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Chern-Simons orbital magnetoelectric coupling in generic insulators SINISA COH, DAVID VANDERBILT, Rutgers University, ANDREI MALASHEVICH, UC Berkeley, IVO SOUZA, Centro de Fisica de Materiales, San Sebastian — The isotropic Chern-Simons coupling θ is a component of the orbital contribution to the magnetoelectric coupling.¹ In a generic insulator it can have any value, while it must be exactly π in a strong Z_2 topological insulator. The results of our first-principles density-functional calculations for the ordinary magnetoelectrics Cr_2O_3 , BiFeO_3 and GdAlO_3 confirm that the Chern-Simons contribution is quite small in these materials.² We discuss various strategies for finding insulators for which θ is large but not equal to π . For example, we show that if the spatial inversion and time-reversal symmetries of the Z_2 topological insulator Bi_2Se_3 are broken by hand, large induced changes appear in the Chern-Simons magnetoelectric coupling. We also perform an analysis based on space-group representation theory to determine the simplest possible magnetic structures which allow for a non-zero and possibly large value of θ .

¹A. Malashevich *et al.*, New J. Phys. **12**, 053032 (2010); A. M. Essin *et al.*, Phys. Rev. B **81**, 205104 (2010).

²S. Coh *et al.*, arXiv:1010.6071.

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