Local Adiabatic Mixing of Kramers Pairs of Majorana Bound States
Konrad Wölms, Ady Stern, Karsten Flensberg

arXiv:1405.5104
We consider Kramers pairs of Majorana bound states under adiabatic time evolution. This is important for the prospects of using such bound states as parity qubits. We show that local adiabatic perturbations can cause a rotation in the space spanned by the Kramers pair. Hence the quantum information is unprotected against local perturbations, in contrast to the case of single localized Majorana bound states in systems with broken time reversal symmetry. We give an analytical and a numerical example for such a rotation, and specify sufficient conditions under which a rotation is avoided. We give a general scheme for determining when these conditions are satisfied, and exemplify it with a general model of a quasi 1D time reversal symmetric topological superconductor.

The optical lattice Weyl semimetal
Sriram Ganeshan, S. Das Sarma
arXiv:1405.4866
We theoretically construct three-dimensional topological semimetallic phases akin to Weyl systems by generalizing one-dimensional Aubry-Andre-Harper lattice tight binding models.. . . Our work provides a theoretical connection between the incommensurate AAH model and Weyl semimetals, and points toward practical methods for the laboratory realization of such three dimensional topological systems in atomic and photonic lattices.

Majorana Braiding Dynamics on Nanowires
Cássio Sozinho Amorim, Kazuto Ebihara, Ai Yamakage, Yukio Tanaka, Masatoshi Sato
arXiv:1405.5153
. . . In this paper, we investigate the braiding dynamics of Majorana fermions on superconducting nanowires. In a finite size system, a non- adiabatic dynamical process dominates the non-Abelian braiding that operates qubits of Majorana fermions. Our simulations clarify how qubits behave in the real-time braiding process, and elucidate the optimum condition of superconducting nanowires for efficient topological quantum operation.

Exchange-based two-qubit gate for singlet-triplet qubits
Matthew P. Wardrop, Andrew C. Doherty
arXiv:1405.5274
We analyse a simple exchange-based two-qubit gate for singlet-triplet qubits in gate-defined semiconductor quantum dots that can be implemented in a single exchange pulse. Leakage is suppressed by a magnetic field gradient that causes spin-flip transitions to be non-energy-conserving. We show that the use of adiabatic pulses greatly reduces leakage processes compared to square pulses. We also characterise the effect of charge noise on the entanglement fidelity of the gate both analytically and in simulations; demonstrating high entanglement fidelities for physically realistic experimental parameters. Specifically we find that it is possible to achieve fidelities and gate times that are comparable to single-qubit states using realistic magnetic field gradients.

Kitaev chains with long-range pairing
Davide Vodola, Luca Lepori, Elisa Ercolessi, Alexey V. Gorshkov, Guido Pupillo
arXiv:1405.5440
We propose and analyze a generalization of the Kitaev chain for fermions with long-range p-wave

pairing, which decays with distance as a power-law with exponent α. Using the integrability of the model, we demonstrate the existence of two types of gapped regimes, where correlation functions decay exponentially at short range and algebraically at long range ($\alpha > 1$) or purely algebraically ($\alpha < 1$). Most interestingly, along the critical lines, long-range pairing is found to break conformal symmetry for sufficiently small α. This is accompanied by a violation of the area law for the entanglement entropy in large parts of the phase diagram in the presence of a gap, and can be detected via the dynamics of entanglement following a quench. Some of these features may be relevant for current experiments with cold atomic ions.

Surface Theory of a Family of Topological Kondo Insulators
Bitan Roy, Jay D. Sau, Maxim Dzero, Victor Galitski
arXiv:1405.5526
A low-energy theory for the helical metallic states, residing on the surface of cubic topological Kondo insulators, is derived. Despite our analysis being primarily focused on a prototype topological Kondo insulator, Samarium hexaboride (SmB_6), the surface theory derived here can also capture key properties of other heavy fermion topological compounds with a similar underlying crystal structure. ...

Intrinsic Josephson junctions in the iron-based multi-band superconductor (V2Sr4O6)Fe2As2
Philip J.W. Moll, Xiyu Zhu, Peng Cheng, Hai-Hu Wen, Bertram Batlogg
arXiv:1405.5693
In layered superconductors, Josephson junctions may be formed within the unit cell due to sufficiently low interlayer coupling. These intrinsic Josephson junction (iJJ) systems have attracted considerable interest for their application potential in quantum computing as well as efficient sources of THz radiation, closing the famous "THz gap". ...

Magnetization dynamics in ultra-small magnetic tunnel junctions coupled to an electromagnetic environment
Mircea Trif, Pascal Simon
arXiv:1405.5744
We study the magnetization dynamics in ferromagnet|insulator|ferromagnet and ferromagnet|insulator|normal metal ultra-small tunnel junctions, and the associated voltage drop in the presence of an electromagnetic environment assisting the tunneling processes. We show that the environment strongly affects the resulting voltage, which becomes a highly non-linear function of the precession cone angle θ. We find that voltages comparable to the driving frequency ω can be reached even for small precession cone angles θ, in stark contrast to the case where the environment is absent. Such an effect could be useful in detecting, with high sensitivity, local magnetization precessions in textured ferromagnets, or in probing the environment via the magnetization dynamics.

Quantum charge pumping through fractional Fermions in charge density modulated quantum wires and Rashba nanowires
Arijit Saha, Diego Rainis, Rakesh P. Tiwari, Daniel Loss
arXiv:1405.5719