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Anderson localization of a weakly interacting Bose-Einstein condensate

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Abstract

Localization of waves due to disorder is a very general phenomenon, that has rather well been understood in the theoretical frame set by Anderson for non interacting particles. In many physical systems however nonlinearities or dissipation are present, making a full understanding of the physics of disorder more difficult. Here we employ a Bose-Einstein condensate with tunable contact interaction to study the interplay between disorder and nonlinearity. We use a tight one-dimensional optical lattice, where a quasi-periodic disorder is introduced by means of a second, weak incommensurate lattice. This represents a physical realization of the well known Aubry-Andrè model. By investigating the behaviour in both position and momentum space, we observe an Anderson-like localization of the condensate for negligible interaction. In this regime the system is fragmented into a series of exponentially localized spatial modes. We then study how a controllable repulsive interaction gradually drives back the system into an extended, superfluid state. We will report on an ongoing investigation of such crossover between localized and extended states.