Stability of unconventional superfluid phases in the honeycomb lattice with population imbalance

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We study the superconducting properties of population-imbalanced ultracold Fermi mixtures in the honeycomb lattice that can be effectively described by the spin-imbalanced attractive Hubbard model (AHM) in the presence of a Zeeman magnetic field. We use the mean-field theory approach to obtain the ground state phase diagrams including some unconventional superconducting phases such as the Fulde–Ferrell–Larkin–Ovchinnikov (FFLO) phase, and spatially homogeneous spin-polarized superfluidity (SC_M) (called Sarma phase). We discuss the possibility of realization of the reentrant FFLO superconductivity. Finally, we examine the influence of the next-nearest-neighbor hopping integrals (t_2) on the stability of the SC_M phase.

This work was supported by Narodowe Centrum Nauki (NCN) through the Grant Fuga, No. UMO-2016/20/S/ST3/00274.