PHYSICS SEMINAR

Antiferroelectrics: Landau Theory, Ising Models, and Energy Storage

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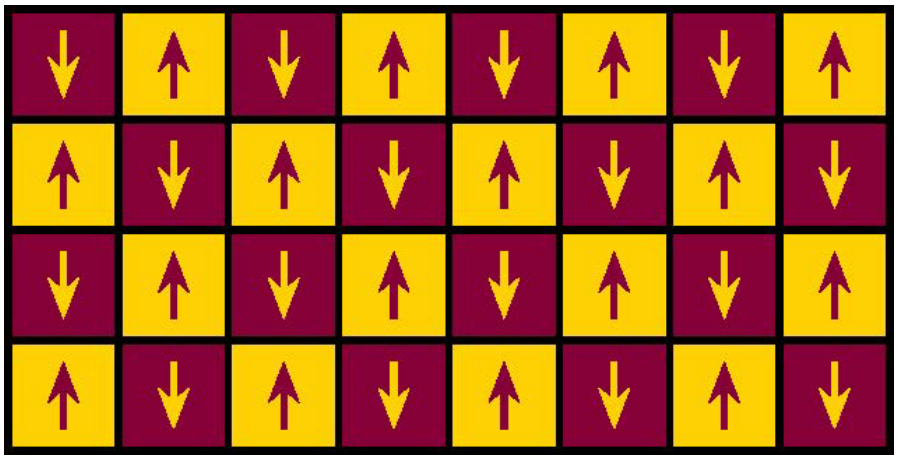
Thursday, September 3, 2026
12:30 – 1:30 p.m.
Wubben 264

Ferroelectrics are the unsung heroes of modern electronics. Electric dipoles -- internal pairs of positive and negative charge -- spontaneously align to create a macroscopic polarization. Controlling this polarization using an external field enables essential devices such as capacitors, sensors, and memory. This spontaneous polarization is also a disadvantage – the material ``remembers'' its state, trapping energy that requires a reverse field to release.

Enter the antiferroelectric. Neighboring dipoles arrange into an antiparallel, checkerboard pattern, yielding zero total polarization, while still permitting field-induced switching. We introduce the physics of these materials using two approaches. First, a macroscopic thermodynamic description invoking Landau theory predicts the response to temperature and electric fields. Next, a microscopic Ising model reveals how dipole interactions generate the anti-alignment pattern. Together, these ideas explain why antiferroelectrics may lead to the next generation of electrostatic energy storage.



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