

Fluctuation phenomena in mesoscopic conductors

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Recent experiments on shot noise in diffusive mesoscopic conductors are presented. After discussion of the significance of current noise as a probe of non-equilibrium states in mesoscopic structures, special emphasis is put on superconductor(S)/normal(N) metal hybrid structures. We observe the signatures of multiple Andreev reflection in the differential conductance of relatively long Cu wires between Al reservoirs. The noise measurements reveal that multiple Andreev reflections at the SN-interfaces lead to a pronounced broadening of the quasiparticle distribution function, even at very small applied voltages V . This broadening corresponds to finite shot noise. When the energy gap Δ of the superconductor greatly exceeds the applied voltage, many Andreev reflections are required to transfer quasiparticles between the reservoirs. Each incident quasiparticle leads to an avalanche of Andreev reflections, transferring a bunch of charge $q^* \approx 2ne = 2\Delta/V$, where n is the number of Andreev reflections. If the inelastic scattering is weak, noise corresponding to charge avalanches with n up to ≈ 50 can be observed. If the inelastic scattering is important, it reduces the nonequilibrium noise by narrowing the quasiparticle distribution function. This is verified on measurements on Nb/Au samples.