Far-infrared and submillimeter-wave conductivity in electron-doped cuprate
La$_{2-x}$Ce$_x$CuO$_4$

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We performed far-infrared and submillimeter-wave spectroscopy in the electron-doped cuprates La$_{2-x}$Ce$_x$CuO$_4$. The onset of the absorption in the superconducting state appears gradual in frequency and is inconsistent with a BCS gap. Instead, a narrow quasiparticle peak is observed at zero frequency and a second peak at finite frequencies. The infrared conductivity as well as the suppression of the quasiparticle scattering rate below $T_c$ are qualitatively similar to the results in the hole-doped cuprates.

In addition, the conductivity has been investigated for La$_{2-x}$Ce$_x$CuO$_4$ films tilted 1° off from the ab-plane. The effective conductivity measured in this geometry reveals an intensive peak at finite frequency ($\nu \sim 50$ cm$^{-1}$) even in the normal state, which is due to a mixing of the in-plane and out-of-plane responses. The peak disappears for the pure in-plane response transforming into a Drude-like contribution. Comparative analysis of the mixed and the in-plane contributions allows to extract the c-axis conductivity which shows a Josephson plasma resonance in the superconducting state.