Universal Topological Data for Gapped Quantum Liquids in Three Dimensions and Fusion Algebra for Non-Abelian String Excitations
Heidar Moradi, Xiao-Gang Wen, arXiv:1404.4618
Recently we conjectured that a certain set of universal topological quantities characterize topological order in any dimension. Those quantities can be extracted from the universal overlap of the ground state wave functions. For systems with gapped boundaries, these quantities are representations of the mapping class group MCG(M) of the space manifold M on which the systems lives. We will here consider simple examples in three dimensions and give physical interpretation of these quantities, related to fusion algebra and statistics of particle and string excitations. In particular, we will consider dimensional reduction from 3+1D to 2+1D, and show how the induced 2+1D topological data contains information on the fusion and the braiding of non-Abelian string excitations in 3D. These universal quantities generalize the well-known modular S and T matrices to any dimension.

Detection of spin entanglement via spin-charge separation in crossed Tomonaga-Luttinger liquids
Alexander Schroer, Bernd Braunecker, Alfredo Levy Yeyati, Patrik Recher, arXiv:1404.4524
We investigate tunneling between two spinful Tomonaga-Luttinger liquids (TLL) realized, e.g., as two crossed nanowires or quantum Hall edge states. When injecting into each TLL one electron of an opposite spin pair, the dc-current measured after the crossing differs for singlet, triplet or product states. This is a striking new non-Fermi liquid feature because the (mean) current in a non-interacting beam splitter is insensitive to spin-entanglement. It can be understood in terms of collective excitations subject to spin-charge separation. This behavior may offer an easier alternative to traditional entanglement detection schemes based on current noise, which we show to be suppressed by the interactions.

Effect of spin-orbit interaction on the critical temperature of an ideal Bose gas
Arunesh Roy, Sayak Ray, S. Sinha, arXiv:1404.4500
We consider Bose-Einstein condensation of an ideal bose gas with an equal mixture of 'Rashba' and 'Dresselhaus' spin-orbit interactions and study its effect on the critical temperature. In uniform bose gas a 'cusp' and a sharp drop in the critical temperature occurs due to the change in the density of states at a critical Raman coupling where the degeneracy of the ground states is lifted. Relative drop in the critical temperature depends on the diluteness of the gas as well as on the spin-orbit coupling strength. In the presence of a harmonic trap, the cusp in the critical temperature smoothened out and a minimum appears. Both the drop in the critical temperature and lifting of 'quasi-degeneracy' of the ground states exhibit crossover phenomena which is controlled by the trap frequency. By considering a 'Dicke' like model we extend our calculation to bosons with large spin and observe a similar minimum in the critical temperature near the critical Raman frequency, which becomes deeper for larger spin. Finally in the limit of infinite spin, the critical temperature vanishes at the critical frequency, which is a manifestation of Dicke type quantum phase transition.

Fractionally Quantized Berry Phase, Adiabatic Continuation, and Edge States
Toshikaze Kariyado, Yasuhiro Hatsugai,arXiv:1404.4451
Symmetry protected quantization of the Berry phase is discussed in relation to edge states. Assuming an existence of some adiabatic process which protects quantization of the Berry phase, non trivial Berry phase $\gamma = \pm 2\pi\rho$ (ρ is a local filling of particles) for the bulk suggests appearance of edge states with boundaries. We have applied this generic consideration for Bloch states of some two dimensional model with massless Dirac fermions where $\gamma = \pm\pi/2$ implies the edge states. Entanglement entropy is evaluated for the models and its relation to the bulk-edge correspondence of Dirac fermions is discussed as well.

Edge Chemistry Effects on the Structural, Electronic, and Electric Response Properties of Boron Nitride Quantum Dots *Dana Krepel, Lena Kalikhman-Razvozov, Oded Hod, arXiv:1404.4264*
The effects of edge hydrogenation and hydroxylation on the relative stability and electronic properties of hexagonal boron nitride quantum dots (h-BNQDs) are investigated. Zigzag edge hydroxylation is found to result in considerable energetic stabilization of h-BNQDs as well as a reduction of their electronic gap with respect to their hydrogenated counterparts. The application of an external in-plane electric field leads to a monotonous decrease of the gap. When compared to their edge-hydrogenated counterparts, significantly lower field intensities are required to achieve full gap closure of the zigzag edge hydroxylated h-BNQDs. These results indicate that edge chemistry may provide a viable route for the design of stable and robust electronic devices based on nanoscale hexagonal boron-nitride systems.

The Role of Alternance Symmetry in Magnetoconductance *Josep Planelles, Juan I. Climente, arXiv:1404.4254* We show that the direction of coherent electron transport across a cyclic system of quantum dots or a cyclic molecule can be modulated by an external magnetic field if the cycle has an odd number of hopping sites, but the transport becomes completely symmetric if the number is even. These contrasting behaviors, which remain in the case of interacting electrons, are a consequence of the absence or presence of alternance symmetry in the system. These findings are relevant for the design of nanocircuits based on coupled quantum dots or molecular junctions.

Topological superconductivity and unconventional pairing in oxide interfaces
Mathias S. Scheurer, Jrg Schmalian, arXiv:1404.4039
To pinpoint the microscopic mechanism for superconductivity has proven to be one of the most outstanding challenges in the physics of correlated quantum matter. Thus far, the most direct evidence for an electronic pairing mechanism is the observation of a new symmetry of the order-parameter, as done in the cuprate high-temperature superconductors. Like distinctions based on the symmetry of a locally defined order-parameter, global, topological invariants allow for a sharp discrimination between states of matter that cannot be transformed into each other adiabatically. Here we propose an unconventional pairing state for the electron fluid in two-dimensional oxide interfaces and establish a direct link to the emergence of nontrivial topological invariants. Topological superconductivity and Majorana edge states can then be used to detect the microscopic origin for superconductivity. In addition, we show that also the density wave states that compete with superconductivity sensitively depend on the nature of the pairing interaction. Our conclusion is based on the special role played by the spin-orbit coupling and the shape of the Fermi surface in SrTiO3/LaAlO3-interfaces and closely related systems.

Spin pumping and spin-transfer torques in antiferromagnets
Ran Cheng, Jiang Xiao, Qian Niu, Arne Brataas, arXiv:1404.4023
Spin pumping and spin-transfer torques are two widely studied reciprocal phenomena in ferromagnets. However, pumping phenomena in homogeneous antiferromagnets and their relations to current-induced torques have not been explored. By calculating how electrons scatter off a normal metal-antiferromagnetic interface, we derive pumped spin and staggered spin currents in terms of the staggered field, the magnetization, and their rates of change. For both compensated and uncompensated interfaces, spin pumping is large and of a similar magnitude with a direction controlled by the microwave polarization. The pumped currents are connected to current-induced torques via Onsager reciprocity relations.

Superfluid spin transport through antiferromagnetic insulators
So Takei, Bertrand I. Halperin, Amir Yacoby, Yaroslav Tserkovnyak, arxiv:1404.3987
A theoretical proposal for realizing and detecting spin supercurrent in an isotropic antiferromagnetic insulator is reported. Superfluid spin transport is achieved by inserting the antiferromagnet between two metallic reservoirs and establishing a spin accumulation in one reservoir such that a spin bias is applied across the magnet. We consider a class of bipartite antiferromagnets with Neel ground states, and temperatures well below the ordering temperature, where spin transport is mediated essentially by the condensate. Landau-Lifshitz and magneto-circuit theories are used to directly relate spin current in different parts of the heterostructure to the spin-mixing conductances characterizing the antiferromagnet—metal interfaces and the antiferromagnet bulk damping parameters, quantities all obtainable from experiments. We study the efficiency of spin angular-momentum transfer at an antiferromagnet—metal interface by developing a microscopic scattering theory for the interface and extracting the spin-mixing conductance for a simple model. Within the model, a quantitative comparison between the spin-mixing conductances obtained for the antiferromagnet—metal and ferromagnet—metal interfaces is made.

Renormalization group approach to a p-wave superconducting model
Mucio A. Continentino, Fernanda Deus, Heron Caldas, arXiv:1404.3647
We present in this work an exact renormalization group (RG) treatment of a one-dimensional p-wave superconductor. The model proposed by Kitaev consists of a chain of spinless fermions with a p-wave gap. It is a paradigmatic model of great actual interest since it presents a weak pairing superconducting phase that has Majorana fermions at the ends of the chain. Those are predicted to be useful for quantum computation. The RG allows to obtain the phase diagram of the model and to study the quantum phase transition from the weak to the strong pairing phase. It yields the attractors of these phases and the critical exponents of the weak to strong pairing transition. We show that the weak pairing phase of the model is governed by a chaotic attractor being non-trivial from both its topological and RG properties. In the strong pairing phase the RG flow is towards a conventional strong coupling fixed point. Finally, we propose an alternative way for obtaining p-wave superconductivity in a one-dimensional system without spin-orbit interaction.