

Odd-parity responses in conventional antiferromagnets without nonrelativistic spin splitting

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Collinear antiferromagnets that break time-reversal symmetry, known as altermagnets, have recently attracted great attention in condensed matter physics. Their hallmark is a large non-relativistic spin splitting in electronic bands, arising solely from spontaneous spin order. Such splitting, reaching the eV scale even in weak spin-orbit-coupled materials, drives striking responses including the anomalous transverse transport and spin-charge interconversion. By contrast, conventional time-reversal-symmetric collinear antiferromagnets, such as NiO, have long been regarded as less interesting because they lack this effect.

Here we propose a new class of collinear antiferromagnets: magnetic systems with odd-parity response hosting hidden spin splitting. In these magnets, macroscopic symmetries like mirror and inversion are violated, yet the electronic bands remain spin-degenerate. The key mechanism behind is the incompatibility between nonsymmorphic crystalline symmetries and finite propagation vectors of magnetic order. The enlarged unit cell accommodates a compensated but effective spin splitting, which, when combined with nonsymmorphic lattice features, produces sizable responses free from spin-orbit coupling.

We demonstrate this through symmetry analysis and first-principles calculations for MnS₂, a weak spin-orbit-coupled collinear magnet, where hidden splitting induces large Berry curvature dipoles and odd-parity responses. This finding shows that even spin-degenerate antiferromagnets can host unconventional responses, broadening the scope of antiferromagnetic spintronics and opening a new route to spin-orbit-free functional materials[1].

[1] J. Matsuda, H. Watanabe, R. Arita, Phys. Rev. Lett. 134, 226703 (2025)