Observation of skyrmion breathing motion with X-ray technique

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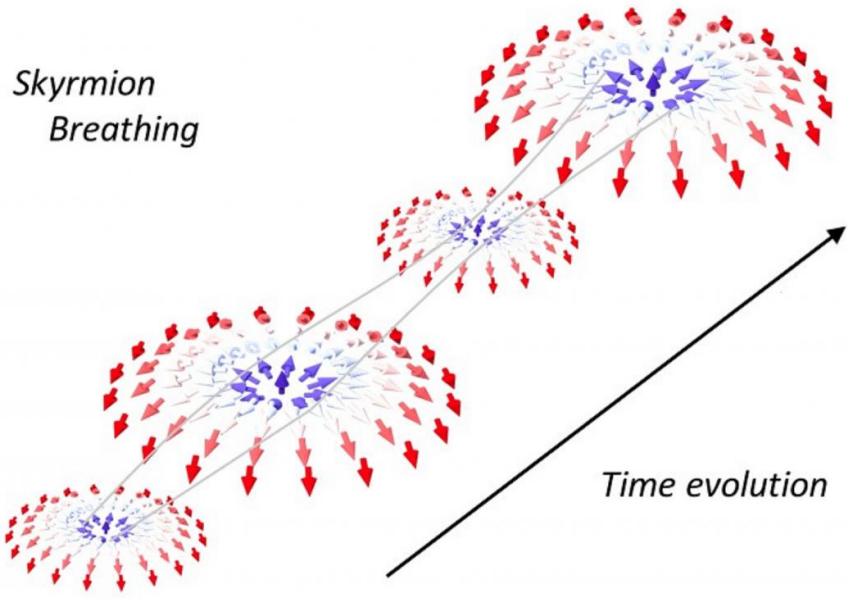

A schematic of the skyrmion breathing movement that changes with time by the external current stimulus. Credit: DGIST

Skyrmions are swirling spin structures with spiral shapes described in 2009. They have attracted attention in academia as representing a possible basic unit of ultra-high-density next-generation memory devices due to their unique topological stability, small size, and efficient movement. Recently, Korean researchers have developed a technology

that can be applied to communication devices using skyrmions.

Researchers have predicted that it is possible to implement a unique kinetic dynamic of skyrmions called "skyrmion breathing" in next-generation high-frequency oscillator devices and memory devices. However, due to the ultra-small size and ultra-fast motion of skyrmions, direct observations of skyrmion breathing have been considered difficult to achieve.

The results of this research are the first to describe skyrmion breathing based on experimental observations. The DGIST-KIST collaborative research team successfully observed and measured the controlled motion and breathing of a skyrmion in response to external signals that occur within a few nanoseconds using a synchrotron X-ray technique with excellent time and space resolving powers.

In addition, this research has also developed an efficient skyrmion generation method using external current pulses. The results of this study are important, because they suggest that skyrmions can play a significant role in many other future electronic devices, beyond memory devices, which had been of primary focus till now.

Director Jung-Il Hong from the DGIST-LBNL Research Center for Emerging Materials said, "The new approach utilizing skyrmions presented in the results of this study suggest a new method of operation for an entire device, so its implications are great in light of the existing research trends."

Senior researcher Seong-hoon Woo from the KIST Center for Spintronics said, "The research results show that high-efficiency, next-generation communication devices based on skyrmions are actually feasible. This research will contribute to accelerating the development of next-generation communication devices for efficient communication

among future high-performance electronic devices."

More information: Seonghoon Woo et al, Spin-orbit torque-driven skyrmion dynamics revealed by time-resolved X-ray microscopy, *Nature Communications* (2017). DOI: 10.1038/ncomms15573

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