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11. Mathematical Physics

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A probabilistic method for vortex motion in turbulent fluids

Consider a Navier-Stokes incompressible turbulent fluid in two spatial dimensions. Assume a vortex in the fluid possesses a continuous trajectory, $\mathbf{x}(t)$, described by a stochastic differential equation. Based on [N], we derive the evolution equation of $\psi(\mathbf{x}, t)$, the probability of finding the vortex in position $\mathbf{x}$ at time t. In contrast to stochastic mechanics, the velocity of the vortex intrinsically has both gradient and rotational parts, hence ψ is in general multi-valued. We present some solutions of the evolution equation in this context.

References: [H] X. He, *Chaos, Solitons and Fractals* **4** (1994), 693-699. [N] E. Nelson, *Lecture Notes in Mathematics* **1362** (1988), 428-450.