Charging and $E \times B$ Rotation of Ablation Clouds Surrounding Refueling Pellets

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Abstract. The finite resistivity Frontier-MHD code is used to study the ablation rate of refueling pellets, with magnetically collimated ablation outflows simultaneously undergoing $E \times B$ rotation. A strong space charge radial electric field $E \sim T_{e\infty}/r_c$ develops to maintain quasi-neutrality and ambipolarity inside the ablation cloud of radius r_c ($T_{e\infty}$ = plasma temperature). The induced rotation of the cloud about its symmetry axis parallel to the magnetic field B can become supersonic. The key finding is that the centrifugal force of cloud rotation pushes the cloud density radially outwards, creating a more "transparent" ablation channel. With reduced shielding, the *steady state* ablation rate of a deuterium pellet can increase by $\sim 35\%$ to 100%, depending on the B-field strength, bringing the ablation rate into better accord with the pellet ablation data base for tokamaks, and known theoretical scaling laws.

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