
A New Era in Ferroelectrics

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Complex topological configurations are a fertile playground to explore novel emergent phenomena and exotic phases in condensed-matter physics. I will describe the discovery of polar skyrmions and vortices in a lead-titanate layer confined by strontium-titanate layers by atomic-resolution scanning transmission electron microscopy. Phase-field modeling and second-principles calculations reveal that the polar skyrmions have a skyrmion number of +1 and resonant soft X-ray diffraction experiments show circular dichroism confirming chirality. Such nanometer-scale polar skyrmions exhibit a strong signature of negative permittivity at the surface of the skyrmion, which is furthermore highly tunable with an electric field. They are a new state of matter and electric analogs of magnetic skyrmions, and may be envisaged for potential applications in information technologies.

References

[1] Junquera, et al, Reviews of Modern Physics, 2022

Figures



Figure 1: Turing patterns formed by polar skyrmions.