Dr. Stuart S. P. Parkin
Max Planck Institute for Microstructure Physics, Halle, Germany
IBM Research – Almaden, California 91205, USA

Email: stuart.parkin@mpi-halle.mpg.de; stuart.parkin@icloud.com

TOPIC:

Spintronic and Ionitronic Computing Technologies

ABSTRACT:

Recent advances in manipulating spin-polarized electron currents in atomically engineered magnetic heterostructures make possible entirely new classes of sensor, memory and logic devices - a research field generally referred to as spintronics. A magnetic recording read head, initially formed from a spin-valve, and more recently by a magnetic tunnel junction, has enabled a 1,000-fold increase in the storage capacity of hard disk drives since 1997. The enormous storage capacity of arrays of hard disk drives in the "cloud" has made possible the digital storage and access to all of humankind's knowledge since the beginning of mankind, thereby ushering in the age of "Big Data" and data analytics. The creation of unforeseen data-driven businesses and the transformation of entire industries is impacting society in manifold ways. Increasing the performance and reducing the energy consumption of storage and computing technologies will very likely spur yet more innovative applications of such technologies. Spintronic and ionitronic devices that rely on atomically engineered materials have novel properties that may allow for higher performance, lower energy and more compact computing devices. The Racetrack Memory is a novel three-dimensional technology that stores information as a series of magnetic domain walls in nanowires, manipulated by spin-polarized current. Racetrack Memory, a spintronic technology - combines the best attributes of magnetic disk drives – their very low cost per stored bit - with those of solid-state memories – their high performance and reliability. Ionitronics allows for the reversible, non-volatile transformation between insulating and metallic states via the flow of tiny currents of ions. Such devices may allow for "plastic" devices that mimic synaptic switches in the brain, thereby allowing for the possibility of very low power computing devices.

PROFILE:

Dr. Stuart Parkin is an IBM Fellow, Manager of the Magnetoelectronics group at the IBM Almaden Research Center, and a Consulting professor in the Dept. of Applied Physics at Stanford University. Recently Dr. Parkin was appointed Director, Max Planck Institute for Microstructure Physics, Halle

Germany, and an Alexander von Humboldt Professor at the Martin Luther University Halle-Wittenberg. Dr. Parkin's research interests include oxide thin film heterostructures, high-temperature superconductors, and, magnetic thin film structures and spintronic materials and devices for advanced sensor, memory, and logic applications. Parkin's discoveries in magneto-resistive thin film structures enabled a 1000 fold increased in the storage capacity of magnetic disk drives. Most recently, Parkin's research is focused on a novel storage class memory device, "Racetrack Memory", and cognitive materials that could enable very low power computing technologies. Parkin is a Member of the National Academy of Sciences, and the National Academy of Engineering, a Fellow of the American Academy of Arts and Sciences, a Fellow of the Royal Society (London), an Honorary Fellow of the Indian Academy of Sciences and a Fellow of TWAS, the World Academy of Sciences. Parkin is the recipient of numerous awards and honors including, most recently, the 2012 von Hippel Award from the Materials Research Society, 2013 Swan Medal of the Institute of Physics (London), and the 2014 Millennium Technology Award from the Technology Academy Finland (worth 1,000,000 Euros).