SUPERCONDUCTING RF DEVELOPMENT AT INTER-UNIVERSITY ACCELERATOR CENTRE (IUAC)

(JOINT PROPOSAL FROM *IUAC & Delhi University (DU)*)

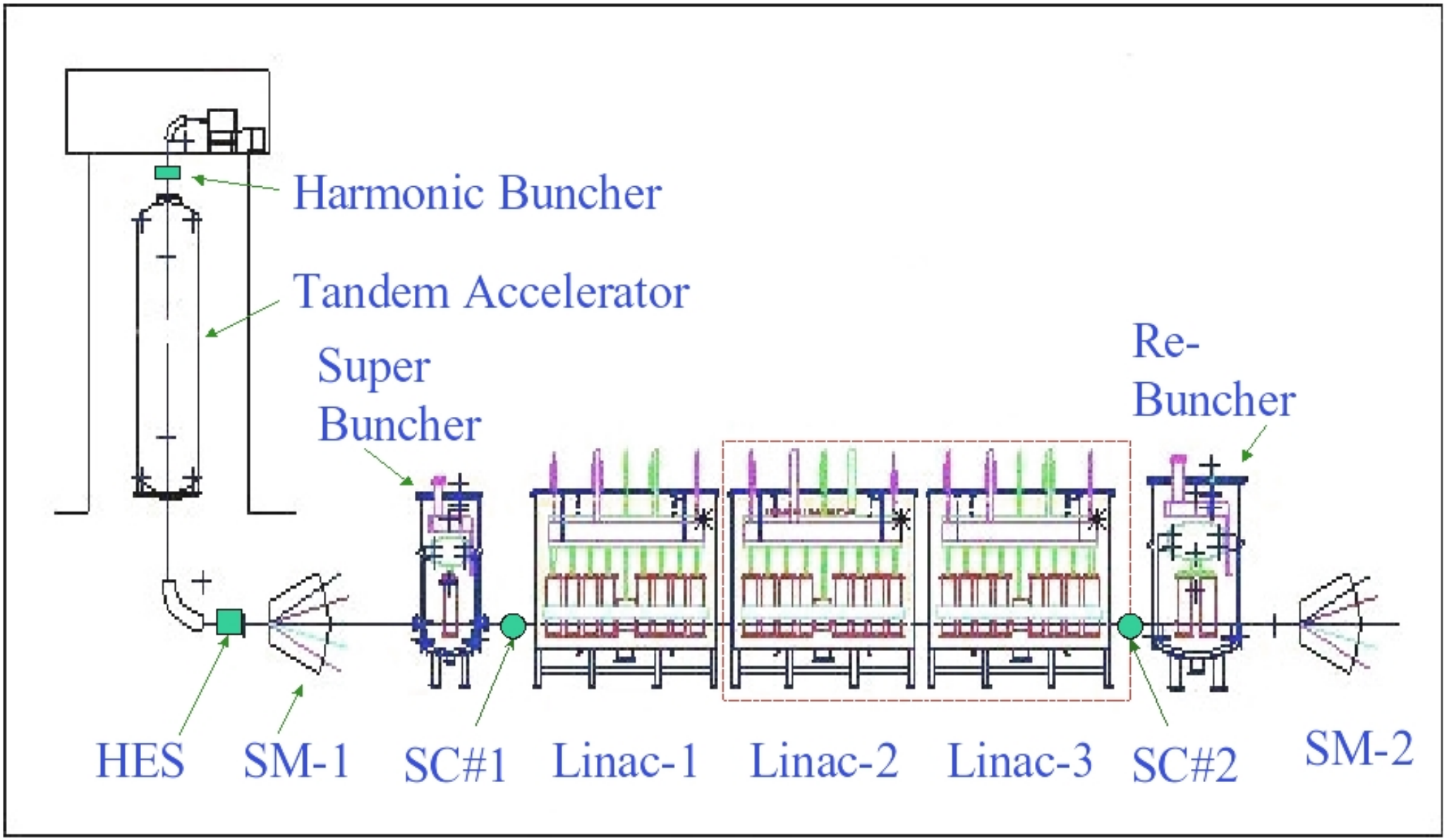
Amit Roy
Director, IUAC

to be presented by Kirti Ranjan (DU / Fermilab)

Overview

- Superconducting Linac Booster & existing SCRF program at IUAC
- Superconducting Resonator Fabrication Facility at IUAC
- RF & Electronics Development at IUAC
- ECR based High Current Injector program at IUAC
- Accelerator related collaborations of IUAC
- Delhi University's (DU) perspective
- PROPOSAL

Inter-University Accelerator Centre Pelletron & Linac Booster



EXISTING SCRF PROGRAMME AT IUAC

Superconducting Linac Booster

- Design and Fabrication of Nb QWR cavities 12 made at ANL, 18 at IUAC (Programme near completion, July/August 2007)
- Design and fabrication of Cryomodule
- Design and Fabrication of Cryo distribution system (valve boxes, transfer lines, thermometry, level sensors)
- Design and fabrication of He purity monitor, He purifier

Facilities:

- In-house LHe plant (~500W) and LN2 plant (~90 l/hr)
- Vertical Test Cryostat
- Electron Beam Welding Machine (60 KV, 250 mA)
- Electropolishing facility, High Pressure Rinsing system, Clean Room
- High Vacuum Furnace (1300 C, 10^{-6} Torr)

Superconducting Resonator Fabrication Facility (SuRFF)

Established at IUAC for fabricating Superconducting Niobium Resonators Indigenously.

Electron Beam Welding Machine

15 kW, 60 kV, 250 mA

Vacuum Chamber: 2.5m x 1.0m x1.0 m

X-Y motion & rotary chuck

High Vacuum Furnace

Hot Zone 600mm x1000mm

1300 C @ $1x10^{-6}$ Torr

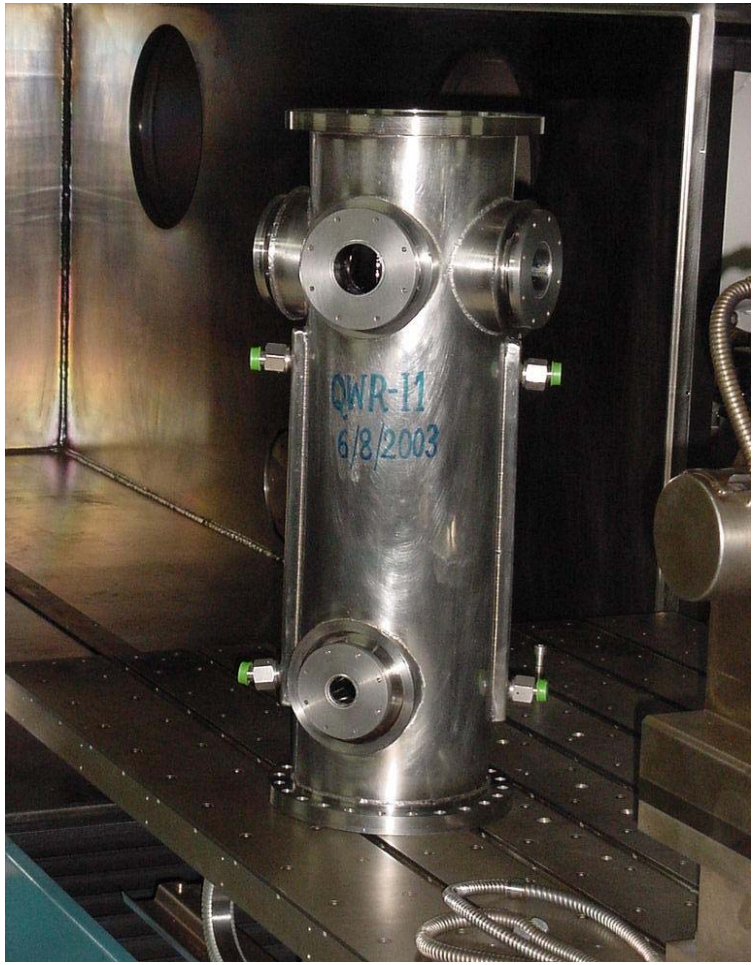
Superconducting Resonator Fabrication Facility (SuRFF)

Fumehood, Power supply, Ultrasonic bath, Refrigerator & Acid Pump

Vertical Test Cryostat

Superconducting Resonator Fabrication Facility (SuRFF)

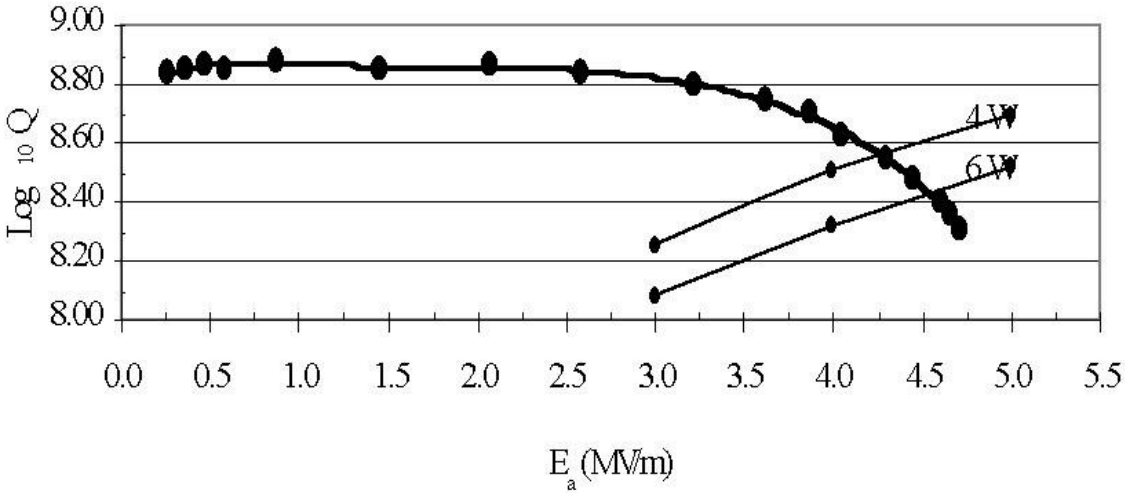
High Pressure Rinsing assembly



First QWR cavity fabricated at IUAC

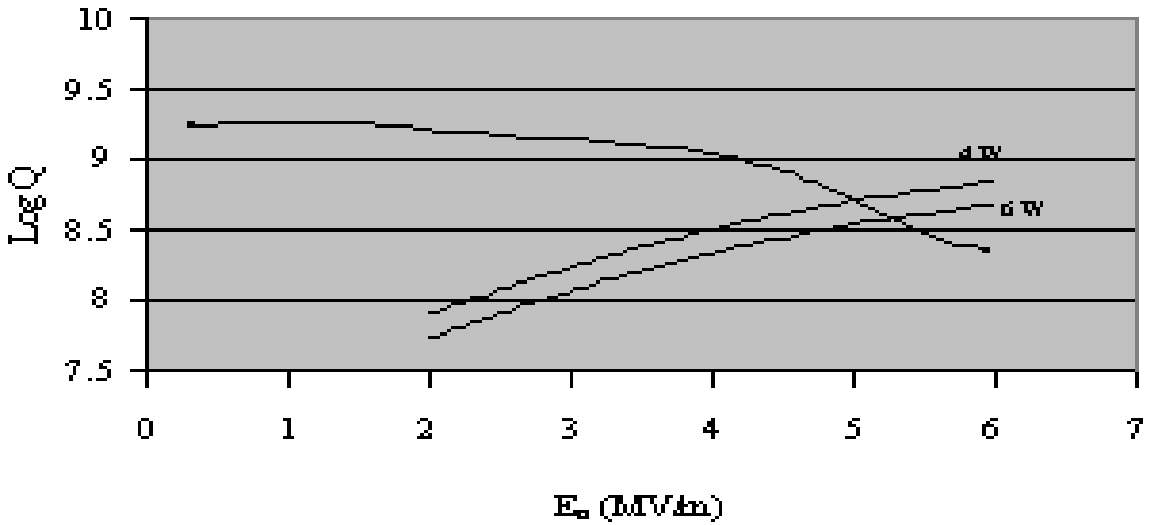
QWR-I1, RUN#1 - STC

(Fabricated at IUAC)



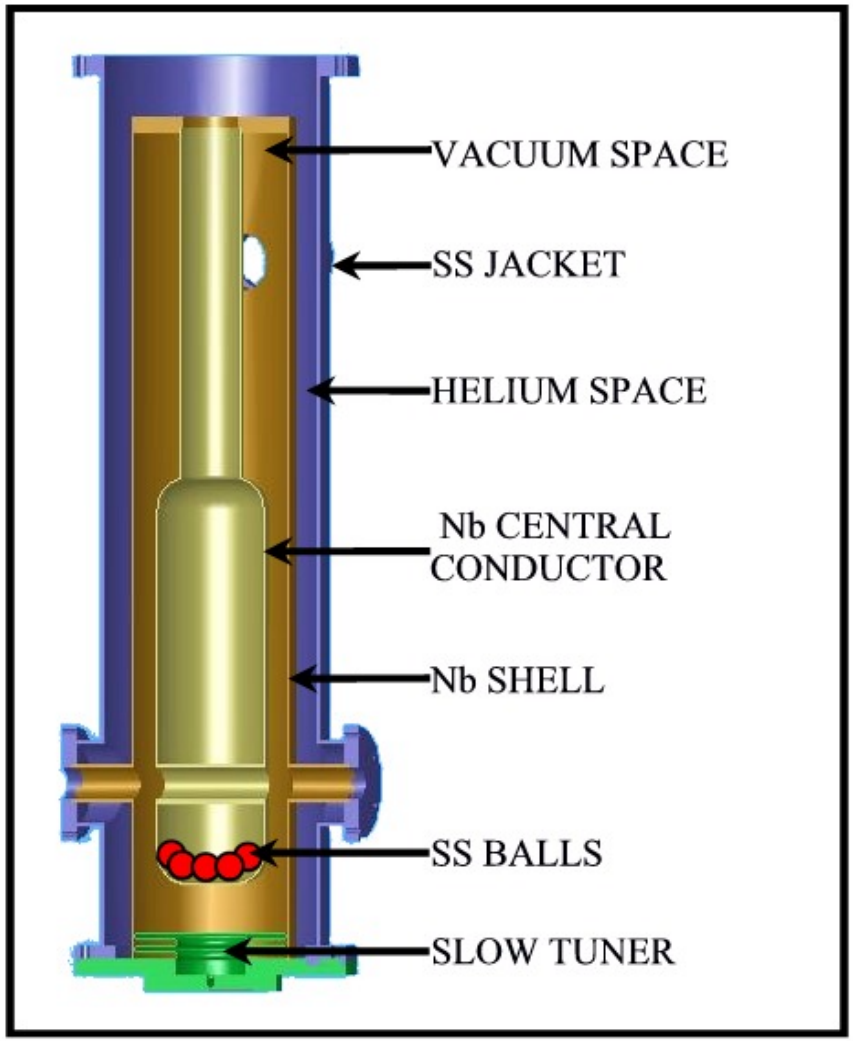
QWR-3 Cold Test Results

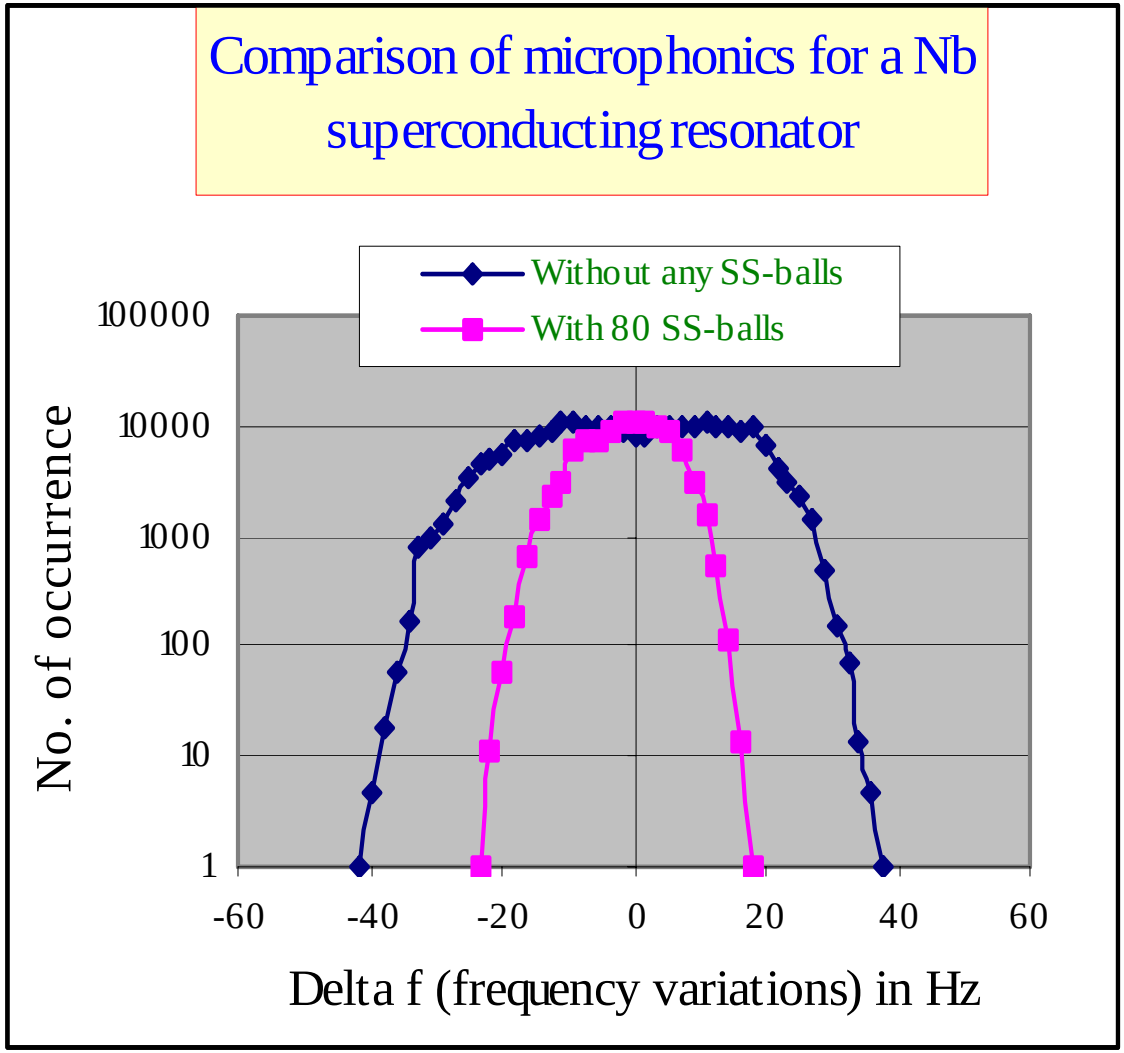
(Fabricated at ANL)



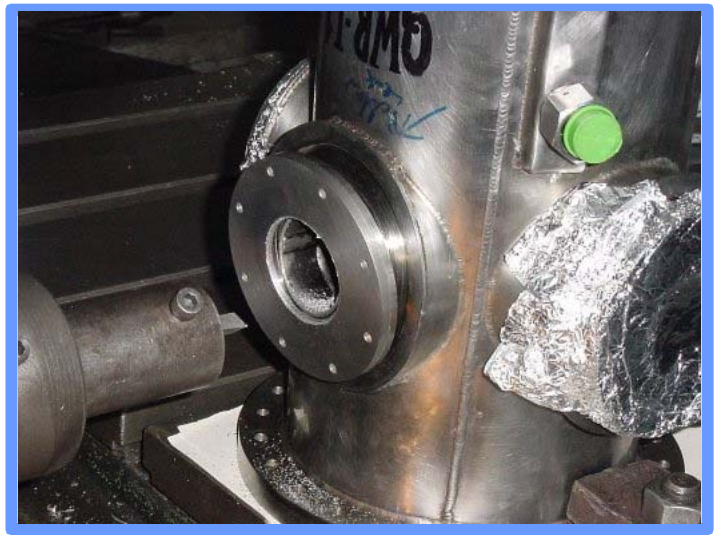
R & D on SCRF Cavities

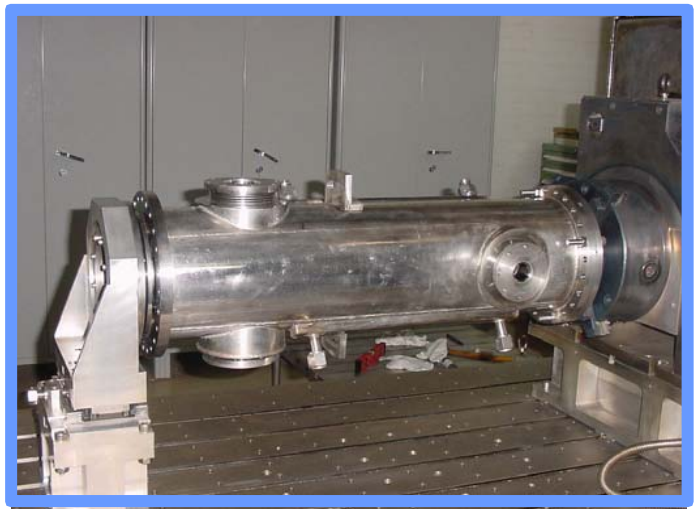
Damping of Mechanical vibrations of resonators





Repair of Cavities





- Six QWRs (8 ports) were modified using this technique.
- The 1st Linac Module could be loaded with all 8 QWRs for beam tests.

Components of QWR resonators under fabrication at IUAC

Outer Housings with its ports

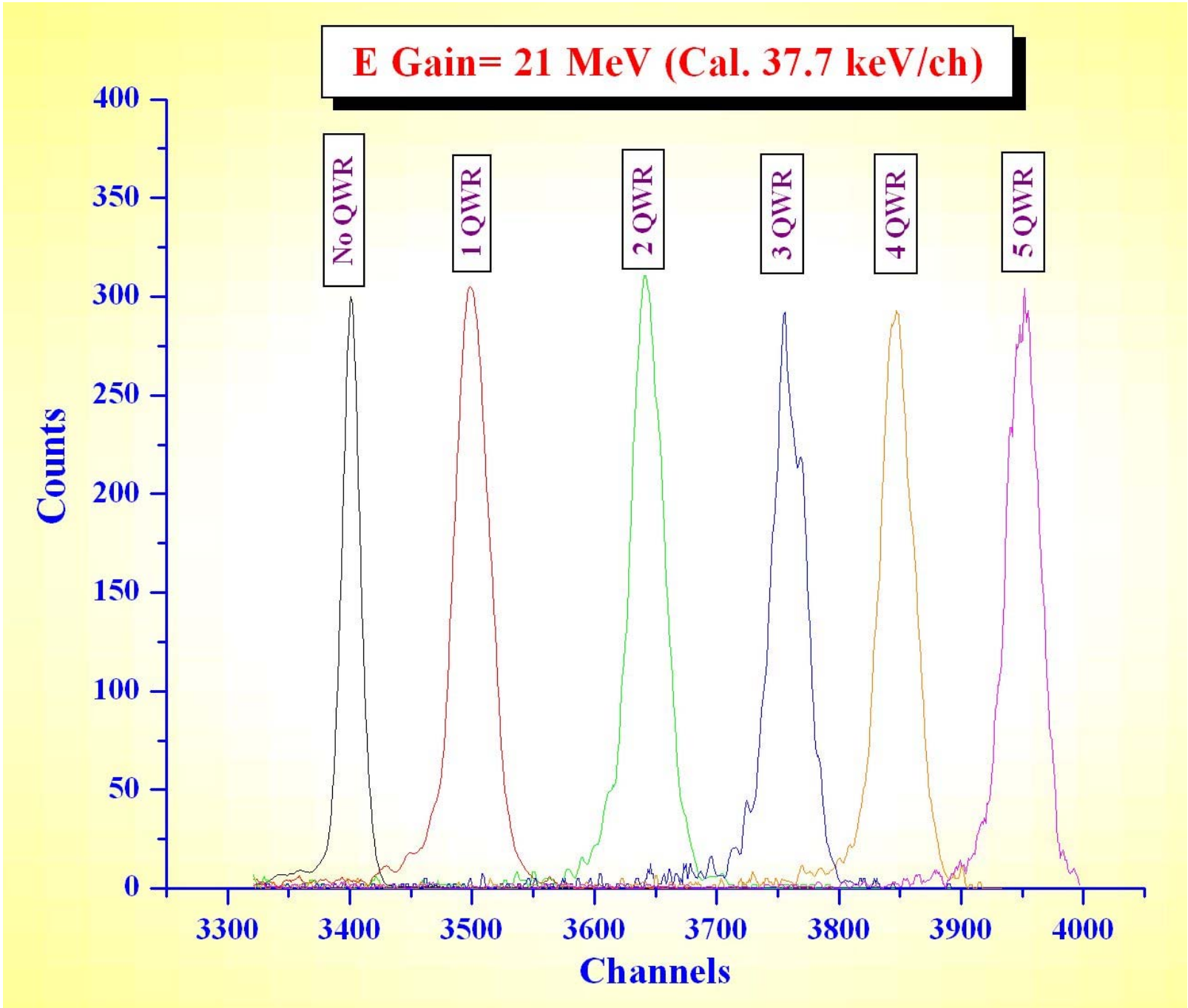
Drift Tubes (top) and Loading Arms (bottom)

Components of the Drift Tube assembly

Superbuncher cryostat in beam line connected to the valve box

Linac Module with Beam Line and Cryogen distribution lines

8 QWRs and superconducting solenoid in Linac module 1



Energy gain for a Si^{10+} beam through Linac module
E_{in} = 130 MeV, E_{out} = 151 MeV

500 W He Refrigerator

5000 W LN2 Plant

Cryogenics

He purifier

He impurity Monitor

RF & Electronics Development

Tandem-LINAC Control Electronics

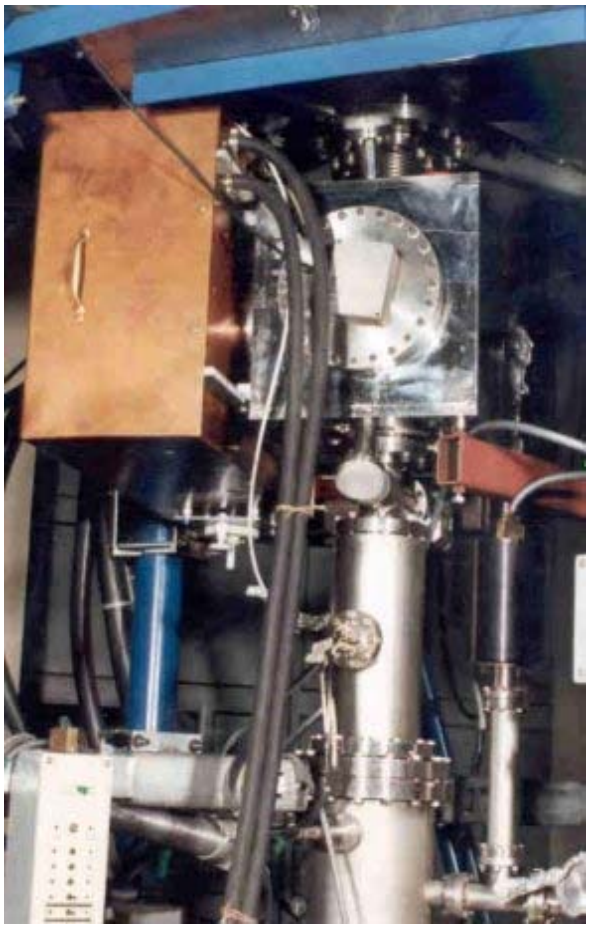
1. Resonator Controller
2. Power Amplifier
3. Ethernet CAMAC Crate Controller
4. CAMAC Interface for Resonator Controller
5. Other modules like

   16 bit 16 channel Scanning ADC,
   8 channel 12 bit DAC,
   24 bit Output register,
   24 bit input gate etc.

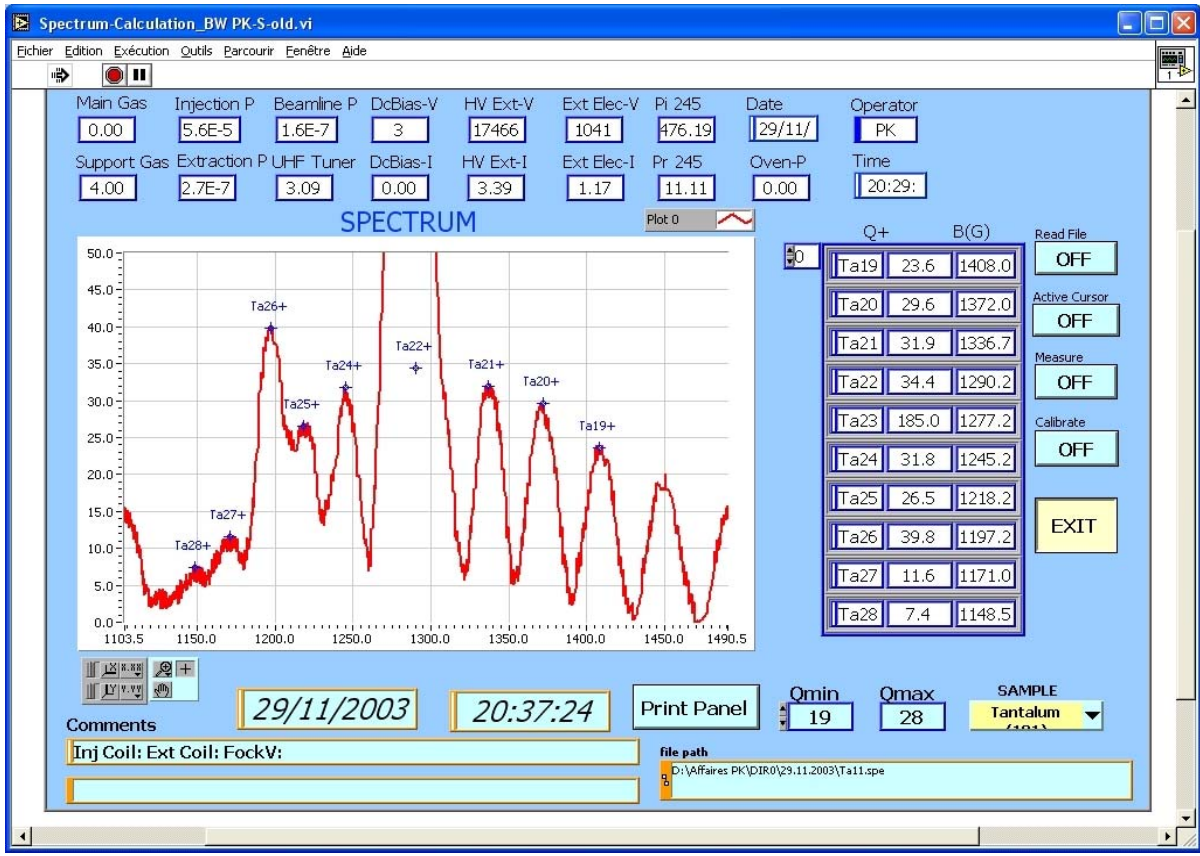
6. Slow Tuner Assembly
7. Multiharmonic Buncher

RF Plasma Sputtering System

400 W , 97 MHz RF POWER AMPLIFIER

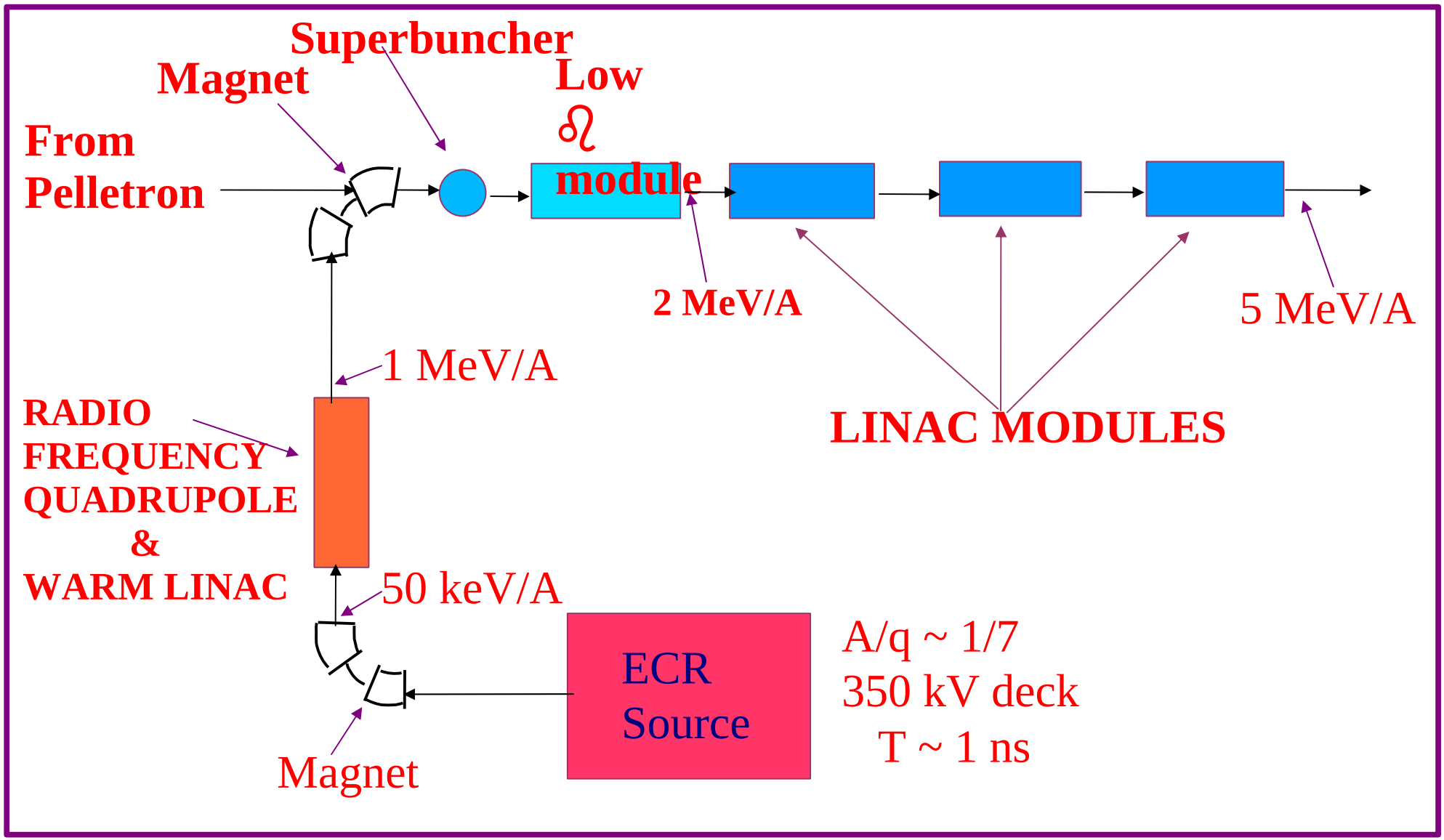


Multiharmonic Buncher in low energy section of Pelletron



ECR SOURCE With HIGH Tc MAGNET

ECR based High Current Injector for LINAC



ACCELERATOR RELATED COLLABORATIONS OF IUAC

MOU with Argonne National Laboratory, (1992-1999)

For SCRF QWR cavity design and fabrication
Design of Cryostat
Design and test of RF amplifier
Design and fabrication of Multiharmonic Buncher

With National Superconducting Cyclotron Laboratory, MSU

Training in helium refrigerator and cryoplant operation, training in cryostat design.(1991-1995)
Development of superconducting quadrupole magnets for a gas-filled spectrometer (2005)

MOU with Fermi National Accelerator Laboratory (2007-)

For fabrication of two spoke cavity resonators.

Delhi University - to join with IUAC

- **Delhi University is soon setting up a program in *M.Tech. Course in Nuclear Science and Technology***
  - **Accelerator Science and Technology is a key component**
  - **Proposal for Accelerator Driven System (ADS)**
  - **Human Resource readily available – PhDs, Postdocs, and Faculty**

- **Personal experience with ILC Main Linac Beam Dynamics simulation in Fermilab (for past three years)**
  - **Soon to join DU**
  - **Our group is very much interested in joining the TTC R&D efforts – for ex. cryomodule modelling and design etc.**

IUAC has the capability for

Nb cavity development
Cryomodule development
Design of cryogen distribution lines and valve boxes

and

a trained team for SCRF R & D.

By joining TESLA Technology Collaboration, the IUAC (with DU) can contribute to the Collaboration and also enhance its own capabilities.