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Theoretical spin-wave dispersions in the antiferromagnetic phase AF1 of MnWO4 based on the polar atomistic model in P2

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Multiferroic properties have attracted much attention since they may have applications in electronic devices. Several models have been proposed to explain the mechanism of magnetoelectric effects such as the change of the modulation wavelength, and another key factor can be a noncollinear spin configuration which is in accord with the theory associated with Aharonov-Casher effect or the inverse Dzyaloshinskii-Moriya interaction.

MnWO4 is an exemplary prototype of magnetoelectric control. At zero field, 3 phase transitions are observed: the commensurate AF1 below 8 K, the incommensurate elliptical spiral spin structure AF2 in 8~12.3 K, and the incommensurate collinear sinusoidal spin structure AF3 below 13.5 K. Its space group has been believed to be P2/c until our studies confirmed the true symmetry P2 and the noncollinear spin-canting structure [1]. With this new magnetic model, it is necessary to re-examine the excitation spectra and the exchange couplings as they are sensitive to the spin configurations.

We present spin wave calculations based on the noncollinear magnetic structure; and show good agreements with previous experimental spectra [2]. Interestingly, one of the low-lying excitation modes observed in recent neutron scattering study [3] which cannot be described by the collinear model, may be properly described in this work.

[1] J. Phys. Condens. Matter 30, 135802 (2018)
[2] Phys. Rev. B 83, 140401 (R) (2011)
[3] Phys. Rev. B 93, 214428 (2016)

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