TT 73: Topology: Other Topics

Time: Friday 11:00–12:15 Location: HSZ 103

TT 73.1 Fri 11:00 HSZ 103

Electronic transport in one-dimensional Floquet topological insulators via topological-and non-topological edge states — •Niclas Müller[1], Dante M. Kennes[1], Jelena Klinovaja[2], Daniel Loss[2], and Herbert Schoeller[1] — [1]Institut für Theorie der Statistischen Physik, RWTH Aachen, 52074 Aachen,Germany — [2]Department of Physics, University of Basel, Klingelbergstr. 82, CH-4056 Basel, Switzerland

Based on probing electronic transport properties, we study the recently discovered phase diagram of 1D Floquet topological insulators [Kennes et al., Phys. Rev. B 100, 041103(R) (2019)]. Using Keldysh formalism, we compute transport properties of this model, where we consider a setup in which states with a large relative edge-weight primarily contribute to the transport, which grants experimental access to the topological phase diagram. Surprisingly, we find conductance values similar in magnitude to those corresponding to topological edge states, when tuning the lead Fermi energy to special values in the bulk, which coincide with bifurcation points of the dispersion relation in quasimomentum space. These peaks reveal the presence of bands of states whose wave functions are linear combinations of delocalized bulk states and exponentially localized edge states, where the amplitude of the edge-state component is sharply peaked at the bifurcation point, resulting in an unusually large relative edge-weight. We discuss the emergence of these states in terms of an intuitive yet quantitative physical picture, which is not specific to the model, suggesting that they may be present in a wide class of systems.

TT 73.2 Fri 11:15 HSZ 103

Topological Sign Problems — •Adam Smith[1] and Zohar Ringel[2] — [1]Technical University Munich, Garching, Germany — [2]Racah Institute of Physics, The Hebrew University of Jerusalem, Israel

Sign-problems are one of the major obstacles for the numerical study of complex many-body quantum systems. They render such models intractable to otherwise powerful techniques, most famously demonstrated by the exponential difficultly of quantum Monte Carlo methods. Here we provide a simple criterion to diagnose incurable sign-problems in topologically ordered systems – that is, whether the model has a sign-problem that cannot be removed by any local unitary transformation. Explicitly, if the exchange statistics of the anyonic excitations do not form complete sets of roots of unity, then the model has an incurable sign-problem. This establishes a concrete connection between the statistics of anyons, contained in the modular S and T matrices, and the presence of a sign-problem in a microscopic Hamiltonian. We prove this criterion for the large set of bosonic non-chiral models described by an abelian topological quantum field theory at low-energy, and offer evidence that it applies more generally.

TT 73.3 Fri 11:30 HSZ 103

Interacting topological frequency converter — •Simon Körber[1], Lorenzo Privitera[1], and Björn Trauzettel[1,2] — [1]Institute of Theoretical Physics and Astrophysics, University of Würzburg, 97074 Würzburg, Germany — [2]Würzburg-Dresden Cluster of Excellence ct.qmat, Germany

Driving with a periodic force effectively raises the dimensionality of a system since each eigenstate can be expanded with respect to the harmonics of the drive frequency, with the Fourier amplitudes acting as additional coordinates. This extension opens a new approach to engineer and explore novel topological phases in synthetic dimensions. In this context, it has been shown that a two-level system coupled to two circularly polarized drives can act as the temporal analog of a Chern insulator, where the Hall response translates into a quantized frequency conversion between the dynamical drives.

In this talk, we extend this idea by analyzing a two-spin model with spin-spin interactions in addition to external fields. We demonstrate that the interplay of interaction and synthetic dimension gives rise to striking topological phenomena that have no counterpart in the non-interacting regime. By calculating the topological phase diagrams as a function of interaction strength, we show that this can lead to an enhancement of the frequency conversion as a direct manifestation of the correlated topological response.

TT 73.4 Fri 11:45 HSZ 103

Quantum robustness of three-dimensional fracton codes — •Matthias Mühlhauser[1], Matthias Walther[1], David A. Reiss[2], and Kai P. Schmidt[1] — [1]Institute for Theoretical Physics I, FAU Erlangen-Nürnberg, Germany — [2]Dahlem Center for Complex Quantum Systems and Physics Department, FU Berlin, Germany

We investigate zero-temperature phase transitions out of three-dimensional fracton phases. For this reason exactly solvable fracton codes like the X-Cube model, which features fracton topological order of type I, are studied in the presence of an external homogeneous magnetic field. We apply high order linked-cluster expansions to calculate the ground-state energy as well as excitation energies of fractonic quasi-particles in order to determine the ground-state phase diagram quantitatively. To this end a full graph decomposition is performed for these three-dimensional quantum many-body systems.

TT 73.5 Fri 12:00 HSZ 103

Parafermions and Z_3 Charge-Flux attachment — •Peng Rao and Inti Sodemann — Max Planck Institute for the Physics of Complex System, Dresden

A recent construction (Ann. Phys. 393, 234 (2018)) has introduced an interesting route to bosonization of fermions in two spatial dimensions by implementing a precise lattice version of flux-charge binding. The idea is to modify Kitaev's Toric code so that the electric charge (e) and magnetic flux (m) are always created in a tight “dipolar" pair ε ($=e \times m$) which is a fermion, providing a way to represent any local fermionic Hamiltonian as a local Hamiltonian of spins. We discuss an extension of these ideas to the case of a Z_N toric code which allows a bosonization of anyons with more general statistical angles. We have focused particularly in the case of N=3. We will prove that ground states in the torus in this case are at least three-fold degenerate, and, discuss a model featuring a topological phase transition between a 3-fold degenerate state and a 9-fold degenerate ground state featuring parafermionic excitations.