

# Transport in nanostructures: recent developments\*

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The recent work on the transport through nanostructures will be discussed. It turns out that such structures very often directly serve as monitoring and/or controlling devices. I will focus on quantum dots, which are small islands containing finite number of charges. If connected to external electrodes, they have been proposed as building blocks of single electron transistors [1], quantum bits or registers of future computers [2] working according to quantum logic, as efficient factories of entangled states [3], precise ampere (current) meters [4] or potentially efficient energy conversion instruments [5]. Because their small size, the charging energy in considered structures is large and gives rise to many interesting phenomena. In this context I will discuss the Kondo effect [6], appearing in quantum dots weakly coupled to external electrodes at low temperatures and its effect on the conductance of the system, its thermopower and other transport coefficients. The important goal of recent studies is to use the electron spin instead of charge in modern electronic devices. For the realization of electronics with spins (called spintronics) the precise control and efficient monitoring of spins is necessary [7]. Two ways of achieving the goal will be briefly discussed. One is the control of nuclear spin embedded in two dimensional electron gas with help of strong magnetic field [8], the other by electric field in the presence of spin – orbit coupling *via* so called spin Hall effect [9].

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