ZERNIKE INSTITUTE COLLOQUIUM

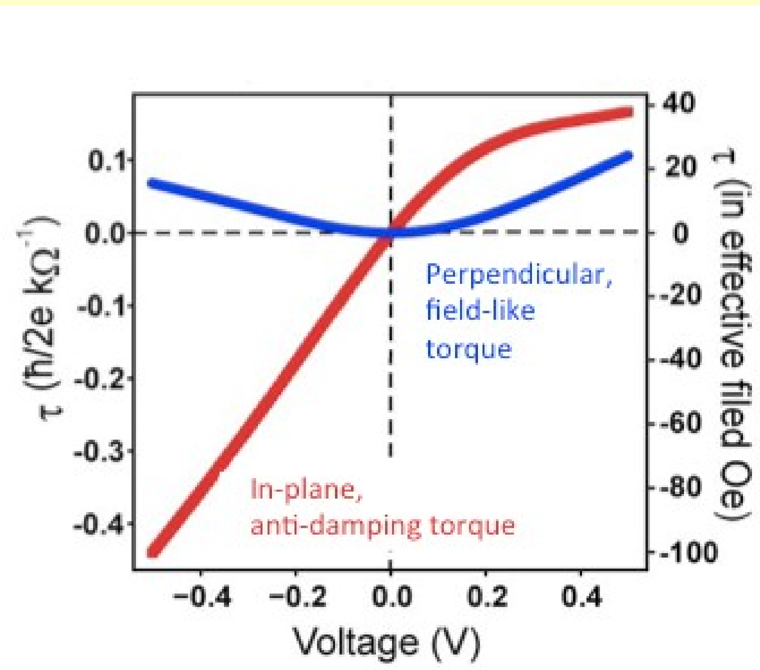
Thursday, April 5th, 2012

16:00h, Lecture Hall: 5111.0080 **Coffee and cakes from 15:30h**

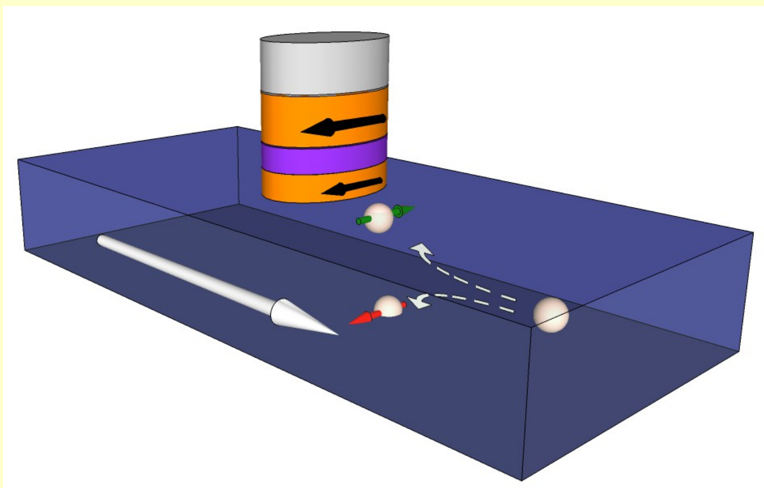
Spin torque and the “giant” spin Hall effect in magnetic nanostructures

R. A. Buhrman
Center for Nanoscale Systems
Cornell University
Ithaca, NY 14853 USA

Since the predictions and subsequent demonstrations that magnetic dynamics can be efficiently excited in thin film nanostructures by the transfer of angular momentum from a spin-polarized current to the local magnetic moment, there has been remarkable progress in advancing the fundamental understanding and control of spin torque effects and magnetic dynamics in nanostructures. Initially a somewhat obscure theoretical prediction that appeared challenging to test, this phenomenon is now being moved rapidly towards major technological implementations, most notably spin-torque magnetic memory cells and spin-torque nanoscale microwave oscillators.



After briefly reviewing the basics of spin torque I will discuss some recent research that has sought to advance quantitative understanding of the phenomena, and that utilizes spin-torque effects as an incisive new tool for studies of spin transport and spin excitations, including the quantification of the spin Hall effect (SHE) in non-magnetic (NM) thin films. The SHE is the consequence of the passage of a charge current through a non-ferromagnetic conductor where the spin-orbit interaction generates a pure spin current transverse to the electrical current. By applying an RF current to a NM/FM thin film bilayer, the transverse RF spin current can induce spin-torque-driven ferromagnetic resonance (ST-FMR) of the FM, enabling a determination of the SHE strength with precision. The surprisingly large magnitude of the SHE in several types of NM is sufficient to reversibly switch the magnetic orientation of either perpendicularly or in-plane magnetized FM layers.



We have very recently fabricated three-terminal devices that incorporate a magnetic tunnel junction (MTJ) and a SHE layer to induce in-plane reversible switching of one of the MTJ’s electrodes. The simple architecture of this three terminal device and the high efficiency of the SHE induced switching make it a promising technique for future memory and non-volatile logic applications.

university of groningen

zernike institute for advanced materials