

## Spring 2015 Seminar Series

Presented by the ECE Division

### COMPUTING WITH SPINS AND MAGNETS

THURSDAY MARCH 19, 2015

2:00 PM – HEC 101

Significant advances in the past three decades have led to the merger of two otherwise independent fields of solid state devices. Spintronics was traditionally about low temperature phenomena that modulate the spin of electrons or nuclei for quantum computing applications or in spin field effect devices. Magnetics was very much an engineering field at room temperature with applications in hard disc drive industry. Two major advancements changed the landscape: one was the invention of the giant magneto resistance (GMR) effect in 1988 which led to the ability to READ the state of magnets using spin polarized currents. The other was experimental demonstration (early 2000's) of previously predicted (1996) theory of spin transfer torque (STT) to WRITE the state of magnets using spin polarized currents. READ/WRITE operations, material and structural advances culminated in a device called Magnetic Tunnel Junction (MTJ) which uses the tunneling magneto resistance effect and is the main elemental building block for STT based memories. There is currently widespread research and development in academia and industry that includes most major semiconducting companies for bringing to market STT based memories while logic applications are more actively being pursued in academia and research institutions with some industry participation.

This talk will briefly go over a concise history of the field followed by introducing the basic concepts at the heart of the technology. Recent challenges and advances for developing viable MTJ devices will be discussed next. The talk will end by briefly describing the fundamental differences between memory and logic devices while providing some specific magnetic based structures that could enable various logic applications for Boolean and non-Boolean computing.

### DR. BEHTASH BEHIN-AEIN GLOBALFOUNDRIES



Behtash Behin-Aein is currently with GLOBALFOUNDRIES. His interests include none-Si based FinFETs, STT-MRAM and spin based logic. He earned his PhD in Electrical and Computer Engineering from Purdue University in 2010 with specialization in spintronics for logic applications. As an author of more than 25 technical publications and patents with more than 500 citations, he has given 11 contributed and 7 invited talks. The spintronics device modeling formalisms for memory and logic that he co-authored with his colleagues at Purdue are currently being used in various industry and academic institutions. He is the recipient of the 2012 Proctor prize grant-in-aid of research from scientific research society Sigma XI also featured in American Scientist. Behin-Aein has been a lead industry liaison for Semiconductor Research Corporation (SRC) on spins based devices, lead principal investigator for Department of Energy's ALCC award, distinguished industry associate for C-SPIN and an invited author for MRS bulletin. He has served as chairperson and judge in international magnetics and SRC TECHCON conferences.

