

Two problems in non-equilibrium statistical mechanics: Hydrodynamic turbulence, and linear response

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The main scientific contributions of Claude-Alain Pillet are in non-equilibrium statistical mechanics. This is not at this time a unified field, and I wish to present two aspects of it to honor the 60th birthday of C.-A. Pillet.

There is a beautiful and useful theory of hydrodynamic turbulence due to Kolmogorov and based on assuming isotropic and homogeneous turbulence. Homogeneity is however violated in experiments: we have intermittency. We present here an intermittent approach to turbulence which is natural from the point of view of dynamics, and which fits reasonably the experimental data.

A natural physical state of a chaotic dynamical system may be represented by some special probability measure (SRB state) invariant under the dynamics. It is natural to assume that for a small change in the dynamics there is a small change in the physical state proportional to the change in the dynamics: this is the principle of linear response. But there are many counterexamples. Linear response holds for uniformly hyperbolic dynamical systems, and we shall make a non-rigorous study of more general situations.