[1] **Tunneling spectra simulation of interacting Majorana wires**

Ronny Thomale, Stephan Rachel, and Peter Schmitteckert. *Physical Review B*, 88(16):161103, 2013.

Recent tunneling experiments on InSb hybrid superconductor-semiconductor devices have provided hope for a stabilization of Majorana edge modes in a spin-orbit quantum wire subject to a magnetic field and superconducting proximity effect. Connecting the experimental scenario with a microscopic description poses challenges of a different kind, such as accounting for the effect of interactions on the tunneling properties of the wire. We develop a density matrix renormalization group (DMRG) analysis of the tunneling spectra of interacting Majorana chains, which we explicate for the Kitaev chain model. Our DMRG approach allows us to calculate the spectral function down to zero frequency, where we analyze how the Majorana zero-bias peak is affected by interactions. For topological phase transitions between the topological and trivial superconducting phase in the Majorana wire, the bulk gap closure generically affects the proximity peaks and the Majorana peak.

[2] **Coherent Ultrafast Measurement of Time-Bin Encoded Photons**

John M. Donohue, Megan Agnew, Jonathan Lavoie, and Kevin J. Resch. *Physical Review Letters*, 111(15):153602, 2013.

Time-bin encoding is a robust form of optical quantum information, especially for transmission in optical fibers. To readout the information, the separation of the time bins must be larger than the detector time resolution, typically on the order of nanoseconds for photon counters. In the present work, we demonstrate a technique using a nonlinear interaction between chirped entangled time-bin photons and shaped laser pulses to perform projective measurements on arbitrary time-bin states with picosecond-scale separations. We demonstrate a tomographically complete set of time-bin qubit projective measurements and show the fidelity of operations is sufficiently high to violate the Clauser-Horne-Shimony-Holt-Bell inequality by more than 6 standard deviations.

[3] **Linear Optical Quantum Computing in a Single Spatial Mode**

Peter C. Humphreys, Benjamin J. Metcalf, Justin B. Spring, Merritt Moore, Xian-Min Jin, Marco Barbieri, W. Steven Kolthammer, and Ian A. Walmsley. *Physical Review Letters*, 111(15):150501, 2013.

We present a scheme for linear optical quantum computing using time-bin-encoded qubits in a single spatial mode. We show methods for single-qubit operations and heralded controlled-phase (cphase) gates, providing a sufficient set of operations for universal quantum computing with the Knill-Laflamme-Milburn [Nature (London) 409 46 (2001)] scheme. Our protocol is suited to currently available photonic devices and ideally allows arbitrary numbers of qubits to be encoded in the same spatial mode, demonstrating the potential for time-frequency modes to dramatically increase the quantum information capacity of fixed spatial resources. As a test of our scheme, we demonstrate the first entirely single spatial mode implementation of a two-qubit quantum gate and show its operation with an average fidelity of 0.840.07.

[4] **Effect of gate-driven spin resonance on the conductance through a one-dimensional quantum wire**

Almas F. Sadreev and E. Ya. Sherman. *Physical Review B*, 88(11):115302, 2013.

We consider quasiballistic electron transmission in a one-dimensional quantum wire subject to both time-independent and periodic potentials of a finger gate that results in a local time-dependent Rashba-type spin-orbit coupling. A spin-dependent conductance is calculated as a function of external constant magnetic field, the electric field frequency, and potential strength. The results demonstrate the effect of the gate-driven electric dipole spin resonance in a transport phenomenon such as spin-flip electron transmission.

[5] F. Deuretzbacher, D. Becker, J. Bjerlin, S. M. Reimann, and L. Santos. **Quantum magnetism without lattices in strongly-interacting one-dimensional spinor gases** . arXiv e-print 1310.3705, 2013.

We show that strongly-interacting multicomponent gases in one dimension (1D) can be described by an effective spin model. This constitutes a surprisingly simple scenario for the realization of one-dimensional quantum magnetism in cold gases in the absence of an optical lattice. The spin-chain model allows for an intuitive understanding of recent experiments and for a simple calculation of relevant observables. We analyze the adiabatic preparation of antiferromagnetic (AF) and ferromagnetic (F) ground states, and show that many-body spin states may be efficiently probed by means of tunneling experiments. The spin-chain model is valid for more than two components, opening the possibility of realizing SU(N) quantum magnetism in strongly-interacting one-dimensional alkaline-earth or Ytterbium Fermi gases.

[6] Christian Ertler, Martin Raith, and Jaroslav Fabian. **Gate-defined coupled quantum dots in topological insulators** . arXiv e-print 1310.1463, 2013.

We consider electrostatically coupled quantum dots in topological insulators, otherwise confined and gapped by a magnetic texture. By numerically solving the (2+1) Dirac equation for the wave packet dynamics, we extract the energy spectrum of the coupled dots as a function of bias-controlled coupling and an external perpendicular magnetic

field. We show that the tunneling energy can be controlled to a large extent by the electrostatic barrier potential. Particularly interesting is the coupling via Klein tunneling through a resonant valence state of the barrier. The effective three-level system nicely maps to a model Hamiltonian, from which we extract the Klein coupling between the confined conduction and valence dots levels. For large enough magnetic fields Klein tunneling can be completely blocked due to the enhanced localization of the degenerate Landau levels formed in the quantum dots.

[7] Jukka P. Pekola, Jonne V. Koski, and Dmitri V. Averin. **Coulomb gap refrigerator** . arXiv e-print 1310.1471, 2013.

We propose a remarkably simple electronic refrigerator based on the Coulomb barrier for single-electron tunneling. A fully normal single-electron transistor is voltage V biased at a gate position such that tunneling through one of the junctions costs an energy of about $k_BT \ll eV, E_C$, where T is the temperature and E_C is the transistor charging energy. The tunneling in the junction with positive energy cost cools both the electrodes attached to it. Immediate practical realizations of such a refrigerator make use of Andreev mirrors which suppress heat current while maintaining full electric contact.

[8] A. Dyrda, J. Barna, and V. K. Dugaev. **Current-induced spin polarization in graphene due to Rashba spin-orbit interaction** . arXiv e-print 1310.1698, 2013.

Spin polarization induced by an external electric field in graphene is considered theoretically in the linear response regime. The graphene is assumed to be deposited on a substrate which leads to the spin-orbit interaction of Rashba type. The induced spin polarization is shown to be in the graphene plane and perpendicular to the electric field. However, the spin polarization changes sign when the Fermi level, whose position can be controlled by an external gate voltage, crosses the Dirac points.

[9] Marco O. Hachiya, Gonzalo Usaj, and J. Carlos Egues. **Ballistic spin resonance in multisubband quantum wires** . arXiv e-print 1310.3707, 2013.

Ballistic spin resonance was experimentally observed in a quasi-one-dimensional wire by Frolov et al. [Nature (London) 458, 868 (2009)]. The spin resonance was generated by a combination of an external static magnetic field and the oscillating effective spin-orbit magnetic field due to periodic bouncings of the electrons off the boundaries of a narrow channel. An increase of the D'yakonov-Perel spin relaxation rate was observed when the frequency of the spin-orbit field matched that of the Larmor precession frequency around the external magnetic field. Here we develop a model to account for the D'yakonov-Perel mechanism in multisubband quantum wires with both the Rashba and Dresselhaus spin-orbit interactions. Considering elastic spin-conserving impurity scatterings in the time-evolution operator (Heisenberg representation), we extract the spin relaxation time by evaluating the time dependent average of the spin operators. The magnetic field dependence of the non-local voltage, which is related to the spin relaxation time behavior, shows a wide plateau, in agreement with the experimental observation. This plateau arises due to injection in higher subbands and small-angle scattering. In this quantum mechanical approach, the spin resonance occurs near the spin-orbit induced energy anticrossings of the quantum wire subbands with opposite spins. We also predict anomalous dips in the spin relaxation time as a function of the magnetic field in systems with strong spin-orbit couplings.

[10] Takehito Yokoyama and Yaroslav Tserkovnyak. **Spin diffusion and magnetoresistance in ferromagnet/topological-insulator junctions** . arXiv e-print 1310.3354, 2013.

We study spin and charge diffusion in metallic-ferromagnet/topological-insulator junctions. The coupled diffusion equations are derived perturbatively with respect to the strength of the interlayer tunneling. We calculate spin accumulation in the ferromagnet and junction magnetoresistance associated with a current bias along the interface.

[11] Alessandro Ricottone, Jeroen Danon, and Piet W. Brouwer. **Spin-wave-induced corrections to the electronic density of states in metallic ferromagnets** . arXiv e-print 1310.3511, 2013.

We calculate the correction to the electronic density of states in a disordered ferromagnetic metal induced by spin-wave mediated interaction between the electrons. Our calculation is valid for the case that the exchange splitting in the ferromagnet is much smaller than the Fermi energy, but we make no assumption on the relative magnitude of the exchange splitting and the elastic electronic scattering time. In the "clean limit", where the exchange splitting is much larger than the electronic scattering rate, we find a correction with a $T^{d/2}$ temperature dependence, where d is the effective dimensionality of the ferromagnet. In the opposite "dirty limit" the density-of-states correction is a non-monotonous function of energy and temperature.