Symmetries of resistive two-fluid magnetohydrodynamics under reversals of toroidal field, current, and rotation

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Abstract. Solutions of the time-independent, axisymmetric, ideal magnetohydrodynamic (MHD) equations remain solutions under reversals of the toroidal field, current density, rotation, or any combination thereof. Introducing non-axisymmetry, resistivity, and two-fluid effects into the equations each break different symmetries. In particular, both resistivity and two-fluid effects break the invariance of solutions under reversal of the toroidal rotation. Symmetry groups for solutions possessing up-down spatial symmetry are also considered. Because the symmetry groups of ideal, resistive, and two-fluid MHD are distinct, it should be possible to ascertain the dominant physical mechanism of various phenomena through a series of experiments in which at least two of the toroidal field, current, and rotation are independently reversed. These results, which hold for nonlinear solutions in arbitrary geometry, should also be of use in testing numerical codes.

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