NY CREATES Emerging Technologies Seminar Series

April 16th (Thursday), 2020: 11:30 am – 12:30 pm

ZOOM meeting (weblink in calendar invite)

"Physics and Applications of Spin-Transfer Torques"

by: Prof. Andrew Kent

(Director, Center for Quantum Phenomena, Department of Physics, New York University)

Abstract: The magnetization of a magnetic material can be reversed by electric currents that transport spin angular momentum [1]. This was predicted in magnetic tunnel junctions — two metallic ferromagnetic layers separated by a thin insulating barrier — by John Slonczewski in 1989 and demonstrated experimentally about a decade later. This discovery has had an enormous impact on magnetism research and technology [2], as prior to this the primary means to reorient the magnetization of a magnet was by applying magnetic fields (dating to 1819 and Oersted!). In this talk I will highlight some of the physics and applications enabled by the discovery of spin-transfer torques. This includes experiments that explore the material characteristics [3] and spin-torque switching mechanisms of perpendicularly magnetized magnetic tunnel junctions [4,5], the device used in spin-transfer torque magnetic random-access memories.

[1] A. Brataas, A. D. Kent and H. Ohno, "Current-Induced Torques in Magnetic Materials," Nature Materials 11, 372 (2012)

[2] A. D. Kent and D. C. Worledge, "A new spin on magnetic memories," Nature Nanotechnology 10, 187 (2015)

[3] J. B. Mohammadi, B. Kardasz, G. Wolf, Y. Chen, M. Pinarbasi, and A. D. Kent, "Reduced Exchange Interactions in Magnetic Tunnel Junction Free Layers with Insertion Layers," ACS Appl. Electron. Mater 1, 2025 (2019)

[4] C. Hahn, G. Wolf, B. Kardasz, S. Watts, M. Pinarbasi and A. D. Kent, "Time-resolved studies of the spin-transfer reversal mechanism in perpendicularly magnetized magnetic tunnel junctions," Physical Review B 94, 214432 (2016)

[5] L. Rehm, G. Wolf, B. Kardasz, M. Pinarbasi, and A. D. Kent, "Sub-nanosecond spin-torque switching of perpendicular magnetic tunnel junction nanopillars at cryogenic temperatures," Appl. Phys. Lett. 115, 182404 (2019)

Biography: Andrew Kent is a Professor of Physics and Director of the Center for Quantum Phenomena at New York University. He received a B.Sc. with Distinction in Applied and Engineering Physics at Cornell University in 1982 and his Ph.D. from Stanford University in Applied Physics in 1988. He conducted post-doctoral research at the University of Geneva in Switzerland and the IBM T. J. Watson Research Center. His research interests are in the physics of magnetic nanostructures, nanomagnetic devices and magnetic information storage. Kent has expertise in thin film growth and characterization, device nanofabrication and high frequency measurements including, ferromagnetic resonance, electron paramagnetic resonance and time-resolved studies of magnetization dynamics. In 2007 he founded Spin Memory Inc. (formerly named Spin Transfer Technology), a startup company developing spin torque magnetic random access memory devices he invented at NYU. The company is based in Fremont, California and has raised over $150 million in funding from Allied Minds and Invesco Asset Management. Kent is a fellow of the American Physical Society (APS), has served as chair of APS topical group on magnetism and its applications (GMAG) and is an advisory board member of the Committee of Concerned Scientists. He served on the executive committee of the APS Division of Condensed Matter Physics (DCMP) and Program Co-Chair of the 58th Annual Magnetism and Magnetic Materials conference (MMM 2013). Kent accomplishments were recognized by an Honorary Doctorate from the University of Lorraine ("Docteur Honoris Causa" de l'Universite de Lorraine), in September 2013. He received the French Jean d'Alembert Research Fellowship in 2017 and was named Professor at Lorraine in the 2018 Lorraine University Excellence Initiative.