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Ferroelectricity from magnetic order

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Magnetic insulators with competing exchange interactions can give rise to strong fluctuations and qualitatively new ground states. The proximity of such systems to quantum critical points can lead to strong cross-coupling between magnetic long-range order and the chemical lattice. Case in point is a new class of multiferroic materials in which the magnetic and ferroelectric order parameters are directly coupled, and a magnetic field can suppress or switch the electric polarization [1]. Our neutron measurements reveal that ferroelectricity is induced by magnetic order and emerges only if the magnetic structure creates a polar axis [2-5]. Our experiments prove that the onset of ferroelectricity is described by a magneto-electric Landau theory that seems to apply for a wide range of multiferroic materials [6]. The spin dynamics and the field-temperature phase diagram of the ordered phases provide evidence that competing ground states are essential for ferroelectricity. The magneto-electric coupling, however, arises from relatively small interactions that are currently under intense investigation.

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