Vortex motion, stretching and shedding

Andrew D Gilbert (with Steve Childress, Emmanuel Dormy, Paul Valiant)

Vorticity is advected and diffused in fluid flow, and many flows are best understood in terms of vortex dynamics and the mixing and transport of vorticity. Many open problems concern the evolution of coherent vortices and how rapidly vortex stretching can occur, with and without viscosity. We will discuss evolution of vortex dipoles, in particular those that result from the collision of vortex rings. We will show how vorticity erosion – the shedding of vorticity – is inevitable through conservation of energy and a more detailed analysis. We will also discuss aspects of the stretching of vortex dipoles that come together in a hairpin configuration and stress many aspects of this problem, for example the role of axial flow, that remain poorly understood.