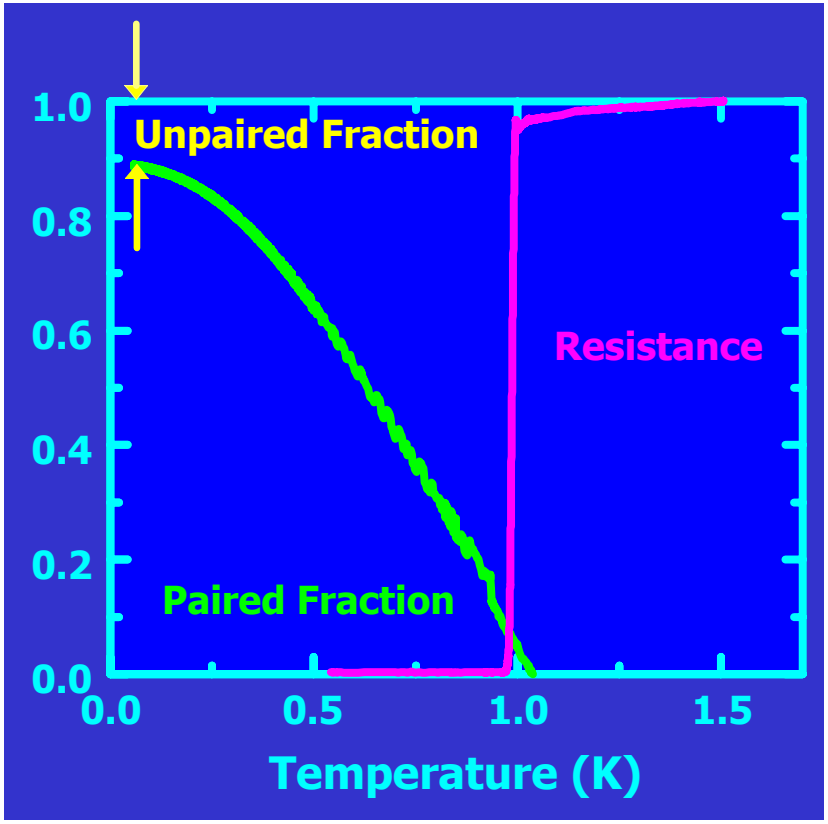
Quantum Phase Transitions in Nanostructured Superconductors in Two-Dimensions

James M. Valles, Jr., *Brown University*, DMR-0203608

At low temperatures, the resistance of some conductors abruptly drops to zero signaling their transformation from a *metal* into a *superconducting* phase. All of the metal's current carrying electrons form pairs that can flow without energy dissipation. Recently, an exotic hybrid phase with zero resistance but incomplete electron pairing has been predicted. This hybrid should only appear in materials with nanometer scale structure.

Valles' research on nano-composites of silver (metal) and lead (superconductor) at ultralow temperatures hint at such an exotic phase. The data reveal a phase with zero resistance and a large unpaired fraction of electrons.



Properties of a 4 nm Pb, 16 nm Ag granular bilayer

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Education:

Three graduate students (Zhenyi Long, Taejoon Kouh and Michael Stewart), contributed to this work. Taejoon Kouh earned a PhD in 2002 and is currently a postdoc at Boston University.

Outreach:

The PI has made presentations to elementary school age children at the Providence Children's Museum. These have highlighted the magic and explanations behind static electricity. The lightening from the Van de Graaf generator is always a hit.