

## Localization transitions in disordered and quasiperiodic interacting Bose superfluids

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The dynamics of many-body quantum systems is attracting a growing attention, motivated by the development of novel devices where parameters can be accurately controlled. In disordered media, the interplay of interactions and localization still poses many challenging questions [1,2] and ultracold-atom quantum simulators offer fantastic opportunities to address them with unprecedented control [3]. Here we report recent theoretical work on Anderson localization in many-body, disordered and quasiperiodic, Bose superfluids [4-7]. We show that, while the density background is extended owing to strong-enough repulsive interactions, Anderson localization survives at the many-body-excitation level. We develop an analytical approach valid in arbitrary dimension, which allows us to derive quantitative predictions, and draw a clear physical picture. We also report numerical calculations, which confirm our analytical predictions. The disordered and quasiperiodic cases are discussed and compared. Implications on experiments with disordered ultracold atoms are discussed.

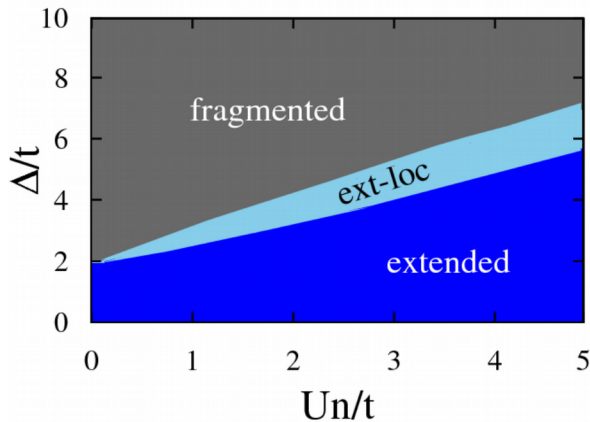


Fig 1: Localization diagram as a function of the interaction strength ( $U$ ) and the quasiperiodic amplitude ( $\Delta$ ). It displays three regimes: (i) “extended regime” where the density background is connected and all excitations are extended; (ii) “fragmented regime” where the density background is fragmented; and (iii) “extended-localized regime” where the density background is connected and the excitation spectrum shows a delocalization-localization transition with exponentially localized high-energy states and extended low-energy states. From Ref. [6].

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