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Life of a theorist without a small parameter

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Materials with interesting properties, like high-temperature superconductors, happen to often appear in regimes where their quantum mechanical state is far from any state that can serve as a starting point for perturbation theory. These materials have challenged, in particular, two of the best established theories of condensed matter: band theory and the BCS theory of superconductivity. In this talk, I will discuss a few of the new conceptual frameworks that have been developed to take up the challenge and what we have learned from them. Algorithms and supercomputers play an important role in implementing these ideas. There is perhaps a future for designing new classes of materials in silico.

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