Physicists reveal novel magnetoelectric effect

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(Phys.org) —New research at the University of Arkansas reveals a novel magnetoelectric effect that makes it possible to control magnetism with an electric field.

The novel mechanism may provide a new route for using multiferroic materials for the application of RAM (random access memories) in computers and other devices, such as printers.

An international research team, led by U of A physicists, reported its findings in an article titled, "Prediction of a Novel Magnetoelectric Switching Mechanism in Multiferroics," on Feb. 5 in the journal *Physical Review Letters*.

The researchers studied a new predicted state of the multiferroic bismuth ferrite, a compound that can change its electrical polarization when under a magnetic field or magnetic properties when under an electric field. Because of these effects, bismuth ferrite interests researchers who want to design novel devices—based on magnetoelectric conversion.

The "coupling mechanism" in bismuth ferrite between magnetic order and electrical polarization order is required for this phenomenon to be clearly understood, said Yurong Yang, a research assistant professor of physics in the J. William Fulbright College of Arts and Sciences.

"We discovered an unknown magnetoelectric switching mechanism," Yang said. "In this mechanism, the magnetic order and electrical

polarization are not coupled directly, they are coupled with oxygen octahedral tilting, respectively. The switching polarization by electric field leads to the change of the sense of the rotation of oxygen octahedral, which in turn induces the switching of the magnetic order.

"These two couplings are governed by an interaction between three different physical quantities, called 'tri-linear coupling,' he said. "In contrast with the trilinear-coupling effects in the literature, the new coupling involves a large polarization and thus can be easily tuned by an electric field."

Yang performed calculations with the assistance of the Arkansas High Performing Computing Center at the University of Arkansas. He was joined in the study by Laurent Bellaiche, a Distinguished Professor of physics at the U of A. Bellaiche and Yang conducted their research in the university's Institute for Nanoscience and Engineering.

More information: Yurong Yang, Jorge Íñiguez, Ai-Jie Mao, and L. Bellaiche. "Prediction of a Novel Magnetoelectric Switching Mechanism in Multiferroics." *Phys. Rev. Lett.* 112, 057202 (2014) [5 pages] DOI: 10.1103/PhysRevLett.112.057202

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