652nd ASRC Seminar

Date: Wednesday, November 16, 15:00 ～

Location: Room 302, ASRC bldg.

Speaker: Dr. Kei Yamamoto
(Tohoku University)

Title: Spin torque and fluctuation-dissipation at FM-AFM tunneling junctions

Abstract: For studies of phase transitions, Muon Spin Relaxation (mSR) has a unique Antiferromagnetic materials (AFM) are emerging as a promising candidate to be a fundamental building block of next generation spintronic devices. One of the highlights from recent experimental findings is their peculiar spin transport characteristics. In ferromagnetic-antiferromagnetic heterostructures, spin pumping measurements revealed a strong temperature dependence of AFM spin conductivity, while their spin-Hall magnetoresistance indicates that AFM can be as good a sink of spin as ferromagnetic materials (FM).

In this talk, I present a microscopic description of non-equilibrium spin transport through FM-AFM tunneling junctions. Employing path integral formulation of quantum statistical mechanics, one can derive formulas for spin torque, spin pumping and the power spectrum of spin current fluctuations at the junction in a single unified framework. Compared to FM-FM junctions, anti-damping-like torque is somewhat suppressed due to the spin degeneracy of electrons at different sublattice sites. Gilbert damping and noise magnetic field, which are equivalent to spin pumping and spin current fluctuations respectively, are explicitly shown to be dependent on the mutual orientation of FM and AFM. As an application, the AFM magnetic moment fluctuation induced by a steady voltage/temperature bias is computed and its angular/temperature dependence is discussed.

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