Putting Spin into Electronics - Vision for the Future

Igor Zutic, State University of New York at Buffalo

Conventional electronics relies on the electron's charge for logic operations in computer microprocessors. In contrast, robust information storage in computer hard drives and high-capacity iPods can use another of the electron's properties: its spin, rather than its charge. While the electron charge can be simply described by the laws of classical physics, the electron spin is more elusive and is responsible for intriguing magnetic behavior in many materials. Permanent magnets, such as iron, retain their magnetic properties even when the power is switched off (no power is needed for a refrigerator magnet to work). This is superior for various memory applications. Could we then combine charge-based logic and spin-based memory within the same types of devices? This effort, known as spin electronics or spintronics could even help us to create really cool laptops. They would use only a fraction of the power needed for the power-hungry laptops of today, which generate so much excess heat that they can keep us warm on cold winter days.

In this public interest talk we discuss some simple aspects of electron spin and its connection to magnetism, which could enable novel spintronic devices. We illustrate some puzzling examples where spin and magnetism play the key role: from levitation of trains to phenomena in bacteria.