Optical and transport anisotropies in spin-textured altermagnets

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Spin textures are ubiquitous in antiferromagnets [1], yet their consequences for altermagnets remain largely unexplored [2-3].
Here we derive a controlled low-energy theory by projecting the SU(2) gauge-covariant texture coupling onto the altermagnetic doublet and show that gradients of the Néel order act as emergent gauge fields on the electronic pseudospin [4-5]. These fields generate strong in-plane anisotropies in transport and optical absorption, even in the absence of intrinsic spin–orbit coupling.

As a concrete example, we study a spin helix and predict that the principal axes of conductivity and optical absorption track the helix wave vector, with the anisotropy tunable by the texture geometry.

Our results identify spin textures as a simple route to direction-selective electronic and optical functionality in altermagnets.

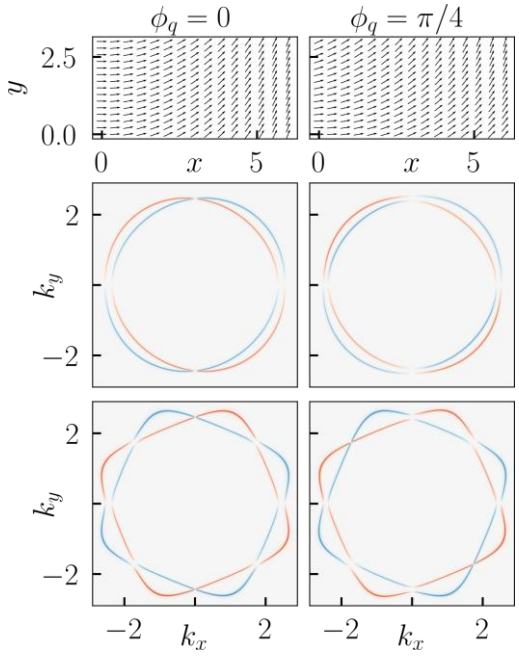

Figure 1: Real-space spin texture for a planar spin helix shown for two helix orientations and momentum-resolved sublattice-polarized spectral function for a d-wave and g-wave altermagnet.

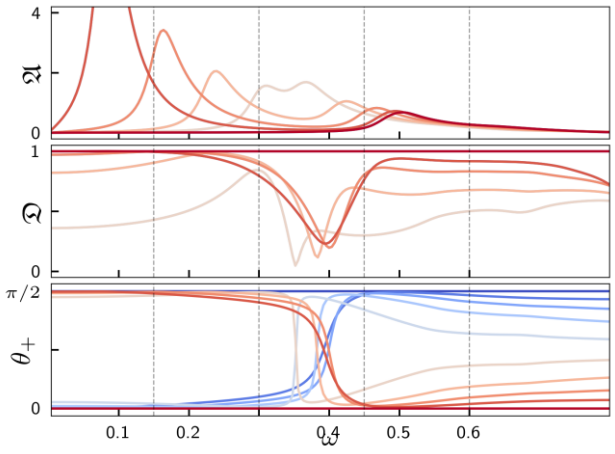

Figure 2: (a) Total optical absorption for different orientations from 0 (red line) to pi (blue line) and (b) corresponding linear dichroism. (c) Frequency dependent orientation of the principal absorption axis.

References

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[4] Roig, et al., Phys. Rev. B 110, 144412 (2024)
[5] G. Tatara, Phys. E, 106, 208 (2019)

Figures