

The Sir Martin Wood Prize Lecture

Measurement and Control of the Phase of an Electron Wave



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Biography

Mar. 2004 Ph. D. The University of Tokyo

Apr. 2004 Research Associate, Department of Applied
Physics, The University of Tokyo

Jun. 2006 Visiting Scholar, Department of Physics,
Harvard University, USA

Feb. 2009 Visiting Scientist, Institut Neel, CNRS,
France

Oct. 2013 PRESTO Researcher, Japan Science and
Technology Agency

Jun. 2014 Lecturer, Department of Applied Physics,
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G22 Lecture Theatre
Pearson Building
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The phase of a wave function is the most fundamental concept of quantum mechanics. Using electron wave interferometers, numerous attempts have been made to measure and control the phase shift of an electron wave. Despite the apparent simplicity, however, no reliable phase measurement had been realized because multiple-path interference usually masks the unambiguous information of the phase. In this talk, I present a pure two-path interference that is realized by combining an Aharonov-Bohm ring with parallel tunnel-coupled quantum wires, where the phase shift can be measured and electrically controlled. We also embedded a quantum dot into one of the two paths to measure the scattering phase through an artificial atom. We have revealed influences of the parity of orbital wave function in the quantum dot and the interaction between a local spin confined in the quantum dot and conducting electrons in the reservoirs, i.e. the Kondo effect.

Associate Professor Yamamoto was awarded the Sir Martin Wood Prize at the Millennium Science Forum which took place at the British Embassy, Tokyo in November 2017. The Millennium Science Forum was established in 1998 to promote scientific exchange between Britain and Japan and recognize the work of outstanding young Japanese researchers. The prize is named after Sir Martin Wood, Founder of Oxford Instruments.

