Correction of the ground state energy of one-dimensional gross-pitaevskii equation with gain-loss term

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Abstrak

We consider the correction of ground state energy of one-dimensional Gross-Pitaevskii equation by adding a gain-loss term as a time-dependent external potential. The interesting purpose of this term is that it can be used to explain the experimental results especially in the nonlinear fiber optics regarding the pulse propagation and collapse-revival of the condensate in the Bose-Einstein condensation. In the Bose-Einstein condensation itself, the function can represent that
condensate can interact with the normal atomic cloud. Some analytical solutions have been obtained by choosing anansatz solution of the wave function and its solution can be dark or bright soliton. Since the Gross-Pitaevskii equation can be treated as a macroscopic quantum oscillator, we can use time-dependent perturbation theory as in ordinary
quantum mechanics to find the ground state energy correction if we assume other terms to be very small. In addition, time-dependent potential allows a transition from one energy level to others. In this case, we expand the solution of nonstationary one-dimensional wave function as a linear superposition of harmonic oscillator normalized eigen functions. To get the recursive formulas, we suggest an option to formulate the coefficients after inserting the initial condition which must be satisfied such as in quantum mechanics.