Lee-Yang Zeros at Quantum Phase Transitions

Pascal M. Vecsei[1], **Jose L. Lado**[1], **Christian Flindt**[1]

[1]Department of Applied Physics, Aalto University, 00076 Aalto, Finland.

Determining the phase diagram of interacting quantum many-body systems is an important task for a wide range of problems such as the understanding and design of quantum materials. For classical equilibrium systems, the Lee-Yang formalism provides a rigorous foundation of phase transitions, and these ideas have also been extended to the quantum realm. Here, we develop a Lee-Yang theory of quantum phase transitions that can include thermal fluctuations caused by a finite temperature. The onset of a symmetry-broken phase is signaled by the zeros of the moment generating function approaching the origin in the complex plane of a counting field that couples to the order parameter. Moreover, the zeros can be obtained by calculating the high cumulants of the order parameter, which can be done using tensor-network or neural-network quantum state calculations.

Pascal M. Vecsei