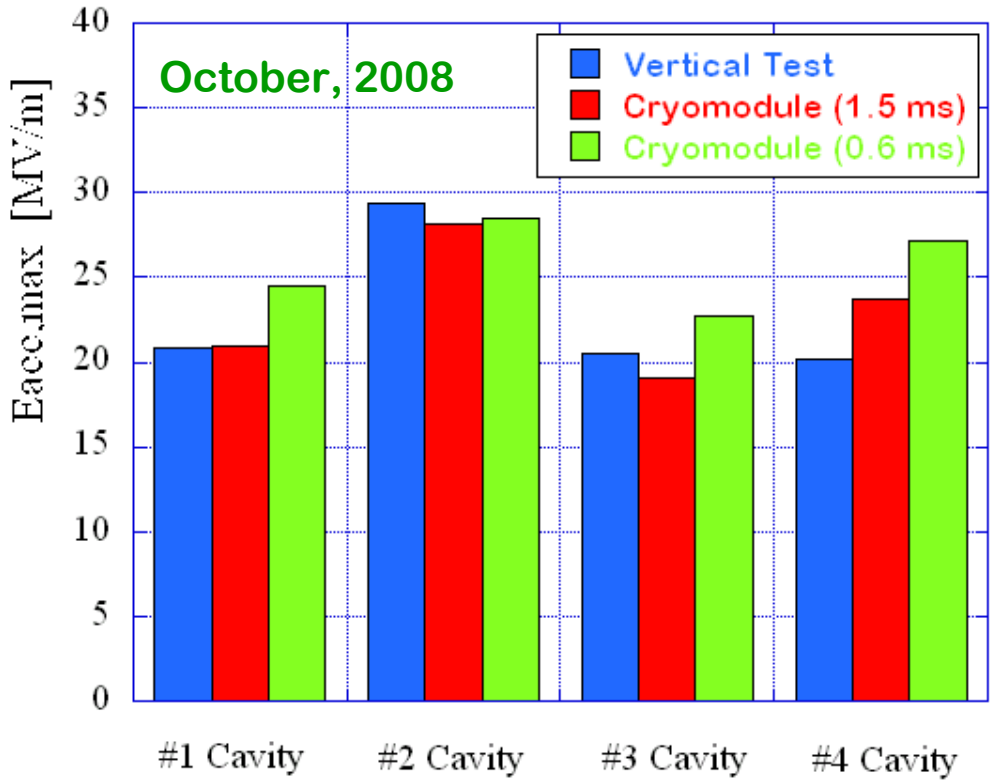
Photo by N. Toge

Cryomodule Tests in STF Phase-1.0 (2)

Coupler Processing at room temp.



Comparison of achieved Eacc,max
Vertical tests and Cryomodule tests



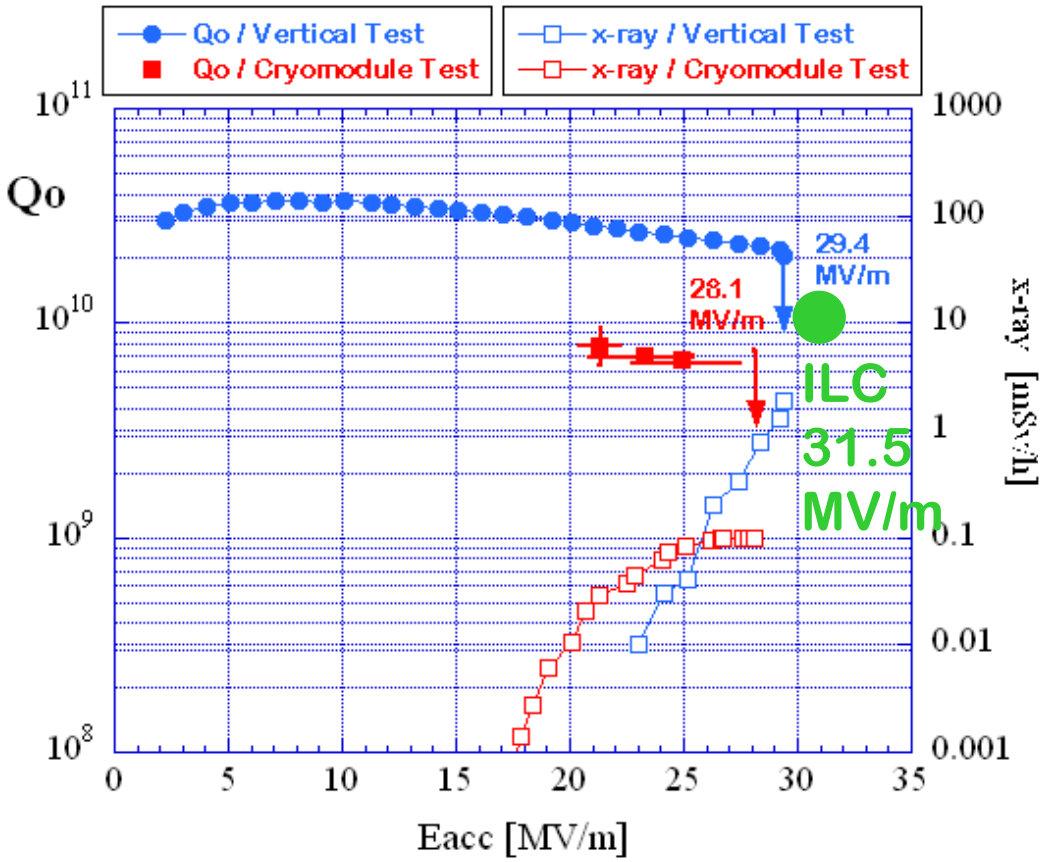
Ave. Eacc,max (V.T) = 22.7 MV/m

Ave. Eacc,max (Cryo.) = 23.0 MV/m

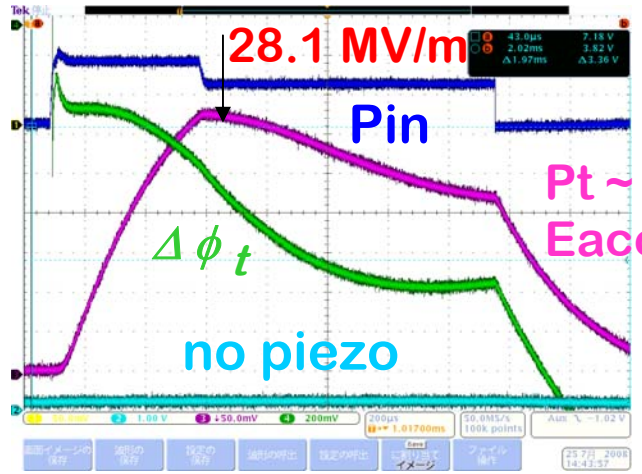
Cryomodule Tests in STF Phase-1.0 (3)

Dynamic rf loss measurement

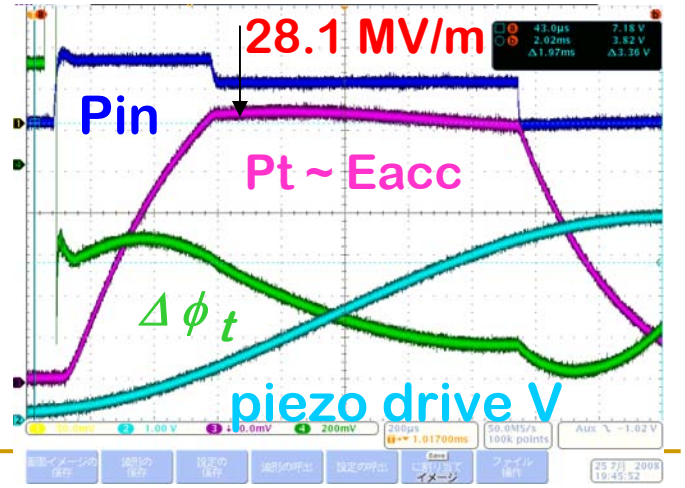
STF-BL#2 Cavity July, 2008'



No compensation

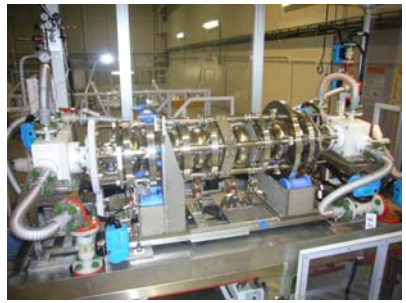


Compensation by Piezo-tuner



Cavity Tests at STF (1)

Flange-CP



EP

H_2O_2
Hot bath
(Alcohol)
(Degreasing)

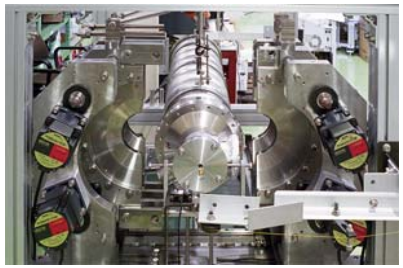
Rinsing

HPR

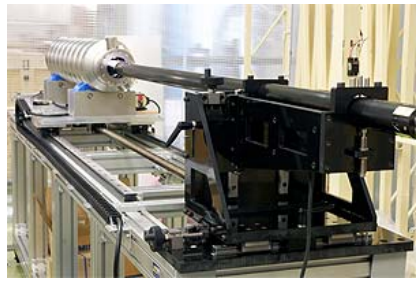
Assembly
(Class 10)

Infrastructure in STF Hall

System check with AES cavity, now.



Pre-tuning
fo adjustment



Inspection of
Inner Surface

Vertical Test

Hanging
Stand

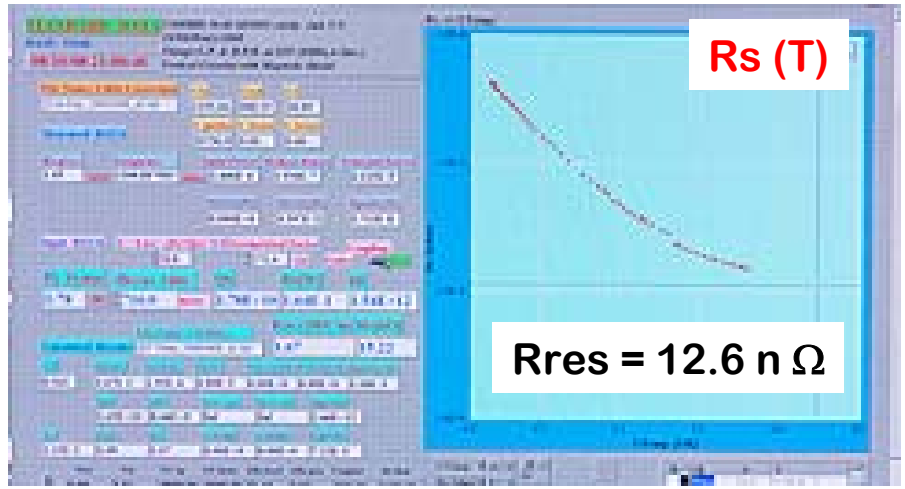
Baking
(Class 1000)

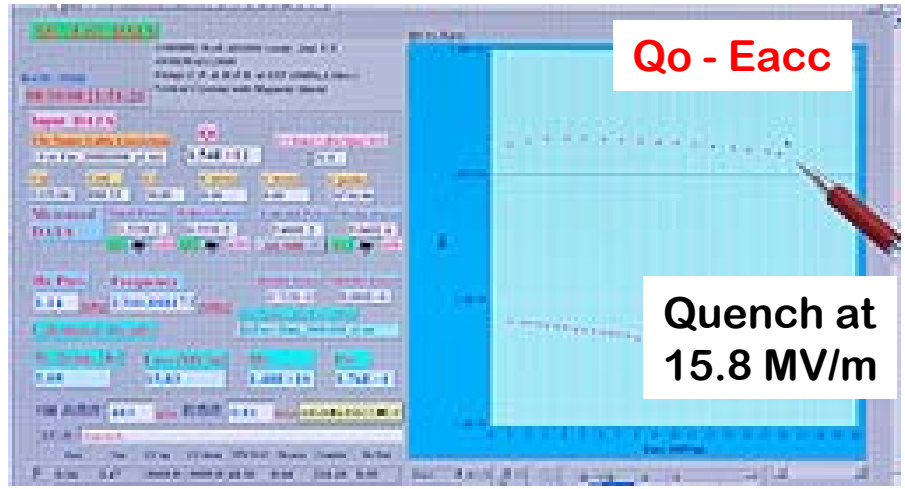
Cavity Tests at STF (2)

Oct. 09, 2008'

Vertical Test System

Vertical Test Result of AES Cavity





Cavity Tests at STF (3)

STF-BL#5 Cavity

STF-BL#6 Cavity

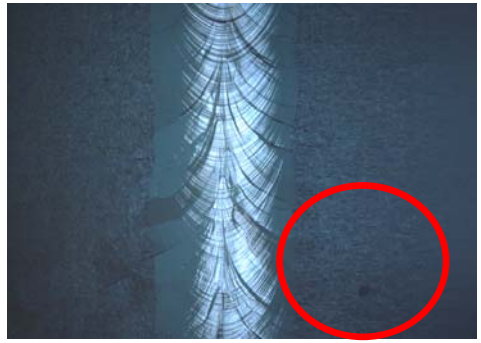
New STF-BL#7, #8, #9 ; Three cavities will be fabricated in FY2008.

Surface Inspection System

Temp. Mapping System

Passband-modes Meas.

1. As Received



2. preEP & EP-I (total 25μm)

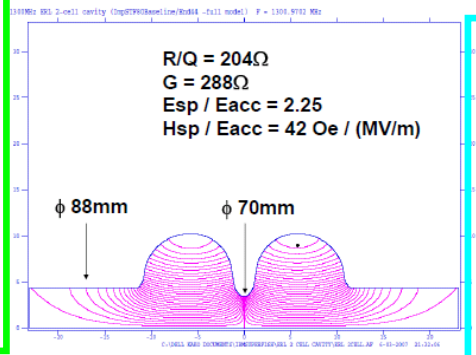
Same location

3. Add. EP-I (total 125μm)

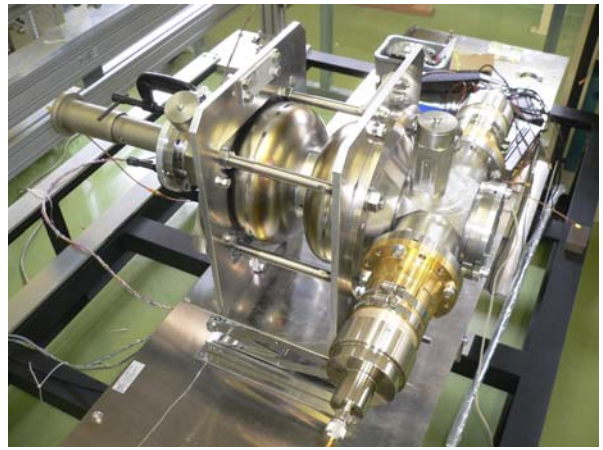
Diameter 350 μm
Depth ~15 μm

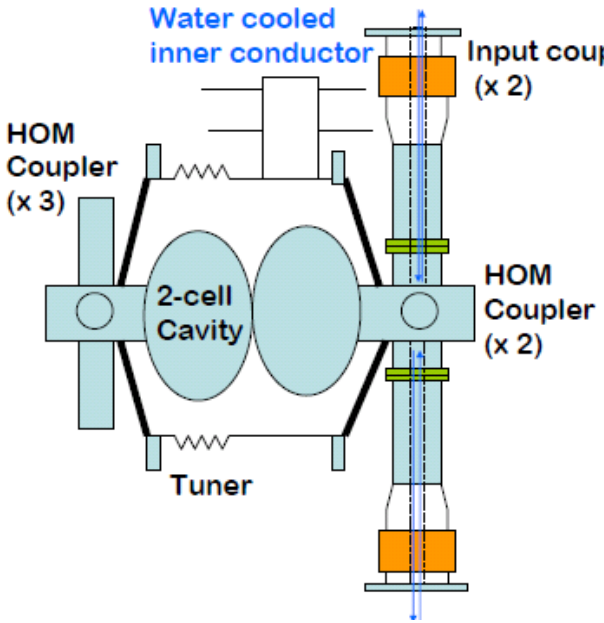
ERL Cavities for Injector Linac

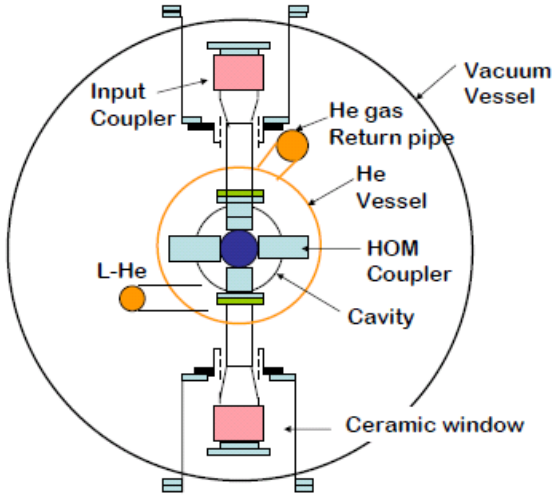
Frequency : 1.3 GHz
Beam Current : 100 mA CW
Beam Energy : 10 MeV
2-cell Cavity x 3, Eacc=15 MV/m
Input Power ; 170 kW CW x 6



Prototype 2-cell Cavity







Schematic drawing of ERL injector cryomodule

ERL Cavities for Main Linac

by K. Umemori
(KEK)

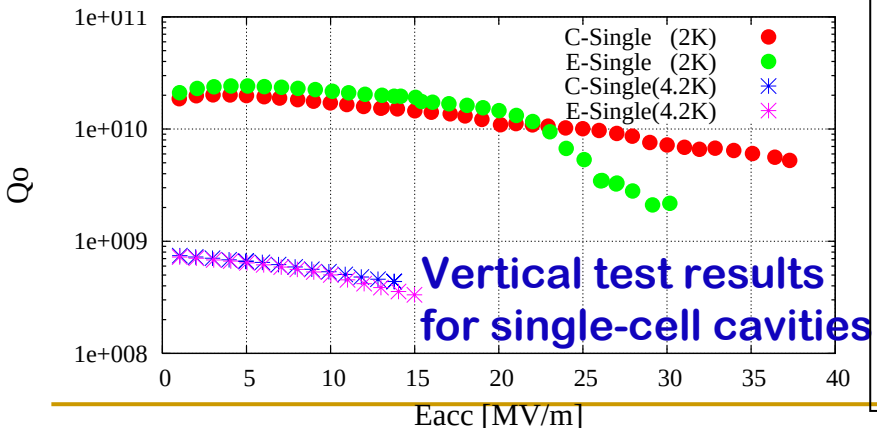
ERL cavity --- strongly HOM damped 9-cell cavity (1.3GHz)

- Optimized cell shape with large iris diameter(ϕ80mm)
- Large beampipes(ϕ120mm/100mm) with RF absorber
- Eccentric fluted beampipe for quadrupole HOM damping

Center-type single-cell

End-type single-cell

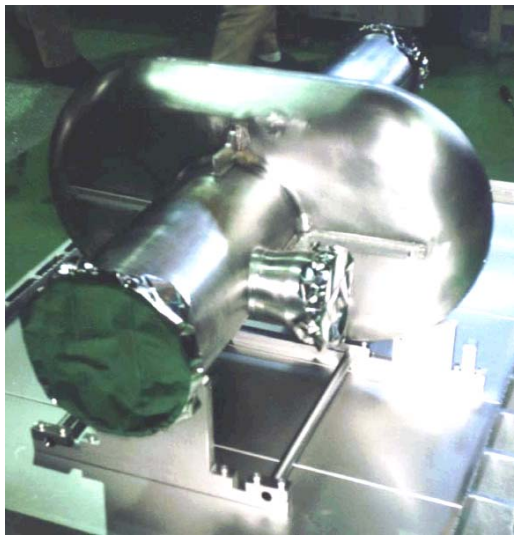
ERL 9-cell cavity



- Single-cell cavities show good performance.
- A 9-cell cavity was fabricated and surface treatment procedures were applied.
- Vertical tests of the 9-cell cavity are currently under way at KEK-STF.

Crab Cavities for KEKB Factory

by H. Nakai (KEK)



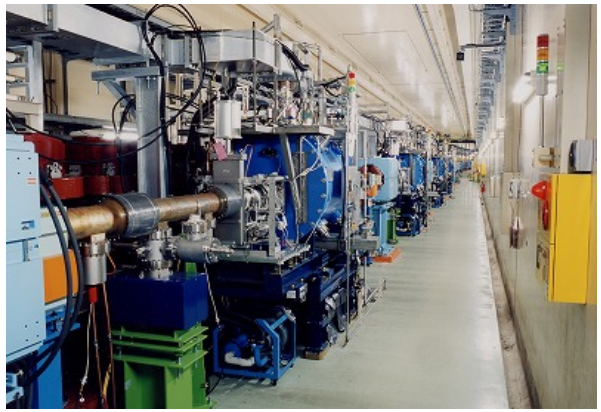
- Two (2) superconducting crab cavities installed in KEKB Factory (KEKB) have operated stably since their installation, and rendered great service to the luminosity increment of KEKB.
- Some modifications in cryogenic system for crab cavities are in progress for improvement of crab cavity performance by lowering their operation temperature.

Accelerating Cavities for KEKB Factory

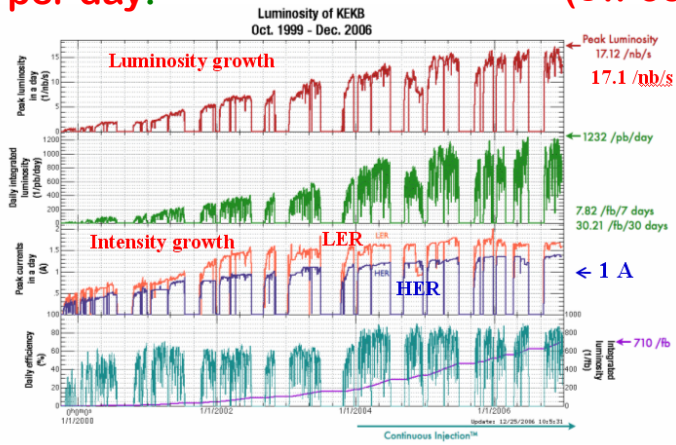
by T. Furuya (KEK)

KEKB-SC : storage ring RF for an ampere class beam

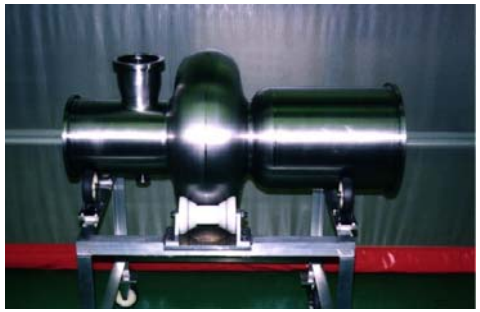
- The peak luminosity of 1.7 x 10^{34} $cm^{-2}s^{-1}$ at 1.6 A (LER) x 1.4 A (HER), and 1200 p^{-1}/day.
- Eight single-cell cavities provide a voltage of 11 MV delivering a power of 2.6 MW.
- Stable top-up operation with a trip rate of 0.1 per day. (cw 350 kW/coupler)



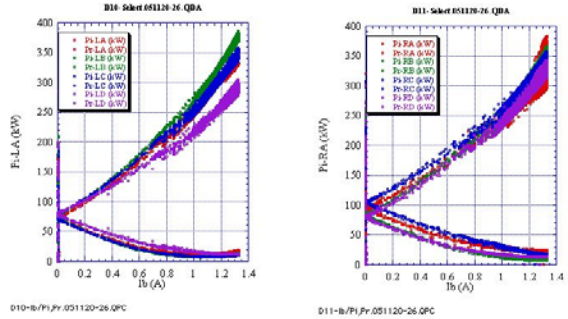
SC accelerating cavities in the KEKB tunnel.



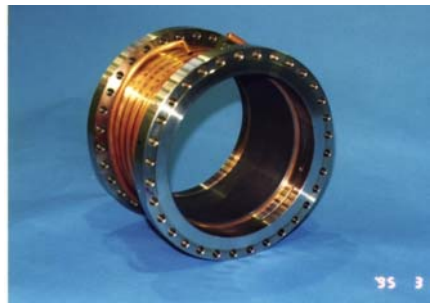
Current & luminosity growth of KEKB since 1999.



509 MHz Nb single-cell cavity.
Large iris dia. of 220 mm with a cylindrical BP of 300 mm in dia.



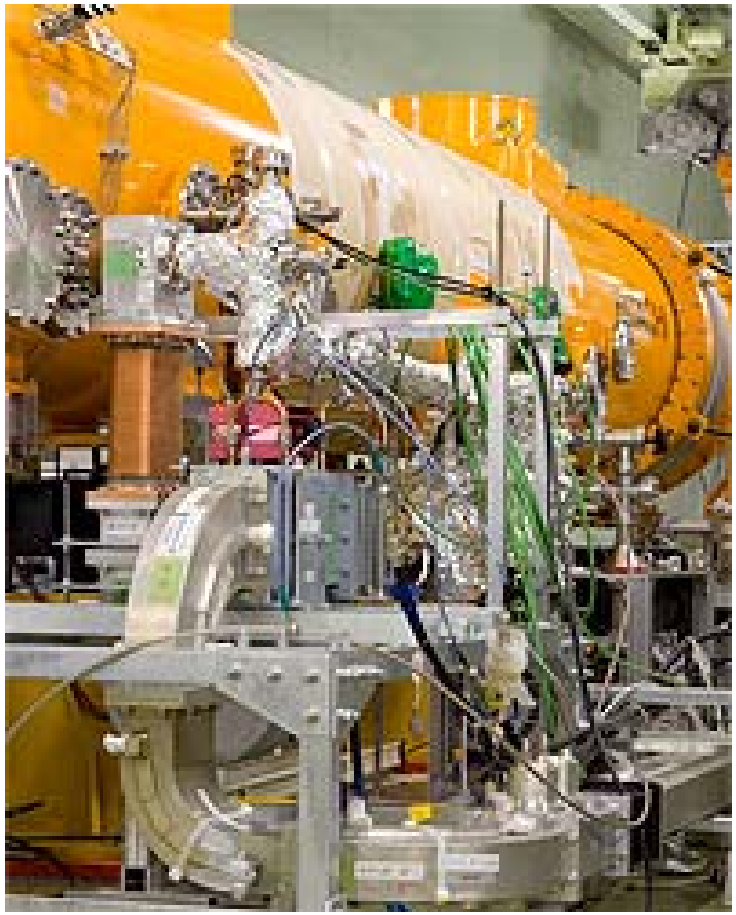
>350 kW with a small reflection power at top-up.
Eight SC cavities deliver 2.6 MW.



Absorbed HOM of 16 kW/cavity.

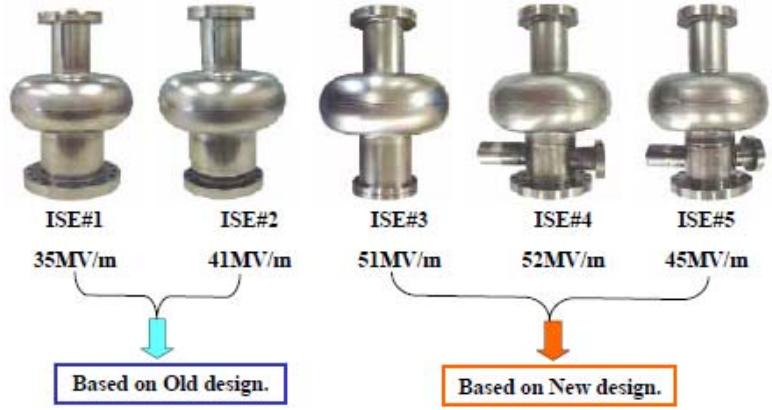
Low Loss Cavities for ILC

by F. Furuta
(KEK)



Cryomodule Test of a LL cavity
in STF Phase-0.5
(March, 2008)

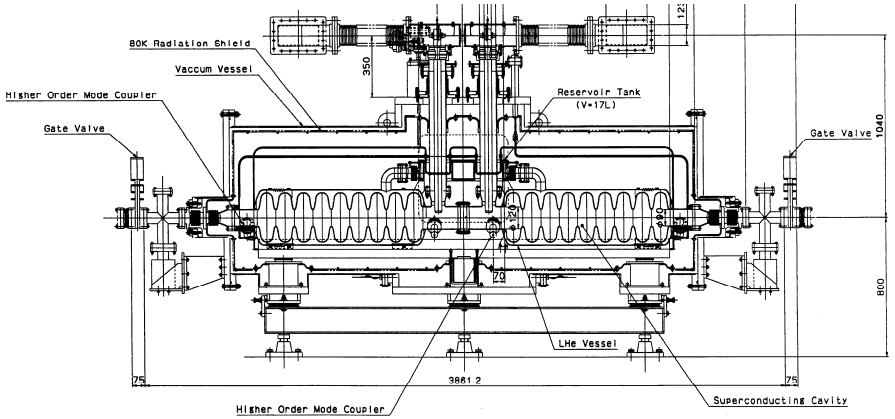
Single-cell LL Cavities

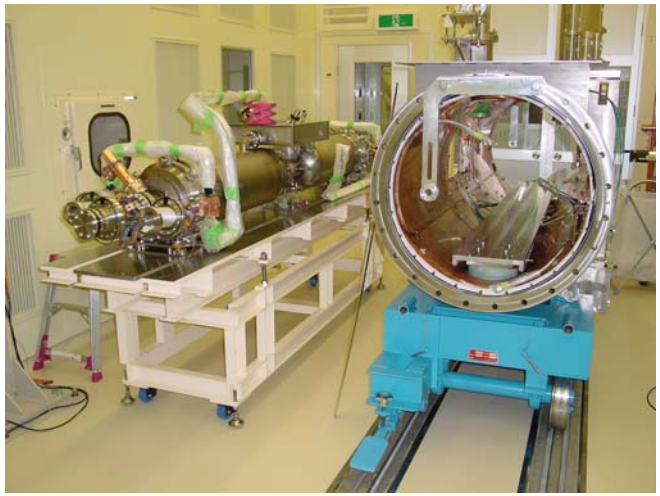


9-cell LL Cavities

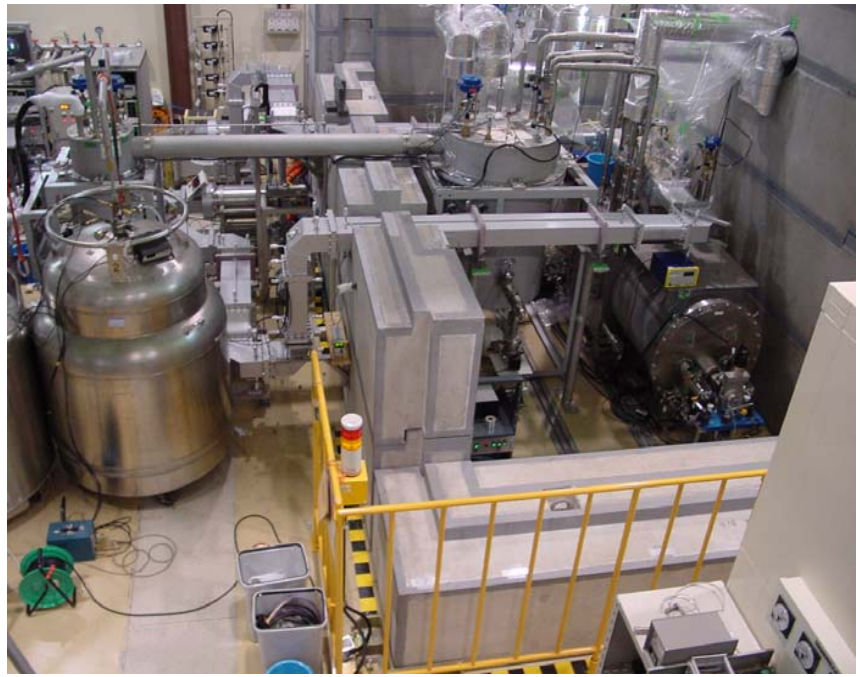
ADS Cavities for J-PARC

Prototype Cryomodule with two 972 MHz 9-cell Cavities (β=0.725)





The cryomodule was constructed by the collaboration KEK/JAEA, and was tested in 2004~2005.



Activities re-started in 2008 for SC proton Linac (400~600 MeV) in J-PARC phase-II.

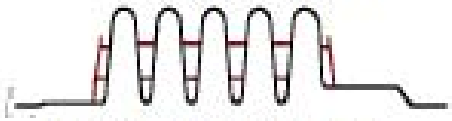
SC-RF Activities in PEFP, KAERI

by Kim H.-S. (KNU)

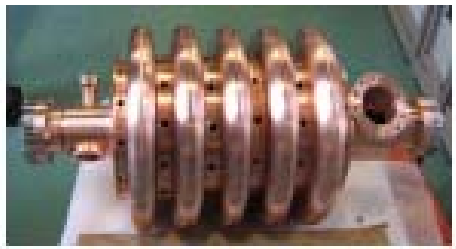
Superconducting RF Project at PEFP (Proton Engineering Frontier Project) ; (Sun An, Yong-Sub Cho, Byung-Ho Choi)

- To develop a superconducting RF linac to accelerate a proton beam from 100 MeV at 700 MHz.

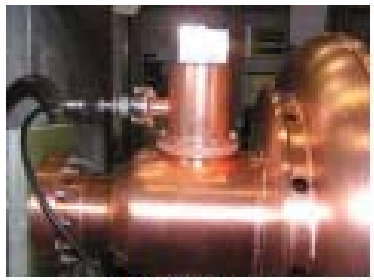
Electronic field profile of the TM010 π mode of PEFP low-beta cavity



Stiffening structure of the PEFP Low-beta cavity



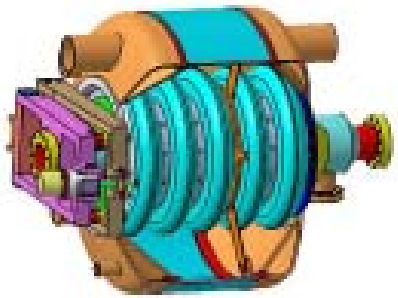
Prototype copper Cavity A



HOM coupler

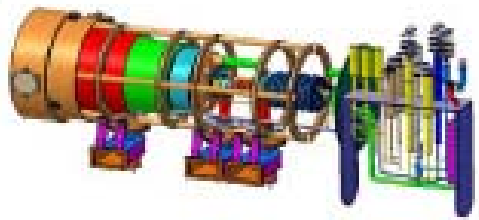
Prototype copper Cavity B

Fundamental Power Coupler



Helium Vessel Design

PEFP cavity's field flatness tuning system



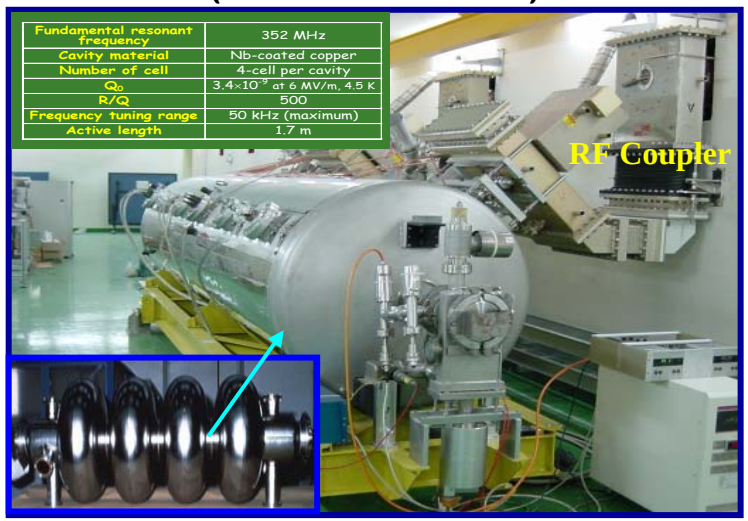
PEFP low-beta cryomodule

SC-RF Activities in KAERI, PAL, KNU

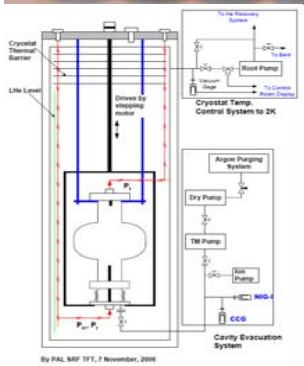
by Kim H.-S. (KNU)

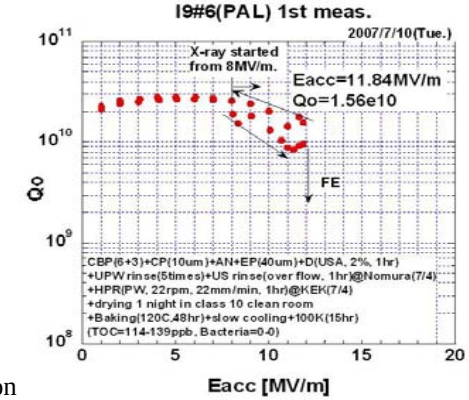
352 MHz Superconducting Cavity at KAERI (S.H. Park et al.)

Fundamental resonant frequency	352 MHz
Cavity material	Nb-coated copper
Number of cell	4-cell per cavity
Q_0	3.4×10^{9} at 6 MV/m, 4.5 K
R/Q	500
Frequency tuning range	50 kHz (maximum)
Active length	1.7 m



9-cell Cavity: PAL-9SC #1 at PAL (Y. Sohn)

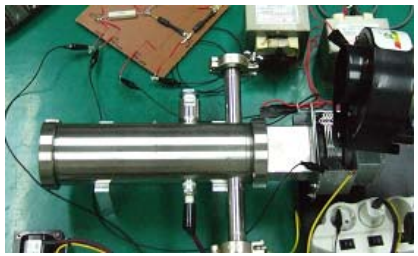


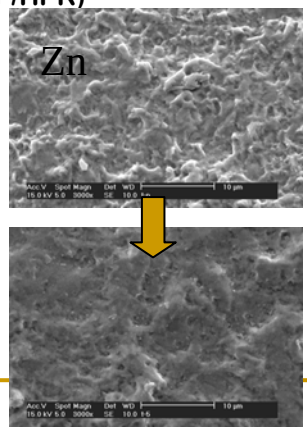


Test cryostat under construction

Dry Surface-treatment under development at KNU

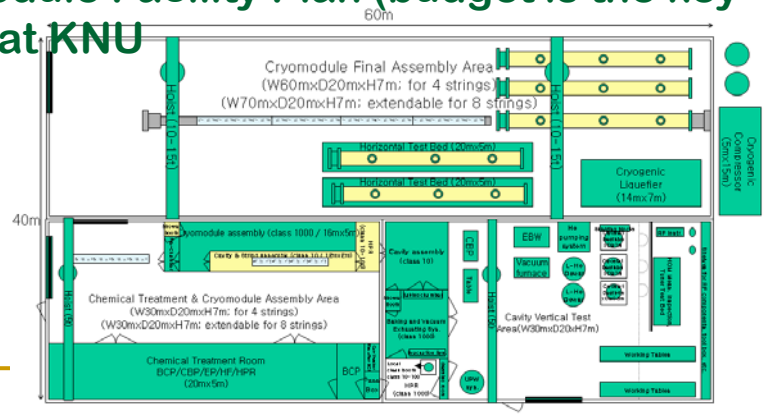
- Prototype to replace wet treatment (CP/EP/HPR)





Atmospheric Pressure Microwave Plasma Glow Discharge / Adaptive Shape Plasma Dry Polishing and Cleaning

Cryomodule Facility Plan (budget is the key issue!) at KNU



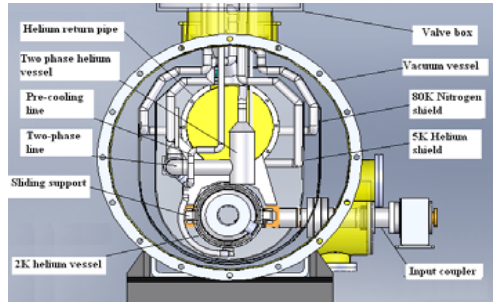
SC-RF Activities in IHEP, Beijing

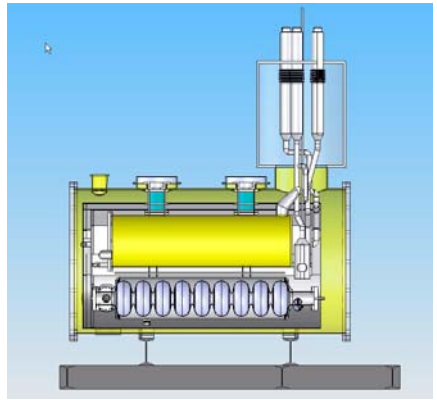
by Gao Jie
(IHEP)

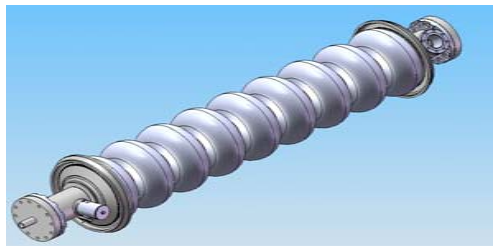
Single-cell cavities

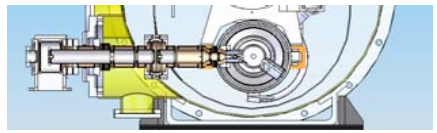
IHEP-ILC Group fabricated six 1.3 GHz LL-type single-cell cavities. Two large grain cavities were surface-treated at IHEP and were tested at KEK without EP. They have reached at 40MV/m without Q-slope.

IHEP 1.3 GHz Cryomodule Test Stand







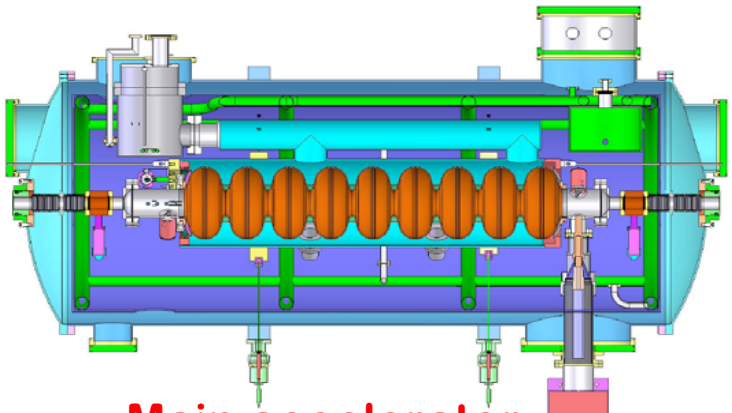


Aim:
Design, fabrication and testing a 1.3 GHz superconducting accelerating unit, which includes one 9-cell large grain cavity, couplers, tuner, cryostat and LLRF.

SC-RF Activities in Peking Univ.

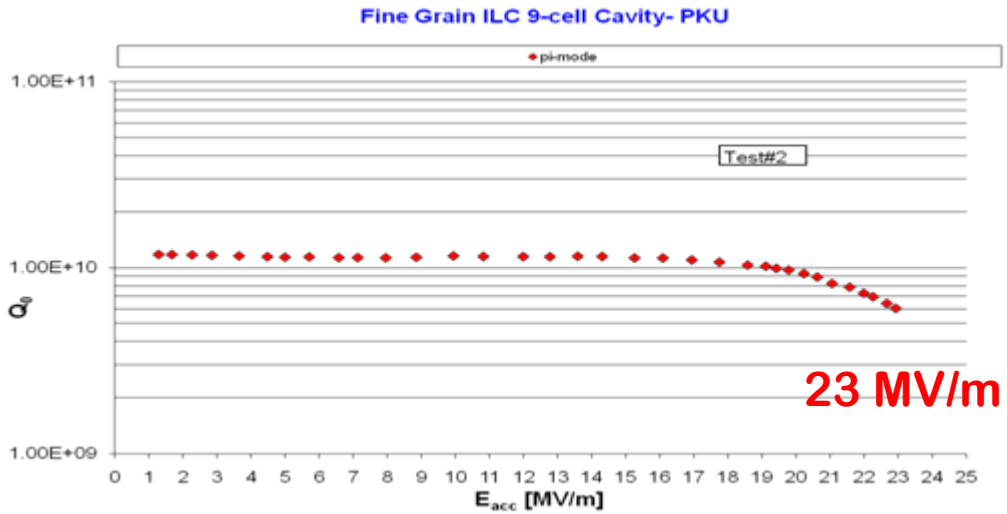
by Zhan Boacheng (PKU)

Since 2005, R&D of large grain Nb sheets has been carried out, and large grain Nb singel-cell cavities have been fabricated.



Main accelerator with a Tesla-type 9-cell cavity

A 9-cell Tesla-type cavity with fine grain Nb sheets was fabricated at PKU in 2007, and surface-treated and tested at JLab in 2008 .



This assembly will start in 2008.

SC-RF Activities in RRCAT, Indore

by S.C. Joshi (RRCAT)

Electron beam welding activities for a single-cell Aluminum prototype cavity using facility of Indian Industry.

Forming tooling

Ready for equator weld

Bead-pull measurement set-up for an assembled cavity

End Group- Design for manufacturing by machining

Status

Prototypes in Copper already complete (picture enclosed). Machining in Low RRR niobium block is underway.

Summary of Highlights

- **Japan**
  - . Cryomodule tests (4 cavities) in STF Phase-1.0 are going on, now.
  - . Cavity tests at STF have just started.
  - . ERL 2-cell and 9-cell cavities will be tested, soon.
  - . KEKB crab and accelerating cavities are in stable operation.
- **Korea**
  - . R & D for SC proton accelerator has been carried out at KAERI.
  - . Dry surface-treatment is under development at KNU.
- **China**
  - . Construction of Test Cryomodule Stand will be started at IHEP.
  - . Assembly of Cryomodule with a 9-cell cavity will be started at PKU.
- **India**
  - . End-group copper model by machining was fabricated at RRCAT.

Thank you for your attention.

The END.