

***Tufts University***  
***Physics and Astronomy Colloquium***

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**“Unsolved Mysteries: Electron  
Pairing in High Temperature  
Superconductors”**

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The electron-electron interaction is normally repulsive. In some materials at low temperatures, this repulsive force is defeated and electrons feel an attractive force that binds them into pairs. It is the formation of these pairs that creates a zero resistance material: a superconductor. We now know that the miracle glue that binds electrons into pairs in conventional superconductors is phonons. But after two decades of intense research on *high-temperature (high- $T_c$ ) superconductors*, there is no consensus on the basic question: what is the mechanism that causes electron pairing? The ‘high- $T_c$  problem’ remains one of the most important outstanding problems in condensed matter physics today. Even as we explore the possibility that pairing in these unconventional superconductors proceeds without the involvement of a bosonic glue, we have recently made exciting progress in identifying candidates that could potentially mediate pairing. I will present low temperature scanning tunneling microscopy data on the high- $T_c$  superconductor  $\text{Pr}_{0.88}\text{LaCe}_{0.12}\text{CuO}_4$  (PLCCO) where we have discovered a bosonic mode at energies of  $10.5 \pm 2.5$  meV. I will discuss the possible origins of this mode and its implications for the pairing mechanism of the high- $T_c$  superconductors.

***Friday***  
***December 5, 2008***  
***3:00 PM***  
***Anderson 206***

***Refreshments at 2:30 PM in Knipp Library, Robinson 251***