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Particle-in-cell simulations of Magnetic Field Generation, Evolution, and Reconnection in Laser-driven Plasmas[1] JACK MATTEUCCI, Princeton University, CLMENT MOISSARD, cole normale suprieure de Cachan, WILL FOX, AMITAVA BHATTACHARJEE, Princeton Plasma Physics Laboratory — The advent of high-energy-density physics facilities has introduced the opportunity to experimentally investigate magnetic field dynamics relevant to both ICF and astrophysical plasmas. Recent experiments have demonstrated magnetic reconnection between colliding plasma plumes, where the reconnecting magnetic fields were self-generated in the plasma by the Biermann battery effect. In this study, we simulate these experiments from first principles using 2-D and 3-D particle-in-cell simulations. Simulations self-consistently demonstrate magnetic field generation by the Biermann battery effect, followed by advection by the Hall effect and ion flow. In 2-D simulations, we find in both the collisionless case and the semi-collisional case, defined by $eV_i \times B \gg R_{ei}/n_e$ (where R_{ei} is the electron ion momentum transfer) that quantitative agreement with the generalized Ohm's law is only obtained with the inclusion of the pressure tensor. Finally, we document that significant field is destroyed at the reconnection site by the Biermann term, an inverse, 'anti-Biermann' effect, which has not been considered previously in analysis of the experiment. The role of the anti-Biermann effect will be compared to standard reconnection mechanisms in 3-D reconnection simulations.

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