Title
Progress in the Heavy Ion Fusion Science Virtual National Laboratory

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Progress in the Heavy Ion Fusion Science Virtual National Laboratory*

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presented on behalf of the Heavy Ion Fusion Science Virtual National Laboratory

Since HIF04, we report new results in longitudinal beam compression, beam-target interaction, high-brightness transport, beam production, a new Pulse-Line Ion Accelerator (PLIA), and advances in theory and simulations.

Longitudinal Beam Compression The Neutralized Drift Compression Experiment (NDCX) applied a linear head-to-tail velocity tilt to a high perveance ion beam, resulting in longitudinal compression of the beam by a factor of 50 as the beam drifted through a meter-long neutralizing plasma. Good agreement was found between measurements and 3-D simulations using the hybrid PIC code LSP. A three-dimensional kinetic model was also developed to describe the longitudinal compression.

Beam Target Interaction We have explored how ion beams can be used to study warm dense matter (WDM) by entering the targets at energies just above the peak of dE/dx. We have identified promising accelerator, beam, and target configurations, as well as candidate experiments to study WDM target properties. Hydrodynamic simulations show uniform conditions (<5% temperature variation) can be achieved.

High Brightness Transport We have studied electron accumulation in quadrupole and solenoid beam transport systems originating from beam-background gas ionization, beam-tubes struck by ions near grazing incidence, and end-walls struck by ions near normal incidence. We will show similarities of measurements and 3-D WARP simulations (see below) of beam phase space distortions when electrons from end walls are introduced.

Beam Production The merging-beamlet injector experiment merged one hundred and nineteen argon ion beamlets into an electrostatic quadrupole channel to form a single beam of 70 mA. Measured un-normalized emittance of the merged beam of 200-250 mm-mrad, sufficient brightness for future needs, was in good agreement with WARP3D simulations.

Beam Acceleration We have first experimental tests of a new accelerator concept based on a traveling wave structure for acceleration, the Pulse Line Ion Accelerator (PLIA). The PLIA potentially offers a lower cost accelerator for WDM drivers. Measured energy gain, longitudinal phase space, and beam bunching are in good agreement with WARP3D simulations.

Advances in theory and simulation models We have developed and implemented into the WARP3D particle-in-cell code Adaptive Mesh Refinement, new large-time step advancement of electron orbits, and a comprehensive suite of models for electrons, gas, and wall interactions. The Beam Equilibrium Stability and Transport code (BEST) was optimized for massively parallel computers and applied to studies of the collective effects of 3D bunched beams and the temperature-anisotropy instability. Space-charge-dominated beam physics experiments relevant to long-path accelerators were carried out on the recently completed University of Maryland Electron Ring, and on the Paul Trap Simulator Experiment at PPPL.

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