

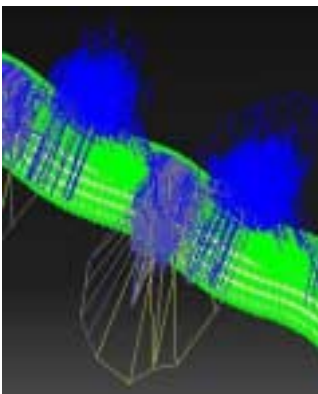
**CMERI , Durgapur contributes to the development of
India's first indigenously developed (2nd in ASIA after Japan)
Radio Frequency Quadrupole (RFQ) Linear Accelerator (LINAC)
at Variable Energy Cyclotron Center (VECC) Kolkata**

News Release from VECC Kolkata [Event RFQ dated 28.09.05]

“ We are pleased to announce that at the Variable Energy Cyclotron Center, Kolkata on 28th September the heavy ion Radio Frequency Quadrupole was successfully commissioned. The RFQ is operating at 33.7 MHz accelerated 21 keV $3^+ 16$ O beam from the ECR up to energy close to 500 keV. The beam transmitted through the very first time achieved a transmission efficiency almost 100% , a remarkable record in the area of high technology. ”

The RFQ is one of the most complex and truly a state of the art linear accelerator at the edge world advanced technology of today. Tried out at first time in 1980 at USA there are only a handful number of countries in the world which have been successful in this venture. India has now the distinction of joining the club ; in Asia the only other country which has reached this distinction in Japan.... ”

The design and fine tuned mechanical engineering demanded by RFQ were entirely done by VECC in collaboration with SAMEER , and CMERI at Durgapur; the collaboration with RIKEN Japan greatly contributed to this success..... ”



Analysis of Vane Profile



2kW RFQ under assembly.

What is RFQ?

RFQ is a Radio frequency cavity (Frequency ~ 33.7 MHz) of very pure copper that houses four (quadrupole) precisely vanes which take care of the acceleration , bunching and focusing. RFQ is the optimum choice for accelerating very low energy ions to medium energy.

More

The high energy Radioactive Ion Beam (RIB) play an important role in R&D in the field of Physics, Astrophysics, Material Science, Biology and Medical Science. The technology needed for developing RIB facility is extremely complex and it requires extensive R&D in the field of particle accelerators , ion sources , instrumentation and manufacturing technology.

To carry out this challenging task Variable Energy Cyclotron Center (VECC, Department of Atomic Energy) has signed an MOU with Central Mechanical Engineering Research Institute (CMERI), Durgapur, for collaborative work in system design, development, fabrication, and commissioning of Radioactive Ion beam facility at VECC.

In collaboration with VECC, CMERI was entrusted with the development of ECR (Electron Cyclotron Resonator) Ion Source, RFQ (Radio Frequency Quadruple)LINAC and LINAC (RB), in three Phases.

Phase-I development, comprising of Ion Source system (ECR) has been completed and commissioned at VECC Kolkata. This facility is under operating and the output of low energy Radioactive Gas Ions has been verified. (Figure-1)

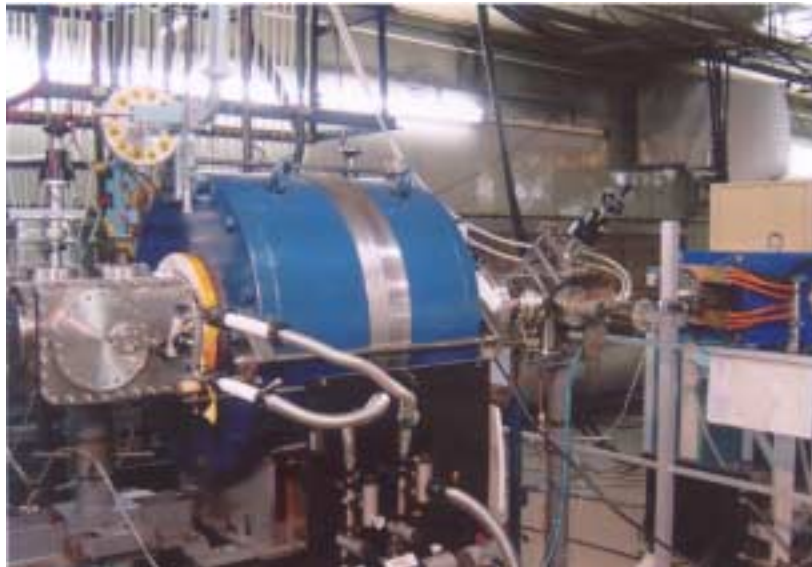


Fig. 1 Installation of ECR –Ion Source with Injection and extraction Chambers at VECC Kolkata.VECC RIB Project -Phase-I.

The Phase-II work comprising the development Full scale Radio Frequency Quadrupole (RFQ) linac. RFQ linac is an accelerator for acceleration, bunching and focusing of low energy ion-beams. The resonant structure of RFQ is made of copper and consists of four electrodes (vanes), assembled in a quadrupolar symmetry on supports (posts) arranged on a base plate as shown in figure below.(Figure-2) The resonant structure is encased in a vacuum cavity. The vanes are excited to high electric potential ~ 50 kV by RF resonant excitation. The vane pole tip is modulated in a variable 3-dimensional geometry along the length of the vanes. The modulation gives rise to an axial electric field which accelerates the ion-beam.

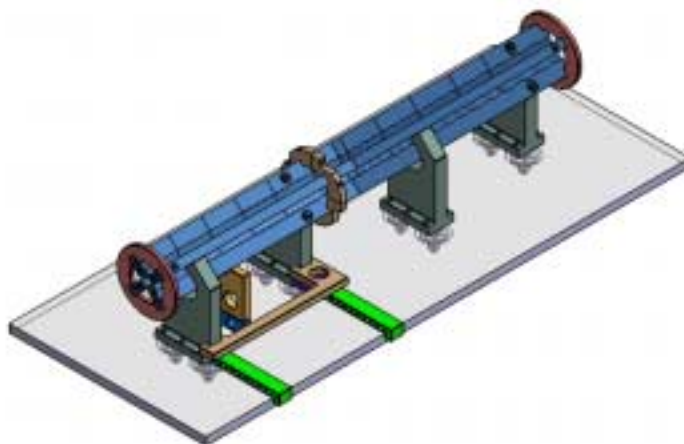


Fig.-2 Digital model of 2kW RFQ prototype (only modulated vanes , posts and baseplate shown in the model) -

The 2kW RFQ with segmented vane design has been successfully installed and a vacuum of $4 \cdot 10^{-7}$ torr achieved with water cooling at 10 kg/cm² pressure. Full power tests have been done and the required vane voltage of 16.5 kV achieved. To our knowledge, this is the first indigenous segmented-vane heavy-ion RFQ that has been built and successfully tested. (Figure-3) The design and development of full scale RFQ is under progress.

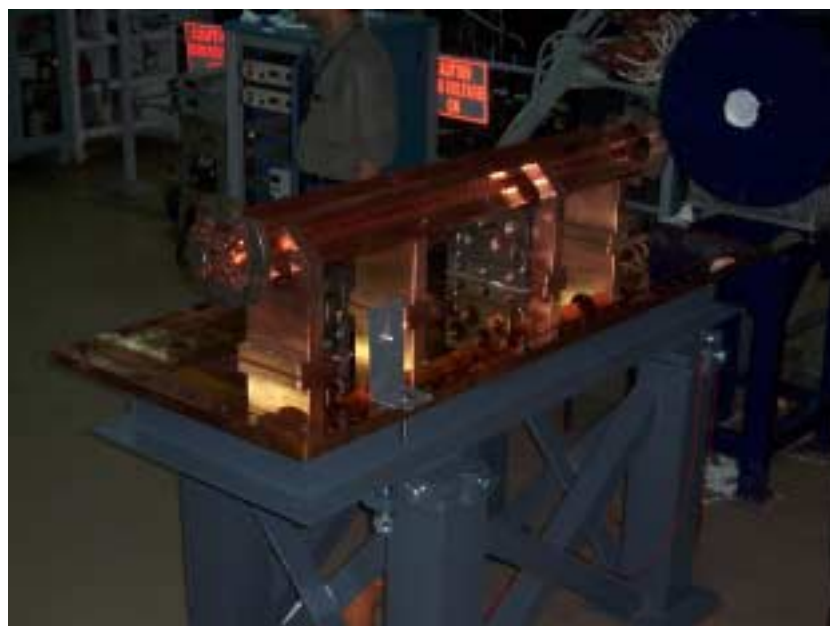


Fig.- 3 The2kw RFQ linac under assembly (cavity opened) and integration with the ECR and subsequent beam line at VECC Kolkata.-

A prime example is the use of ion beams in material science to modify the properties of materials and to analyze the location and chemical nature of their constituents. Beams of radioactive nuclei greatly expand the scope of such applications and the last decade has seen rapid growth and development in the use of low energy (< 400 keV) beams of radioactive isotopes to study the properties of solid-state materials. Although there is some emphasis to date on semiconductors they have also been used to study metals, insulators, superconductors, surfaces, interfaces and even complex bio-molecules. All these results in experimentation, tracing and formulation of new bio molecules, which will boost the drug formulation of various diseases.