

Heavy Ion Linear Accelerator programmes in India

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The heavy ion linear accelerator programme in India has grown over the years at two Centres, Inter-University Accelerator Center (IUAC), Delhi and Bhabha Atomic Research Centre (BARC) – Tata Institute of Fundamental Research (TIFR), Mumbai almost in parallel.

The programme started with the 14 UD BARC-TIFR Pelletron at Mumbai and then with the 15UD IUAC Pelletron at Delhi, both supplied by M/s NEC corporation, USA. Superconducting linac boosters were chosen for augmentation of the energy of heavy ions and the chosen technology for Mumbai was Pb plated Cu Quarter Wave resonators(QWR) similar to the one developed at Stony Brook and for IUAC it was bulk Nb QWR of a new design in collaboration with Argonne National Laboratory.

The 15 UD Pelletron accelerator using compressed geometry tubes is in regular operation at IUAC since 1990. It has been providing various ion beams in the energy range from a few tens of MeV to 250MeV for scheduled experiments. The accelerator augmentation programme has now reached its second phase with part of the superconducting linac with niobium quarter wave resonators being operational for experiments. The remaining modules of the linac are currently in installation phase. A high current injector (HCI) system to replace the Pelletron for injection of highly charged ions into the superconducting linac is under construction. It consists of a novel high Tc based ECR source, operating well for past two years. This will be followed by a radio frequency quadrupole (RFQ) accelerator for ions with $A/q \sim 6$ accelerated to an energy of 180 keV/A. The beam will then be accelerated further by drift tube Linacs (DTL) to the required velocity to inject the ion beams to the linac booster. Prototypes of both have been fabricated and cold tests performed. In addition to the in-house programmes, two niobium single spoke resonators for Project-X at Fermi National Accelerator Laboratory, USA are under construction. The fabrication of a Tesla-type single cell cavity has also been taken up in collaboration with Raja Ramanna Centre for Advanced Technology, Indore.

The superconducting Linac booster for the 14MV Pelletron accelerator at TIFR, Mumbai, has been operational since July 2007. The Linac consists of seven modular cryostats, each housing four lead plated quarter wave resonators, designed for an optimum velocity $\beta=0.1$ at an operating frequency of 150MHz. The Linac phase I (superbuncher + 3 modules) and phase II (4 modules) are connected by an achromatic, isochronous midbend magnet system. Initial beam trials have yielded an average energy gain of 0.4 MV/q per cavity corresponding to 80% of the design value. Beam transmission from entry to exit of LINAC was found to be 80%, without using any beam steerers. The beam timing measured at target after collimation was found to be excellent (~ 600 ps). A project for an alternate injector similar to the one at IUAC has also been planned.

The status of these projects will be presented.