Self-consistent electric fields and flows in the edge plasma of FRCs

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The shorting of open field lines where they intersect external boundaries strongly modifies the electric field all along the field lines.[1] However, it doesn't simply force the radial electric field to zero. The self-consistent electric field is found by an extension of the familiar Boltzmann relation for the electrical potential. The resulting electric field vector is actually pointed *outward*, away from the field-reversed configuration (FRC). With this field, the electric drift can be found. The rotational flow for the self-consistent electric field is applied to three aspects of FRCs: (1) the plasma rotation rate; (2) the particle-loss spin-up mechanism; and (3) the sustainability of rotating magnetic field current drive.

The outflow of plasma along open field lines is also analyzed using a double-adiabatic model. The outflow is represented as that in a magnetic "duct" extending from the side of the FRC proper out through the jet. The effects of double-adiabaticity (different parallel and perpendicular ion temperatures) and the conservation of angular momentum may explain the anomalously slow outflow of particles as inferred from experiments.[2]

[1] L.C. Steinhauer, Phys. Plasmas **9**, September 2002 issue (in press)

[2] L.C. Steinhauer, Phys. Fluids **29**, 3379 (1986).

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