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Effects of magnetic field rotation on the transport of localized plasma irregularities at the magnetopause: three-dimensional kinetic simulations

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The transport of localized plasma irregularities (or clouds, blobs, jets, streams, plasmoids) across transverse magnetic field geometries typical for the terrestrial magnetopause is a fundamental research topic for understanding the physics of the magnetosphere and its interaction with the solar wind. In the present paper we use three-dimensional electromagnetic particle-in-cell simulations to study the dynamics of magnetosheath plasma clouds/jets interacting with tangential discontinuities with rotating/sheared magnetic field. We consider a non-diamagnetic small Larmor radius plasma cloud moving across a background non-uniform magnetic field that increases over a finite-width transition region that covers few ion Larmor radii. The magnetic field rotates across the discontinuity by an angle varying between 0 and 75 degrees. We analyze and discuss the space and time variations of the plasma parameters and electromagnetic field for different rotation angles of the background magnetic field. The simulations reveal the formation of a polarization electric field that sustains the forward convection of the cloud across the discontinuity. The numerical results obtained are compared with the theoretical model describing the impulsive penetration mechanism.