Altermagnets: Scientists Image a New Type of Magnetism

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In December 2024, scientists at the University of Nottingham’s School of Physics and Astronomy imaged a new type of magnetism: altermagnetism. This study consisted of mapping the magnetic domains of manganese telluride (MnTe) on the nanoscale (Dumé, 2025).

Caused primarily by the spins and orbits of electrons, magnetic moments measure an object’s tendency to align with a magnetic field; as vector quantities, they indicate directionality (Sarkar, 2014). In most magnetic materials, namely the classic ferromagnets and antiferromagnets, magnetic moments either align parallel to one another or alternate in an antiparallel fashion (Dume, 2025). Altermagnetism, however, refers to a magnetic order where the spins of atoms align antiparallel, while the atoms hosting these spins are rotated based on the motion of nearby atoms (Dume, 2025 & ScienceDaily, 2024). As a result, altermagnets hold properties found respectively in ferromagnets and antiferromagnets.

In the Nottingham study, the scientists employed photoemission spectroscopy on the surface of MnTe exposed to radiation by a polarized X-ray beam (Dume, 2025 & Wadley et al., 2024). According to the lead scientist of the study, Peter Wadley, the “emitted electrons depend on the polarization of the X-ray beam in ways not seen in other classes of magnetic materials, and this can be used to map the magnetic domains in the material with unprecedented detail” (Dume, 2025). Their findings revealed that it was possible to manipulate the magnetic qualities of MnTe as well by cooling the material while exposed to a magnetic field (Dume, 2025). The discovery of altermagnetism carries significant implications for both academia and the tech industry. According to Senior Research Fellow Oliver Amin, “experimental work has provided a bridge between theoretical concepts and real-life realisation, which hopefully illuminates a path to developing altermagnetic materials for practical applications" (ScienceDaily, 2024).

Said applications include "the potential to lead to a thousand fold increase in speed of microelectronic components and digital memory while being more robust and energy efficient" (ScienceDaily, 2024). Magnets are valuable components in the hardware of long-term computer memory devices and microchips, found in the Internet of things—devices that connect to and exchange data with other devices—and artificial intelligence (Dume, 2025). According to the abstract from the Nottingham study, the discovery of altermagnets "motivates exploration and exploitation of the unconventional nature of this magnetic phase in an extended family of materials, ranging from insulators and semiconductors to metals and superconductors" (Wadley et al., 2024).

With the techniques devised by Wadley and his peers, developers may gain newfound control over magnetic properties through the manipulation of altermagnets. Indeed, the study invites an entirely new field of research and technological development in magnetism.

References

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