Superconducting LINAC Booster for the TIFR Pelletron

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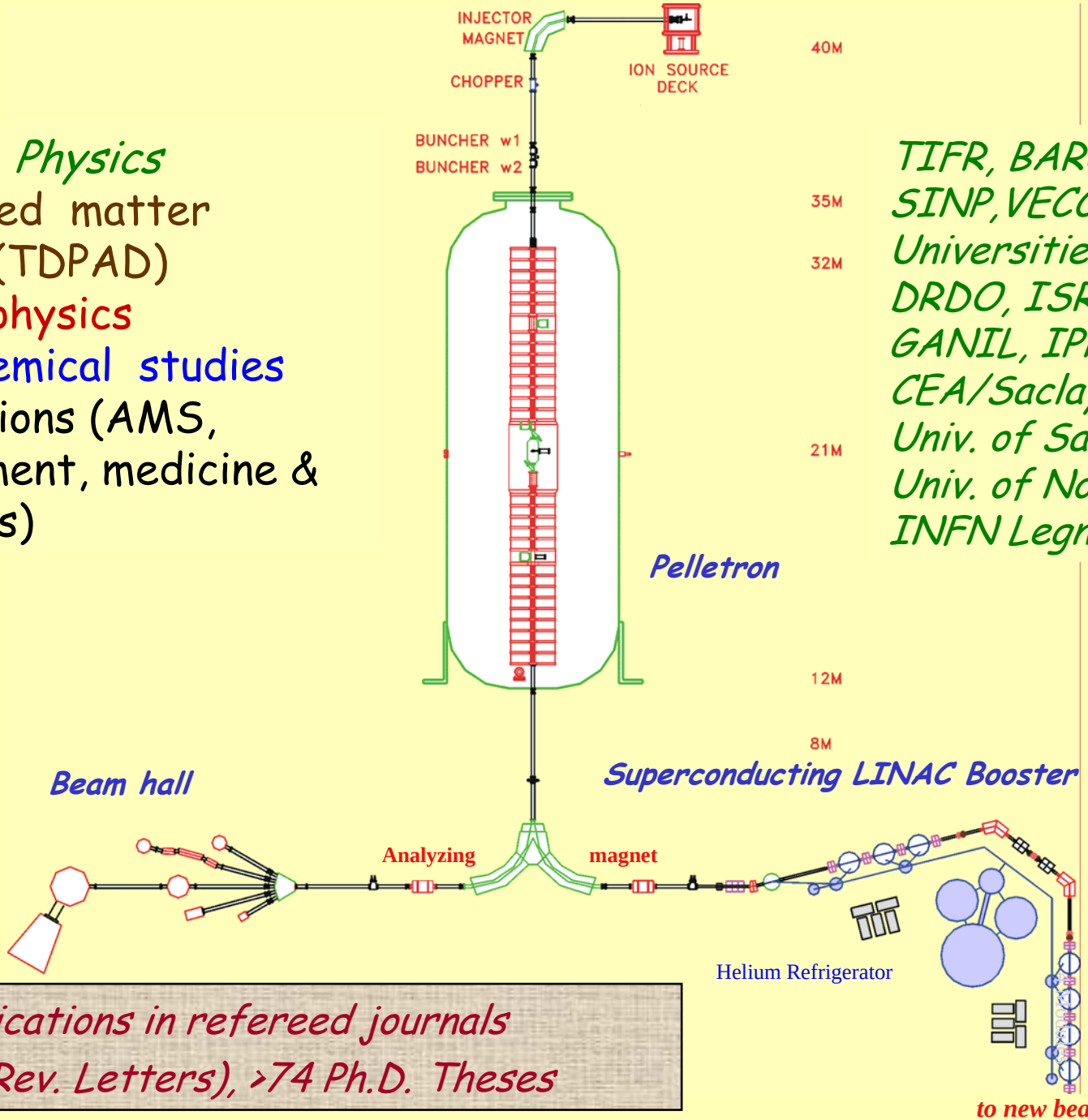
- *Nuclear Physics*
- Condensed matter physics (TDPAD)
- Atomic physics
- Radiochemical studies
- Applications (AMS, environment, medicine & materials)



TIFR, BARC, SINP, VECC, Universities, DRDO, ISRO , GANIL, IPN-Orsay, CEA/Saclay, Univ. of Sao Paulo, Univ. of Notre Dame, INFN Legnaro, …

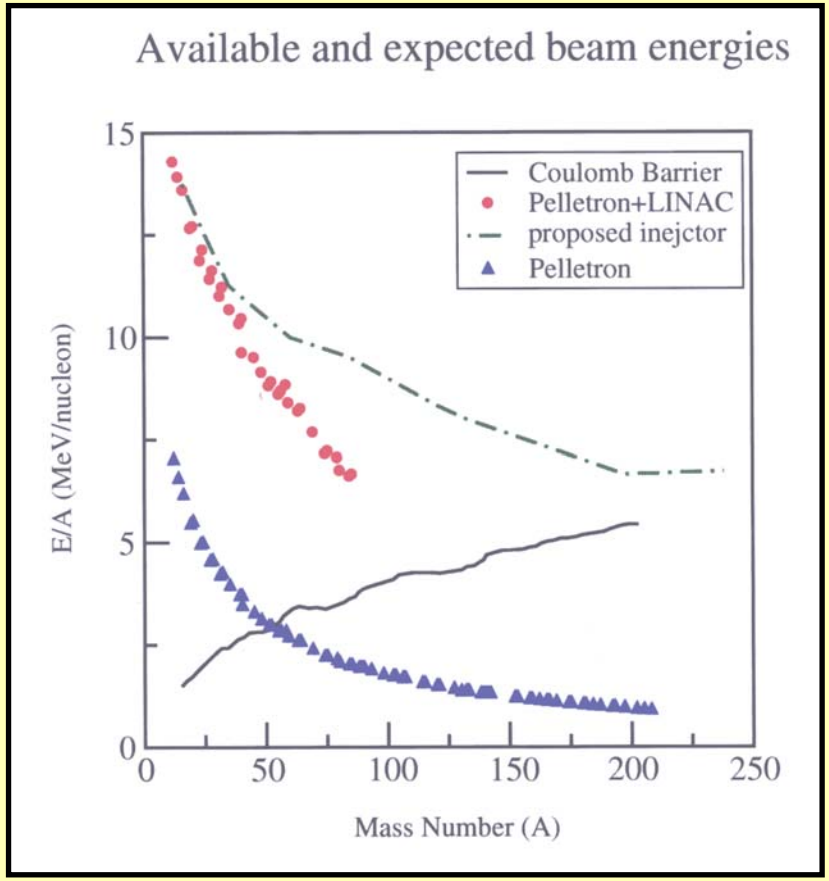
>400 publications in refereed journals (12 Phys. Rev. Letters), >74 Ph.D. Theses

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)



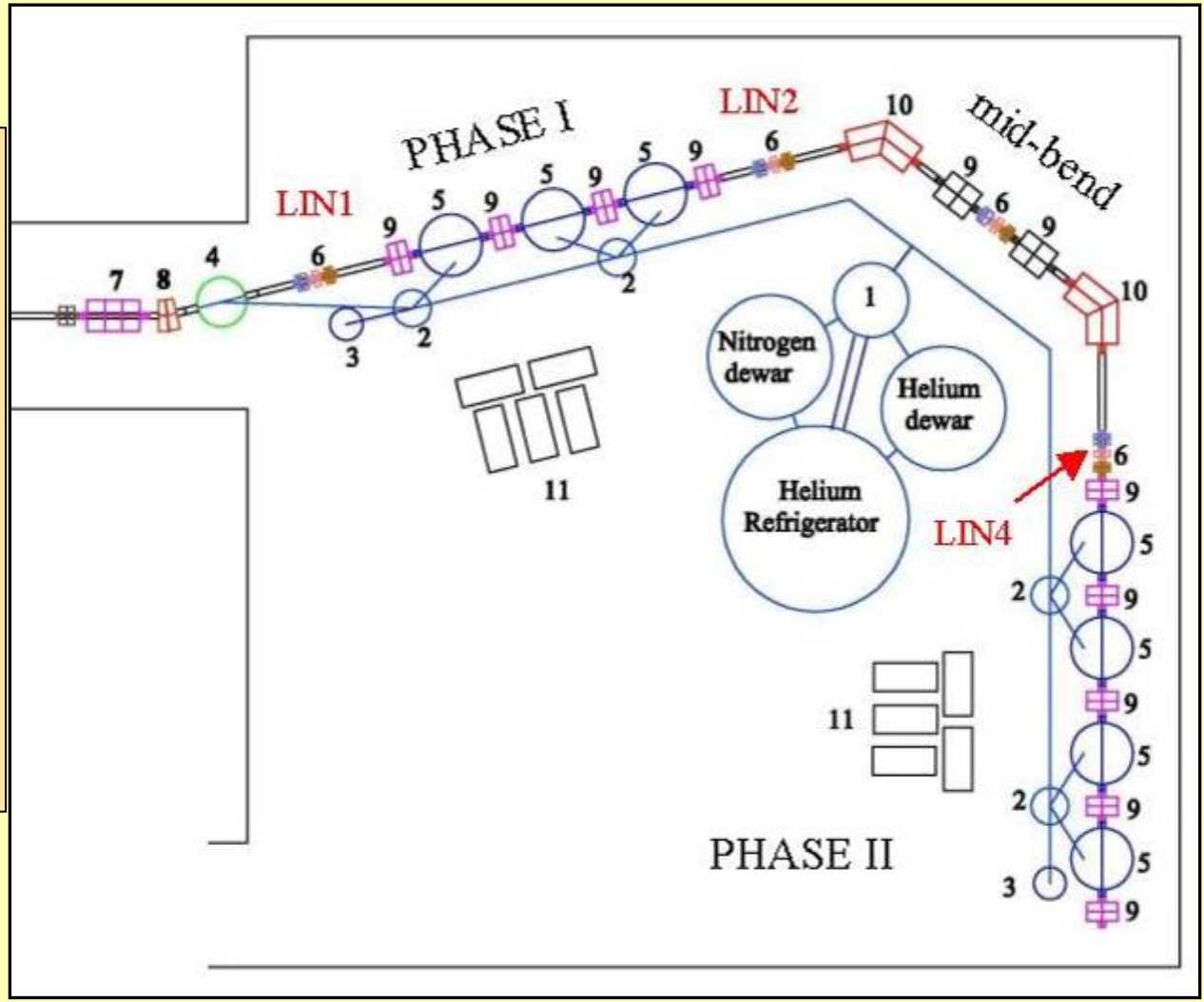
Joint TIFR – BARC Project

Specifications

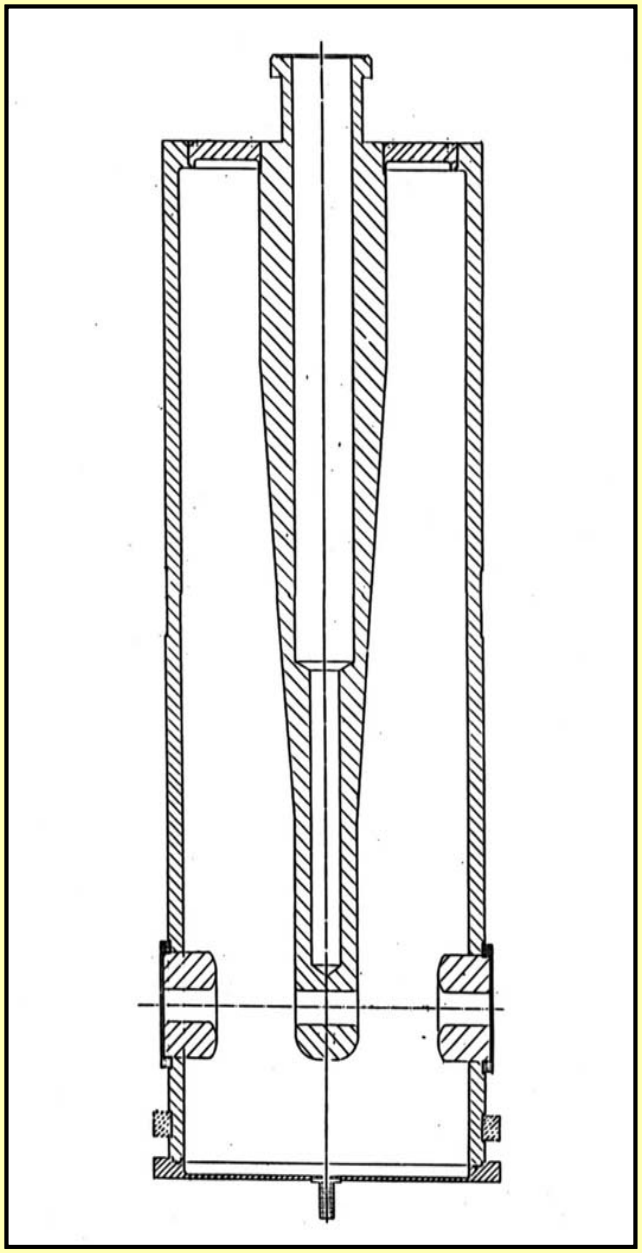
Heavy ions upto A~80
E/A~5-12 MeV

Energy gain 14MV/q
Module 7 nos
Resonators 28 nos

Bunch width ~200 ps
Beam Intensity 0.1-10 pnA

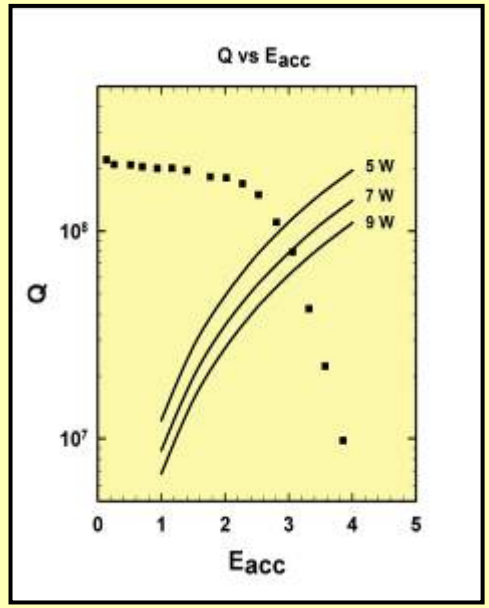


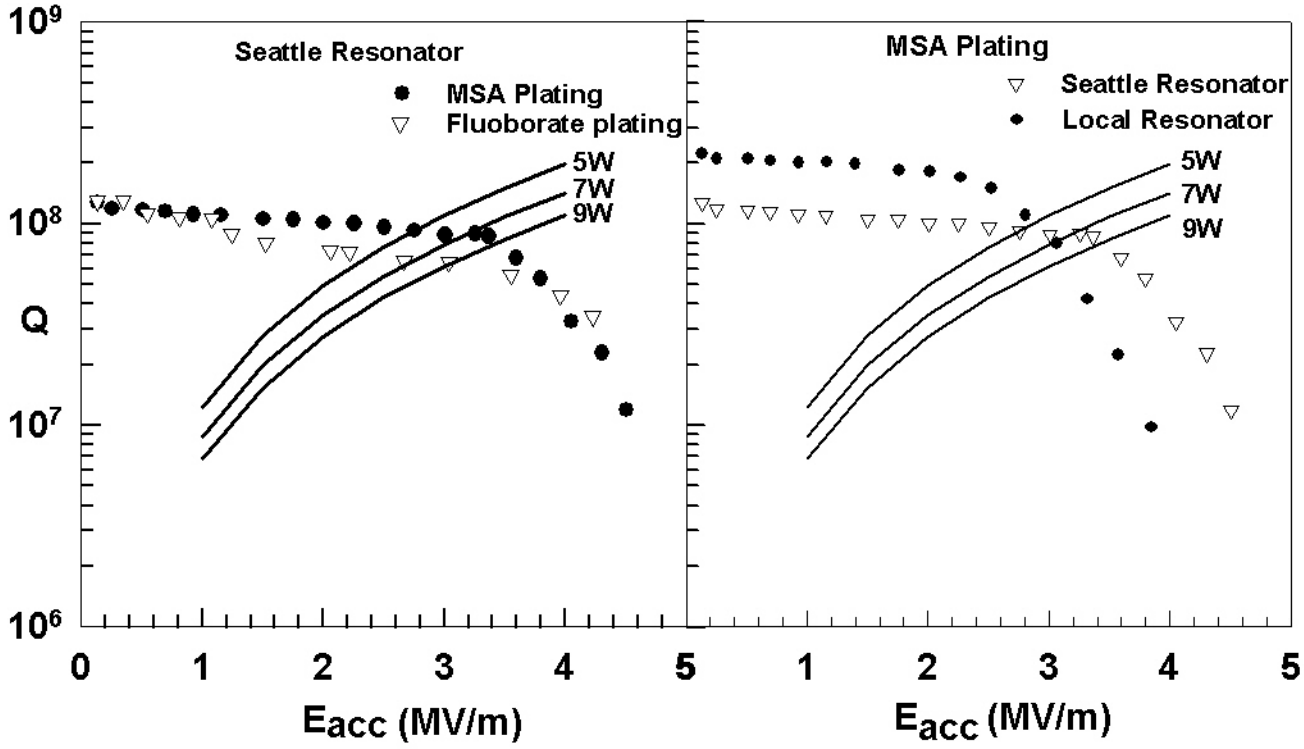
Phase I commissioned on September 22nd, 2002
Phase II commissioned on July 9th, 2007
LINAC dedicated to users on Nov. 28th, 2007



Quarter Wave Resonators

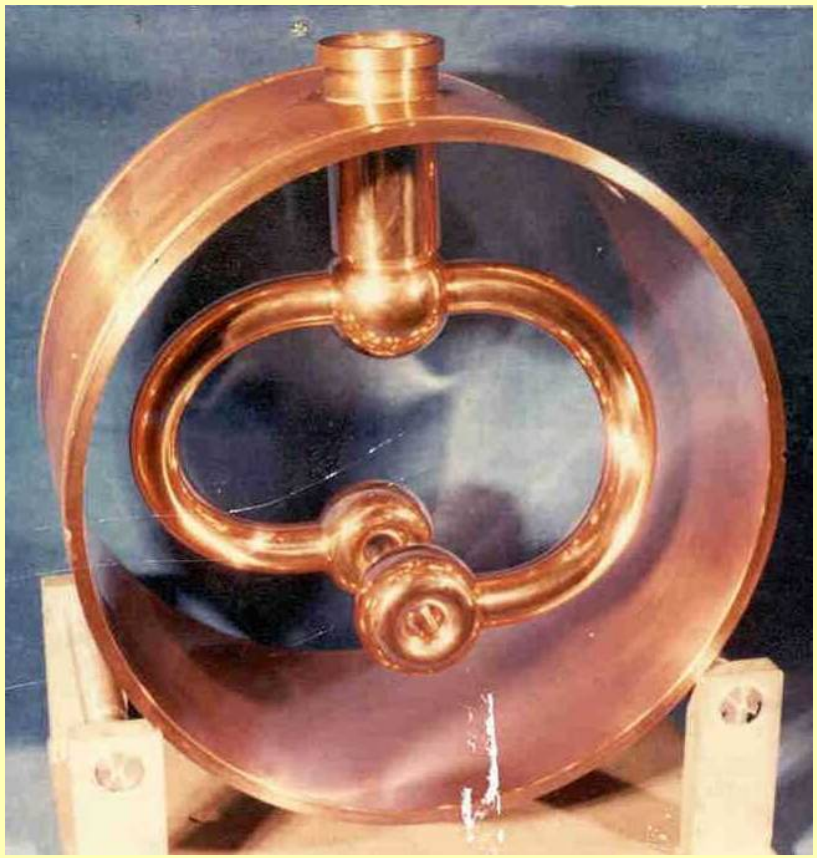
Material	OFHC Cu
Superconducting surface	2 μm thick. Pb
Frequency	150 MHz
Cavity Length	64 cm
Cavity Diameter	20 cm
Optimum velocity	β=0.1
Design goal	2.5 to 3 MV/m @ 6 to 9 Watts




Seattle Resonator
MSA Plating
Fluoborate plating
5W
7W
9W
Q
10^9
10^8
10^7
10^6
0
1
2
3
4
5
E_{acc} (MV/m)
MSA Plating
Seattle Resonator
Local Resonator
5W
7W
9W
1
2
3
4
5
E_{acc} (MV/m)

Superbuncher cavity

Before Plating

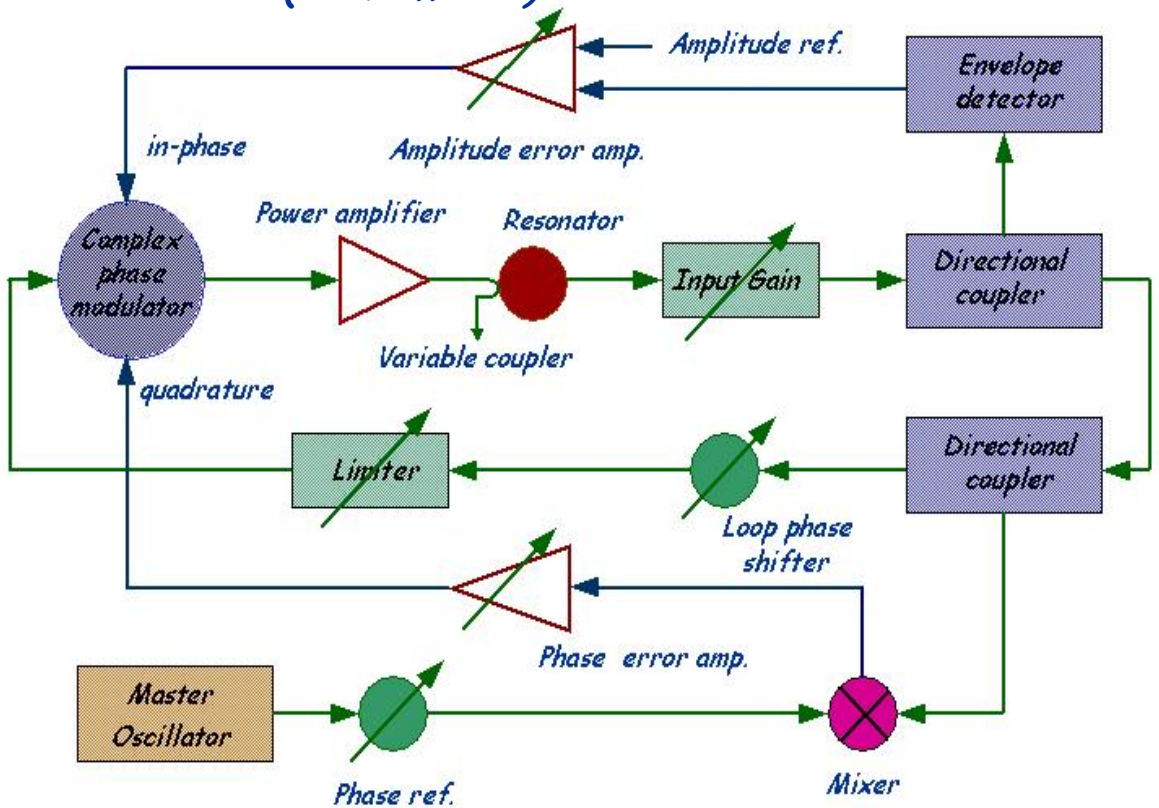


After Lead Plating

Module Cryostat

Top view of the module

RF Controller (schematic)

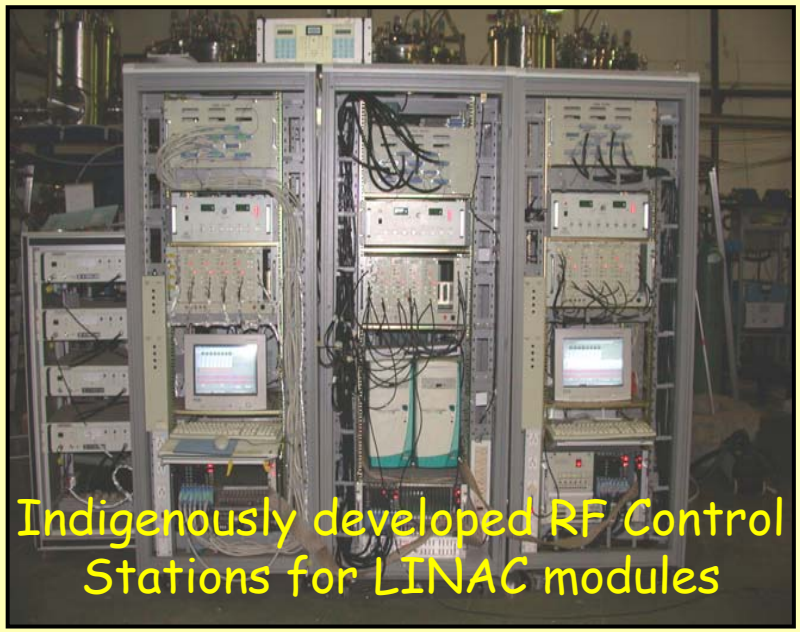


- RF controller cards based on self excited loop based on phase and amplitude feedback.

Also delivered to ANU Canberra, IUAC New Delhi

RF Electronics and LINAC Control System

- Resonator controller and CAMAC system
  - *In house development using Indigenous/easily available RF modules*
  - *150 Watts, 150 MHz RF Power Amplifiers*
- LINUX based Operating system with JAVA
- Web based distributed control system (master + local stations)



Indigenously developed RF Control Stations for LINAC modules

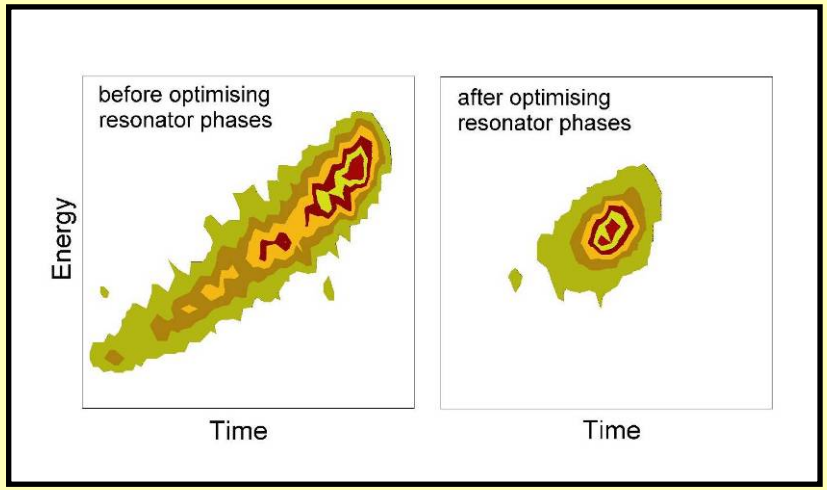
Cryogenics system for the Linac

Helium Refrigerator	Linde TCF-50S
Al Plate Fin Heat Exchangers	
Two stage Turbine Expansion	Engines
Two stage JT Expansion	
250 KW Screw Compressor	62 g/s

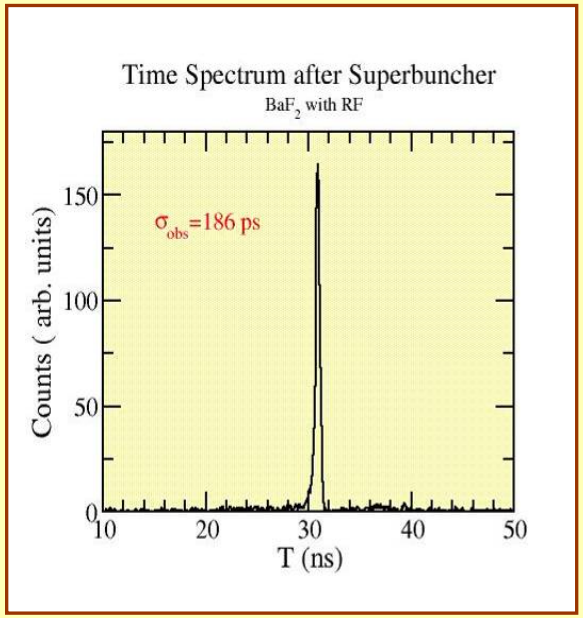
Refrigeration at 4.5 K/Liquification

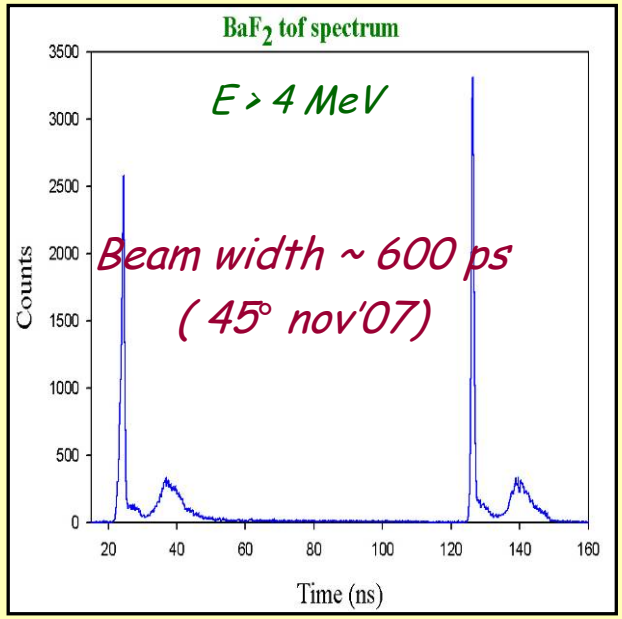
Without LN_2	300 W, 50 l/hr
With LN_2 pre-cooling	380 W, 120 l/hr

The entire cryogenic distribution was fabricated and assembled on-site.



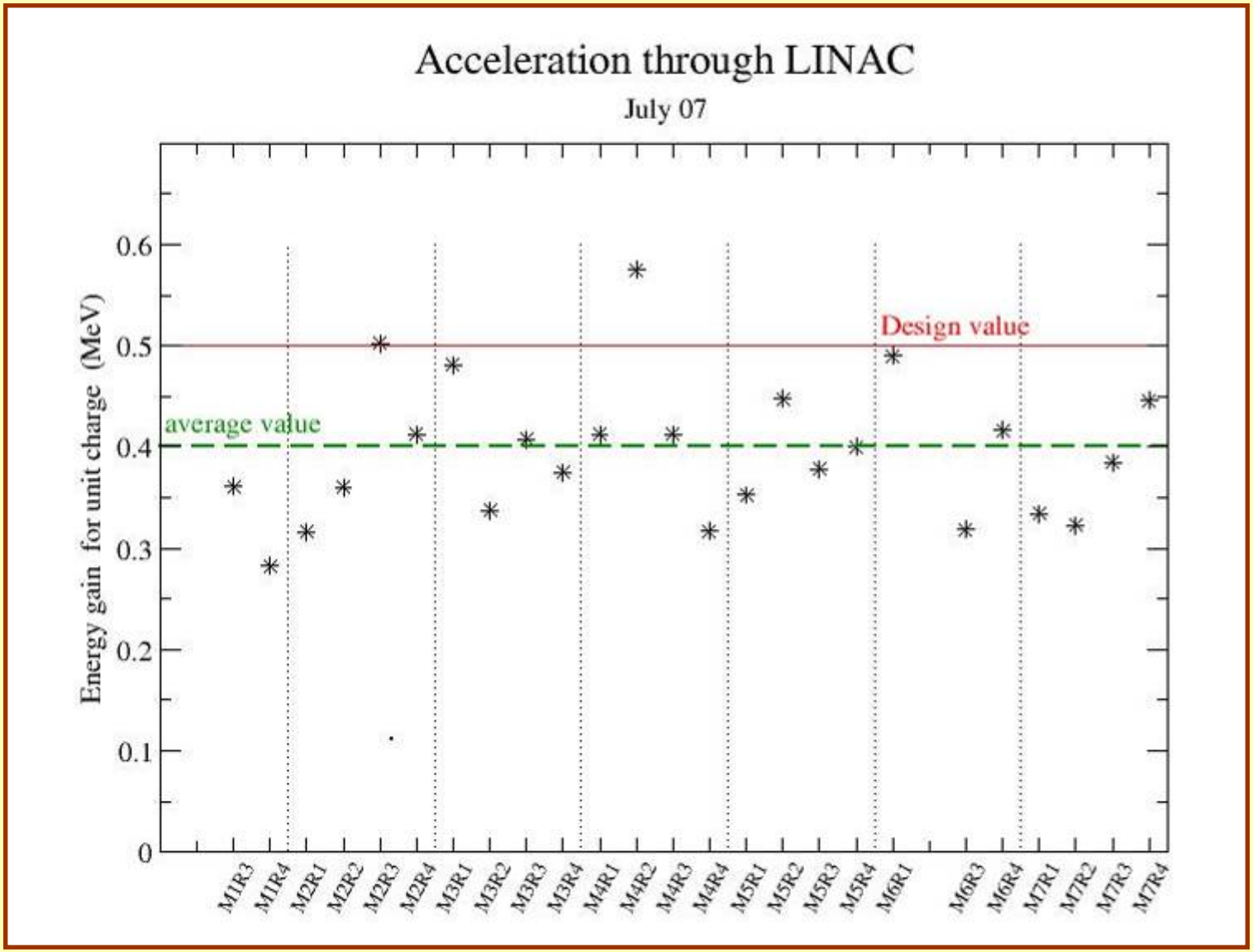
Longitudinal phase space after mid-bend

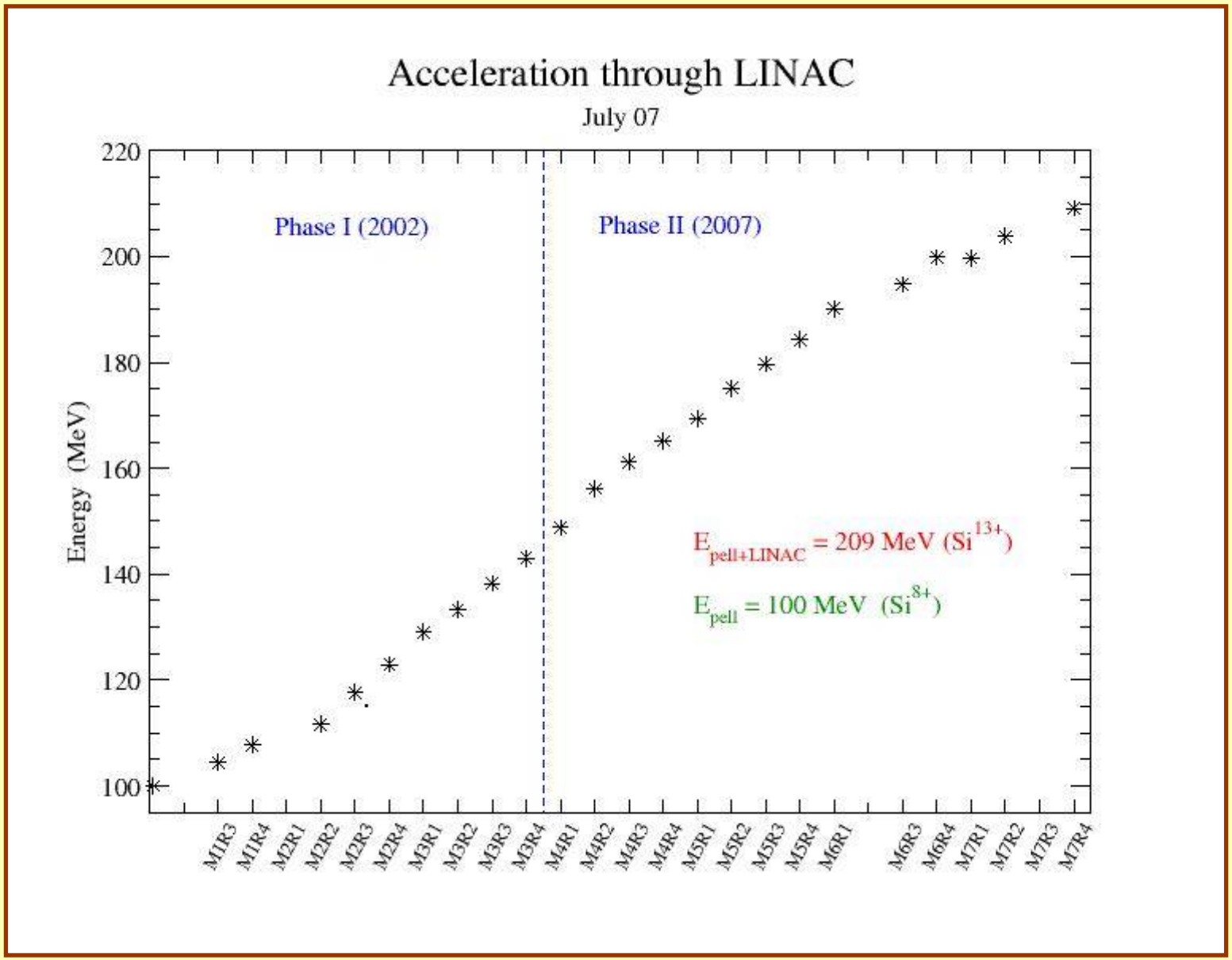




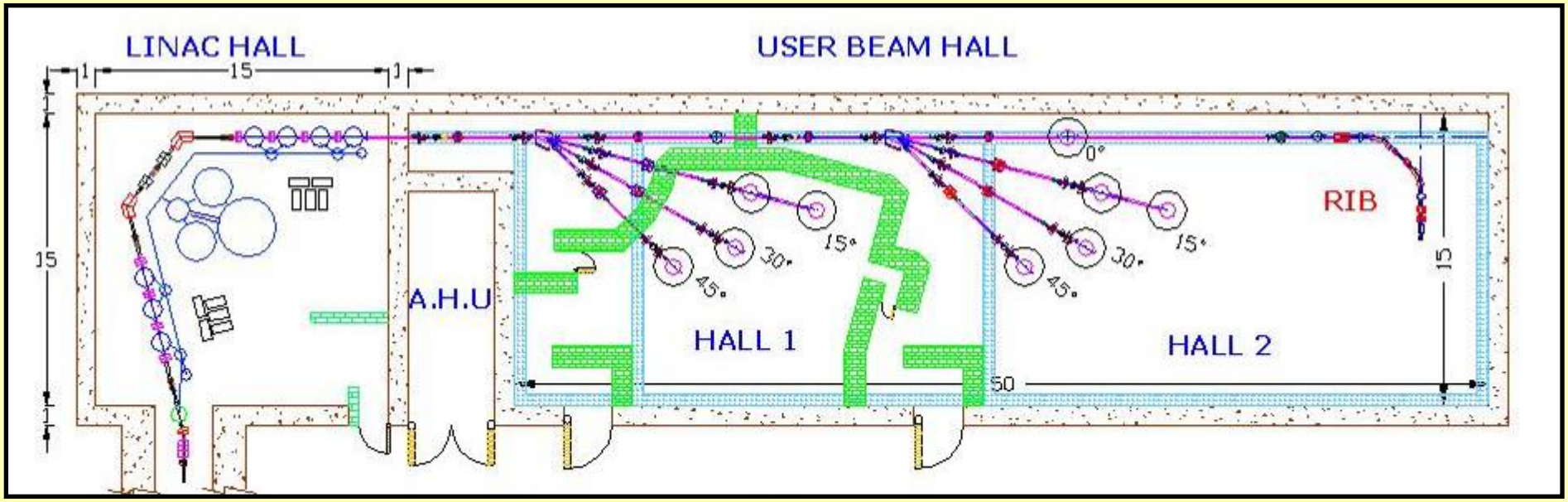
Full LINAC Test (July 07)

$^{28}Si^{13+}$




Acceleration through LINAC
July 07
Energy (MeV)
220
200
180
160
140
120
100
Phase I (2002)
Phase II (2007)
E pelI+LINAC = 209 MeV (Si 13+)
E pelI = 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

LINAC & Experimental Beam Halls



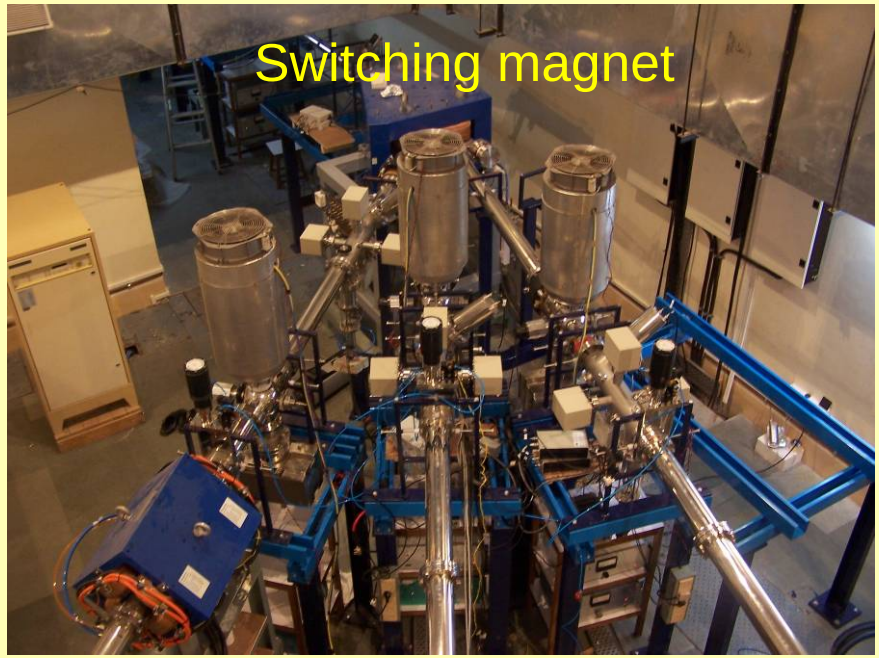
Hall 1

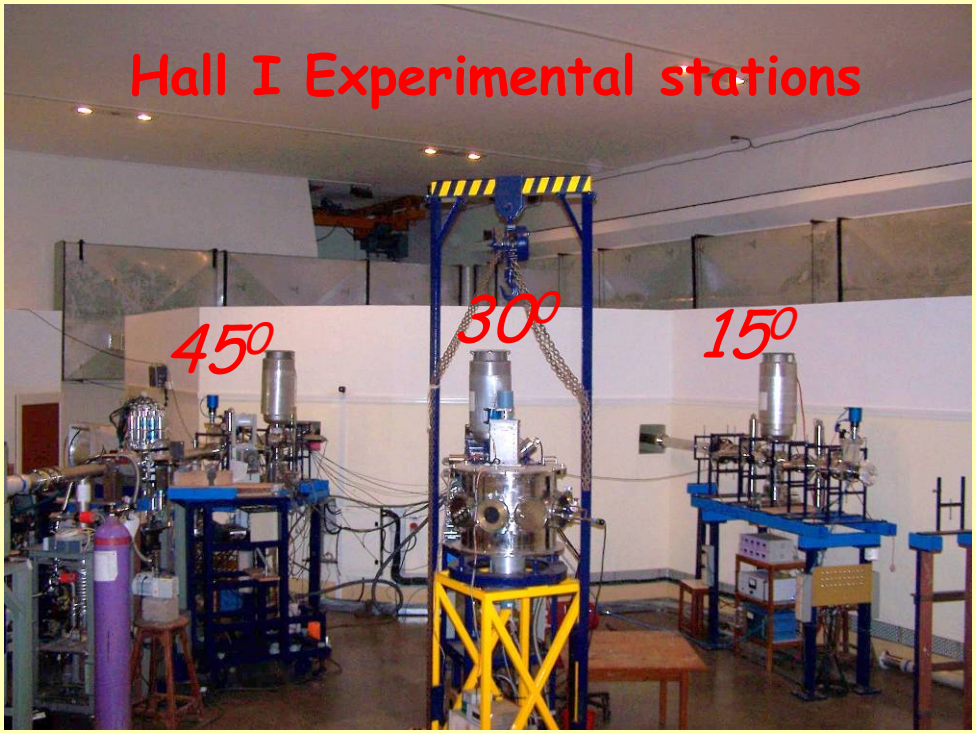
- Condensed Matter Physics (7 T Magnet) & Atomic, Molecular & Cluster Physics
- General purpose / Irradiation line
- High energy gamma ray & neutron wall

Hall 2

- General Purpose Scattering Chamber
- HP Ge Spectrometer (INGA)
- Charged particle ball
- Magnetic separator for light RIBs

User beam Hall I





TIFR & BARC

PelletronTeam

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TIFR

- Dept of Nuclear And Atomic Physics
- Central Workshop
- Central Services
- Low Temperature Facility

BARC

- Nuclear Physics Division
- Electronics Division
- Central Workshop

Vendors

IBP • Vacuum Techniques • Aarti Engineering • Fullinger• SMP Enterprises Accelerator Consultancy Services• Transact-India/Danfysik • BEL • Sameer • Kamal Engineering • BOC Edwards • Pfeiffer