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How Randomness Prevents Super Exponential Mixing in Fluids

Wednesday, 14 January 2026 09:00 (1 hour)

I will present recent work with M. Hairer, T. Rosati, and J. Yi on the maximum rate of mixing in randomly stirred fluids. By analyzing the top Lyapunov exponent for the advection-diffusion and linearized Navier-Stokes equations, we prove that the decay rate cannot be infinitely fast. Our main result establishes a quantitative lower bound on this rate that depends on a negative power of the diffusion parameter.

This finding provides the first rigorous lower bound on the Batchelor scale in stochastically driven systems. To do this, we leverage the concept of "high-frequency stochastic instability," a mechanism where random stirring prevents energy from getting trapped in fine-scale patterns where it would dissipate too quickly.

Presenter: PUNSHON-SMITH, Samuel