Superconducting plasma edge along the $c$ axis in $\text{La}_{2-x}\text{Ba}_x\text{CuO}_4$\textsuperscript{1}

C. C. HOMES, M. HÜCKER, JINSHENG WEN, ZHIJUN XU, G. D. GU, J. M. TRANQUADA, Condensed Matter Physics and Materials Science Dept., Brookhaven National Laboratory, Upton, NY — The optical properties of $\text{La}_{2-x}\text{Ba}_x\text{CuO}_4$ (LBCO) have been measured for a number of temperatures over a wide frequency range along the poorly-conducting $c$ axis for the $x = 0.095, 0.125$ and $0.155$ Ba concentrations. In slightly underdoped LBCO ($x = 0.095, T_c \simeq 32$ K), a sharp plasma edge is observed in the reflectance at low frequency below $T_c$; this plasma edge is associated with Josephson coupling of the copper-oxygen planes and the formation of a bulk three-dimensional superconducting state. A plasma edge is also observed in the more heavily-doped material ($x = 0.155, T_c \simeq 32$ K) below $T_c$ at higher frequency; however, it is significantly broader in character. Interestingly, for the $x = 1/8$ doping, static charge and spin stripe order develop at $54$ and $42$ K, respectively; the superconducting transition is strongly suppressed ($T_c \simeq 3$ K) and the plasma edge is not observed. The failure to observe a plasma edge for this doping is consistent with the recently proposed view that the layers are decoupled due to the formation of spin stripes, blocking the formation of a coherent three-dimensional superconducting state.

\textsuperscript{1}This work was supported by the DOE under contract number DE-AC02-98CH10886.

Christopher Homes
Brookhaven National Laboratory

Date submitted: 27 Nov 2007

Electronic form version 1.4