

## Quantum Physics

# Bloch oscillations of Bose-Einstein condensates: Quantum counterpart of dynamical instability

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We study the Bloch dynamics of a quasi one-dimensional Bose-Einstein condensate of cold atoms in a tilted optical lattice modeled by a Hamiltonian of Bose-Hubbard type: The corresponding mean-field system described by a discrete nonlinear Schrödinger equation can show a dynamical (or modulation) instability due to chaotic dynamics and equipartition over the quasimomentum modes. It is shown, that these phenomena are related to a depletion of the Floquet-Bogoliubov states and a decoherence of the condensate in the many-particle description. Three different types of dynamics are distinguished: (i) decaying oscillations in the region of dynamical instability, and (ii) persisting Bloch oscillations or (iii) periodic decay and revivals in the region of stability.

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