# Condensed Matter Seminar

Date: Dec. 3 (Wed.) 16:00 ～

Speakers:

(1) Dr. **M. Hatami** (TU Delft)

(2) Prof. **H.W. Lee** (POSTECH, Korea)

(3) Prof. **H.S. Yang** (NU Singapore)

Title:

(1) Spin Hall and Nernst-Ettingshausen effects: coupling between electronic charge, spin and heat currents
(2) Electron transport in nanostructures
(3) Higher order tunneling phenomena in magnetic tunnel junctions

Room: Seminar room at 5th floor, 2nd Bldg

## Abstract (1):

Spin caloritronics seeks to exploit interplay between the conduction spin electrons with thermoelectric charge and heat transport. The anomalous Nernst and Ettingshausen effects are the thermal counterpart to the anomalous Hall effect. The spin (anomalous) Hall effects refer to a flux of electron spin transverse to an applied electric bias in normal (ferromagnetic) metals in the absence of external magnetic fields. Here we address a microscopic study of the spin Hall as well as the spin Nernst and Ettingshausen effects in the presence of spin and heat diffusion. For a metallic thin-film wire placed in a uniform temperature gradient we find transverse spin-thermoelectric fields, spin particle and heat accumulations, in the presence of spin-orbit interactions. The thermally induced spin accumulations are sensitive to spin-flips but also inelastic scattering processes. Recent experiment can be explained in terms of the spin Nernst effect for reasonable parameter values of the spin Hall angle and thermopowers.

## Abstract (2):

As systems shrink from macroscopic size to nanoscales, their transport properties change qualitatively. Electronic coherence and electron-electron interaction are two important ingredients responsible such changes. In this talk, I will present my works on electronic transport properties in various nanostructure systems such as atomic wires, electronic Mach-Zehnder interferometers in integer quantum Hall edge states, and Luttinger liquids.

## Abstract (3):

The tunneling magnetoresistance and polarization of the tunneling current in MTJs is highly sensitive to the detailed structure of the tunneling barrier. Using MgO tunnel barriers we find TSP values as high as 92% at 0.25K. The TMR is, however, depressed by insertion of ultra thin layers of both non-magnetic and magnetic metals in the middle of the MgO barrier. For ultra-thin, discontinuous magnetic layers of CoFe, we find evidence of Kondo assisted tunneling, from increased conductance at low temperatures (<50K) and bias voltage (<20 mV). Over the same temperature and bias voltage regimes the tunneling magnetoresistance is strongly depressed. The Kondo temperature is sensitive to the thickness of the inserted CoFe layer and decreases with increased CoFe thickness. We also present data on the interplay between the Kondo effect and superconductivity in large area planar magnetic double tunnel junctions (DTJs) of the form superconductor/ insulator/ ferromagnet/ insulator/ superconductor. We have also explored the properties of MTJs in which we have inserted thin insulating antiferromagnetic (AF) layers at the MgO interfaces. We report the magneto-transport properties, as a function of temperature and bias, of MTJs grown with barriers formed from double layers of MgO/NiO, as well as triple layers of MgO/NiO.

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