

***Ab initio* study of topological spin-orbit torque in the compensated ferrimagnetic Weyl semimetal Ti₂MnAl**

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Magnetic Weyl semimetals (WSMs) are promising systems for investigating the interplay between electronic structure, topology, and the electrical control of magnetic order via spin-orbit torque (SOT).

In this work, we studied the compensated ferrimagnet Ti₂MnAl and its intrinsic response relevant to topological SOT, using density functional theory (DFT) with spin-orbit coupling (SOC). We constructed an effective tight-binding Hamiltonian from symmetry-adapted Wannier functions in *Wannier90* and evaluated its intrinsic response with *WannierBerri*. The effective Hamiltonian reproduces the low-energy *ab initio* bands around the 24 previously reported Weyl points (WPs) [1], which lie above the Fermi level. Then, based on Meguro et al.'s previous work [2], we used the Kubo-Bastin formalism and the mixed Berry curvature to calculate the energy dependence of the intrinsic effective-field response. Our analysis shows that the regions surrounding the WPs account for approximately 83% of the net response (Fig. 1).

These results clarify the microscopic origin of the intrinsic magnetic response in Ti₂MnAl, supporting its potential for electrically controlled spintronic applications.

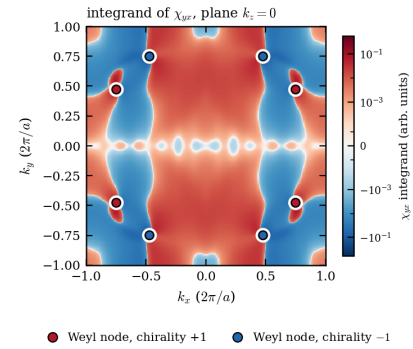


Fig. 1. Momentum-space map of the integrand of the intrinsic effective-field response, χ_{yx} . Circle marks are the WPs.

[1] W. Shi et al., *Prediction of a magnetic Weyl semimetal without spin-orbit coupling and strong anomalous Hall effect in the Heusler compensated ferrimagnet Ti₂MnAl*, Phys. Rev. B **97**, 060406(R) (2018).

[2] T. Meguro et al., *Topological spin-orbit torque in ferrimagnetic Weyl semimetal*, Phys. Rev. Research **7**, L022065 (2025).