CSU PHYSICS COLLOQUIUM

“ Beyond BCS: An Exact Model for Superconductivity and Mottness”

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Monday, April 10th at 4:00 PM

120 Engineering (Hammond Auditorium)

Abstract

The Bardeen-Cooper-Schrieffer (BCS) theory of superconductivity described all superconductors until the 1986 discovery of the high-temperature counterpart in the cuprate ceramic materials. This discovery has challenged conventional wisdom as these materials are well known to violate the basic tenets of the Landau Fermi liquid theory of metals, crucial to the BCS solution. Precisely what should be used to replace Landau's theory remains an open question. The natural question arises: What is the simplest model for a non-Fermi liquid that yields tractable results. Our work builds[1] on an overlooked symmetry that is broken in the normal state of generic models for the cuprates and hence serves as a fixed point. A surprise is that this fixed point also exhibits Cooper's instability [2,3]. However, the resultant superconducting state differs drastically[3] from that of the standard BCS theory. For example the famous Hebel-Slichter peak is absent and the elementary excitations are no longer linear combinations of particles and holes but rather are superpositions of composite excitations. Our analysis here points a way forward in computing the superconducting properties of strongly correlated electron matter.

[1] E. Huang, G. La Nave, P. Phillips, Nat. Phys., 18,

pages511–516 (2022).

[2] PWP, L. Yeo, E. Huang, Nature Physics, 16, 1175-1180 (2020).

[3]J. Zhao, L. Yeo, E. Huang, PWP, PRB, Phys. Rev. B 105, 184509 (2022).

Biography

Professor Philip Phillips earned a bachelor's degree from Walla Walla College in 1979, and a Ph.D. from the University of Washington in 1982. Following a Miller Fellowship at Berkeley, he joined the faculty at MIT. Since 1993, he has been on the Physics faculty at the University of Illinois at Urbana-Champaign. Among other honors, Professor Phillips is a Fellow of the American Physical Society and of the American Association for the Advancement of Science. Much of his research has focused on developing theoretical approaches to explain experimental observations that challenge standard paradigms of electronic and magnetic behavior in systems which exhibit strong interactions, disorder, and/or proximity to quantum critical points.