Enhancement of an Inertial Electrostatic Confinement Device with a Helicon Ion Source for Helium-3 Fusion

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HELIOS is an inertial electrostatic confinement (IEC) fusion device specifically designed for ³He-³He fusion studies as part of the advanced fuels program at the University of Wisconsin [1]. HELIOS uses a helicon discharge as a source of ions, which are subsequently accelerated radially to fusion energies by the electrostatic field between the spherical chamber wall and a concentric cathode grid. The experimental setup, in which ³He-³He fusion in an IEC system has previously been demonstrated [2], has been upgraded in order to raise fusion rates to allow for diagnostic studies of IEC physics with helium-3 fuel, in order to benchmark the single-atomic-species formalism of a Volterra-integral-equation numerical code on spherically convergent ion flow [3]. The helicon ion source has been characterized through double probe measurements of plasma density and electron temperature for various rf antenna and magnetic field. Furthermore, the high-voltage feed-through has been redesigned to sustain higher cathode voltages for an increase in achievable ion energies.