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Z_2 topological classification in BEC-BCS crossover phenomena
MITSUHIRO ARIKAWA, University of Tsukuba, ISAO MARUYAMA, Osaka University, YASUHIRO HATSUGAI, University of Tsukuba — Recently, the BEC-BCS crossover is experimentally realized in ultracold atomic Fermi gases— the Bose-Einstein condensation of real space molecules in a strongly attractive system and the BCS superfluidity in a weakly coupled case. They are not clearly distinguished by the standard order parameters. They are just separated as a crossover, that is, the two ground states are adiabatically connected even in the thermodynamic limit. Introducing a topological order parameter as the Z_2 Berry phase with a local U(1) twist[1], we have discussed the BCS hamiltonian in a real space for the chiral symmetric case. This local Z_2 Berry phase distinguishes the BEC-BCS crossover as a local quantum phase transition, that is the phases are separated by closing of the energy gap under the local twist, although the gap of the translational invariant system is always open. Physically it characterizes the paired electron is itinerant or localized. This comes from the bulk-edge correspondence in the BEC-BCS crossover as is well established in the Quantum Hall effects. [1] Y. Hatsugai, J. Phys. Soc. Jpn. 75, 123601 (2006) .

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