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Fachbereich Physik, Universität Stuttgart
Max-Planck-Institut für Festkörperforschung
Max-Planck-Institut für Intelligente Systeme

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Quantum fields and materials at criticality and beyond

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Abstract

The study of phase transitions and critical phenomena has shaped our understanding of nature in a fundamental way and far beyond the realm of classical statistical physics. In fact, this field of study finds many applications, e.g., through the Higgs mechanism in the Standard Model of particle physics or in the phase diagrams of quantum chromodynamics and novel correlated two-dimensional materials, just to name a few prominent examples. In my talk, I will discuss basically three scenarios, in which our standard paradigms with which we typically understand phase transitions are challenged and novel concepts come into play. Specifically, I will discuss how the presence of massless Dirac excitations strongly modifies the critical behavior near a quantum critical point of a two-dimensional quantum material. Then, I will show how topological excitations in certain spin models can lead to the disappearance of true critical behavior and replace it by the newly discovered concept of Nordic Walking. Finally, I will discuss the phenomenon of temperature-resistant order, i.e., a type of Pomeranchuk effect near a very special quantum critical point where order can persist at all temperatures.