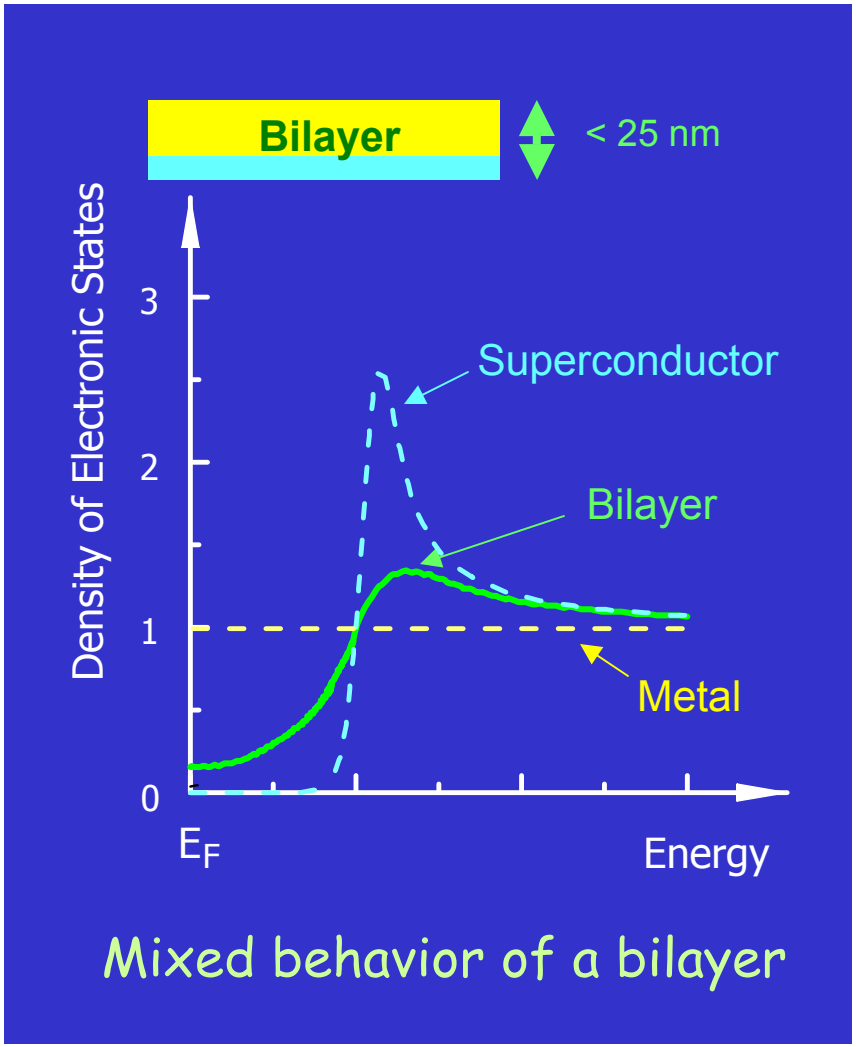
Quantum Phase Transitions in Nanostructured Superconductors in Two-Dimensions

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

Electrons in materials assume a variety of different phases including insulating, metallic, superconducting and magnetic. Some of the new, technologically promising materials (e.g. high Tc superconductors) exhibit a combination of the properties of the familiar phases. Phases seem to mix and compete!

Valles' group creates nanometer scale composites of simple superconductors and metals to explore such effects. Bilayers of Pb and Ag thinner than 25 nm, for example, exhibit zero resistance, like a superconductor, but their density of electronic states near E_F, the Fermi energy, has both metal and superconductor qualities. Resolving the origin of these "mixed" phenomena in this simple system can provide insight into the behavior of the more complex materials systems.



Mixed behavior of a bilayer

Quantum Phase Transitions in Nanostructured Superconductors in Two-Dimensions

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

Education:

Three graduate students (Zhenyi Long, Taejoon Kouh and Michael Stewart), and an undergraduate REU student (Niravun Pavenayotin) contributed to this work. Taejoon Kouh earned his 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 presentations highlighted the magic and explanations behind static electricity. The lightening from the Van de Graaf generator is always a hit.