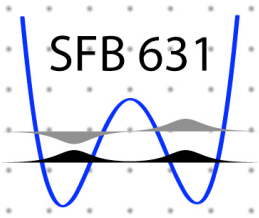

Sonderforschungsbereich 631

Festkörperbasierte Quanteninformationsverarbeitung

TECHNISCHE UNIVERSITÄT MÜNCHEN

SONDERSEMINAR

Mittwoch, 16. September 2009

17:15 Uhr

WSI, Seminarraum S 101

"Coherent spin injection and spin state tomography by light in a semiconductor quantum well"

We demonstrate that the polarization coherence of light can be coherently transferred to the spin coherence of electrons in a semiconductor quantum well, and the prepared coherence of the electron spin can also be coherently read out with light by the developed tomographic Kerr rotation method.

Spin is a fundamental property of electrons and plays an important role in information storage. For spin-based quantum information technology, preparation and readout of the electron spin state are essential functions. Since coherence of the spin state is the manifestation of quantum nature, both the preparation and readout should be spin coherent. However, a traditional spin injection based on optical selection rule and spin measurement based on Kerr rotation, basically prepare and read out the up or down projective spin states, which do not carry the spin coherence. Here we show schemes of coherence transfer and measurement by generalizing the traditional optical selection rule and the Kerr rotation method to directly prepare and readout the electron spin coherence with light independent on the basis selection. Both of the developed spin coherence transfer and the tomographic Kerr rotation (TKR) method utilize the light-hole excitons under in-plane magnetic field in a g-factor controlled semiconductor quantum wells.

The spin coherence transfer and the spin state tomography demonstrated here will be applicable to the transfer of a single-particle quantum state and a two-particle entangled state, which is the kind of transfer needed for quantum information technology. The developed scheme offers a tool for performing basis-independent preparation and readout of a spin quantum state in a solid-state device for quantum cryptography and quantum distributed computing.

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