Physicists discover new type of spin waves

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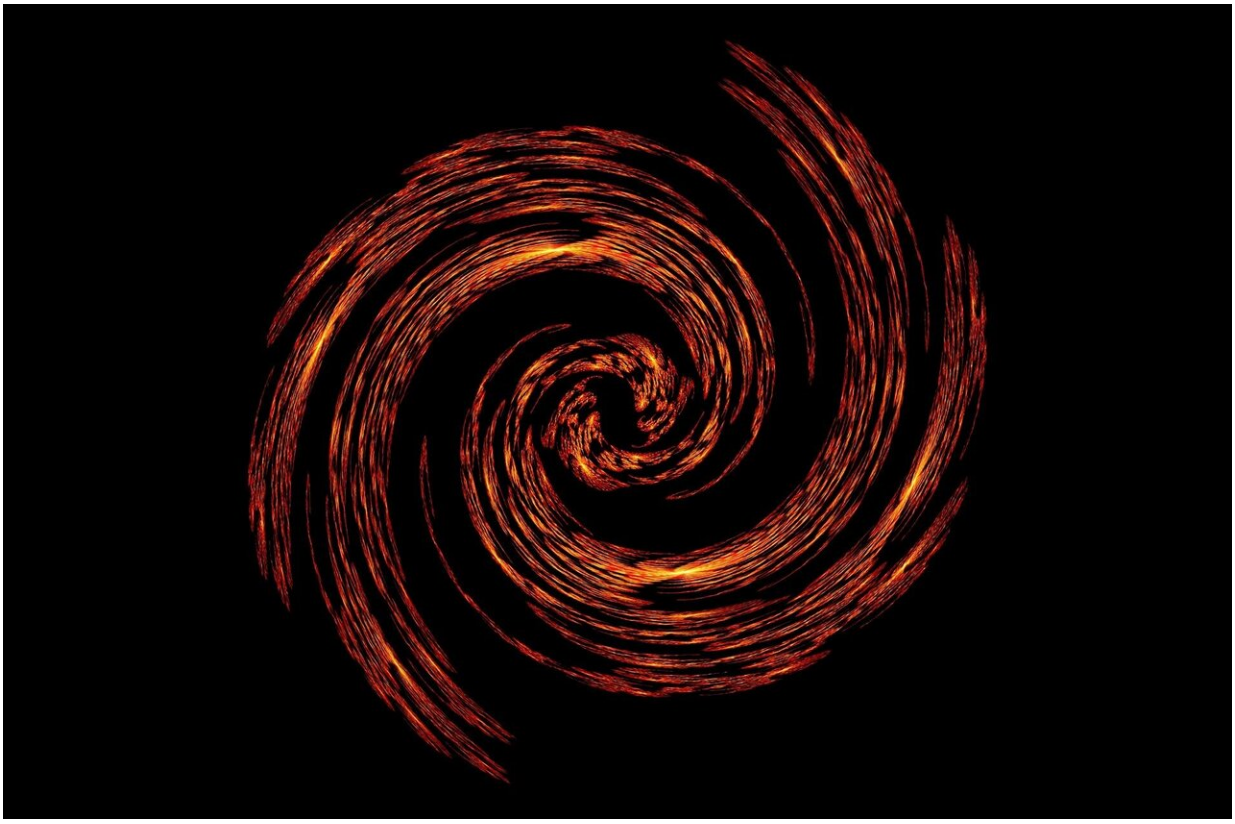

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Current technologies for information transfer and processing are challenged by fundamental physical limits. The more powerful they become, the more energy they need, and the more heat is released to the environment. Also, there are physical limits on the smallness and efficiency of communication devices. The recent discovery by physicists

at Martin Luther University Halle-Wittenberg (MLU) and Lanzhou University in China offers a new route for progress on these issues. In the latest edition of the scientific journal *Nature Communications*, they describe a novel type of spin wave that can be used to transmit and process information with considerably higher efficiency and lower energy consumption.

Conventional IT applications are based on electric charge currents. "This results inevitably in energy losses heating up the environment," says MLU physicist Professor Jamal Berakdar. The researcher added that more energy is needed and also dissipated to operate more powerful and compact devices. Thus, it is very challenging to maintain the pace of advancement based on charge-current-based technology. For their study, the teams led by Professor Berakdar and Professor Chenglong Jia of Lanzhou University examined alternative concepts for data communication and processing.

Their work revolved around magnons. "These are waves that are stimulated in ferromagnets by just a fraction of the energy needed for generating the required charge currents," explained Berakdar. "Magnons can be used to transmit signals and for logical operations in various components while producing virtually no heat."

In this latest study, the German-Chinese research team describes a type of twisted magnon for which the twist or the winding number is protected against damping. Technically the twist is related to magnon orbital angular momentum and can be controlled in magnitude and orientation by electric voltages. This makes possible multiplex twist-based signal encoding and transmission across large distances. According to the scientists, the reported results open the way to high density information transmission via magnons. In addition to the energy efficiency, the magnon wavelengths are controllable and short compared to optical waves, which itself is advantageous for miniaturization.

Magnonic elements can also be integrated in existing technologies.

More information: Chenglong Jia et al, Twisted magnon beams carrying orbital angular momentum, *Nature Communications* (2019). DOI: 10.1038/s41467-019-10008-3