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Vortex filaments in the 3D Navier-Stokes equations

We consider the 3D Navier-Stokes equations with initial vorticity given by a measure concentrated on a smooth, non-self-intersecting curve with vorticity of constant magnitude directed along the tangent. Such initial data is an idealization of the coherent structures commonly observed in 3D fluids at high Reynolds numbers known as vortex filaments. The initial data is also exactly in the Koch-Tataru critical regularity class BMO^{-1}, the largest class of initial data for which global well-posedness of mild solutions is known for small data. However, for large data in BMO^{-1}, even local existence of mild solutions is open (note this is in contrast to smaller critical spaces such as L^3). We construct (locally-in-time) mild solutions for vortex filaments of arbitrary circulation which are smooth for all $t > 0$. The solutions we construct are approximately a locally self-similar Gaussian transverse to the filament and are unique and stable in a certain class of such possible solutions. Joint work with Pierre Germain and Benjamin Harrop-Griffiths.