ICN2 EXCELENCIA SEVERO OCHOA

Manuel Cardona Lectures

This series of lectures offer the opportunity to interact with some of the most prominent researchers in nanoscience-related fields. At the same time, they are a tribute to Prof Manuel Cardona, a key figure in the history of this Institute.

Albert Fert

Unité Mixte de Physique CNRS/Thales, Université Paris-Sud, France

Wednesday, Nov 11, 2015, 11:00h

ICN2 Seminar Hall, ICN2 Building, UAB

Invited by: ICN2- Severo Ochoa Centre of Excellence

Short Bio

Prof Albert Fert received his PhD in 1970 at Université Paris-Sud, Orsay, France. Currently, he is Emeritus Professor at Université Paris-Sud, Orsay, France, and Scientific Director of Unité Mixte de Physique CNRS/Thales, Orsay, France. He is also Adjunct Professor of physics at Michigan State University, USA. The Nobel Prize in Physics 2007 was awarded jointly to Albert Fert and Peter Grünberg *"for the discovery of Giant Magnetoresistance"* which brought about a breakthrough in gigabyte hard disks. He has made many contributions to the field of spintronics.

Don't miss this opportunity to meet him in person!

To confirm your attendance, please register at
http://goo.gl/forms/pxnmEKw4lq
Registration is free!

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Spin-orbitronics, a new direction for spintronics

Albert Fert

UMP CNRS-Thales, 1 Av. Fresnel, Palaiseau, 91767, France and Université Paris-Sud

Classical spintronic devices use the exchange interaction between conduction electron spins and local spins in magnetic materials to create spin-polarized currents or to manipulate nanomagnets by spin transfer from spin-polarized currents. A novel direction of spintronics - that can be called **spin-orbitronics** - exploits the Spin-Orbit Coupling (SOC) in nonmagnetic materials instead of the exchange interaction in magnetic materials to generate, detect or exploit spin-polarized currents. This opens the way to spin devices made of only nonmagnetic materials and operated without magnetic fields. Spin-orbit coupling can also be used in magnetic materials to create new types of topological objects as the magnetic skyrmions or the Dzyaloshinskii-Moriya domain walls. After a **short introduction on spintronics and some of its applications**, I will review **recent advances in two directions of spin-orbitronics**:

a) **Magnetic skyrmions: Magnetic skyrmions:** The magnetic skyrmions are topologically-protected localized spin windings that exhibit fascinating physical properties and present large potential in highly energy efficient applications for the storage and processing of information. Up to now however they had been observed only at low temperature in a few exotic materials and ultra-thin films. I will show that they can be found at room temperature in multilayers in which the symmetry breaking by interfaces induces strong Dzyaloshinskii-Moriya Interactions (DMI). These findings open the road to room-temperature skyrmion spintronics.

b) **Conversion between charge and spin currents by SOC:** I will present a review of spin-orbit effects allowing the conversion of charge current into spin current (or vice-versa), by the Spin Hall Effect in bulk materials or by similar effects in two dimensional electron gas at Rashba interfaces or in topological insulators. I will discuss the motion of magnetic domain walls and switching of nanomagnets by the resulting current-induced SOC torques.