

CONDENSED MATTER SCIENCES SEMINAR

Professor Erica Carlson

Purdue University

Host

Dr Vladimir Dobrosavljevc

Title

Critical Nematic Correlations Throughout the Superconducting Doping Range in BSCO

Friday, January 24th, 2025

1st Floor – B101

15:00-16:00

Abstract

Rapidly expanding experimental capabilities have led to a growing wealth of data on multiple length scales, revealing rich electronic textures at the nanoscale and mesoscale in many correlated oxides. We have defined new conceptual frameworks for interpreting and understanding the multiscale electronic textures observed at the surface of these materials by employing theoretical tools from fractal mathematics and disordered statistical mechanics. This allows us to use the rich spatial information available from scanning probes in order to diagnose criticality from the spatial structure alone, without the need of a sweep of temperature or external field. These new methods have enabled the discovery of universal, fractal electronic textures across a variety of quantum materials. By applying these cluster techniques to scanning tunneling microscopy on $\text{Bi}_2\text{-zPbzSr}_2\text{-yLayCuO}_{6+x}$, and computing new critical exponents at free surfaces including that of the pair connectivity correlation function, we show that the charge modulations in this material are locally one dimensional, and moreover that they arise from 3D criticality throughout the entire superconducting doping range. [Nature Commun. 14, 2622 (2023).]

Bio

Erica W. Carlson, Ph.D., is Professor of Physics at Purdue University. Prof. Carlson holds a BS in Physics from the California Institute of Technology (1994), as well as a Ph.D. in Physics from UCLA (2000). Prof. Carlson researches electronic phase transitions in quantum materials. In 2015, she was elected a Fellow of the American Physical Society "for theoretical insights into the critical role of electron nematicity, disorder, and noise in novel phases of strongly correlated electron systems and predicting unique characteristics." Prof. Carlson has been on the faculty at Purdue University since 2003, where she was recently named a "150th Anniversary Professor" in recognition of teaching excellence. She is a founding member of Innovation in Quantum Pedagogy and its Relation to Culture (<https://www.iqparc.com>)