Conductivity Measure for Lattice Fermions from the Second Law of Thermodynamics

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Abstract: The concept of conductivity measure has been introduced for the first time by Klein, Lenoble and Müller for non-interacting lattice fermions in presence of disorder. We show how such measures can be obtained from the second law of thermodynamics, which says that systems in the equilibrium are unable to perform mechanical work in cyclic processes. Our approach can be applied to fermions with short range interactions and in presence of disorder. We prove, moreover, that the conductivity measure is the Fourier transform of a time-correlation function of current fluctuations, i.e., it satisfies Green-Kubo relations.