# TT 27 Symposium Twenty Years High-$T_c$ Cuprates - Recent Progress

Time: Thursday 09:30–13:00 Room: HSZ 02

## Invited Talk

TT 27.1 Thu 09:30 HSZ 02

**Vorticity in the phase diagram of cuprates: evidence from Nernst effect and torque magnetometry** — •N. P. Ong — Department of Physics, Princeton University, Princeton, New Jersey 08544, U.S.A.

A key question in cuprates is whether the critical transition at $T_c$ corresponds to the BCS gap-closing scenario or the loss of long-range phase coherence. The observation in LSCO of a large Nernst signal that extends from above the $T_c$ "dome" to a temperature $T_{onset}$ with a peak value of 130 K has provided strong evidence for the phase-disordering scenario[1]. The vortex-Nernst signal implies that the pair condensate remains finite above $T_c$. Similar evidence for a large vortex Nernst signal has been reported in the hole-doped cuprates Bi 2201, Bi 2212, Bi 2223, YBCO, but not in the electron-doped cuprate NdCeCuO. The existence of vorticity in turn implies that significant 2D diamagnetism must exist above $T_c$. Recently, the diamagnetic signal has been confirmed using torque magnetometry. The signal remains robust in fields up to 45 T and scales closely with the vortex-Nernst signal over a broad range of $T$. I will review the evidence and discuss implications for the phase diagram and the pseudogap state.

1. Yayu Wang, Lu Li and N. P. Ong, cond-mat/0510470.

## Invited Talk

TT 27.2 Thu 10:00 HSZ 02

**Recent Photoemission Data from Layered Manganites and Cuprates** — •Zhi-xun Shen — Department of Physics, Applied Physics and Stanford Synchrotron Radiation Laboratory, Stanford University

We present recent angle-resolved photoemission data from manganites and cuprates. Despite the difference in their ground state properties, superconductivity versus ferromagnetism, these materials exhibit interesting similarity in their electronic structure. In particular, the pseudogap state in deeply underdoped curpates finds a counterpart in manganites. We will also report recent data from a new cuprate with four CuO$_2$ planes per unit cell, where we discovered a strong Fermi surface dependence of the superconducting gap.

## Keynote Talk

TT 27.3 Thu 10:30 HSZ 02

**"Kinks", Nodal Bilayer Splitting and Interband Scattering in YBCO** — •Sergey Borisenko — IFW Dresden, Institute for Solid State Research, P.O.Box 270116, D-01171 Dresden

We apply the new-generation ARPES methodology to the most widely studied cuprate superconductor YBCO. Considering the nodal direction, we found noticeable renormalization effects known as "kinks" both in the quasiparticle dispersion and scattering rate, the bilayer splitting and evidence for strong interband scattering - all the characteristic features of the nodal quasiparticles detected earlier in BSCCO. Typical energy scale and the doping dependence of the "kinks" clearly point to their intimate relation with the spin-1 resonance seen in the neutron scattering experiments performed on the same samples. Our findings strongly suggest a universality of the electron dynamics in the bilayer superconducting cuprates and a dominating role of the spin-fluctuations in formation of the quasiparticles along the nodal direction.

This work is supported by the Deutsche Forschungsgemeinschaft (Research unit 538).

**— 30 min. break —**

## Keynote Talk

TT 27.4 Thu 11:30 HSZ 02

**Universal magnetic spectrum in high-temperature superconductors** — •Bernhard Keimer — Max-Planck-Institut für Festkörperforschung, 70569 Stuttgart

We outline recent experimental evidence for a magnetic excitation spectrum of the cuprate high-temperature superconductors whose main features are independent of materials-specific details. The spectrum consists of upward- and downward-dispersing branches that merge at the wave vector characteristic of antiferromagnetism in the undoped parent compounds. We will argue that information about the in-plane anisotropy of the spectrum is crucial for its microscopic interpretation. In order to determine this anisotropy, we have use neutron scattering to collect an extensive data set on untwinned $YBa_2Cu_3O_{6+x}$ single crystals with different doping levels x. The results will be compared to calculations based on Fermi-liquid states and states with static and dynamic "stripe" order. Combined with complementary photoemission data on the same single samples, these data provide a detailed, microscopic picture of the interaction between spin and charge excitations in the copper oxide superconductors.

Collaborators: V. Hinkov, S. Pailhès, P. Bourges, Y. Sidis, A. Ivanov, A. Kulakov, C.T. Lin, D.P. Chen, C. Bernhard

This work is supported by the Deutsche Forschungsgemeinschaft (Research unit 538).

Recent publications: B. Keimer, Nature 430, 650 (2004); S. Pailhès, Y. Sidis, P. Bourges, V. Hinkov, A. Ivanov, C. Ulrich, L.P. Regnault, and B. Keimer, Phys. Rev. Lett. 93, 167001 (2004).

## Keynote Talk

TT 27.5 Thu 12:00 HSZ 02

**Spin-fluctuation mechanism of high-temperature superconductivity** — •Andrey Chubukov — Physics, UW-Madison, 1150 University ave, Madison, WI 53706, USA

I will review the spin-fluctuation approach to high-temperature superconductivity. The key idea behind the approach is to depart from relatively high dopings, where fermions form Landau Fermi liquid, and consider how the 2D system behavior evolves as the system approaches an antiferromagnetic instability. I show that in the normal state, spin fluctuations are overdamped. The interaction with overdamped spin fluctuations gives rise to the fermionic self-energy which mimics marginal Fermi-liquid behavior over a wide range of frequencies. I next consider the pairing and show that there exists two regimes on the phase diagram: the low-T regime, in which the pairing involves Fermi-liquid quasiparticles, and the high -T regime, in which the pairing involves incoherent fermions. I argue that Fermi-liquid pairing leads to a $d-$wave superconductivity, while the pairing of incoherent fermions produces spin-singlet pairs, which still remain incoherent and do not carry a supercurrent. I discuss various feedbacks from the pairing on both electronic and magnetic properties (including the emergence of the resonance peak), and link spin-fluctuation approach to theories that depart from a Mott insulator at half-filling.

## Keynote Talk

TT 27.6 Thu 12:30 HSZ 02

**The origin of anomalous transport in a high-temperature superconductor** — •Nigel Hussey — H. H. Wills Physics Laboratory, University of Bristol, Tyndall Avenue, Bristol, UK

The metallic state of high-temperature superconductors is anomalous in that the Hall coefficient is strongly temperature dependent while the resistivity varies linearly in temperature over a wide temperature range. Although this $T$-linear resistivity gradually weakens with doping, crucially it survives until superconductivity is destroyed. Both the superconducting pairing interaction and the origin of this anomalous transport have yet to be determined, though most theoretical approaches consider them to be intrinsically linked. Through analysis of polar angular magnetoresistance oscillations, we have succeeded to determine the full temperature and momentum dependence of the mean free path of the charge carriers in highly doped $Tl_2$ $Ba_2$ $CuO_{6+\delta}$ ($T_c$ = 15K) up to 60K. From this, we have been able to identify the origin of the $T$-linear resistivity and the temperature dependence of the Hall coefficient for this particular compound. Given the correlation between the appearance of the $T$-linear resistivity and the onset of superconductivity, this new scattering mechanism is also a prime candidate for the pairing mechanism for high temperature superconductivity itself.