Imaging currents in HgTe quantum wells in the quantum spin Hall regime
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http://arxiv.org/abs/1212.2203,
supplementray material at: *http://www.stanford.edu/group/moler/publications.html*

The quantum spin Hall (QSH) state is a genuinely new state of matter characterized by a non-trivial topology of its band structure. Its key feature is conducting edge channels whose spin polarization has potential for spintronic and quantum information applications. The QSH state was predicted and experimentally demonstrated to exist in HgTe quantum wells. The existence of the edge channels has been inferred from the fact that local and non-local conductance values in sufficiently small devices are close to the quantized values expected for ideal edge channels and from signatures of the spin polarization. The robustness of the edge channels in larger devices and the interplay between the edge channels and a conducting bulk are relatively unexplored experimentally, and are difficult to assess via transport measurements. Here we image the current in large Hallbars made from HgTe quantum wells by probing the magnetic field generated by the current using a scanning superconducting quantum interference device (SQUID). We observe that the current flows along the edge of the device in the QSH regime, and furthermore that an identifiable edge channel exists even in the presence of disorder and considerable bulk conduction as the device is gated or its temperature is raised. Our results represent a versatile method for the characterization of new quantum spin Hall materials systems, and confirm both the existence and the robustness of the predicted edge channels.

Quantum Simulation of Small-Polaron Formation with Trapped Ions
Vladimir M. Stojanović, Tao Shi, C. Bruder, and J. Ignacio Cirac
Phys. Rev. Lett. ***109****, 250501 (2012).*
We propose an analog quantum simulation of small-polaron physics using a one-dimensional system of trapped ions acted upon by off-resonant standing waves...

Identifying topological order by entanglement entropy
Hong-Chen Jiang, Zhenghan Wang, and Leon Balents
Nature Physics ***8****, 902–905 (2012).*
... Here we report a practical method to identify topological phases in arbitrary realistic models by accurately calculating the topological entanglement entropy using the density matrix renormalization group (DMRG)...

Zero-bias peaks and splitting in an Al–InAs nanowire topological superconductor as a signature of Majorana fermions
Anindya Das, Yuval Ronen, Yonatan Most, Yuval Oreg, Moty Heiblum, Hadas Shtrikman
Nature Physics ***8****, 887–895 (2012).*
... Here, we present thorough experimental studies, backed by numerical simulations, of a system composed of an aluminium superconductor in proximity to an indium arsenide nanowire, with the latter possessing strong spin–orbit coupling and Zeeman splitting... Although not providing definite proof of a Majorana state, the presented data and the simulations support its existence.

Shot-Noise Thermometry of the Quantum Hall Edge States
Ivan P. Levkivskyi and Eugene V. Sukhorukov
Phys. Rev. Lett. ***109****, 246806 (2012).*

Observation of Entanglement between Itinerant Microwave Photons and a Superconducting Qubit
C. Eichler, C. Lang, J. M. Fink, J. Govenius, S. Filipp, and A. Wallraff
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Suppression of hyperfine dephasing by spatial exchange of double quantum dots
David Drummond, Leonid P. Pryadko, and Kirill Shtengel
Phys. Rev. B ***86****, 245307 (2012).*

Large nuclear spin polarization in gate-defined quantum dots using a single-domain nanomagnet
Gunnar Petersen, Eric A. Hoffmann, Dieter Schuh, Werner Wegscheider, Geza Giedke, Stefan Ludwig
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Kondo physics of reconstructed vacancies in graphene
Andrew K. Mitchell, Lars Fritz
http://arxiv.org/abs/1212.2631

Hedgehog Spin-texture and Berry's Phase tuning in a Magnetic Topological Insulator
Su-Yang Xu et al.
http://arxiv.org/abs/1212.3382

Reaching Fractional Quantum Hall States with Optical Flux Lattices
Nigel R. Cooper, Jean Dalibard
http://arxiv.org/abs/1212.3552

All optical quantum control of a spin-quantum state and ultrafast transduction into an electric current
K. Müller, T. Kaldewey, R. Ripszam, J. S. Wildmann, A. Bechtold, M. Bichler, G. Koblmüller, G. Abstreiter, J. J. Finley
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Single quasiparticle excitation dynamics on a superconducting island
V. F. Maisi, S. V. Lotkhov, A. Kemppinen, A. Heimes, J. T. Muhonen, J. P. Pekola
http://arxiv.org/abs/1212.2755