Design of an Ion Source for Low Pressure IEC Operation*

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Inertial Electrostatic Confinement (IEC) systems have been used for decades to investigate the feasibility of fusion, including the use of advanced fuels, such as D-D and D-^{3}He. These reactions require high center-of-mass energies (50-100 keV). Typically, fusion fuels are ionized to provide the source of ions inside of the device, restricting operating pressures to ~1mTorr or greater. In this pressure range, ion-neutral collisions and charge exchange occur frequently and dominate the ion dynamics. In order to reduce the negative effects of atomic processes and increase center-of-mass collision energies, the IEC must be operated at much lower pressures, < 50μTorr, where ion-neutral collisions will be infrequent. To this end, an ion injection system has been constructed, which consists of a high density helicon plasma generator and a high-voltage, differentially pumped extraction system. Plasma currents of up to 10 mA of ^{4}He have been achieved into a vacuum of 50μTorr. The design of the hardware, recent results, and the capability of this source to generate a beam of ionized ^{3}He for IEC fusion will be discussed.

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