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- **Topological Transition in a Non-Hermitian Quantum Walk**
  M. S. Rudner and L. S. Levitov , *Phys. Rev. Lett 102, 065703 (2009)*
  We analyze a quantum walk on a bipartite one-dimensional lattice, in which the particle can decay whenever it visits one of the two sublattices. The corresponding non-Hermitian tight-binding problem with a complex potential for the decaying sites exhibits two different phases, distinguished by a winding number dened in terms of the Bloch eigenstates in the Brillouin zone. We nd that the mean displacement of a particle initially localized on one of the nondecaying sites can be expressed in terms of the winding number, and is therefore quantized as an integer, changing from zero to one at the critical point. We show that the topological transition is relevant for a variety of experimental settings. The quantized behavior can be used to distinguish coherent from incoherent dynamics.

- **Phase-Sensitive Probes of Nuclear Polarizationin Spin-Blockaded Transport**
  M. S. Rudner, I. Neder, L. S. Levitov, B. I. Halperin , *arXiv:0909.0060v1 (2009)*
  We study the dynamics of electron and nuclear spins in spin-blockaded quantum dots in the regime where the hyperfine coupling to nuclear spins competes with a purely electronic spin-flip mechanism, such as the spin-orbital interaction or coupling to an inhomogeneous Zeeman field. Coherent interference between the two processes results in a modulation of the electron spin-flip rate which is sensitive to both the phase and magnitude of the transverse component of nuclear polarization. This surprising phenomenon represents a novel type of electron-nuclear coupling and provides means for electrical detection of transverse nuclear spin dynamics. In particular, in a system repeatedly driven through a singlet-triplet avoided crossing, nuclear precession manifests itself through oscillations in the nuclear spin pumping rate and electron transport characteristics, in resemblance to recent experimental observations by S. Foletti et al., arXiv:0801.3613.

- **Observation of a d-wave nodal liquid in highly underdoped** $Bi_2Sr_2CaCu_2O_{8+\delta}$
  U. Chatterjee, M. Shi, D. Ai, J. Zhao, A. Kanigel, S. Rosenkranz, H. Raffy, Z. Z. Li, K. Kadowaki, D. G. Hinks, Z. J. Xu, J. S. Wen, G. Gu, C. T. Lin, H. Claus, M. R. Norman, M. Randeria, J. C. Campuzano , *arXiv:0910.1648v1*
  We use angle resolved photoemission spectroscopy to probe the electronic excitations of the non-superconducting state that exists between the antiferromagnetic Mott insulator at zero doping and the superconducting state at larger dopings in $Bi_2Sr_2CaCu_2O_{8+\delta}$. We find that this state is a nodal liquid whose excitation gap becomes zero only at points in momentum space. Despite exhibiting a resistivity characteristic of an insulator and the absence of coherent quasiparticle peaks, this material has the same gap structure as the d-wave superconductor. We observe a smooth evolution of the spectrum across the insulator-to-superconductor transition, which suggests that high temperature superconductivity emerges when quantum phase coherence is established in a non-superconducting nodal liquid.

- **Metal-insulator quantum critical point beneath the high Tc superconducting dome**
  Suchitra E. Sebastian, N. Harrison, M. M. Altarawneh, C. H. Mielke, Ruixing Liang, D. A.

Bonn, W. N. Hardy, G. G. Lonzarich *arXiv:0910.2359v1*

An enduring question in correlated systems concerns whether superconductivity is favoured at a quantum critical point (QCP) characterised by a divergent quasiparticle effective mass. Despite such a scenario being widely postulated in high Tc cuprates and invoked to explain non-Fermi liquid transport signatures, experimental evidence is lacking for a critical divergence under the superconducting dome. We use ultra-strong magnetic fields to measure quantum oscillations in underdoped YBa2Cu3O6+x, revealing a dramatic doping-dependent upturn in quasiparticle effective mass at a critical metal-insulator transition beneath the superconducting dome. Given the location of this QCP under a plateau in Tc in addition to a postulated QCP at optimal doping, we discuss the intriguing possibility of two intersecting superconducting subdomes, each centred at a critical Fermi surface instability.

- **Fluctuation-Dissipative Phenomena in a Narrow Superconducting Channel Carrying Current Below Critical**

  Yu.N.Ovchinnikov, A.A.Varlamov *arXiv:0910.2659*

  The theory of current transport in a narrow superconducting channel accounting for thermal fluctuations is developed. These fluctuations result in the appearance of small but finite dissipation in the sample. The value of corresponding voltage is found as the function of temperature (close to transition temperature) and arbitrary bias current. It is demonstrated that the value of the activation energy (exponential factor in the Arrenius law) when current approaches to the critical one is proportional to $(1 - J/Jc)^(5/4)$. This result is in concordance with the one for the affine phenomenon of the Josephson current decay due to the thermal phase fluctuations, where the activation energy proportional $(1 - J/J_c)^(3/2)$ (the difference in the exponents is related to the additional current dependence of the order parameter). Found dependence of the activation energy on current explains the enormous discrepancy between the theoretically predicted before and the experimentally observed broadening of the resistive transition.

- **Symmetry protection of topological order in one-dimensional quantum spin systems**

  Frank Pollmann, Erez Berg, Ari M. Turner, Masaki Oshikawa, *arXiv:0909.4059v1*

  We discuss characterization and stability of the topological order of the Haldane phase. We find that an odd-S Haldane phase has a robust topological order protected by any one of the following three global symmetries: (i) the dihedral group of π-rotations about x, y and z axes; (ii) time-reversal symmetry $S^{x,y,z} \to -S^{x,y,z}$; (iii) link inversion symmetry (reflection about a bond center). On the other hand, an even-S Haldane phase is more fragile and protected only by global SU(2) symmetry. The symmetry protection can be extended to more general models, such as spin ladders.

- **Universal Features of Coherent Photonic Thermal Conductance in Multilayer Photonic Band Gap Structures**

  Wah Tung Lau, Jung-Tsung Shen, and Shanhui Fan , *Phys. Rev. B (to be published)*

  The pure vacuum of a thermos is not the best possible insulator for keeping your soup warm. Last year a team found theoretically that a structure known as a photonic crystal could block heat flow even more effectively than vacuum. In the October Physical Review B they present a complete theory explaining the phenomenon and reveal that the structure's insulating ability is surprisingly independent of its structural details. Their work suggests that photonic crystals, which have promising applications in communications and computing, might one day be used for their thermal properties, perhaps in devices that turn the sun's heat into usable energy.