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Evidence for Intertwining of Superconductivity and Antiferromagnetism in a Cuprate[1] JOHN TRANQUADA, ZHIJUN XU, BNL, C. STOCK, S.X. CHI, NCNR, A.I. KOLESNIKOV, ORNL, G.Y. XU, G.D. GU, BNL — We have used inelastic neutron scattering to measure the low-energy, incommensurate antiferromagnetic spin excitations both above and below the superconducting transition temperature ($T_c = 32$ K) of $La_{1.905}Ba_{0.095}CuO_4$ [1]. While the magnetic excitations in optimally-doped cuprates typically show the development of a spin gap and magnetic resonance below T_c, our sample shows no such effect. Instead strong, gapless spin excitations coexist with bulk superconductivity. To understand this, we note that previous transport measurements have shown that the superconducting layers are decoupled by a magnetic field applied along the c-axis, resulting in a state with frustrated interlayer Josephson coupling, similar to LBCO with $x = 1/8$, where it has been proposed that pair-density-wave superconductivity occurs. This suggests that, in a similar fashion, the spatially modulated antiferromagnetic correlations (which we see directly in the $x = 0.095$ sample) are intertwined with a spatially modulated superconducting pair wave function.

[1] Z. J. Xu *et al.*, arXiv:1309.2718.

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