Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Why is the electrocaloric effect so small in ferroelectrics?[1] GIAN G. GUZMAN-VERRI, Argonne National Laboratory, PETER B. LITTLEWOOD, Argonne National Laboratory and The University of Chicago — Ferroelectrics are attractive candidate materials for environmentally friendly solid state refrigeration free of greenhouse gases. Their thermal response upon variations of external electric fields is largest in the vicinity of their phase transitions, which may occur near room temperature. The magnitude of the effect, however, is too small for useful cooling applications even when they are driven close to dielectric breakdown. Insight from microscopic theory is therefore needed to characterize materials and provide guiding principles to search for new ones with enhanced electrocaloric performance [1]. Here, we present meaningful figures of merit derived from well-known microscopic models of ferroelectricity which provide insight into the relation between the strength of the effect and the characteristic interactions of ferroelectrics such as dipole forces. We find that the long range nature of these interactions results in a small effect. A strategy is proposed to make it larger by shortening the correlation lengths of fluctuations of polarization [2].

[1] X. Moya, S. Kar-Narayan, and N. D. Mathur, Nat. Mater. 13, 439 (2014).
[2] G. G. Guzmán-Verri and P. B. Littlewood, arXiv:1411.1326.

[1]Work at Argonne is supported by the U.S. Department of Energy, Office of Basic Energy Sciences under contract no. DE-AC02-06CH11357.

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Date submitted: 11 Nov 2014 Electronic form version 1.4