

Can a vortex core polarization be used as a data storage method?

The application of small bursts of an oscillating magnetic field can be used to reverse controllably the gyration direction of a vortex core structure, and hence switch the direction of the out-of-plane vortex core polarization. This raises the possibility of using this core switching scheme as a means of magnetic data storage.

What is a magnetic vortex?

A magnetic vortex (1, 2) is one of the fundamental spin configurations occurring in thin micrometer-/nanometer-sized ferromagnetic disk elements due to the confinement of spins imposed by geometrical restrictions (2, 3).

Could ferromagnetic disks have a magnetic vortex core?

Researchers have also theoretically predicted the remarkable reduction of the required magnetic switching field for a topological magnetic vortex core at a temperature closely below the Curie point (36) and the possibility of all-optical switching of a magnetic vortex core (37) in ferromagnetic disks.

How does a vortex structure react with an alternating magnetic field?

The vortex structure is excited with an alternating magnetic field (frequency 250 MHz, amplitude 0.1 mT). Two sequences (phase steps 90°) of images show the dynamic response of the vortex structure before and after a 4 ns 'single period' burst (amplitude 1.5 mT).

What is a ferromagnetic vortex?

The vortex state, characterized by a curling magnetization, is one of the equilibrium configurations of soft magnetic materials<sup>1,2,3,4</sup> and occurs in thin ferromagnetic square and disk-shaped elements of micrometre size and below. The interplay between the magnetostatic and the exchange energy favours an in-plane, closed flux domain structure.

How do magnetostatic and exchange energy affect a vortex structure?

The interplay between the magnetostatic and the exchange energy favours an in-plane, closed flux domain structure. This curling magnetization turns out of the plane at the centre of the vortex structure, in an area with a radius of about 10 nanometres--the vortex core<sup>5,6,7</sup>.

The differences between nano-pillar and nano-contact geometries are described, mainly that the physical confinement in nano-pillars "guarantees both the vortex state and a confining potential", whereas in nano-contacts the current-induced Oersted-Ampere fields are required to form a magnetic vortex (which holds a higher magnetic energy than a ...

The magnetic field both inside and outside the coaxial cable is determined by Ampere's law. Based on this magnetic field, we can use Equation ref{14.22} to calculate the energy density of the magnetic field. The magnetic energy is ...

Magnetic vortices have recently been proposed for use in a variety of spintronics applications due to their resistance to thermal perturbations, flexibility in changing core polarity, simple patterning procedure, and potential uses in magnetic data storage with substantial density, sensors for the magnetic field, devices for logic operations ...

A case study of different magnetic strength fields and thermal energy effects in vortex generation of Ag-TiO<sub>2</sub> hybrid nanofluid flow. ... The periodic magnetic field effect was noticed by Geridonmez and Oztop [4] ... its usages are in energy storage geothermal reservoirs, nuclear reactors, underground water flow, and so forth. ...

A magnetic vortex is a fundamental spin configuration [1] which is realized in ferromagnetic disks of certain sizes [2]. This magnetic state is characterized by two degrees of freedom and is described by the core polarity  $p = \pm 1$  (perpendicularly magnetized central part of the vortex) and the shell vorticity  $c = \pm 1$  (clockwise or counterclockwise oriented ...

The data storage and computing capabilities of vortex-based devices are highly integrated and energy-efficient, with low drive current requirements. Thus, a comprehensive ...

Magnetic Vortex Rings on Demand Published 19 March 2024. Scientists have devised a promising method for generating and manipulating exotic spin patterns called magnetic vortex rings, which could have ...

flywheel energy storage September 27, 2012 ... Mix the particles with a "vortex" magnetic field. 2. Add the mixture to a polymer and degas. 3. Centrifuge the dense mixture in a swinging bucket rotor. 4. Remove excess polymer, restir, and recentrifuge. 5. Cure the dense solid and characterize the magnetic and mechanical

This confirms a new fundamental property of the magnetic field - changing in time, the magnetic field generates an electric field. This conclusion was first reached by Maxwell. Now the phenomenon of electromagnetic ...

An energy vortex is a specific location on Earth which acts as a swirling center of energy, containing more earthly energy than any normal place would. ... The rock has a ...

Efficient switching of the vortex core without magnetic-field application is achieved owing to resonance. This opens up the potentiality of a simple magnetic disk as a building ...

Mahfoud et al. [17] studied swirling flow in a vertical annulus filled with a liquid metal, with counter-rotating end disks under the influence of an axial magnetic field. Their results showed that, when the magnetic field's strength exceeded a certain threshold, the steady asymmetric flow transitioned to an axisymmetric flow.

For both square and triangular disks, the energy increase levels off for the magnetic structures with more than three topological magnetic defects ...

Curcic, M. et al. Magnetic vortex core reversal by rotating magnetic fields generated on micrometer length scales. Phys. Status Solidi B 248, 2317-2322; 10.1002/pssb.201147208 (2011).

Electric control of magnetic vortex dynamics in a reproducible way on an ultrafast time scale is a key element in the quest for efficient spintronic devices with low-energy consumption. To be ...

Developing the Future of Salt Mining, Hydrogen / Energy Storage Company Focus Vortex Energy is focused on leveraging its assets for salt mining and energy. Salt Mining Vortex Energy's North American Salt project, nearby to ...

The single-hole ring and the double-hole ring form a closed vortex structure with a small magnetic field, which reduces the demagnetization energy, and the magnetic field of the twin-vortex has a wider range and is less affected by ...

However, there are still some challenges in magnetic field-related energy storage research that need to be addressed. For example, a magnetic field helps in reducing internal resistance by inducing substantial changes at the molecular level across the electrode-electrolyte interface. ... (B ?J), a primary MHD flow is a vortex around the rim ...

The vortex distribution in a high-quality stoichiometric superconductor  $\text{CaKFeAs}_4$  is studied using low-temperature magnetic force ...

Vortices: New magnetic state can mimic biological synapses, improve data storage. Researchers develop voltage-controlled "vortices" for energy-efficient data storage, mimicking biological ...

We will assume that the difference in energy between disordered and perfect vortex structures, at least in high magnetic field, is small compared with the energy for condensation from liquid to ...

Magnetic vortices are topological objects found in magnetic thin films and microstructures. The study of vortices has attracted much attention for their fundamental ...

Besides, we find that the nucleation field of the vortex pair can be efficiently increased by enlarging the angle between the in-plane magnetic field and the x-axis in the absence of the SAWs. When the angle between the in-plane magnetic field and the x-axis is constant, applying the SAW also increases the nucleation field of the vortex pair.

Solidification is an essential process in phase-change energy storage and magnetic fields have great effects on it. While the majority of previous studies focused on non-uniform magnetic fields, this study investigated the differences using uniform magnetic fields. ... However, when  $Fo = 0.1$ , the vortex at the phase interface of the PW split ...

Here, we report on generation of magnetic vortex clusters in one-dimensional  $\text{La}_{0.67}\text{Sr}_{0.33}\text{MnO}_3$  (LSMO) wires, wherein the magnetic vortex clusters are directly observed using variable-temperature magnetic force microscopy (VT-MFM) as well as magnetoresistance measurements. To identify the origin of the stability of these clusters, we carried out phase ...

As a topological magnetic structure in the ground state, magnetic vortex usually exists in soft ferromagnetic micro- or nano-disks, and its formation depends on the result of competition between magnetic anisotropy energy, exchange energy and demagnetization energy [[1], [2], [3]]. The magnetic vortex can be characterized by the circulation of the in-plane curling ...

We propose to characterize the vorticity-current interaction underlying the energy-loading mechanism through its contribution to the effective electric inductance in the rf ...

Photoemission electron microscopy (PEEM) experiments have demonstrated that the circulation direction of a magnetic vortex can be switched by the application of an electric field, opening the door to digital devices with ...

Scientists have devised a promising method for generating and manipulating exotic spin patterns called magnetic vortex rings, which could have applications in energy-efficient data storage and processing.

An experimentally feasible energy-storage concept is formulated based on vorticity (hydro)dynamics within an easy-plane insulating magnet. The free energy associated with the ...

Magnetic data storage devices would be more energy efficient if data were written using electric fields instead of electric currents or magnetic fields. This technological goal forms a core aspect of the large volume of research into magnetoelectric effects [ 21 ], where voltage-controlled magnetic order has been demonstrated in different types ...

Local polarization of magnetic materials has become a well-known and widely used method for storing binary information. Numerous applications in our daily life such as credit cards, computer hard drives, and the popular magnetic drawing ...

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