EINLADUNG ZUM

WIENER PHYSIKALISCHEN KOLLOQUIUM

MANIPULATION AND DETECTION OF SPIN ENTANGLEMENT WITH QUANTUM DOTS

Seigo TARUCHA

Department of Applied Physics
The University of Tokyo, Japan

Manipulation of quantum entanglement is the core of quantum computation and has recently been implemented in solid state systems for spins and superconducting Josephson junctions. The local entanglement is typically the case for spin singlet states, and its manipulation enables to prepare universal sets of logical gates in quantum computing. We have recently used a two qubit gate of combined spin rotation and spin exchange coupling to control spin entanglement in double quantum dots [1]. On the other hand, the concept of non-local entanglement is well established for correlated photon pairs but not yet for solid state systems because of the strong interaction with environment. We have recently proposed new schemes of manipulating and detecting non-local entanglement using a technique of surface acoustic wave (SAW) and quantum dot Josephson junctions. In this talk I will review the schemes of manipulating local and non-local spin entanglement with quantum dots.

We previously demonstrated that an electron can be trapped and moved by a SAW burst from one dot to another [2]. This SAW technique can also be used to transfer two electrons or singlet pair through a quantum wire and separate them into two branches of an AB ring connected to the wire. The entanglement may be maintained for the split electrons in the AB ring if the transport through the system is phase coherent [3]. In addition, we have recently prepared a Josephson junction including single InAs quantum dots to observe the Josephson current significantly depending on the charge state because the pair tunneling or local Josephson current is strongly influenced by Coulomb blockade effect [4]. Now we use a similar Josephson junction but including two parallel coupled InAs quantum dots to study the non-local Josephson current, which may be larger than the local Josephson current. We observe the supercurrent depending on the double dot charge state and discuss the contribution from the split Cooper pair tunneling through two separate dots as a non-local process.

[1] R. Brunner, Y.-S. Shin, T. Obata, Y. Tokura, M. Pioro-Ladrière,T. Kubo,T. Taniyama, and S. Tarucha, Phys. Rev. Lett. 107, 146801 (2011).
[2] S. Hermelin, S. Takada, M.Yamamoto, S. Tarucha, A.D. Wieck, L. Saminadayar, C. Bäuerle, and T. Meunier, Nature 477, 435 (2011).
[3] M. Yamamoto, S. Takada, C. Bäuerle, K. Watanabe, A.D.Wieck, and S. Tarucha, Nature Nano. 7, 247 (2012).
[4] Y. Kanai, R. S. Deacon, A. Oiwa, K. Yoshida, K. Shibata, K. Hirakawa, and S. Tarucha, Appl. Phys. Lett. 100, 202109 (2012).

Montag, 10. Dezember 2012, 17:30 Uhr
(ab 17:00 Uhr Kaffee)

Universität Wien
Fakultät für Physik, Lise-Meitner-Hörsaal
Strudlhofgasse 4, 1090 Wien

www.univie.ac.at/wpk

TU WIEN

universität wien