Considerations of ferroelectricity – a comparison with ferromagnetism

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Abstract:

Collective behavior in matter can be considered as a spyglass into specific interactions between atoms and electrons inside the material that cause them to organize cooperatively. Many of the collective solid state phases, such as ferromagnetism or ferroelectricity, have emergent effects that are widely used in basic science as well as application: Meissner effect and vanishing electric resistance of superconductors, nonlinear optical elements, memory effects in hysteretic phenomena, nonlinear conductivity of sliding density waves, … .

In ferromagnetism constituents of the long range order are spins, while in ferroelectricty these constituents are electrical dipoles. Both ferromagnetism and ferroelectricity give rise to spatial domains of strongly preferred orientation of their respective dipole moments and display hysteresis under external field reversal. Although at the first glance ferromagnetism and ferroelectricty look very similar there are important phenomenological differences that make ferroelectricity a separate property governed by different principles.

In this seminar we will consider ferroelectricity from different aspects while trying to provide a parallel with ferromagnetism. Crystallographic constraints and symmetry requirements will be given, anisotropy discussed, and particular focus will be given to experimental characterization of novel materials with ferroelectric or ferroelectric-like properties.

References:
[1] Blundell, S. Magnetism in Condensed Matter. Oxford University Press, 2001.
[2] Rabe, Karin M. ; Ahn, Charles H. ; Triscone, Jean-Marc; Physics of Ferroelectrics – A modern perspective, Springer-Verlag Berlin Heidelberg, 2007.