ABSTRACT:

A knot---a closed loop tangled with itself, which cannot be untangled without cutting the loop---preserves its identity when stretched or rotated. Remarkably, knots in the vortex lines of a dissipationless fluid, or in the magnetic field lines of an infinitely conducting plasma, can stretch and rotate as they evolve but can never untangle, persisting forever. Seeking a better understanding of the persistence of knots, we study if knots can persist in a linear theory such as Maxwell’s equations. A consequence of the persistence of knots in dissipationless fluids and plasmas, is an additional conserved quantity: helicity, which has far-reaching implications for the dynamics of fluids and plasmas. We seek to understand if an additional conserved quantity analogous to helicity exists in superfluids since they also flow without dissipation.