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Two-dimensional Fermi gas in antiparallel magnetic fields[1]

TAKAAKI ANZAI, YUSUKE NISHIDA, Tokyo Institute of Technology — Experimental techniques in ultracold atoms allow us to tune parameters of the system at will. In particular, synthetic magnetic fields have been created by using the atom-light coupling and, therefore, it is interesting to study what kinds of quantum phenomena appear in correlated ultracold atoms subjected to synthetic magnetic fields. In this work, we consider a two-dimensional Fermi gas with two spin states in spin-dependent magnetic fields which are assumed to be antiparallel for different spin states [1]. By studying the ground-state phase diagram within the mean-field approximation, we find quantum spin Hall and superfluid phases separated by a second-order phase transition. We also show that there are regions where the superfluid pairing gap is proportional to the attractive coupling, which is in marked contrast to the usual exponential dependence. Moreover, we elucidate that the universality class of the phase transition belongs to that of the XY model at special points of the phase boundary, while it belongs to that of a dilute Bose gas anywhere else [2]. [1] M. C. Beeler et al., Nature **498**, 201 (2013). [2] T. Anzai and Y. Nishida, Phys. Rev. A **95**, 051603 (2017).

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