# Charge transport in cuprates by the spin vortices: quantum Brownian motion of vortex in frustrated background

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In the ground state of $Nd$ doped $La_{2-x}Sr_xCuO_4(0.02 < x < 0.05)$ the spins form spirals frustrated by magnetic dipoles located on holes. The system allows for existence of the non-Abelian $Z_2$ spin vortices. Due to interaction with frustrated background, their energy (mass) is finite i.e. $Z_2$ vortices can move. The mobile vortices carry the charge since the holes have tendency to attach to defect structure (vortices). It opens the new channel of conductivity in cuprates.

9.7 cm

We study the quantum dynamics of the $Z_2$ spin vortices in the frustrated background of cuprates. We describe it in terms of the order parameter of spirals (the rotation matrix) interacting with $SO(3)$ gauge field which represents the frustrations. The relevant model for this problem is non-Abelian $SO(3)$ Higgs model. The $Z_2$ vortex is the localized (particle-like) solution in that model. We canonically quantized $Z_2$ vortex using the concept of collective coordinates and we derived the effective Hamiltonian describing quantum dynamics of a vortex. In our scenario the heavy particle (vortex) moves in a gas of magnons and gauge field quanta – quantum Brownian motion of vortex. The vortex motion is dissipative since magnons and gauge field photons are scattered by it. Our results will be used in the construction of kinetic equation (Fokker-Planck equation) for vortex and consequently the calculation of of the cuprates conductivity.

13.4 cm

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