CrSb Reveals a Novel 3D Magnetic Order

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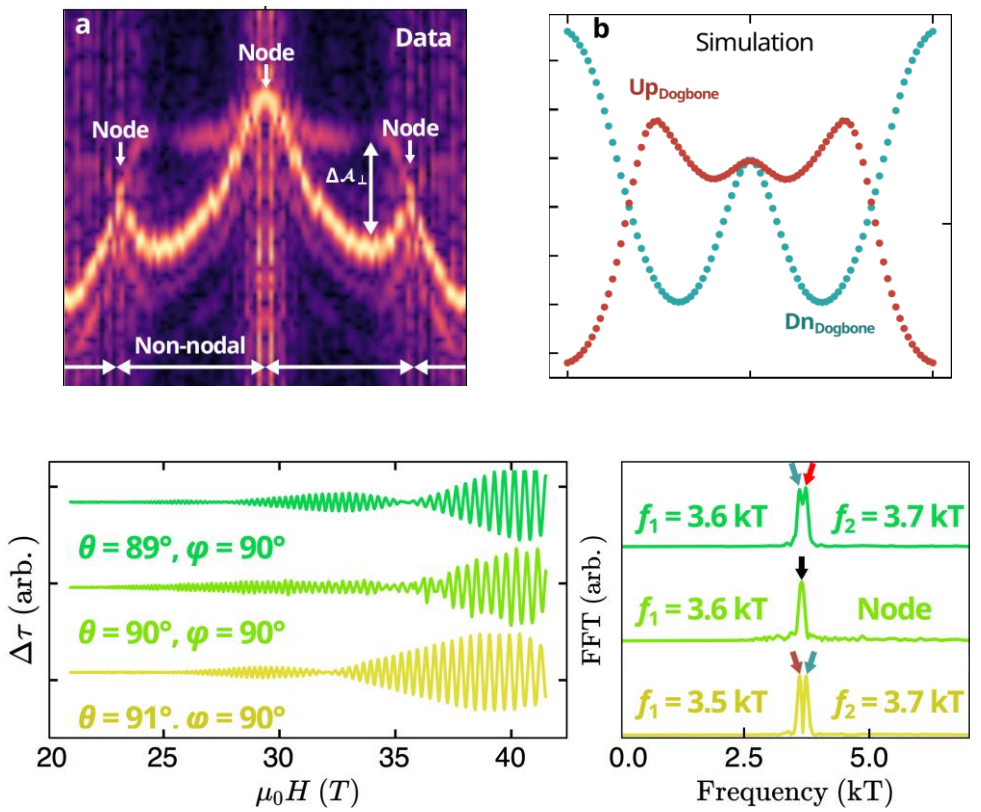
Altermagnets combine the zero net magnetization of antiferromagnets with the momentum-dependent spin splitting usually associated with ferromagnets. For metallic chromium antimonide (CrSb), while surface probes had suggested this state, a bulk-sensitive, three-dimensional test of its electronic and magnetic order was still absent.

Researchers rotated single-crystal CrSb through high- and low-symmetry directions in the MagLab's **41.5 tesla DC magnet** and measured de Haas-van Alphen magnetic oscillations with torque magnetometry. The quantum oscillation frequency is proportional to the area of the extremal orbit perpendicular to the magnetic field. The observed frequencies merge at symmetry-protected nodal directions and split away from them, matching density-functional-theory predictions. This angular fingerprint maps the spin-dependent Fermi surface—the boundary of occupied electronic states—and identifies a *g*-wave order parameter, an eight-lobed sign-changing pattern, in the bulk.

This result provides the first experimental evidence of bulk altermagnetism in CrSb. Its combination of compensated magnetism, long mean free path, and robust spin splitting provides a strong materials platform for studying unconventional magnetism and pursuing low-energy spintronic devices.



Measured quantum-oscillation frequencies (left) match the predicted spin-up and spin-down branches. (right) **The branches join at symmetry-protected nodes and separate elsewhere—the bulk fingerprint of g-wave order.** Bottom: spin-split high magnetic field quantum oscillations and frequencies.

Facilities and instrumentation used: MagLab 41.5 T all-resistive magnet (Cell 6); helium-3 torque magnetometry with in-situ rotation. Other shared facility: HLD-EMFL pulsed fields to 64 T.
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