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Tunneling, charge spreading, and the infrared catastrophe in conductors KELLY PATTON, MICHAEL GELLER, The University of Georgia — In many strongly correlated and low-dimensional electron systems the tunneling density of states (DOS) is suppressed near the Fermi energy; for example, the Luttinger-liquid characterization of one-dimensional conductors predicts that the DOS vanishes as a power law. Here we establish a connection between these DOS anomalies and the infrared catastrophe. The infrared catastrophe can occur during a tunneling event in systems where the relaxation of the newly introduced charge is inhibited by low dimensionality or other localizing effects. This catastrophe is known to be responsible for the x-ray edge spectra of metals, the Anderson orthogonality catastrophe, and the Kondo effect. By expressing the exact Green's function as a functional average of non-interacting Green's functions over of all space and time dependent potentials, we can appropriately treat the potentials responsible for the infrared catastrophe. The resulting interacting Green's function is the product of the noninteracting Green's function and e^{-S}, where S is interpreted as a classical electrostatic action of a charge density spreading in time. These results give justification to other previously introduced phenomenological charge spreading theories. We apply this formalism to the Tomonaga-Luttinger, Calogero-Sutherland and other models.

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