Project Title:	**Magnetic Tunnel Junctions incorporating anti-ferromagnetic electrodes**
Project Short description	The groundbreaking discovery of the giant magnetoresistive (GMR) effect in 1988 created the field of Spintronics, in which the spin of the electron is used to transport and store information. The subsequent development of spin valves (SVs) and magnetic tunnel junctions (MTJs) opened the study of spin-dependent electrical transport at the nanoscale and supported the exponential increase of the areal density of hard disk drives up to today. Until recently, MTJ and SV sensors relied solely on ferromagnetic electrodes and their relative magnetization orientation to generate an electrical output. This changed in 2004 when Gould et al. [1] first observed Tunneling anisotropic magnetoresistance (TAMR) in a structure consisting of a normal metal / insulator / ferromagnetic / ferromagnetic tunneling device. The TAMR ratio dramatically drops when the AFM thickness increases just above the domain-wall width. The Néel temperature of the AFM increases with its thickness, and the TAMR only exists at temperatures smaller than the Néel temperature. Most of the works presented in the literature are performed at low temperature, around 4K. Theoretically, there is no apparent physical limit for the spin-orbit-induced anisotropic magnetoresistance phenomena to operate at high temperatures. Extensive optimization of individual layers and interfaces in the AFM-TAMR structures is required to establish the limits of high-temperature operation. The objectives of this project are : 1) Optimize the deposition conditions and stacks of MTJs with an anti-ferromagnet electrode 2) Characterize the structural, magnetic and electrical properties of the devices produced. 3) Demonstrate the ability to use an anti-ferromagnetic MTJ device as a room temperature magnetic field sensor, establish the field detection limits of such device and compare it with conventional magnetoresistive sensors. [1] C. Gould, C. Rüster, T. Jungwirth, E. Girgis, G. M. Schott, R. Giraud, K. Brunner, G. Schmidt, and L. W. Molenkamp, "Tunneling anisotropic magnetoresistance: A spin-valve-like tunnel magnetoresistance using a single magnetic layer," Phys. Rev. Lett., vol. 93, p. 117203, 2004.
Expected Start/End date	March 1st, 2017 – March 30th 2018
Required degree and Background knowledge of students, minimum gradepoint average, etc...	Students applying to this project should preferably have a background on Physics/Physics Engineering. Students with prior experience on any of the following topics are preferred: - Magnetism - Micro and Nanofabrication - Automation of Data Acquisition Systems

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