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Lectures: Generalised hydrodynamics: exact solutions, fluctuations, and all-order expansion

Monday, June 9, 2025 9:30 AM (1h 30m)

Hydrodynamics is more than a set of PDES. It is a framework for emergent dynamical behaviour in many-body systems. Generalised hydrodynamics (GHD), with its exact equations and rich structure, has led to a much deeper understanding of this framework.

Lecture 1: Following on from Herbert's talk, I will explain the general features of GHD for classical and quantum systems, focusing on the quantum Lieb-Liniger model. This includes: the hydrodynamic equation and its linear response, GHD as a dressed classical kinetic theory, a geometric mapping to freely propagating waves, wave-packet / soliton gas relation, exact solutions, Hamiltonian form, and general solvability theorems.

Lecture 2: I will come back to the fundamental concepts at the basis of hydrodynamics, putting the Mori-Zwanzig projection idea on a firmer basis. This gives a full theory of non-linear response, typical and large-deviation form of fluctuations, emergent hydrodynamic noise and why it is absent in integrable models, and all-order hydrodynamic expansion.

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