Titel:

Interplay of multiple scales at quantum criticality

Abstract:

A basic paradigm of quantum criticality is the scaling hypothesis. It predicts that physical observables depend on temperature and on the tuning parameter that controls the distance to the transition like, e.g., magnetic field, in a power-law fashion. This scaling behavior is detectable in experiments, and it is invaluable for the characterization and identification of such transitions. In this talk we discuss several theoretical scenarios where a simple scaling Ansatz is inadequate or even breaks down.

We show that (1) scaling predictions become ambiguous whenever the transition is driven by several critical modes that are characterized by different dynamics. As an example we discuss the Pomeranchuk instability in a metal that is accompanied by coexisting damped and undamped critical modes. In addition, a violation of scaling might also occur if (2) the critical degrees of freedom interact with other gapless modes. Here, the resulting hybridization may even change the universality class or drive the transition first-order. As examples, we discuss

a certain conductance-plateau transition in quantum wires and the coupling of phonons to the critical degrees of freedom.