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Flow of incompressible turbulent-like rough vector fields

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I will begin with recalling some key ingredients of the phenomenology of three- dimensional fluid turbulence, both in the Eulerian framework and in its Lagrangian coun- terpart. It will be the occasion for us to define so-called fractional Gaussian fields: they are random representation of statistically homogeneous Hölder-continuous functions, and can be considered as a simplistic probabilistic formulation of the expected behavior of fluids at infinite Reynolds numbers (choosing the particular Hölder exponent 1/3). We will propose then a numerical exploration of the induced flow once these fields are regularized at small scales over the Kolmogorov length scale. In such a setting, Cauchy-Lipschitz theorem warrants the uniqueness of the trajectories and a clear meaning to the flow. This allows us to observe how the flow behaves as the Kolmogorov length scale goes to zero, and gives a numerical picture of the selection process by viscosity of the flow of Hölder-continuous fields. Joint work with Jason Reneuve, and more recent developments with Charles-Edouard Bréhier and Matthieu Châtelin.

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