Quantum State Transfer and Routing via Resonant Tunnelling

Tony John George Apollaro[*]

[*] *Dip. Fisica, Universita' della Calabria, 87036 Arcavacata di Rende (CS), Italy*
INFN - Gruppo collegato di Cosenza

Centre for Theoretical Atomic, Molecular and Optical Physics,
School of Mathematics and Physics, Queens University, Belfast BT7 1NN, United Kingdom
`tony.apollaro@fis.unical.it`

Quantum-State Transfer (QST) is an important requisite in many Quantum Information Processing protocols. For short distance communication, interacting spin-1/2 chains as a means of data bus fulfilling faithful QST between a sender and a receiver qubit have been widely investigated and many different protocols have been proposed. In this talk we will review some of them and allow for the presence of multiple possible receiver. The aim is to design a protocol for high-fidelity QST to a selected receiver with minimal engineering needs. Two different schemes for such a task to be achieved are presented: in the first one, by weakly coupling the sender/receiver qubits to the data bus and allowing for local/global magnetic field intensity tuning, QST is achieved via resonant coupling; *in the second one, the sender/receivers are not directly coupled to the spin bus, but rather via effective 'barrier qubits', on which strong magnetic fields act as knobs for the QST, occuring via a resonant coupling mechanism that allows the spin excitation to tunnel towards the opposite end of the chain [1]. The latter scheme may also be useful for the transfer of an e-bit between the edges of an open spin chains by locating appropriately two barrier qubits on the spin chain [2].*

References

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