TT 76: Topology: Other Topics

Time: Wednesday 17:00–18:30 Location: A 053

TT 76.1 Wed 17:00 A 053

Robustness and quantum phase transitions of the perturbed 3D toric code — •David A. Reiss[1,2] and Kai P. Schmidt[2] — [1]Dahlem Center for Complex Materials and Physics Department, Free University Berlin — [2]Chair for Theoretical Physics 1, University of Erlangen-Nürnberg

Topological quantum order in 3D represents quantum phases with exotic excitations which are spatially extended and have anyonic statistics different from bosons and fermions. This talk discusses the robustness against quantum fluctuations and the quantum phase transitions of a paradigmatic example, the 3D toric code in a uniform magnetic field. First, the qualitative dynamics of its quasiparticles according to perturbation theory is reviewed: the point excitations are mobile, while the single constituents of spatially extended excitations stay spatially localized to all orders of perturbation theory in a translationally invariant system without disorder. This is similar to excitations in so-called fracton phases, which might be employed as thermally stable topologically-protected quantum memories in contrast to the 3D toric code. Second, a variational ansatz and exact duality relations of special magnetic field cases of the toric code to other models are employed to determine the zero-temperature phase diagram. The main results are that (1) for the breakdown of 3D topological quantum order, the exotic mutual statistics of the point excitations and the spatially extended excitations is not relevant compared to their deconfinement and confinement, respectively, and that (2) the perturbed 3D toric code is robust and features a rich phase diagram.

TT 76.2 Wed 17:15 A 053

Dynamical Equilibration of Topological Properties — Andreas Kruckenhauser[1,2] and •Jan Carl Budich[1,3] — [1]Department of Physics, University of Gothenburg, SE 412 96 Gothenburg, Sweden — [2]Institute for Theoretical Physics, University of Innsbruck, A-6020 Innsbruck, Austria — [3]Institute of Theoretical Physics, Technische Universität Dresden, 01062 Dresden, Germany

We discuss the dynamical process of equilibration of topological properties in quantum many-body systems undergoing a parameter quench between two topologically inequivalent Hamiltonians. This scenario is motivated by recent experiments on ultracold atomic gases, where a trivial initial state is prepared before the Hamiltonian is ramped into a topological insulator phase. While the manybody wave function must stay topologically trivial in the coherent post-quench dynamics, here we show how the topological properties of the single particle density matrix dynamically change and equilibrate in the presence of interactions. In this process, the single particle density matrix goes through a characteristic level crossing as a function of time, which plays an analogous role to the gap closing of a Hamiltonian in an equilibrium topological quantum phase transition. We exemplify this generic mechanism with a numerical case study on one-dimensional topological insulators.

TT 76.3 Wed 17:30 A 053

Quantum Oscillations in Insulators with Neutral Fermi Surfaces — •Inti Sodemann[1], Debanjan Chowdhury[2], and T. Senthil[2] — [1]Max-Planck Institute for the Physics of Complex Systems, D-01187 Dresden, Germany — [2]Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA

We describe a theory of quantum oscillations in insulators with a fermi sea of neutral fermions minimally coupled to an emergent U(1) gauge field. In the presence of a physical magnetic field the emergent magnetic field develops a non-zero value leading to Landau quantization for the neutral fermions. We will describe the temperature and magnetic field dependence of oscillations in magnetization and in electrical resistivity and discuss suitable experimental conditions for the observation of these effects in the composite exciton fermi liquid state proposed in mixed valence insulators as well as in the spinon fermi surface state proposed in triangular organic materials.

TT 76.4 Wed 17:45 A 053

Non-Hermitian Hamiltonian for exceptional points of cavity modes — •Heinrich-Gregor Zirnstein and Bernd Rosenow — Institut für Theoretische Physik, Universität Leipzig, Germany

Recently, the existence of exceptional points in uniaxial optical cavities has been predicted [S. Richter et al., Phys. Rev. A **95**, 023836 (2017)]. In order to pave the way for a topological characterization of these exceptional points, it is desirable to derive an effective non-Hermitian Hamiltonian that describes the corresponding cavity modes. Since open cavities are characterized by their transmission and reflection coefficients, i.e. their S-matrix, we use the Mahaux-Weidenmüller formula together with a partial fraction expansion to connect the S-matrix to a non-Hermitian Hamiltonian. In an exactly solvable toy model with two coalescing resonances, i.e. an exceptional point, we find that the Hamiltonian and the S-matrix describe the exceptional point with excellent agreement. Using a more realistic model for an optical cavity, we demonstrate that two exceptional points with opposite chirality merge into a Dirac point in the hypothetical limit of a decoupled cavity.

TT 76.5 Wed 18:00 A 053

Shining a light on fractional excitations — •Dirk Wulferding[1,2], Peter Lemmens[1,2], Alexander Glamazda[3], Vladimir Gnezdilov[3], A.K. Bera[4], A.T.M.N. Islam[4], Bella Lake[4], Seunghwan Do[5], Youngsu Choi[5], Vladimir Kurnosov[3], Bodo Lobbenmeier[1], and Kwang-Yong Choi[5] — [1]IPKM, TU-BS, Braunschweig, Germany — [2]LENA, TU-BS, Braunschweig, Germany — [3]ILTPE, NASU, Kharkov, Ukraine — [4]Helmholtz-Zentrum Berlin, Germany — [5]Chung-Ang Univ., Seoul, Korea

Quantum spin liquid ground states host exotic, fractional spinon or Majorana fermion excitations that are notoriously difficult to verify experimentally. Raman scattering is an alternative approach used on Kitaev-, Kagome-, and Haldane-chain materials [1,2,3,4,5] to provide spectroscopic fingerprints of fractional excitations. Work supported by the Quantum- and Nanometrology initiative "QUANOMET" within Project NL-4, the NTH School "Contacts in Nanosystems", and the DFG Project LE967/16-1.

[1] Sandilands et al., PRL 114, 147201 (2015)
[2] Nasu et al., Nat. Phys. 12, 912 (2016)
[3] Glamazda et al., Nat. Commun. 7, 12286 (2016)
[4] Glamazda et al., PRB 95, 174429 (2017)
[5] Wulferding et al., PRB 82, 144412 (2010)

TT 76.6 Wed 18:15 A 053

Tailoring topological features in the excitation spectra of spin chains via their quantum spin number — •Peter Lemmens[1,2], Dirk Wulferding[1,2], Vladimir Gnezdilov[3], Vladimir Kurnosov[3], Yurii Pashkevich[4], A.K. Bera[5], A.T.M.N. Islam[5], and Bella Lake[5] — [1]IPKM, TU-BS, Braunschweig, Germany — [2]LENA, TU-BS, Braunschweig, Germany — [3]ILTPE, NASU, Kharkov, Ukraine — [4]DonFTI, NASU, Donetsk, Ukraine — [5]Helmholtz-Zentrum Berlin, Germany

We provide a comparative insight into the rich spectrum of magnetic excitations in the isostructural spin chain compounds $SrCo_2V_2O_8$ ($s = 1/2$) and $SrNi_2V_2O_8$ ($s = 1$). Evidence for fractionalization is obtained for the Haldane chain in an anomalous T-dependence of the scattering intensity and other features.

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