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Charging and Rotation of Pellet Ablation Cloud[1] ROMAN SAMULYAK, TIANSHI LU, Brookhaven National Laboratory, PAUL PARKS, General Atomics — The interior of pellet ablation clouds charge to a negative electric floating potential because the incident plasma ions are stopped in a thin layer at the cloud/plasma interface, and this floating potential varies radially causing $E \times B$ rotation of the cloud with azimuthal velocities of order $v_\theta \simeq T_e/Br_c$ [1]. Numerical simulations of this effect with a time-dependent pellet ablation model have been performed using the front tracking based MHD code. The main features of the model include a self-consistent evolving potential distribution in the ablation cloud, inward $J \times B$ forces and outward centrifugal forces, atomic processes, and an improved electrical conductivity model which accounts for direct impact ionization of the cold ablated neutrals by the incident plasma electrons. The major conclusion of the study is that the cloud rotation reaches velocities comparable to ablation sound speeds, and therefore the centrifugal force adds significantly to the pressure gradient forces, thus broadening the width of the field aligned ablation channel. Cloud widening, in turn, reduces the cloud opacity and leads to a 30% increase in the ablation rate compared to the no rotation case for pellets crossing the pedestal region in ITER.
[1] P.B. Parks, Plasma Phys. Control. Fusion 38, (1996) 571.

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