Thermal Hall response in the pseudogap phase of cuprates

Étienne Lefrançois

Abstract

The nature of the pseudogap phase of cuprates remains a major puzzle of condensed matter physics. Although Fermi-surface, transport and thermodynamic signatures of the pseudogap phase are reminiscent of a transition into a phase with antiferromagnetic order, there is no clear evidence of long-range magnetic order throughout the pseudogap phase of cuprates. Here we show that a negative thermal Hall signal appears with the onset of the pseudogap phase in the cuprates $La_{1.6-x}Nd_{0.4}Sr_xCuO_4$, $La_{1.8-x}Eu_{0.2}Sr_xCuO_4$ and $Bi_2Sr_2CuO_{6+\delta}$, which grows with reduced doping to become very large in the undoped Mott insulators La_2CuO_4 and Nd_2CuO_4. Since charge is localized in the latter, we attribute the negative thermal Hall signal to spin degrees of freedom, implying that the pseudogap phase has either magnetic order at low temperature, which would become short-ranged at high doping, or spin-liquid-like properties, as in other magnetic insulators.