Vortex magnetic field energy storage

Can magnetic vortex rings be used for energy-efficient data storage?

Phys. Rev. Lett. 132,199902 (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 storageand processing. See more in Physics We need you to provide your credentials before accessing this content.

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).

Do magnetic vortex cores have a spin structure?

Their properties are strongly influenced by the spin structure in the vortex core. We have used spin-polarized scanning tunneling microscopy on nanoscale iron islands to probe for the first time the internal spin structure of magnetic vortex cores.

What are magnetic vortices?

Magnetic vortices are topological objects found in magnetic thin films and microstructures. The study of vortices has attracted much attention for their fundamental beauty and because vortices could be constituents of non-volatile storage and sensing devices as well as of radiofrequency and neuro-inspired devices.

What determines stray field energy of a vortex core?

The experimental data are compared with micromagnetic simulations. The results confirm theoretical predictions that the size and the shape of the vortex core as well as its magnetic field dependence are governed by only two material parameters,the exchange stiffness and the saturation magnetizationthat determines the stray field energy.

What is the difference between a magnetic vortex and a Vortice?

In comparison to vortices in meteorology,magnetic vortices are twelve orders of magnitude smaller. Schematics of the magnetization configuration of a a spiral skyrmion and b a magnetic vortex a Edge of a large permalloy rectangle observed by Kerr microscopy. The domains align along the edges.

Energy storage of vortex magnetic field. The free energy associated with the magnetic winding texture is built up in a circular easy-plane magnetic structure by injecting a vorticity flow in the radial direction. The latter is accomplished by electrically induced spin-transfer torque, which pumps energy into the mag Contact online >>

In the presence of a high magnetic field, the energy of magnetic skyrmions E (Eq. 3) is positive. In this case, skyrmions exist as locally stable two-dimensional particles (cylinders) in a ...

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We investigate the dynamics of a closed-corona Cartesian reduced magnetohydrodynamic model where photospheric vortices twist the coronal magnetic field ...

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 ...

Because of the diverse magnetic domain configurations from superparamagnetism, single domain, vortex domain to multi-domain, magnetic functional materials with different frequency spectrum characteristics are widely used in the field of medical treatment, information record/storage, electronic device, and electromagnetic wave absorption [[1], [2], [3]].

Thin film nanoscale elements with a curling magnetic structure (vortex) are a promising candidate for future nonvolatile data storage devices. Their properties are strongly influenced by the spin structure in the vortex core.

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 ...

A magnetic vortex (MV) is characterized by an in-plane rotation of magnetization and an out-of-plane magnetic component in the center 1 of the magnet. MV is a stable state with linear response to ...

Herein, unique magnetic vortex domain is firstly obtained in the Ni nanoparticles (NPs) reduced from the Ni-based metal-organic frameworks (MOFs) precursor. Due to both ...

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 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 ...

This study investigates the thermal pinning and depinning behaviors of vortex domain walls (VWs) in constricted magnetic nanowires, focusing on the influence of intrinsic magnetic properties on VW stability under thermal stress. Using micromagnetic simulations, we analyze the roles of saturation magnetization (Ms), uniaxial magnetic anisotropy (Ku), and ...

In this study, we investigated the stress-controlled magnetization processes and dynamic susceptibility of a magnetic vortex in FeGa disk under an external magnetic field. Our primary objectives were to elucidate the ...

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A magnetic vortex is one of the fundamental and topologically nontrivial spin textures in condensed matter physics. Magnetic vortices are usually the ground states in ...

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 ...

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

Here, we report on generation of magnetic vortex clusters in one-dimensional La 0.67 Sr 0.33 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 ...

We also demonstrated that the presence of magnetic vortex cores is not a necessity anymore for the excitation of short-wavelength spin waves when using current-driven Oersted fields as the long-wavelength branch of the ...

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

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.

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 ...

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 ...

Combine magnetic particles of differing sizes to create a sufficiently dense solid that the field is forced to penetrate the particles. Mix the particles with a "vortex" magnetic field. ...

The spiral state has a lower energy than the vortex state in zero field for all allowed values of the 180 e1 90 0 -I 0 h= 0 - 0.05 -0.10 -0.15 -0.20 10 5 Fig. 7. Profiles of embedded vortices at negative magnetic fields, representing a metastable vortex lattice state, for the case of zero effective anisotropy.

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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 ...

Detailed understanding of the magnetism of nanostructures is a major requirement for the future progress in magnetic data storage technology. For example, circular nanostructures that exhibit a curling in-plane magnetic ...

produces a clockwise magnetic B field, as Seen from above. On the return Stroke, the current is moving upward which produces a counterclockwise magnetic B field. Thus the thunderStorm produces two huge bucking magnetic B fields which is the magnetic geometry of this magnetic Vortex generator. Using my tetrahedron diagram, I will then Show

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 ...

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

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).

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], ...

The reversal process depends on the stability of different possible zero-field magnetization configurations with respect to the dot geometrical parameters and application of an external magnetic ...

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☑ PROTECTION IP54/IP55
☑ BATTERY /6000 CYCLES

500KW 1MW 2MW