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Quantized Magnetoresistance

The conversion of a tiny magnetic flux into a change in the resistance of an external circuit, a process called magnetoresistance, is at the heart of the $60-billion magnetic hard-disk-drive industry. Digital data, stored on the disk in the form of minuscule domains only 50 by 200 nm in size, representing a 1 or a 0, are read out by a sensor flying only 10 nm overhead.

The first unambiguous observation of a digital version of the magnetoresistance effect–the change in the resistance recorded by the sensor changes in discrete steps as the magnetization orientation relative to the sensor is changed–was reported by physicists from the University of Nebraska and the Institut de Physique et de Chimie des Materiaux de Strasbourg (France).

The quantization of conductance on the sensor side was achieved by having the current flow through a constriction that tapers down to the size of a single atom, a passage which imposes quantum conditions. According to Nebraska scientist Andrei Sokolov, an atom-sized point contact makes the read-write process ever more compact in physical extent, allowing much greater data storage. (Sokolov et al., *Nature Nanotechnology* **2**, 171-175 (2007))