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BEC in a shaken optical lattice[1] E. ARIMONDO, D. CIAMPINI, H. LIGNIER, O. MORSCH, A. ZENESINI, Dipartimento di Fisica, Universita di Pisa, Italy — The formal similarity between matter waves in periodic potential and solid-state physics processes has triggered a large interest on quantum simulation based on Bose/Fermi gases in optical lattices. Here this similarity is extended to matter waves in periodically driven potentials and electrons in oscillating electromagnetic fields. We have demonstrated that the tunneling properties of a Bose-Einstein condensate in spatially "shaken" periodic potentials can be precisely controlled. We have taken additional crucial steps towards future applications of this method by proving that the strong shaking of the optical lattice preserves the coherence of the matter wavefunction and that the shaking parameters can be changed adiabatically, even in the presence of interactions. Thus we have reversibly induced the quantum phase transition to the Mott insulator in a driven periodic potential. In addition the exact dynamic localization of a Bose-Einstein condensate in the shaken optical lattice was produce by square-wave forcing. The creation of "dressed matter waves" with new properties by shaking a periodic potential appears to be a promising tool to realize band structures for solid-state physics quantum simulations.

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