Irreversibility on the Level of Single-Electron Tunneling

Phys. Rev. X **2**, 011001 (2012)

B. Küng, C. Rössler, M. Beck, M. Marthaler, D. S. Golubev, Y. Utsumi, T. Ihn, and K. Ensslin

We present a low-temperature experimental test of the fluctuation theorem for electron transport through a double quantum dot. The rare entropy-consuming system trajectories are detected in the form of single charges flowing against the source-drain bias by using time-resolved charge detection with a quantum point contact. We find that these trajectories appear with a frequency that agrees with the theoretical predictions even under strong nonequilibrium conditions, when the finite bandwidth of the charge detection is taken into account.

Two-stage orbital order and dynamical spin frustration in $KCuF_3$

Nat. Phys. **8**, 63 (2012)

James C. T. Lee*, et al.*

Orbital order is important to many correlated electron phenomena, including colossal magnetoresistance and high-temperature superconductivity. A study of a previously unreported structure transition in $KCuF_3$ suggests that direct interorbital exchange is important to understanding such order.

Chiral superconductivity from repulsive interactions in doped graphene

Nat. Phys. **8**, 158 (2012)

Rahul Nandkishore, L. S. Levitov & A. V. Chubukov

Chiral superconducting states are expected to support a variety of exotic and potentially useful phenomena. Theoretical analysis suggests that just such a state could emerge in a doped graphene monolayer.

Protecting entanglement from decoherence using weak measurement and quantum measurement reversal

Nat. Phys. **8**, 117 (2012)

Yong-Su Kim, Jong-Chan Lee, Osung Kwon & Yoon-Ho Kim

The unavoidable coupling between a quantum state and its environment leads to decoherence. Weak measurements—indirectly observing a quantum state without disturbing it—are now shown to be a useful tool for reducing or even nullifying the effects of decoherence.

Complete Optical Absorption in Periodically Patterned Graphene

Phys. Rev. Lett. 108, 047401 (2012)

Sukosin Thongrattanasiri, Frank H. L. Koppens, and F. Javier García de Abajo

We demonstrate that 100% light absorption can take place in a single patterned sheet of doped graphene. General analysis shows that a planar array of small particles with losses

exhibits full absorption under critical-coupling conditions provided the cross section of each individual particle is comparable to the area of the lattice unit cell. Specifically, arrays of doped graphene nanodisks display full absorption when supported on a substrate under total internal reflection and also when lying on a dielectric layer coating a metal. Our results are relevant for infrared light detectors and sources, which can be made tunable via electrostatic doping of graphene.

Wave-Function Mapping of Graphene Quantum Dots with Soft Confinement

Phys. Rev. Lett. 108, 046801 (2012)
D. Subramaniam, et al.

Using low-temperature scanning tunneling spectroscopy, we map the local density of states of graphene quantum dots supported on Ir(111). Because of a band gap in the projected Ir band structure around the graphene *K* point, the electronic properties of the QDs are dominantly graphenelike. Indeed, we compare the results favorably with tight binding calculations on the honeycomb lattice based on parameters derived from density functional theory. We find that the interaction with the substrate near the edge of the island gradually opens a gap in the Dirac cone, which implies soft-wall confinement. Interestingly, this confinement results in highly symmetric wave functions. Further influences of the substrate are given by the known moiré potential and a 10% penetration of an Ir surface resonance into the graphene layer.

Topological superfluid in one-dimensional spin-orbit coupled atomic Fermi gases

arxiv:1204.5663 (2012)
Xia-Ji Liu and Hui Hu

We investigate theoretically the prospect of realizing a topological superfluid in one-dimensional spin-orbit coupled atomic Fermi gases under Zeeman field in harmonic traps. In the absence of spin-orbit coupling, it is well-known that the system is either a Bardeen-Cooper-Schrieffer (BCS) superfluid or an inhomogeneous Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) superfluid. Here we show that with spin-orbit coupling it could be driven into a topological superfluid, which supports zeroenergy Majorana modes. However, in the weakly interacting regime the spin-orbit coupling does not favor the spatially oscillating FFLO order parameter. As a result, it seems difficult to create an inhomogeneous topological superfluid in current cold-atom experiments.

All-electric qubit control in heavy hole quantum dots via non-Abelian geometric phases

arxiv:1202.0289 (2012)
Jan C. Budich, Dietrich G. Rothe, Ewelina M. Hankiewicz, Björn Trauzettel

We demonstrate how non-Abelian geometric phases can be used to universally process a spin qubit in heavy hole quantum dots in the absence of magnetic fields. A time dependent electric quadrupole field is used to perform any desired single qubit operation by virtue of non-Abelian holonomy. During the proposed operations, the degeneracy of the time dependent two level system representing the qubit is not split. Since time reversal symmetry is preserved and hyperfine coupling is known to be weak in spin qubits based on heavy holes, we expect very long coherence times in the proposed setup.