Abstract

Hydrodynamics is a powerful theory for the emergent behaviours at large scales of space-time in many-body systems. The theory says that only few degrees of freedom are sufficient in order to describe what is observed at such scales, and it provides equations for the dynamics of these degrees of freedom. Think of the simple water waves emerging from the motion and interaction of a myriad of water molecules. It is strongly based on the presence of microscopic conservation laws in the many-body model, such as conservation of energy, momentum and mass. But the standard equations of hydrodynamics fail to describe one-dimensional integrable systems, including the ultracold atomic gases observed in experiments. Integrable systems admit an extensive number of conservation laws, which must be taken into account in the emergent hydrodynamic theory. Recently this theory, dubbed ``generalised hydrodynamics", has been developed. In this talk, I will review fundamental aspects of hydrodynamics and the main idea and equations of generalised hydrodynamics. I will discuss recent cold-atom experiments that confirm the theory, and, as time permits, some results that can be obtained with this formalism such as nonequilibrium steady states, asymptotic of correlation functions, a generalisation of the Luttinger liquid theory, and some mathematically rigorous aspects.