学术报告

Numerical methods for Bogoliubov-de Gennes excitations of Bose-Einstein condensates

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Abstract： We study the analytical properties and the numerical methods for the Bogoliubov-de Gennes equations (BdGEs) describing the elementary excitation of Bose-Einstein condensates around the mean field ground state, which is governed by the Gross-Pitaevskii equation (GPE). Derived analytical properties of BdGEs can serve as benchmark tests for numerical algorithms and three numerical methods are proposed to solve the BdGEs, including sine-spectral method, central finite difference method and compact finite difference method. Extensive numerical tests are provided to validate the algorithms and confirm that the sine-spectral method has spectral accuracy in spatial discretization, while the central finite difference method and the compact finite difference method are second-order and fourth-order accurate, respectively. Finally, sine-spectral method is extended to study elementary excitations under the optical lattice potential and solve the BdGEs around the first excited states of the GPE.

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