Propositions
accompanying the thesis
Knots in Plasma

1. A localized helical magnetic field relaxes to a self-organized structure with field lines lying on nested toroidal surfaces. This state is not a Taylor state. [This thesis, chapter 2]

2. A localized magnetic field cannot attain a force-free configuration. It can only be in equilibrium if there is a finite external pressure and there is a toroidal depression in pressure. [This thesis, chapter 3]

3. Magnetic surfaces with non-zero Euler characteristic appear in the resistive decay of configurations that are solitons in ideal MHD. These surfaces can exist because of persistent zero lines that are present in these fields, and it is the index of the zero line along the z-axis that determines the topology of the new magnetic surfaces.
[This thesis, chapter 4]

4. The resistive decay of the self-organized toroidal structure follows a universal pattern that can be fully understood through Pfirsch-Schlüter diffusion and the faster decay of the toroidal component of the field. This is true unless the structure becomes susceptible to nonaxisymmetric perturbations. [This thesis, chapter 5]

5. Since J. B. Taylor was careful to specify his conjecture (relaxation to a linear force-free field) to hold only in toroidally bounded plasmas, the 'counterexamples' such as the topological constraints put forth by Yeates et al, calculations by Moffatt, and the self-organized state in this thesis do not challenge the conjecture itself, but merely its overzealous application to any relaxing magnetic field.
[J. B. Taylor, Phys. Rev. Lett. **33**, 1139 (1974)]

6. The flow of fluid helicity across scales as identified by Scheeler et al. is based on geometrical principles and holds equally true for magnetic helicity. [M. W. Scheeler et al., PNAS **111**, 15350 (2014)]

7. Kedia et al. provide a valuable formalism for constructing a knotted vector field with tunable helicity. Even though they do not mention them, also in these fields zero lines must exist, at least for the hyperbolic knots. Similar to chapter 4, the geometry of these lines will be crucial to understanding the resistive evolution.

   [H. Kedia et al., Phys. Rev. Lett. **117**, 274501, (2016).]

8. The derivation of the equilibrium radius of the Kamchatnov-Hopf soliton does not add any insight to this configuration: the equations are solved for any radius, and the notion of varying the radius to find the point where angular momentum conservation balances helicity conservation is physically unsound since the fluid under consideration necessarily is incompressible.

   [A. M. Kamchatnov, Sov. Phys.-JETP, **55** 117 (1982).]

9. A theoretical physicist is the very model of a modern major general.

   [Gilbert and Sullivan, Pirates of Penzance 1879]

10. The more robust a physical phenomenon is, the more fundamental the mathematical principle underlying it. This is especially true for phenomena that are based on topology.

11. The notion that modern communication technology is degrading human contact and social interaction disregards the inherently social nature of humans, who will use any and all technology at their disposal to find meaningful contact, and stems from the inability of the aggrieved to comprehend said communication.

12. The tendency of the well-read socialite to only consume critical opinion pieces with which they agree beforehand leads to a semblance of a debate, polarization between disjunct societal groups, and actually harms the debate on socially relevant issues.

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