IEEE Distinguished Lecturer

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TITLE:	**Pure Spin Currents: Discharging Spintronics**
SPEAKER:	**Axel Hoffmann**
	Materials Science Division, Argonne National Laboratory
DATE:	Tuesday, November 22, 2011
TIME:	Reception: 3:30 PM – Lecture: 4:00 PM
PLACE:	Center for Magnetic Recording Research – Auditorium
HOST:	Prof. Eric E. Fullerton

As semiconducting electronic devices are miniaturized to ever-smaller dimensions, power dissipation becomes an ever-increasing problem due to leakage charge currents. Spintronics may help addressing some of these issues by utilizing besides the charge degree of freedom also the electron spin. Conventional spintronics approaches are used for non-volatile devices, such as magnetic random access memory, where spin currents are mainly considered as spin-polarized charge currents and as a result the spin and charge currents are in parallel and directly coupled. Looking further into the future, the question arises, whether eliminating charge currents altogether could provide additional benefits for applications. Towards addressing this question, non-local device geometries allow for separating spin and charge currents, which in turn enables the investigation and use of pure spin currents [1]. This approach opens up new opportunities to study spin-dependent physics and gives rise to novel approaches for generating and controlling angular momentum flow.

This lecture will discuss different approaches for generating pure spin currents, such as non-local electrical injection from a ferromagnet, charge-to-spin current conversion via spin Hall effects, and spin pumping from ferromagnetic resonance. Furthermore, examples will be shown for how spin currents can be used for gaining new insights into spin dependent phenomena. In particular, the temperature dependence of spin and charge relaxation times allows to identify different spin relaxation mechanisms [2]. In addition, spin pumping facilitates the generation of macroscopically large pure spin currents. This permits to quantify spin Hall effects with great precision, even in materials where these effects are relatively weak [3,4]. Finally, the lecture will conclude with a brief outlook on the current scientific and future technological opportunities for pure spin currents.

[1] A. Hoffmann, Phys. Stat. Sol. (c) 4, 4236 (2007).
[2] G. Mihajlović, J. E. Pearson, S. D. Bader, and A. Hoffmann, *Phys. Rev. Lett*. 104, 237202 (2010).
[3] O. Mosendz, J. E. Pearson, F. Y. Fradin, G. E. W. Bauer, S. D. Bader, and A. Hoffmann, *Phys. Rev. Lett.* 104, 046601 (2010).
[4] O. Mosendz, V. Vlaminck, J. E. Pearson, F. Y. Fradin, G. E. W. Bauer, S. D. Bader, and A. Hoffmann, *Phys. Rev. B* 82, 214403 (2010).

BIO: Axel Hoffmann received his Diploma degree with honors from the RWTH Aachen in 1994 and his Ph.D. in Physics from the University of California-San Diego in 1999. He was a postdoctoral fellow at the Los Alamos National Laboratory working on neutron scattering from magnetic heterostructures. In 2001 he joined the Materials Science Division of the Argonne National Laboratory, where he is currently a staff member in the Magnetic Thin Film Group. His research interests encompass a wide variety of magnetism related subjects, including basic properties of magnetic heterostructures, spin-transport in novel geometries, and biomedical applications of magnetism. Recently, his main focus has been on pure spin currents investigated by magnetotransport and magnetization dynamic measurements. He has over 100 publications, four book chapters, and three magnetism-related U.S. patents. He has served as the chair for the Topical Group on Magnetism and its Applications of the American Physical Society and the chair of Technical Committee for the IEEE Magnetics Society. Currently he is an associate editor for the Journal of Applied Physics, a senior IEEE member and a member of the Advisory Committee for the IEEE Magnetics Society. He has been active in many Intermag and Magnetism and Magnetic Materials Conferences, including serving as a publication co-chair for the 2007 Joint MMM/Intermag conference and a program co-chair of the MMM conference in 2010. In 2013 he will be the general chair for the MMM Conference.

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