

# ACCELERATORS IN INDIA

**14UD Pelletron at TIFR, Mumbai**

**15UD Pelletron at NSC, Delhi**

**K=140 Variable Energy Cyclotron at Kolkata**

**700 MeV electron synchrotron at CAT, Indore, 450 MeV storage ring INDUS-I**

**3UD Pelletrons at Bhubaneswar and Hyderabad**

**2MV Van de Graaff at, IIT, Kanpur and IGCAR, Kalpakkam**

**7 MeV cyclotron at Chandigarh**

**5.5 MV Van de Graaff at BARC converted into a 7 MV folded tandem**

**8 MeV electron microtrons at Pune and Mangalore**

**Small (<1 MV) Van de Graaff and Cockroft-Walton generators at BHU, Patiala, Waltair and Calicut.**

## UNDER CONSTRUCTION

*Superconducting Linac booster upgrades at Mumbai and Delhi,*

*Superconducting Cyclotron at Calcutta*

*2.5 GeV Storage ring, INDUS-II at Indore*

**High Intensity ( 1 GeV, >10 mA) proton machine for ADS**

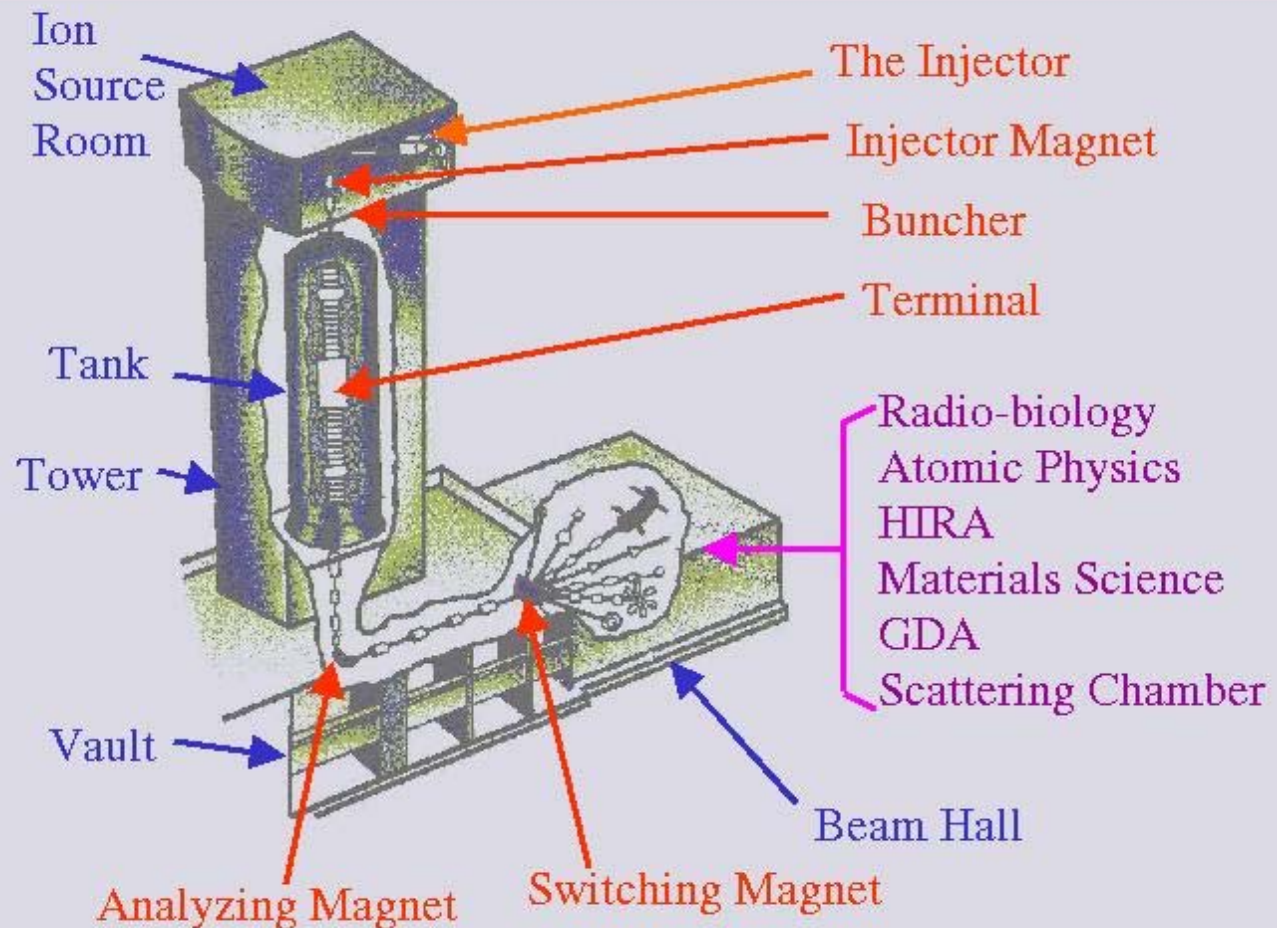
# The Pelletron Accelerator

Tank ht: 26.5 m  
Diameter: 5.5 m  
Pressure: 86 PSI  
of SF<sub>6</sub> gas

Ions  
accelerated:  
H to Au beams

Ion Currents:  
Typically  
5 - 50 pA

Energy : 30 -  
250 MeV



At NSC, Delhi & TIFR, Mumbai

# Accelerator Augmentation at NSC



## 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

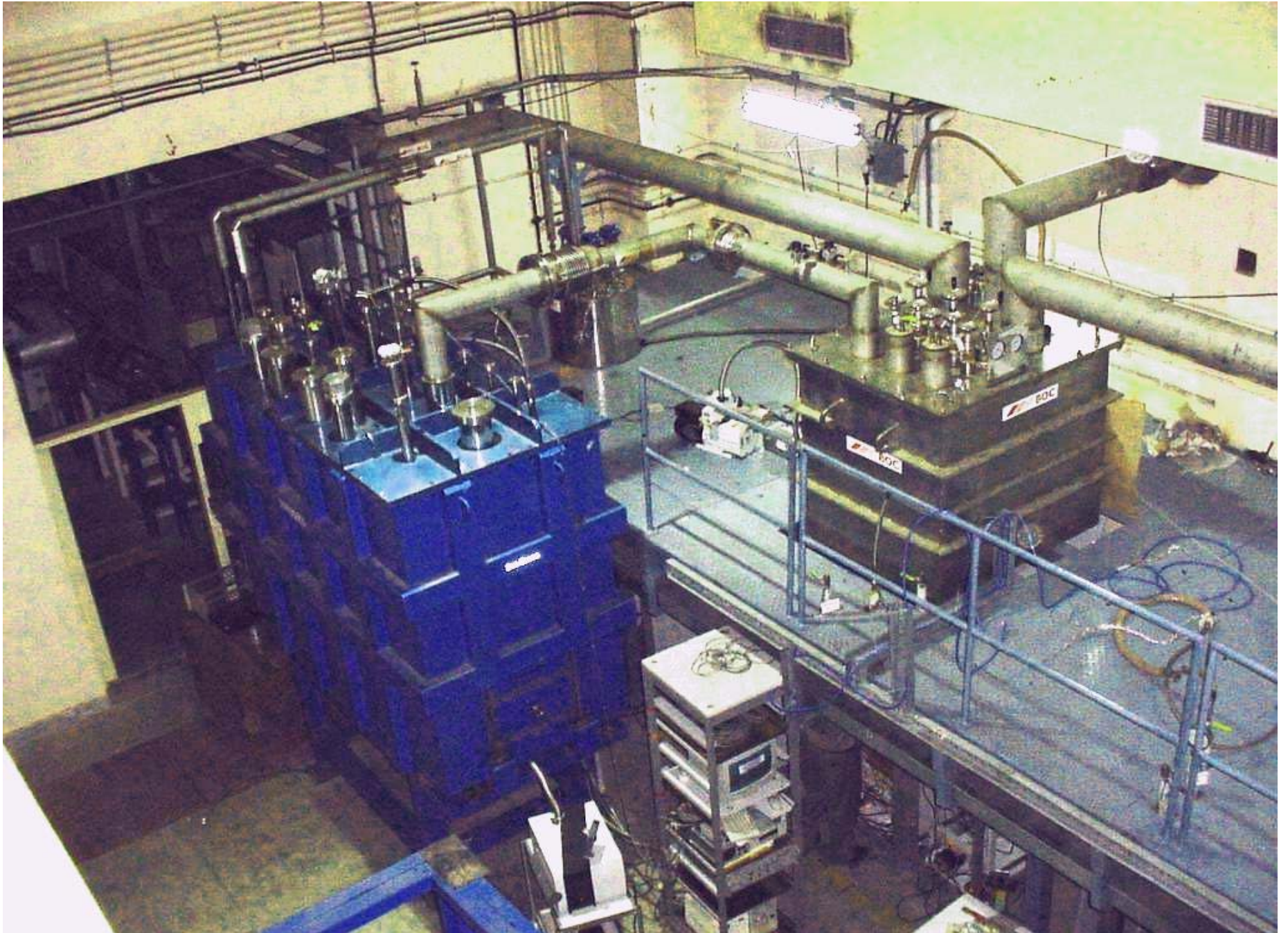
Versatile facility for heavy ions , multiply charged ions down to few keV energy.

## High Current Injector

Novel Electron Cyclotron Resonance ion source using high Tc superconductor.

Radio frequency quadrupole accelerator

# First Linac Module aligned in beam line at NSC



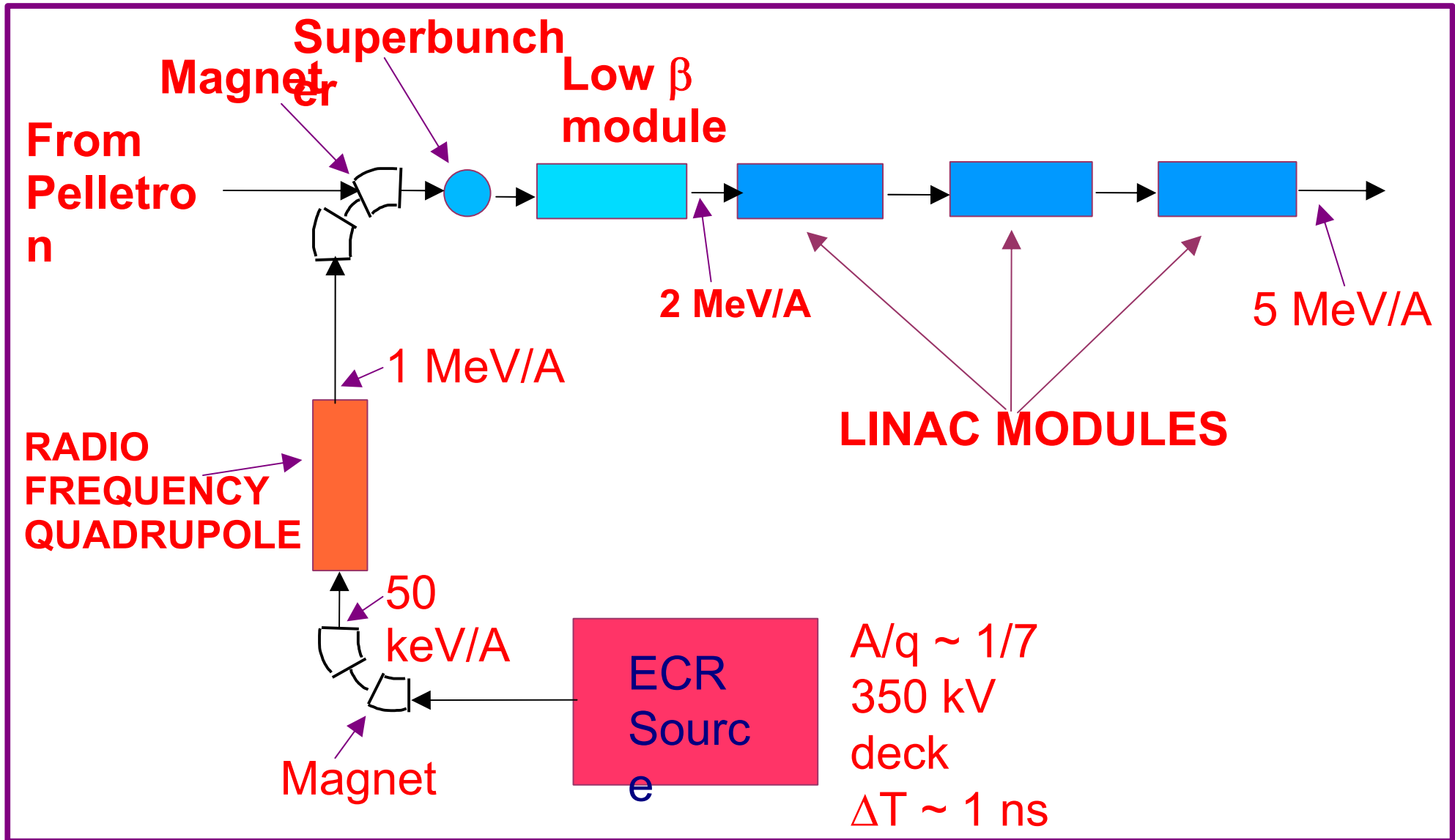
# QWR Resonators mounted in linac cryostat



# Indigenously welded Resonator, NSC

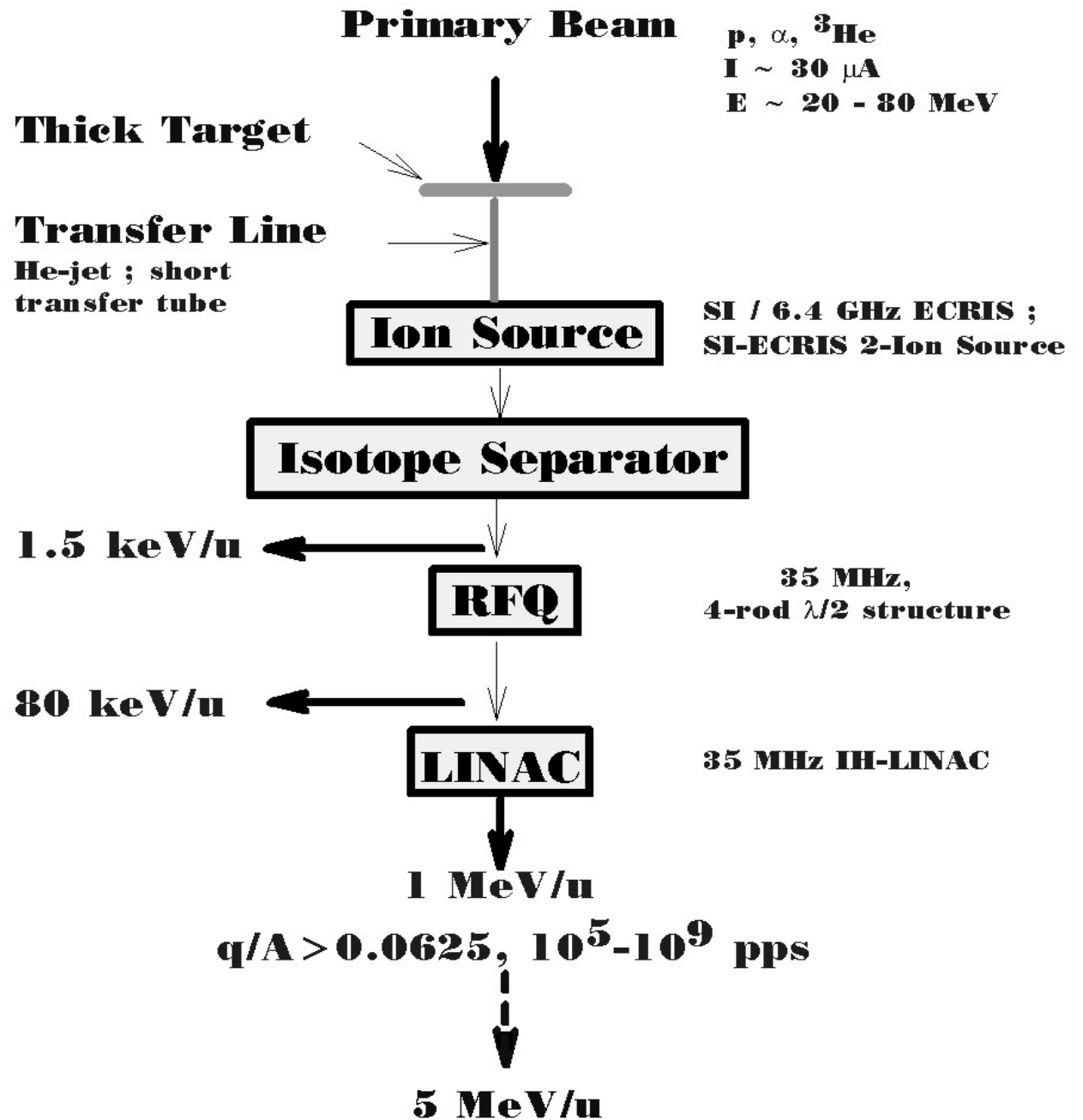


# ECR based High Current Injector for LINAC



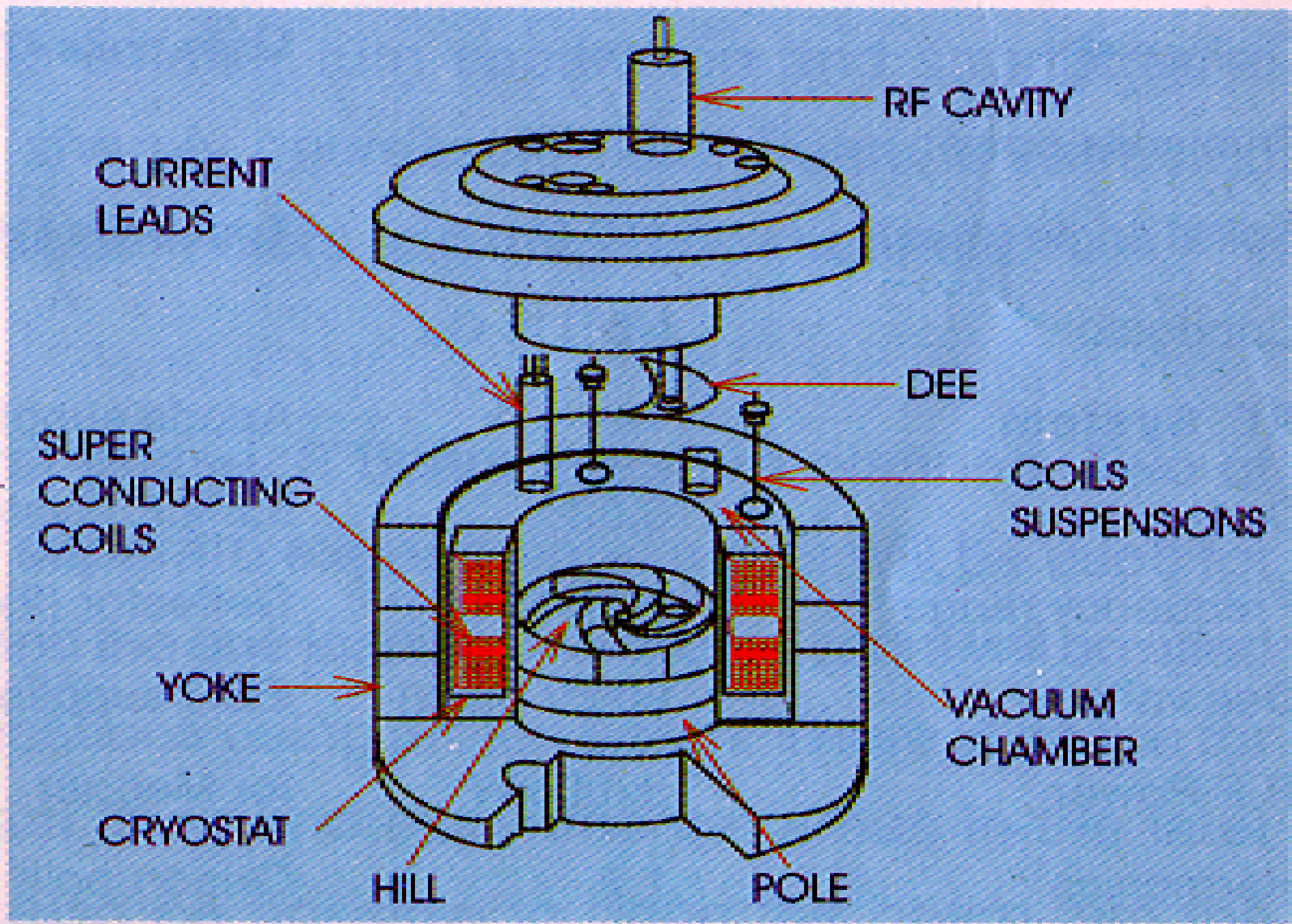


**K= 140 Variable Energy Cyclotron to be used as the primary beam source for Radioactive Ion Beams.**



**Proposed RIB facility at VECC Calcutta**





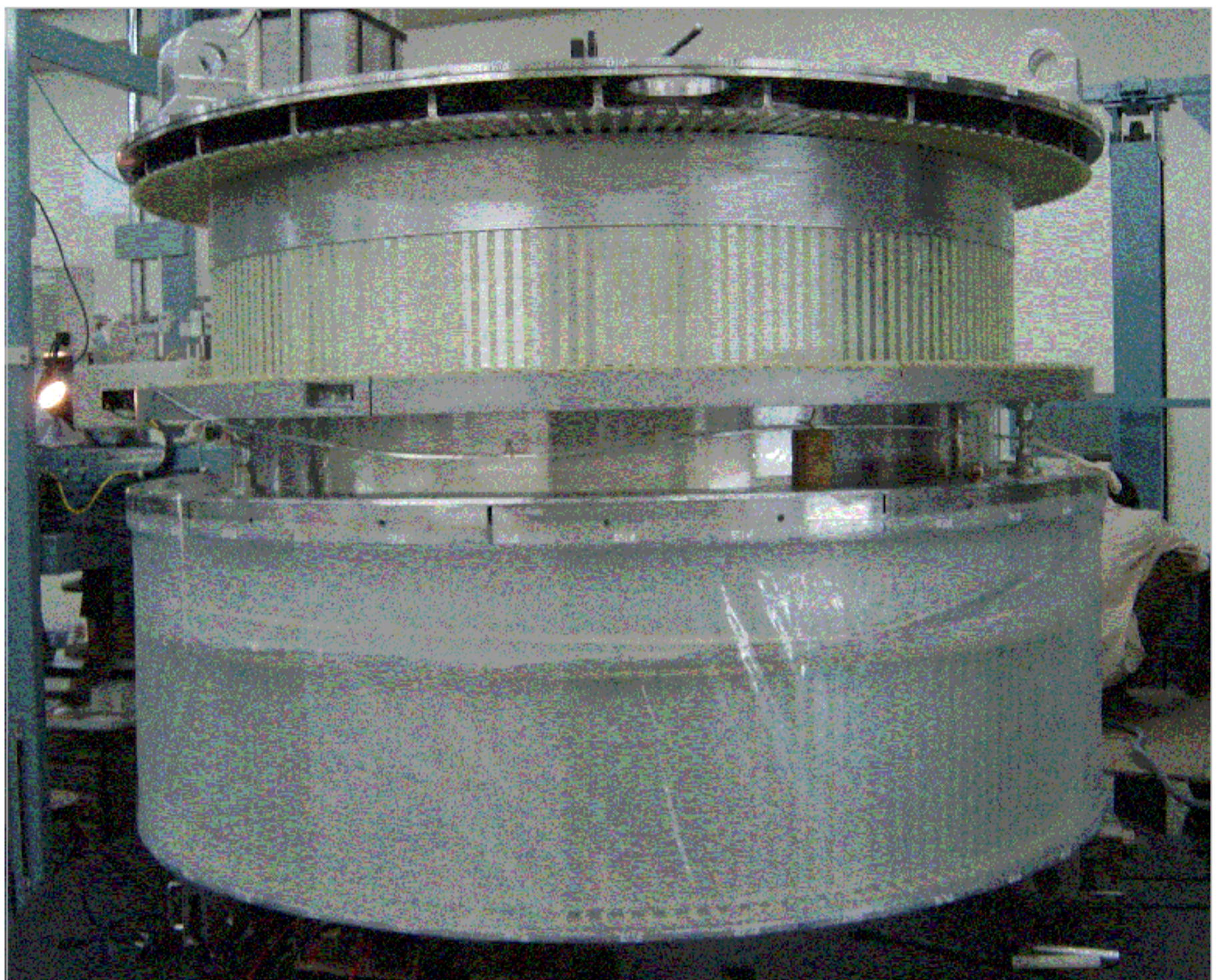
Schematic of Superconducting Cyclotron at Kolkata



Top cap of magnet for superconducting cyclotron, Kolkata

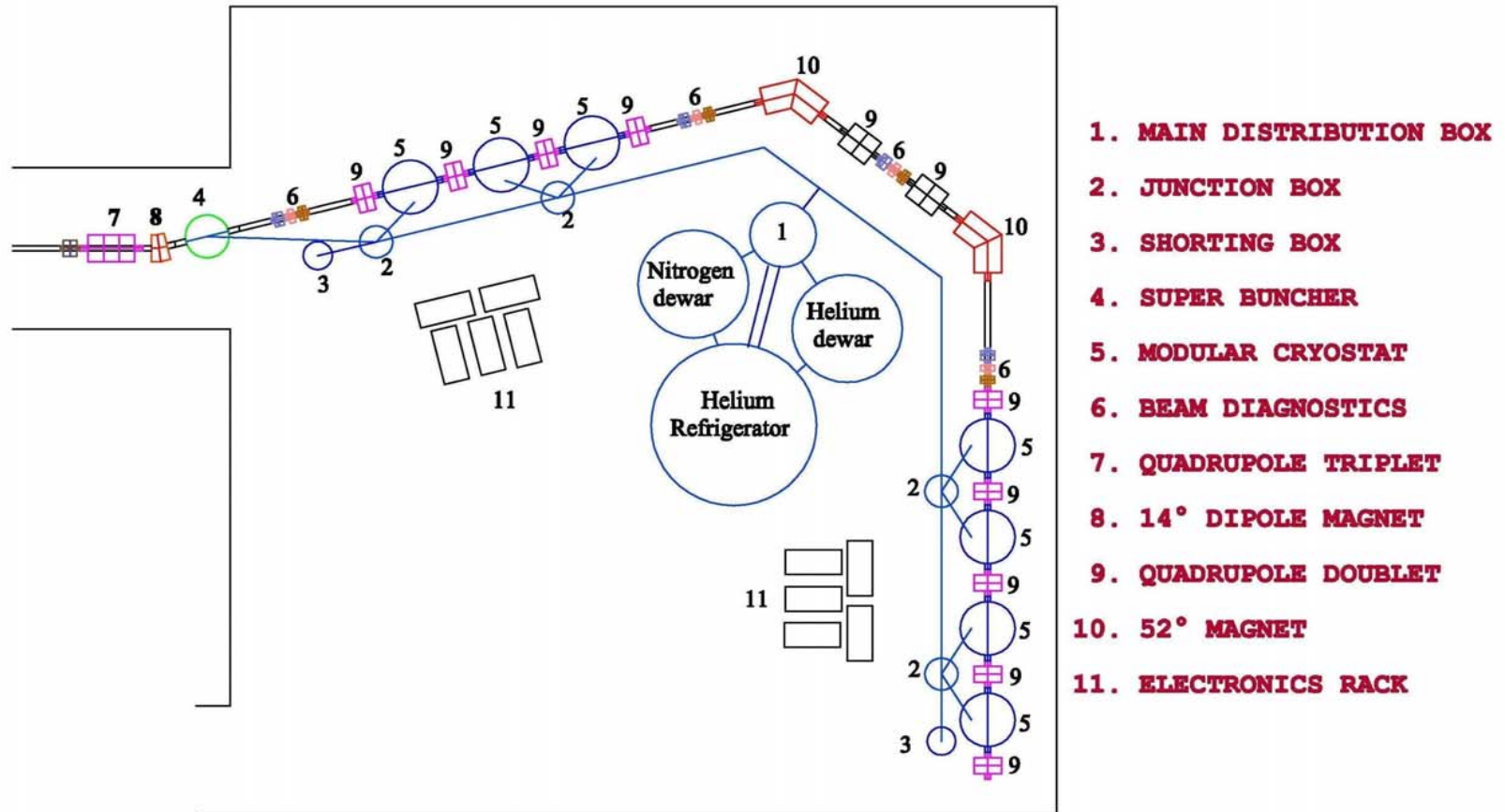


**Coil Winding Set Up for K- 500 Superconducting Cyclotron Magnet Coil**



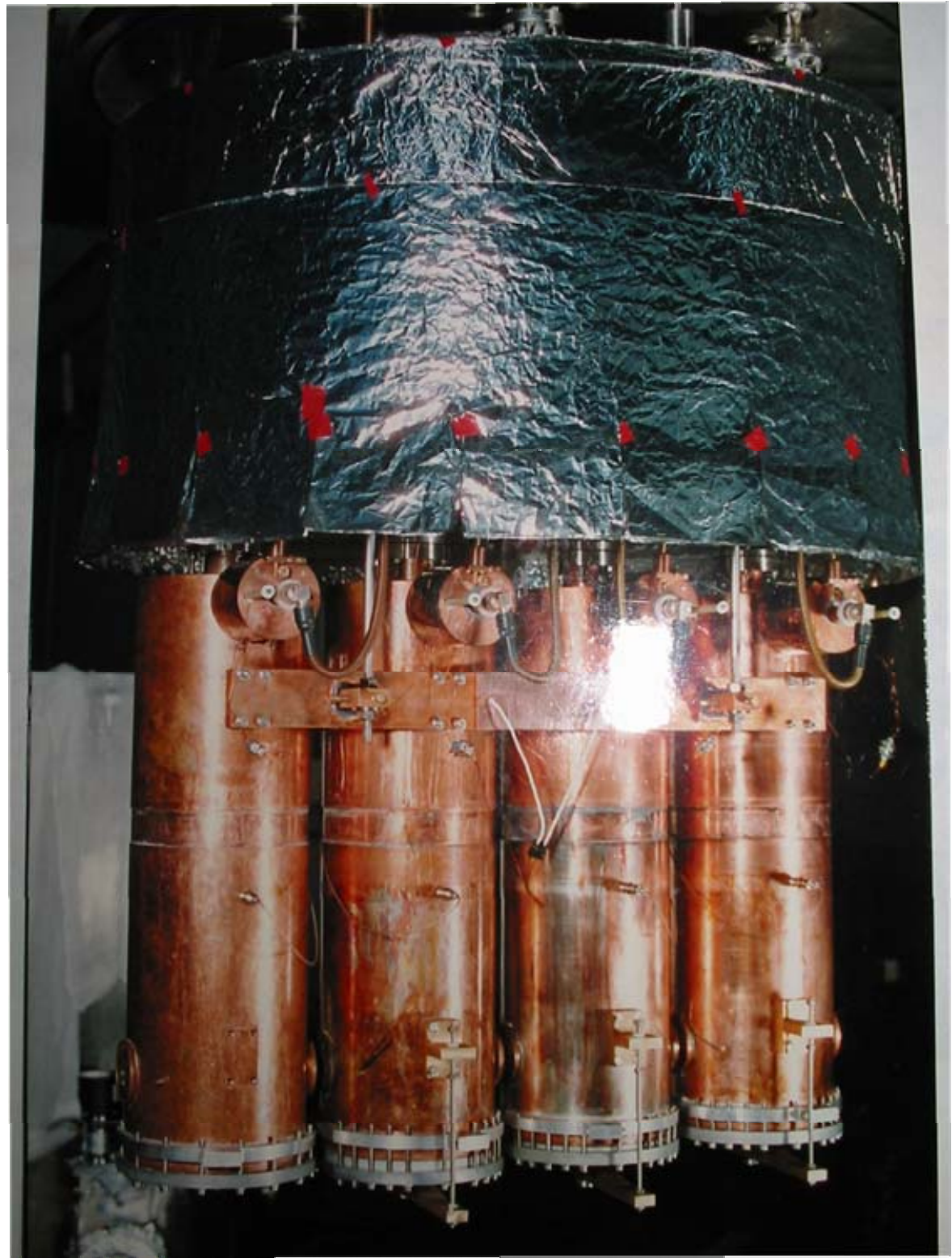
**Superconducting Magnet Coil (Lower  $\alpha$  &  $\beta$  Coil Completed)**

# Schematic of Superconducting Linac booster at TIFR



***SCHEMATIC LAYOUT OF LINAC HALL***

**Pb plated Cu QuarterWave  
Resonators mounted in the  
Cryostat for TIFR Linac**



# Technologies Developed

**Resonant Cavity :** Design & Fabricatiopn of bulk Nb,  
Pb plating

**Cryogenics:** Cryostats, Transfer lines & Valve  
Boxes

He purifiers, Impurity Monitors

**RF systems:** RF generators, Control Electronics

**Beam Transport:** Dipole Magnets, Quadrupoles,  
Correctors

Transport Codes

# Centre for Advanced Technology, Indore



## Parameters of INDUS-1

Electron Energy : 450 MeV  
Current : 100 mA  
Critical wavelength:  
a) Bending : 61 Å  
b) Wiggler : 31 Å  
Circumference : 19 m  
Magnetic Field : 1.5 Tesla  
Beam Life time : ~ 4 hours  
Bending radius : 1 m  
Lattice type : combined  
Beam envelope vacuum :  $< 10^{-9}$   
mbar

## Booster

Electron energy : 700 MeV  
Beam current : 30 mA  
Lattice type : separated  
Magnetic field : 1.32 Tesla  
Circumference : 28.44 meters  
Beam envelope vacuum :  $< 10^{-6}$   
mbar  
Bending magnet radius : 1.8 m





INDUS I Ring at CAT

# PARAMETERS OF INDUS II RING

## Parameter

## Value

Beam Energy	2.5 GeV
Beam Average Current	300 mA
Bending Magnetic field	1.502 T
Bunch length (2s)	2.24 cm
Circumference	172.4743 m
Beam half lifetime	24 hours
Energy spread	9.0 E-4
Harmonic Number	291
Beam emittance : x	5.81 E <sup>-8</sup> m.rad
Beam emittance : y	5.81 E <sup>-9</sup> m.rad
Revolution frequency	1.738 MHz
RF cavity frequency	505.812 MHz

## Magnet type

## Bending

## Multipole wiggler

## High Field Wiggler

Critical

wavelength

2.0 A

1.66 A

0.60 A

Photon Flux

1.20 x 10<sup>13</sup>

1.32 x 10<sup>14</sup>

1.20 x 10<sup>13</sup>

Brightness

1.02 x 10<sup>14</sup>

4.42 x 10<sup>14</sup>

5.47 x 10<sup>13</sup>

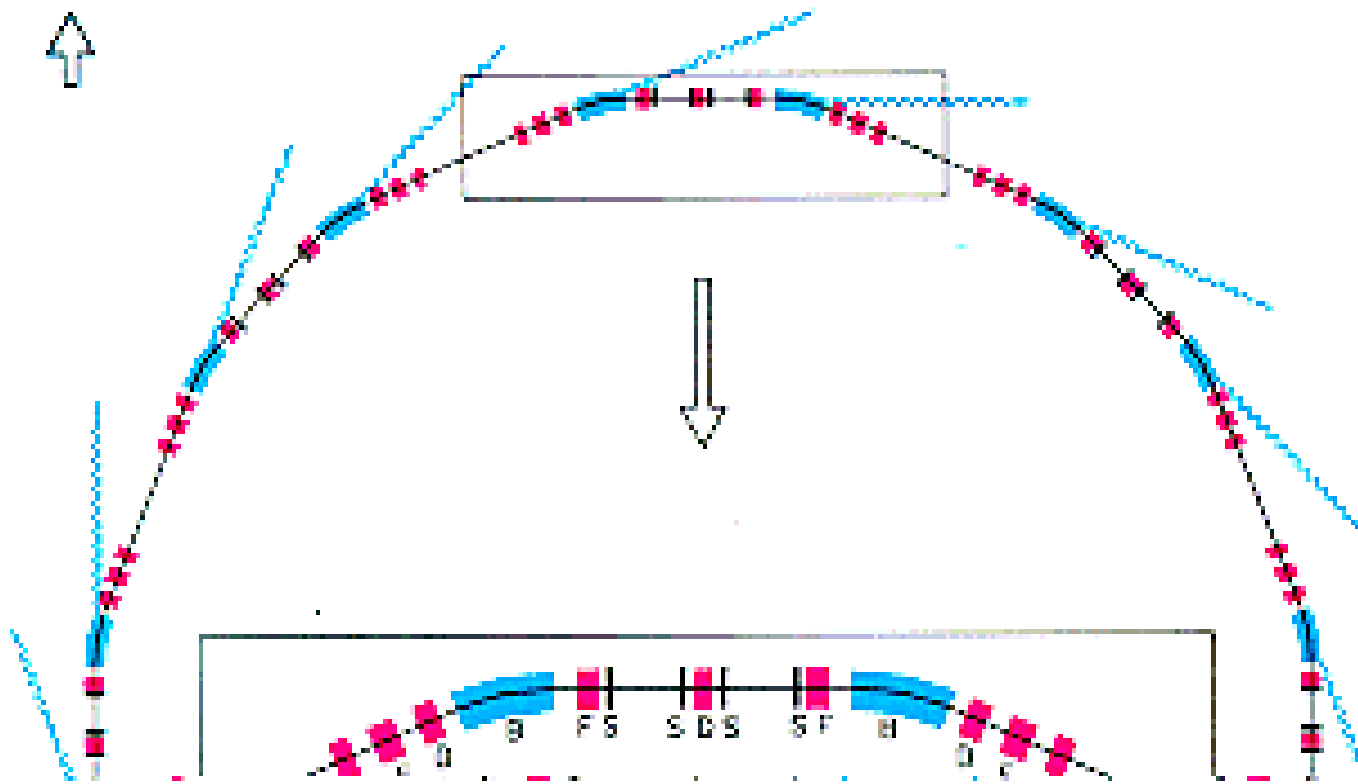
Radiation

Power Loss

186.6 kW

8.1 kW

6.7 kW



Scheme of INDUS II Ring

