Hydrodynamic limit for a harmonic chain with random masses

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We consider the Hamiltonian dynamics of an unpinned chain of harmonic oscillators with random masses. Under a hyperbolic rescaling of space and time we obtain the full set of Euler equations for the macroscopic evolution of energy, momentum and volume stretch. This is in contrast with the deterministic masses case, where there is no autonomous macroscopic evolution for the energy field if the system is not in thermal equilibrium.

The dynamics is completely integrable, but Anderson localization, due to the randomness of the masses, freeze the evolution of the thermal (microscopic) frequency modes, allowing a clear separation of scales from the macroscopic modes that are governed by the Euler equations.

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