Non-Abelian vortices in the spin glass phase of cuprates

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The Sr doped $La_{2-x}Sr_xCuO_4$ (LSCO) in the low doping regime, $(0.02 < x < 0.05)$, is the 2D non-collinear Heisenberg (n=3) antiferromagnet (NCHAF). In this phase the rotational symmetry of spin system is completely broken and, consequently, the order parameter is the rotation matrix or equivalently the triad of orthonormal vectors. That order parameter allows for existence of non-Abelian Z_2 spin vortices in LSCO, however, their energy (mass) is infinite i.e. Z_2 vortices cannot move. In fact the spins in LSCO are frustrated due to induced magnetic moment located on holes. We claim that interaction of Z_2 vortex with frustrations makes its energy finite i.e. the Z_2 vortices in frustrated NCHAF can move. Since the holes concentrate on defect structure (vortices), the moving vortices, with holes attached to them, carry the charge opening the new channel of conductivity in cuprates.

Representing the frustrations by a $SO(3)$ gauge fields, the relevant Lagrangian of frustrated NCHAF is the nonlinear sigma model (with the triad as the order parameter) coupled minimally to the $SO(3)$ gauge field. Within that model the Z_2 vortex solution with finite energy has been found. The distribution of frustrations, spins and spin current in the vortex is presented. The simplicity of our vortex makes it a good candidate to evaluation of vortex contribution to cuprate conductivity.

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