Electronic transport in Weyl semimetals with a uniform concentration of torsional dislocations

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Abstract

In this article[1], we consider a theoretical model for a type I Weyl semimetal, under the presence of a diluted uniform concentration of torsional dislocations. By a mathematical analysis for partial wave scattering (phase- shift) for the T-matrix[2,3], we obtain the corresponding retarded and advanced Green's functions that include the effects of multiple scattering events with the ensemble of randomly distributed dislocations[1]. Combining this analysis with the Kubo formalism, and including vertex corrections[1], we calculate the electronic conductivity as a function of temperature and concentration of dislocations. We further evaluate our analytical formulas to predict the transport coefficients (electrical conductivity, thermal conductivity and Seebeck) of several transition metal monopnictides, i.e. TaAs, TaP, NbAs and NbP.

References

[1] D. A. Bonilla and E. Muñoz, Nanomaterials, 12 (2022) 3711.
[2] R. Soto-Garrido, E. Muñoz and V. Juricic, Physical Review Research, 2 (2020) 012043 (R).
[3] D. A. Bonilla, E. Muñoz, and R. Soto-Garrido, Nanomaterials, 11 (2021) 2972.

Figures

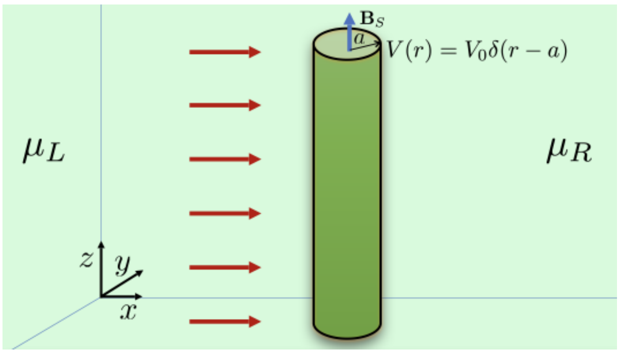

Figure 1: Scattering of Weyl fermions by a single torsional dislocation

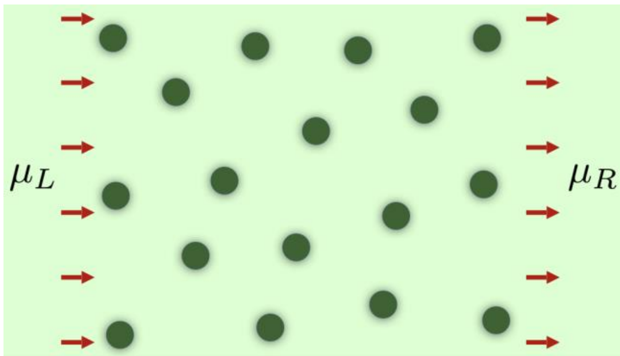

Figure 2: Random distribution of torsional dislocations in a bulk Weyl semimetal (as seen from a plane perpendicular to the dislocation´s axis)