physikalisches Kolloquium

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Relativistic Approaches to Spintronics with Antiferromagnets

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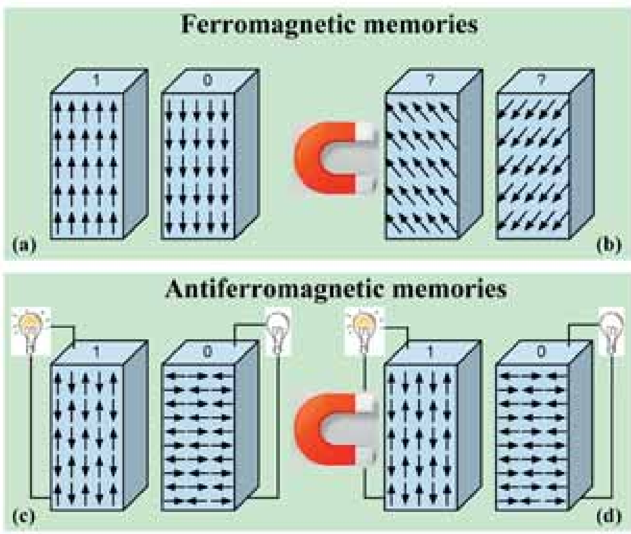
Commercial spin-based memory and storage devices rely on one type of magnetic order and one basic principle in which the opposite magnetic moment orientations in a ferromagnet represent the 0's and 1's. Magnetic random access memory (MRAM) is a solid-state-memory variant of the hard disk in which the magnetic medium for storing and the magnetoresistive read-element are merged into one piece of a ferromagnet. Unlike in hard disks, the magnetic stray field is not anymore needed for reading the state of the FM bit and the most advanced spin-transfer-torque based MRAMs do not even use electromagnets coupled to the ferromagnetic moment of the bit for writing. Still the tradition of using ferromagnets, set historically by the hard disk and magnetic tape media, continues to date in the main-stream research and development of spin-based devices. In the talk we will propose to step out of the narrow box limited by ferromagnets. Instead, we will consider a family of relativistic phenomena allowing us to utilize antiferromagnets as active building blocks of spintronic devices, in which magnetic order is accompanied by a zero net magnetic moment. Antiferromagnets are attractive for spintronics because they offer insensitivity to magnetic field perturbations, produce no perturbing stray fields, are readily compatible with metal, semiconductor, or insulator electronic structure, can generate large magneto-transport effects, and may offer ultra-fast means for spin reorientation unparalleled in ferromagnets.



Ferromagnetic memory (a) disturbed by magnetic field (b) and antiferromagnetic memory (c) not disturbed by magnetic field (d)