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3rd International Conference on

Applied Physics

August 23-24, 2018 | London, UK

Local broken symmetry and spin transport in the frustrated two-dimensional model

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The local spontaneous symmetry breaking is a general phenomena in condensed matter physics. It is characterized by the fact that the action has a local symmetry but the quantum theory, instead of having a unique vacuum state which respects this symmetry, has a family of degenerate vacua that transform into each other under the action of the symmetry group. A simple example is given by a ferromagnetic model in which the action governing its microscopic dynamics is invariant under spatial rotations. A kind of local gauge invariance or spontaneous breaking of U(1) gauge symmetry is realized in nature in the phenomenon of superconductivity. We have proposed the Meissner mechanism for the spin supercurrent in quantum spin systems. Besides, we study the behavior of the AC spin conductivity in neighborhood of quantum phase transition in a frustrated spin model such as the antiferromagnet in the compass lattice with single ion anisotropy at T=0. Our results show the curve of conductivity varying strongly with the behavior of the critical anisotropy Dc and J.

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