

# Fixed-Phase Path Integral Monte Carlo Simulations of Quantum Dots in Magnetic Fields

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Magnetic fields couple to the trajectories and spins of electrons through the orbital and Zeeman terms. We have developed fixed-phase path integral techniques to treat both these effects in semiconductor nanostructures. We first demonstrate the method on spinless electrons in a 2-D parabolic dot in a magnetic field. The PIMC method allows us to extend the simulation to a realistic 3-D model of an InGaAs/GaAs lens-shaped self-assembled dot, so we can study the deviations from an idealized 2-D parabolic dot model. Our new technique for spin simulation represents a spinor with two of the four excited states of a four dimensional(4-D) harmonic oscillator. This formalism allows the spin degrees of freedom, exchange and Coulomb interactions to be calculated within one simulation at finite temperature.