UNIVERSITÄT DUISBURG ESSEN

Offen im Denken

Theorie-Kolloquium SS 2021
Fr 16.07.2021, 12:00-13:30
Online (URL in E-Mail)

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Quantum Transport in Molecular Junctions

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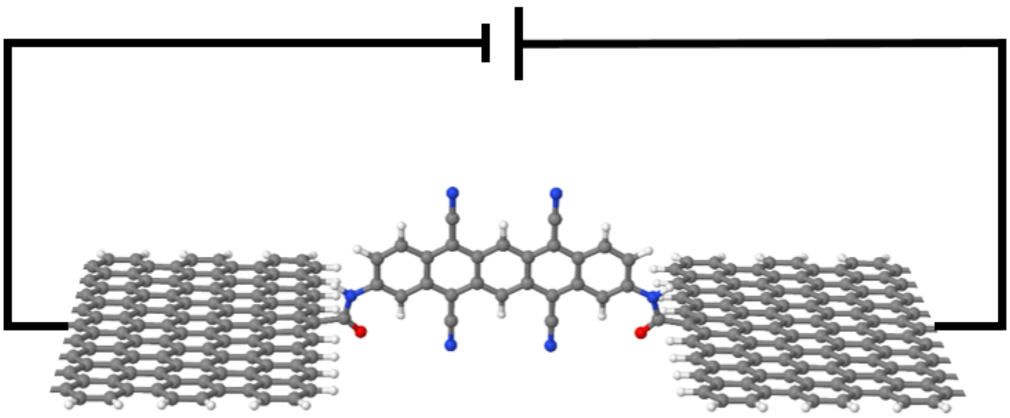

Quantum transport in nanostructures is of fundamental interest for studying non-equilibrium quantum physics at the nanoscale and holds potential for future applications in nanoelectronic devices. A versatile architecture to investigate quantum transport processes at the nanoscale is provided by molecular junctions. Consisting of a single molecule bound to electrodes, molecular junctions are among the smallest electrical circuits. Recent experimental and theoretical studies of molecular junctions have revealed a wealth of interesting transport phenomena.

In this talk, mechanisms that determine quantum transport at the molecular scale are discussed. This includes co-tunneling and resonant transport processes, quantum interference and decoherence as well as current fluctuations. Furthermore, the important role of electronic-vibrational interaction is analyzed, an aspect that distinguishes nanoscale molecular conductors from mesoscopic devices and is crucial for their mechanical stability. The theoretical studies employ a combination of first-principles based models and transport methods such as the hierarchical quantum master equation approach, which allows a numerically exact treatment of the many-body quantum transport problem.