Zak phase for spin waves in one-dimensional magnonic crystals

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The dispersion relation of a one-dimensional magnonic crystal is composed of the sequence of the non-overlapping bands. The calculation of the Zak phases [1,2] for the bands below the selected gap allows identifying if the gap is supportive to the existence of edge modes [3] in terminated structures. In this work, we have calculated Zak phases for magnonic crystal operating in exchange regime, composed of the two alternatively repeated magnetic layers. An expression for the dispersion relation of such magnonic crystals has been derived and the corresponding Bloch function has been found. We determined the Zak phases of the successive bands by analyzing the symmetries of the Bloch in a centrosymmetric unit cell, at the edges of bands (i.e. for the wavenumbers in the center and edges of the Brillouin zone). For this, we have used an important result from J. Zak's work [1] for 1D one-dimensional crystals with inversion symmetry [1], which were generalized to a magnonic system. In conclusion, we have presented a general approach for studying the topological properties of Bloch bands in 1D magnonic crystals in an exchange regime.

References:

[1] J. Zak, Phys. Rev. Lett. 62, 2747 (1989)
[2] M. Xiao, Z. Q. Zhang, C. T. Chan, Phys. Rev. X 4, 021017 (2014)
[3] J. Rychły, J. W. Kłos, J. Phys. D: Appl. Phys. 50 164004 (2017)