EXTRACTION AND ACCELERATION OF HIGH LINE CHARGE DENSITY BEAMS

E. Henestroza, J.W. Kwan, E.P. Lee, S. S. Yu, LBNL, Berkeley, CA, 94720

R. J. Briggs, SAIC, Alamo, CA, 94507

HEDP applications and the modular linac systems approach to HIF, a lower-cost development path for a driver, require high line charge density (λ) ion beams. An efficient method to obtain high line charge density beams is to extract a long pulse, high current beam from an ion gun at high energy, and let the beam pass through a decelerating field to compress it, thus obtaining a high line charge density beam. The low energy beam bunch is loaded into a solenoid and matched to a Brillouin equilibrium flow. Once the beam is loaded, the Brillouin equilibrium is independent of the energy if the relationship between the beam size (a), solenoid magnetic field strength (B) and line charge density (λ) is such that λ/(Ba)^2 is constant. Thus it is possible to accelerate a matched beam at constant λ. We call this scheme the Accel-Decel-Load-and-Fire Solenoid Bunching Injector. Two experiments, NDCX-1 and NDCX-2 are being designed to test the feasibility of this type of injectors. NDCX-1, a proof-of-principle experiment, will extract a 500 ns, 12 mA, potassium beam at 285 keV, decelerate it to 30 keV (λ ~0.03 μC/m), and load it into a 3 T solenoid where it will be accelerated to 80—130 keV (head to tail) at constant λ to a final current of 24 mA and 250 ns pulse length. NDCX-2, an HEDP application injector experiment, will extract a 1 μs, 1 A, helium beam at 300 keV, decelerate it to 10 keV (λ ~1.4 μC/m), and load it into a 1.7 T solenoid where it will be accelerated to 70—210 keV (head to tail) at constant λ to a final current of 5 A and 200 ns pulse length. The head-to-tail velocity tilt can be used to increase bunch compression and to control longitudinal beam expansion. We will present the physics design and numerical simulations of the proposed experiments.

*This work performed under the auspices of the U.S Department of Energy by University of California, Lawrence Berkeley National Laboratories under contract No. DE-AC03-76SF00098.