Staus of the High Current Injector Project at IUAC

Ajith Kumar B. P.
Inter-University Accelerator Centre, Aruna Asaf Ali Marg
New Delhi 11007 email: bpajith@gmail.com

The High Current Injector (HCI) project at Inter University Accelerator Centre would use a Radio Frequency Quadrupole (RFQ), Drift Tube Linac (DTL) and low beta superconducting cavities to accelerate heavy ions having A/q ≤ 6, from the 18 GHz high temperature superconducting electron cyclotron resonance ion source (HTS-ECRIS called PKDELIS) to the existing superconducting linear accelerator (SC LINAC). The DTL has been designed to accelerate ions from 180 keV/u to 1.8 MeV/u, using six Interdigital-H (IH) type RF resonators operating at 97 MHz. The required output energy of the DTL is decided by the minimum input velocity (beta = 0.06) required for the existing superconducting LINAC. The HCI project was envisaged to overcome the low current limitation of the Pelletron Accelerator and to provide varieties of ion species like Noble gases etc. which are not possible with the existing Pelletron Accelerator.

Ion beams extracted from PKDELIS ECR ion source, installed on a 200 kV high voltage deck, is transported to RFQ through Low Energy Beam Transport (LEBT) section. A 4-rod CW RFQ operating at 48.5MHz will be used to accelerate the ions of 8 keV/amu energy from ECR to 180 keV/amu. DTL cavities will further accelerate the ions to 1.8 MeV/amu. After the DTL, beam will be transported to the entrance of the superbuncher using four 90 degree achromat bends. In the LEBT section a multi-harmonic buncher (fundamental frequency of 12.125 MHz) will be used to provide time bunching of the ion beams at the entrance of the RFQ. In this section a Travelling Wave Chopper (TWC) will be installed to meet the repetition rate requirements at the experimental stations. Presently the high voltage deck and ECR ion source are installed and beam extraction and optimization of parameters is underway.

The Medium Energy Beam Transport (MEBT) section has been designed to transport the beams from RFQ to DTL. A 48.5 MHz spiral buncher has been fabricated to match the longitudinal emittance at the entrance of the first DTL cavity. First DTL cavity was successfully tested upto 5 kW of input power for several weeks. The unperturbed resonance frequency was found to be 97.2 MHz and was brought to design value of 97.00 MHz using a frequency tuner. The design power requirement for this cavity is 4.3 kW. To preserve the transverse and longitudinal emittance of the ion beam in between DTL cavities a highly compact quadrupole triplet and a compact diagnostic chamber has been fabricated and tested. The physical length of the quadrupole triplet is 360 mm and maximum field gradient is 75 T/m.

The High energy Beam Transport (HEBT) section transports the beam from the last DTL cavity to the entrance of the superbuncher, located in the first beam hall area. A rebuncher is planned to be installed in the HEBT section to match the longitudinal emittance at the entrance of the superbuncher. A gas and foil stripper to increase the charge state of the ions will be installed at the entrance of the last achromat bend. Table below gives salient features of the HCI project.

Element	Structure	Energy
ECRIS	18 GHz, HTS	8 keV/amu
RFQ	48.5 MHz, Copper	8 - 180 keV/amu
DTL	97 MHz, Copper	0.180 - 1.8 MeV/amu
Low Beta Cavity	97 MHz, Niobium	β_0 = 0.05