Vortex magnetic field energy storage

Why is magnetic vortex important for information storage?
Magnetic vortex has attracted attention in the field of information storage because their topological spin structures with chiral bistable states. If the vortex core polarity and vortex circulation sense can be controlled simultaneously in a nanodisk,which will be more beneficial to realize the multi-bit ultrahigh density storage.

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.

What is a magnetic vortex?
As one kind of topological magnetic defect3,a magnetic vortex is characterized by an in-plane curling magnetization (chirality: either clockwise or counterclockwise) and an out-of-plane nanometer-sized core magnetization (polarity: up or down).

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 possibilityof using this core switching scheme as a means of magnetic data storage.

How does a vortex structure react with an alternating magnetic field?
The vortex structure is excitedwith 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 materials1,2,3,4 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.

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 ...

The RLC circuit of magnetic stimulation mainly consists of the energy-storage capacitor C, circuit equivalent resistor R, and coil inductor ... the excitation of the vortex magnetic field by a changing electric field. Full size

image. Fig. 8.3. Example of propagation of electromagnetic oscillations in space. Full size image. 1.3 Electromagnetic ...

A superconductor in a magnetic field acquires a finite electrical resistance caused by vortex motion. A quest to immobilize vortices and recover zero resistance at high fields made intense studies ...

A typical 3D configuration in the superconducting vortex phase in the (hyper)magnetic field background of about 150 exatesla. The equipotential surfaces of the superconducting W condensate are ...

Magnetic vortex state can be found to commonly exist in micro or submicron sized circular shape soft magnetic thin film. 1,2 This specific topological vortex structure consists an out-of-plane magnetization in the central region and an in-plane magnetization elsewhere. 3 The formation of in-plane flux closure domain is governed by the competition of the ...

Crucially, the ability to control magnetic order with electric fields has the potential to vastly reduce the energy require-ments compared to magnetic field or spin polarized current control. At quasistatic time scales the manipulation of magnetic domains by the application of strain in the soft magnetostrictive material Galfenol (Fe81Ga19) has ...

The ground state, i.e. the magnetic state at vanishing external magnetic field, was often a single-vortex state, making the nanodot with the respective dimensions suitable for data storage ...

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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 ...

After applying a fast magnetic field step to translate the vortex from one pinning site to another, we observe long-lived dynamics of the vortex as it settles to the new equilibrium. We then demonstrate how the addition of a short (<10 ns) magnetic field pulse can induce additional energy dissipation, strongly damping the long-lived dynamics.

1. 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, ...

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 applications in energy-efficient data storage and processing. See more in Physics

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A case study of different magnetic strength fields and thermal energy effects in vortex generation of Ag-TiO 2 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 typical 3D configuration in the superconducting vortex phase in the (hyper)magnetic field background of about 150 exatesla. ... (Superconducting Magnetic Energy Storage) and serves as a core of ...

In this paper, the in situ control of radial vortex polarity and chirality at room temperature mediated by perpendicular magnetic field pulse has been reported via micromagnetic simulations. The correlative results show that the polarity and chirality are switched simultaneously without resulting in a large core movement, the simulation built-in magnetic ...

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 induction appears to us in a new light. The main thing in it is the process of birth of an electric field from a magnetic field.

where (nabla theta) is the angle gradient of magnetization vectors along the loop C.Based on Eq. (), the winding numbers of in-plane vortex and antivortex are +1 and -1, respectively [].The winding number represents the topological quantity of the singularity in the vector field, which is defined in two-dimensional space by the contour integration of the ...

In this study, we investigate the thermal pinning and depinning behaviors of vortex domain walls (VDWs) in constricted magnetic nanowires, with a focus on potential applications in storage memory nanodevices. Using micromagnetic simulations and spin transfer torque, we examine the impacts of device temperature on VDW transformation into a ...

Magnetic vortex has attracted attention in the field of information storage because their topological spin structures with chiral bistable states. If the vortex core polarity ...

Vortex states have also been realized in FeGa microstructures fabricated on piezoelectric substrates, enabling voltage-induced control of magnetization via magnetoelastic coupling to the substrate [42, 43].FeGa is a good candidate for microstructures to be used in various applications due to its high magnetostriction, magnetic softness and ductility [[44], [45], ...

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

The ferroelectric chiral vortex domains are highly desirable for the application of data storage devices with

low-energy consumption and high-density integration. However, the controllable ...

In planar superconductor thin films, the places of nucleation and arrangements of moving vortices are determined by structural defects. However, various applications of superconductors require reconfigurable steering of fluxons, which is hard to realize with geometrically predefined vortex pinning landscapes. Here, on the basis of the time-dependent ...

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 ...

The effects of the nanowire shape on magnetic vortex structure are studied first. Three nanowires of 576 nm long but with different thickness D and width W are considered: 24 nm×48 nm, 48 nm×48 nm, and 48 nm×24 nm.Magnetic domain evolution is simulated starting from an initial configuration of uniform magnetization along the positive x-axis under random ...

The desired number of vortices in the junction is set by applying pulses of magnetic field; an energy-efficient non-destructive readout is done by slightly shaking the introduced vortices with a ...

Optimizing the microstructure of YBa2Cu3O7-x coated conductors across the magnetic field-temperature phase diagram is important for strengthening vortex pinning and thereby enhancing the ...

This explains why many paleomagnetic experiments fail to accurately measure the intensity of ancient magnetic fields in volcanic rocks, which are rich in vortex-state particles. Heating these samples can trigger changes in their magnetic states, causing the original remanence to be lost.

Figure 1: The counter-flow vortex tube with a temperature gradient. Point 1 is the entrance, Point 2 is the core outlet, and Point 3 is the periphery outlet 1 3 2 Oxygen Separation in a Vortex Tube with Applied Magnetic Field J Raymond, C Bunge, G Henderson, and J Leachman HYdrogen Properties for Energy Research (HYPER) Laboratory

The energy contributions for stabilizing complex magnetic systems include the symmetric Heisenberg exchange interaction, the asymmetric exchange interaction (the Dzyaloshinskii-Moriya interaction [DMI]), the Zeeman energy exerted by an applied magnetic field, the anisotropy energy associated with the crystal lattice, and the long-range ...