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The infrared conductivity of Na_xCoO_2 : evidence of gapped states¹

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We present infrared ab-plane conductivity data for the layered cobaltate Na_xCoO_2 for $x = 0.25, 0.30, 0.50$, and 0.75 . The Drude weight increases monotonically with hole doping, $1 - x$. At the lowest hole doping level 0.75 the system resembles the normal state of underdoped cuprate superconductors with a scattering rate that varies linearly with frequency and temperature and there is an onset of scattering by a bosonic mode at 600 cm^{-1} . The hole doping level of $x = 0.30$ sample shows a metallic behavior and a bosonic mode with a similar onset frequency as $x = 0.75$. Doping to both $x = 0.50$ and 0.25 causes a gap to develop in the optical conductivity at low temperatures and the material becomes an insulator. The spectral weight lost in the gap region is shifted to a prominent peak. We propose that the two gapped states of $x = 0.50$ and 0.25 are pinned charge ordered states.

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