Transmission phase shift across a Kondo correlated quantum dot

SHINTARO TAKADA, (1)Department of Applied Physics, University of Tokyo, Bunkyo-ku, Tokyo 113-8656, Japan, CHRISTOPHER BÄUERLE, (2)Institut Néel - CNRS and Université Joseph Fourier, 38042 Grenoble, France, MICHISHIYA YAMAMOTO, KENTA WATANABE, (1), SYLVAIN HERMELIN, TRISTAN MEUNIER, (2), ANDREAS D. WIECK, (3)Lehrstuhl für Angewante Festkörperphysik, Ruhr - Universität Bochum, D-44780 Bochum, Germany, SEIGO TARUCHA, (1)

— We report on measurements of the transmission phase across a quantum dot embedded in an original two-path interferometer both in the strong and weak Kondo regime. The Kondo effect is a well known many-body phenomenon, which is characterized by a single energy scale, the Kondo temperature $T_K$. In the strong Kondo regime at low temperatures ($T/T_K < 1$) we found that the transmission phase is locked to $\pi/2$ in the Kondo valley when the single level spacing $\delta$ is significantly larger than the level broadening $\Gamma$. When $\Gamma$ is relatively large, on the other hand, the phase smoothly shifts by $\pi$ across two peaks on both ends of the Kondo valley without showing any plateau. As the temperature is increased exceeding $T_K$, the Kondo correlation becomes lifted and then the phase shift looks similar to that in the Coulomb blockade regime, where the phase evolves $\pi$ across a Coulomb peak followed by a $\pi$-phase lapse in the Coulomb valley. In such a weak Kondo regime ($T/T_K > 1$) we observed asymmetric phase evolution about the valley center, which is linked to the orbital parity relation between the levels of interest.

Shintaro Takada
Department of Applied Physics, University of Tokyo,
Bunkyo-ku, Tokyo 113-8656, Japan

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