A CURRENT CONTROLLED RANDOM-ACCESS MEMORY EMPLOYING THE VORTEX HANDEDNESS

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Current-driven magnetization dynamics is currently being investigated as it is a new concept for spintronic devices and fast data storage elements. We propose a memory element based on a magnetic vortex which is operated simultaneously by a spin-polarized current and a magnetic field. Starting from our recent analytical description of the vortex motion [1-3] we developed a scheme that allows to transfer the vortex into an unambiguous binary state, defined as the product of chirality and core polarization.

In a Vortex Random Access Memory (VRAM) the information is stored in the product of two intrinsic properties of the magnetic vortex: the chirality c and the core polarization p. In a parallel current and magnetic field arrangement the amplitude of gyration depends on the sign of the product cp: An enhancement of the rotation amplitude occurs for $cp = -1$ and a quenching for $cp = +1$. Therefore without the need to determine the absolute values p or c, a distinct cp-state can be obtained by field assisted current induced vortex-core switching. The writing mechanisms of the VRAM can be operated with alternating currents or short current pulses. For the reading mechanism it is necessary to determine the product cp, as neither the polarization p of a vortex nor its chirality c is unambiguously determined within the writing procedure.

The VRAM concept is non-volatile and the stability requirements for a memory device are fulfilled: the vortex state is stable against temperature and static magnetic fields as long as they remain in the millitesla regime. Foremost, the VRAM is a fast memory concept which needs no reading and no erasing before writing.

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