Robert-Jan Slager, Louk Rademaker, Jan Zaanen, Leon Balents

Impurity Bound States and Greens Function Zeroes as Local Signatures of Topology

arXiv: 1504.04881

We show that the local in-gap Greens function of a band insulator G0(ϵ,k∥,r⊥=0), with r⊥ the position perpendicular to a codimension-1 or -2 impurity, reveals the topological nature of the phase. For a topological insulator, the eigenvalues of this Greens function attain zeros in the gap, whereas for a trivial insulator the eigenvalues remain nonzero. This topological classification is related to the existence of in-gap bound states along codimension-1 and -2 impurities. Whereas codimension-1 impurities can be viewed as 'soft edges', the result for codimension-2 impurities is nontrivial and allows for a direct experimental measurement of the topological nature of 2d insulators.

Takahiro Chiba, Gerrit E. W. Bauer, Saburo Takahashi

Magnetization damping in noncollinear spin valves with antiferromagnetic interlayer couplings

arXiv:1504.06042

We study the magnetic damping in the simplest of synthetic antiferromagnets, i.e. antiferromagnetically exchange-coupled spin valves in which applied magnetic fields tune the magnetic configuration to become noncollinear. We formulate the dynamic exchange of spin currents in a noncollinear texture based on the spindiffusion theory with quantum mechanical boundary conditions at the ferrromagnet|normal-metal interfaces and derive the Landau-Lifshitz-Gilbert equations coupled by the static interlayer non-local and the dynamic exchange interactions. We predict non-collinearity-induced additional damping that can be sensitively modulated by an applied magnetic field. The theoretical results compare favorably with published experiments.

Keita Hamamoto, Motohiko Ezawa, Naoto Nagaosa

Quantized Anomalous Hall Effects in Skyrmion Crystal

arXiv:1504.06024

We theoretically study the quantized anomalous Hall effect (QAHE) in skyrmion crystal (SkX) without external magnetic field. The emergent magnetic field in SkX could be gigantic as much as ~4000T when its lattice constant is ~1nm. The band structure is not flat but has a finite gap in the low electron-density regime. We also study the conditions to realize the QAHE for the skyrmion size, carrier density, disorder strength and temperature. Comparing the SkX and the system under the corresponding uniform magnetic field, the former is more fragile against the temperature compared with the latter since the gap is reduced by a factor of $\sim$ 1/5, while they are almost equally robust against the disorder. Therefore, it is expected that the QAHE of SkX system is realized even with strong disorder at room temperature when the electron density of the order of one per a skyrmion.

R.S. Akzyanov, A.L. Rakhmanov, A.V. Rozhkov, Franco Nori

Majorana fermions at the edge of superconducting islands

arXiv: 1504.05688

We investigate the properties of electron states localized at the edge of a superconducting island placed on the surface of a topological insulator in a magnetic field. In such systems, Majorana fermions emerge if an odd number of vortices (or odd multivortex vorticity) is hosted by the island; otherwise, no Majorana states exist. Majorana states emerge in pairs:

one state is localized near the vortex core, and another at the island edge. We analyze in detail the robustness of Majorana fermions at the edge of the island threaded by a single vortex. If the system parameters are optimized, the energy gap between the Majorana fermion and the first excited state at the edge is of the order of the superconducting gap induced on the surface of the topological insulator. The stability of the Majorana fermion state against a variation of the gate voltage and its sensitivity to the magnetic field allows one to distinguish experimentally the edge Majorana fermion from conventional Dirac fermions.

Stockklauser, V. F. Maisi, J. Basset, K. Cujia, C. Reichl, W. Wegscheider, T. Ihn, A. Wallraff, K. Ensslin

Microwave Emission from Hybridized States in a Semiconductor Charge Qubit
arXiv: 1504.05497

We explore the microwave radiation emitted from a biased double quantum dot due to the inelastic tunneling of single charges. Radiation is detected over a broad range of detuning configurations between the dot energy levels with pronounced maxima occurring in resonance with a capacitively coupled transmission line resonator. The power emitted for forward and reverse resonant detuning is found to be in good agreement with a rate equation model, which considers the hybridization of the individual dot charge states.

Caroline Richard, Alexandre Buzdin, Manuel Houzet, Julia S. Meyer

Signatures of odd-frequency correlations in the Josephson current of superconductor/ferromagnet hybrid junctions
arXiv:1504.04400

Contacting a bilayer ferromagnet with a singlet even-frequency superconductor allows for the realization of an effective triplet odd-frequency superconductor. In this work, we investigate the Josephson effect between superconductors with different symmetries (e.g. odd- versus even-frequency). In particular, we study the supercurrent flowing between two triplet odd-frequency superconducting leads through a weak singlet even-frequency superconductor. We show that the peculiar temperature dependence of the critical current below the superconducting transition of the weak superconductor is a signature of the competition between odd/odd-frequency and odd/even-frequency Josephson couplings.

Mohammad Alidoust, Klaus Halterman

Spontaneous Edge Accumulation of Spin Currents in Finite-Size Two-Dimensional Diffusive Spin-Orbit Coupled SFS Heterostructures
arXiv:1504.05950

We theoretically study spin and charge currents through finite-size two-dimensional s-wave superconductor/uniform ferromagnet/s-wave superconductor (SFS) junctions with intrinsic spin-orbit interactions (ISOIs) using a quasiclassical approach. Considering experimentally realistic parameters, we demonstrate that the combination of spontaneously broken time-reversal symmetry and lack of inversion symmetry can result in spontaneously accumulated spin currents at the edges of finite-size two-dimensional magnetic SF hybrids. Due to the spontaneous edge spin accumulation, the corners of the F wire host the maximum spin current density. We further reveal that this type edge phenomena are robust and independent of either the actual type of ISOIs or exchange field orientation. Moreover, we study spin current-phase relations in these diffusive spin-orbit coupled SFS junctions. Our results unveil net spin currents, not accompanied by charge supercurrent, that spontaneously accumulate at the sample edges through a modulating superconducting phase difference. Finally, we discuss possible experimental implementations to observe these edge phenomena.