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Flexomagnetic response of multiferroics

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Using direct matrix method we established the structure, including the number of nonzero and independent elements, of the poorly studied flexomagnetic coupling tensor for all 90 magnetic classes. We used the point symmetry of the unit cell, its magnetic symmetry, previously known permutation symmetry, as well as we establish previously unexplored permutation symmetry of the flexomagnetic tensor. For several symmetries, which correspond to the most important for applications multiferroics with nonzero flexomagnetic effect, such as BiRFeO_3 ($R = \text{La, Pr, Eu}$), $\text{Sr}_{1-x}\text{Ba}_x\text{MnO}_3$, LiMPO_4 ($M = \text{Fe, Co, Ni}$), TbMn_2O_5 , YMnO_3 , InMnO_3 and $\text{RMn}_{1-x}\text{Ga}_x\text{O}_3$ ($R = \text{Ho, Y}$), we visualize the effective flexomagnetic response of the banded magnetoelectric plate, analyze its anisotropy and angular dependences. We discuss how the established symmetry can simplify the problem of the flexomagnetic constants determination from experiments, opening the way for its novel applications.

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