Sonderforschungsbereich 631

Festkörperbasierte Quanteninformationsverarbeitung

TECHNISCHE UNIVERSITÄT MÜNCHEN

Special Seminar Announcement

Optical Investigation of Electron Spin Coherence and Electron-Nuclear Spin Interactions in Self-Assembled InGaAs/GaAs Quantum Dots

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The potential to use electron spin excitations in semiconductor quantum dots is gaining more popularity as a result of new studies that show electron spin lifetimes in QDs of milliseconds. However for the realization of a spin-qubit, the spin dephasing time must be equally long, in order to allow coherent manipulation of the spin state. We report on Faraday rotation measurements of electron spin coherence in n-modulation doped InGaAs/GaAs quantum dots which contain on average a single electron per dot. The coherence is monitored by probing the spin precession in a transverse magnetic field. By isolating optically the dots which cannot absorb circularly polarized light and allowing them to precess, a spin dephasing time of at least 10ns is observed at zero magnetic field, which is limited by precession about the fluctuating magnetic fields of the lattice nuclei in the dot ensemble. While a randomly polarized nuclear system leads to a partial loss of spin coherence, this may be reduced for a polarized nuclear system. We demonstrate the optical polarization of the QD nuclei using polarized resident electron spins in n-doped QDs. The absence of the electron-hole exchange interaction allows us to demonstrate nuclear polarization even at zero applied magnetic field. We report nuclear spin polarization lifetimes of over 10ms, demonstrating that the effective magnetic field of the electron allows the hyperfine interaction to overcome nuclear dipole-dipole dephasing mechanisms, giving rise to an ultra-stable electron-nuclear system.

Friday 30th September at 13:15 WSI Seminarraum (S101)