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Microscopic origin of Magnetic Ferroelectrics in Non-collinear Multiferroics CHEN FANG, JIANGPING HU, Purdue University — We propose a microscopic mechanism to understand the origin of magnetoelectric coupling in the best known multiferroic family $R\mathrm{MnO}_3$ (R=Tb, Dy...). The mechanism lies in the vanishing of electric current in an insulator. A spontaneous electric polarization is thus necessary, as it causes an electric current through a spin-orbit coupling to cancel another nonzero local electric current induced by a non-collinear modulated magnetic structure. Within this counter-balance mechanism, the magnitude of the ferroelectric order is determined by the magnetic order parameter and the spin-orbit coupling strength. Based on the theory, we predict a general physical limit for the value of ferroelectricity.

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