Geometrically frustrated ferroelectrics and relaxors

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For over a century, materials science has concentrated on comparing magnetism and ferroelectricity, uncovering similarities in order types, domains, hysteresis, and responses to external stimuli. The exceptional physical properties of magnets often stem from frustration, which can arise from site disorder and lattice geometry. While disordered relaxor ferroelectrics exhibit ultra-high dielectric and piezoelectric properties and behavior akin to spin glasses, ferroelectric-like materials with distinct geometrically frustrated states have not been previously identified. This report will explore mechanisms of frustration that are not related to disorder per se. Specifically, we will examine the composite-induced crossover between B-site and A-site-driven ferroelectricity in perovskites, which results in a strongly diffused ferroelectric phase transition [1]. Additionally, we introduce a new type of relaxor material, a geometrically frustrated relaxor, exemplified by a $Bi_2Ti_2O_7$ single crystal with a compositionally ordered pyrochlore structure [2]. Our findings demonstrate canonical relaxor behavior, including dielectric anomalies, dipole freezing, non-ergodicity, and a lack of spontaneous phase transitions.

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Bibliography

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