Superconducting LINAC Booster for the TIFR Pelletron

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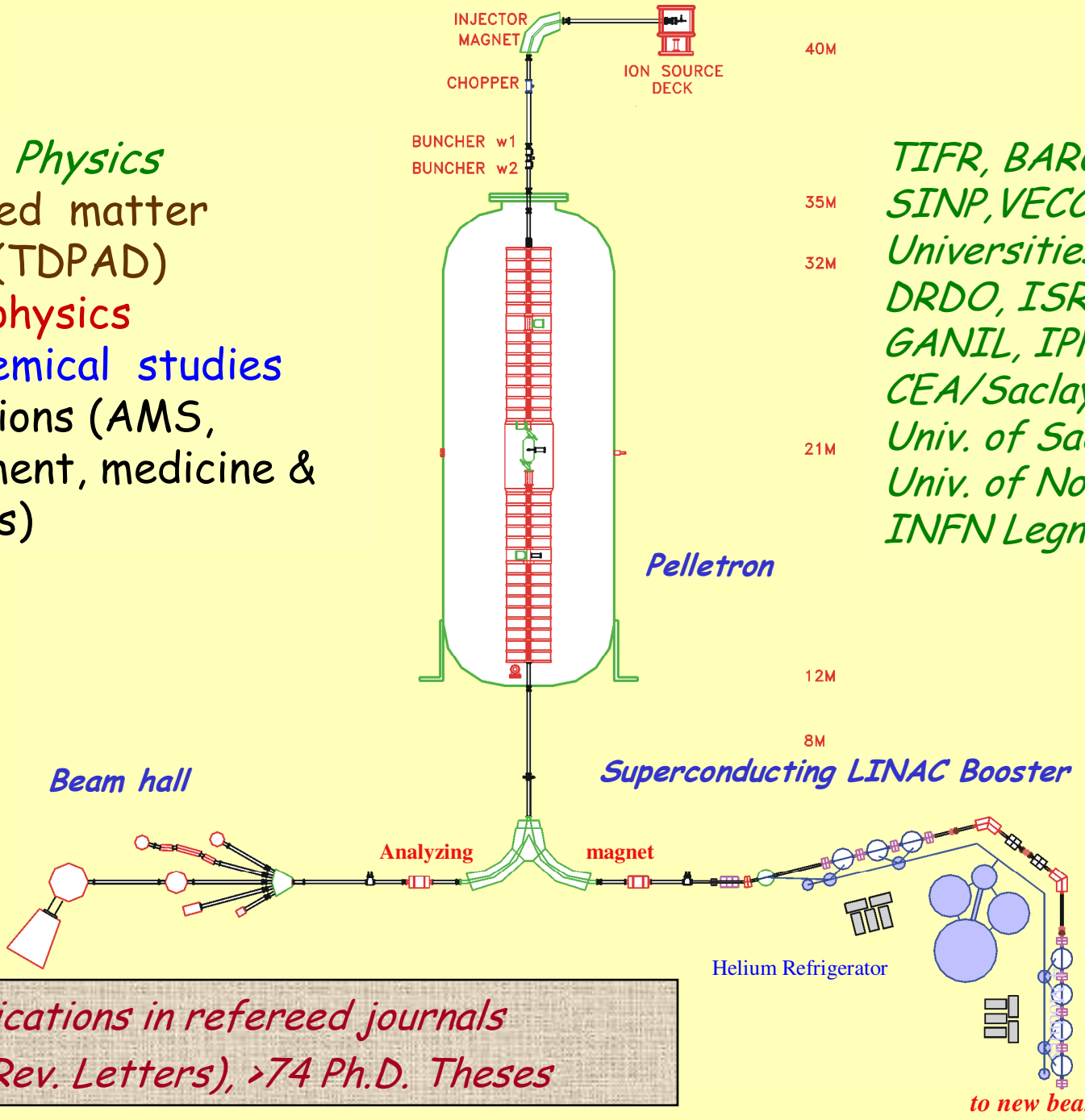
- *Nuclear Physics*
- Condensed matter physics (TDPAD)
- Atomic physics
- Radiochemical studies
- Applications (AMS, environment, medicine & materials)



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

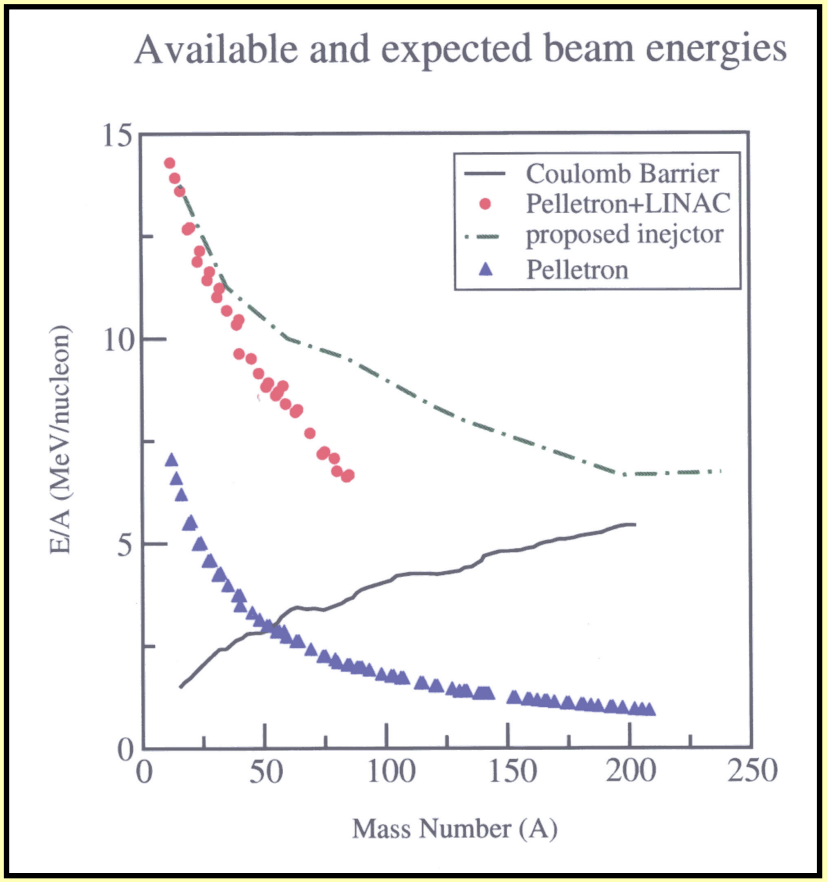
>400 publications in refereed journals (12 Phys. Rev. Letters), >74 Ph.D. Theses

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)



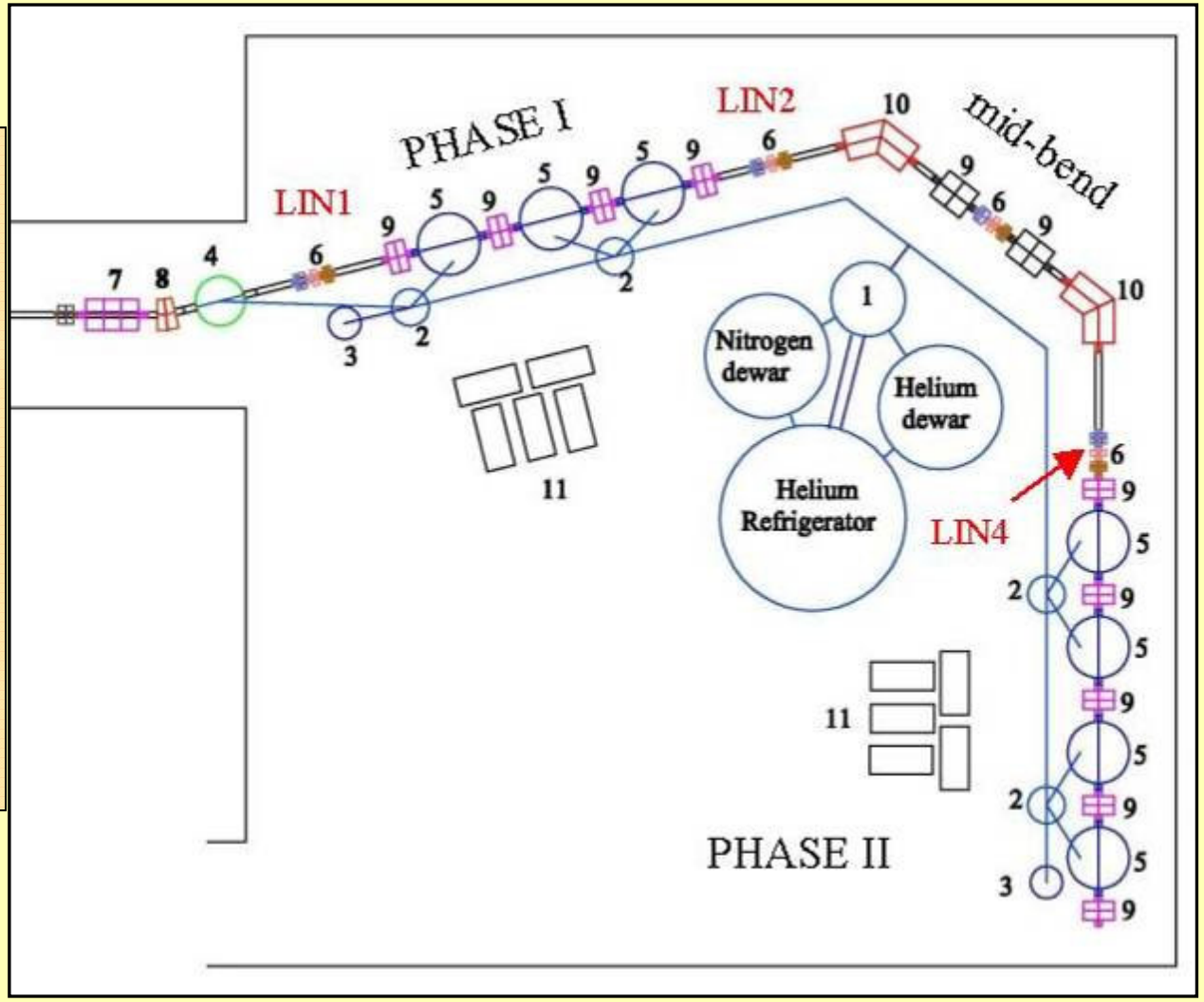
Joint TIFR – BARC Project

Specifications

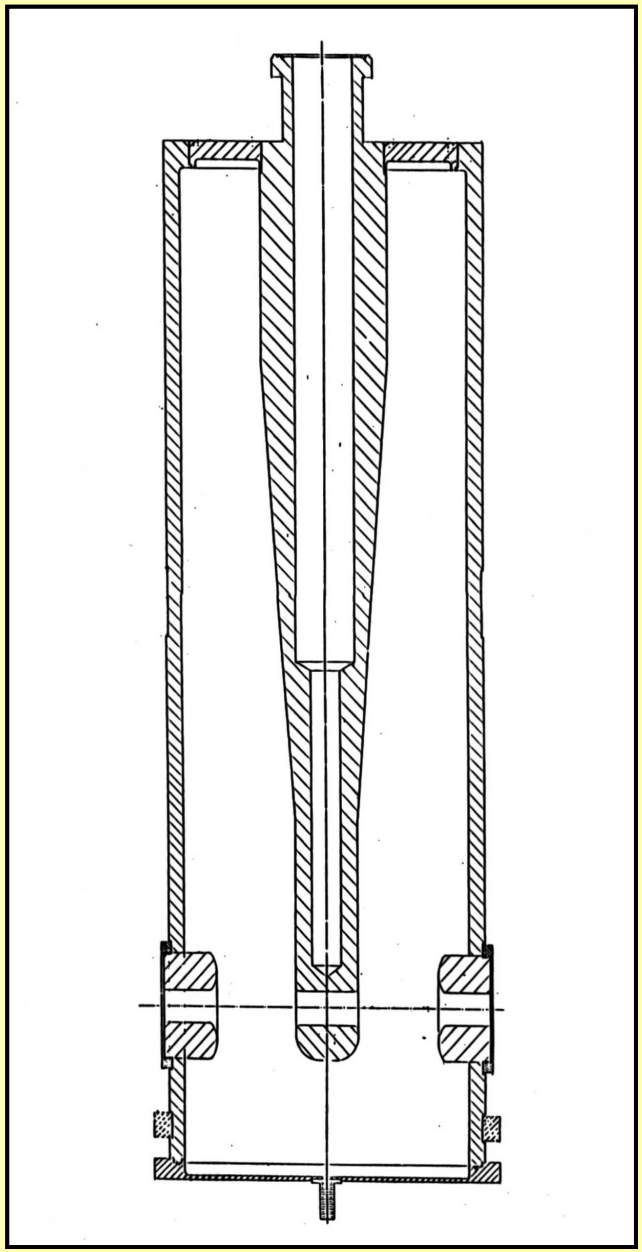
Heavy ions upto A~80
E/A~5-12 MeV

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

Bunch width ~200 ps
Beam Intensity 0.1-10 pnA

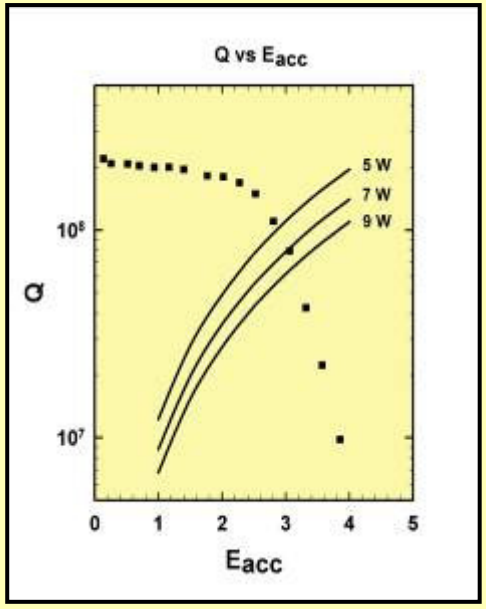


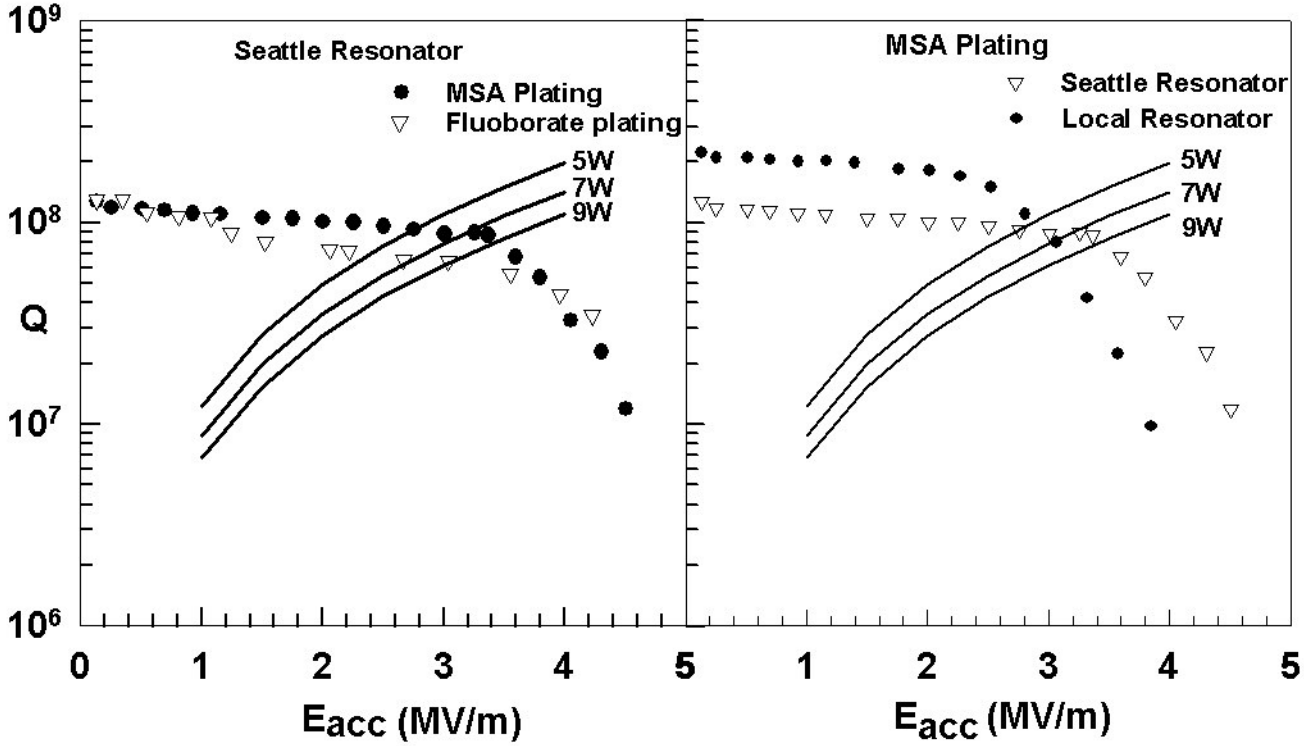
Phase I commissioned on September 22nd, 2002
Phase II commissioned on July 9th, 2007
LINAC dedicated to users on Nov. 28th, 2007



Quarter Wave Resonators

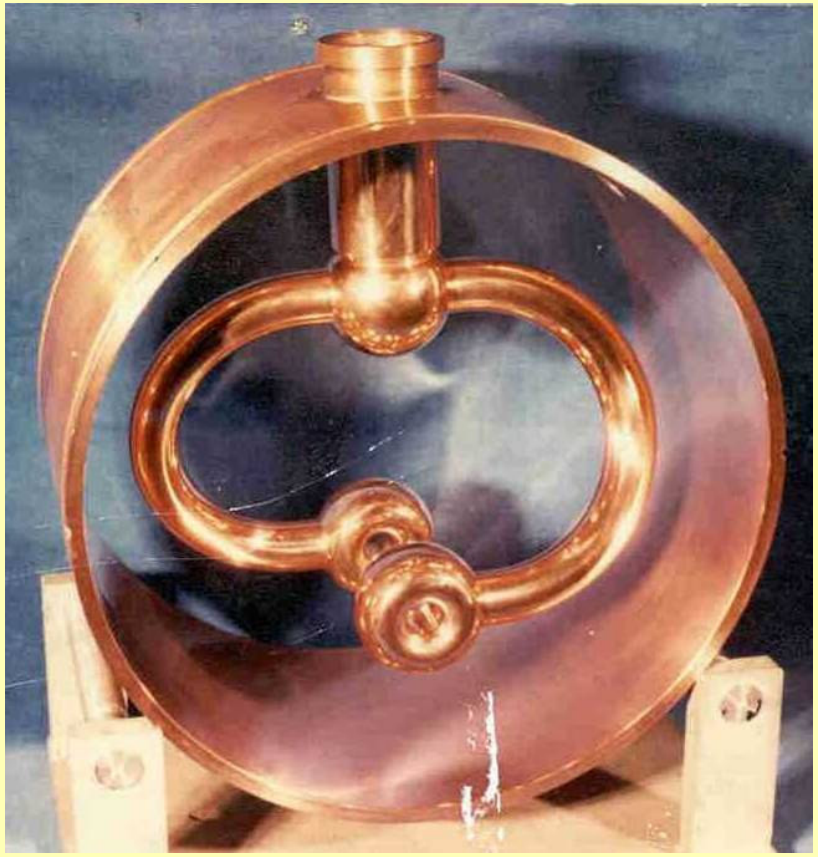
Material	OFHC Cu
Superconducting surface	2 μm thick. Pb
Frequency	150 MHz
Cavity Length	64 cm
Cavity Diameter	20 cm
Optimum velocity	β=0.1
Design goal	2.5 to 3 MV/m @ 6 to 9 Watts




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)

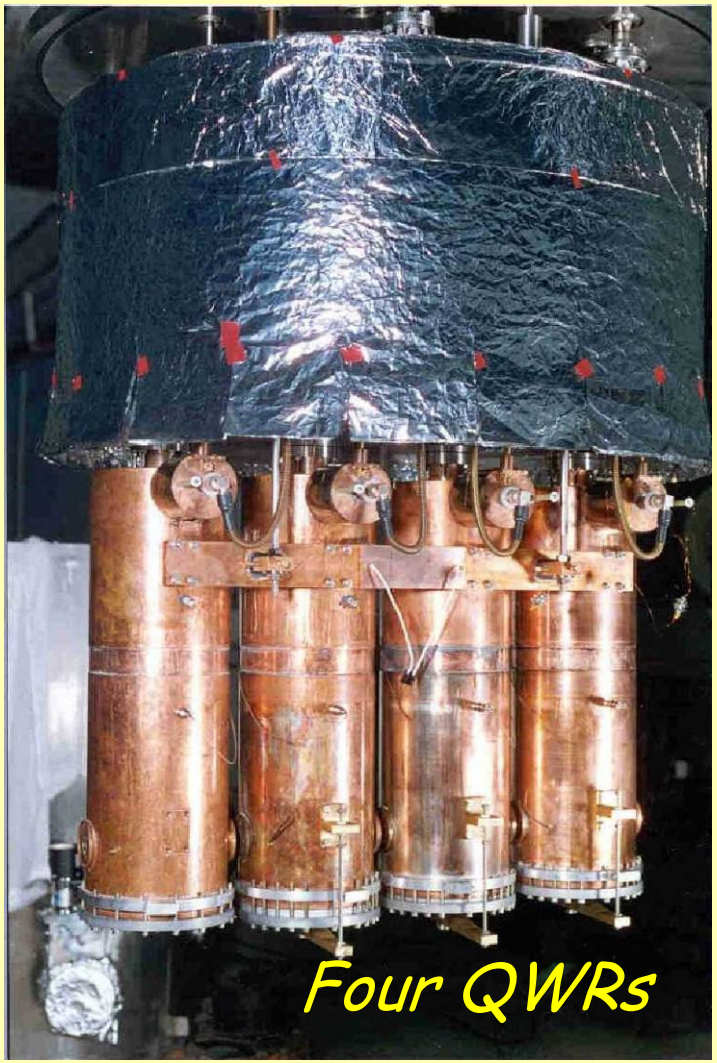
Superbuncher cavity

Before Plating

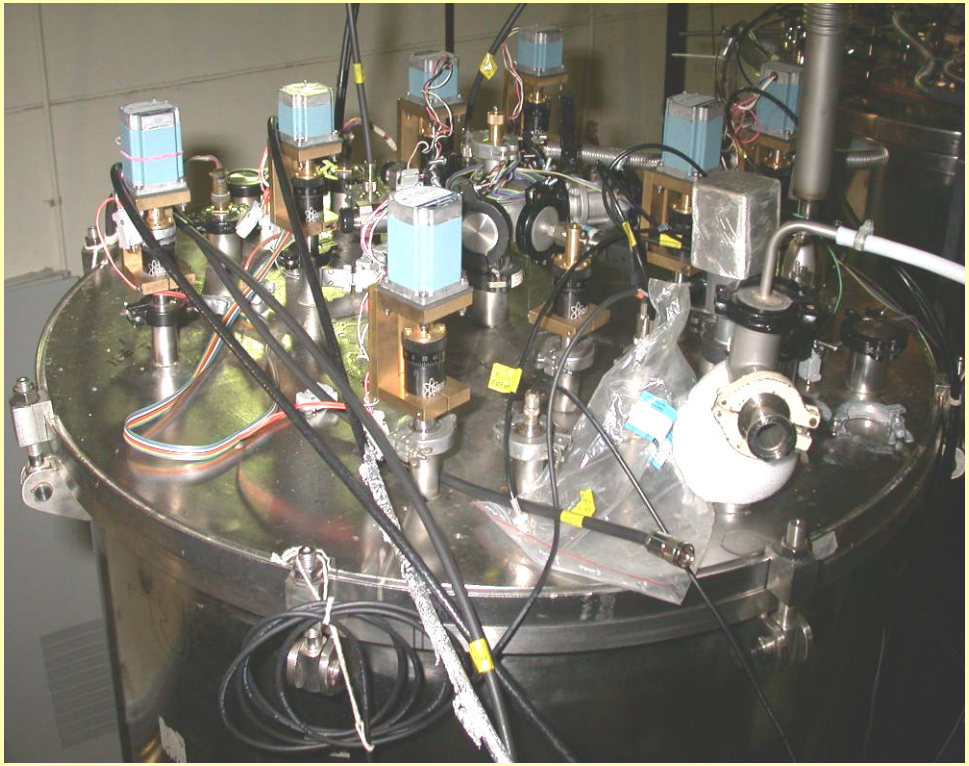


After Lead Plating

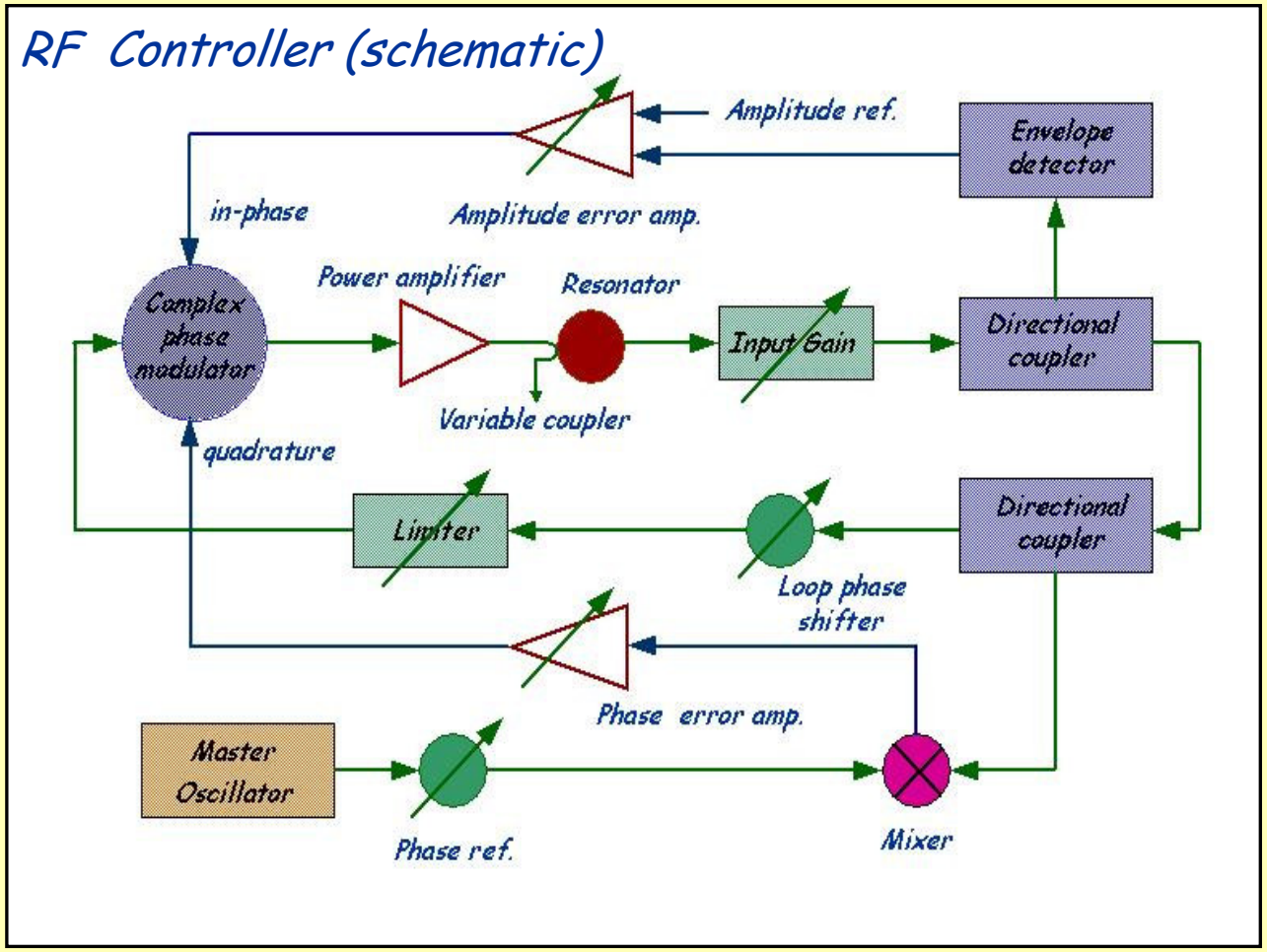
Module Cryostat

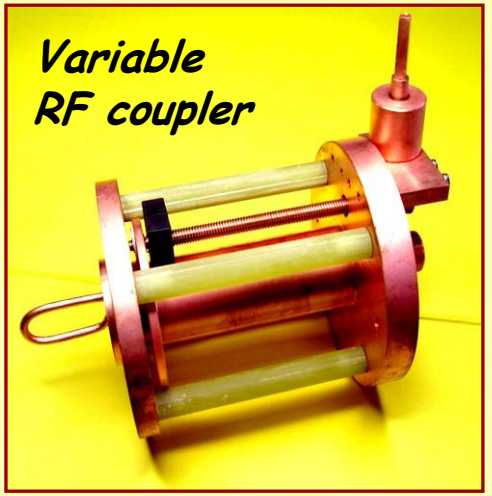


Top view of the module



RF Controller (schematic)



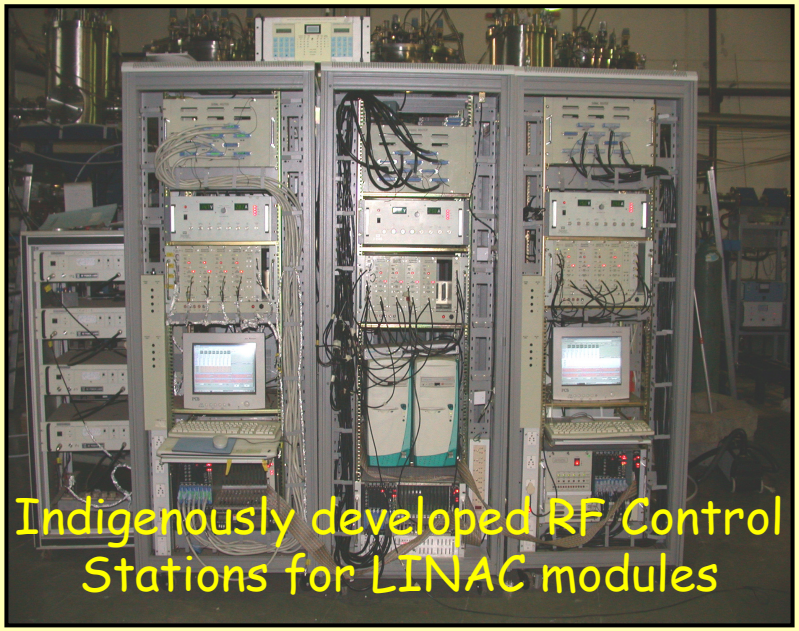


- *RF controller cards based on self excited loop based on phase and amplitude feedback.*

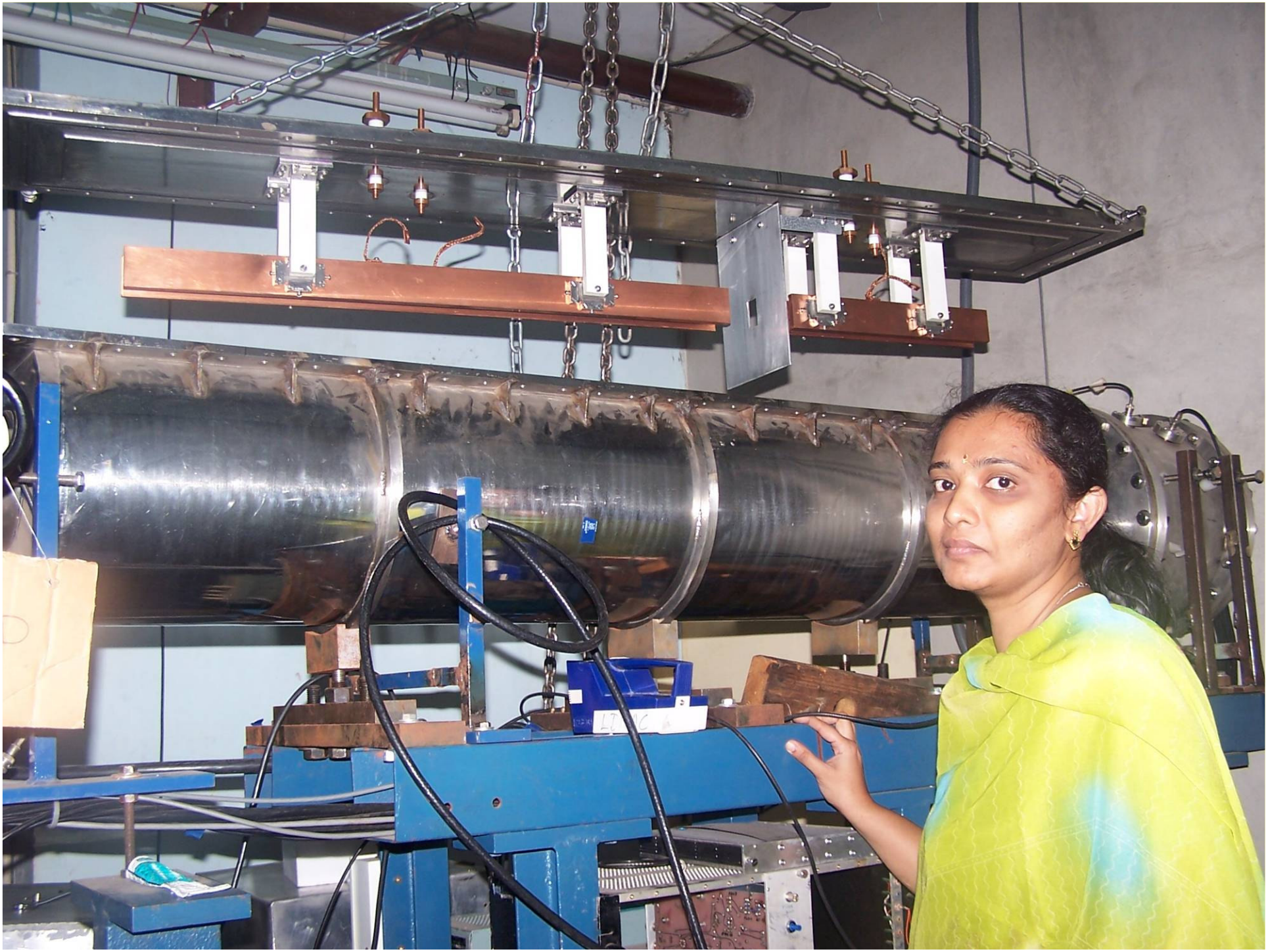
Also delivered to ANU Canberra, IUAC New Delhi

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



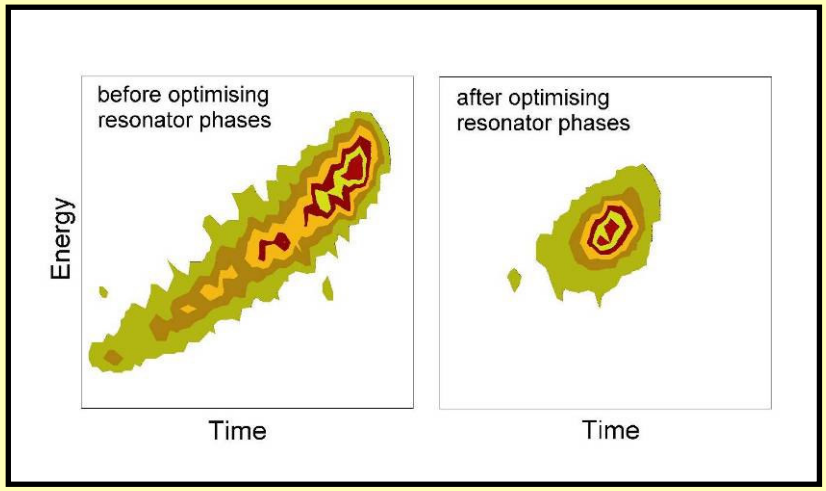
Cryogenics system for the Linac

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

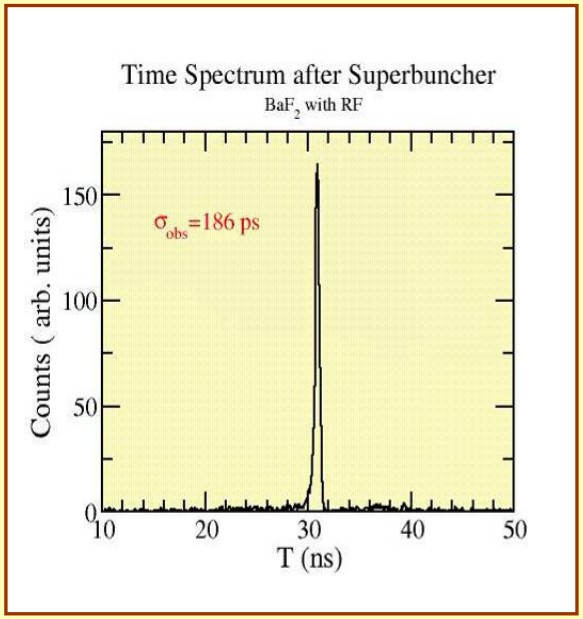
Refrigeration at 4.5 K/Liquification

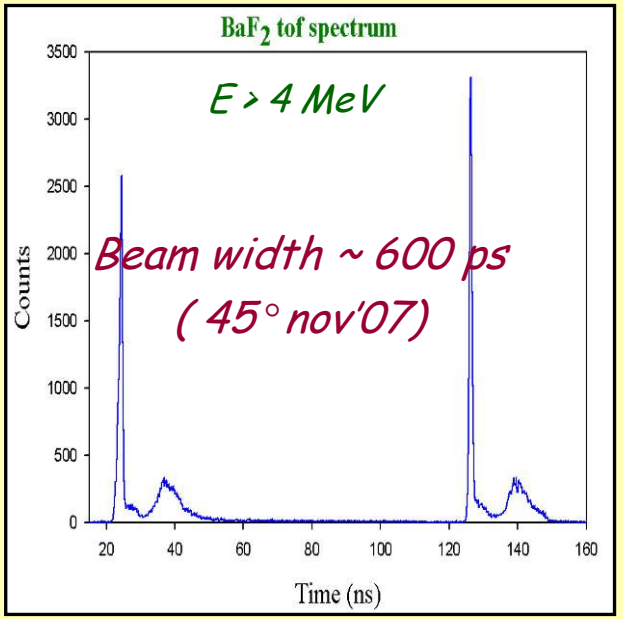
Without LN_2	300 W, 50 l/hr
With LN_2 pre-cooling	380 W, 120 l/hr

The entire cryogenic distribution was fabricated and assembled on-site and has performed as per design.



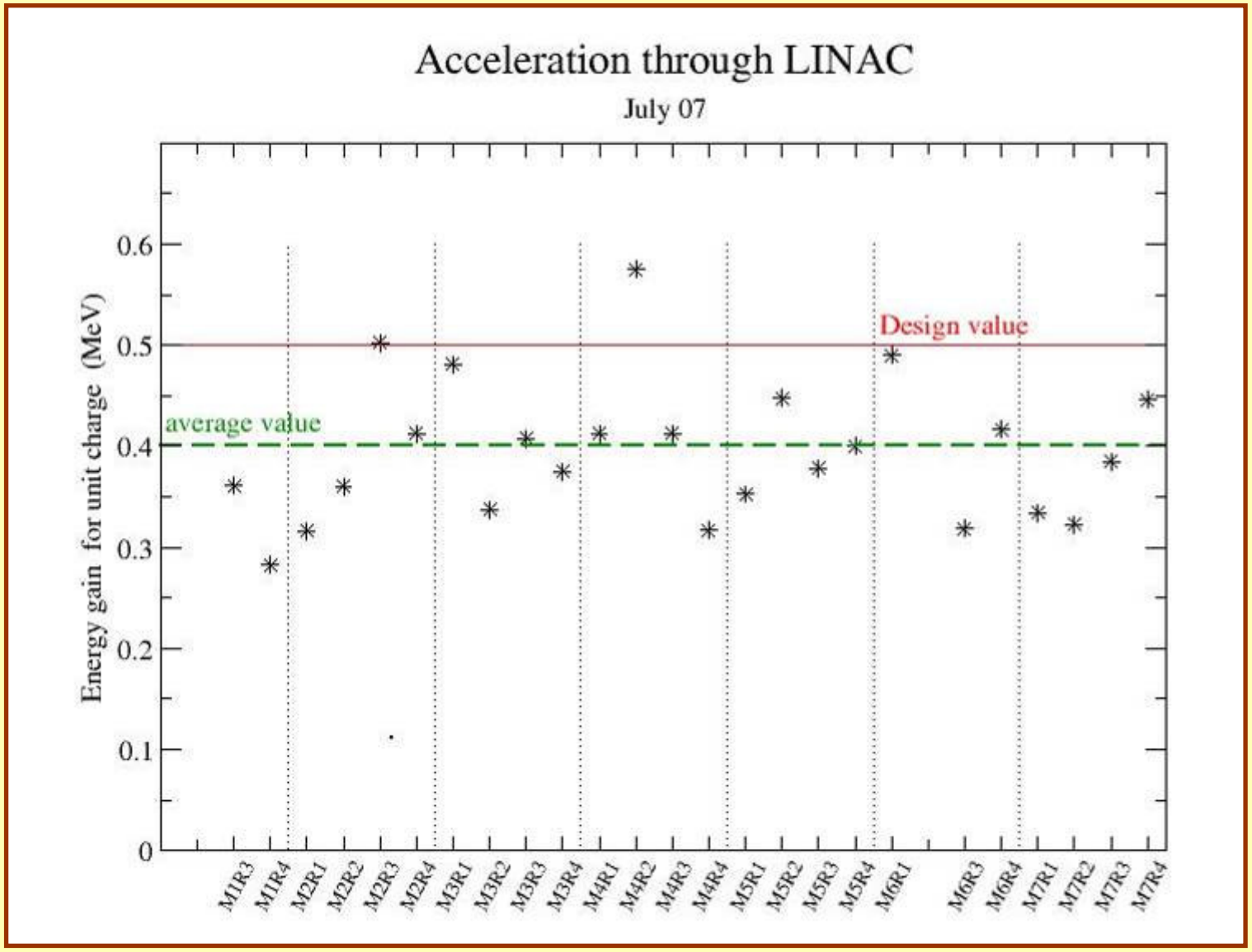
Longitudinal phase space after mid-bend

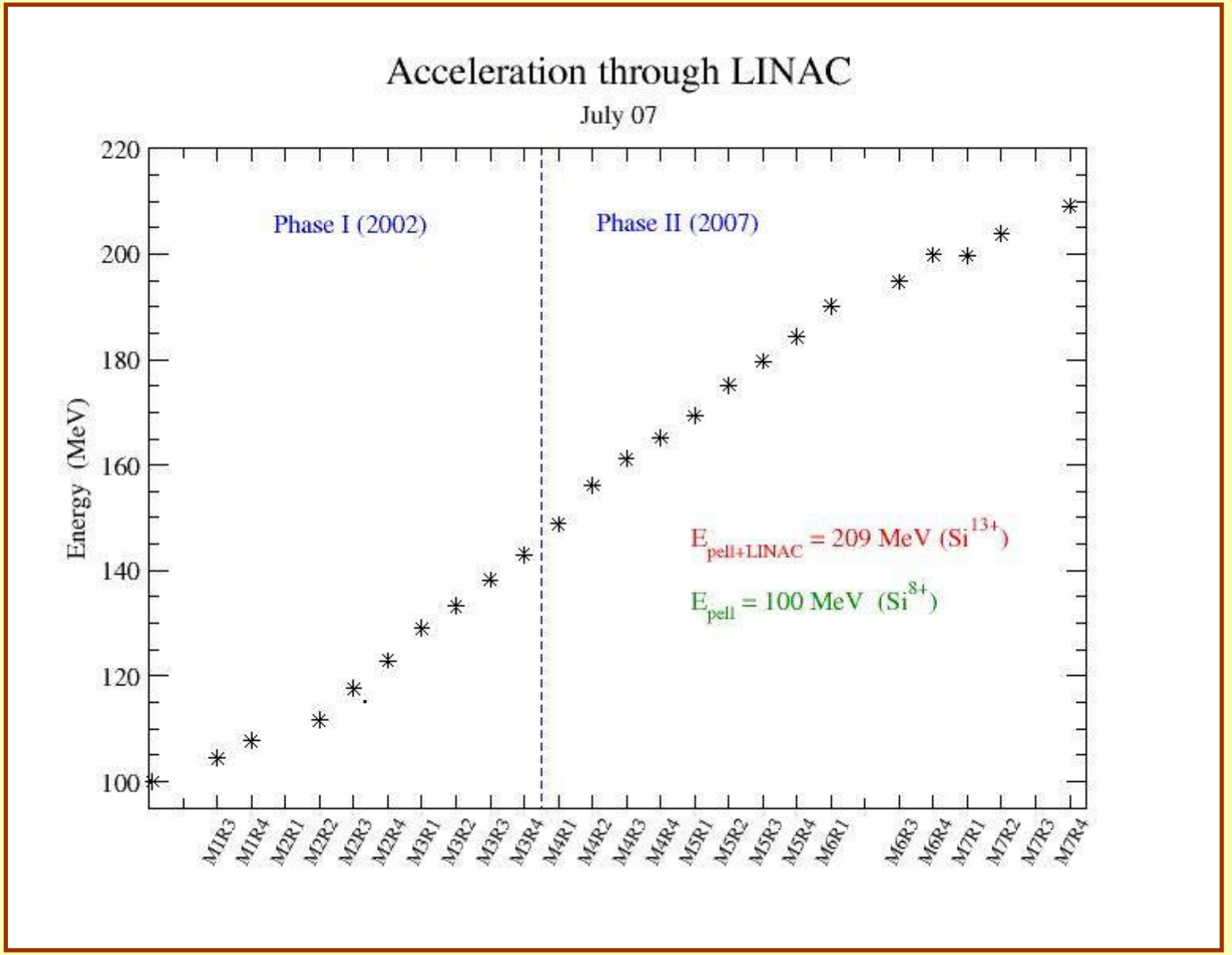




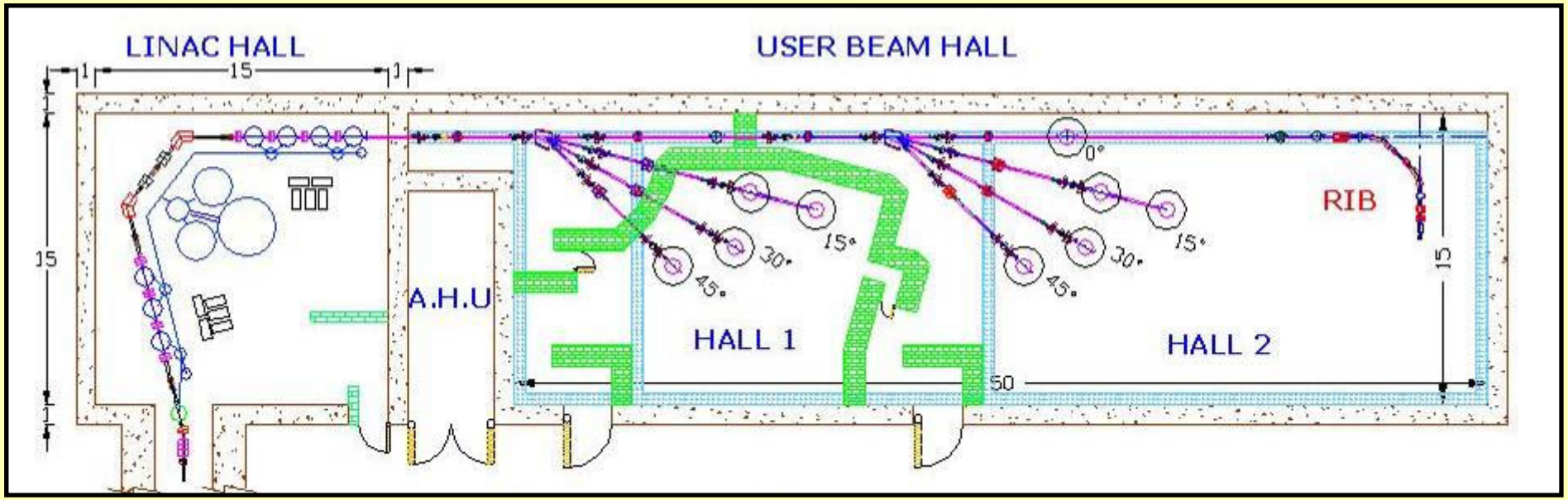
Full LINAC Test (July 07)

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




Acceleration through LINAC
July 07
Phase I (2002)
Phase II (2007)
Energy (MeV)
220
200
180
160
140
120
100
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

LINAC & Experimental Beam Halls



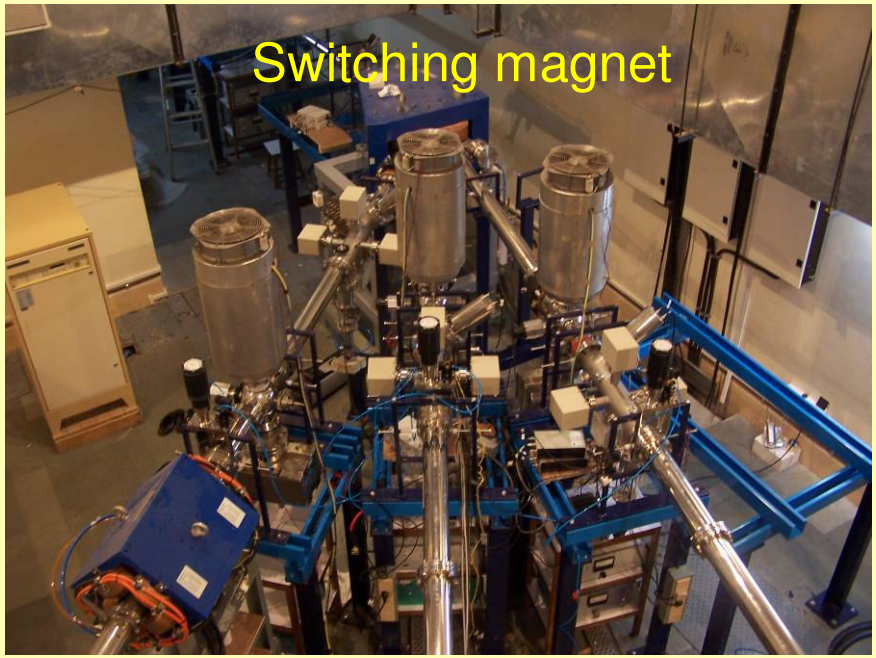
Hall 1

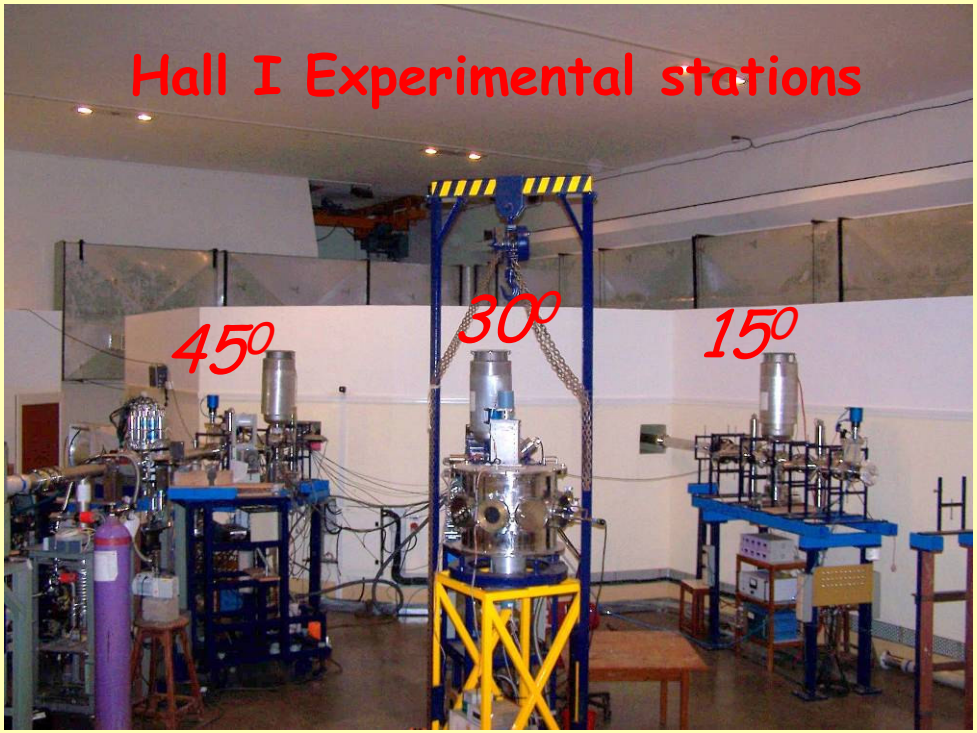
- Condensed Matter Physics (7 T Magnet) & Atomic, Molecular & Cluster Physics
- General purpose / Irradiation line
- High energy gamma ray & neutron wall

Hall 2

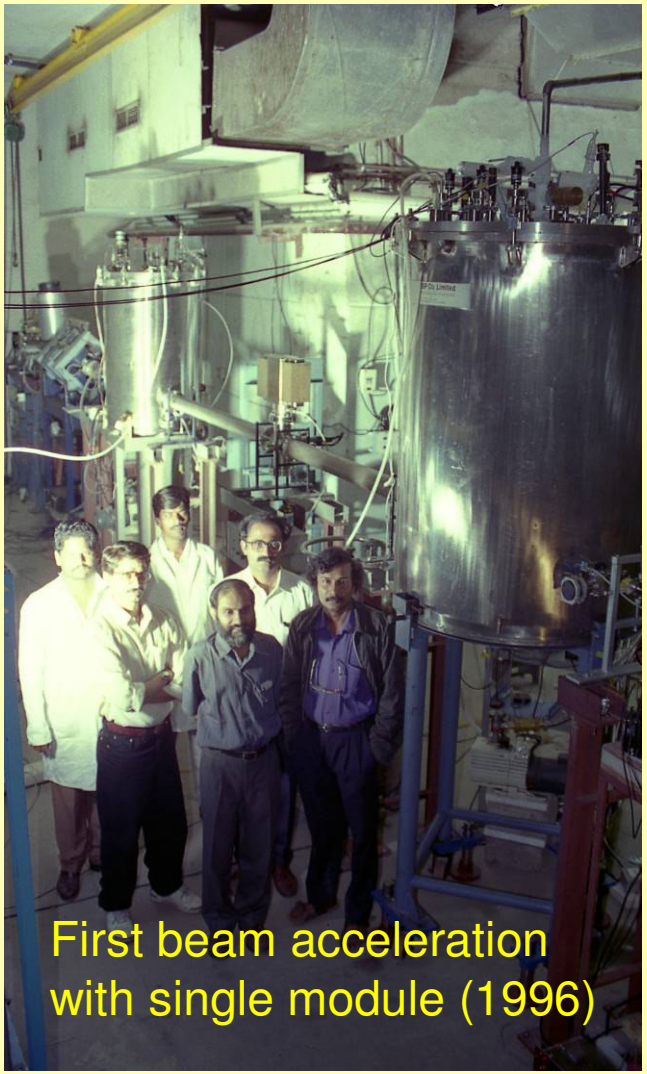
- General Purpose Scattering Chamber
- HP Ge Spectrometer (INGA)
- Charged particle ball
- Magnetic separator for light RIBs

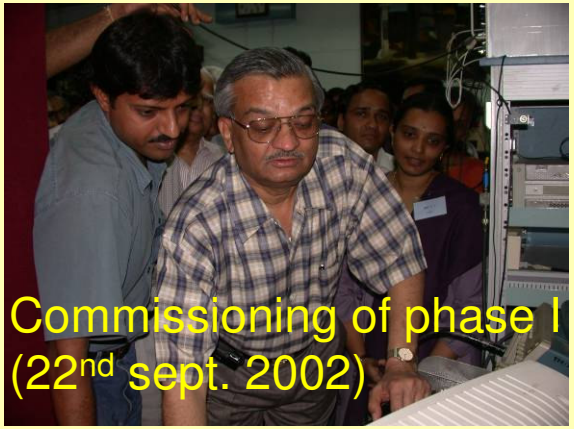
User beam Hall I





Some Milestones …


First beam acceleration with single module (1996)


Commissioning of phase I (22nd sept. 2002)


First LINAC experiment begins on 16th April 2003


Dedicated to Users on November 28th, 2007

TIFR & BARC

PelletronTeam

R.G. Pillay R.K. Choudhury S. Kailas P.V. Bhagwat A.K. Gupta S.K. Sarkar J.A. Gore S.G. Kulkarni N.Mehrotra A.G. Mahadkar D. Thapa R.M. Kale A. Shanbag C. Sunil P. Surendran S.C. Sharma Ramlal Ramjilal Q.N. Ansari J.P. Nair N.G. Ninawe R.N. Lokare M.L. Yadav J.K. Yadav U.V. Matkar M. Ekambaram H. Sparrow G.K. Nikam P.V. Gudekar P.C. Bolar S.B. Salvi J.K. Patil W.A. Joseph M.K. Salunke S.M. Jadhav N.T. Jadhav R.S. Worlikar

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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

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