Nested Phase Transitions and the Mott Insulator Distemper

Twenty-five years after the discovery of cuprate superconductivity there is still no accepted understanding of the underlying quantum mechanics of these materials, in particular why they superconduct at such high temperatures. However, casual reflection on the matter reveals that this cannot be so. It is impossible that the underlying cause should not be known. The Hamiltonian is the usual one of solid state physics. The strength of the coulomb interactions is the same as in all conventional matter, namely 1, as required by the virial theorem. What has happened is simply a meltdown of the scientific process unhappily familiar to students human political behavior. At the center of this storm of is the Mott Insulator, a concept that "everybody knows" and that is mentioned routinely and matter-of-factly in refereed literature, yet cannot be written down at the blackboard or defined in terms of underlying quantum degrees of freedom. From the Mott Insulator has spawned the Non-Fermi Liquid, an equally fuzzy non-state state of matter which likewise cannot be written down and which likewise has spread through the literature as though it were scientific fact. (Boris Altschuler likes to refer to it as a "non-banana".) But the inability of anyone to actually write these things down is the tipoff that they are not scientific fact at all but pseudoscience made possible by an enormous body of bad experiment. The cuprates have exacerbated this problem by having experimental properties that don't reproduce well. The underlying reason is that cuprates possess at least 3 kinds of order that coexist with each other and that circumvent and thwart each other in a delicate dance of death that is ultrasensitive to sample chemistry and preparation history. To make matters worse, quantum glassiness often ensues. The formal name for this dance of death is "quantum criticality." Thus the 25-year nightmare of the cuprates is caused by something physical, namely the ability of second-order quantum phase transitions to confuse the data, not the ineptness of scientists.
It is a sobering lesson to believers of scientific logic as the solution to all problems.

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