Category Number and Subject: 5.2.0 MHD and Stability

[**x**] Theory   [ ] Experiment

A Logical, Physically Motivated Formulation of Magnetic Helicity and Its Evolution,* M.J. Schaffer, *GA* – Magnetic helicity is a quantitative measure of the global topological linkage of a *complete* magnetic field B. Many systems of interest have a time-dependent volume V(t) bounded by a moving and deforming closed surface S(t) that does not contain all of the field. Most authors impose significant, sometimes unstated, restrictions. The physical basis of my formulation is topological linkage and relative helicity enunciated by Berger & Field, extended to include both simply and toroidally connected (nonrelativistic) deforming volumes arbitrarily linked by external magnetic flux and penetrated by B. Continuity conditions across S(t) are derived for gauge independence and preservation of physical meaning, and the resulting extra terms are kept. Further physics insight into relative helicity and its evolution is gained by separating B into closed (does not penetrate S) and open (penetrates S) field components, subject to the required continuity conditions. The choice of a reference field for relative helicity, having considerable freedom, can be used to leave only a few, physically interpretable terms. Helicity flow is calculated across the moving and deforming bounding surface. Examples will be given.