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Propagation of randomness under the flow of nonlinear dispersive equations.

The study of partial differential equations (PDEs) with randomness has become an important and influential subject in the last few decades. In this talk we focus on the time dynamics of solutions of nonlinear dispersive equations with random initial data. It is well known that in many situations, randomization improves the behavior of solutions to PDEs: the key underlying difficulty is in understanding how randomness propagates under the flow of nonlinear PDEs. In this context, starting with an overview of J. Bourgain's seminal work on the invariance of Gibbs measures for nonlinear Schrödinger equations we describe new methods that offer deeper insights. We discuss in particular the theory of random tensors, a powerful new framework that we developed with Yu Deng and Haitian Yue, which allows us to unravel the propagation of randomness beyond the linear evolution of random data and probe the underlying random structure that lives on high frequencies/fine scales. This enables us to show the existence and uniqueness of solutions to the NLS in an optimal range relative to the probabilistic scaling. A beautiful feature of the solution we find is its explicit expansion in terms of multilinear Gaussians with adapted random tensor coefficients.

We conclude with some future directions and open problems. (Received July 6, 2020)