R&D Activities on High Intensity Superconducting Proton Linac at RRCAT

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Major Accelerator Laboratories in India

Raja Rammana Centre for Advanced Technology (RRCAT), Indore : Home for 2 SRS; Running SCRF Program Nodal DAE institute for CERN Collaboration

Inter University Accelerator Centre (IUAC), Delhi : 15 UD Pelletron & SC Booster - Nuclear Physics & Material Science.

Variable Energy Cyclotron Centre (VECC), Kolkata: Hosts Variable Energy Cyclotron; SC Cyclotron has been set up; Building RIB Facility

Bhabha Atomic Research Centre (BARC), Mumbai: Folded Tandem Ion Accelerator, Building an injector for HIPA

Tata Institute of Fundamental Research (TIFR), Mumbai:
14 UD Pelletron+SC Booster

Schematic Layout of Future Accelerator Facility

IS

Front End

NC / SC structures

150 – 200 MeV

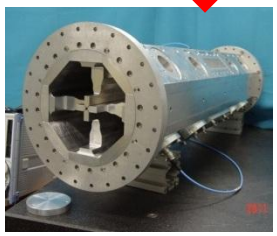
SCRF Linac

1 GeV

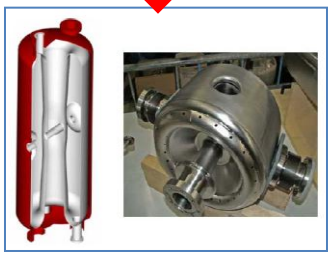
SCRF Cavities

> 1GeV

Nuclear Physics



RFQ



Low Beta SCRF Cavities

Elliptical SCRF cavities

Accumulator Ring

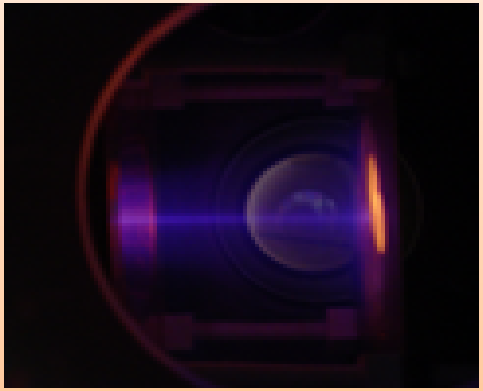
Target

R&D Activities related to concept building, design, simulation and development of various technologies have been initiated.

Development of Frontend Components

H-Ion Source

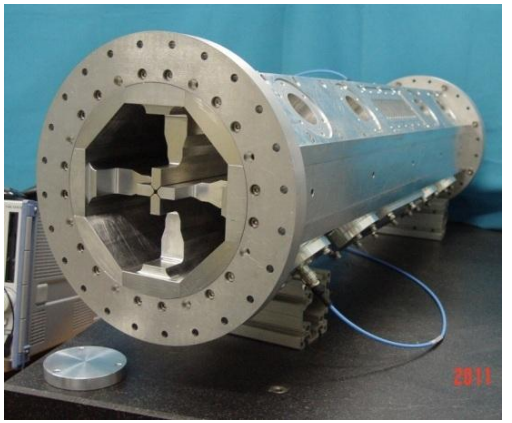
H- Ion source experimental set-up



Hydrogen beam on Ti plate

Type of Ion Source	Multicusp filament
Energy	50 keV
Current	30 mA peak

Prototype RFQ

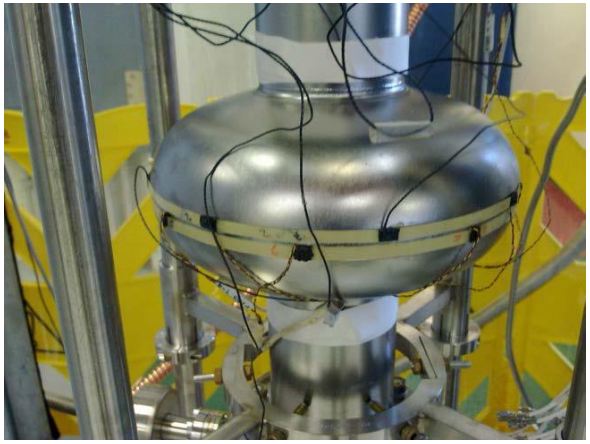


Design Parameters

Frequency	352.2 MHz
Energy	3 MeV
Current	30 mA peak
Duty Factor	1. 25 %
Inter-vane Voltage	80kV

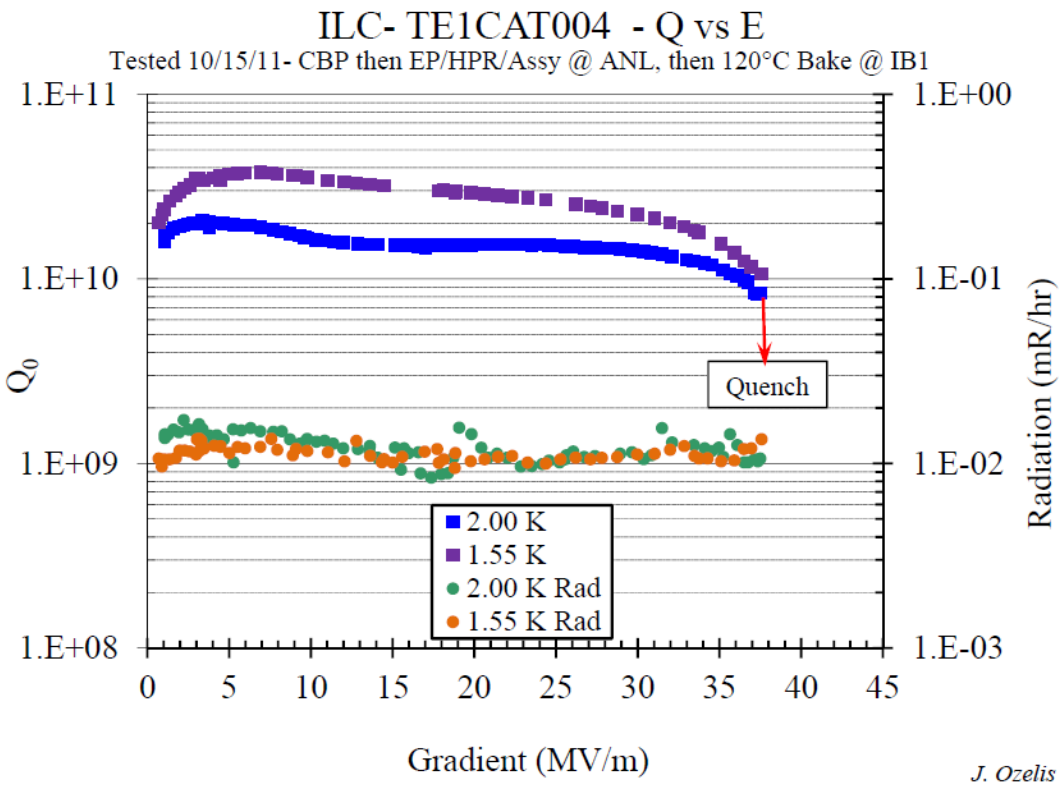
Development of 1.3 GHz Single-cell SRF Cavity

1.3 GHz Single cell cavity



1.3 GHz Single cell cavity during VTS testing at FNAL

Test Result of 1.3 GHz Single-cell cavity



Accelerating gradient 37.5 MV/m,
Q 8.4 x E9 at 2K

Indigenous Development of Nb for SRF Cavities

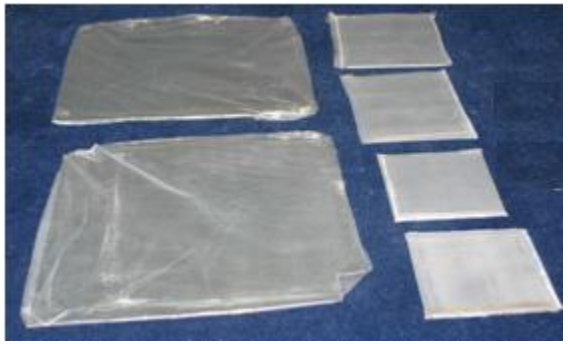
NFC, Hydrabad

- Development of material and testing of mechanical properties

RRCAT, Indore

- Electrical & superconducting properties and elemental analysis

Niobium sheets



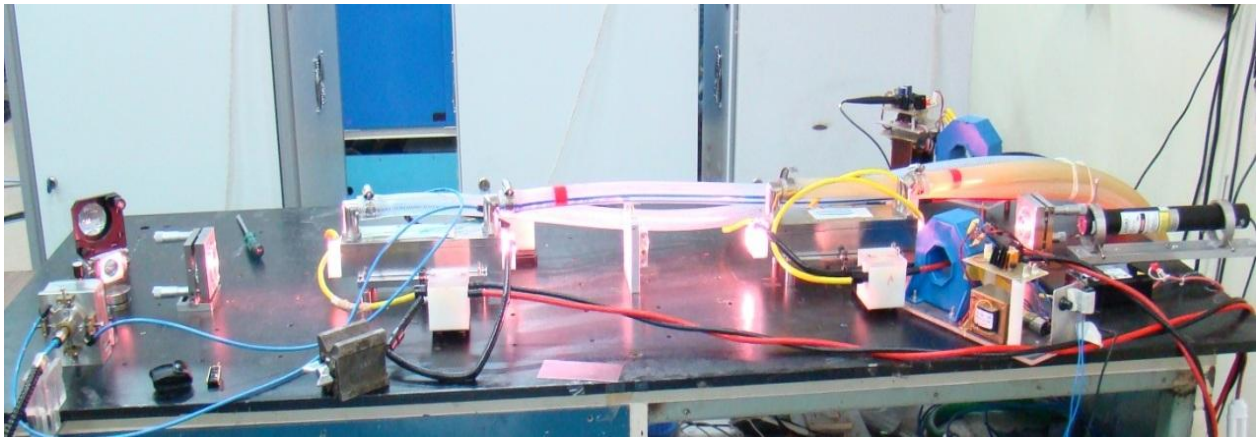
- RRR is ~ 100
- Size 300 mm x 2.8 mm thickness

Formed half cells (3.9 GHz)

- Suitable for 1.3 GHz Cavities
- SC properties acceptable

Laser Welding Technology for SRF Cavity Fabrication

20 kW Nd:YAG fiber-coupled laser

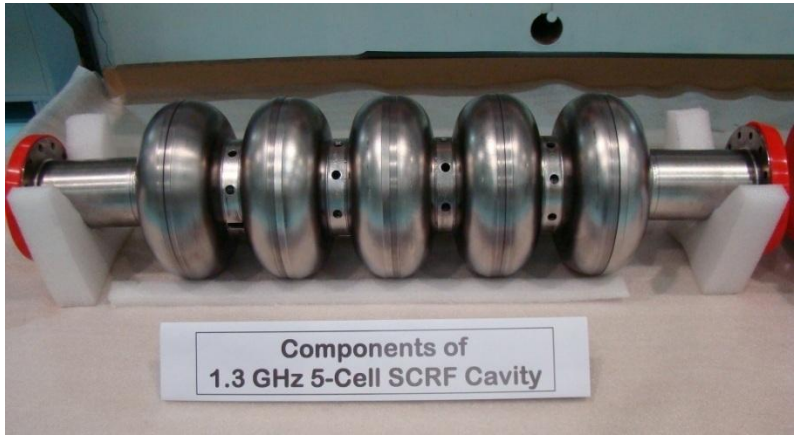


Prototype 3.9 GHz
SCRF Nb cavity

Prototype 1.3GHz cavity
Nb half cells welded

9-cell copper cavity

Development of Multi-cell Elliptical Cavities



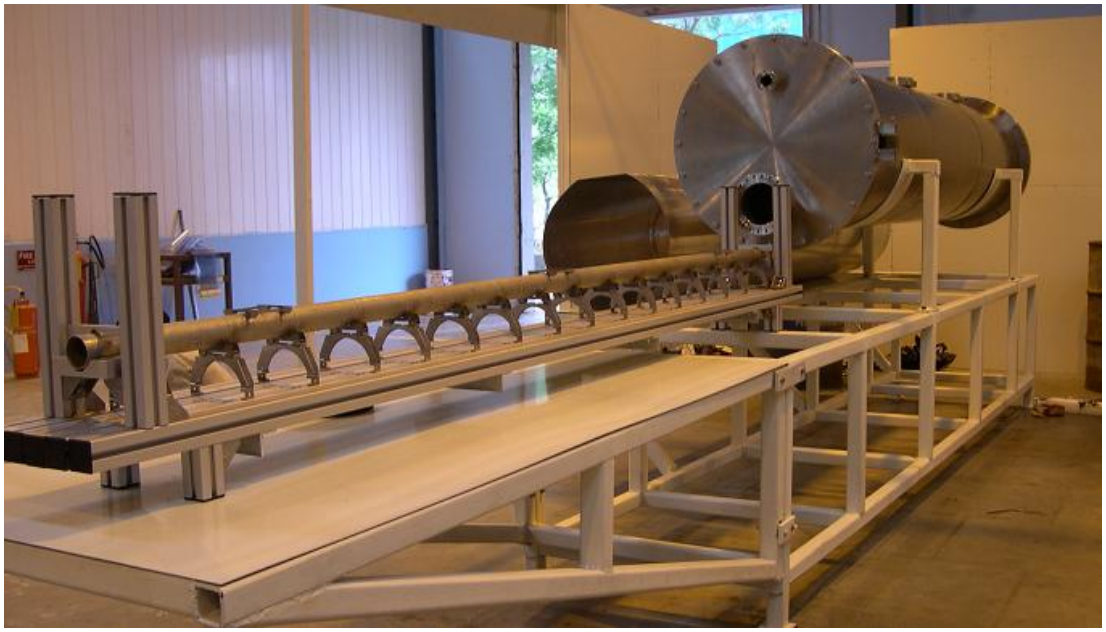
Prototype 1.3 GHz, 5-cell SCRF Nb cavity

End Group for 1.3 GHz, SCRF Nb cavity

Prototype 3.9 GHz, 1.3 GHz and 650 MHz cavity development

Cryomodule Component Test Rig

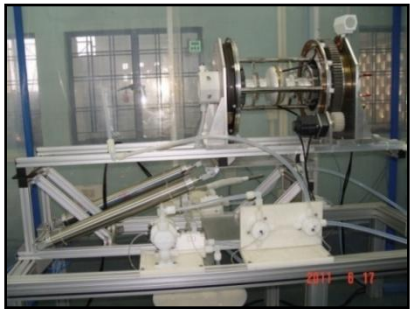
A cryomodule component test rig has been installed to validate design calculations of different subsystems of Cryomodule and Horizontal Test Stand



RRCAT had earlier suggested some value engineering concepts (cavity support system, 2K helium supply line) in existing cryomodule designs (DESY/JLab). This rig will be used to validate these concepts.

Infrastructure for SCRF Cavity Fabrication and Processing

Cavity forming facility



Electro-polishing setup

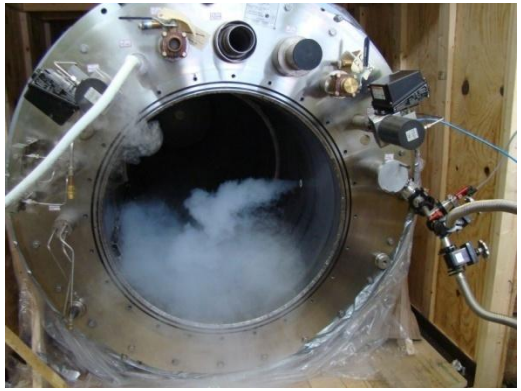
Centrifugal barrel polishing machine

High pressure rinsing Set up

SCRF Cavity manufacturing hall

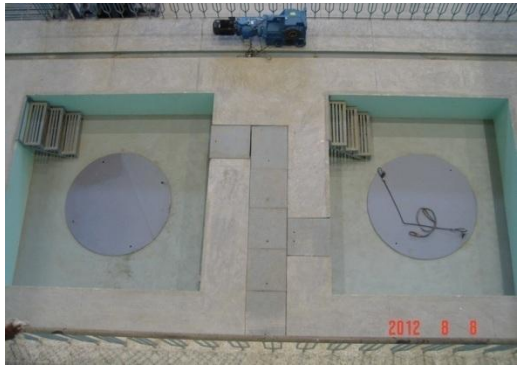
Test and measurement facilities building

Development of VTS Facility



Cold Shock Testing

External Magnetic Shield segment under fabrication



VTS Pit

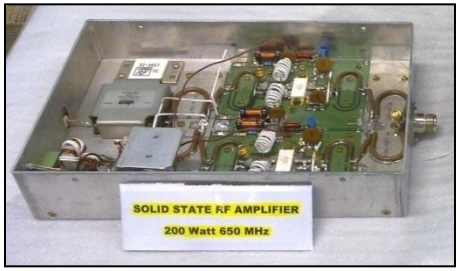
500W 1.3 GHz RF System

Cavity Insert

Development of RF Components

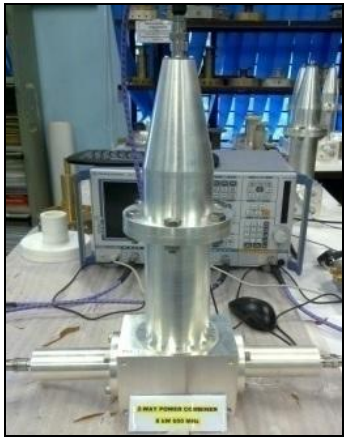
Several RF components such as power combiners, directional couplers, dummy loads etc have already been developed and tested for 505.8 / 650 MHz operation

20 W Low Power Driver



200 W Amplifier Module

Coaxial Transitions

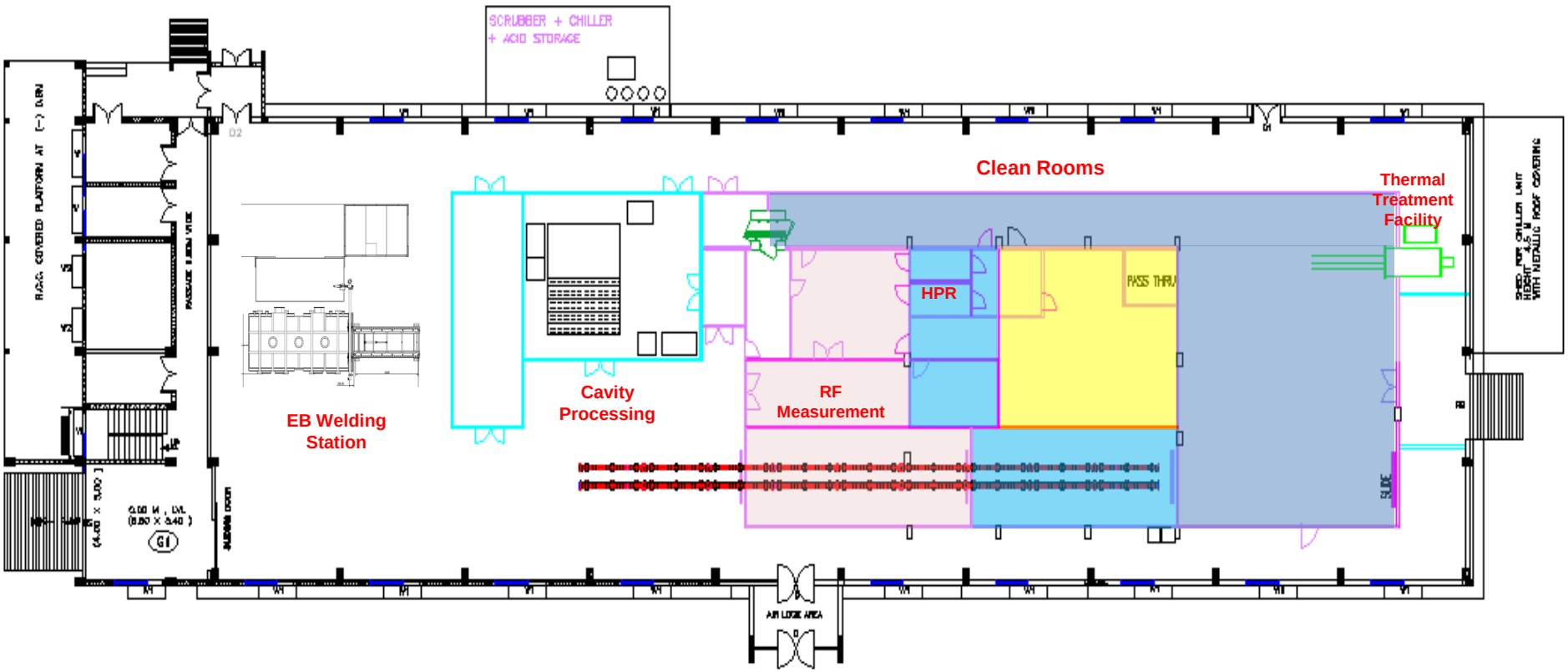


2-way 15 kW Power Combiner

4 kW & 1 kW Coaxial Directional Couplers

30 kW RF Dummy Load

SCRF Cavity Processing Building
(Equipment Layout)



Cavity Fabrication, Assembly & Processing Building

- Electron beam welding machine (15 kW) and a vacuum annealing furnace are under procurement.

Acknowledgement

- We sincerely acknowledge the contributions of all the team members from various Divisions of RRCAT, Indore
- We also acknowledge the contributions of Inter University Accelerator Centre, New Delhi, for 1.3 GHz SRF Cavity Welding
- We also acknowledge contribution of Fermilab, USA for 1.3 GHz Single cell cavity and VTS development under IIFC.