Magnonic interferometer paves way toward energy-efficient information processing devices

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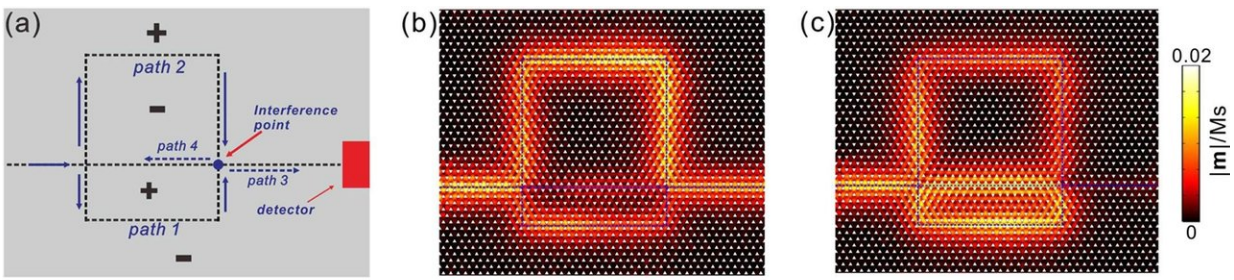

Illustration of the magnon interferometer with interference patterns. Credit: Li et al. ©2018 American Chemical Society

Researchers have designed an interferometer that works with magnetic quasiparticles called magnons, rather than photons as in conventional interferometers. Although magnon signals have discrete phases that normally cannot be changed continuously, the magnonic interferometer can generate a continuous change of the magnon signal. In the future, this ability could be used to design magnonic integrated circuits and other magnonic devices that overcome some of the limitations facing their electronic counterparts.

The researchers, Yun-Mei Li, Jiang Xiao, and Kai Chang, have published a paper on their work with magnons in a recent issue of *Nano*

Letters.

One of the characteristic features of magnons is their discrete and topological nature, as they carry a fixed amount of energy and can be thought of as quantized spin waves. This characteristic of magnons makes them robust against local perturbations and forbidden backscattering processes, such as Joule heating and local defects, which often cause losses in electronic devices. For this reason, researchers are investigating the possibility of using magnon currents instead of electric currents to transfer and process information in highly efficient information processing systems.

Controlling magnons, however, requires the ability to continuously change the magnon signal, which has been challenging. In the new paper, the researchers achieve this by fabricating a waveguide made of artificial magnonic crystals composed of the magnetic insulator yttrium-iron garnet, which is patterned with triangular holes. They showed that magnonic modes emerge from the interface between two of these magnonic crystals that have opposite rotation directions of triangular holes. These magnonic modes have the desirable properties of being immune to backscattering and remaining highly coherent during propagation, making it possible to use them in a magnonic interferometer capable of continuously changing the magnonic signal.

To demonstrate, the researchers used the magnonic interferometer to split a magnonic beam, send it down two propagation paths, and direct both parts of the beam to meet again. Manipulating the beam in this way, the researchers could achieve a continuous change of the magnonc signal at a detector located at the end of one of the beam paths.

"The interferometer is very sensitive to external magnetic fields, since a very weak magnetic field (about 1 Gauss) can change the signal significantly," Chang told *Phys.org*.

The researchers expect that, in the future, the interferometer's ability to control magnonic signals in this way could lead to the design of magnonic information processing devices that can avoid the losses that plague conventional electronic devices.

More information: Yun-Mei Li, Jiang Xiao, and Kai Chang. "Topological Magnon Modes in Patterned Ferrimagnetic Insulator Thin Films." Nano Letters. DOI: 10.1021/acs.nanolett.8b00492