The life of vortex knots and the conservation of helicity

Irvine, William; University of Chicago

What happens if you take a vortex loop - akin to a smoke ring in air - and tie it into a knot or a link? The possibility of such knottiness in a fluid has fascinated physicists and mathematicians ever since Kelvin's 'vortex atom' hypothesis, in which the atoms of the periodic table were hypothesized to correspond to closed vortex loops of different knot types.

More recently, helicity - a measure of knottiness in fluids and plasmas — has re-emerged in fluid dynamics because, as a conserved quantity it offers the potential for fundamental insights.

Progress in understanding its implications has been hindered by lack of accessible experimental systems and explicit models. I will tell of how to make a vortex knot and link in water (in experiment), in the wave function of a superfluid (on a computer) and of what happens thence. I will use this to talk about the fabric of helicity in classical and quantum fluids and emphasize universal aspects of how it evolves.