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Evidence for two energy scales in the superconducting state of optimally doped (Bi,Pb)$_2$(Sr,La)$_2$CuO$_{6+\delta}$ TAKESHI KONDO, TSUNEHIRO TAKEUCHI, SYUNSUKE TSUDA, SHIK SHIN, ADAM KAMINSKI, Ames Lab. and Dept. of Physics and Astronomy, Iowa State University — We use angle-resolved photoemission spectroscopy (ARPES) to investigate the properties of energy gap(s) in the optimally doped (Bi,Pb)$_2$(Sr,La)$_2$CuO$_{6+\delta}$ (Bi2201). We find significant differences in the momentum- and temperature- dependence of the pseudogap and supercondcuting gap suggesting that these gaps have two separate energy scales. The ARPES spectra slightly off the node have a sharp peak with a small gap below T_c, which closes at T_c. Around the antinode, the broad spectra with a large energy gap of $\sim$40meV are observed above and below T_c. The spectral shape and the gap size around the antinod are almost unchanged across T_c, indicating that the pseudogap state coexists with superconducting state below T_c, and it dominates the character of ARPES spectra around antinode. We speculate that the pseudogap state competes with superconductivity by diminishing spectral weight in the superconducting antinode.

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