Chirality and Topology

Claudia Felser
Max Planck Institute for Chemical Physics of Solid.Germany
felser@cpfs.mpg.de

Chirality is a very active field of research in organic chemistry, closely linked to the concept of symmetry. Topology, a well-established concept in mathematics, has nowadays become essential to describe condensed matter [1,2]. At its core are chiral electron states on the bulk, surfaces and edges of the condensed matter systems, in which spin and momentum of the electrons are locked parallel or anti-parallel to each other. Magnetic and non-magnetic Weyl semimetals, for example, exhibit chiral bulk states that have enabled the realization of predictions from high energy and astrophysics involving the chiral quantum number, such as the chiral anomaly, the mixed axial-gravitational anomaly and axions [3-5]. Chiral topological crystals exhibit excellent chiral surface states [6,7] and different orbital angular momentum for the enantiomers, which can be advantageous in catalysis. The potential for connecting chirality as a quantum number to other chiral phenomena across different areas of science, including the asymmetry of matter and antimatter and the homochirality of life, brings topological materials to the fore [8].

References

[1] M. G. Vergniory, B. J. Wieder, L. Elcoro, S. S. P. Parkin, C. Felser, B. A. Bernevig, N. Regnault, Science 2022, 376, 6595.
[2] P. Narang, C. A. C. Gracia and C. Felser, Nat. Mater. 2021, 20, 293.
[3] J. Gooth et al., Nature 2017, 547, 324.
[4] J. Gooth et al., Nature 2019, 575, 315.
[5] D. M. Nenno, et al., Nat Rev Phys 2022, 2, 682.
[6] B. Bradlyn, J. Cano, Z. Wang, M. G. Vergniory, C. Felser, R. J. Cava and B. A. Bernevig, Science 2016, 353, aaf5037.
[7] N. B. M Schröter, et al., Science 2020, 369, 179.
[8] C. Felser, J. Gooth, preprint arXiv:2205.05809

Figures

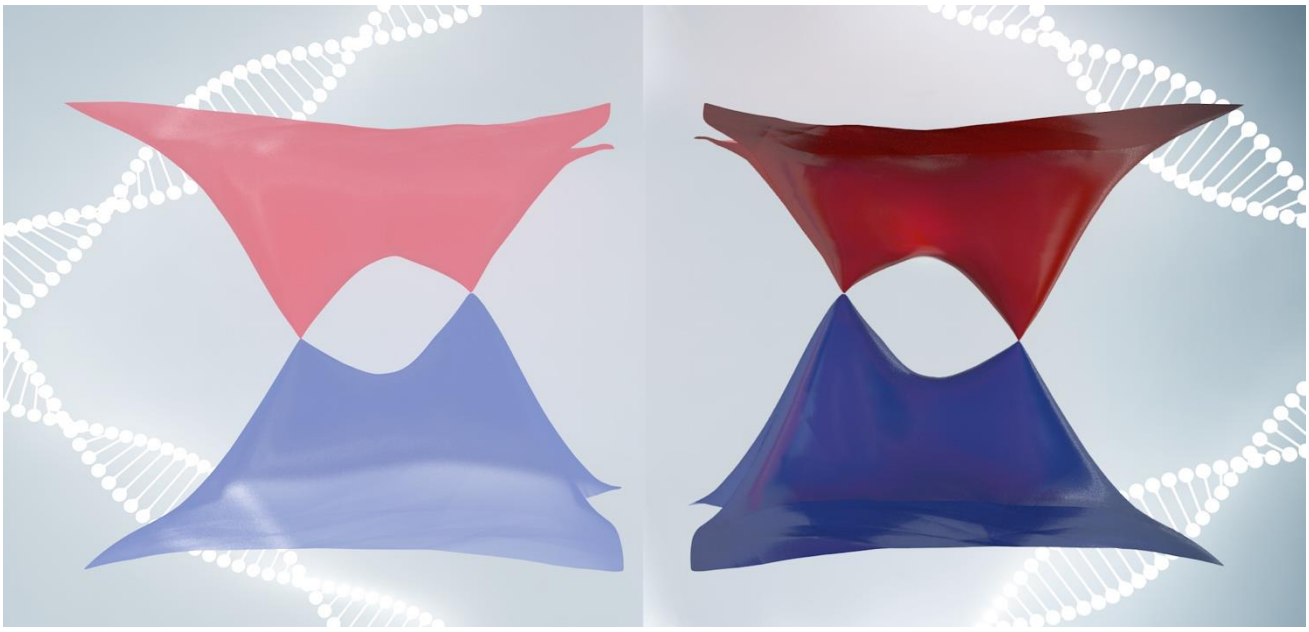

Figure 1: the Weyl points in Chiral Fermions for the two enantiomorphs