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Building Action Principles for Extended MHD Models[1] IOANNIS KERAMIDAS CHARIDAKOS, MANASVI LINGAM, PHILIP MORRISON, RYAN WHITE, Institute for Fusion Studies and Department of Physics, The University of Texas at Austin, ALEXANDER WURM, Department of Physical and Biological Sciences, Western New England University — The general, non-dissipative, two-fluid model in plasma physics is Hamiltonian, but this property is sometimes lost in the process of deriving simplified two-fluid or one-fluid models from the two-fluid equations of motion. One way to ensure that the reduced models are Hamiltonian is to derive them from an action. We start with the general two-fluid action functional for an electron and an ion fluid interacting with an electromagnetic field, expressed in Lagrangian variables. We perform a change of variables and make various approximations (eg. quasineutrality and ordering of the fields) and small parameter expansions directly in the action. The resulting equations of motion are then mapped to the Eulerian fluid variables using a novel nonlocal Lagrange-Euler map. The correct Eulerian equations are obtained after we impose locality. Using this method and the proper approximations and expansions, we recover Lust's general two-fluid model, extended MHD, Hall MHD, and Electron MHD from a unified framework. The variational formulation allows us to use Noether's theorem to derive conserved quantities for each symmetry of the action. References: I.Keramidas Charidakos, M.Lingam, P.J.Morrison, R.White, A. Wurm "Action Principles for Extended MHD Models" (to be submitted)

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