Journal Club

Enhanced transport when Anderson localization is destroyed
Y. Krivolapov, L. Levi, S. Fishman, M. Segev, and M. Wilkinson, arXiv:1110.3024
We investigate the anomalous transport in optically-induced potentials that are random in both space and time. We find that the time variation destroys Anderson localization, replacing it by transport that is faster than diffusion, which in some cases can be even faster than ballistic. We relate this phenomenon to Chirikov's theory of overlapping resonances, and find radical differences between the anomalously-enhanced transport in one-dimensional and two-dimensional systems.

Generalized Polaron Ansatz for the Ground State of the Sub-Ohmic Spin-Boson Model: An Analytic Theory of the Localization Transition
A. W. Chin, J. Prior, S. F. Huelga, and M. B. Plenio, Phys. Rev. Lett. **107**, 160601 (2011)
The sub-Ohmic spin-boson model possesses a quantum phase transition at zero temperature between a localized and a delocalized phase, whose properties have so far only been extracted by numerical approaches. Here we present an extension of the Silbey-Harris variational polaron ansatz which allows us to develop an analytical theory which correctly describes a continuous transition with mean-field exponents for $0 < s < 0.5$. *The critical properties, couplings, and observables we obtain show excellent agreement with existing numerical results, and we give an intuitive microscopic description of the changing correlations between the system and bath which suppress the spin coherence and drive the transition.*

Realizing flexible two-qubit controlled phase gate with a hybrid solid-state system
F.-Y Zhang, Y. Shi, C. Li, and H.-S. Song, arXiv:1110.1901
We propose a theoretical scheme for realizing flexible two-qubit controlled phase gate. A transmission line resonator is used to induce the coupling between nitrogen-vacancy (N-V) in diamond and superconducting qubit. The N-V center acts as control qubit and the superconducting qubit as target qubit. Through adjusting external flux, we obtain desired coupling between random superconducting qubit and transmission line resonator...

Dual-probe decoherence microscopy: Probing pockets of coherence in a decohering environment J. Jeske, J. H. Cole, C. Müller, M. Marthaler, and G. Schön, arXiv:1110.1901
We study the use of a pair of qubits as a decoherence probe of a non-trivial environment. This dual-probe configuration is modelled by three two-level-systems which are coupled in a chain in which the middle system represents an environmental two-level-system (TLS). This TLS resides within the environment of the qubits and therefore its coupling to perturbing fluctuations (i.e. its decoherence) is assumed much stronger than the decoherence acting on the probe qubits. We study the evolution of such a tripartite system including the appearance of a decoherence-free state (dark state) and non-Markovian behaviour. We find that all parameters of this TLS can be obtained from measurements of one of the probe qubits...

Hyperfine Interaction-Dominated Dynamics of Nuclear Spins in Self-Assembled InGaAs Quantum Dots

C. Latta, A. Srivastava, and A. Imamoglu, Phys. Rev. Lett. **107**, 167401 (2011)
We measure the dynamics of nuclear spins in a single-electron charged self-assembled InGaAs quantum dot with negligible nuclear spin diffusion due to dipole-dipole interaction and identify two distinct mechanisms responsible for the decay of the Overhauser field. We attribute a temperature-independent decay lasting 100sec at 5 T to intradot diffusion induced by hyperfine-mediated indirect nuclear spin interaction. By repeated polarization of the nuclear spins, this diffusion induced partial decay can be suppressed. We also observe a gate voltage and temperature-dependent decay stemming from cotunneling mediated nuclear spin flips that can be prolonged to 30h by adjusting the gate voltage and lowering the temperature to 200 mK...

Quantum phase transition of the sub-Ohmic rotor model
M. Al-Ali and T. Vojta, arXiv:1110.2470
We investigate the behavior of an N-component quantum rotor coupled to a bosonic dissipative bath having a sub-Ohmic spectral density $J(\omega) \propto \omega^s$ with $s < 1$. With increasing dissipation strength, this system undergoes a quantum phase transition from a delocalized phase to a localized phase. We determine the exact critical behavior of this transition in the large-N limit. For $1 > s > 1/2$, we find nontrivial critical behavior corresponding to an interacting renormalization group fixed point while we find mean-field behavior for $s < 1/2$. The results agree with those of the corresponding long-range interacting classical model...

Mesoscopic Stoner instability in metallic nanoparticles revealed by shot noise
B. Sothmann, J. König, and Y. Gefen, arXiv:1110.2589
We study sequential tunneling through a metallic nanoparticle close to the Stoner instability coupled to parallely magnetized electrodes. Increasing the bias voltage successively opens transport channels associated with excitations of the nanoparticle's total spin. For the current this leads just to a steplike increase. The Fano factor, in contrast, shows oscillations between large super-Poissonian and sub-Poissonian values as a function of bias voltage. We explain the enhanced Fano factor in terms of generalized random-telegraph noise and propose the shot noise as a convenient tool to probe the mesoscopic Stoner instability.

Robust Trapped-Ion Quantum Logic Gates by Microwave Dynamical Decoupling
A. Bermudez, P. O. Schmidt, M. B. Plenio, and A. Retzker, arXiv:1110.1870
We introduce a hybrid scheme that combines laser-driven phonon-mediated quantum logic gates in trapped ions with the benefits of microwave dynamical decoupling. We demonstrate theoretically that a strong driving of the qubit decouples it from the external magnetic noise, and thus enhances the fidelity of two-qubit quantum gates. Moreover, the scheme does not require ground-state cooling, is inherently robust to undesired ac-Stark shifts, and simplifies previous gate schemes thus decreasing the effort in their realization.

Tunneling conductance and local density of states in tight-binding junctions
C. Berthod and T. Giamarchi, Phys. Rev. B **84**, 155414 (2011)
We study the relationship between the differential conductance and the local density of states in tight-binding tunnel junctions where the junction' geometry can be varied between the point-contact and the planar-contact limits. The conductances are found to differ significantly in these two limiting cases. We also examine how the matrix element influences the tunneling characteristics and produces contrast in a simple model of scanning tunneling microscope (STM). Some implications regarding the interpretation of STM spectroscopic data in the cuprates are discussed.