Elitenetzwerk Bayern

UNIVERSITÄT BAYREUTH

Einladung zum Gastvortrag im Elitestudiengang Scientific Computing

Datum: 09.05.2023 | Beginn: 16:30 Uhr | Ort: H31, Gebäude FAN B

Kaffee/Tee ab 16:00 Uhr im Konferenzraum K VI, Gebäude FAN B

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Exact Continuum Representation of Long-range Interacting Systems and Emerging Exotic Phases in Unconventional Superconductors

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Gast am Lehrstuhl für Wiss. Rechnen bei Prof. Dr. Mario Bebendorf

Abstract: Continuum limits are a powerful tool in the study of many-body systems in condensed matter physics, yet their validity is often unclear when long-range interactions are present. In this work, we rigorously address this issue and put forth an exact representation of long-range interacting lattices that separates the model into a term describing its continuous analog, the integral contribution, and a term that fully resolves the microstructure, the lattice contribution. Here, we use the recently developed Singular Euler–Maclaurin expansion, a generalization of the 300-year old Euler–Maclaurin summation formula to multidimensional sums that involve functions with algebraic singularities. For any system dimension, any lattice, any power-law interaction, and for linear, nonlinear, and multi-atomic lattices, we show that the lattice contribution can be described by a differential operator based on the multidimensional generalization of the Riemann zeta function, namely the Epstein zeta function. We employ our representation in Fourier space to solve the long-standing problem of long-range interacting unconventional superconductors. We derive a generalized Bardeen–Cooper–Schrieffer gap equation, solve it numerically, and find emerging exotic phases in two-dimensional superconductors with topological phase transitions. Finally, we determine the quantum time evolution and utilize non-equilibrium Higgs spectroscopy to analyze the impact of long-range interactions on the collective excitations of the condensate.