

Dottorato di Ricerca in Fisica dell'Università degli Studi di Messina
23 Giugno 2011, ore 15.00, Aula E. Majorana, Dip.to di Fisica,
V.le F. Stagno d'Alcontres 31, S. Agata, Messina

Electrical conductivity and charge diffusion in disordered solids

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Electrical resistivity (Ohm's law) in solids is caused by the scattering of almost free conduction electrons on impurities and irregularities in the periodic lattice. The basic theoretical tools for description of quantum transport are linear response theory and Kubo formulas. We review in this talk many-body and Green function methods of calculation of the impact of scatterings of electrons on randomly distributed impurities in metals. We stress the necessity of renormalizations of the perturbation expansion in the strength of the impurity potential and of consistency between one- and two-electron Green functions dictated by conservation laws, electron-hole symmetry and gauge invariance of the electromagnetic system. Finally we discuss disorder-driven metal-insulator transitions due to discharging of the Fermi energy and due to vanishing of diffusion in the limit of strong randomness.