

Orbital Quantum Bits in Si Quantum Dots

Doyeol Ahn, J. H. Oh and S. W. Hwang

*Institute of Quantum Information Processing & Systems, University of Seoul
Seoul 130-743, Korea; +82-2-2210-2468 (Office)*

Current status of experimental and theoretical work on quantum bits based on the semiconductor quantum dots will be presented. A new proposal utilizing the multi-valley quantum state transitions in a Si quantum dot as a possible candidate for a quantum bit with a long decoherence time will be also given. Qubits are the multi-valley symmetric and anti-symmetric orbitals. Evolution of these orbitals is controlled by an external electric field, which turns on and off the inter-valley interactions. Initialization is achieved by turning on the inter-valley Hamiltonian to let the system settle down to the symmetric orbital state. Estimates of the decoherence time is made for the longitudinal acoustic phonon process. Elementary single-and two-qubit gates are also proposed.

* E-mail: dahn@uos.ac.kr; davidahn@hitel.net