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Kinematic fast dynamo problem for 2D maps

Abstract:
Magnetic dynamo theory belongs to the area of magnetohydrodynamics and involves the study of the generation of the magnetic field in astrophysical objects such as planets and stars. It attempts to gain some understanding of the non-diffusive processes that might be involved by addressing the question of what sort of fluid motions can induce exponential growth of the magnetic field at high magnetic Reynolds number. This is one of a large class of singular problems with important physical implications for which there is a need for a better understanding of the limiting behaviour of complicated processes.

The kinematic fast dynamo problem asks whether there exist a divergence-free velocity field in a compact domain such that the energy of the magnetic field grows exponentially in time for some initial field and for arbitrarily low diffusivity.

This is a Cauchy problem for an equation of Navier-Stokes type.

I will present an approach to a solution based on a careful analysis of certain random two-dimensional systems which are of independent interest.