The Virginia Tech Physics Department presents the following colloquium:

Prof. Christian Binek

(Department of Physics, University of Nebraska, Lincoln)

Electric and Magnetic Field Control of Exchange Bias

Abstract:

Exchange bias (EB) is a fundamental interface phenomenon in coupled magnetic thin films with significant impact in modern spintronic applications. Atomic proximity of adjacent layers gives rise to exchange coupling at the interface between a ferromagnetic (FM) thin film and a magnetic pinning layer. The latter is conventionally antiferromagnetic (AF) but can also be realized by a hard FM film. In both cases interface coupling induces unidirectional magnetic anisotropy in the FM top layer which causes its hysteresis loop to shift along the magnetic field axis. When cycling the heterostructures through consecutive hysteresis loops a monotonic change of this shift, known as the training effect, is observed. Here I report on the electric and magnetic field control of the EB. Electric control is realized in a $Cr_2O_3(111)/(Co/Pt)_3$ heterostructures, taking advantage of the magnetoelectric properties of the AF Cr_2O_3 pinning layer. Based on these experimental results novel spintronic applications such as pure voltage control of magnetic configurations in spin valve-type architectures are proposed. In addition, training of the EB effect is studied in novel all FM heterostructures of exchange coupled soft and hard FM thin films. Our experiments show unambiguously that EB training is driven by deviations from the equilibrium spin configuration of the pinning layer. The experimental data show excellent agreement with our theoretical predictions including a subtle dynamic enhancement of the EB training effect.

Friday, February 9
2:30 P.M.
210 Robeson Hall