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New Avenues toward Complex Pairing States

Current challenges of quantum many-body theory include correlated super-conductivity, topological materials, non-equilibrium phenomena, and complexity at surfaces and interfaces. In particular, the physics near interfaces and surfaces has attracted attention, as it can lead to phases of matter that might not be realized in bulk materials. The increase in functionality due to spin-triplet pairing states in devices has led to the new field of superconducting spintronics.

Of particular interest are effects based on the presence of gemetric phases and on topological stability. Whereas the former open new avenues toward spin control, the latter have recently attracted strong interest due to their robustness with respect to surface disorder. Spin triplet pairing states in bulk materials can be realized in superfluid 3He, in some correlated superconductors, or in non-centrosymmetric superconductors. Spin-orbit locking in non-centrosymmetric materials may lead to topological superconductivity giving rise to topologically protected surface Andreev states.

I will present self-consistent calculations for topological superconductivity in non-centrosymmetric materials, and for superfluid order in 3He in the presence of spin-active surfaces.