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Nuclear Spin Induced Oscillatory Current in Spin Blockaded Quantum Dots

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Hyperfine interactions between electron and nuclear spins in quantum dots are subject to intensive studies from the viewpoints of quantum computing. In this talk I will review our recent experimental studies for a GaAs-based double quantum dots in the spin blockade regime where the electron conduction is mostly blocked by Pauli effect unless the electron spin state is changed [1]. Thus a small leakage current observed in the spin-blockaded double dot can be a sensitive measure not only for electron spin-flip events but also for a nuclear spin states in the dot if the spin-flip is mediated by hyperfine interactions. We have observed the leakage current shows time-dependent oscillations and is significantly diminished by application of an AC magnetic field whose frequency can induce nuclear magnetic resonance for 71Ga and 69Ga nuclei [2]. A possible nuclear spin polarization mechanism due to hyperfine flip-flop scattering is proposed. [1] K. Ono et al., Science, 297, 1313 (2002). [2] K. Ono et al., Phys. Rev. Lett 92, 256803 (2004). cond-mat/0309062.