

Shining soft x-rays on magnetic materials

Professor Gerrit van der Laan
CCLRC Daresbury Laboratory, Warrington, United Kingdom

Information processing technology has thus far purely relied on charge-based devices, ranging from the old vacuum tube to today's microchips. However the quantum properties of the electron known as spin can be used as a tag for the electron path and is the cornerstone of magnetism. Microelectronic devices that operate by using the spin are a nascent multibillion dollar industry and may lead in the near future to quantum computing. Novel magnetic materials can be tailored thanks to the application of polarized synchrotron radiation. Examples from recent research are presented, such as x-ray magnetic circular dichroism and resonant scattering on ferromagnetic semiconductors, giant magnetoresistance materials, magnetic tunnel junctions, half metallic systems, spin valves, biomagnets and magnetic nanostructures. Third generation facilities make it possible to use the phase coherence and time structure of the x-rays, giving access to the local magnetic order and to the spin dynamics. Examples will be presented from recent work at the ESRF on magnetic nanostructures and self-assembled domain structures reaching storage densities of terabits per square inch.