TT 70: Correlated Electrons: Method Development III

Time: Thursday 9:30–10:45 Location: HSZ/0101

TT 70.1 Thu 9:30 HSZ/0101

Lineon Condensation in the XY toric code — •Maximilian Vieweg, Viktor Kott, Matthias Mühlhauser, and Kai Phillip Schmidt — Staudtstraße 7, 91058 Erlangen, Germany

In this work, we study the XY toric code[1] in an external magnetic field and determine its quantum phase diagram using high-order series expansions. The XY toric code is a generalization of the toric code that introduces anisotropic couplings on the star operators. The phase diagram of the XY toric code without a magnetic field is exactly solvable via duality mappings and hosts both topologically ordered and spontaneous-subsystem-symmetry-broken phases (SSSB), and therefore supports fractons and subdimensional particles as excitations in the SSSB phase. Our results for the transitions out of the SSSB in certain parameter regimes are consistent with an exotic second-order phase transition that is not described by a scale-invariant theory.

[1] M. Vieweg, K.P. Schmidt, Phys. Rev. Res. 7 (2025)

TT 70.2 Thu 9:45 HSZ/0101

Real Green functions for the Anderson disorder model — •Marcus Kollar[1], Martin Biehle[1], Yannick Schäffer[1], and Bas Lodewijks[2] — [1]Theoretical Physics III, Institute of Physics, University of Augsburg — [2]Probability Group, School of Mathematical and Physical Sciences, University of Sheffield

Green functions for the Anderson model on the Bethe lattice fulfill a recursion relation, leading to a self-consistent solution for the complex self-energy [1]. Recently a new criterion for the localization transition was introduced [2] using the susceptibility of real cavity Green functions to changes of the disorder potential at distant lattice sites, which can be expressed in terms of repeated applications of an asymmetric integral kernel corresponding to the conditional probability distribution of cavity Green functions on neighboring sites. We derive a system of equations that connects this integral kernel and the distributions of real local and cavity Green functions to an arbitrary disorder distribution. For the special case of Cauchy disorder we use it to determine the Green function distributions explicitly for all energies. Furthermore for the band center we determine the complete kernel spectrum exactly, from which typical Lyapunov exponents and Green function correlation functions are obtained. Applications to other disorder distributions are also discussed.

[1] R. Abou-Chacra et al., J. Phys. C **6**, 1734 (1973).
[2] G. Parisi et al., J. Phys. A **53**, 014003 (2019).

TT 70.3 Thu 10:00 HSZ/0101

CFET-Enhanced TDVP Simulations of Floquet Dynamics in the Driven t-V Model — •Tobias Blum[1], Karun Gadge[2], Salvatore Manmana[2], and Reinhard Noack[1] — [1]Philipps-Universität Marburg, 35032 Marburg, Germany — [2]Georg-August-University Göttingen, 37077 Göttingen, Germany

Periodically driven interacting systems feature characteristic Floquet sidebands and frequency-dependent heating, but time evolution remains challenging for explicitly time-dependent Hamiltonians. We study the one-dimensional t-V model using the time-dependent variational principle (TDVP) combined with commutator-free exponential time propagators (CFET). We describe the integration of CFET into an already existing implementation of TDVP within the MPS framework. Its integration allows significantly reduced time-evolution errors. We compare standard TDVP and TDVP enhanced with CFET and analyze heating rates and the structure of Floquet sidebands for different driving frequencies, going from high-frequency regimes to low-frequency behavior. The results show that CFET-enhanced TDVP substantially improves the accuracy of calculated observables in explicitly time-dependent strongly correlated systems.

TT 70.4 Thu 10:15 HSZ/0101

Noninteracting tight-binding models for Fock parafermions — •Edward McCann — Department of Physics, Lancaster University, Lancaster, LA1 4YB, United Kingdom

By mapping itinerant spin-1/2 fermions to four-state Fock parafermions, we construct noninteracting tight-binding models for Fock parafermions in one dimension. They have single-particle real energy spectra consisting of a sum of single-particle energy levels each multiplied by a parafermionic occupation number. The single-particle levels may be determined by diagonalizing a square matrix whose order scales linearly with system size, and these levels are the same as those of noninteracting fermionic models. We generalize the approach to describe tight-binding models in two dimensions. We show that the thermodynamic distribution function for the occupation numbers of noninteracting four-state parafermions, the internal energy, and the heat capacity are consistent with the mapping to spin-1/2 fermions.

TT 70.5 Thu 10:30 HSZ/0101

A new take on an old method for approximating quantum many-body ground states — •Joe Crossley[1], Bruno Bertini[2], Arash Jafarizadeh[3], Molly Gibbins[1], and Adam Gammon-Smith[1] — [1]University of Nottingham, United Kingdom — [2]University of Birmingham, United Kingdom — [3]None

For decades, quantum chemists have been using so-called "post Hartree-Fock" methods to study systems of many interacting electrons moving on a fixed structural background. This set-up closely resembles many important problems from the world of condensed matter physics. However, despite the conceptual overlap, these methods have seen little adoption within the physics community. In this talk, I will discuss our recent progress on exploring the potential of post Hartree-Fock techniques applied to condensed matter problems—particularly in regimes where standard tools such as tensor networks and quantum Monte Carlo are known to struggle.