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Electrical conductivity in disordered spin-dependent media: application to diluted magnetic semiconductors[1] FEDIR KYRYCHENKO, CARSTEN ULLRICH, Department of Physics and Astronomy, University of Missouri-Columbia — Most theoretical calculations of the electrical conductivity and optical response in diluted magnetic semiconductors (DMSs) treat disorder in relaxation time approximation, using phenomenological relaxation times. However, the role of disorder in III-V DMS materials, particularly the non-trivial effects of spin-dependent scattering from magnetic impurities, requires more careful consideration. In this work we go beyond the relaxation time approximation and derive the electrical conductivity in spin-dependent disordered systems based on the equation of motion for the paramagnetic current-current response function. The general expression relates the full current response function to the set of full system spin-density response functions and is valid for any strength of disorder. We present numerical results for conductivities and dielectric functions in the weak disorder limit, treating carriers with a simple parabolic band model and electron interactions within RPA. For various system parameters we study the relative importance of Coulomb and spin-dependent scattering processes. Special attention is paid to the effects of spatially correlated versus random scattering centers.

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