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The Biermann Catastrophe in Numerical MHD[1] CARLO GRAZIANI, PETROS TZEFERACOS, University of Chicago Flash Center, DONG-WOOK LEE, Univ of California, Santa Cruz and University of Chicago Flash Center, KLAUS WEIDE, DONALD LAMB, MILAD FATENEJAD, JOSHUA MILLER, University of Chicago Flash Center — The Biermann Battery (BB) effect is widely invoked as a mechanism to generate cosmic magnetic fields from unmagnetized plasmas. The BB effect, which relies on large, non-aligned gradients of electron density and pressure, is expected to function most efficiently at shocks, where such gradients are largest. Simulations of cosmic magnetogenesis have accordingly relied on shocks to enhance the BB effect. What went unnoticed until recently is the fact that straightforward algorithmic implementations of the BB effect in MHD codes break down precisely at hydrodynamic discontinuities such as shocks – where the BB effect is of greatest interest – yielding results that fail to converge with resolution. We discuss this breakdown, show its origin, and present an alternative algorithm that gives finite and convergent results. We demonstrate convergence using an implementation of the algorithm within the FLASH code, and verify that the algorithm yields physically sensible results at shocks. We discuss novel – and physically observable – effects that attend the BB effect at shocks.

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