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Meissner mechanism for the spin supercurrent and influence of the critical behavior on spin transport in the frustrated Heisenberg 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 neighbourhood of quantum phase transition in a frustrated spin model such as the antiferromagnet in the union jack lattice with single ion anisotropy at $T = 0$ [2]. We investigate the spin conductivity for this model that presents exchange interactions *J1* and *J2*. Our results show a single peak for the conductivity with the height varying with the behavior of critical anisotropy *Dc* with *J2* [3]. We obtain the conductivity tending to zero in the limit w ® 0.

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