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Entropy conservation in dynamic plasma simulations JOACHIM BIRN, Los Alamos National Laboratory, MICHAEL HESSE, NASA/Goddard Space Flight Center, KARL SCHINDLER, Ruhr-University Bochum, Germany — The one-fluid magnetohydrodynamic (MHD) equations are the most common tool in investigating plasma behavior on temporal and spatial scales that are large compared to typical particle scales, such as gyroperiods and gyroradii. One of the frequent assumptions is that of adiabatic, i.e., entropy conserving, transport. In general, non-isotropic, plasmas this assumption may be violated, in addition to the possible break-down of the frozen-in flux approximation of ideal MHD. Here, entropy conservation is investigated for the dynamic field evolution associated with fast magnetic reconnection, based on a comparison between resistive MHD and particle-in-cell (PIC) simulations. Specifically, the entropy and mass integrated along magnetic flux tubes are compared between the simulations. It is shown that there is very good agreement between the conservation of these quantities in the two simulation approaches, despite the effects of dissipation, provided that the resistivity in the MHD simulation is strongly localized. This follows from the fact that dissipation is highly localized in the PIC simulation also, and that slipaage and heat flux across magnetic flux tubes have negligible effect. This result lends support for using the entropy-conserving MHD approach not only before and after reconnection but even as a constraint connecting the two phases.

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