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Precise determination of the superconducting gap along the diagonal direction of $Bi_2Sr_2CaCu_2O_{8+y}$: Evidence for extended s-wave gap symmetry GUO-MENG ZHAO, Department of Physics and Astronomy, CSULA — We have analyzed the data of electron self-energy along the diagonal ($\Gamma - Y$) direction for a nonsuperconducting $La_{1.97}Sr_{0.03}CuO_4$ (LSCO) crystal and a superconducting $Bi_2Sr_2CaCu_2O_{8+y}$ (BSCCO) crystal with $T_c = 91$ K. The high-resolution spectra of the second derivative of electron self-energy show clear peak features associated with the phonon modes strongly coupled to electrons. By precisely matching the phonon structures of the superconducting BSCCO with those of nonsuperconducting LSCO, we accurately determine the diagonal superconducting gap to be 9 ± 1 meV for the BSCCO. The substantial non-zero diagonal gap observed in the optimally doped cuprate definitively rules out seemingly well accepted d-wave gap symmetry and strongly supports an extended s-wave gap symmetry with eight line nodes.

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