Abstract Submitted
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Origins of bad metal conductivity and the insulator-metal transition in the rare-earth nickelates ($R\mathbf{NiO}_3$, R = rare earth) RAFAEL JARAMILLO, MIT, SIEU HA, Harvard University, DANIEL SILEVITCH, The University of Chicago, SHRIRAM RAMANATHAN, Harvard University — For most metals increasing temperature (T) or disorder quickens electron scattering. This scattering time hypothesis informs the Drude model of electronic conductivity. However, for so-called bad metals with very low conductivity this hypothesis predicts scattering times so short as to conflict with Heisenberg's uncertainty principle. Bad metal conductivity has remained a puzzle since its discovery in the 1980s in high T superconductors. Here we introduce the rare-earth nickelates ($R\mathrm{NiO}_3$, R = rare earth) as a class of bad metals. We study SmNiO_3 thin films using infrared (IR) spectroscopy while varying T and disorder. We show that the interaction between lattice distortions and Ni-O bond covalence explains both the bad metal conductivity and the insulator-metal transition (IMT) in the nickelates. It does so by shifting spectral weight over the large energy scale established by the Ni-O orbital interaction, thus enabling very low conductivity while preserving the Drude model and without violating the uncertainty principle.

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