PHYSICS DEPARTMENT COLLOQUIUM

"*Inhomogeneous Superconducting States at High Magnetic Fields: An Experimental Overview*"

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Exploring the matter at high magnetic fields has contributed to shape our understanding of the collective behavior of electrons. Interactions among electrons can lead to a macroscopic quantum state in which the electrons are paired. The main property of this state is to conduct electricity without dissipation. Metallic systems which exhibit it are known as superconductors. I will start by reviewing our current understanding of this phenomenon.

The question that has been central for over 40 years is how superconductivity can survive at high magnetic fields. One possibility is via the formation of inhomogeneous states. I will illustrate this on two examples of unconventional superconductors. The first is the vortex state of high-T_c cuprates. I will discuss recent Nernst Effect measurements in underdoped cuprates in an attempt to establish a connection between vortices and the anomalous properties of the metallic state. The second example is the "Fulde-Ferrell-Larkin-Ovchnnikov"(FFLO) state, which appears as a consequence of finite momentum pairing. Its experimental observation has proved difficult despite significant efforts. I will review experiments suggesting that the FFLO state is realized in a recently discovered heavy fermion superconductor.

Understanding these inhomogeneous states at high magnetic fields is crucial for the technological applications of superconducting materials, and also has relevance to other fields in physics, ranging from astrophysics to atomic and high energy physics.

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