The Hierarchical Nature of the Quantum Hall Effects
Parsa Bonderson, arXiv:1108.1624v1 [cond-mat.mes-hall]

I demonstrate that the wavefunction for a $\nu = n + \tilde{\nu}$ quantum Hall state with Landau levels 0,1,...,n-1 filled and a filling fraction $\tilde{\nu}$ quantum Hall state with $0 < \tilde{\nu} \leq 1$ in the nth Landau level can be obtained hierarchically from the $\nu = n$ state by introducing quasielectrons which are then projected into the (conjugate of the) $\tilde{\nu}$ state. In particular, the $\tilde{\nu} = 1$ case produces the filled Landau level wavefunctions hierarchically, thus establishing the hierarchical nature of the integer quantum Hall states. It follows that the composite fermion description of fractional quantum Hall states fits within the hierarchy theory of the fractional quantum Hall effect. I also demonstrate this directly by generating the composite fermion ground-state wavefunctions via application of the hierarchy construction to fractional quantum Hall states, starting from the $\nu = 1/m$ Laughlin states.

Entanglement Entropy of Gapped Phases and Topological Order in Three dimensions
Tarun Grover, Ari M. Turner, Ashvin Vishwanath, arXiv:1108.4038v1 [cond-mat.str-el]

We discuss entanglement entropy of gapped ground states in different dimensions, obtained on partitioning space into two regions. For trivial phases without topological order, we argue that the entanglement entropy may be obtained by integrating an 'entropy density' over the partition boundary that admits a gradient expansion in the curvature of the boundary. This constrains the expansion of entanglement entropy as a function of system size, and points to an even-odd dependence on dimensionality. For example, in contrast to the familiar result in two dimensions, a size independent constant contribution to the entanglement entropy can appear for trivial phases in any odd spatial dimension. We then discuss phases with topological entanglement entropy (TEE) that cannot be obtained by adding local contributions. We find that in three dimensions there is just one type of TEE, as in two dimensions, that depends linearly on the number of connected components of the boundary (the 'zeroth Betti number'). In D ¿ 3 dimensions, new types of TEE appear which depend on the higher Betti numbers of the boundary manifold. We construct generalized toric code models that exhibit these TEEs and discuss ways to extract TEE in D ¿=3.

Quantum Tunneling of the Magnetic Moment in a Free Particle
M. F. O'Keeffe, E. M. Chudnovsky, D. A. Garanin, arXiv:1108.4189v1 [cond-mat.mes-hall]

We study tunneling of the magnetic moment in a particle that has full rotational freedom. Exact energy levels are obtained and the ground-state magnetic moment is computed for a symmetric rotor. The effect of the mechanical freedom on spin tunneling manifests itself in a strong dependence of the magnetic moment on the moments of inertia of the rotor. Energy of the particle exhibits quantum phase transitions between states with different values of the magnetic moment. Particles of various shapes are investigated and quantum phase diagram is obtained.

Coulomb blockade of Majorana fermion induced transport
A. Zazunov, A. Levy Yeyati, R. Egger, arXiv:1108.4308v1 [cond-mat.mes-hall]

We study Coulomb charging effects for transport through a topological superconducting grain, where Majorana bound states are present at the interface to normal-conducting leads. We construct the general Keldysh functional integral representation, and provide detailed results for the nonlinear current-voltage relation under weak Coulomb blockade conditions.

Relaxation and Readout Visibility of a Singlet-Triplet Qubit in an Overhauser Field Gradient

C. Barthel, J. Medford, H. Bluhm, A. Yacoby, C. M. Marcus, M. P. Hanson, A. C. Gossard, arXiv:1108.4210v1 [cond-mat.mes-hall]

Using single-shot charge detection in a GaAs double quantum dot, we investigate spin relaxation time T_1 and readout visibility of a two-electron singlet-triplet qubit following single-electron dynamic nuclear polarization (DNP). For magnetic fields up to $2T$, the DNP cycle is in all cases found to increase Overhauser field gradients, which in turn decrease T_1 and consequently reduce readout visibility. This effect was previously attributed to a suppression of singlet-triplet dephasing under a similar DNP cycle. A model describing relaxation after singlet-triplet mixing agrees well with experiment. Effects of pulse bandwidth on visibility are also investigated.

Quantum phases of atomic Fermi gases with anisotropic spin-orbit coupling

M. Iskin, A. L. Subasi, arXiv:1108.4263v1 [cond-mat.quant-gas]

We consider a general anisotropic spin-orbit coupling (SOC) and analyze the phase diagrams of both balanced and imbalanced Fermi gases for the entire BCS–Bose-Einstein condensate (BEC) evolution. In the first part, we use the self-consistent mean-field theory at zero temperature, and show that the topological structure of the ground-state phase diagrams is quite robust against the effects of anisotropy. In the second part, we go beyond the mean-field description, and investigate the effects of Gaussian fluctuations near the critical temperature. This allowed us to derive the time-dependent Ginzburg-Landau theory, from which we extract the effective mass of the Cooper pairs and their critical condensation temperature in the molecular BEC limit.

Interacting Dirac Fermions on a Topological Insulator in a Magnetic Field

Vadim M. Apalkov, Tapash Chakraborty, arXiv:1108.4085v1 [cond-mat.mes-hall]

We have studied the fractional quantum Hall states on the surface of a topological insulator thin film in an external magnetic field, where the Dirac fermion nature of the charge carriers have been experimentally established only recently. Our studies indicate that the fractional quantum Hall states should indeed be observable in the surface Landau levels of a topological insulator. The strength of the effect will however be different, compared to that in graphene, due to the finite thickness of the topological insulator film and due to the admixture of Landau levels of the two surfaces of the film. At a small film thickness, that mixture results in a strongly non-monotonic dependence of the excitation gap on the film thickness. At a large enough thickness of the film, the excitation gap in the lowest two Landau levels are comparable in strength.

Fermi surface of two-dimensional Hubbard models

Jörg Bünemann, Tobias Schickling, Florian Gebhard, arXiv:1108.4284v1 [cond-mat.str-el]

We study the correlation-induced deformation of Fermi surfaces by means of a new diagrammatic method which allows for the analytical evaluation of Gutzwiller wave functions in finite dimensions. In agreement with renormalization-group results we find Pomeranchuk instabilities in two-dimensional Hubbard models for sufficiently large Coulomb interactions.