Signatures of Majorana Zero Modes in Spin-Resolved Current Correlations
Arbel Haim, Erez Berg, Felix von Oppen, and Yuval Oreg
arXiv:1411.0673
We consider a normal lead coupled to a Majorana bound state. We show that the spin-resolved current correlations exhibit unique features which distinguish Majorana bound states from other lowenergy resonances. In particular, the spin-up and spin-down currents from a Majorana bound state are anti-correlated at low bias voltages, and become uncorrelated at higher voltages. This behavior is independent of the exact form of coupling to the lead, and of the direction of the spin polarization. In contrast, an ordinary low-energy Andreev bound state gives rise to a positive correlation between the spin-up and spin-down currents, and this spin-resolved current-current correlation approaches a non-zero constant at high bias voltages. We discuss experimental setups in which this effect can be measured.

Pseudospin-driven spin relaxation mechanism in graphene
Dinh Van Tuan, Frank Ortmann, David Soriano, Sergio O. Valenzuela, and Stephan Roche
*Nature Physics **10**, 857 (2014)*
The prospect of transporting spin information over long distances in graphene, possible because of its small intrinsic spin–orbit coupling (SOC) and vanishing hyperfine interaction, has stimulated intense research exploring spintronics applications. However, measured spin relaxation times are orders of magnitude smaller than initially predicted, while the main physical process for spin dephasing and its charge-density and disorder dependences remain unconvincingly described by conventional mechanisms. Here, we unravel a spin relaxation mechanism for non-magnetic samples that follows from an entanglement between spin and pseudospin driven by random SOC, unique to graphene. The mixing between spin and pseudospin-related Berry's phases results in fast spin dephasing even when approaching the ballistic limit, with increasing relaxation times away from the Dirac point, as observed experimentally. The SOC can be caused by adatoms, ripples or even the substrate, suggesting novel spin manipulation strategies based on the pseudospin degree of freedom.

Magnonic charge pumping via spin–orbit coupling
Chiara Ciccarelli, Kjetil M. D. Hals, Andrew Irvine, Vit Novak, Yaroslav Tserkovnyak, Hidekazu Kurebayashi, Arne Brataas, and Andrew Ferguson
Nature Nanotech., doi:10.1038/nnano.2014.252 (2014)
The interplay between spin, charge and orbital degrees of freedom has led to the development of spintronic devices such as spin–torque oscillators and spin-transfer torque magnetic random-access memories. In this development, spin pumping represents a convenient way to electrically detect magnetization dynamics. The effect originates from direct conversion of low-energy quantized spin waves in the magnet, known as magnons, into a flow of spins from the precessing magnet to adjacent leads. In this case, a secondary spin–charge conversion element, such as heavy metals with large spin Hall angle or multilayer layouts, is required to convert the spin current into a charge signal. Here, we report the experimental observation of charge pumping in which a precessing ferromagnet pumps a charge current, demonstrating direct conversion of magnons into high-frequency currents via the relativistic spin–orbit interaction. The generated electric current, unlike spin currents generated by spin-pumping, can be directly detected without the need of any additional spin–charge conversion mechanism. The charge-pumping phenomenon is generic and gives a deeper understanding of its reciprocal effect, the spin orbit torque, which is currently attracting interest for their potential in manipulating magnetic information.

How two spins can thermalize a third spin
Stephan Kleinbölting and Rochus Klesse
arXiv:1411.2489
We consider thermalization of a microscopic quantum system by interaction with a thermal bath. Our interest is the minimal size the bath can have while still being able to thermalize the system. Within a specific thermalization scheme we show that a single spin-1/2 can be fully thermalized by interaction with a bath that consists of just two other spin-1/2. The two bath spins are initially in a pure, entangled state, and the thermalizing interaction is a Heisenberg exchange-interaction of the system-spin with one of the bath spins. The time dependent coupling strength has to obey a single integral constraint. We also present

a simple generalization of this minimal model in which the bath consists of an arbitrary number of spin-1/2 pairs.

Supercurrent dephasing by electron-electron interactions
Andrew G. Semenov, and Andrei D. Zaikin
arXiv:1411.2558
We demonstrate that in sufficiently long diffusive superconducting-normal-superconducting (SNS) junctions dc Josephson current is exponentially suppressed by electron-electron interactions down to zero temperature. This suppression is caused by the effect of *Cooper pair dephasing* which occurs in the normal metal and defines a new fundamental length scale L_φ in the problem. Provided the temperature length exceeds L_φ this dephasing length can be conveniently extracted from equilibrium measurements of the Josephson current.

Overcoming correlated noise in quantum systems: How mediocre clocks make good qubits
P. J. J. O'Malley, J. Kelly, R. Barends, B. Campbell, Y. Chen, Z. Chen, B. Chiaro, A. Dunsworth, A. G. Fowler, I.-C. Hoi, E. Jeffrey, A. Megrant, J. Mutus, C. Neill, C. Quintana, P. Roushan, D. Sank, A. Vainsencher, J. Wenner, T. C. White, A. N. Korotkov, A. N. Cleland, and John M. Martinis
arXiv:1411.2613
A precise measurement of dephasing over a range of timescales is critical for improving quantum gates beyond the error correction threshold. We present a method for measuring dephasing in experimental quantum systems based on randomized benchmarking that excels at measuring small levels of phase noise at the timescales relevant to gates. We find our SQUID-based qubit is not limited by 1/f flux noise, but instead observe a previously unreported telegraph noise mechanism. We demonstrate that full understanding of dephasing allows for the use of "mediocre clocks"–systems with correlated phase noise–as good qubits.

Split Dirac cones in HgTe/CdTe quantum wells due to symmetry-enforced level anticrossing at interfaces
S.A. Tarasenko, M.V. Durnev, M.O. Nestoklon, E.L. Ivchenko, Jun-Wei Luo, and Alex Zunger
arXiv:1411.1910
We describe the fine structure of Dirac states in HgTe/CdHgTe quantum wells of critical and close-to-critical thickness and demonstrate the formation of an anticrossing gap between the tips of the Dirac cones driven by interface inversion asymmetry. By combining symmetry analysis, atomistic calculations, and k-p theory with interface terms, we obtain a quantitative description of the energy spectrum and extract the interface mixing coefficient. The zero-magnetic-field splitting of Dirac cones can be experimentally revealed in studying magnetotransport phenomena, cyclotron resonance, Raman scattering, or THz radiation absorption.

Electron transport in multiterminal networks of Majorana bound states
Luzie Weithofer, Patrik Recher, and Thomas L. Schmidt
*Phys. Rev. B **90**, 205416*

Spin and Orbital Magnetic Response on the Surface of a Topological Insulator
Yaroslav Tserkovnyak, D. A. Pesin, and Daniel Loss
arXiv:1411.2070

Nuclear spin relaxation in Rashba nanowires
Alexander A. Zyuzin, Tobias Meng, Viktoriia Kornich, and Daniel Loss
*Phys. Rev. B **90**, 195125*

Detecting nonlocal Cooper pair entanglement by optical Bell inequality violation.
Simon E. Nigg, Rakesh P. Tiwari, Stefan Walter, and Thomas L. Schmidt
arXiv:1411.3945

Majorana fermions in Ge/Si hole nanowires
Franziska Maier, Jelena Klinovaja, and Daniel Loss
*Phys. Rev. B **90**, 195421*