Generation and Detection of Quantum Correlation in Semiconductor Nanostructures

Kensuke Kobayashi

(Kyoto University, Institute for Chemical Research, Associate Professor)

【Outline of survey】

When two particles away from each other have a certain quantum correlation between them, the two-particle state is called “entangled state”. For example, even if the two particles in an entangled state are located many miles away from each other, the quantum state of the one is instantaneously defined as soon as you detect that of the other. Although this phenomenon is a direct deduction from quantum mechanics, it is, of course, counterintuitive. So, there has been a lot of and decades-long controversy as to whether the entanglement is a reality or not, which was originally triggered by Einstein, Podolski, and Rosen.

Recent nanotechnology enables us to control various quantum effects in many kinds of nanostructures such as artificial atoms and Aharonov-Bohm rings. However, the entanglement, which was already realized for photons in quantum optics, has never been realized in quantum electronics.

In this project, we aim to address the generation and detection of electronic entanglement in semiconductor nanostructures.

【Expected results】

We believe that this century will be “Quantum Age”. The establishment of the quantum information technology is a great goal in that the quantum mechanics directly contributes to the human society. In this project, we would like to establish the fact that the entanglement can be realized in solid-state devices: This fact will serve as an important driving force in the realistic quantum information technology, which is founded on the entanglement.

【References】

• K. Kobayashi, H. Aikawa, S. Katsumoto, and Y. Iye: Tuning of the Fano Effect through a Quantum Dot in an Aharonov-Bohm Interferometer, *Phys. Rev. Lett.* 88, 256806 (2002).
• M. Sato, H. Aikawa, K. Kobayashi, S. Katsumoto, and Y. Iye: Observation of the Fano-Kondo Anti-Resonance in a Quantum Wire with a Side-Coupled Quantum Dot, *Phys. Rev. Lett.* 95, 1066801 (2005).

【Term of project】 FY2007－2011	【Budget allocation】18,400,000 yen (2007 direct cost)

【Homepage address】 http://ssc1.kuicr.kyoto-u.ac.jp/english/index_e.html