Nonlinear quantum physics in Bose-Einstein Condensates

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Abstract:

In this talk, nonlinear quantum physics in Bose-Einsein Condensates (BECs) are introduced, based on one exact solution of Gross-Pitaevskii Equation (or Nonlinear Schrödinger equation). For nonuniform BECs, we introduce one novel orthogonal basis, and the stability of the ground and first excited state are analyzed. For two weak linked BECs, symmetry-preserving and symmetry-breaking stationary solutions are introduced and the behind reasons are given. Based on these stationary solutions, we find that the nonlinear tunneling (induced by the nonlinear interaction) induces an important correction to its dynamical and stationary properties in the case of strong nonlinear interaction. For BECs in a periodic array of quantum wells, we find nonlinear Bolch solutions and corresponding Wannier functions. We study the sound velocity, effective mass and so on as a function of the nonlinear parameters. Starting from these, the parameters for Bose Hubbard Model are presented.

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