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Oxygen rotation driven ferroelectricity enables controllable magnetization-polarization coupling in $Ca_3Mn_2O_7$ CRAIG FENNIE, NICOLE BENEDEK, School of Applied and Engineering Physics, Cornell University — We show how to achieve the electric field switching of magnetism in a multiferroic with a large polarization by having the ferroelectric state arise from the same lattice instability that modulates the spin system. Oxygen octahedron rotations, ubiquitous in perovskites and related materials, are natural candidates for this lattice instability. First-principles calculations are presented for the layered perovskite $Ca_3Mn_2O_7$, in which rotations induce both ferroelectricity and weak ferromagnetism. The key point is that this rotation pattern is a combination of two non-polar structural modes with different symmetries. We introduce the term "hybrid" improper ferroelectricity to describe this phenomenon. Our results suggest a new strategy in magnetoelectronics, whereby control over magnetism is achieved through functional antiferrodistortive oxygen octahedron rotations.
N. A. Benedek and C. J. Fennie, arXiv:1007.1003 (2010).

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