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Knotty structures of the evolving heliospheric magnetic fields.

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The analogy between MHD and knot theory is utilized in an analysis of structure, stability and evolution of complex magnetic heliospheric flux tubes. Planar projection of a three-dimensional magnetic configuration depicts the structure 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. It is conjectured that the 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, allowing us to predict the observed structures 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. Observation of small scale magnetic features consistent with prime knot may indicate spatial intermittency and non-Gaussian statistics in the turbulent cascade process. 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. Future measurements are suggested for distinctly oriented magnetic fields with directionally varying suprathermal particle fluxes.