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The Physics of Ion Decoupling in Magnetized Plasma Expansions[1] DENNIS HEWETT, LLNL, STEPHEN BRECHT, Bay Area Research Crop., DAVID LARSON, LLNL — The coupling of a super-Alfvénic plasma expansion within a magnetized background plasma is examined. Such coupling plays an important role in several high-energy, quasi-neutral, plasma configurations; the focus here is on High Altitude Nuclear Explosions (HANEs). Fully 3-D Kinetic Ion Simulation Modeling reveals, for some initial conditions, strong coupling of the debris to the magnetized background ionosphere even though all collision processes between the ions have been neglected. The interaction dynamics are found to be sensitive to initial conditions. A slight increase in the ion charge density of the background plasma allows the debris ions to decouple and slip through the magnetized background. These decoupled ions in the expanding plasma then follow trajectories typical of single particle motion. The salient features of this process, guided by 1-D simulations, lead to two thresholds for the onset of decoupling. The first threshold depends on the ratio of the charge density of the expanding plasma to that of the background plasma. The second threshold is evident when the expanding plasma has a finite pulse length comparable to the gyro-radius of the energized background ions.

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