Beam energy recovery for fusion and collector design for tests on compact sources

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Abstract:

The next fusion project DEMO, which will be the evolution of the experimental fusion reactor [International Tokamak Experimental Reactor (ITER)], would require a high efficient energy production. As in ITER, DEMO will use fast Neutral Beam (NB) injectors to increase the plasma temperature needed for the fusion reaction. A way to recover the electric energy production efficiency in DEMO could be the beam energy recovery in the NB production, which is produced by a D−beam, neutralized by a gas cell with 60% efficiency. A compact energy recovery device with an axisymmetric cylindrical ion collector that uses only decelerating electric fields combined with the beam space charge effect has been recently proposed. It can be used for a test on the beam of the NIO1 (Negative Ion Optimization 1) source, a compact ion source (scaled down from ITER size sources) that has been developed at INFN-LNL and Consorzio RFX (Padua). The detailed collector design to be used on one of the beamlets of the NIO1 source within typical space limitation is presented and discussed here. Furthermore, a preliminary trajectory simulation for a beam with a rectangular geometry similar to the beam used in ITER to verify the beam recovery for a non axial symmetric geometry is also shown.