MAR12-2011-001992

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Novel Magnetism in the Pseudogap Phase of the Cuprates[1]

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Magnetic correlations might cause the superconductivity in the cuprates and are generally believed to be antiferromagnetic. Following our success in growing sizable crystals of the tetragonal compound $HgBa_2CuO_{4+\delta}$ [1], we used polarized neutron diffraction to demonstrate that the unusual magnetic order previously observed in $YBa_2Cu_3O_{6+\delta}$ [2] is a universal property of the pseudogap phase [3]. Subsequent inelastic neutron scattering experiments revealed several accompanying, weakly-dispersive magnetic excitation branches in $HgBa_2CuO_{4+\delta}$ [4]. Unlike antiferromagnetism, the novel magnetic order does not break the lattice translational symmetry. Nevertheless, the excitations mix with conventional antiferromagnetic fluctuations. Our results point toward the need for a multi-band description of the cuprates, and they are consistent with the notion that the phase diagram is controlled by an underlying quantum critical point [5]. The neutron scattering results will be discussed together with new dc resistivity data for the pseudogap phase of $HgBa_2CuO_{4+\delta}$ [6].

[1] X. Zhao *et al.*, Adv. Mat. **18**, 3243 (2006).
[2] B. Fauque *et al.*, Phys. Rev. Lett. **96**, 197001 (2006).
[3] Y. Li *et al.*, Nature **455**, 372 (2008).
[4] Y. Li *et al.*, Nature **468**, 283 (2010), and unpublished results.
[5] C. Varma, Nature **468**, 184 (2010).
[6] N. Barisic *et al.*, unpublished results.

[1]Work supported by DOE BES.