Geophysical Research Abstracts
Vol. 17, EGU2015-8035, 2015
EGU General Assembly 2015

Magnetized Knots: Structure, Invariants and Dissipation

Ilan Roth
UC Berkeley, Space Sciences, Physics, Berkeley, United States (ilan@ssl.berkeley.edu)

An analysis of a general, complex magnetized fluid and its dynamics incorporates the topology of a magnetic field. Particular interest is focused on those magnetic configurations which cannot be deformed to simple loop without cutting of the field lines, i.e. magnetic knots. Planar projection of a three-dimensional magnetic configuration depicts it as a two-dimensional diagram with crossings, to which one may assign mathematical operations leading to robust topological invariants. These invariants enrich the topological information of magnetic configurations beyond helicity. Hence, it is conjectured that the magnetic field which emerges from the solar photosphere is structured as one of simplest knot invariants – unknot or prime knot, and these flux ropes are then stretched while carried by the solar wind into the interplanetary medium. Preservation of invariants for small diffusivity and large cross section of the emerging magnetic flux makes them impervious to large scale reconnection, resulting at 1AU as elongated prime knots. Similar structures may be observed in magnetic clouds which got disconnected from their foot-points and in ion drop-out configurations from a compact flare source in solar impulsive solar events. For flux tubes with higher resistivity, magnetic energy decay rate should decrease with increased knot complexity as the invariants are then harder to be violated. It is suggested that the different dissipation rate of various magnetized configurations with identical helicity is controlled by the additional topological invariants, with interesting implications for the dynamics of heliospheric magnetized structures.