Spin-driven spontaneous currents and polarization in Mott insulators: are electrons really localized?

L.N.Bulaevskii[1)], C.D.Batista[1)], D.Khomskii[2)] and M.V.Mostovoy[3)]

1) Los Alamos National Laboratory, USA
2) Universitaet zu Koeln, Koeln, Germany
3) Groningen University, The Netherlands

The standard point of view is that at low energies Mott insulators exhibit only magnetic properties, while charge degrees of freedom are frozen out, because electrons are localized. We demonstrate that in general this is not true [1]: for certain spin textures there exist quite nontrivial effects in the ground and lowest excited states, connected with charge degrees of freedom. In particular this may happen in frustrated systems, e.g. containing triangles as building blocks. We show that in some cases there may exist *spontaneous circular currents* in the ground state of insulators, proportional to the *scalar chirality*; this clarifies the meaning of the latter and opens the ways to directly experimentally access it. For other spin structures there may exist *spontaneous charge redistribution*, so that average charge at a site may be different from 1. This can lead to the appearance of dipole moments and possibly of the net *spontaneous polarization*. This is a novel, purely electronic mechanism of *multiferroic behaviour*. We discuss also some dynamic consequences of the effects discovered, such as dipole-active "ESR" transitions, rotation of electric polarization by magnetic field, and possibility to get negative refraction.

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