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Topologically stable gapped state in a layered superconductor[1]
MAURO DORIA, Univ Fed Rio de Janeiro Brazil, MARCO CARIGLIA, Univ Fed Ouro Preto Brazil, ALFREDO A. VARGAS-PAREDES, Univ Fed Rio de Janeiro Brazil — We show that a layered charged superconductor, described by a spinorial (two-component) order parameter, has a gapped state above the ground state, topologically protected from decay. This state is made of skyrmions, breaks the time reversal symmetry and produces a weak local magnetic field. This excited but stable state contains spontaneous circulating supercurrents, with flow and counter flow in the layers, even without the presence of an external magnetic field. We derive the order parameter and the local magnetic field of this skyrmion state from the Abrikosov-Bogomolny (first order) equations, instead of the second order variational equations. We find a gap density of the order of $0.1\, h_{max}\, \mathrm{meV.nm}^{-3}$, where h_{max} is the maximum local magnetic field between layers expressed in Gauss. The present threshold of detection, set by μSR and NMR/NQR, $h_{max} \sim 0.01\,\mathrm{G}$, gives a gap density of the order $10^{-3}\,\mathrm{meV.nm}^{-3}$ for the single-layer cuprates (inter-layer distance $d \approx 1.0nm$). We suggest that the pseudogap is a skyrmion state, and so, estimate that the density of carriers that condense in the pseudogap is of the order of $10^{-4}\,\mathrm{nm}^{-3}$, or 0.01% of the Cooper pair density in the cuprates.

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Mauro Doria
Univ Fed Rio de Janeiro Brazil

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