Tudor D. Stanescu1 and Sumanta Tewari

Disentangling Majorana fermions from conventional zero energy states in semiconductor quantum wires,

arXiv:1208.6298

A proposed signature for the Majorana zero-energy quasiparticle predicted to occur in semiconductor nanowires proximity-coupled to an s-wave superconductor is the zero-bias conductance peak (ZBCP) for tunneling into the end of the wire. Recently, it has been shown that, in the presence of a smooth confining potential, nearly ZBCPs can occur even in the topologically trivial phase. Here we show that, for a smooth confinement, the emergence of the nearly ZBCP at Zeeman fields corresponding to the topologically trivial phase is necessarily accompanied by a gap closing signature in the end-of-wire local density of state (LDOS). A similar behavior is found for nearly ZBCPs that appear in the presence of strong disorder. Our results strengthen the identification of the ZBCP observed in the recent Delft measurements, which show no gap-closing signatures, with topological Majorana fermions localized at the ends of the wire.

Y. Cao, P. Wang, M. Gong, S.-S. Li, and X.-Q. Li

Demonstrating nonlocality induced teleportation through Majorana bound states in a semiconductor nanowire,

arXiv:1208.3738

It was predicted by Tewari *et al* [Phys. Rev. Lett. **100**, 027001 (2008)] that a *teleportationlike* electron transfer phenomenon is one of the novel consequences of the existence of Majorana fermion, because of the inherently nonlocal nature. In this work we consider a concrete realization and measurement scheme for this interesting behavior, based on a setup consisting of a pair of quantum dots which are tunnel-coupled to a semiconductor nanowire and are jointly measured by two point-contact detectors. We analyze the teleportation dynamics in the presence of measurement backaction and discuss how the teleportation events can be identified from the current trajectories of strong response detectors..

L.-F. Zhang, L. Covaci, M. V. Milosevic, G .R. Berdiyorov, and F. M. Peeters

Unconventional vortex states in nanoscale superconductors due to shape-induced resonances in the inhomogeneous Cooper-pair condensate,

arXiv:1208.1619

Vortex matter in mesoscopic superconductors is known to be strongly affected by the geometry of the sample. Here we show that in nanoscale superconductors with coherence length comparable to the Fermi wavelength the shape resonances of the order parameter results in an additional contribution to the quantum topological confinement - leading to unconventional vortex configurations. Our Bogoliubov-de Gennes calculations in a square geometry reveal a plethora of asymmetric, giant multi-vortex, and vortex-antivortex structures, stable over a wide range of parameters and which are very different from those predicted by the Ginzburg-Landau theory. These unconventional states are relevant for high-Tc nanograins, confined Bose-Einstein condensates, and graphene flakes with proximity-induced superconductivity.

C.T. Olund and E. Zhao

Current-phase relation for Josephson effect through helical metal,

arXiv:1207.7288

Josephson junctions fabricated on the surface of three-dimensional topological insulators (TI) show a few unusual properties distinct from conventional Josephson junctions. In these devices, the Josephson coupling and the supercurrent are mediated by helical metal, the two-dimensional surface of the TI. A line junction of this kind is known to support Andreev bound states at zero energy for phase bias π, and consequently the so-called fractional ac Josephson effect. Motivated by recent experiments on TI-based Josephson junctions, here we describe a convenient algorithm to compute the bound state spectrum and the current-phase relation for junctions with finite length and width. We present analytical results for the bound state spectrum, and discuss the dependence of the current-phase relation on the length and width of the junction, the chemical potential

of the helical metal, and temperature. A thorough understanding of the current-phase relation may help in designing topological superconducting qubits and manipulating Majorana fermions.

Y. Kim, J. Cano, and C. Nayak
Majorana Zero Modes in Semiconductor Nanowires in Contact with Higher-Tc Superconductors,
arXiv:1208.3701
We analyze the prospects for stabilizing Majorana zero modes in semiconductor nanowires that are proximity-coupled to higher-temperature superconductors. We begin with the case of iron pnictides which, though they are s-wave superconductors, are believed to have superconducting gaps that change sign. We then consider the case of cuprate superconductors. We show that a nanowire on a step-like surface, especially in an orthorhombic material such as YBCO, can support Majorana zero modes at an elevated temperature.

D.K. Efimkin and Yu. E. Lozovik
Resonant manifestations of chiral excitons in magnetooptical Faraday and Kerr effects in topological insulator film
arXiv:1208.3320
Manifestation of chiral excitons on surfaces of topological insulator thin film with magnetically induced energy gap in the surface spectrum in magnetooptical Kerr and Faraday effects is analyzes. Excitonic contribution to a surface optical conductivity tensor is calculated. Chiral excitons contrary to conventional ones resonantly contribute to Hall conductivity due to lack of the symmetry between the states with opposite angular momentum. They can lead to considerable enhancement of Faraday angle and ellipticity of transmitted electromagnetic wave. Chiral excitons cause decrease of Kerr angle and prominent signatures in ellipticity of reflected electromagnetic wave. Conditions for experimental observation of described effects are discussed.

J. Bauer, J. I. Pascual, and K.J. Franke
Microscopic resolution of the interplay of Kondo screening and superconducting pairing,
arXiv:1208.3211
Magnetic molecules adsorbed on a superconductor give rise to a local competition of Cooper pair and Kondo singlet formation inducing subgap bound states. For manganese-phthalocyanine molecules on a Pb (111) substrate, featuring numerous different Kondo scales, such states are resolved by scanning tunneling spectroscopy. We show that numerical renormalization group calculations for an effective one channel Anderson impurity model explain the energy and weight of the bound states very well. The application of the model and its parameters are justified by scaling arguments.