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Effects of finite pulse length, magnetic field, and gas ionization on ion beam pulse neutralization by background plasma IGOR D. KAGANOVICH, ADAM B. SEFKOW, EDWARD A. STARTSEV, RONALD C. DAVIDSON, Princeton Plasma Physics Laboratory , DALE R. WELCH, Voss Scientific — We previously developed a reduced analytical model of beam charge and current neutralization for an ion beam pulse propagating in a cold background plasma. The reduced-fluid description provides an important benchmark for numerical codes and yields useful scaling relations for different beam and plasma parameters. This model has been extended to include the additional effects of a solenoidal magnetic field, gas ionization and the transition regions during beam pulse entry and exit from the plasma. Analytical studies show that a sufficiently large solenoidal magnetic field can increase the degree of current neutralization of the ion beam pulse. However, simulations also show that the self-magnetic field structure of the ion beam pulse propagating through background plasma can be complex and non-stationary. Plasma waves generated by the beam head are greatly modified, and whistler waves propagating ahead of the beam pulse are excited during beam entry into the plasma. Accounting for plasma production by gas ionization yields a larger self-magnetic field of the ion beam compared to the case without ionization, and a wake of the current density and self-magnetic field are generated behind the beam pulse. Beam propagation in a dipole magnetic field configuration and background plasma has also been studied.

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