



Ferroelectrics, ever more exotic and surprising

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Ferroelectrics have been around for many decades, and yet they continue to challenge our imagination with unexpected and intriguing behaviors. Arguably, the most recent and important ferroelectric revival is associated to nano-structures displaying exotic orders and properties, some of which were predicted years ago, doubted by most, and now revealed by modern characterization techniques. For example, transmission electron microscopy has recently allowed us to see incredible vortex-like dipole structures in superlattices combining ferroelectric (PbTiO₃) and dielectric (SrTiO₃) layers, confirming the electrostatic/frustration effects anticipated by some theorists in the early 2000's. In this talk I will review the theoretical models that were able to predict the rich behaviors that currently generate so much excitement, and describe our ongoing efforts to make them more accurate and powerful. Among other examples of application, I will describe our current efforts to stabilize and control electric skyrmions around ferroelectric nano-domains; and will also present our recent works on PbTiO₃/SrTiO₃ superlattices, discussing in some detail their negative-capacitance response and the associated, miraculous-sounding voltage amplification. I thus hope to introduce and convey the excitement of this ever-reemerging field.