Macroscopic Limit for the Vorticity Distribution in a 2D Fluid *

Peter M. Kotelenez
Department of Mathematics
Case Western Reserve University
10900 Euclid Avenue
Cleveland, OH 44106
email: pxk4@po.cwru.edu

Abstract

Kotelenez (1995) introduces a stochastic Navier-Stokes equation for the vorticity distribution of a 2D fluid. The solution lives on the space of finite signed measures. The stochastic term depends on spatially correlated Brownian noise and a correlation length $\varepsilon > 0$. Kotelenez and Kurtz (2005) prove a macroscopic limit theorem for a large class of quasilinear stochastic partial differential equations (SPDE's) with solutions in the space of probability measures. These SPDE's are driven by spatially correlated Brownian noise, and the solutions converge to the solution of a deterministic McKean-Vlasov equation, as the correlation length tends to 0. We generalize this result to the signed measure-valued solutions of the stochastic Navier-Stokes equation. The resulting macroscopic limit is described by a deterministic Navier-Stokes equation for the vorticity distribution in the plane.

References

Kotelenez, P. (1995), *A Stochastic Navier Stokes Equation for the Vorticity of a Two-dimensional Fluid.* Ann. Applied Probab. Vol. 5, No. 4. 1126-1160

Kotelenez, P. and Kurtz, T.G. (2005), *Macroscopic Limit for Stochastic Partial Differential Equations of McKean-Vlasov Type.* (Preprint)

*Joint work with Thomas G. Kurtz