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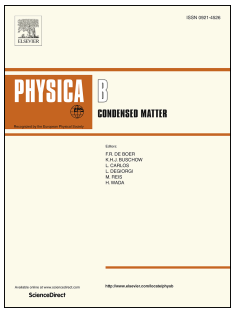

Repulsion-attraction asymmetry in the Bose-Fermi-Hubbard model

I.V. Stasyuk, V.O. Krasnov

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Repulsion-attraction asymmetry in the Bose-Fermi-Hubbard model.

I.V. Stasyuk, V.O. Krasnov*

Institute for Condensed Matter Physics of NAS of Ukraine, 1 Svientsitskii Street, 79011 Lviv, Ukraine
phone. (032) 2761978, fax: (032) 2761158
e-mail: krasnoff@icmp.lviv.ua

Abstract

It is shown that in the Bose-Fermi-Hubbard model, used for a description of the atomic boson-fermion mixture in the optical lattice, the fermion-hole symmetry allows one to establish a correspondence between cases of the on-site repulsion and attraction. Based on the phase diagrams, built with the help of a corresponding transformation of model parameters within the framework of the grand canonical ensemble, the conditions of the superfluid phase existence at the boson-fermion attraction are analyzed. The phase diagrams that illustrate the difference of behavior of the BF mixture in the cases of BF repulsion or attraction are obtained. A relation to the available experimental data is discussed.

Keywords: Bose-Fermi-Hubbard model; Bose-Einstein condensate; optical lattices; phase transitions; boson-fermion interaction

1. Introduction

Creation of optical lattices with ultracold atoms in the earlier 2000s gave a new impulse to the development of physics of strongly correlated quantum particle systems. This direction takes its start from the investigation of electron systems in the narrow conductivity bands with strong local correlations. A widely used model proposed for their description is the Hubbard model where the main role is played, together with the electron transfer in a lattice, by the on-