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The Dark Energy of Quantum Materials

The many correlated electron problems remain largely unsolved after decades; with one stunning success being BCS electron-phonon mediated conventional superconductivity. The Cooper pairing mechanisms of the dozens of families of unconventional superconductors, including the high- T_c cuprate, iron-based, and heavy fermion superconductors remain elusive and quite varied. But some of their fundamental characteristics are strikingly similar, including their ubiquitous phase diagram, with intriguing correlated electron (non-Fermi liquid) phases that break the symmetry of their underlying lattice at temperatures well above T_c . These correlated phases remain among the greatest unsolved problems in physics; and I will present an analogy stressing that. I will start with an overview of the US National MagLab and finish with some of our own recent work on identifying a possible new pairing mechanism in a heavy-fermion superconductor.

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