Quantum Hamiltonian Computer
From theory to first experiments.

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Implementing logic gates using single molecules can be done in many different ways. The Quantum Hamiltonian Computer (QHC) approach proposes to take advantage of the quantum ressources of the system inducing non-local modifications of its electronic conduction using local perturbations of its Hamiltonian [1]. In this approach, the logical inputs of the gate are encoded in such local Hamiltonian modifications and the output signal in the tunnelling current passing through the molecule. To replace the combinatorial optimization strategy used previously, a symbolic analysis of the QHC response has been developped [1]. This symbolic analysis provides a pseudo-Boolean expression of the oscillation frequency between an initial and target state evolving through the system and leads to an easy implementation of any N-input M-output Boolean function. However, the oscillation frequency used to encode the logical output is not easy to read experimentally. We'll therefore show how this frequency is related to the electronic transmission coefficient and therefore can be measured in a STM experimental set up [2]. With this symbolic analysis and this reasonable experimental set up in hands we'll present the first experimental realisation of a QHC logic gate [3, 4] and propose new ones that should be realized soon to test the fiability of the QHC approach [5].

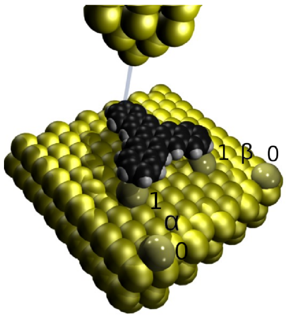

Figure 1: STM experimental set up of a QHC NOR logic gate where the logical inputs are encoded in the position of two surface atoms in the vicinity of the molecule. The positions of these atoms modifies the intensity of the tunnelling current going from the tip to the surface through the molecule and encodes for the logical output of the gate.

References

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