

Propositions

Accompanying the PhD thesis

Optical control of mesoscopic spin ensembles in gallium arsenide

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1. The *electromagnetically induced transparency* (EIT) effect is often denoted as a quantum interference effect. However, this could be formulated more instructively as it can be traced back to the fact that photons obey Bose statistics and tend to aggregate in the same state.
2. The *coherent population trapping* (CPT) effect is treated analogously to EIT and attributed to the same quantum interference effect. More instructively from a physical viewpoint, it can be traced back to the fact that scattered, fluorescent light has larger entropy than laser light. Hence, light scattering in a three-level lambda system leaves this system in a well-defined quantum state with minimum entropy.
3. For an ensemble measurement on donor-bound electrons in GaAs the EIT resonance replicates the shape of the probability distribution of nuclear spin polarization.
4. Blue detuned from the CPT condition the two-laser driven electron spin states are robust against hyperfine fluctuations in their environment, while red detuned from the CPT condition the driven system induces a doubly peaked probability distribution of the spin polarization of the nearby nuclei.
5. Whereas the donor-bound electron spin in GaAs has similarities with semiconductor *quantum dots* (QDs) there are three main differences: It has no material boundary, there is no significant local strain and its electron wave function is spherically symmetric. This may cause excited-state hole spin hyperfine coupling to be dominant for *dynamic nuclear polarization* (DNP) in QDs whereas for the donor-bound system it is the ground-state electron spin hyperfine coupling.
6. Spintronic applications require flexibility in the application of local magnetic fields to nanostructures. Creating such fields in the material via DNP is a better way to achieve this than using external fields or nearby deposited ferromagnetic materials.
7. After finding a material in which the electron spin ensemble displays strong homogeneity, it is still experimentally challenging to address this system homogeneously.
8. The narrowing of fluctuations in a slowly evolving environmental parameter is characteristic for driven coupled resonators whose eigenfrequencies shift oppositely in magnitude with a shift of the environmental parameter. Hence, the mechanism described in Chapter 4 is applicable to a much broader range of systems.
9. A perfectly secure global communications network, can potentially be developed by making use of quantum cryptography. This innovation is not desirable for society, because any form of social control is absent on such a network.
10. Despite claims that the Netherlands is full, many do perceive it as being rather empty. Both viewpoints are valid opinions and are demonstrations of a lack of social cohesion that is caused by the centralized Dutch welfare state.
11. All patent laws should be abolished because they neither stimulate productivity nor innovation.