Mathematics > Analysis of PDEs

Bose-Einstein condensates in optical lattices: mathematical analysis and analytical approximate formulae

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We show that the Gross-Pitaevskii equation with cubic nonlinearity, as a model to describe the one dimensional Bose-Einstein condensates loaded into a harmonically confined optical lattice, presents a set of ground states which is orbitally stable for any value of the self-interaction (attractive and repulsive) parameter and laser intensity. We also derive a new formalism which gives explicit expressions for the minimum energy and the associated chemical potential. Based on these formulas, we generalize the variational method to obtain approximate solutions, at any order of approximation, for the energy, the chemical potential and the ground state.

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