Chirality domain walls in frustrated spin system

P. Rusek

1 Wroclaw University of Technology, Wroclaw, PL

In noncollinear spin system, states have additional quantum number - the chirality: spins can rotate clock- or counter-clock-wise on plaquette. The relevant order parameter of frustrated spins is rotation matrix $O \in SO(3)$. In this case space of available states is disconnected $\Pi_1(SO(3)) = \mathbb{Z}_2$ and consequently linear topological defects - $\mathbb{Z}_2$ vortices can be spontaneously excited in a system. If a chirality distribution in long distance from the vortex is uniform (by inclusion the spin orbit interaction) the $\mathbb{Z}_2$ vortex generates the singular planar defect that is terminated on the vortex- the chirality domain wall (ChDW). In the ChDW the chirality changes its sign. We argue that ChDW has peculiar topology: in ChDW one can go from the ground state with the given chirality to the ground state with the opposite one continuously, encircling $\mathbb{Z}_2$ vortex. We claim that this feature of ChDW topology gives rise to spontaneous creation of holes which edge is (closed) $\mathbb{Z}_2$ vortex. Thus ChDW can colapse to $\mathbb{Z}_2$ vortex and the barrier energy that stabalized ChDW is equal to nucleation energy of $\mathbb{Z}_2$ loops with diameter of order of thickness of ChDW. This, in turn, is equal to the spin orbit length, i.e. the ChDW thickness as well as the energy barrier stabilizing ChDW are not macroscopically large. The application our ideas to the underdoped $La$-based cuprates in spiral phase is discussed.