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The Topology of Canonical Flux Tubes in Flared Jet Geometry[1]
ERIC SANDER LAVINE, SETTHIVOINE YOU, University of Washington — Magnetized plasma jets are generally modeled as magnetic flux tubes filled with flowing plasma governed by MHD. We outline here a more fundamental approach based on flux tubes of canonical vorticity. This approach extends the concept of magnetic flux tube evolution to include the effects of finite particle momentum and enables visualization of the topology of plasma jets in regimes beyond MHD. We examine the morphology of these canonical flux tubes for increasing electrical currents, different radial current profiles, different electron Mach numbers, and a fixed, flared, dipole magnetic field. Calculations of gauge-invariant relative canonical helicity track the evolution of magnetic, cross, and kinetic helicities in the system and show that ion flow fields can unwind to compensate for increasing magnetic twist. The results demonstrate that including a species' finite momentum can result in long, collimated canonical vorticity flux tubes even when the magnetic flux tube is flared. With finite momentum, particle density gradients must be normal to canonical vorticities not to magnetic fields, so observations of collimated astrophysical jets could be images of canonical vorticity flux tubes instead of magnetic flux tubes.

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