In a recent Letter Bakhtiari et al. [1] studied an imbalanced two-component atomic Fermi gas in a one-dimensional optical lattice with a trapping potential, within the Bogoliubov–de Gennes (BdG) approximation. They showed that the prominent oscillations of the pairing gap (within the BdG approximation), characteristic of a Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) state, could be detected in the rf spectra and in the momentum-resolved photoemission spectra of the gas. In this Comment we show that the BdG approximation not only produces inaccurate results for the examples presented in [1], but that they are qualitatively incorrect making the analysis of the rf spectrum unreliable and shedding doubts on the applicability of rf spectroscopy to detect the FFLO state in 1D optical lattices.

The whole Letter [1] is devoted to 1D optical lattices without any reference to higher dimensions where the BdG approximation could be valid. The use of the BdG approximation is justified by saying that it provides qualitative information on the system and allows one to calculate the rf spectrum. In spite of the known failure of the BdG approximation in 1D systems, it is still used [2]. In the absence of a trap the BCS treatment gives large errors in the order parameter as compared to the exact solution (see Ref. [19] of the Letter [1]). With the inclusion of the trap we have to resort to the density matrix renormalization group (DMRG) to produce numerically “exact” solutions for 1D lattice problems of moderate sizes (∼100 sites). Indeed, the DMRG has already been used to study the FFLO phase in a 1D trapped lattice gas (see Refs. [11] and [16] of the Letter [1]). Therefore the DMRG constitutes an ideal benchmark to test the accuracy of the BdG approximation in 1D lattice problems.

In Fig. 1 we show the densities and the absolute value of the local gap parameter $|\Delta|$ as a function of the site index $i$. Upper panels show results for $P = 0.23$ and lower panels for $P = 0.70$. From left to right we show results of BdG without the Hartree term, BdG with the Hartree term, and DMRG.

The subsequent analysis of the rf spectra is based on the BdG results of Figures 1(a) and 1(d). Taking into account that the gap oscillation are reduced by 1 order of magnitude in the DMRG results, it is doubtful that rf spectroscopy could provide information about the spatial structure of the pairing gap. Whether rf spectroscopy could signal the FFLO phase in 1D lattice systems is still an open question which might be confirmed by rf experiments or addressed numerically by means of a DMRG study. Note that within the correction vector approach the calculation of the excitation spectrum is not needed.

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