
Spin torque due to transfer of angular momentum between noncollinear magnetic layers and polarized spin currents

Speaker: Professor Peter Michael Levy
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Venue: Blk S13, #M01-11, Department of Physics Conference Room,
Faculty of Science, NUS

Date: 25th April 2008 (Friday)
Time: 3pm – 4pm

Abstract:

When spin angular momentum is exchanged or transferred between a spin polarized current and a ferromagnetic metallic layer or electrode, a torque is created on the background magnetization by the current when its polarization is not parallel to the magnetization. The details of this transfer depend on whether one uses a purely ballistic description based solely on the equilibrium states of the ferromagnetic layers, or if one includes the out-of-equilibrium spin accumulations attendant to driving a charge current across noncollinear magnetic layers. Also the details depend on whether the nonmagnetic spacer layers between the magnetic layers are metallic or insulating.

For noncollinear metallic magnetic multilayers we find current driven spin accumulation couple magnetic layers that in equilibrium are independent of one another. This alters the description of spin transfer in such a manner that the polarization of the spin current evolves in a continuous fashion between layers; there are no discontinuities across interfaces between layers. We discuss the implications of this model on the resistivity and on the magnitude of the torque produced. The current induced spin flips generated at interfaces by these current driven accumulations allow for more spin torque to be generated than predicated solely on a ballistic description; in addition they lower the resistivity.

Recent data on the bias dependence of the spin transfer effect in magnetic tunnel junctions (when the spacer layer is an insulating or semi conducting barrier) has shown that torque remains intact at bias voltages for which the tunneling magnetoresistance has been strongly reduced. We determine the effect of magnons emitted by hot electrons on charge and spin transport in these junctions by using Caroli's (similar to Landauer's) formalism. The transport is described in terms of the direct, spin dependent, and spin flip probabilities for transmission across the tunnel junction. We find that the excitations due to hot electrons, while reducing the magnetoresistance, *enhance* both the charge current and spin transfer in magnetic tunnel junctions in such a manner that the ratio of the torque to the charge current does not significantly change.

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About speaker:

Born: January 10, 1936-Frankfort, Germany (Naturalized Citizen)

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M.A. 1960, Harvard University
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Professional Society Membership:

American Physical Society, 1961-
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New York Academy of Sciences,
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Honors:

Summa cum laude (B.M.E.)
National Science Foundation Fellow (1958-1962)
Fulbright-Hays Award (1975-1976)
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Fellow, New York Academy of Sciences
Medaille de Vermeil, Société d'Encouragement au Progrès, Paris (1978)
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Invitation Fellowships from Japan Society for the Promotion of Science (1995, 1997, 2003)
Chaire Internationale de Recherche "Blaise Pascal", given by the Préfet and Région Ile de France (2005)
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Professional Experience:

July, 1966 -Feb., 1970: Yale University, Assistant Professor
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Sept., 1975- New York University, Professor of Physics
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