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Spin-driven ferroelectricity in ferroaxial crystals

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Spin-driven ferroelectricity in most non-collinear magnets, such as TbMnO_3 , is induced by the so-called inverse Dzyaloshinskii-Moriya mechanism and requires a cycloidal magnetic structure, an ordered magnetic state that is not truly chiral (or lacks helicity). Conversely, in a truly chiral magnetic state (proper helix), the pseudo-scalar helicity can not couple directly to the electric polarization, and therefore can't induce ferroelectric order. However, in systems of specific crystal symmetry, named here "ferroaxials," the presence of collective structural rotations mediates an indirect coupling between magnetic helicity and ferroelectricity. I will review our recent experimental results for new compounds of this class, obtained by magnetic X-ray and neutron diffraction techniques, including a clear demonstration that the magnetic helicity can be controlled by an electric field.