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Low-frequency optics on Sr_(1–x)Ca_(x)RuO_(3)

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The pseudo-cubic perovskite ruthenates SrRuO_(3) and CaRuO_(3) have recently attracted interest due to their unconventional electronic properties. For both materials, non-Fermi liquid behavior has been reported in previous optical studies at infrared frequencies. In addition to these two pure compounds, the doping series Sr_(1–x)Ca_(x)RuO_(3) offers a rich phase diagram: going from the itinerant ferromagnet SrRuO_(3) to the paramagnet CaRuO_(3), there are indications for a quantum phase transition at x approximately 0.8.

Using low-frequency optical spectroscopy, we have studied Sr_(1–x)Ca_(x)RuO_(3) thin-film samples of very high quality, which were prepared by metalorganic aerosol deposition. In order to be sensitive to the small energy scales expected close to the quantum phase transition, we address the THz and GHz frequency ranges at temperatures down to 2 K. We present optical data, in particular the frequency-dependent conductivity, and discuss it in the framework of the extended Drude model with frequency-dependent relaxation rates and effective masses. While for pure SrRuO_(3) as well as for doped systems (approaching the quantum phase transition) we find conventional metallic Drude behavior at frequencies below 1 THz, CaRuO_(3) exhibits highly unusual optical properties: the relaxation rate increases strongly with frequency. We compare the optical data to dc measurements and discuss them with respect to the temperature ranges with non-Fermi liquid behavior.

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