

MEANINGFUL DEFINITIONS OF MAGNETIC HELICITY IN OPEN DOMAINS

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ABSTRACT

It is well known that the magnetic helicity integral of magnetohydrodynamics is non-unique if the magnetic field passes through the domain boundary. Rather, it depends on the choice of vector potential, even in a topologically simple domain. The same is true of the field line helicity. In some sense, any choice of (field line) helicity is equally meaningful, because all are invariant under ideal deformations that vanish on the boundary. However, our proposition is that some choices are more physically meaningful than others, if one wishes to measure topological complexity of the magnetic field. Candidate vector potentials include the so-called “winding gauge” [1] or the “poloidal-toroidal gauge” [2]. I will outline our ideas about what might be the “natural” choice of vector potential, both in Cartesian domains and in spherical shell domains. The latter are relevant to magnetic fields in the Sun’s atmosphere.

Joint work with Chris Prior and Daining Xiao.

- [1] Prior, C.B. & Yeates, A.R. 2014 On the helicity of open magnetic fields. *Astrophys. J.* **787**, 100.
- [2] Berger, M.A. & Hornig, G. 2018 A generalized poloidal-toroidal decomposition and an absolute measure of helicity. *J. Phys. A: Math. Theor.* **51**, 495501.