Memory Function Representation for the Electrical Conductivity of Solids

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We derive an approximate expression for the electrical conductivity of solids that includes relaxation, dissipation, and quantum coherence effects. The derivation is based on the Kubo expression with a Mori memory function approach to include dissipation effects at all orders relaxation interaction. The expression obtained provides a clear understanding of the evolution of the Drude peak and the broadening of optical transitions for all possible perturbation strength. At the same time offers a practical form of evaluating this important transport coefficient with electronic-structure codes without the complications and limitations of supercell calculations or assumptions about the lost of coherence.