ACCELERATOR OVERVIEW
Japan Proton Accelerator Research Complex (J-PARC)

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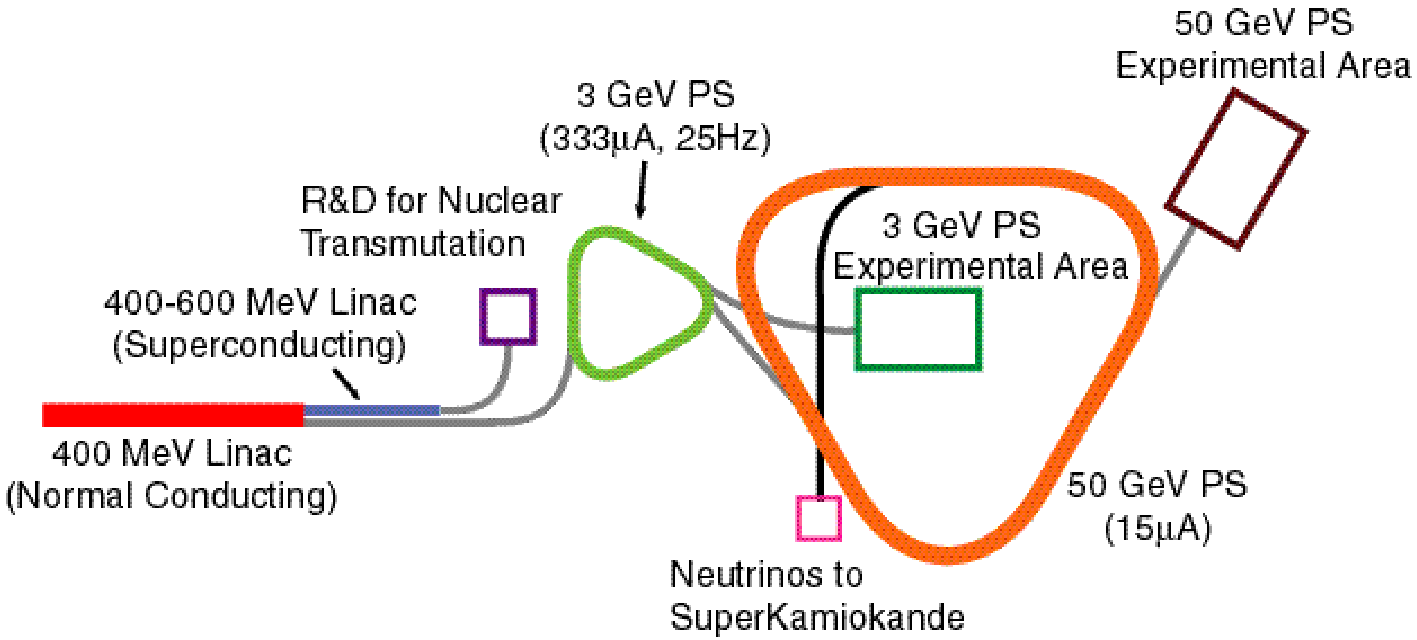
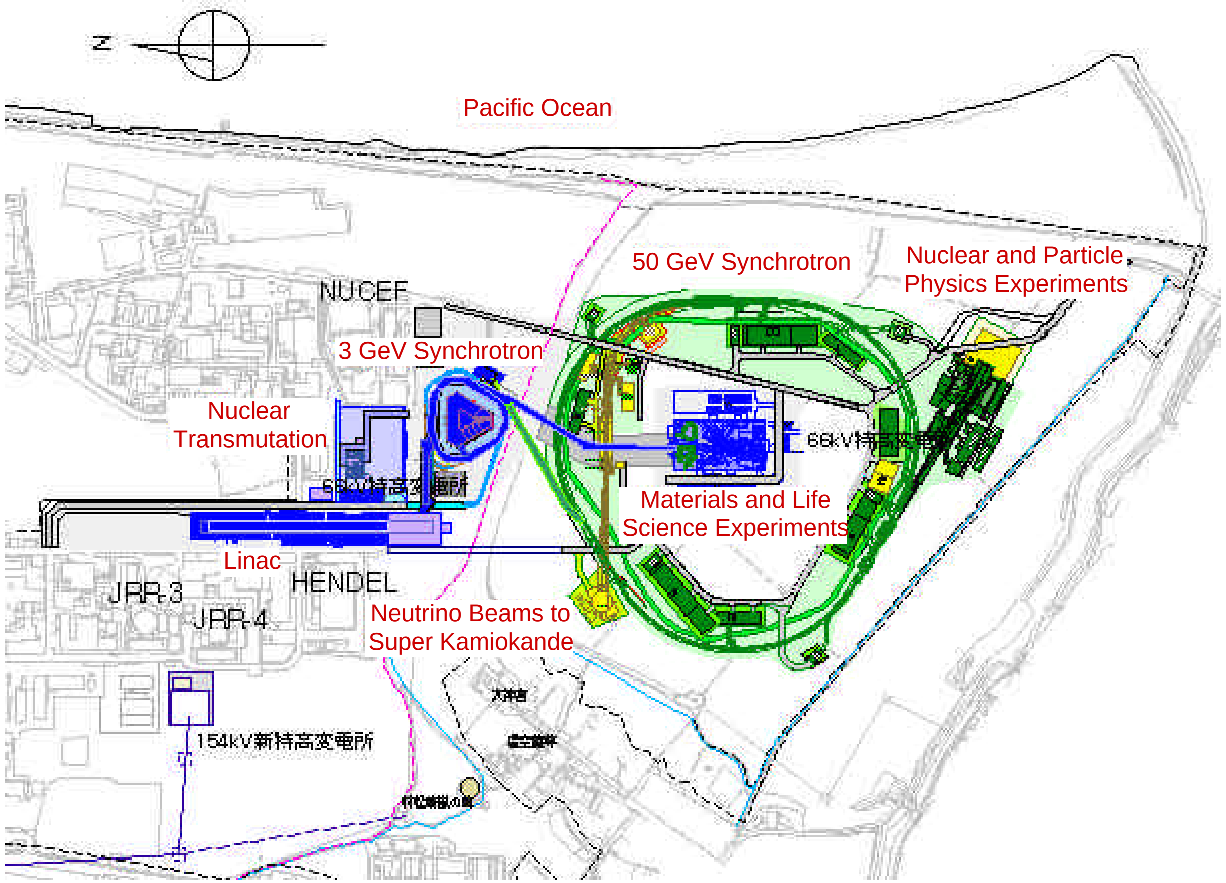
J-PARC Neutron Technical Advisory Committee (NTAC) Meeting
JAERI/TOKAI, October 28th to 30th, 2002

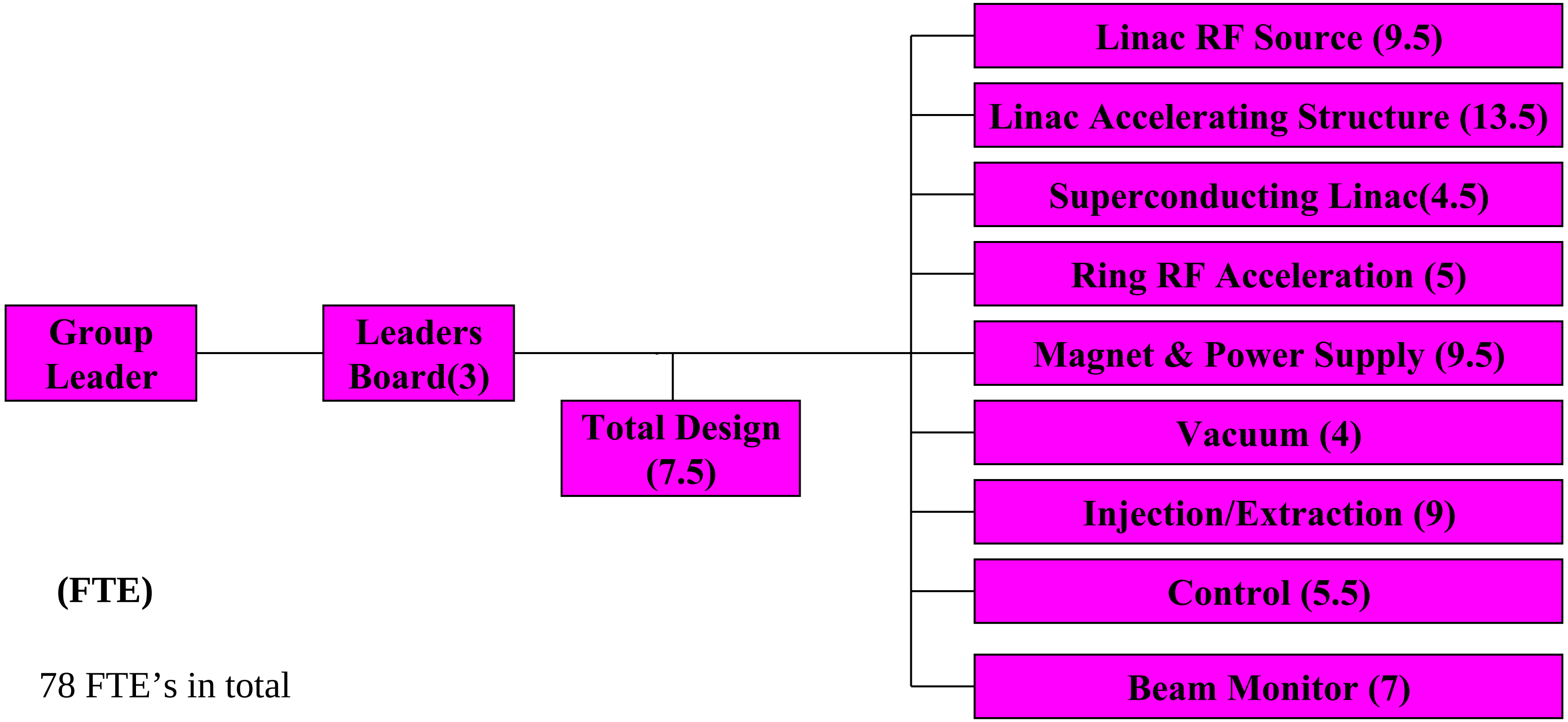
Configuration of the Accelerator Complex



Plan View of the Facility



Accelerator Group Organization
(Instrument Construction)



(FTE)

78 FTE’s in total

Additionally 32 FTE’s are from industries and from post-docs

Requirement

- **~ 50-GeV, 15 μA, slow and fast extraction for nuclear and particle physics experiments**

- **~ 1 GeV, 1 MW, <1 μs, ~ 25 Hz for spallation neutron source**

Features of the Accelerator Complex

- **The cascade system is suitable for the several-ten GeV machine.**
- **The prototype is the present KEK-PS.**
- **The booster Rapid-Cycling Synchrotron (RCS) can also be used for the Neutron Souce. This may be more powerful than the accumulator ring (AR) system with a full-energy linac.**
- **The present project is a kind of scale up of the KEK-PS by a factor of ten.**

RCS Advantage vs AR

- **Lower Beam Current**
- **Lower Injection Energy**
- **Higher Injection Beam Loss is allowed.**

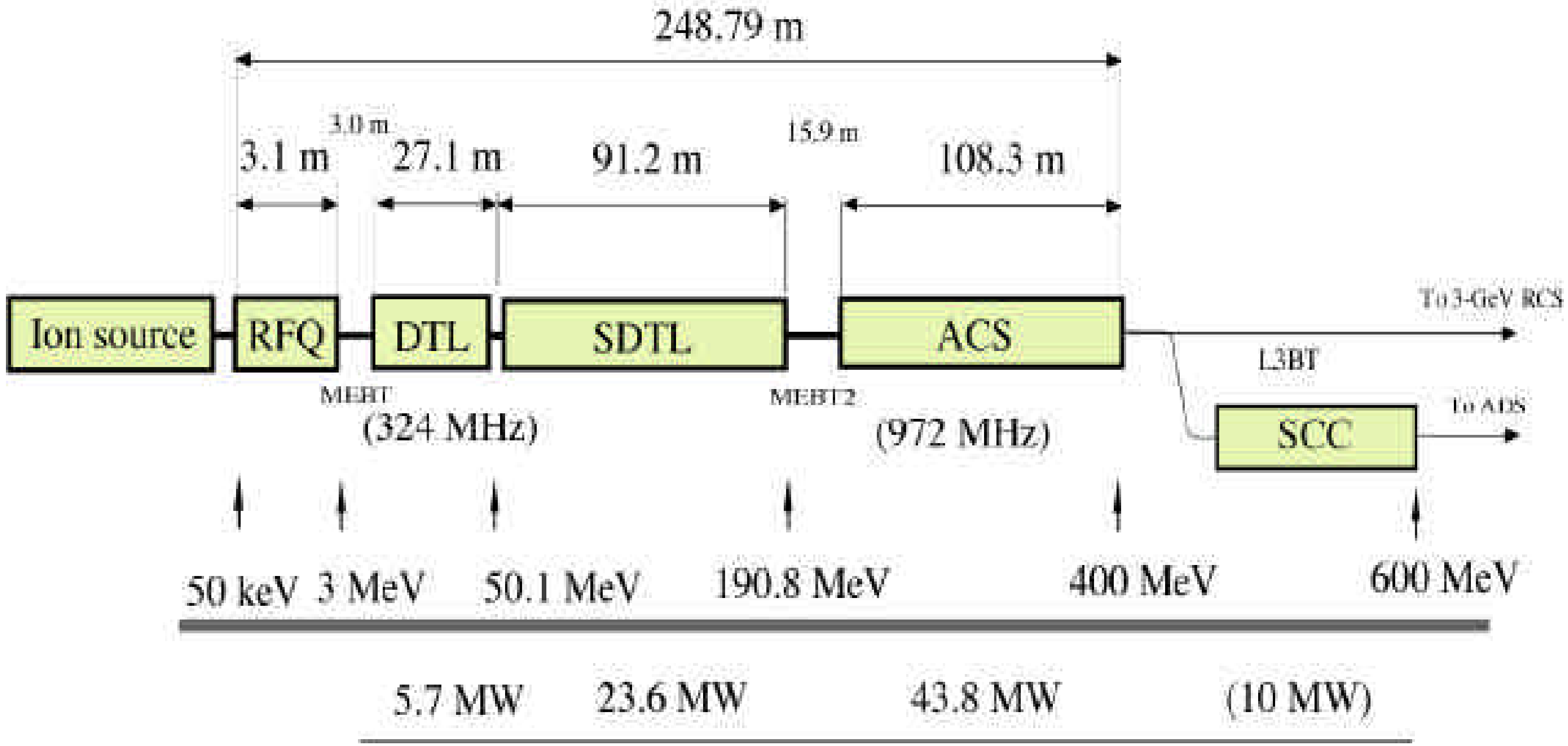
  (If one increases the beam energy by a factor of 7.5 times, the allowed beam loss during the injection is 7.5 times as high as that for AR with the same beam power.)
- **Perhaps immune against the e-p instability**

RCS Disadvantage vs AR

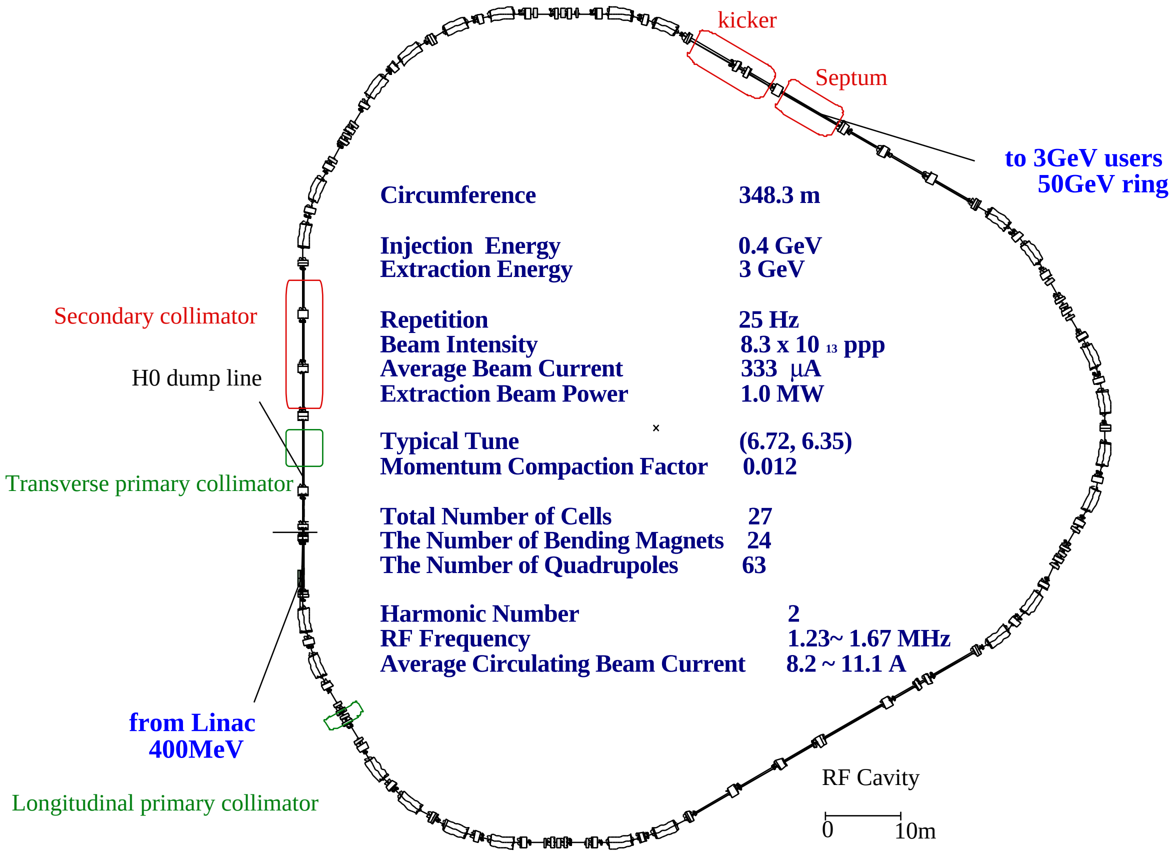
RCS Challenges

- Lower injection energy in turn implies higher space charge effect. Large aperture magnets are required, giving rise to large fringing fields.
- Powerful RF accelerating system
- Ceramics vacuum chamber with RF shield to avoid the eddy current effect
- Stranded coil to overcome the eddy current effect on the magnet coils.
- Precise magnet field tacking is necessary for each family of magnets

Proton linac

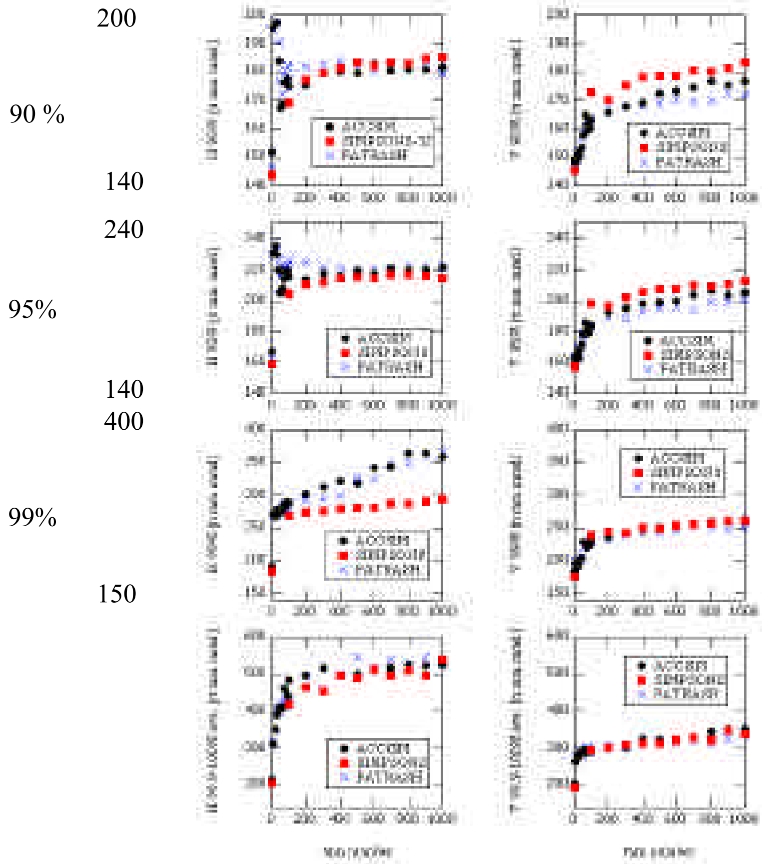


RCS Configuratiion



Circumference	**348.3 m**
Injection Energy	**0.4 GeV**
Extraction Energy	**3 GeV**
Repetition	**25 Hz**
Beam Intensity	**8.3×10^{13} ppp**
Average Beam Current	**333 μA**
Extraction Beam Power	**1.0 MW**
Typical Tune	**(6.72, 6.35)**
Momentum Compaction Factor	**0.012**
Total Number of Cells	**27**
The Number of Bending Magnets	**24**
The Number of Quadrupoles	**63**
Harmonic Number	**2**
RF Frequency	**1.23~ 1.67 MHz**
Average Circulating Beam Current	**8.2 ~ 11.1 A**

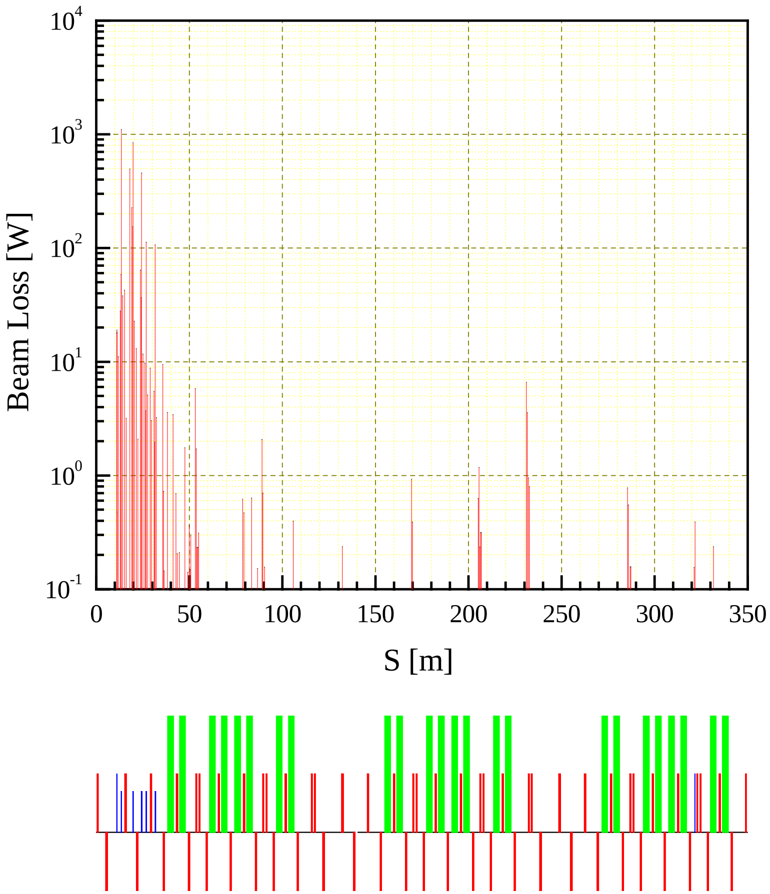
Emittance Growth Simulation in RCS (400 MeV injection)



Courant-Snyder Invariant
20A, Sext on, 100%Q

The 97 % emittance should be confined in 324 π mm mrad.

Beam Loss Distribution



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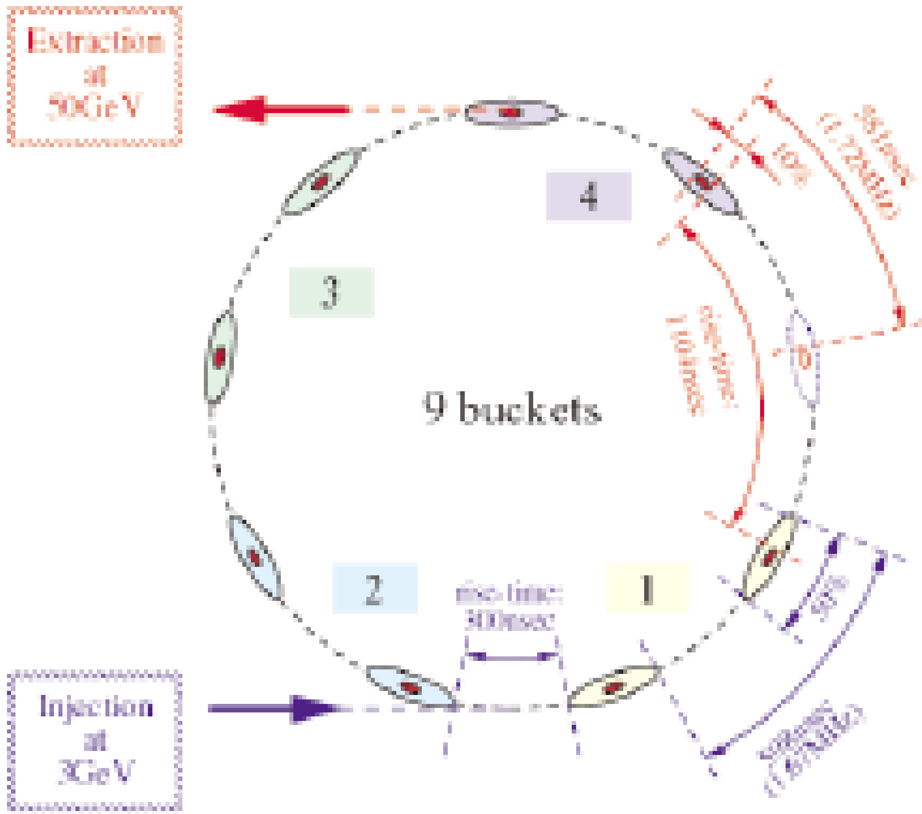
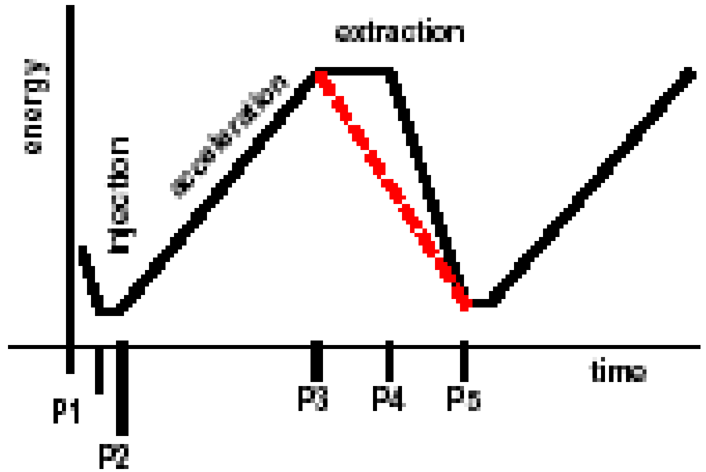
Injection Scheme to 50-GeV Ring

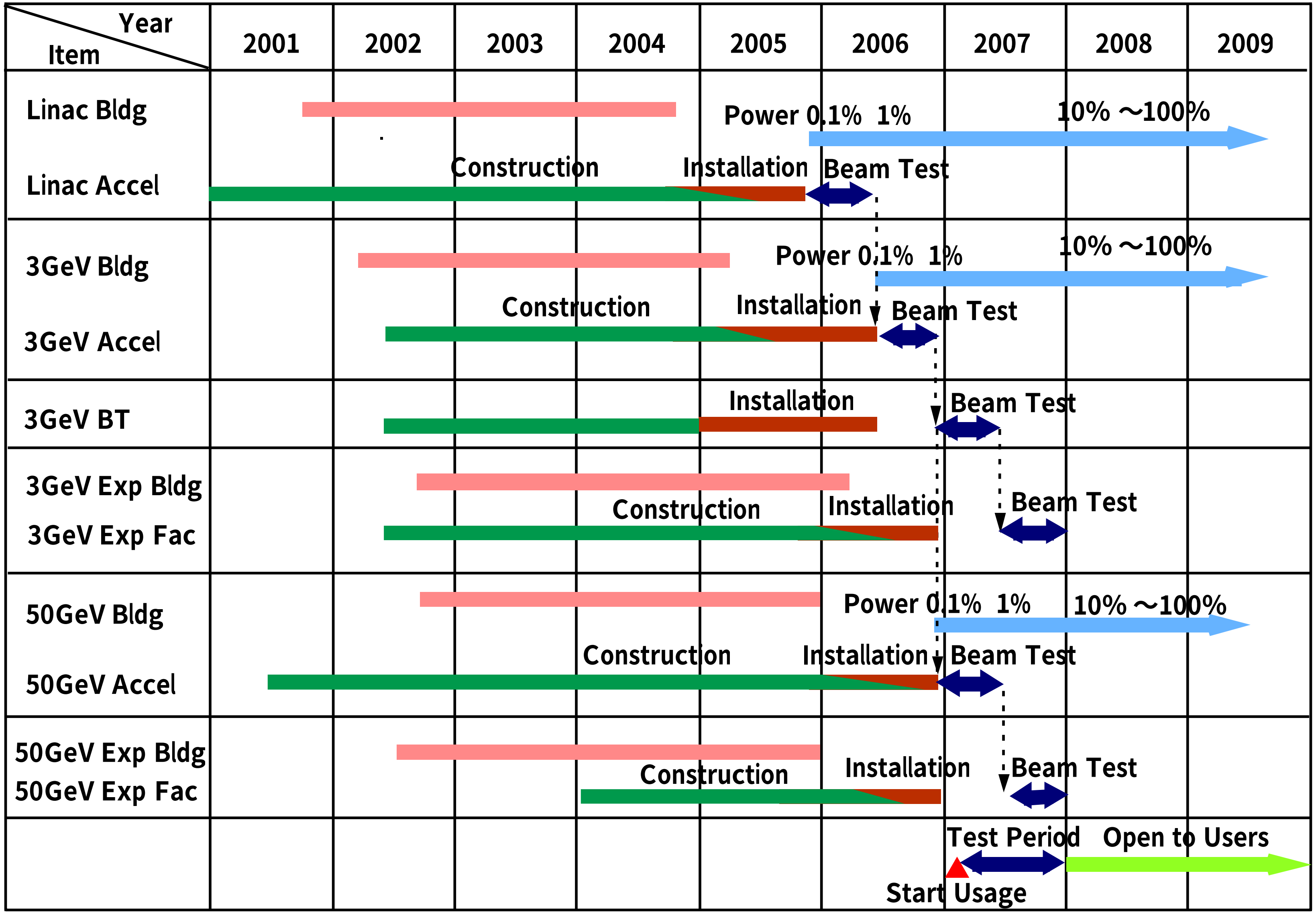


Acceleration Cycle



P1 - P2(injection)	0.14 s
P2 - P3(acceleration)	1.9 s
P3 - P4(extraction)	0.7 s
P4 - P5	0.9 s
total	3.64 s
slow extraction of 50GeV	
duty factor	0.20
average current	15μA

Construction and Commissioning



Linac Schedule Milestones

- **JFY01: Most components for Linac and Bldg. ordered**
- **Mid JFY02: Remaining components for Linac to be ordered**
- **Summer JFY04 : Bldg. to be completed, Installation to be started**
- **March JFY05: Commissioning to be started**
- **Mid JFY 06: Beam injection to RCS to be started**

RCS Schedule Milestones

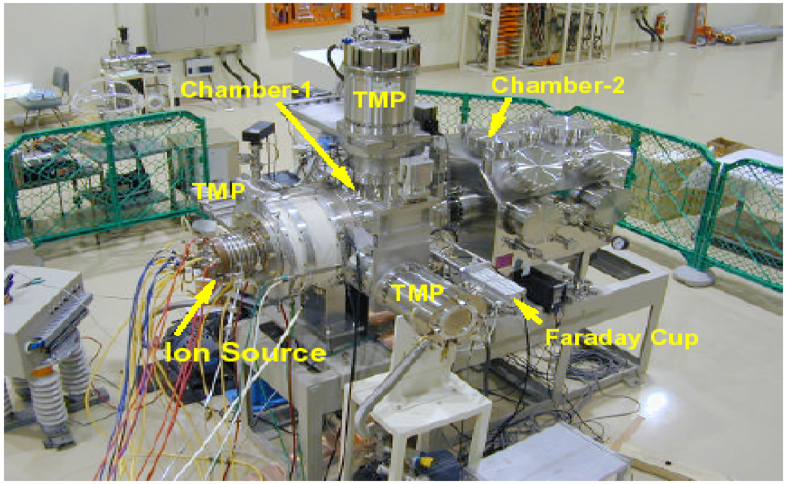
- **Mid JFY02: Half of components and Bldg. to be ordered**
- **Early JFY03: Remaining half of components to be ordered**
- **March JFY04 : Bldg. Completed, Installation to be started**
- **Mid JFY06: Beam injection to RCS, that is, RCS commissioning to be started**
- **March JFY06: Beam extraction to the Neutron Source and to the 50-GeV Ring**

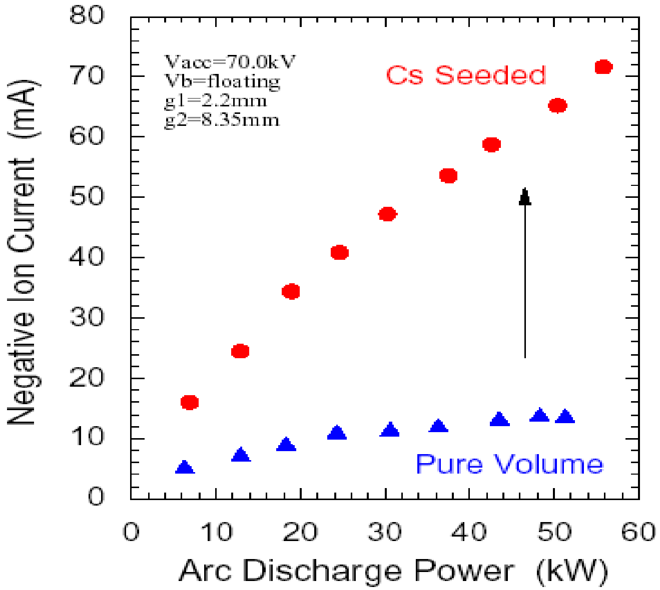
Coil of Electromagnet in Drift Tube

The coil is electroformed and Wire-cutted.

Cs-seeded Ion Source

KEK/JAERI
The Joint Project Team





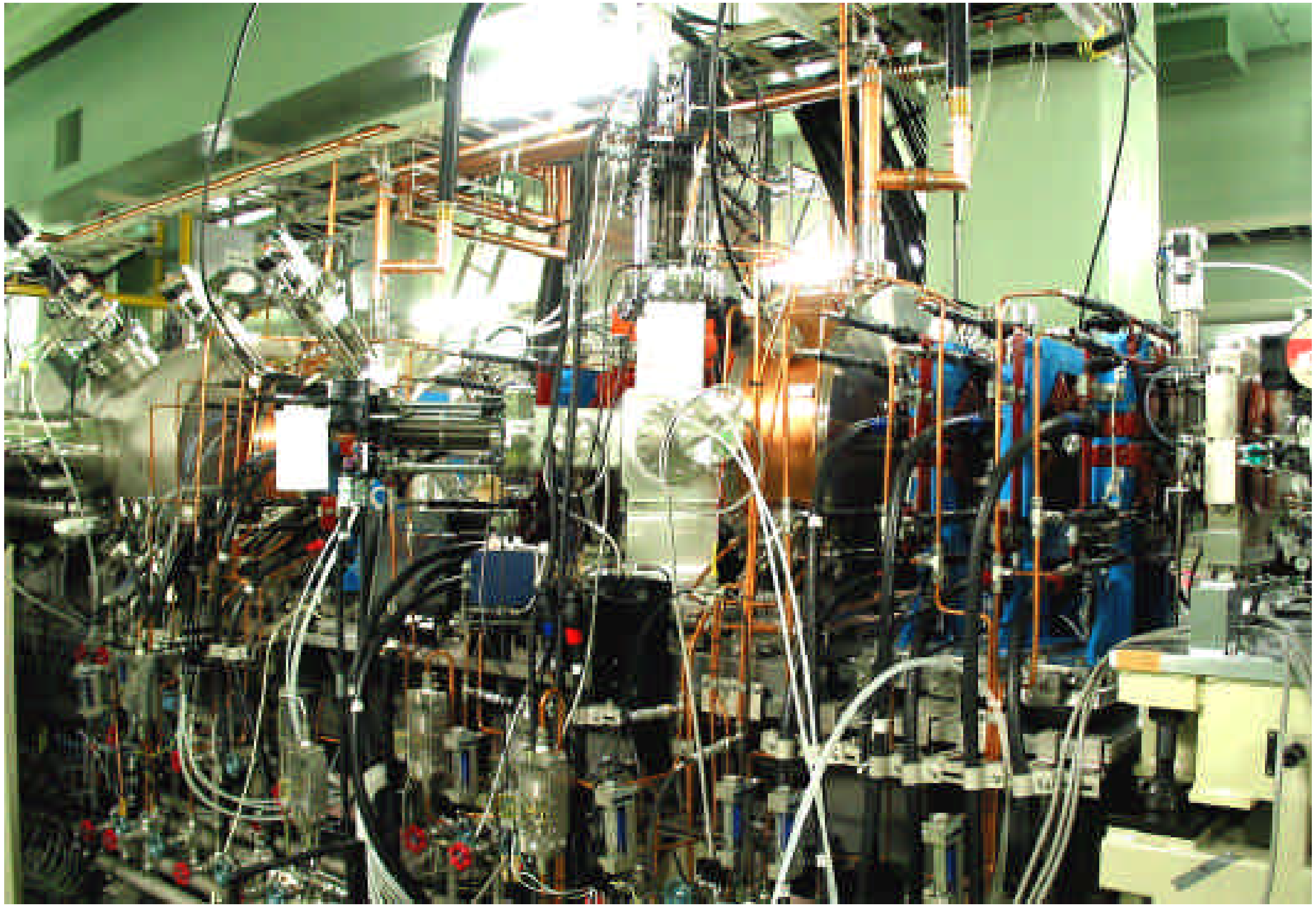
Volume Production Type Negative Ion Source

30mA RFQ

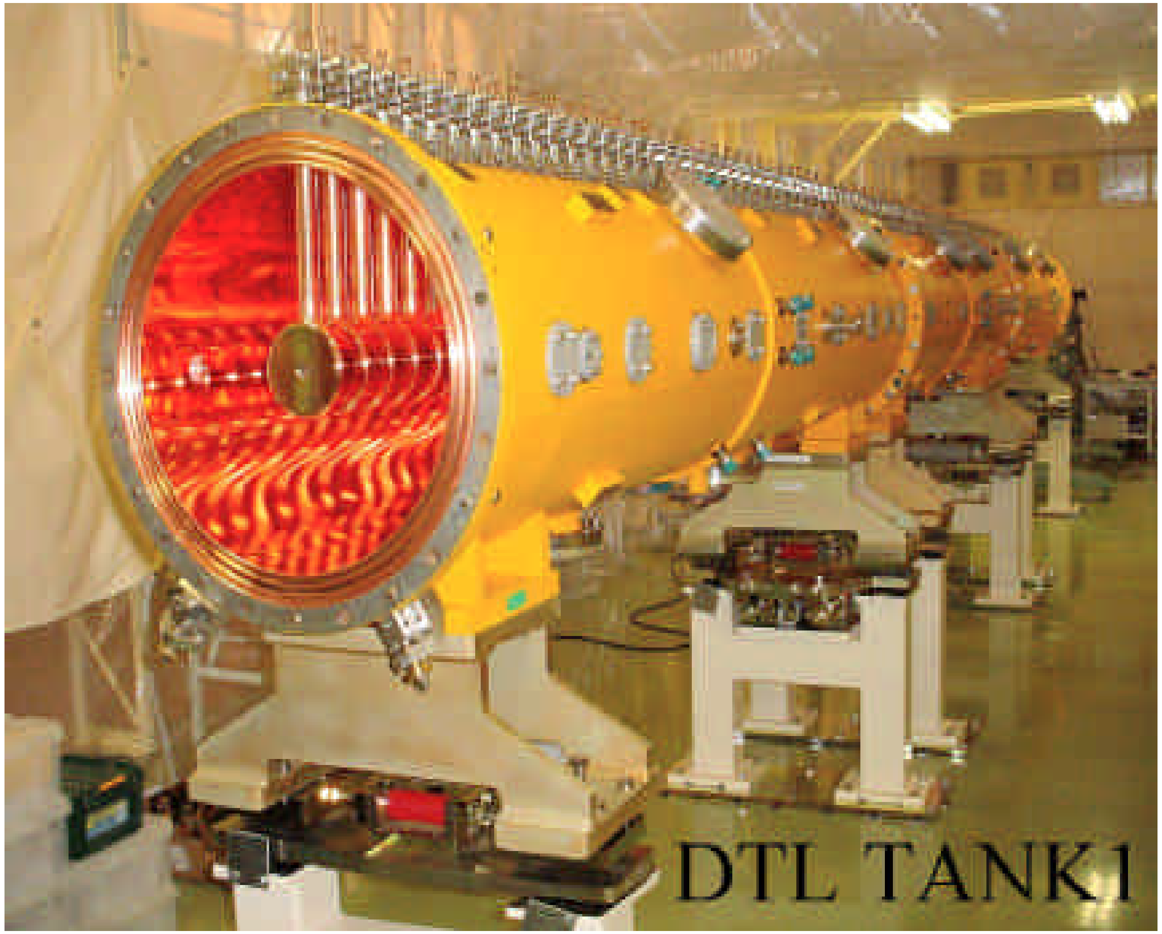
Inside view of the RFQ stabilized with PISLs

The 30mA RFQ installed in the test area

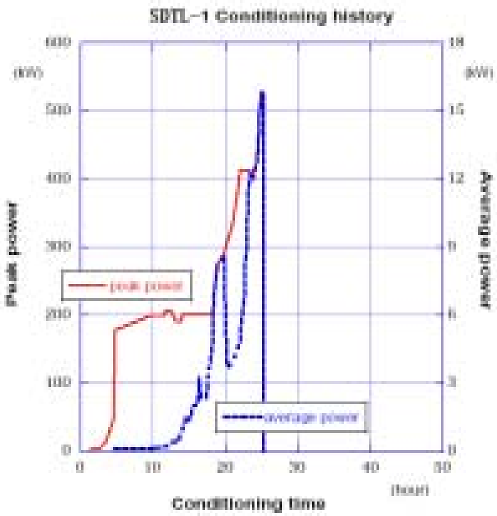
MEBT Photograph



DTL Tank 1 with DT's Installed



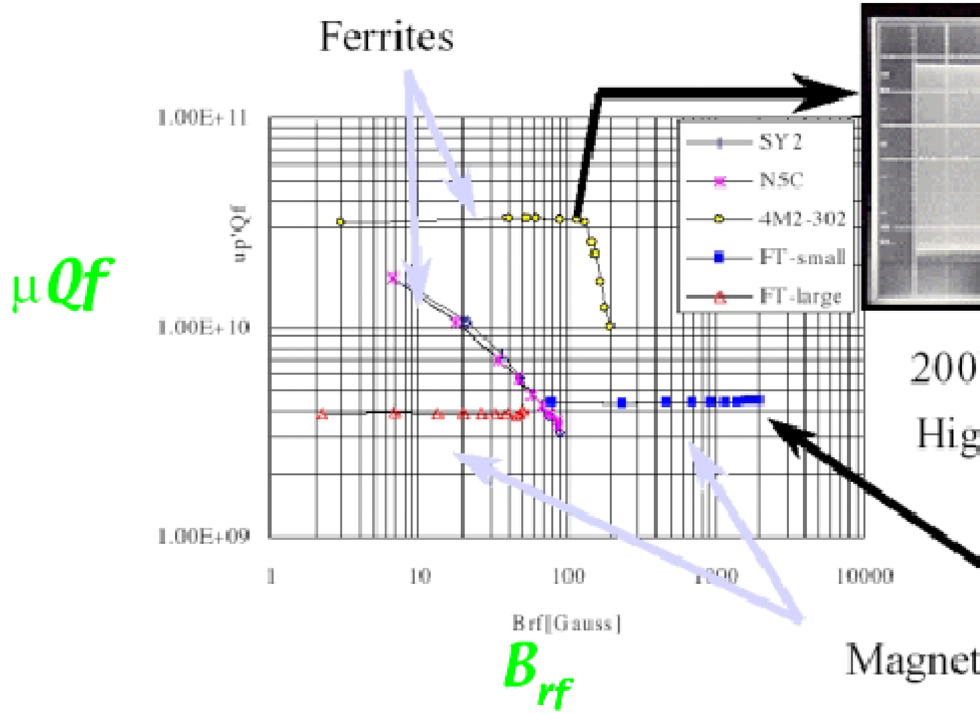
Conditioning of SDTL1

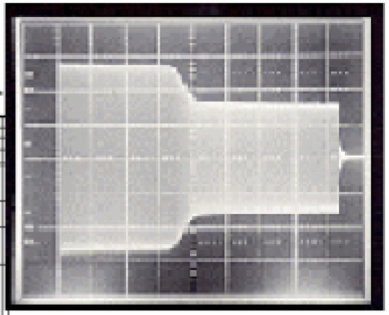


Magnetic Alloy

* *RF behaviour at high field*

  μQf (shunt.imp.) vs. B_{rf}





200V/div, 5ms/div

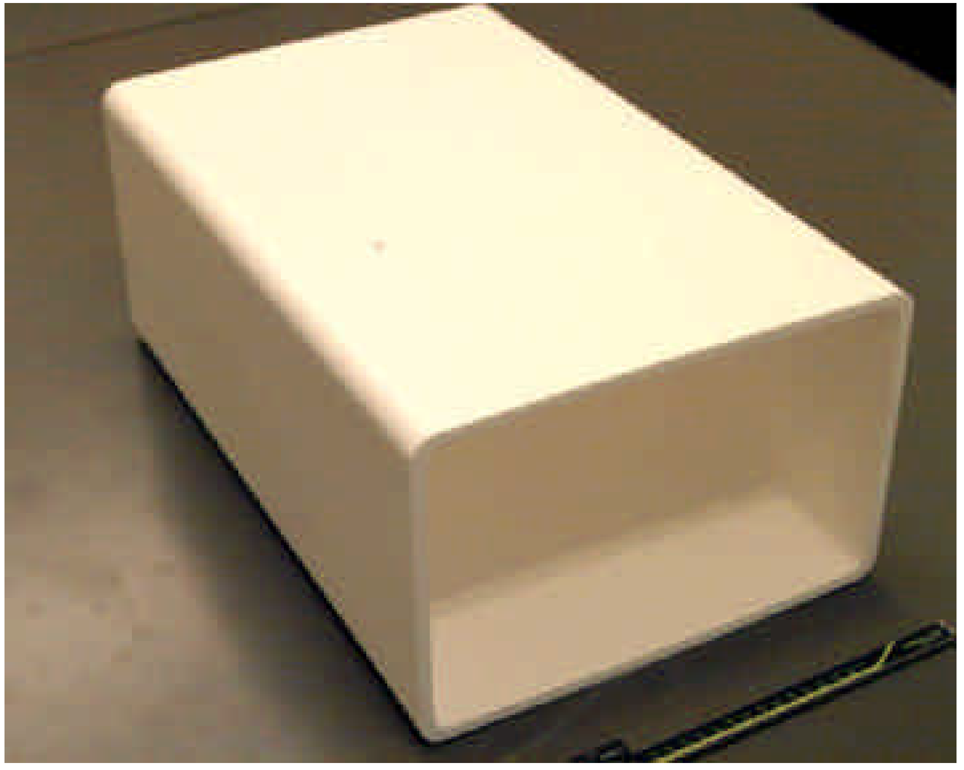
High Loss Effect

Novel RF Cavity with Finemet

FINEMET-loaded Accelerating RF Cavity

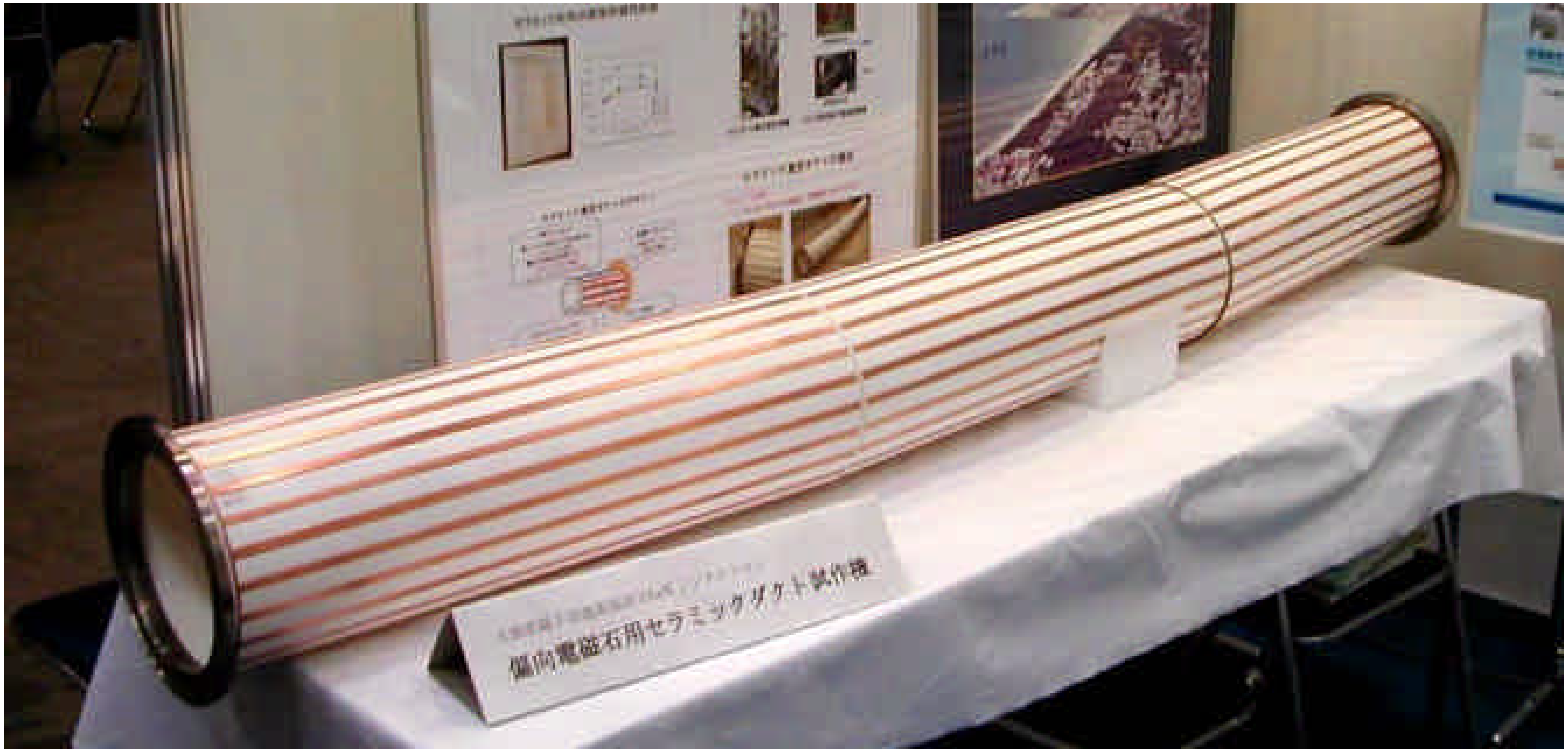
- **High Permeabiility Magnetic Alloy**
- **Highest Accelerating Field Gradient（50kV/m Accomplished**

Rectangular Ceramics Vacuum Chamber

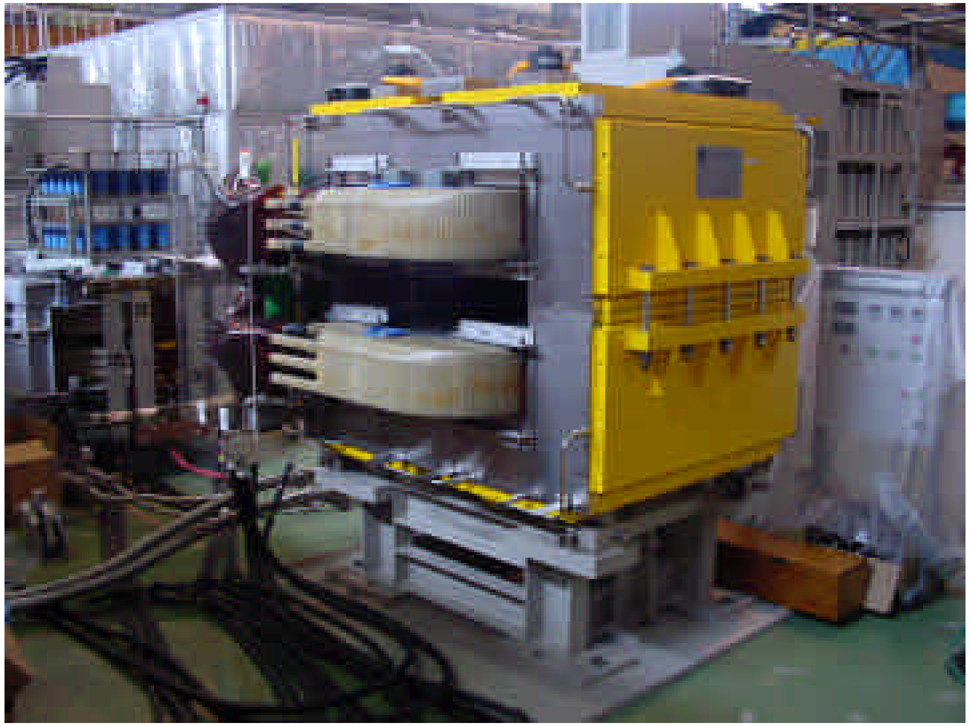


Circular Ceramics Vacuum Chamber

RF shields were electroformed.
Main bodies were metalized and silver-brazed.



R&D Dipole Magnet for 3-GeV Synchrotron



Repetition rate : 25[Hz],
Core length : 1.0[m], Gap height : 210[mm]
Max. field : 1.1[T]（at 3GeV）, Min. field : 0.27[T]（at 400MeV）

Summary

- **The accelerator scheme for the high-intensity proton accelerator facility project in Japan is unique as follows.**
  - ***The RCS scheme is chosen for the MW proton machine producing the pulsed spallation neutrons.***
  - ***The MR is attempting to realize the MW proton machine also for the several ten GeV region.***
- **Not only for the scientific and engineering output, but this accelerator complex will also open up the new era for the field of the accelerator technology.**
- **Together with the success of the SNS and/or ESS projects, this project will contribute a lot to the future several or ten MW accelerators, which are really required for the 21st centuary science and technology, including the biology, the nuclear and particle physics, the energy development, the environmetal science/technology and so forth.**