

A fractional kinetic process describing the intermediate time behaviour of cellular flows

This is joint work with Martin Hairer, Gautam Iyer, Leonid Korolov, and Zsolt Pajor-Gyulai. This work studies the intermediate time behaviour of a small random perturbation of a periodic cellular flow. Our main result shows that on time scales shorter than the diffusive time scale, the limiting behaviour of trajectories that start close enough to cell boundaries is a fractional kinetic process: A Brownian motion time changed by the local time of an independent Brownian motion. Our proof uses the Freidlin-Wentzell framework, and the key step is to establish an analogous averaging principle on shorter time scales. As a consequence of our main theorem, we obtain a homogenization result for the associated advection-diffusion equation. We show that on intermediate time scales the effective equation is a fractional time PDE that arises in modelling anomalous diffusion.