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Quantum magnetic excitations from stripes in copper-oxide superconductors[1]

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Recent inelastic neutron scattering studies show that the magnetic excitation spectra of two well-studied families of cuprate superconductors are much more similar than previously believed. In particular, I will present results we have obtained on $La_{2-x}Ba_xCuO_4$ (LBCO) with x= 0.125 [1,2]. Using very large single crystals grown at Brookhaven, we were able to measure the magnetic excitations up to 200 meV using the MAPS time-of-flight spectrometer at the ISIS spallation source. While the lowest energy excitations are split incommensurately, these disperse inwards towards the antiferromagnetic wave vector with increasing energy, merging at ∼50 meV. At higher energies the excitations disperse outwards again. There is a significant enhancement of the **Q**-integrated magnetic scattering near ∼50 meV compared to lower energies, suggestive of quantum correlations and distinct from spin-wave predictions. Many features of the spectrum are quite similar to those found in $YBa_2Cu_3O_{6.6}$ [3]. One can qualitatively characterize the results with a universal excitation spectrum, together with a material-dependent spin gap in the superconducting state. It is important to note that the LBCO sample exhibits static stripe order [2], as this has significant implications for the origin of the magnetic excitations in superconducting cuprates.

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