Journal Club on January 6, 2015. *Kouki Nakata*

Interfacial Spin and Heat Transfer between Metals and Magnetic Insulators
Scott A. Bender and Yaroslav Tserkovnyak
arXiv:1409.7128
We study the role of thermal magnons in the spin and heat transport across a normalmetal/insulating-ferromagnet interface, which is beyond an elastic electronic spin transfer. Using an interfacial exchange Hamiltonian, which couples spins of itinerant and localized orbitals, we calculate spin and energy currents for an arbitrary interfacial temperature difference and misalignment of spin accumulation in the normal metal relative to the ferromagnetic order. The magnonic contribution to spin current leads to a temperature-dependent torque on the magnetic order parameter; reciprocally, the coherent precession of the magnetization pumps spin current into the normal metal, the magnitude of which is affected by the presence of thermal magnons.

Non-equilibrium dynamics of coupled Luttinger liquids
L. Foini and T. Giamarchi
arXiv:1412.6377
In this work we consider the dynamics of two tunnel coupled chains after a quench in the tunneling strength is performed and the two systems are let evolve independently. We describe the form of the initial state comparing with previous results concerning the dynamics after the splitting of a one-dimensional gas of bosons into two phase coherent systems. We compute different correlation functions, among which those that are relevant for interference measurements, and discuss the emergence of effective temperatures also in connection with previous works.

Paramagnetic spin pumping
Y. Shiomi and E. Saitoh
arXiv:1412.1281 [Phys. Rev. Lett. 113, 266602 (2014)]
We have demonstrated spin pumping from a paramagnetic state of an insulator La_2NiMnO_6 into a Pt film. Single-crystalline films of La_2NiMnO_6 which exhibit a ferromagnetic order at $T_C \approx$270K were grown by pulsed laser deposition. The inverse spin Hall voltage induced by spin-current injection has been observed in the Pt layer not only in the ferromagnetic phase of La_2NiMnO_6 but also in a wide temperature range above T_C. The efficient spin pumping in the paramagnetic phase is ascribable to ferromagnetic correlation, not to ferromagnetic order.

Detection of Nonlocal Spin Entanglement by Light Emission from a Superconducting p-n Junction
Alexander Schroer and Patrik Recher
arXiv:1412.8619
We model a superconducting p-n junction in which the n- and the p-sides are contacted through two optical quantum dots (QDs), each embedded into a photonic nanocavity. Whenever a Cooper pair is transferred from the n-side to the p-side, two photons are emitted. When the two electrons of a Cooper pair are transported through different QDs, polarization-entangled photons are created, provided that the Cooper pairs retain their spin singlet character while being spatially separated on the two QDs. We show that a CHSH Bell-type measurement is able to detect the entanglement of the photons over a broad range of microscopic parameters, even in the presence of parasitic processes and imperfections.

Non-Markovian effects in electronic and spin transport
Pedro Ribeiro and Vitor R. Vieira
arXiv:1412.8486
We derive a non-Markovian master equation for the evolution of a class of open quantum systems consisting of quadratic fermionic models coupled to wide-band reservoirs. This is done by providing an explicit correspondence between master equations and non-equilibrium Green's functions approaches. Our findings permit to study non-Markovian regimes characterized by negative decoherence rates. We study the real-time dynamics and the steady-state solution of two illustrative models: a tight-binding and an XY-spin chains. The rich set of phases encountered for the non-equilibrium XY model extends previous studies to the non-Markovian regime.

Photon-mediated interactions: a scalable tool to create and sustain entangled many-body states
Camille Aron, Manas Kulkarni, and Hakan E. Tureci
arXiv:1412.8477
Generation and sustenance of entangled many-body states is of fundamental and applied interest. [- - -] Here we propose and study such a scalable scheme, based on engineering photon-mediated interactions, for driving a register of spatially separated qubits into multipartite entangled states. We demonstrate how generalized W-states can be generated with remarkable fidelities and the entanglement sustained for an indefinite time. The protocol is primarily discussed for a superconducting circuit architecture but is ideally realized in any platform that permits controllable delivery of coherent light to specified locations in a network of Cavity QED systems.

Out of equilibrium electrons and the Hall conductance of a Floquet topological insulator
Hossein Dehghani, Takashi Oka, and Aditi Mitra
arXiv: 1412.8469
Graphene irradiated by a circularly polarized laser has been predicted to be a Floquet topological insulator showing a laser-induced quantum Hall effect. A circularly polarized laser also drives the system out of equilibrium resulting in non-thermal electron distribution functions that strongly affect transport properties. Results are presented for the Hall conductance for two different cases. One is for the closed system for which the circularly polarized laser has been switched on suddenly. The second is for the open system coupled to an external reservoir of phonons. While for the former, the Hall conductance is far from the quantized limit, for the latter, coupling to a sufficiently low temperature reservoir of phonons is found to produce effective cooling, and thus an approach to the quantum limit, provided the frequency of the laser is large as compared to the band-width. [- - -] For the closed system, the electron distribution function is determined by the overlap between the initial wavefunction and the Floquet states which can result in a Hall conductance which is opposite in sign to that of the open system.

Violation of the Wiedemann-Franz Law for ultracold atomic gases
Michele Filippone, Frank Hekking, and Anna Minguzzi
arXiv:1410.5841
We study energy and particle transport for one-dimensional strongly interacting bosons through a single channel connecting two atomic reservoirs. We show the emergence of particle- and energy-current separation, leading to the violation of the Wiedemann-Franz law. As a consequence, we predict different time scales for the equilibration of temperature and particle imbalances between the reservoirs. Going beyond the linear spectrum approximation, we show the emergence of thermoelectric effects, which could be controlled by either tuning interactions or the temperature. Our results describe in a unified picture fermions in condensed matter devices and bosons in ultracold atom setups. We conclude discussing the effects of a controllable disorder.

Control of Edge Currents at a Ferromagnet - Triplet Superconductor Interface by Multiple Helical Majorana Modes
Damien Terrade, Dirk Manske, and Mario Cuoco
arXiv:1412.7053
We study the spin and charge currents owing at the interface of an itinerant ferromagnet with a topological spin-triplet superconductor having different number of time-reversal-invariant Majorana helical modes. Depending on the number of helical modes, the capacity of carrying spin and charge currents is shown to be directly related to the amplitude and orientation of the ferromagnetic magnetization with respect to the superconducting d-vector. Differently from the one-helical mode spin-triplet superconductor, we find that the presence of a finite amount of electronic hybridization with the two pairs of Majorana helical modes leads to nonvanishing charge current independently of the ferromagnetic exchange. The competition between the two pairs of Majorana helical modes remarkably yields a spin-current response that is almost constant in the range of weak to intermediate ferromagnetism. The behavior of the spin current is tightly linked to the direction of the spin-polarization in the ferromagnet and tends to be flatten for a magnetization that is coplanar to the spin-triplet d-vector independently of the number of helical modes.