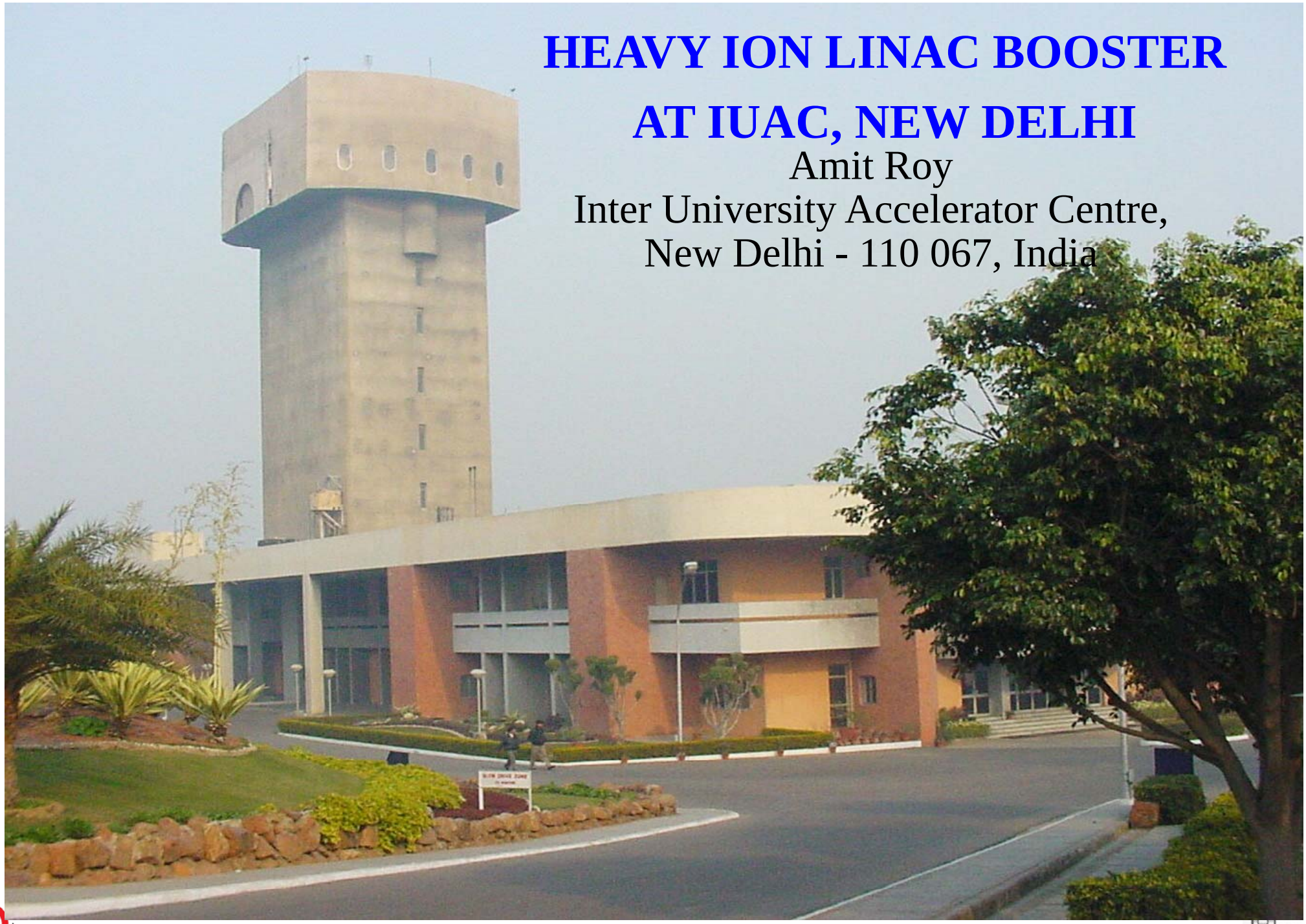
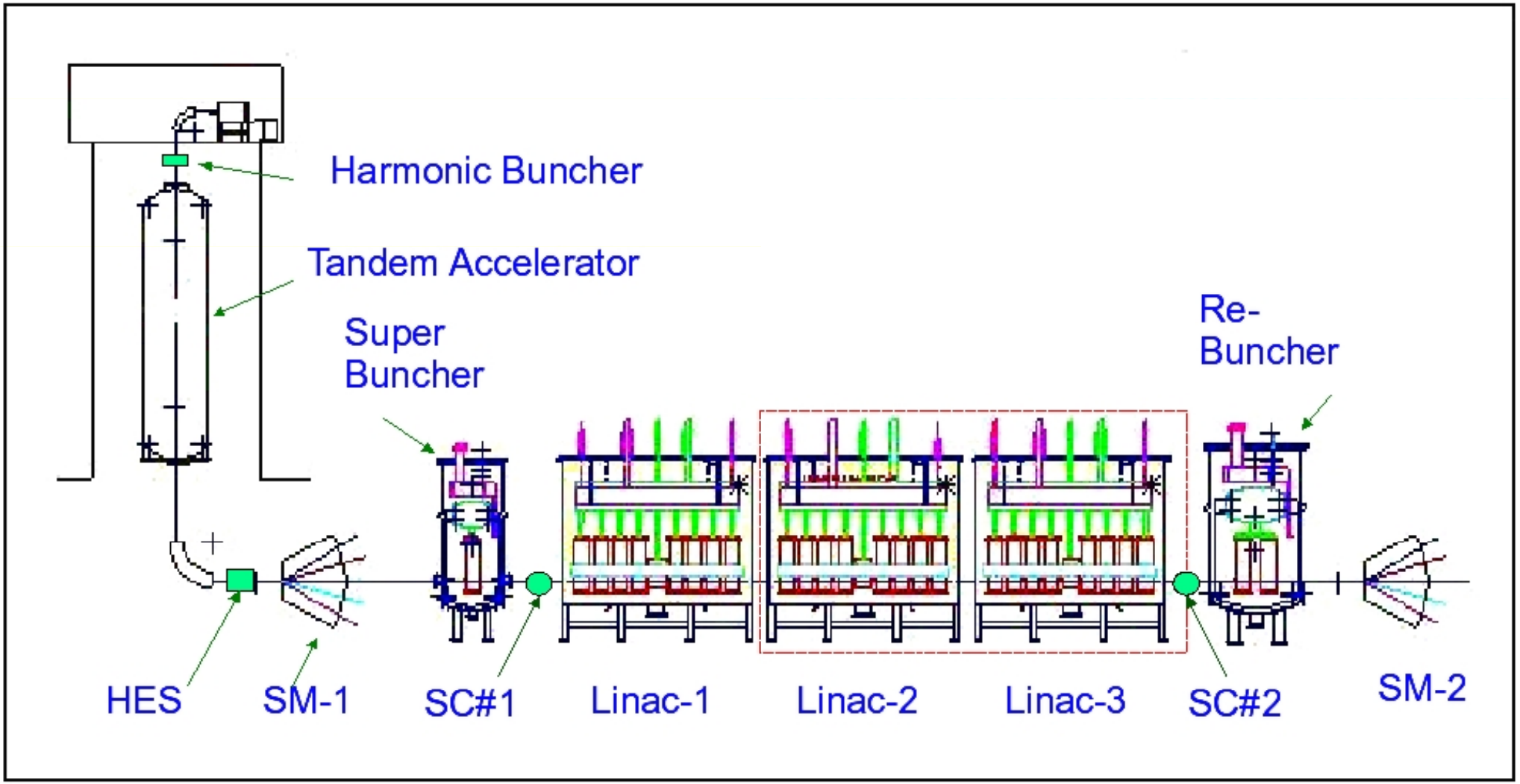


HEAVY ION LINAC BOOSTER AT IUAC, NEW DELHI

Amit Roy
Inter University Accelerator Centre,
New Delhi - 110 067, India

2 Oct 2008

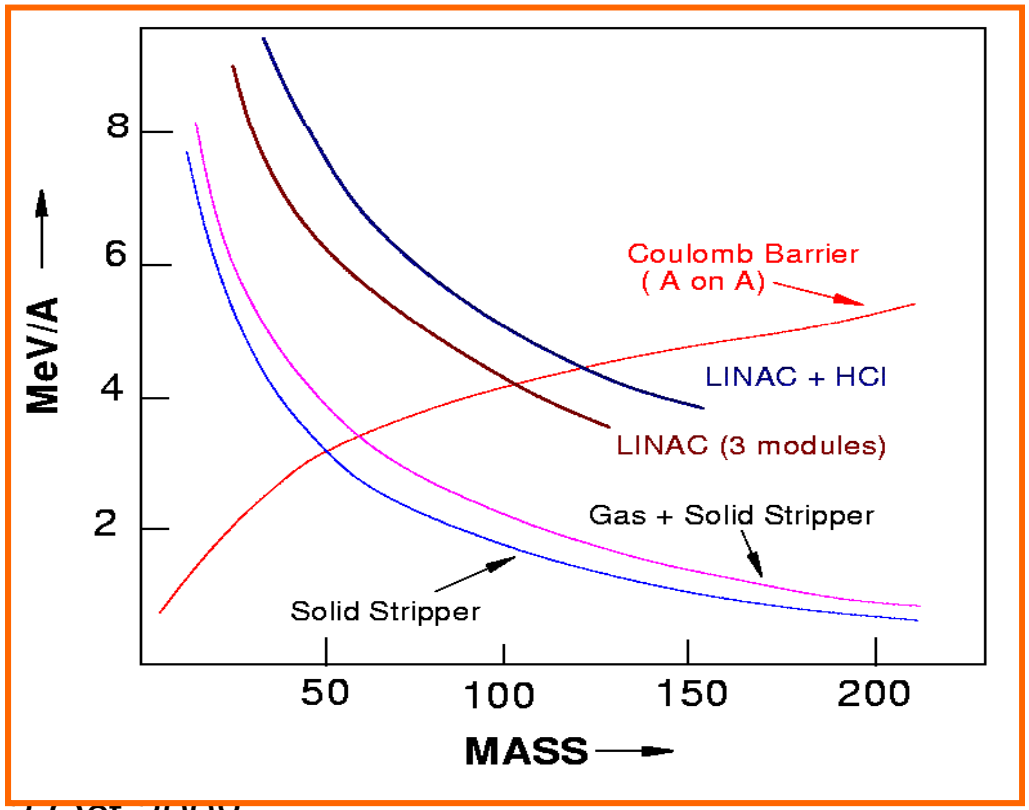
Schematic of 15UD Pelletron and Linac Booster

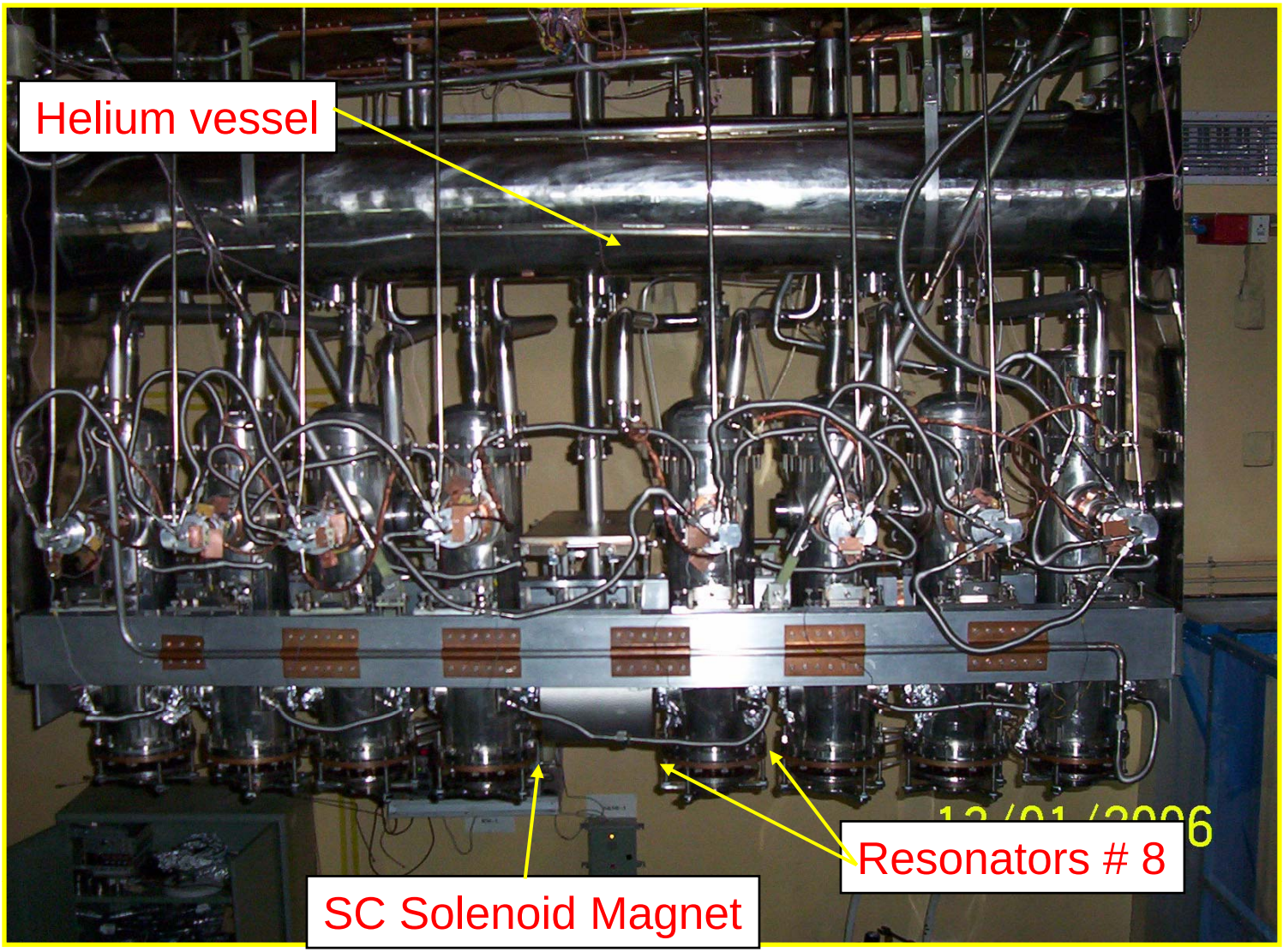


The Accelerator system of IUAC

- **Equipped with a Electrostatic Accelerator (Pelletron)**
  - **Deliver dc (continuous) beam or bunched beam**
  - **Beam species cover almost the whole periodic table**
  - **Energy from few tens to few hundred of MeV**
  - **Beam is utilized to do research in Nucl. Phys, Material science, Biophysics, Atomic Physics etc.**

- **But there is always a demand for more energy**





Cryostat dimension:

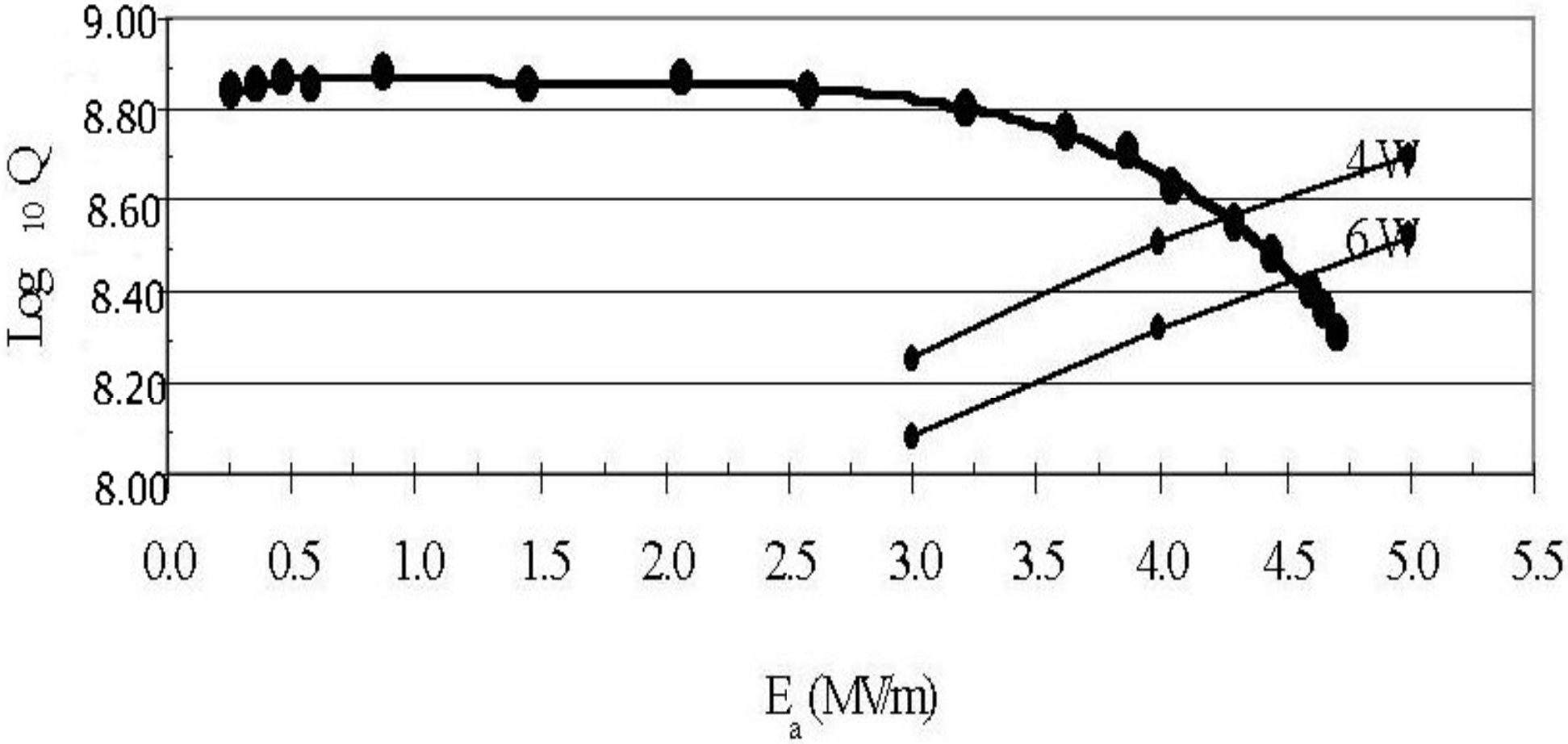
Length = 2.3 m
Height = 1.3 m
Width = 1.1 m

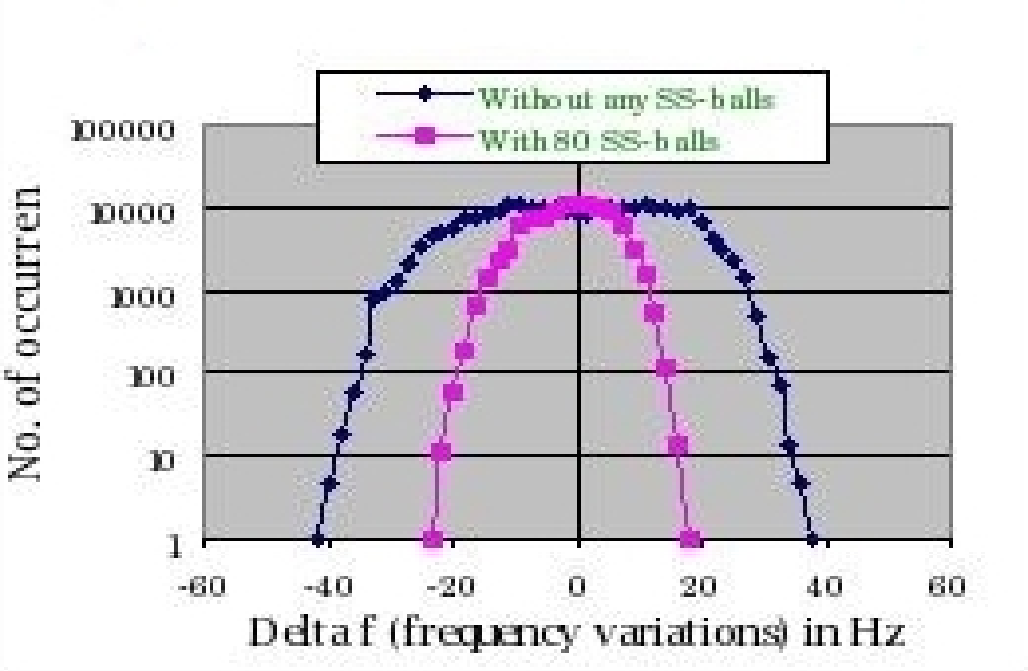
Eight resonators and solenoid in Linac cryostat # 1

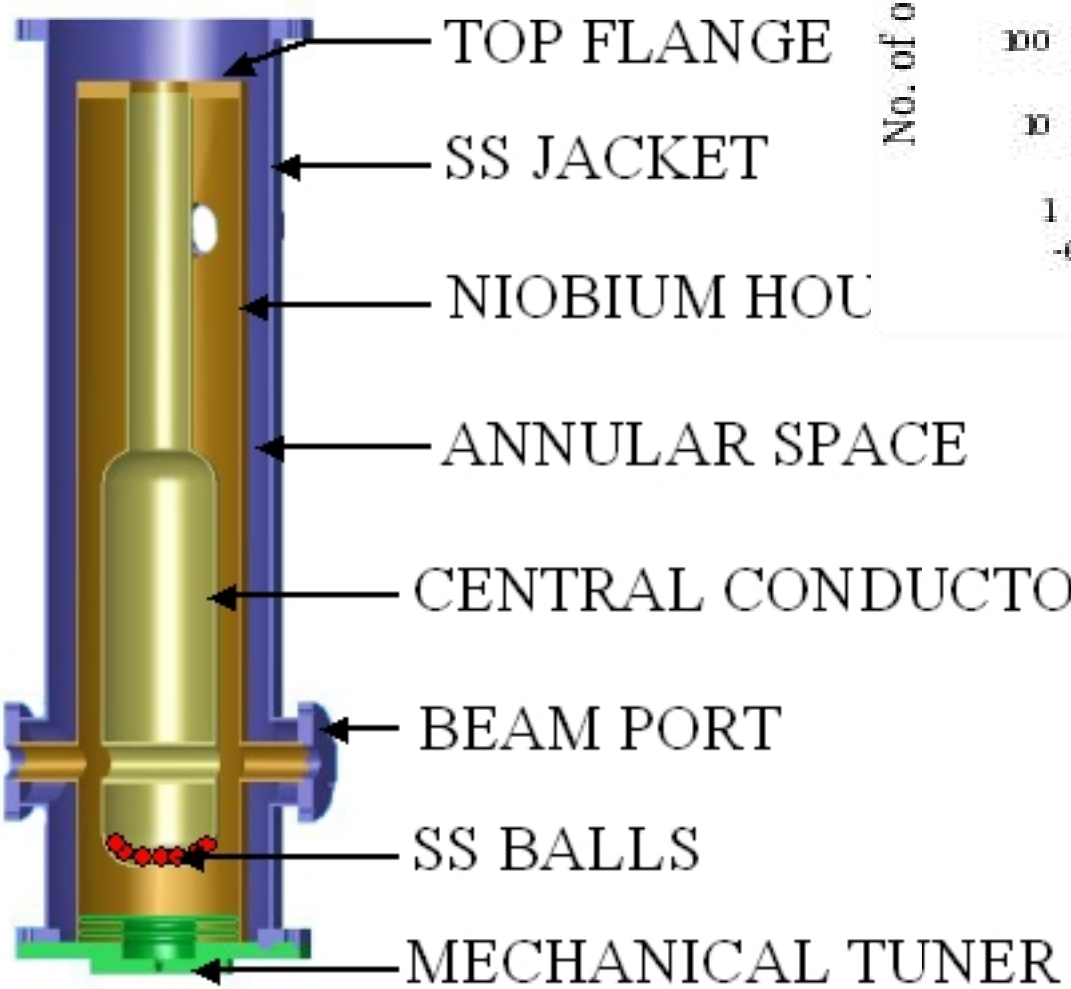
Indigenously built niobium quarter wave resonator with slow tuner bellows at IUAC.

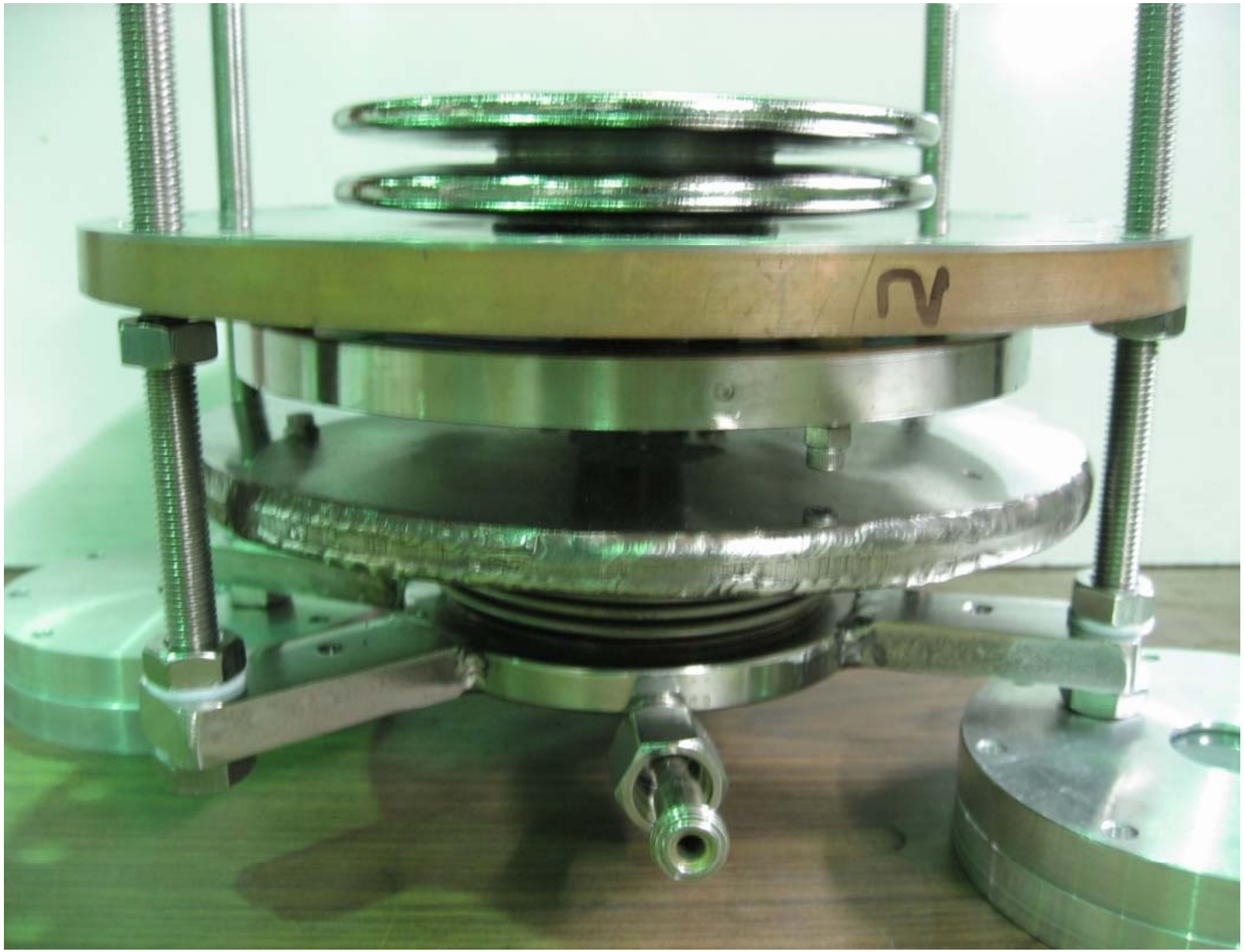
Resonant Frequency	**97MHz**
Synchronous velocity	**0.08c**
Drift tube Voltage	**85kV**
Energy Content	**110 mJ**
Peak Magnetic field	**106 G**
Peak Electric field	**3.9MV/m**
Geometric factor	**17.3**
Active length	**15.9 cm**

Parts of Nb QWR for modules 2 & 3


9.00
8.80
8.60
8.40
8.20
8.00
Log 10 Q
4W
6W
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
E a (MV/m)


Without any SS-balls
With 80 SS-balls
No. of occurren
100000
10000
1000
100
10
1
-60
-40
-20
0
20
40
60
Delta f (frequency variations) in Hz


TOP FLANGE
SS JACKET
NIOBIUM HOU
ANNULAR SPACE
CENTRAL CONDUCTOR
BEAM PORT
SS BALLS
MECHANICAL TUNER



Modified Slow Tuner with ss bellows

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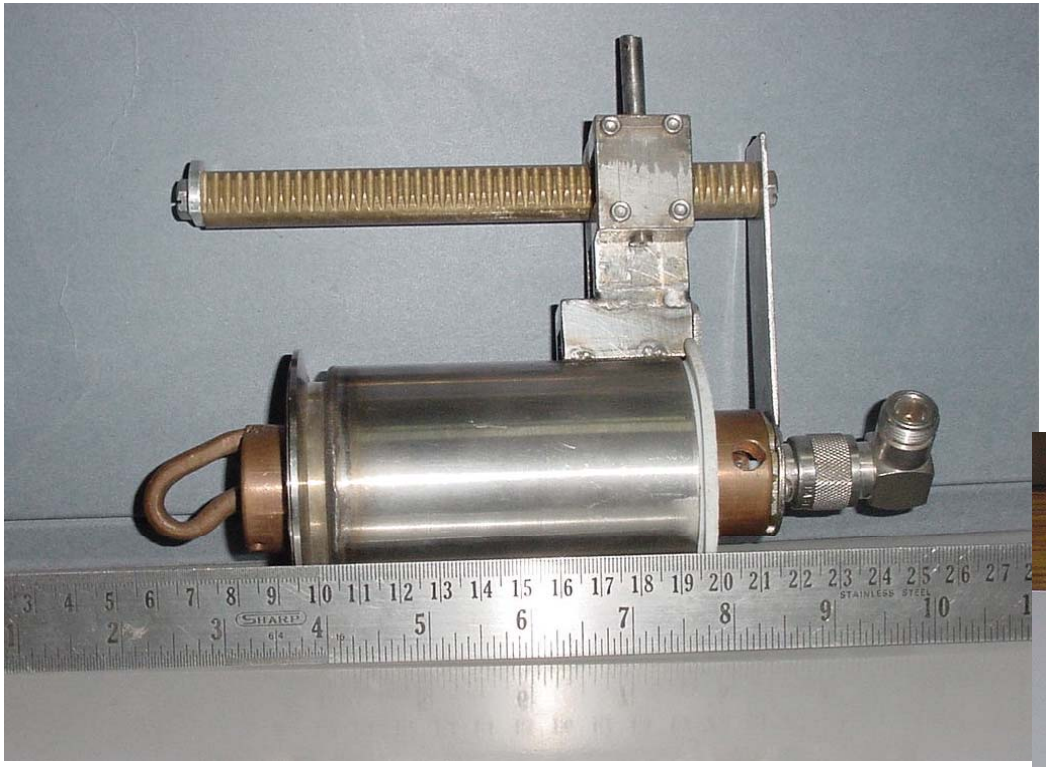
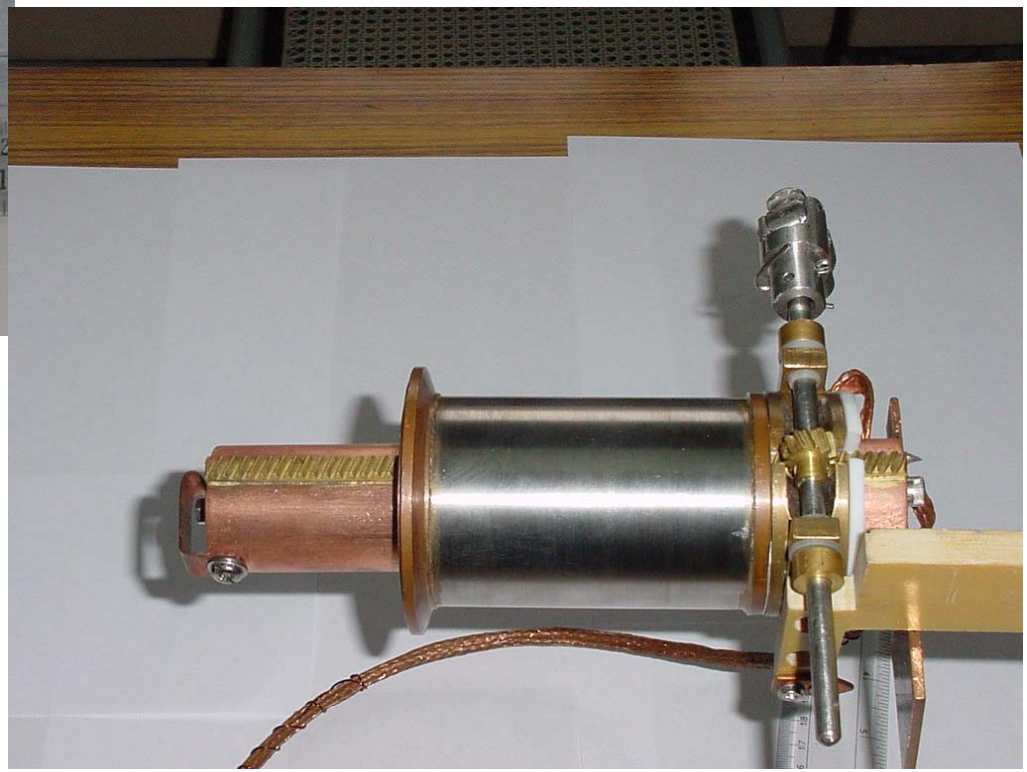
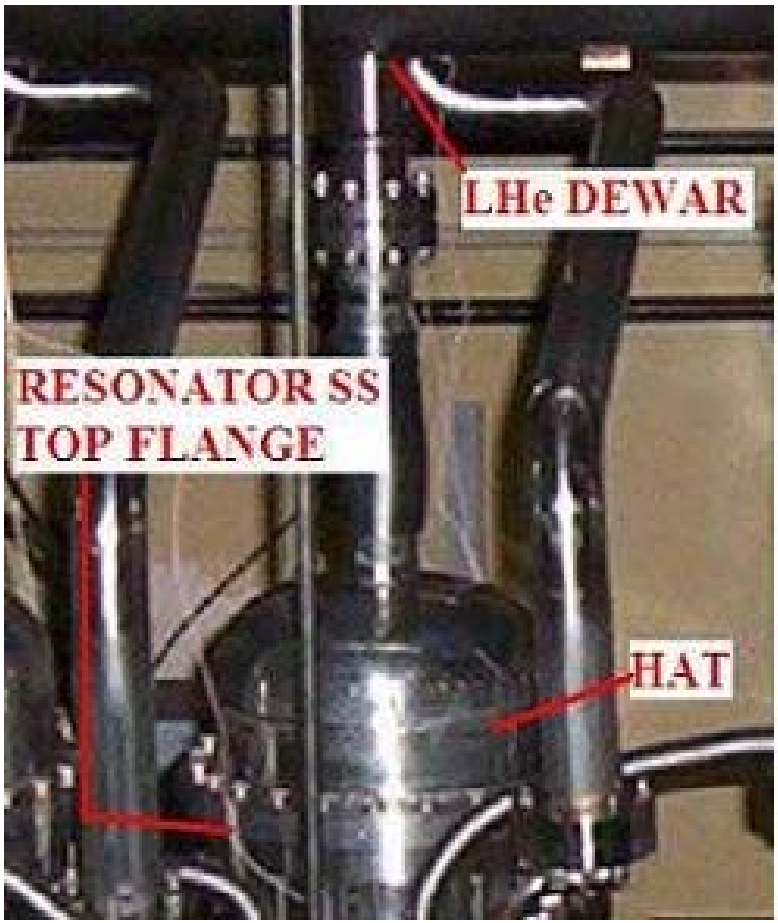
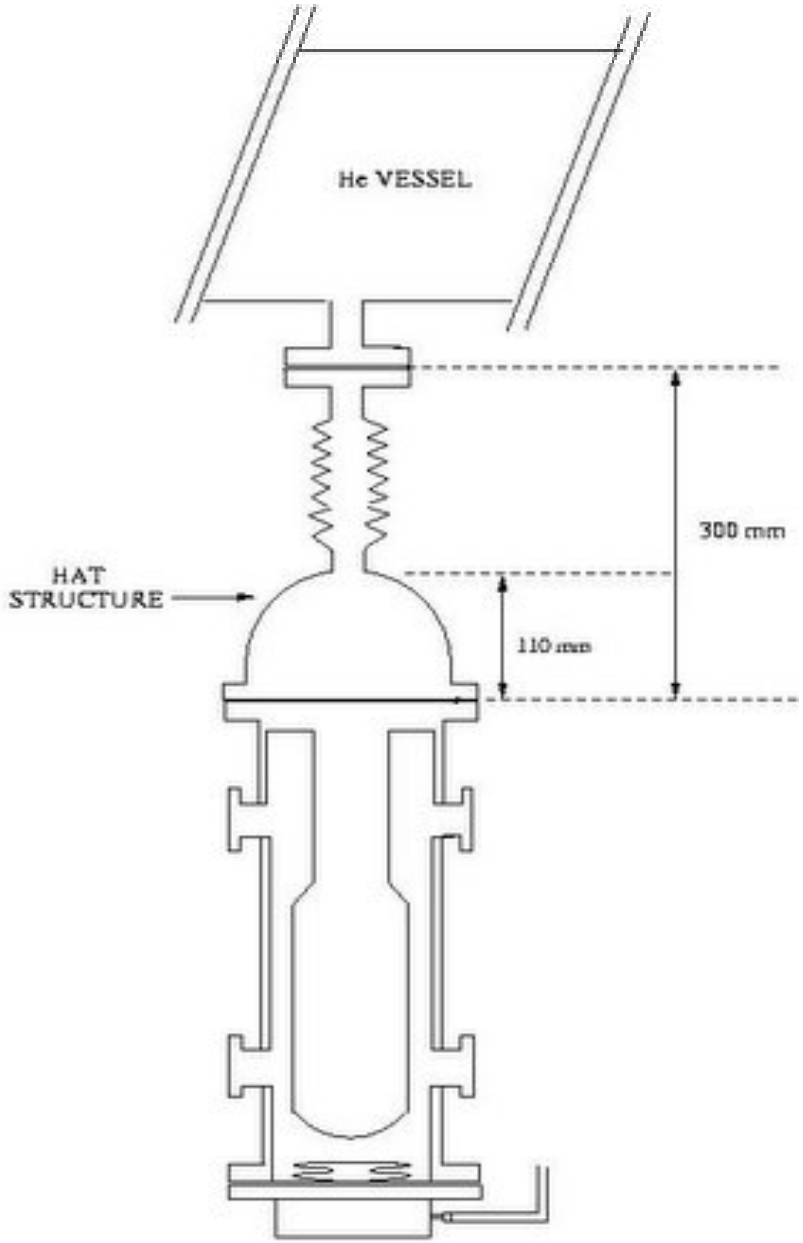


New drive



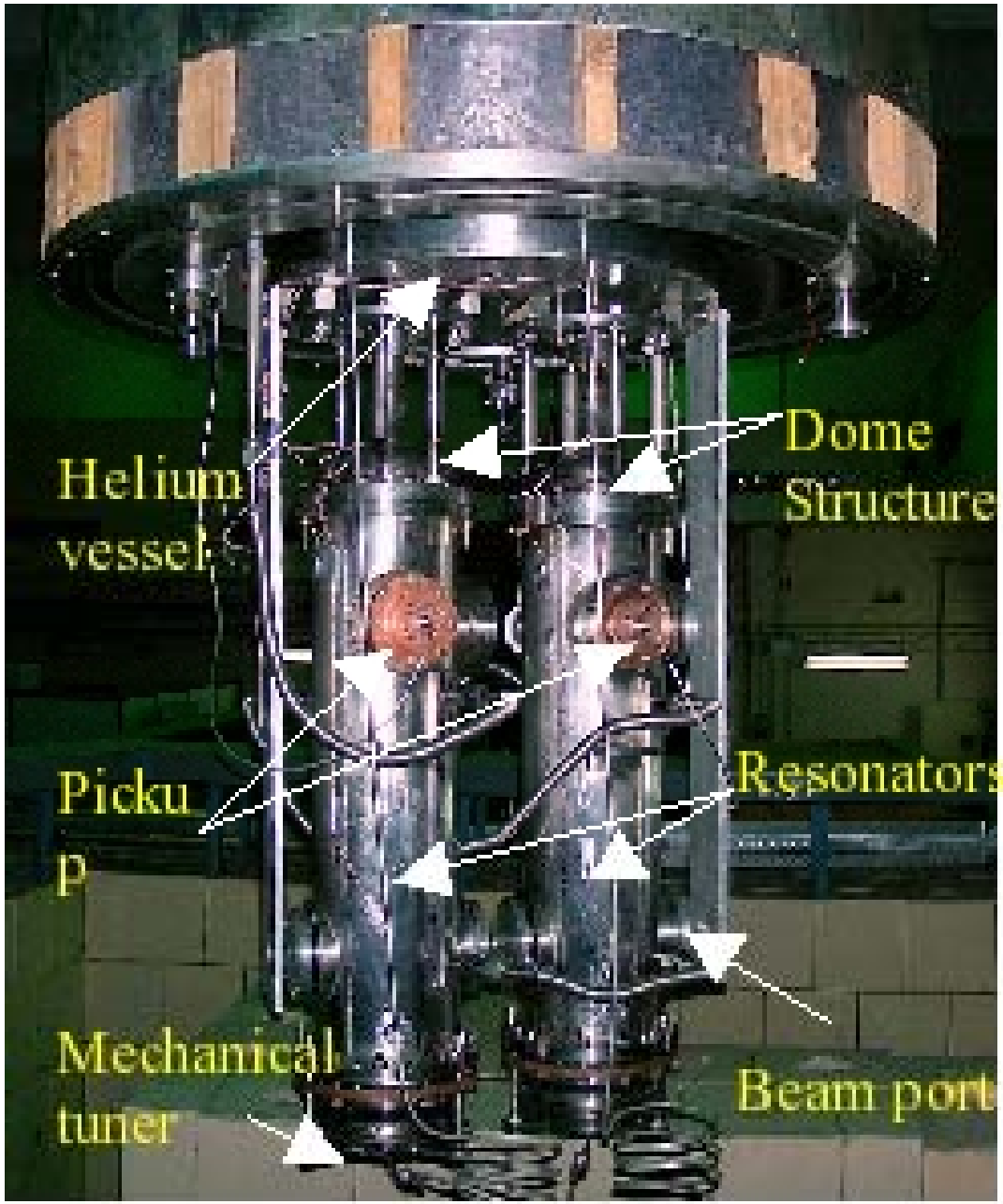
Old drive


LHe DEWAR
RESONATOR SS
TOP FLANGE
HAT


He VESSEL
300 mm
HAT
STRUCTURE
110 mm

Edge welded bellows

Formed bellows



Rebuncher cryostat with two QWRs

2 Oct 2008

Ion Acceleration through Linac

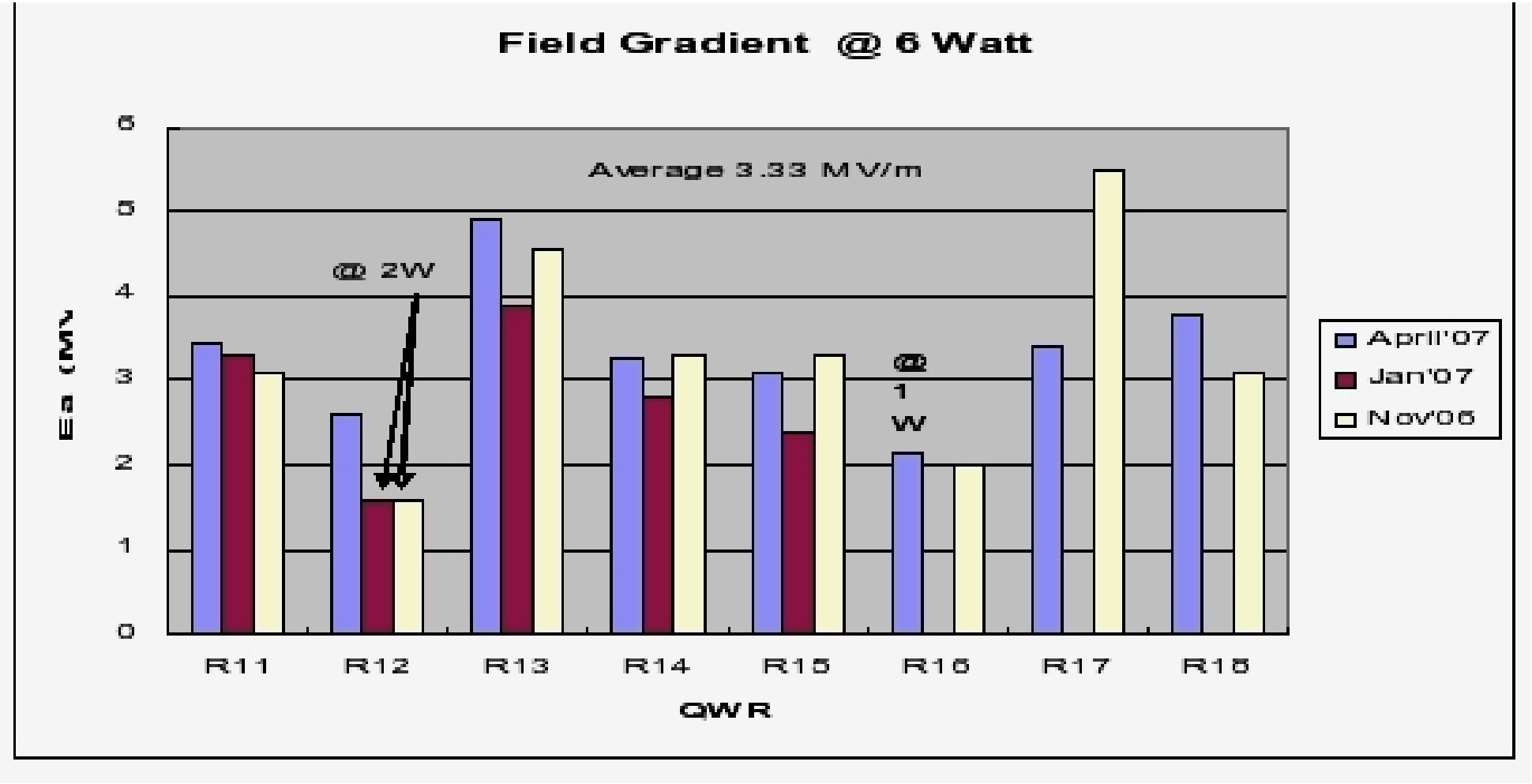
- Typically, a pulsed beam of ~ 1.5 ns is injected into superbuncher (SB)

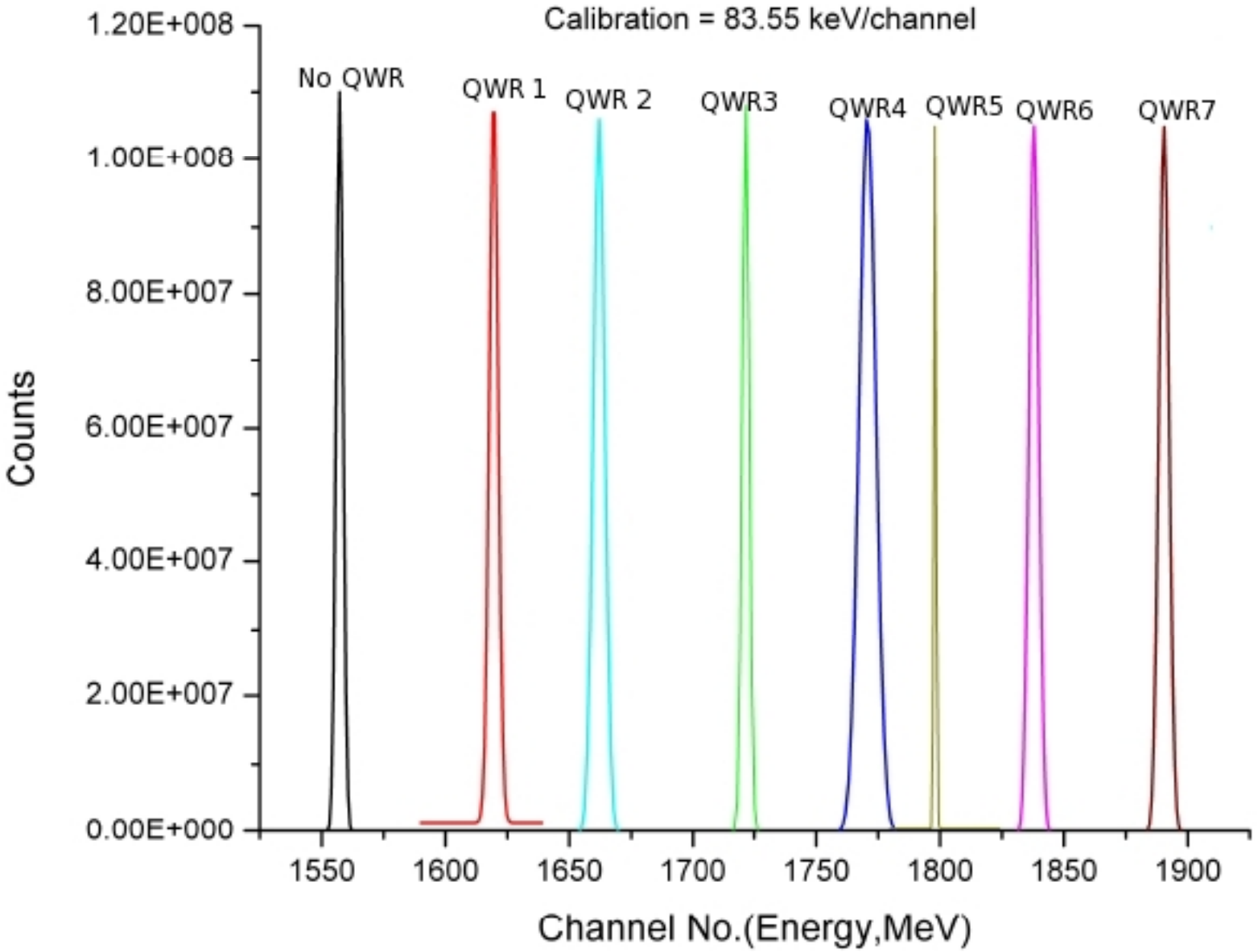
- SB typically compresses it to a couple of hundred pico second at the entrance of Linac

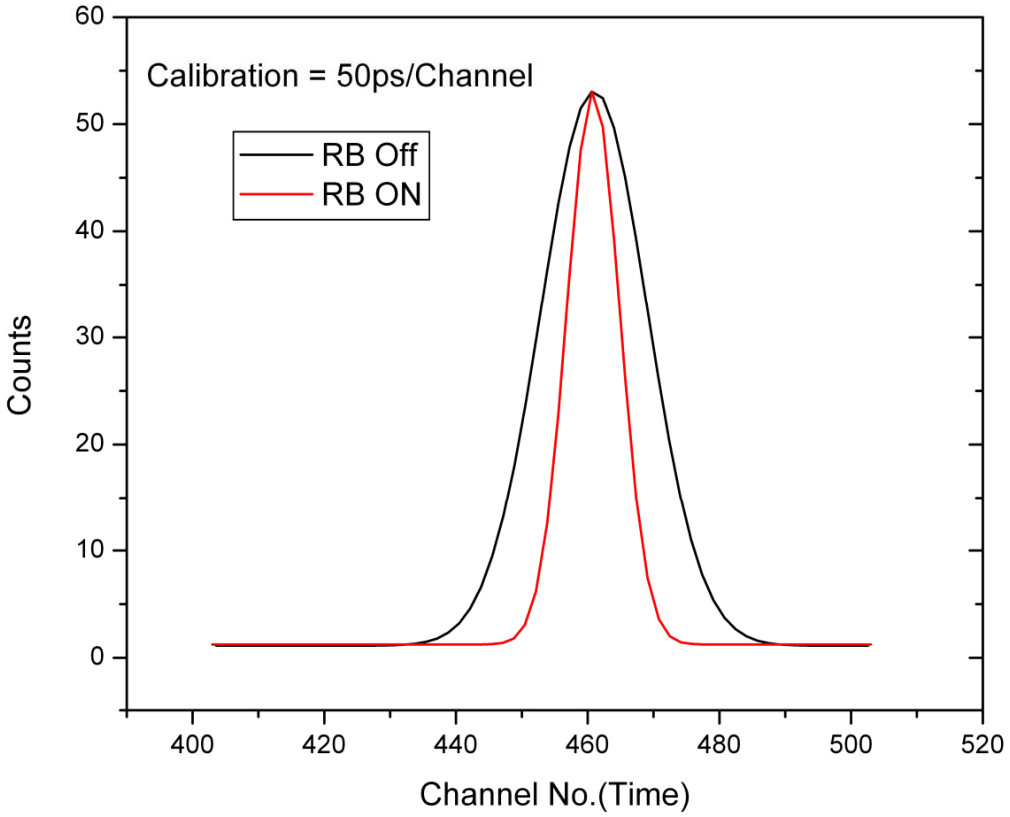
- In a recent experiment, 130 MeV $^{28}Si^{+10}$ beam was injected into Linac having 7 QWR installed at that time

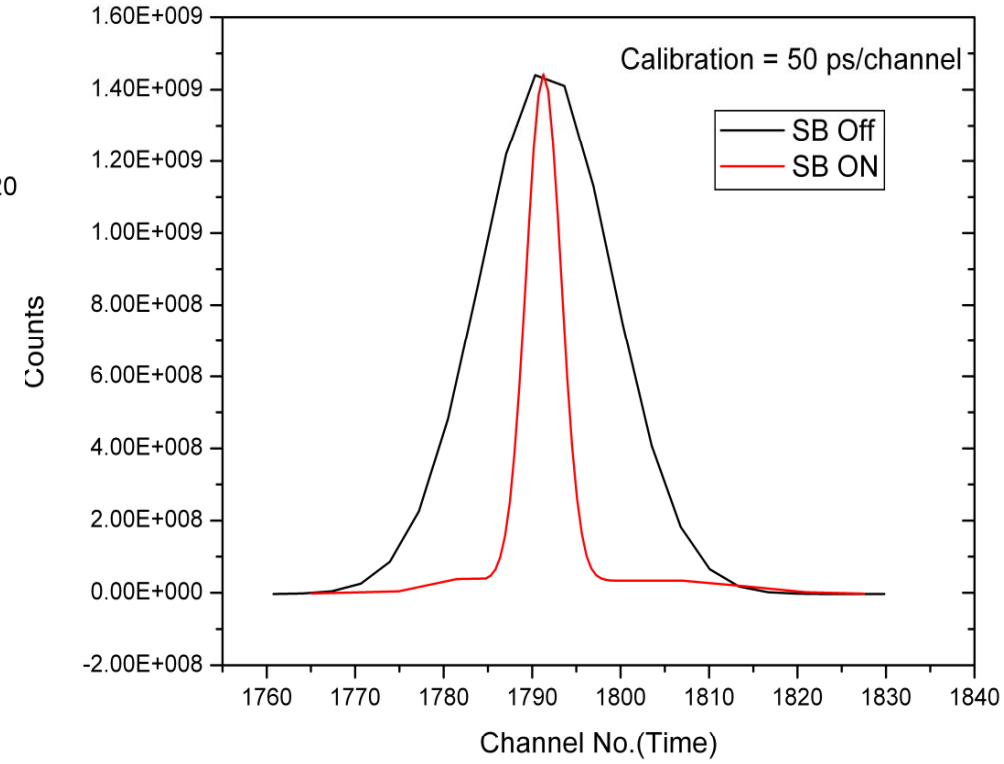
- A final energy of ~ 159 MeV was obtained at the exit of Linac and resonator at rebuncher cryostat compresses the blown up beam to ~ 400 ps at the user's scattering chamber

- 159 MeV $^{28}Si^{+10}$ beam with a time width of 400 ps was delivered for conducting experiment


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


Calibration = 83.55 keV/channel
No QWR
QWR 1
QWR 2
QWR3
QWR4
QWR5
QWR6
QWR7
Counts
1.20E+008
1.00E+008
8.00E+007
6.00E+007
4.00E+007
2.00E+007
0.00E+000
1550
1600
1650
1700
1750
1800
1850
1900
Channel No.(Energy,MeV)


Calibration = 50ps/Channel
RB Off
RB ON
Counts
Channel No.(Time)
60
50
40
30
20
10
0
400
420
440
460
480
500
520


Calibration = 50 ps/channel
SB Off
SB ON
Counts
Channel No.(Time)
1.60E+009
1.40E+009
1.20E+009
1.00E+009
8.00E+008
6.00E+008
4.00E+008
2.00E+008
0.00E+000
-2.00E+008
1760
1770
1780
1790
1800
1810
1820
1830
1840

Fabrication of Superconducting resonator

- 60 kV, 15 kW,
  CNC controlled EBW Machine
- Commissioned in 2001

- **Max Temp. 1200 C**
  @ 5.0 x 10^{-7} torr
- **Hot Zone – ϕ600mm x 1000mm**
- **Commissioned in 2002**

Acid Fume Hood

High pressure rinsing

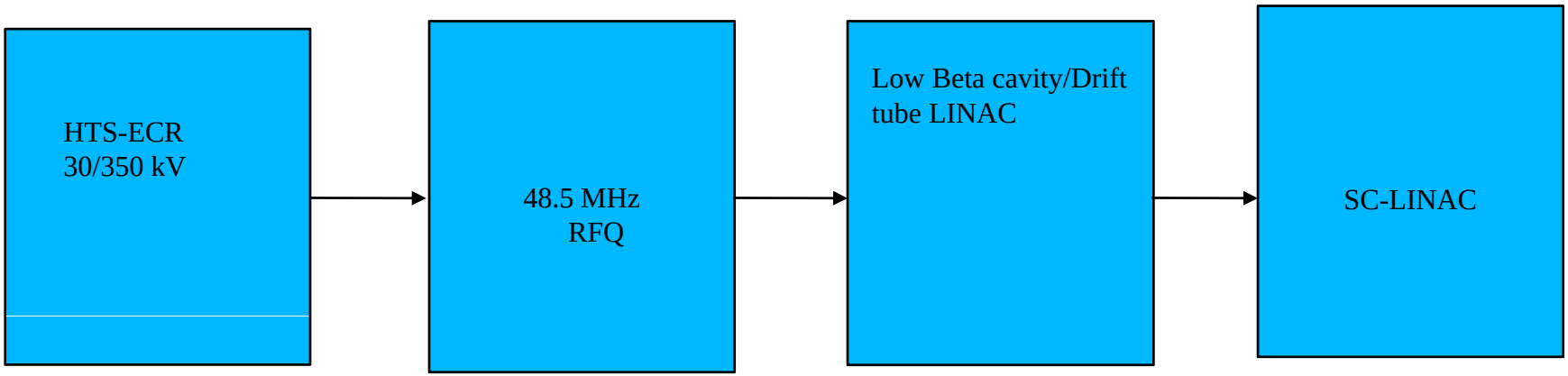
Test Cryostat and top plate with QWR mounted

2 Oct 2008

New Projects

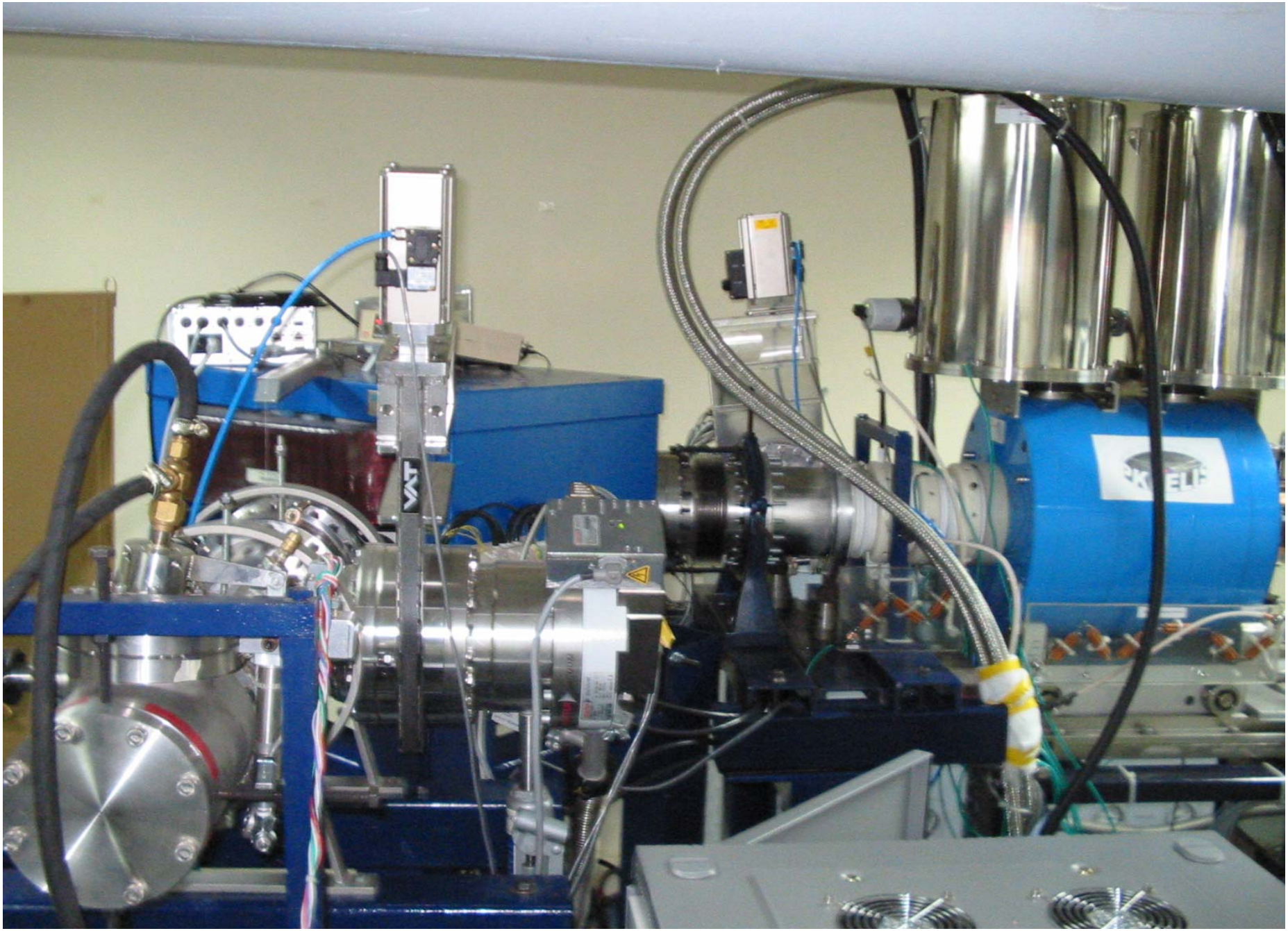
Niobium Single Spoke Resonator, β=0.22, f =325 MHz
Fermilab – IUAC collaboration

Design of a low beta cavity (β = 0.05) for high current injector.



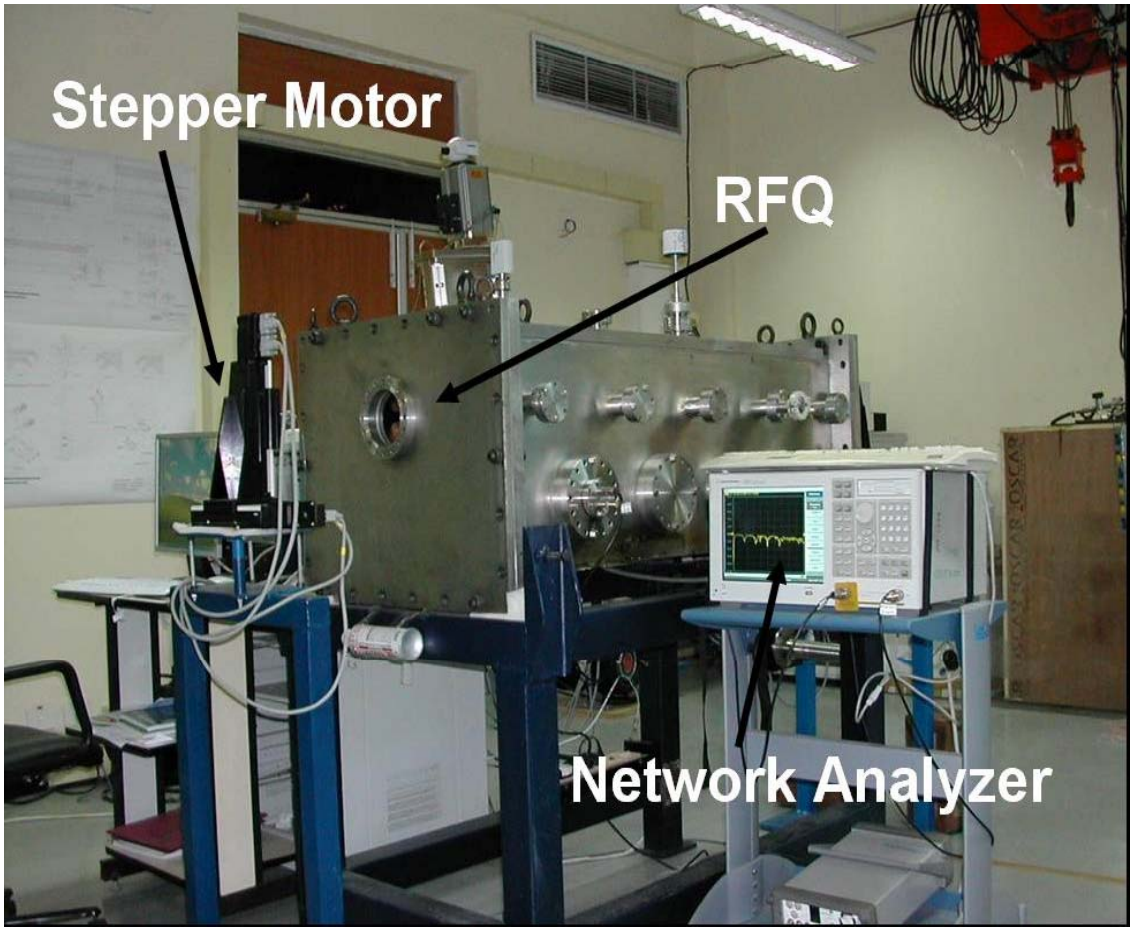
β =0.004/0.01 β = 0.020 β =0.02 - 0.06 β =0.08

Schematic of the proposed high current injector

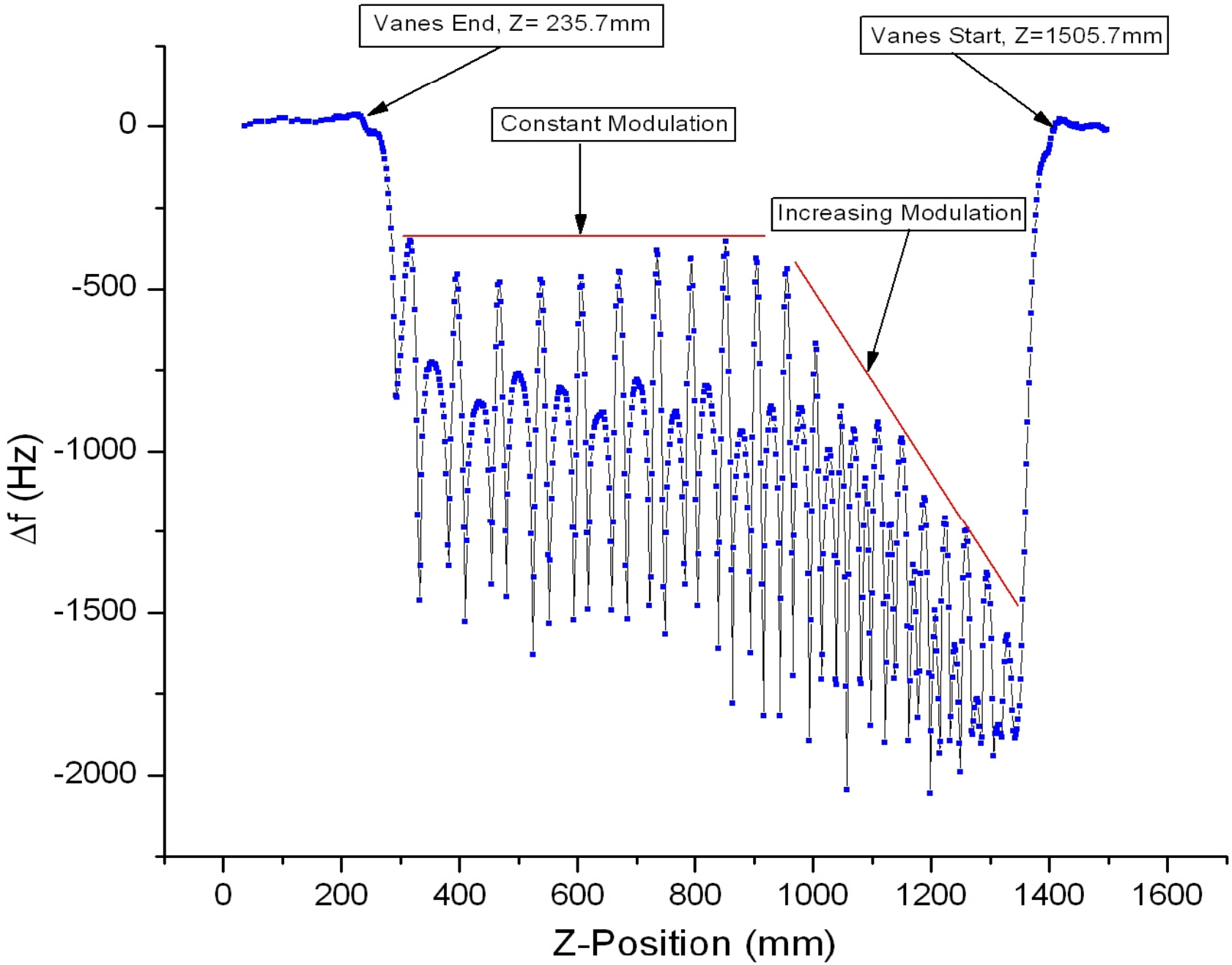


PKDELIS ECR source and low energy beam transport

2 Oct 2008



General Assembly of the 1.17m modulated RFQ,
A/q = 7, E_{in} = 8keV/u,
Eout = 180 keV/u


Vanes End, Z= 235.7mm
Vanes Start, Z=1505.7mm
Constant Modulation
Increasing Modulation
0
-500
-1000
-1500
-2000
Δf (Hz)
0
200
400
600
800
1000
1200
1400
1600
Z-Position (mm)

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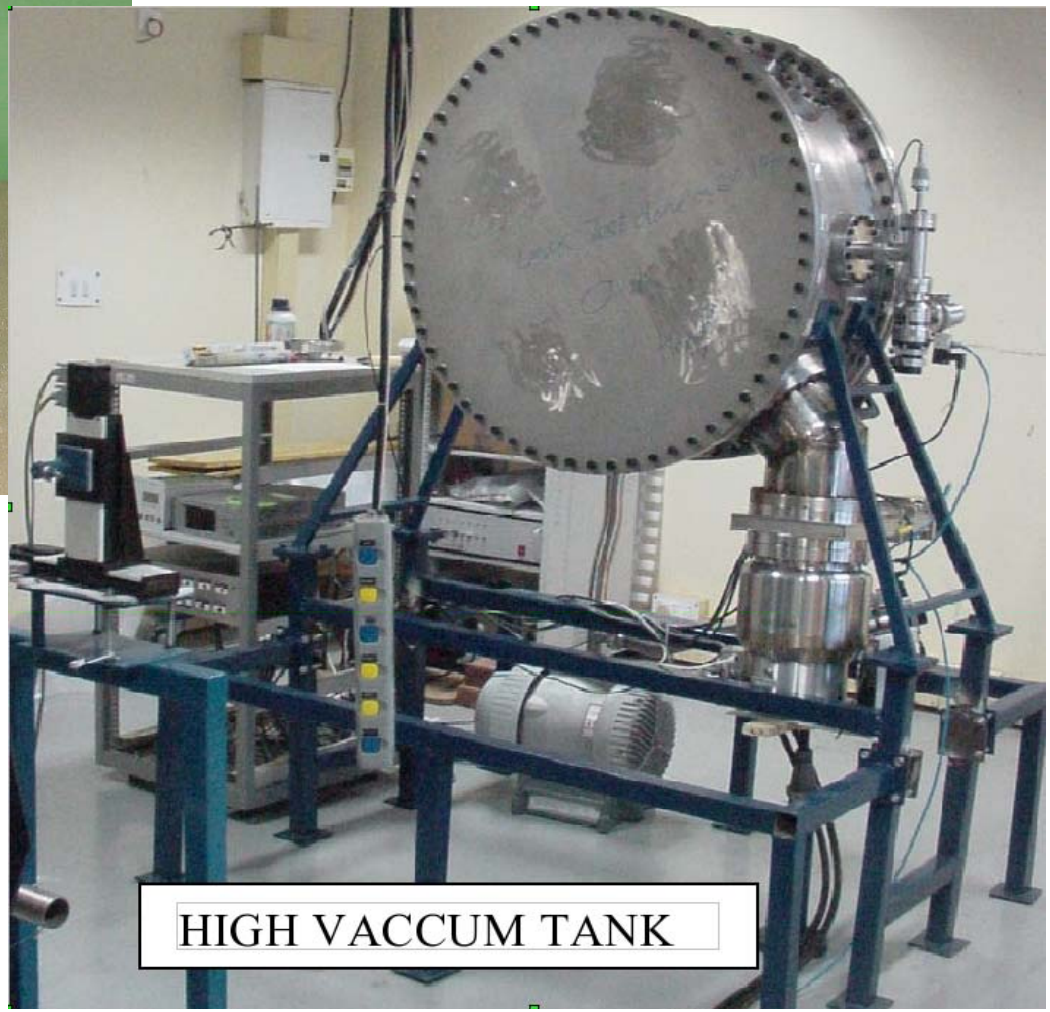
DTL Prototype Stems



Present Status

- **Linac requires (1+24+2 =) 27 QWR**
- **13 QWRs were built in collaboration with Argonne National Lab.**
- **Remaining resonators are being fabricated in-house**
- **The first module of Linac (with 8 QWR) is functioning with Superbuncher (1 QWR) and Rebuncher (2 QWRs)**
- **Linac cryostat # 2 and 3 will be operational in mid- 2009**
- **HTc ECR source operational.**
- **RFQ prototype fabricated. DTL being designed.**