

# Phonon-induced Pure Dephasing of Singlet-Triplet Superpositions in Double Quantum Dots

**Paweł Machnikowski and Katarzyna Roszak**

*Institute of Physics, Wrocław University of Technology, Wrocław, Poland*

We will show that superpositions between singlet and triplet states of two electrons in double quantum dots undergo pure dephasing due to elastic phonon scattering. This mechanism originates from the fundamental principles of quantum mechanics: due to Pauli exclusion, transitions from the low-energy singly-occupied configurations to doubly-occupied states are allowed only for singlet states, while they are forbidden for triplet states. Although real transitions to these high-energy configurations are suppressed at low temperatures, two-phonon processes are possible in which the high-energy state is used only virtually and a phonon scatters on the electrons in an elastic way. As this scattering is possible only in the singlet state each scattering event supplies the phonon reservoir (environment) with information about the quantum state of the electrons. This distinguishability must lead to dephasing of any coherent superposition between singlet and triplet states.

This mechanism seems to be qualitatively different from any previously discussed processes of spin decoherence in QDs. In particular, it does not require spin-orbit coupling, hyperfine interaction, or any other direct or indirect spin-environment coupling. Calculations performed for a model gate-defined lateral GaAs/AlGaAs DQD show that the scattering process considerably contributes to spin decoherence at sub-Kelvin temperatures, yielding microsecond dephasing times, consistent with experimental observations.

K. Roszak and P. Machnikowski, arXiv:0903.0783v1.