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Helicity Conservation and Two-Fluid Relaxation Modeling for Reversed-Field Pinches[1] JOSHUA SAUPPE, CARL SOVINEC, CHRIS HEGNA, VLADIMIR MIRNOV, University of Wisconsin-Madison — We report on NIMROD simulations of two-fluid relaxation relevant to RFP discharges. RFPs typically exhibit periodic relaxation events that flatten the parallel current profile. Taylor recognized that in a dissipative plasma the global magnetic helicity is a more robust invariant than the magnetic energy and postulated that the relaxation minimizes magnetic energy while conserving global helicity [Taylor, PRL Vol. 33, No. 19 (1974)]. The predicted relaxed state is force-free with a globally constant parallel current. Two-fluid physics is significant on the Madison Symmetric Torus RFP and this has consequences for magnetic relaxation [Kuritsyn et. al., PoP Vol. 16 No. 055903 (2009)]. Two-fluid relaxation theories make use of generalized species helicities and predict a relaxed state with both parallel current and parallel flow spatially constant [Hegna, PoP Vol. 5 No. 6 (1998)]. We compare NIMROD two-fluid results to these theories. The magnetic helicity and generalized species helicities are well-conserved relative to the energy over the relaxation event. The parallel current flattens as expected, but the parallel flow develops steeper gradients in some cases.

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