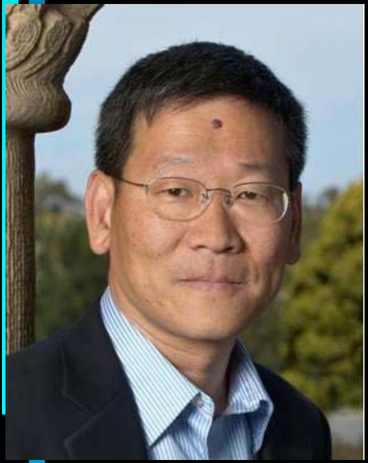
# CU Physics Department Colloquium

**Monday, May 7th, 2012 4:10 PM 428 Pupin Hall**

## "Bridging the Gap in High Temperature Superconductor"

It is now over 100 years since superconductivity was discovered and it took 45 years before a complete theory was formulated by Bardeen-Cooper-Schrieffer. Once understood, the impact has been felt far behind superconductivity itself, and superconductivity became a prime example of emerging properties in quantum system. High-Tc superconductivity in cuprate oxides was discovered 25 years ago and it remains a major unsolved physics problem today. The challenge of the cuprate research is symbolized by its complex phase diagram consists of intertwined states with extreme and unconventional properties in addition to unconventional superconductivity – such as Mott Hubbard insulating state, the peculiar pseudogap state, and so-called strange metal state. None of them are understood by conventional theory, thus compounding the difficulty to understand high-Tc superconductivity itself as these states are different manifestations of the same underlying physical system, making an integrated understanding a necessity.

Angle-resolved photoemission spectroscopy (ARPES) has emerged as a leading experimental tool to address this problem. Over the last two decades, substantial progress towards understanding the cuprate problem has been made in concert with breathtaking progresses in ARPES technique.



In this talk, I will use ARPES derived energy gap as a bridge to link the relationship between the different parts of the phase diagram, with focus on the complex relationship between pseudogap state and superconductivity. The result points to a trisected superconducting dome with interweaving states. In particular, our data is consistent with the presence of a quantum critical point, accompanied by strong dynamic competition between superconductivity and pseudogap state nearby. Such phase competition will likely emerge as a key signature of high-Tc physics, and suggests a revised phase diagram for cuprates that reconciles two conflicting versions currently used in the field.

**Zhi-Xun Shen, Stanford University**