Electronic transport through nanostructures

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Charge transport in conductors confined in at least one dimension (e.g. a "nanostructure") follows greatly altered physics compared to their bulk analogues. Individual nanostructures exhibit an altered density of states and a large contribution of surface effects, which both greatly impact the transport properties. Furthermore, transport through ensembles of nanostructures is dominated by *inter*particle transport rather than the physics of the individual nanostructure. These modifications need to be taken into account when designing electronic devices with nanostructured materials.

In this context, quantum dot solids have been studied extensively, e.g. as transistors, light-emitting diodes (LEDs), scintillators, and photodetectors. I will briefly review the most relevant transport models for quantum dot solids and highlight their dependence on the key parameters coupling energy, charging energy and disorder. It will become apparent that quantum dot solids have undeniable advantages for LEDs, which have already led to commercialization, but struggle to be effective in GHz electronics, for instance as fast transistors or photodetectors. For such applications, two-dimensional nanostructures are often superior, since their macroscopic areas allow for devices composed of single nanostructures, which eliminates the deleterious effect of interparticle transport. I will highlight how these nanostructures can combine GHz-operation of electronic devices with quantum confinement properties, provided that surface and electrode interface effects can be mastered.