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**The Nobel Prize in Physics 2007: Giant Magnetoresistance  
*An idiosyncratic survey of Spintronics from 1963 to the  
present***

**Speaker:** Professor Peter Michael Levy  
Department of Physics, New York University, USA

**Venue:** Blk S13, #M01-11, Department of Physics Conference Room,  
Faculty of Science, NUS

**Date:** 24<sup>th</sup> April 2008 (Thursday)  
**Time:** 2pm – 3pm

**Abstract:**

Work on magnetic multilayers started in Louis Néel's laboratory in the 1960's, but it was not until one learned from the developments for the growth of semiconductor heterostructures that one achieved in the 1980's high quality metallic multilayers. Once this barrier was overcome it was apparent to Albert Fert and Peter Grünberg that one could alter the magnetic configuration in ferromagnetic metals with moderate magnetic fields, and thereby change their resistivities. I will review the principle ideas and developments that lead to a new field that lies at the intersection between physics and technology. The steps taken by the two physicists to achieve Giant Magnetoresistance (GMR), and the differences in their seminal results, will be discussed.

While the twentieth century was dominated by advances in controlling electrical currents through the charge of the electron, a.k.a. electronics, the rapid developments since 1988 have led to a control of currents through the spin of the electron, i.e., spintronics. The groundwork for this field comes from studies on metallic alloys and multilayers started in the early sixties. Due to parallel developments in the growth of semiconductor heterostructures, e.g., molecular beam epitaxy, work on metallic layers rapidly advanced in the late seventies and early eighties. By 1988 groups led by Fert and Grünberg were able to grow metallic multilayers which displayed the sought after effect; a small magnetic field was able to dramatically change the electric resistance of the structures. This led to an immediate explosion in activity in this area; so much so that the materials which display this effect were incorporated in the read heads of hard disk drives of computers by 1995.

I will focus on developments in three distinct time periods. The first was from 1988-1995 which was dominated by metallic multilayers which displayed giant magnetoresistance (GMR), the second from 1995-2000 when reproducible magnetic tunnel junctions (MTJ's) were studied for their tunneling magnetoresistance (TMR), and the third period from 2000-2005 in which the ideas of Berger and Slonczewski were realized on the back action of currents on the magnetic background of the materials doing the conducting, i.e., current induced magnetization switching (CIMS). These developments illustrate the broad range of activities in Spintronics; a field which is barely twenty years old.

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**About speaker:**

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

**Marital Status:** Married, two children.

**Social Security Number:** 054-28-5555

**Degrees:** B.M.E. 1958, City College of New York  
M.A. 1960, Harvard University  
Ph.D. 1963, Harvard University

**Professional Society Membership:**

American Physical Society, 1961-  
Materials Research Society, 1991-  
New York Academy of Sciences,  
Vice President for the Physical Sciences 1983-85

**Honors:**

Summa cum laude (B.M.E.)  
National Science Foundation Fellow (1958-1962)  
Fulbright-Hays Award (1975-1976)  
N.S.F./C.N.R.S. Exchange of Scientists Award (1975-1976) (1983-1984)  
Fellow, New York Academy of Sciences  
Medaille de Vermeil, Société d'Encouragement au Progrès, Paris (1978)  
Fellow, American Physical Society  
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)  
*Outstanding Referee* for the journals of the American Physical Society (February, 2008)

**Professional Experience:**

July, 1966 -Feb., 1970: Yale University, Assistant Professor  
Feb., 1970 -Aug., 1975: New York University, Associate Professor  
Sept., 1975- New York University, Professor of Physics  
Sept., 1976 -Sept., 1982: New York University, Chairman, Department of Physics  
Sept., 1991-Sept., 1997: New York University, Chairman, Department of Physics

**Host By: Assistant Prof Oezylimaz Barbaros**

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