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Coexistence of Localized and Extended States in a Disordered Trap

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We study Anderson localization of matterwaves in a disordered potential combined with an inhomogeneous trap. We show that the spectrum displays both localized and extended states, which coexist at intermediate energies. The coexistence of localized and extended states is in apparent contradiction with the Mott argument, which is widely accepted and verified for several models of homogeneous disorder. We argue and prove numerically that the argument fails when an inhomogeneous trap is superimposed with the disorder. In the coexistence region, we find that the extended states result from confinement by the trap and are weakly affected by the disorder. Conversely, the localized states correspond to eigenstates of the disordered potential, which are only affected by the trap via an inhomogeneous energy shift. In addition to other inhomogeneous systems, these results are directly relevant to disordered quantum gases, which are confined in traps and we propose a realistic scheme to observe the coexistence of localized and extended states in these systems.

[1] L. Pezzé and L. Sanchez-Palencia, Phys. Rev. Lett. **106**, 040601 (2011).