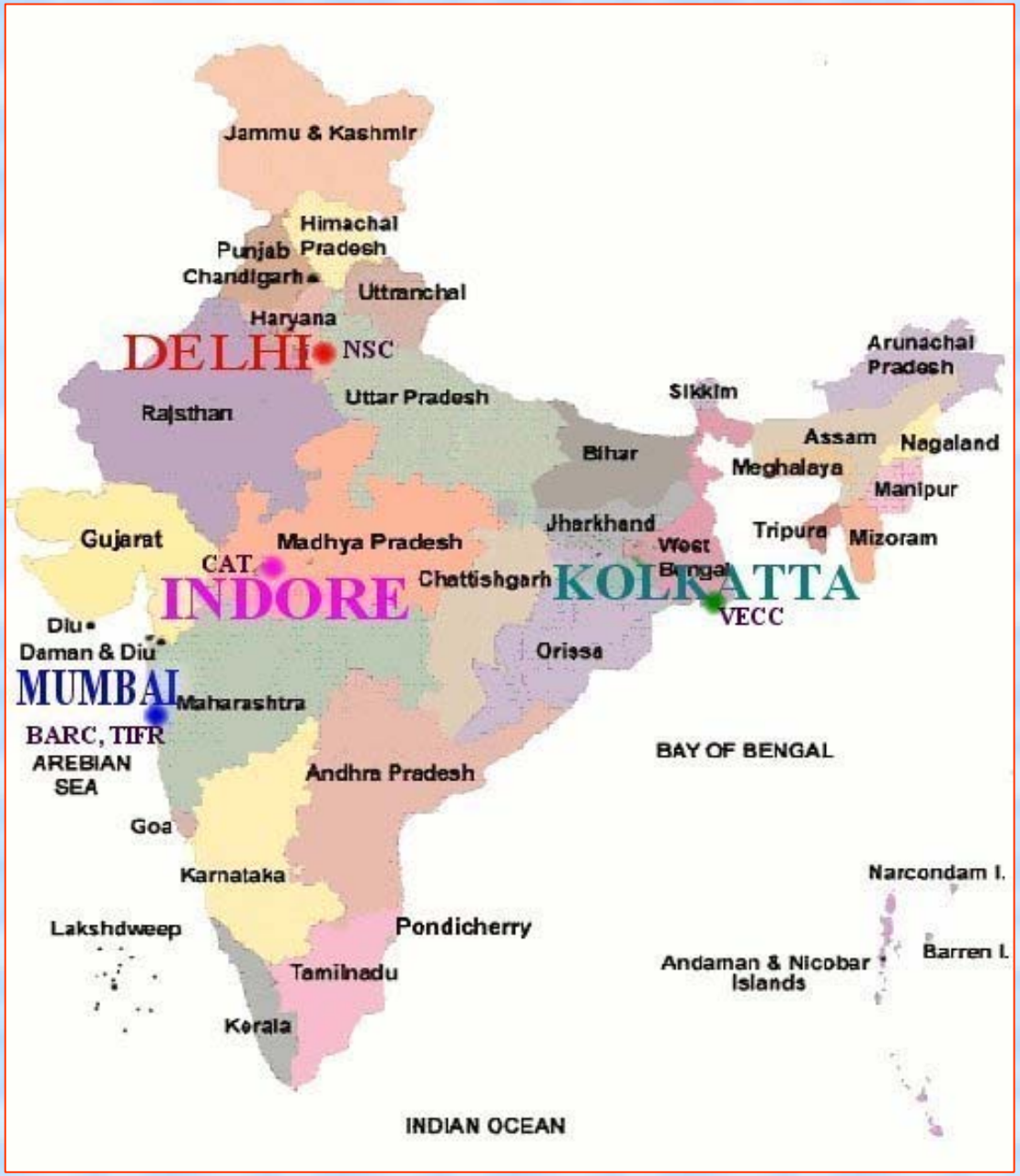
SRF ACTIVITES AT IUAC, NEW DELHI AND OTHER LABORATORIES IN INDIA



Amit Roy

Inter University Accelerator Centre, Aruna Asaf Ali Marg, P.O.Box 10502 New Delhi - 110 067, India

15UD Pelletron atIUAC, Delhi with Nb QWR based Superconducting Linac

14UD Pelletron at TIFR, Mumbai with Pb on Cu QWR based Superconducting Linac

R &D at RRCAT, Indore

Accelerator Augmentation at IUAC

Superconducting Linac booster

- Complete indigenous technology development
- Resonator fabrication facility set-up
- Large Cryogenic system
- RF electronics, synergy with National laboratories and industry
- Beam Transport systems

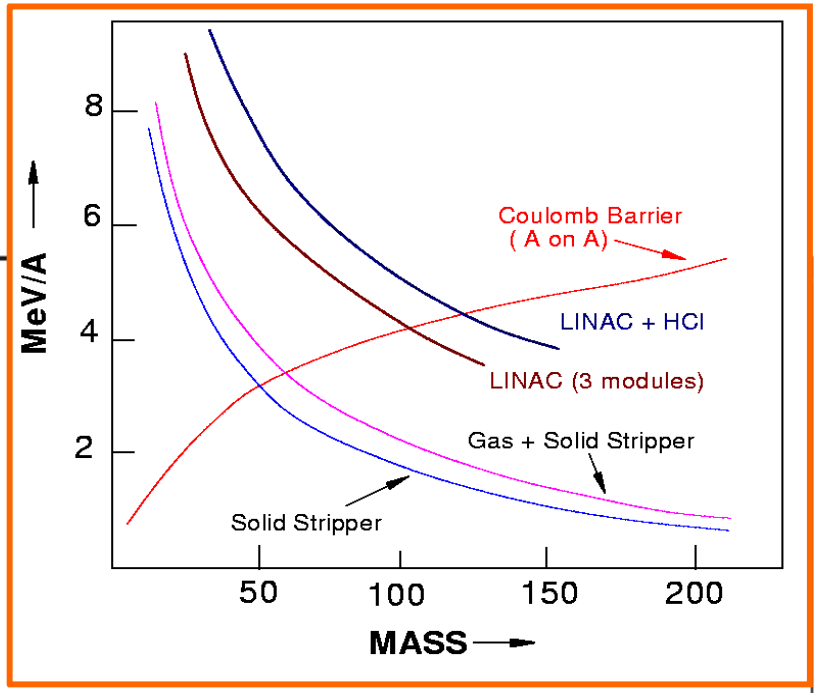
Low Energy Ion Beam Facility

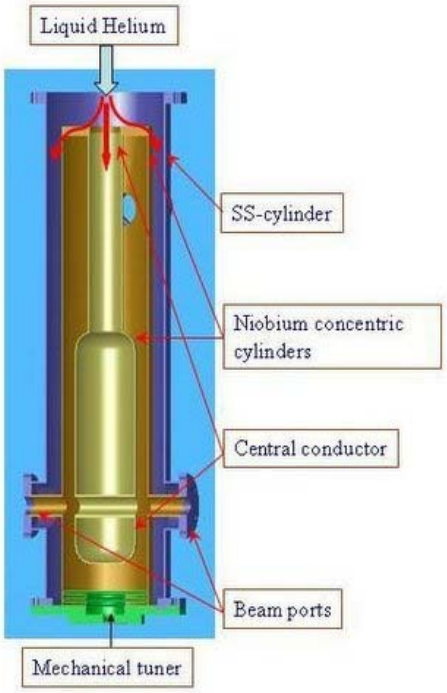
- Versatile facility for heavy ions , multiply charged ions down to few keV energy.

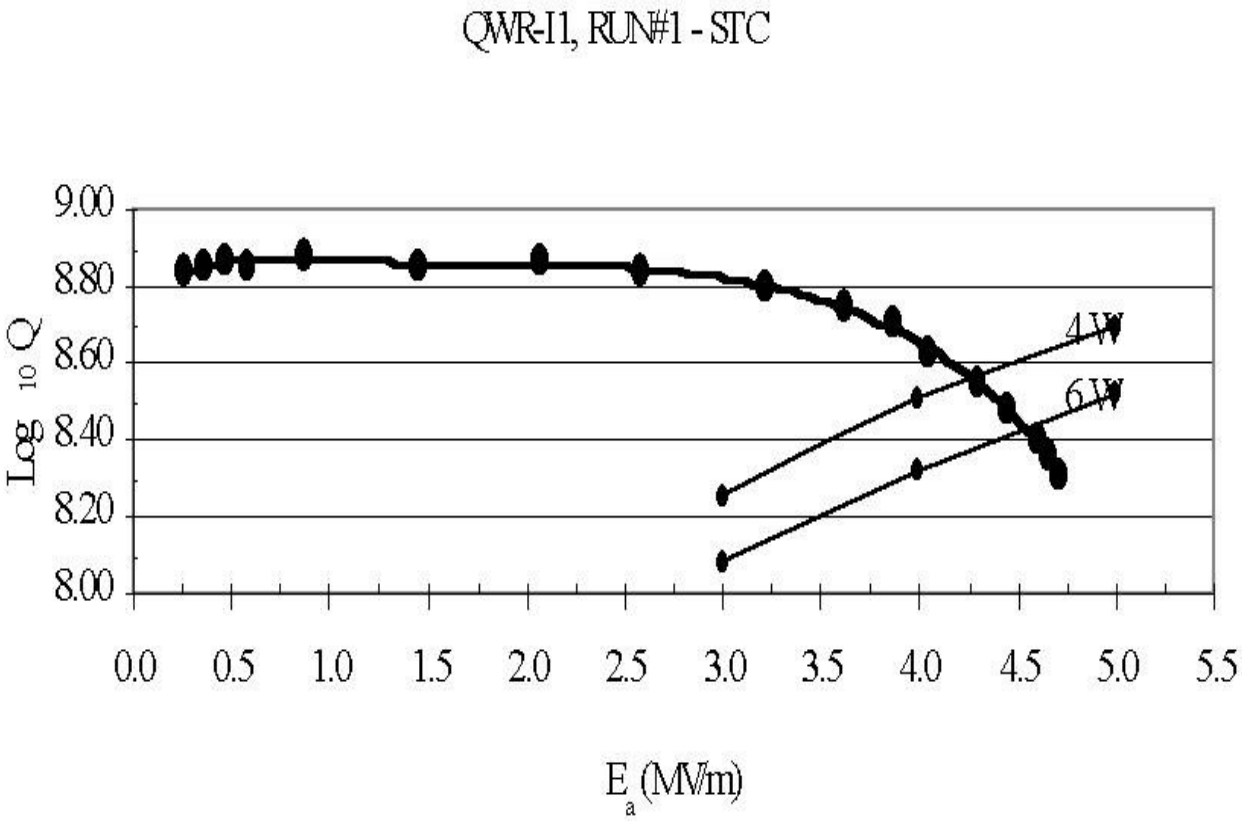
High Current Injector

- Novel Electron Cyclotron Resonance ion source using high Tc superconductor.
- Radio frequency quadrupole accelerator

Inter-University Accelerator Centre Pelletron & Linac Booster







One of the two fully indigenously fabricated resonators at IUAC along with its slow tuner bellows.

Several critical repair jobs of the cavities have also been undertaken.

EBW

VAC FURNACE

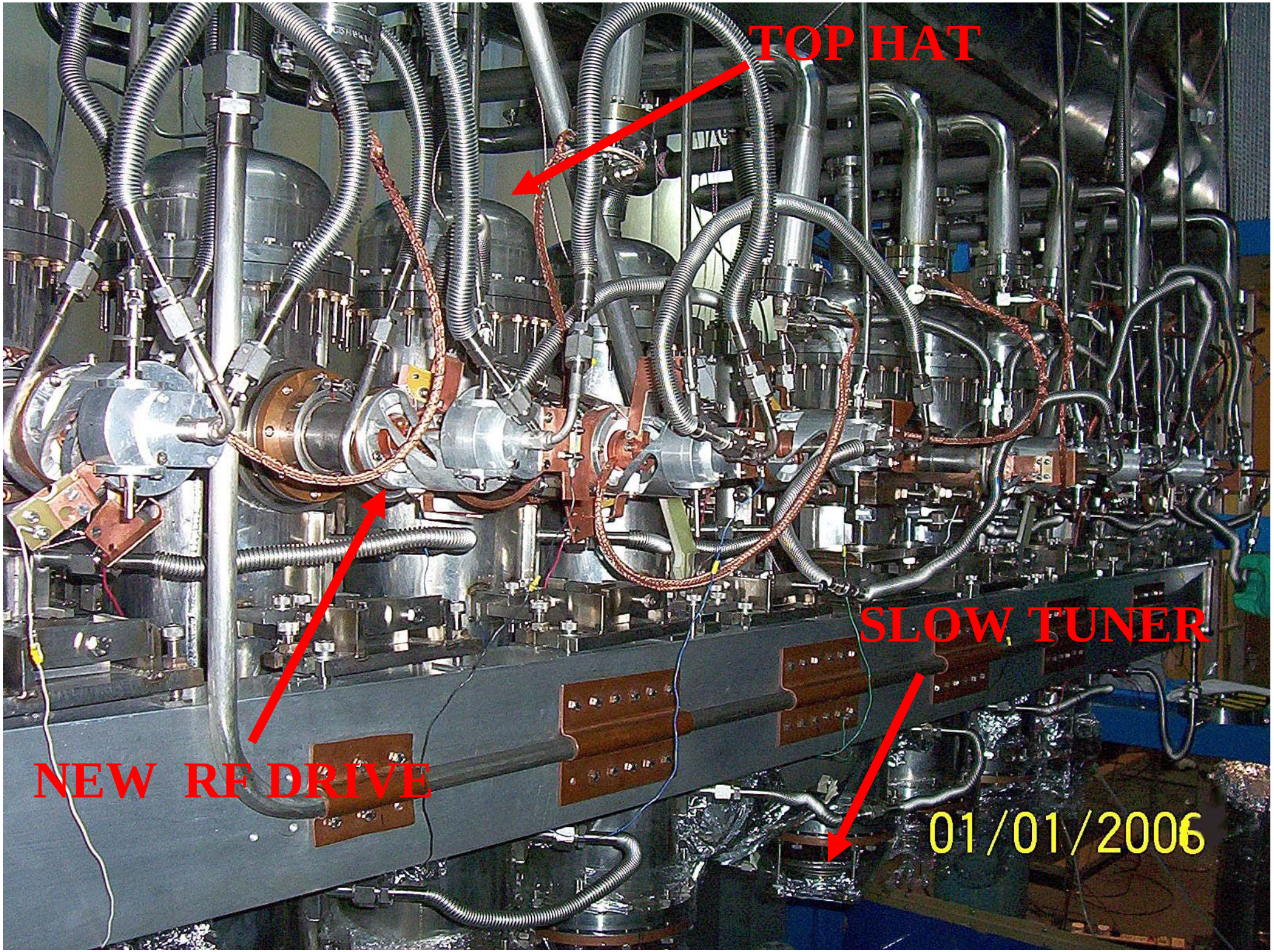
EP SET-UP

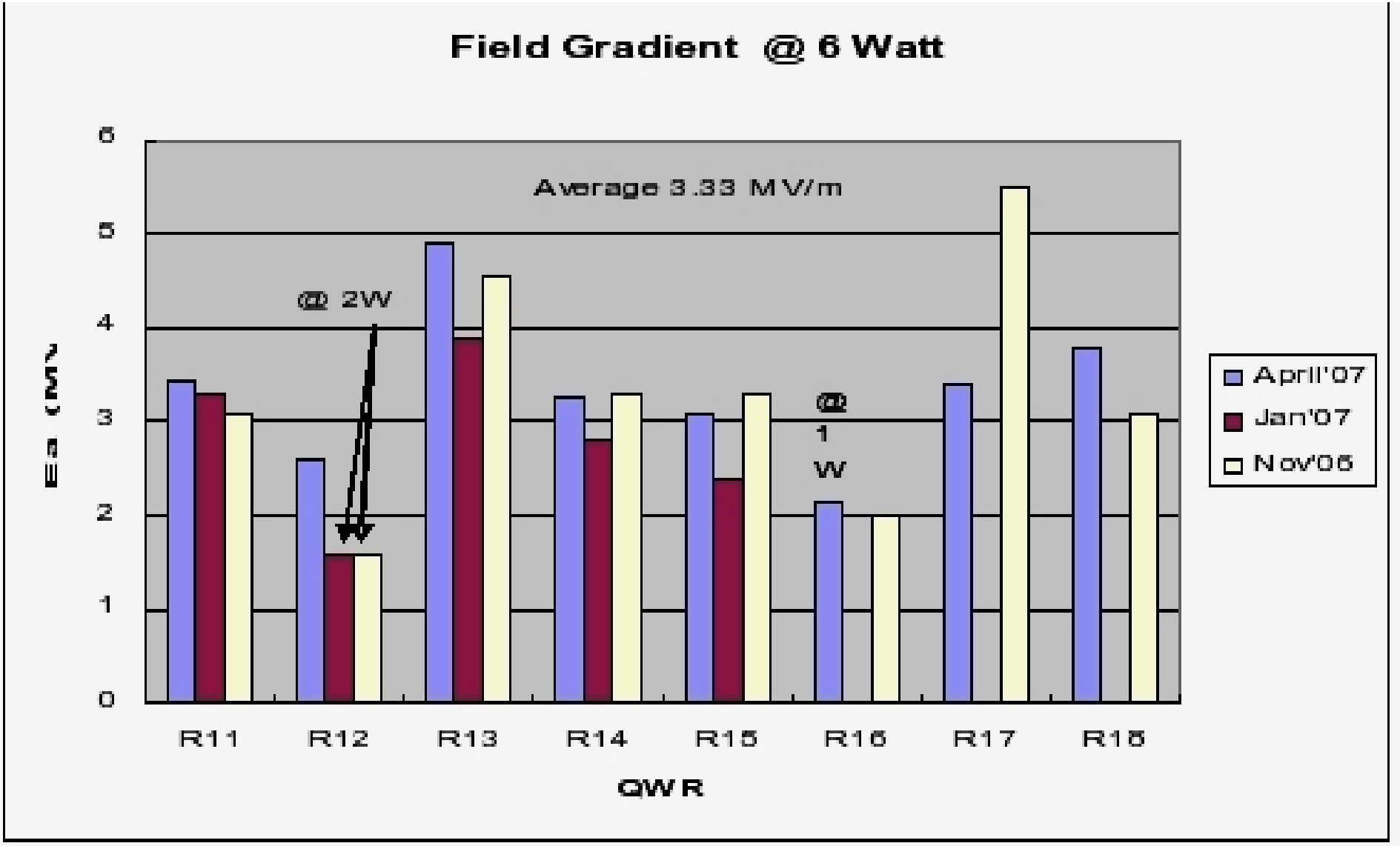
HPR

Test Cryostat

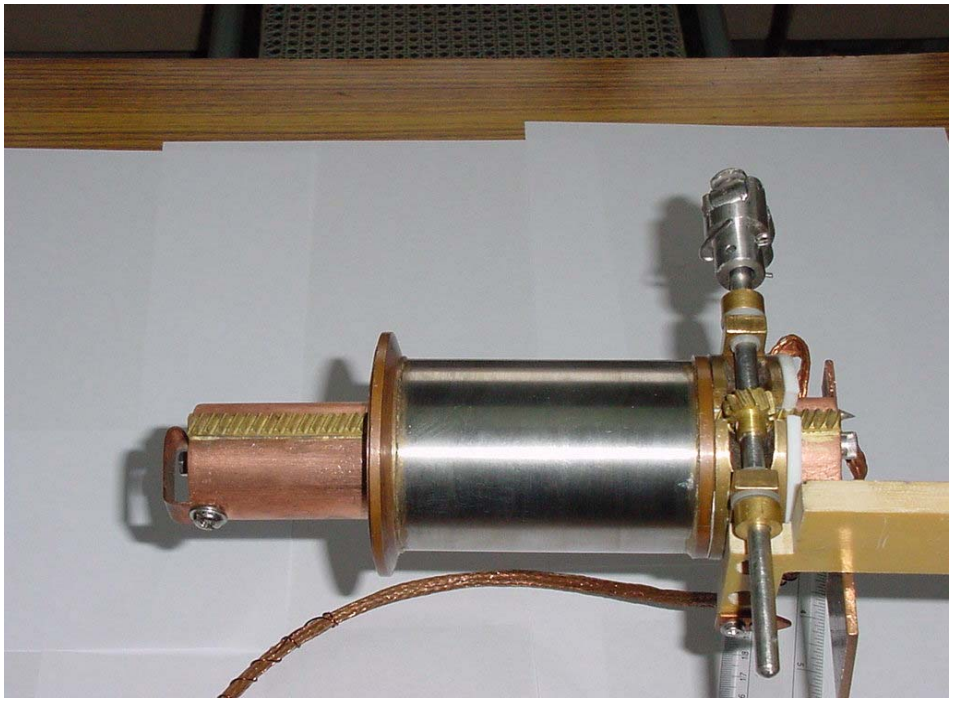
Parts of Nb QWR cavities

First Linac module with post-linac beam line. E_{gain} ~21 MeV for Si^{+10} beam with 5 resonators.


TOP HAT
SLOW TUNER
NEW RF DRIVE
01/01/2006


Field Gradient @ 6 Watt
Average 3.33 MV/m
@ 2W
@ 1 W
Ea (MV
0
1
2
3
4
5
6
R11
R12
R13
R14
R15
R16
R17
R18
QWR
April'07
Jan'07
Nov'06

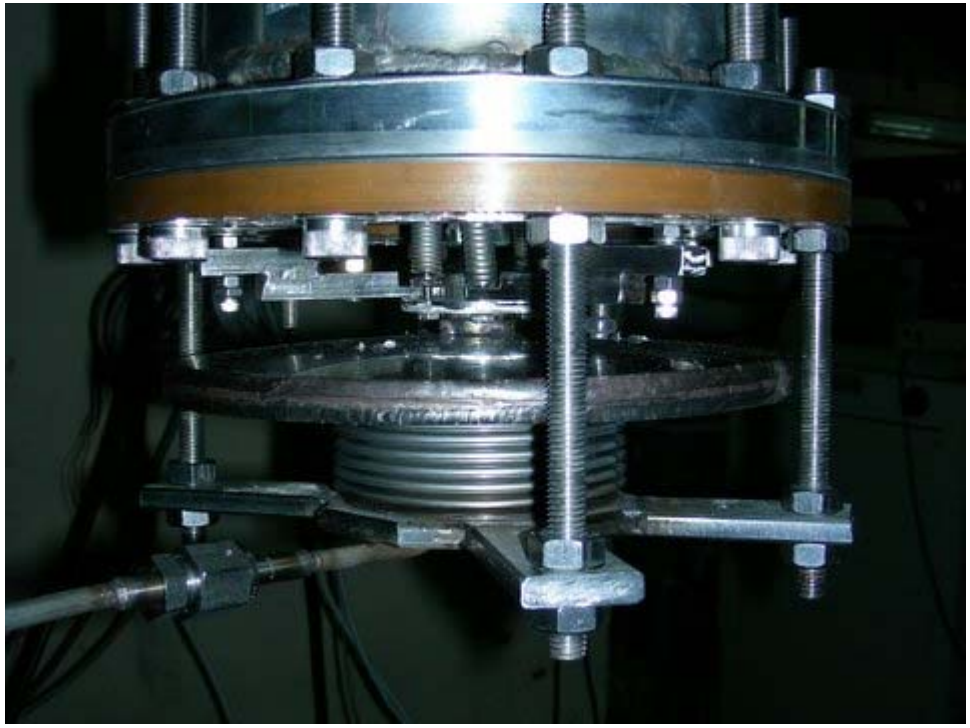
Rebuncher Cryostat



Old Drive

New Drive with linear & rotary motion

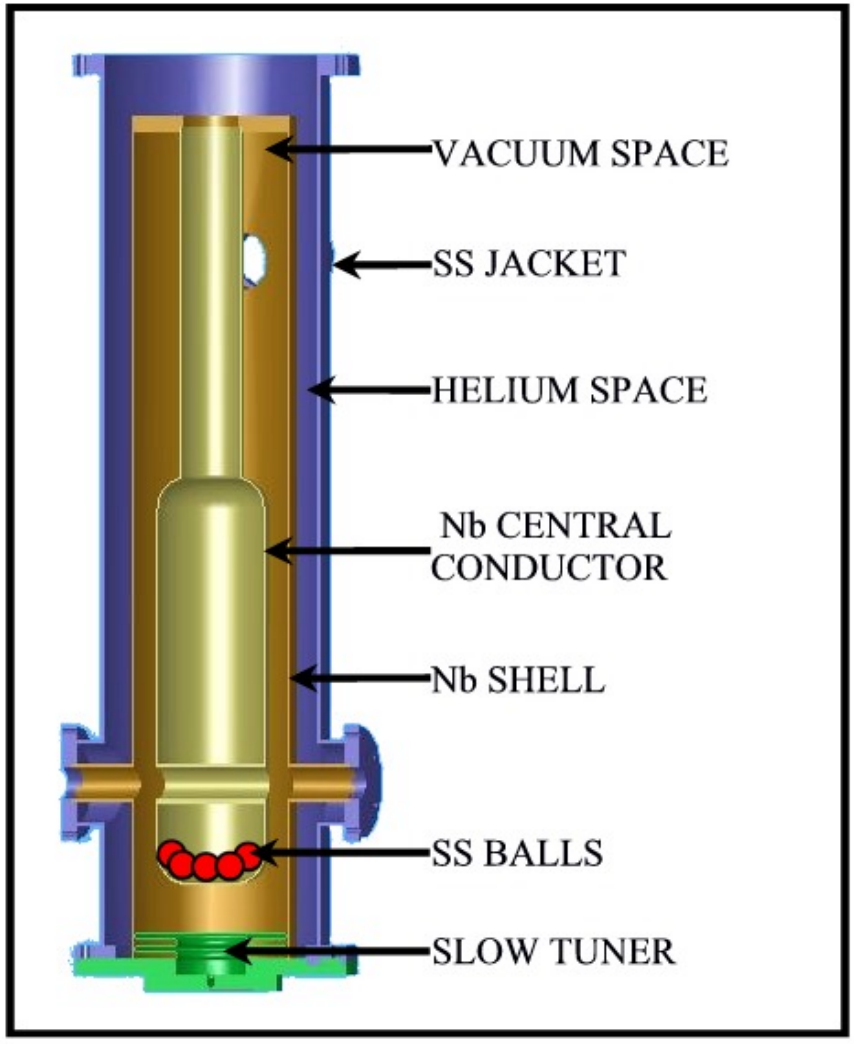
New Drive with rack & pinion outside

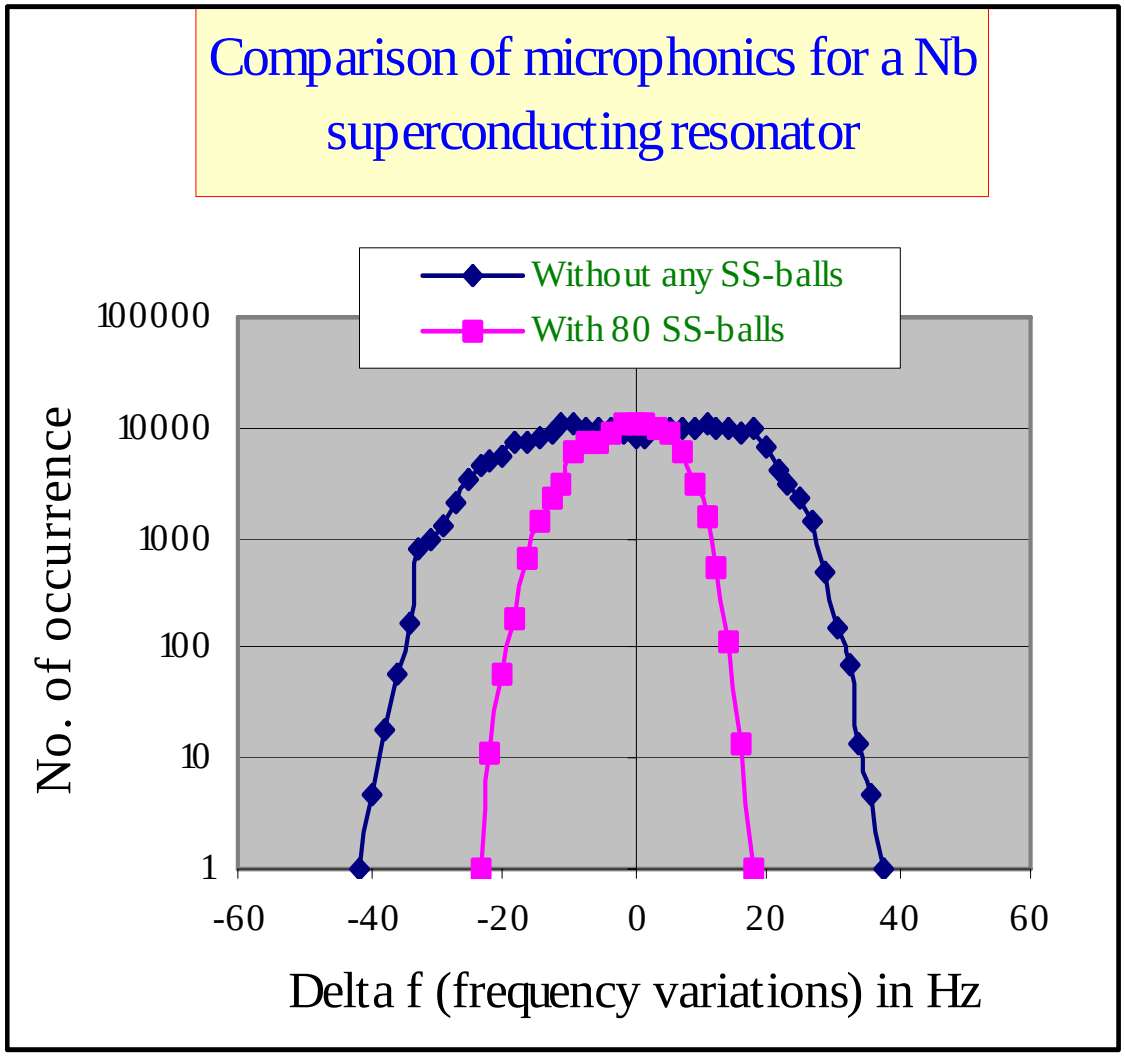


SS bellow for slow-tuner pneumatic control

- Use of formed, instead of welded, bellows appeared as an option.
- Tests with the new design are successful.

Damping of Mechanical vibrations of resonators studied.



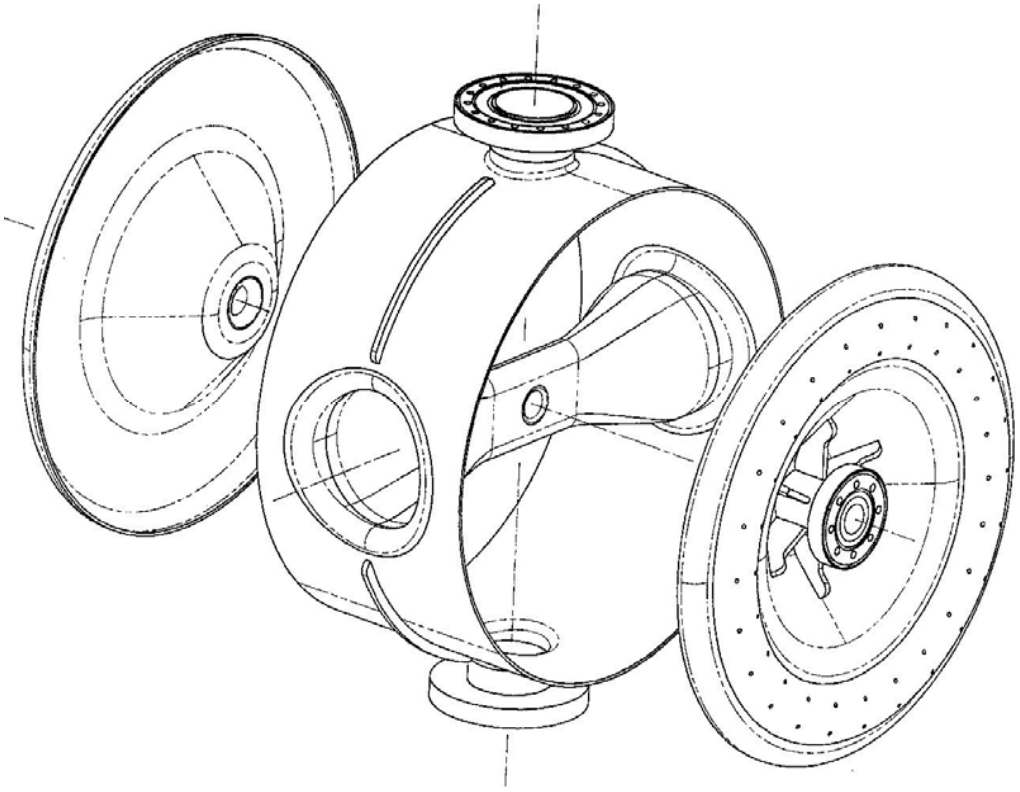


S.Ghosh, P.N.Patra, B.K.Sahu, A.Rai, G.K.Chaudhuri, A.Pandey, D.Kanjilal and A.Roy, Physical Review ST AB 10 (2007) 042002

NEW PROJECT

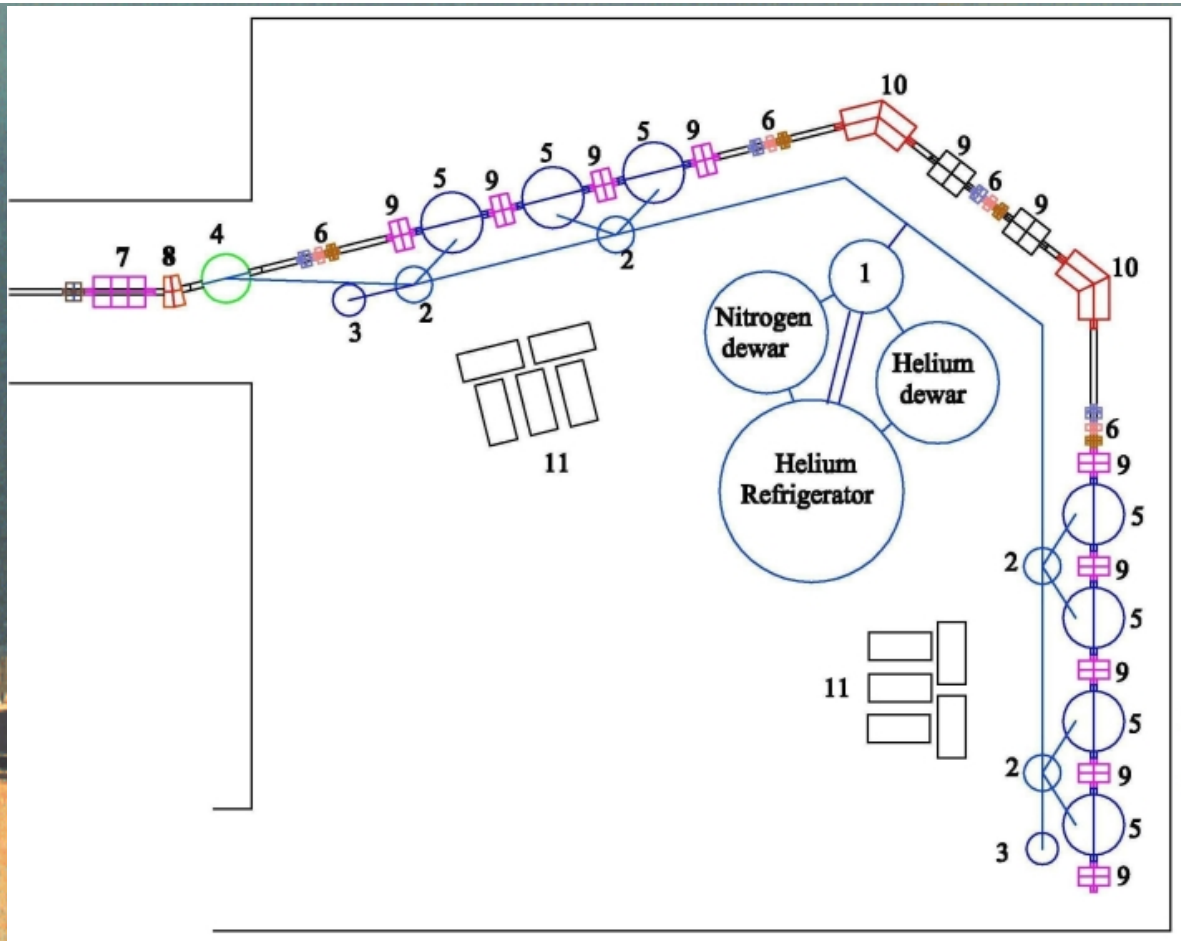
1. **Fabrication of 2 Single Spoke Resonators for Fermi Lab proton driver.**

β = 0.22



2. **Design and fabrication of β = 0.045, QWR for heavy ions for the HCI project.**

Schematic of Superconducting Linac booster at TIFR



1. MAIN DISTRIBUTION BOX
2. JUNCTION BOX
3. SHORTING BOX
4. SUPER BUNCHER
5. MODULAR CRYOSTAT
6. BEAM DIAGNOSTICS
7. QUADRUPOLE TRIPLET
8. 14° DIPOLE MAGNET
9. QUADRUPOLE DOUBLET
10. 52° MAGNET
11. ELECTRONICS RACK

SCHEMATIC LAYOUT OF LINAC HALL

Pelletron accelerator

– E/A ~ 3-7 MeV, β ~ 0.08-0.12

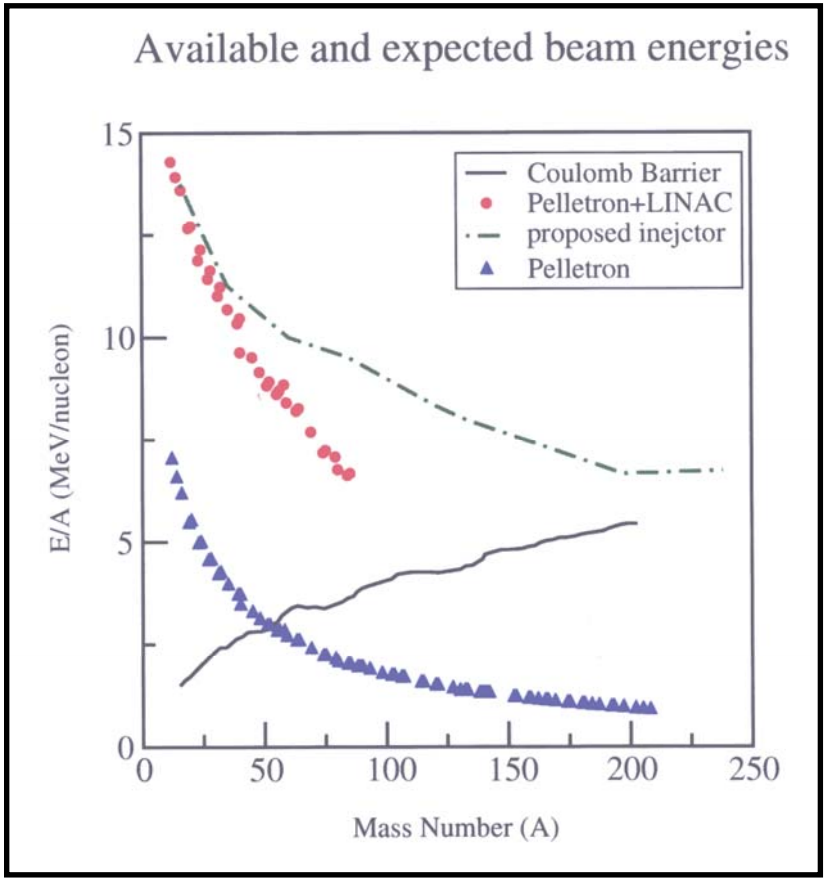
– Heavy ions reactions upto A ~ 40

Superconducting Linac booster

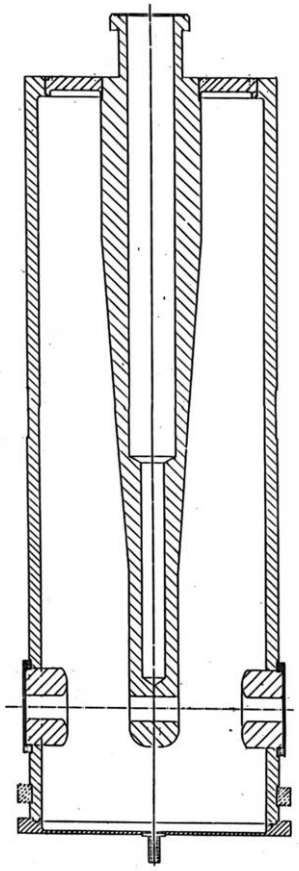
– E/A ~ 5-12 MeV, β ~ 0.10-0.16

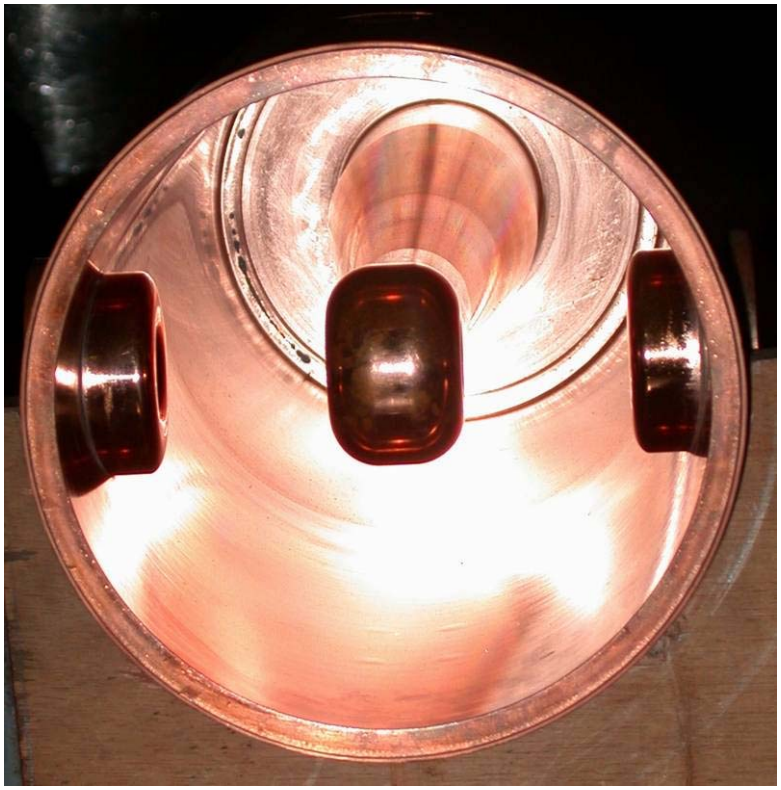
– Heavy ions reactions upto A ~ 80
(limited by pre-accelerator)

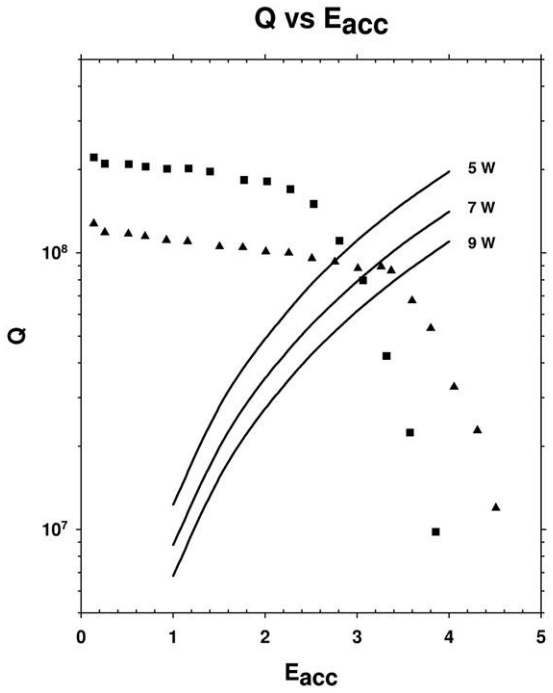
– Beam intensity: 0.1-10 pnA ($10^{9\text{-}11}$ p/s)
(limited by ion source)



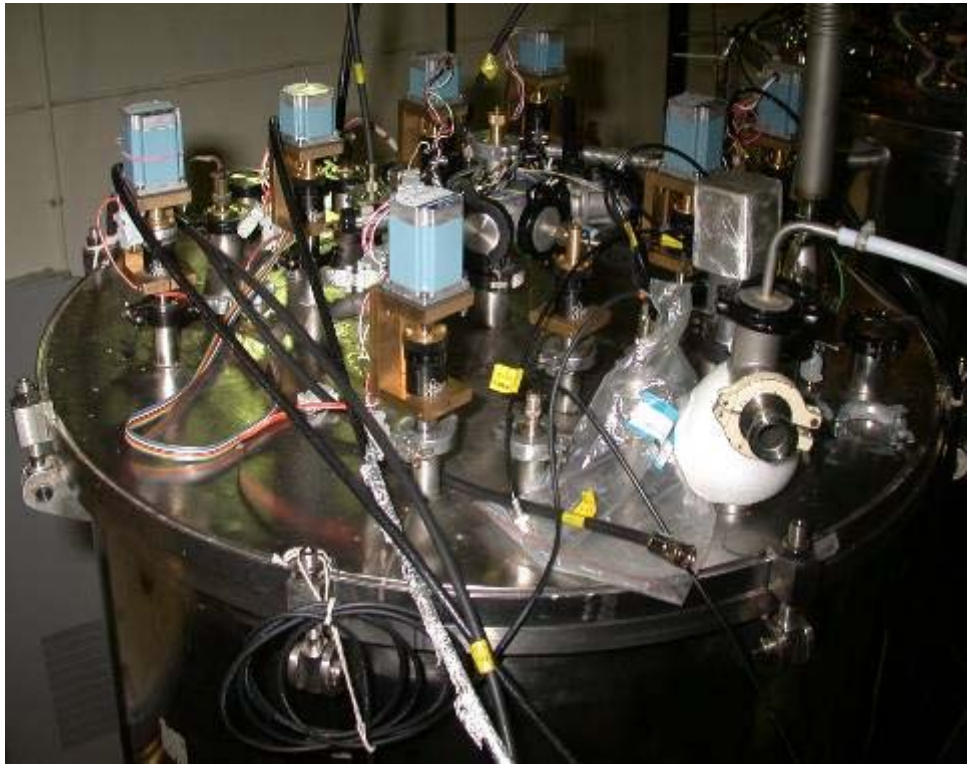
(Pb plated Cu Quarter Wave Resonator)

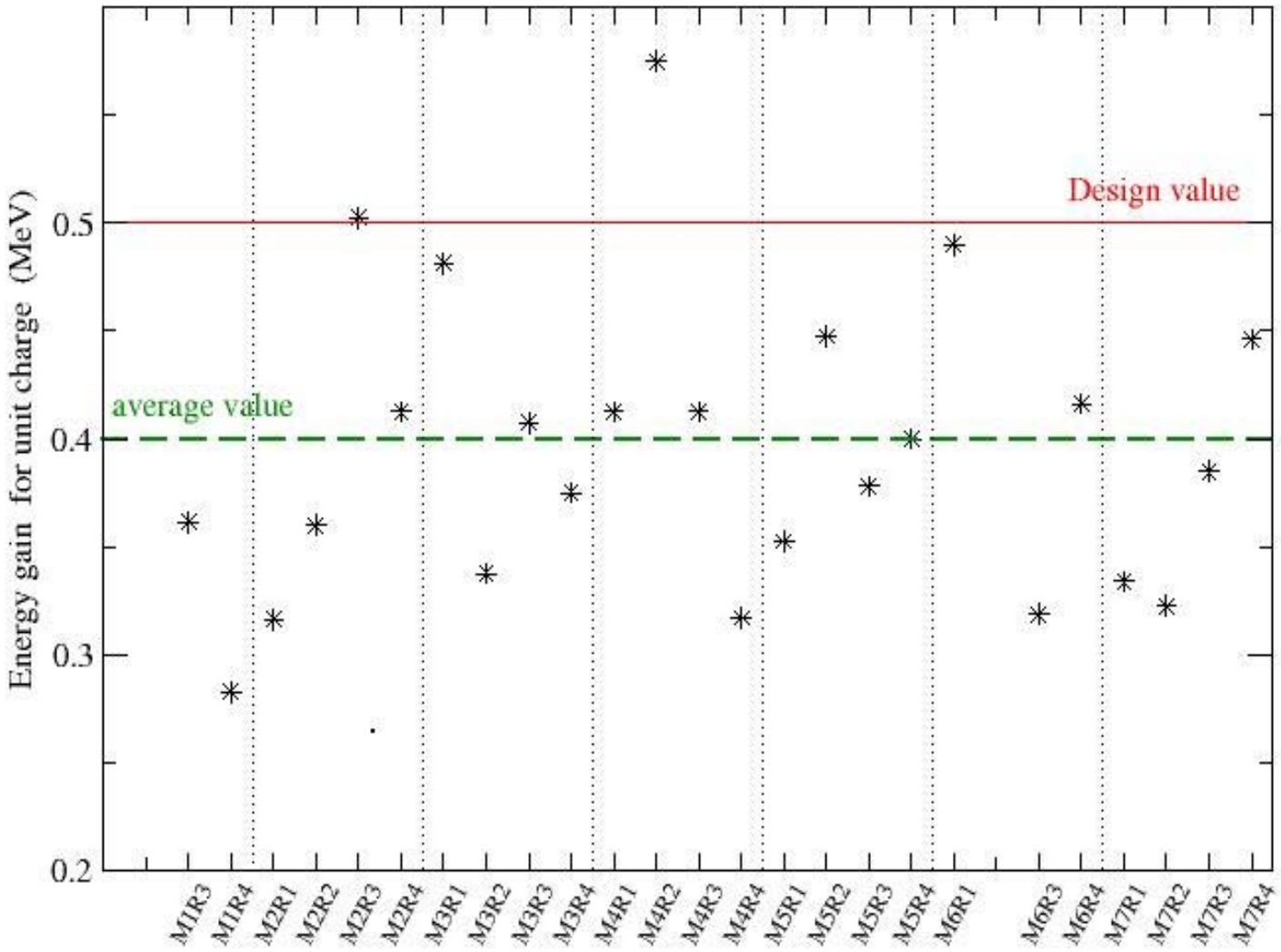


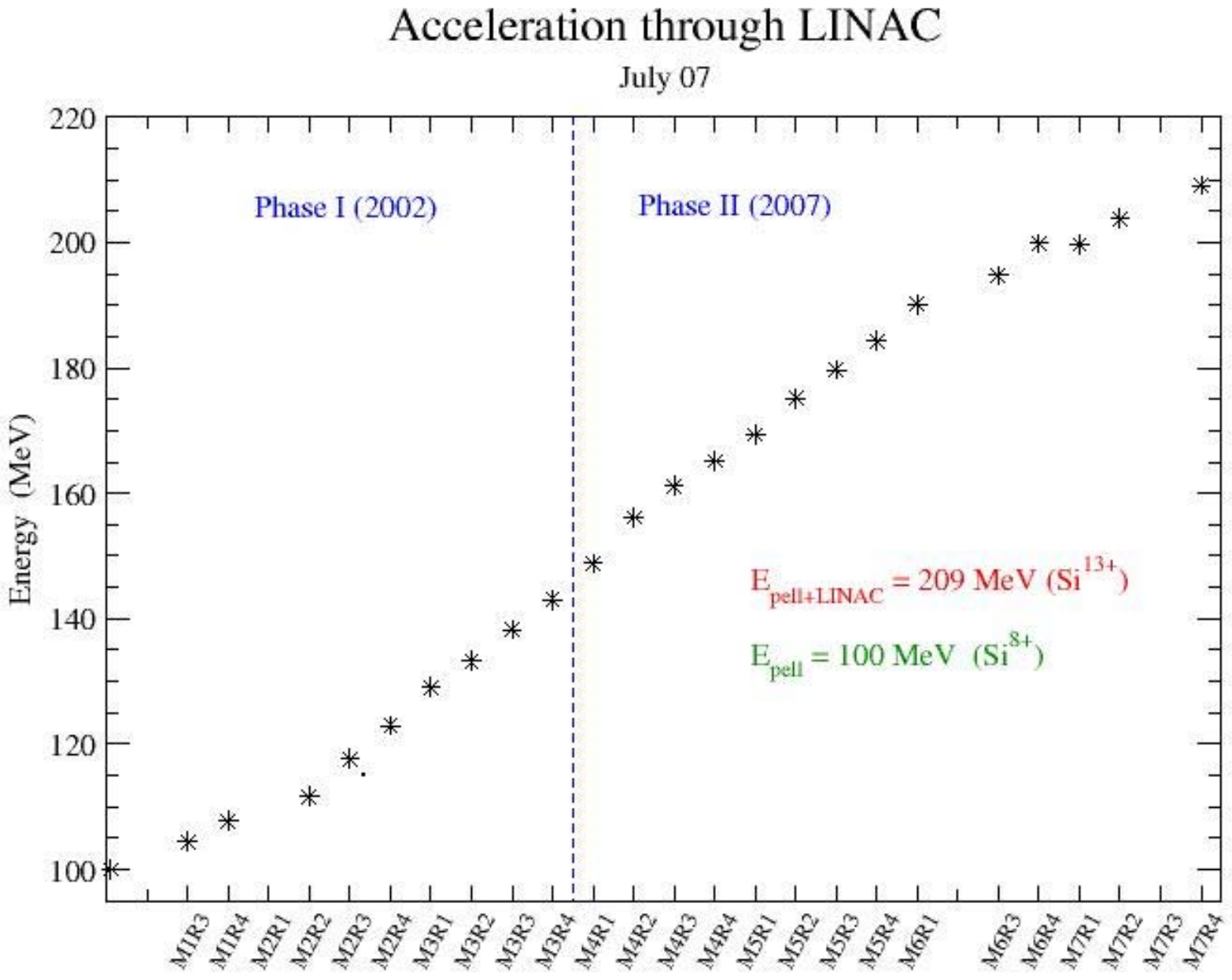




Top view of the module




Acceleration through LINAC
July 07
Energy gain for unit charge (MeV)
0.5
0.4
0.3
0.2
Design value
average value
M1R3
M1R4
M2R1
M2R2
M2R3
M2R4
M3R1
M3R2
M3R3
M3R4
M4R1
M4R2
M4R3
M4R4
M5R1
M5R2
M5R3
M5R4
M6R1
M6R3
M6R4
M7R1
M7R2
M7R3
M7R4


Acceleration through LINAC
July 07
Energy (MeV)
220
200
180
160
140
120
100
Phase I (2002)
Phase II (2007)
E pell+LINAC = 209 MeV (Si 13+)
E pell = 100 MeV (Si 8+)
M1R3
M1R4
M2R1
M2R2
M2R3
M2R4
M3R1
M3R2
M3R3
M3R4
M4R1
M4R2
M4R3
M4R4
M5R1
M5R2
M5R3
M5R4
M6R1
M6R3
M6R4
M7R1
M7R2
M7R3
M7R4

R&D on Superconducting Materials Relevant for Accelerators: Program at RRCAT, Indore

Questions being asked:

Is there any definite dependence of $H_{critical}$ on,

- the methods of sample preparation, grain size ?
- the surface treatment– EP versus BCP ?
- the annealing temperature and time ?

Experimental tools used:

Magnetometry : SQUID magnetometer and VSM.

Surface studies : SEM.

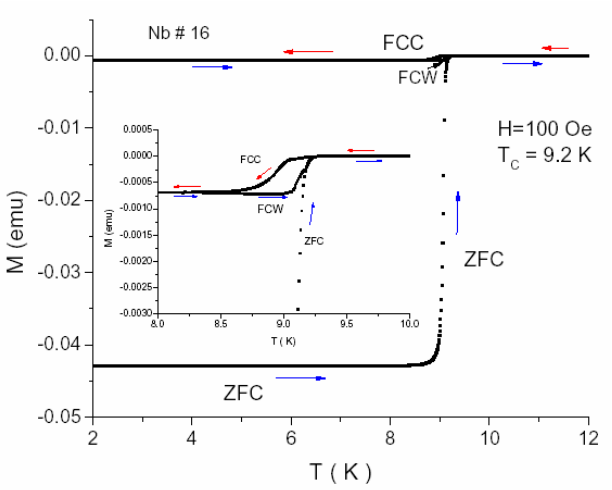
Thermal properties– thermal conductivity & Sp. Heat.

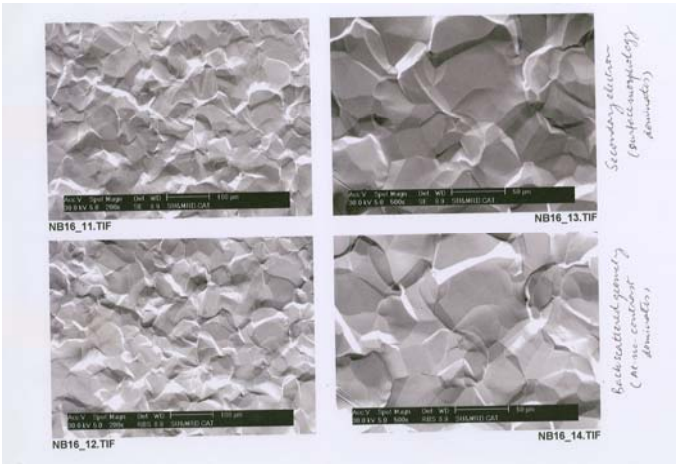
RF surface resistance measurement: Future plan.

Buffered chemically polished (BCP) samples of Niobium obtained from Fermi Lab, USA:

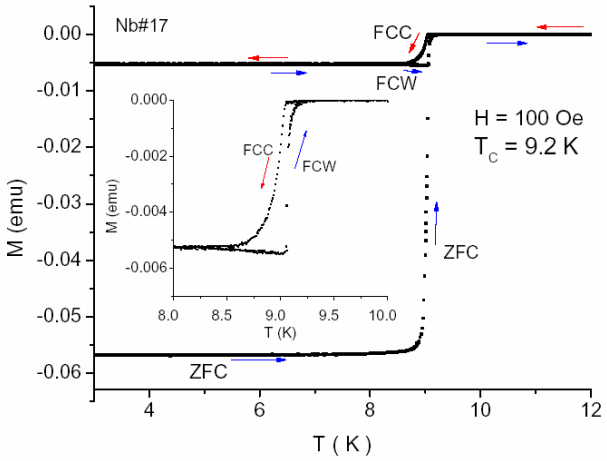
Magnetization versus temperature plots & SEM results

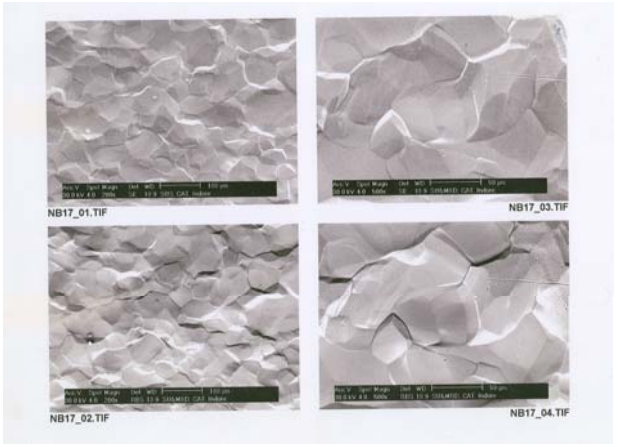
Sample # 16
Avg grain size
~ 30-35 Micron





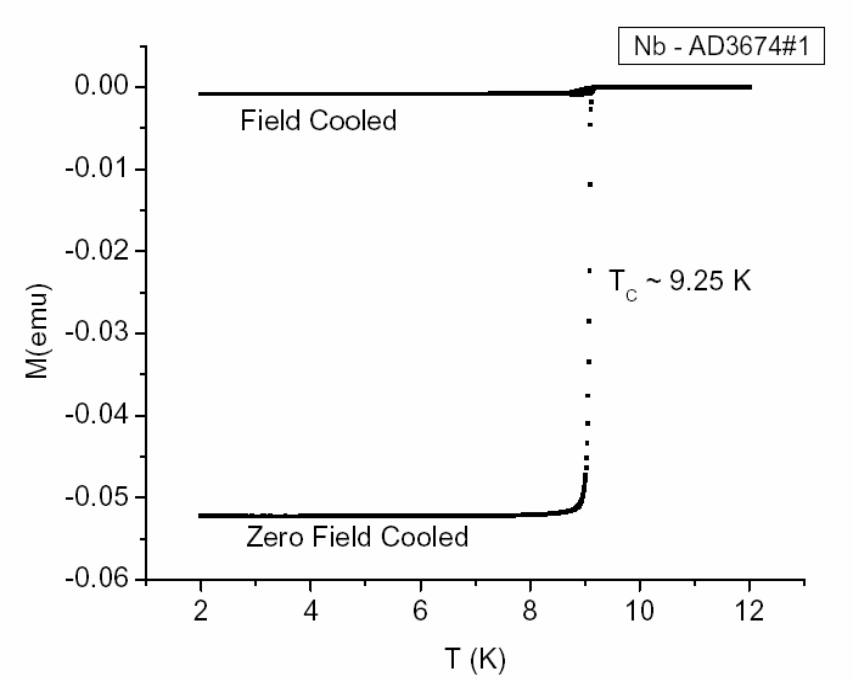
Sample # 17
Avg grain size
~ 40-45 micron



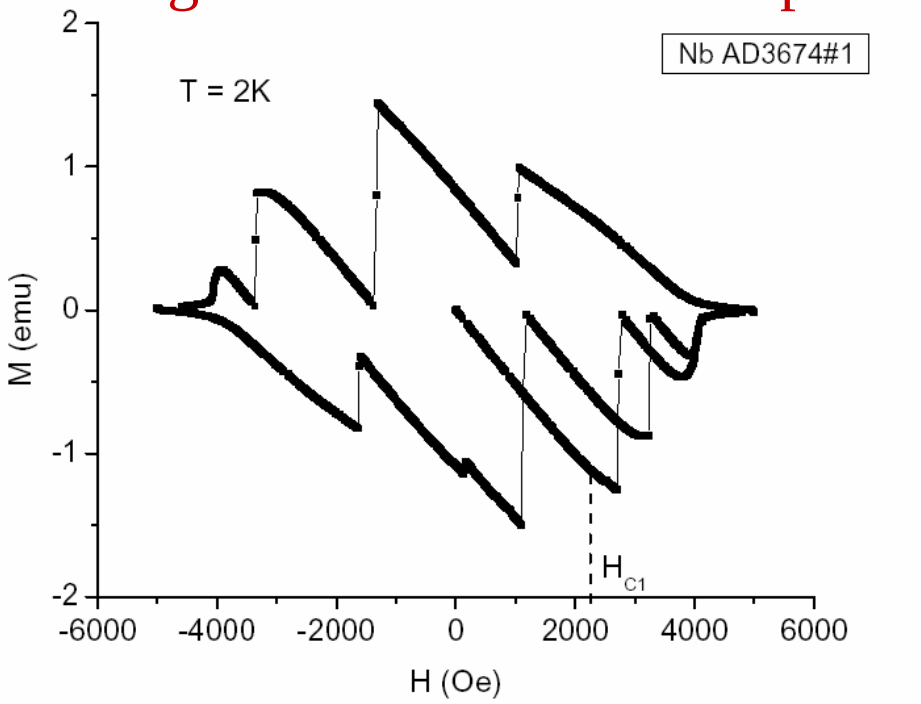


Large grain Niobium from Jefferson Lab

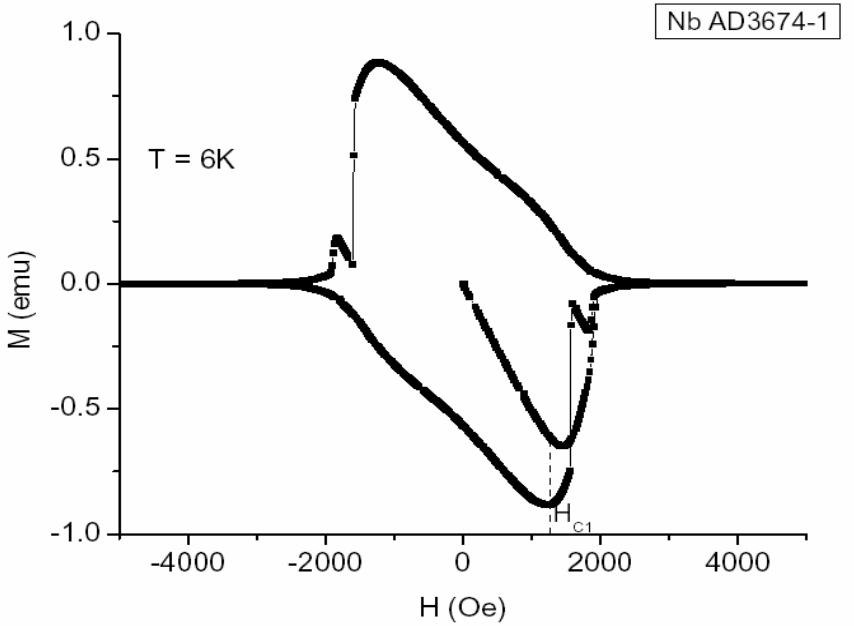
Applied H = 100 Oe



Magnetization versus field plots



Note H_{C1} ~ 2100 Oe at 2K



Note H_{C1} ~ 1200 Oe at 6K

Conclusion from these test results :

- Estimated H_{C1}: Polycrystalline samples from Fermilab

grain size 30-35μ → H_{C1}~1100 Oe. T=5K

grain size 40-45μ → H_{C1}~1000 Oe. T=4K

- Preliminary results indicate a slightly higher H_{C1} (1200 Oe at 6K) for the large grain (~ 1 mm) sample from Jefferson Lab.

- Presence of defects in the material leads to large hysteresis in M-H curves above $H_{C1.}$. However, this may not affect the RF response below H_{C1}.

Future Plans for RRCAT

Facility for Superconducting RF cavity fabrication and processing.

Build a 40 MeV electron linac for IR photons.


Thank You for Your Attention!