Ultra-Fast Magnetism

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Assistant Professor Jian Liu (http://www.phys.utk.edu/faculty/faculty-liu.html) is among the group a scientists who have used light-driven experimental techniques to both manipulate and reveal the magnetic properties in materials. Using synchronized infrared and x-ray laser pulses to switch between magnetic states—in this case with unprecedented precision—could one day revolutionize how data is read and written in computers and other digital devices. The research was published May 9 in *Nature Materials*.

Using time-resolved resonant inelastic scattering, researchers were able to see subtle spin correlations in a compound comprising strontium, iridium, and oxygen. Spin—just like charge—is an intrinsic property of an electron. Spin correlations travel as waves through a material and define its magnetic properties both statically and dynamically. In this work, a key revelation was that temporal spin correlations behaved differently in two- and three-dimensional spaces when sparked by an infrared laser pulse. As pointed out in the journal's News and Views, this particular material (Sr_2IrO_4) has spins that can move in concert in an excitation mode called a magnon, which has a typical frequency of 10-100 terahertz: 1000 times faster than today's processors and memories.

As Liu explained, "the success of this study illustrates the power and potential of epitaxial growth of single crystalline films for investigation and application of ultrafast dynamics in solids, not only for magnon but also other elementary excitations, such as phonon and plasmon."

Please continue reading:

- The above was adapted from the Brookhaven National Laboratory press release, available **here (https://www.bnl.gov/newsroom/news.php?a=11836)**.
- See the paper in *Nature Materials* (**Ultrafast energy- and momentum-resolved dynamics of magnetic correlations in the photo-doped Mott insulator Sr_2IrO_4 (http://www.nature.com/nmat/journal/vaop/ncurrent/full/nmat4641.html)**).
- *Nature Materials* **News and Views—Ultrafast spectroscopy: A glimpse of spin motion (http://www.nature.com/nmat/journal/vaop/ncurrent/full/nmat4647.html)**.