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Strongly momentum dependent electron-phonon coupling in high temperature superconductors TANJA CUK, FELIX BAUMBERGER, DONGHUI LU, NIK INGLE, XING-JIANG ZHOU, HIROSHI EISAKI, NOBUHISA KANEKO, ZAHID HUSSAIN, THOMAS DEVEREAUX, NAOTO NAGAOSA, ZHI-XUN SHEN — Early results on the electron-phonon coupling constant extracted from momentum averaged experiments on the cuprates suggest small values ($\sim$ 0.1). Recent angle resolved photoemission (ARPES) experiments reveal that electron-phonon coupling in the cuprates has pronounced momentum dependence. We explore manifestations of electron-phonon coupling in the ARPES data for two phonon modes that show renormalizations in Raman spectroscopy and neutron scattering. We find that the out-of-plane, out-of-phase O buckling mode $\sim$ 35meV (B_{1g}) involves small momentum transfers and couples strongly to electronic states near the anti-node while the in-plane $\sim$ 70meV Cu-O breathing modes involve large momentum transfers and couple strongly to nodal electronic states. A calculation based on Eliashberg theory, simple symmetry considerations, and kinematic constraints has for the first time described the mode-coupling behavior throughout the brillouin zone in both normal and superconducting states for optimally doped $Bi_2Sr_2Ca_{0.92}Y_{0.08}Cu_2O_{8+delta}$. The data are consistent with a lambda $\sim$ 3 at the maximum of the d-wave gap, but a momentum averaged lambda $\sim$ 0.2. These results suggest that a momentum-sensitive probe is a necessary component for determining coupling constants in the cuprates.

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