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Q-domains in Multiferroic $\mathbf{CoCr_2O_4}$ THOMAS A. KAPLAN, Michigan State University — In spinel $CoCr_2O_4$, the observed spin state at low temperature is, approximately, a "ferrimagnetic spiral"[1], given by[2] $\mathbf{S}_{\mathbf{n}\nu} = \sin\theta_\nu[\hat{\mathbf{x}}\cos(\mathbf{Q}\cdot\mathbf{R}_{\mathbf{n}\nu}+\gamma_\nu)+\hat{\mathbf{y}}\sin(\mathbf{Q}\cdot\mathbf{R}_{\mathbf{n}\nu}+\gamma_\nu)]+\cos\theta_\nu\hat{\mathbf{z}}$. $\nu = 1\cdots 6$ goes over the six magnetic fcc sublattices, $\mathbf{R}_{\mathbf{n}\nu}$ are the positions of the magnetic ions, $\hat{z} = [001]$ crystallographic direction, θ_ν are the cone half-angles on which the spins lie, and γ_ν are the phases of the 6 conical spirals, all with wave vector $\mathbf{Q}$ in the [110] direction. This yields magnetization $\mathbf{M}$,[1] and, via the Katsura et al mechanism[3], electric polarization $\mathbf{P}$.[4] Equivalent $\mathbf{Q}$'s, e.g. $\pm\mathbf{Q}$, with associated $\mathbf{M}$'s and $\mathbf{P}$'s, are expected to give degenerate states, "$\mathbf{Q}-\mathbf{M}-\mathbf{P}$ domains"; poling in electric and magnetic fields selects a single such domain. Reversal of magnetic field then leads to $\mathbf{P}$ reversal[4,5] and $\mathbf{Q}$ reversal[5]. But $\mathbf{Q}\to-\mathbf{Q}$ in the equation above does not appear to give a degenerate state. I show, via the Heisenberg model and the Generalized Luttinger-Tisza method used in the prediction of the spin state,[2] that $\gamma_\nu\to-\gamma_\nu$ on $\mathbf{Q}$ reversal, making manifest the $\mathbf{Q}\to-\mathbf{Q}$ degeneracy.

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