Kraichnan-Kazanstev dynamos in 2.5D flows

Kannabiran SESHASAYANAN & Alexandros ALEXAKIS

Laboratoire de Physique Statistique, École Normale Supérieure, Université Pierre et Marie Curie, 24 rue Lhomond, 75005 Paris
skannabiran@lps.ens.fr

We study the dynamo instability created by a gaussian random flow first studied by [1]. This type of a flow is more commonly known as the Kraichnan flow proposed in [2] for studying passive scalar advection. By taking into account the relevant correlation functions we derive the governing equations for the two point correlation function of the magnetic field in the case of a 2.5D flow, a flow which varies in two dimensions but has three components. We focus on the nonhelical flow where the vorticity and the velocity field are uncorrelated. We look for the unstable modes of the resulting set of equations as a function of the parameters. We show how the growth rate γ varies as a function of k_z and the magnetic Reynolds number Rm, where k_z is the vertical mode in the invariant z direction. We finally compare our results with direct numerical simulations to validate the model.

References

1. Kazantsev, A. P. *Enhancement of a magnetic field by a conducting fluid.* Sov. Phys. JETP, 26, 1031–1034, (1968).
2. Kraichnan, R. H., *Small-Scale Structure of a Scalar Field Convected by Turbulence.* Phys. Fluids , **11**, 5, 945–953, (1968).