Switchable Rashba anisotropy in a layered hybrid organic–inorganic perovskite via hybrid improper ferroelectricity

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Hybrid organic–inorganic perovskites (HOIPs) have emerged as a highly flexible material class with a wealth of technological applications and an impressive variety of exotic physics. Notably, a coexistence of inversion symmetry breaking and spin–orbit interactions can facilitate interesting spin-optoelectronic effects. We report [1] a detailed DFT study of the ferroelectric layered HOIP compound, (4-aminomethyl-piperidinium)PbI4, which exhibits both a chiral magnetic spin texture in momentum space and a large and highly-anisotropic Rashba effect. Remarkably, by reversing the ferroelectric polarization perpendicular to the layers, we can simultaneously reverse the chirality of the spin texture and induce a 90-degree pseudo-rotation of the Rashba anisotropy ellipse. A symmetry-mode analysis of the structural changes reveals a quadrilinear coupling between the PbI4 framework rotation mode, the ferro and antiferro molecular-rotation modes, and the ferroelectric polarization. This phenomenon could provide a mechanism for spin valve or spin FET devices.

[1] F. Wang, H. Gao, C. de Graaf, J. M. Poblet, B. J. Campbell, and A. Stroppa, npj Comput. Mater. 6, 183 (2020).

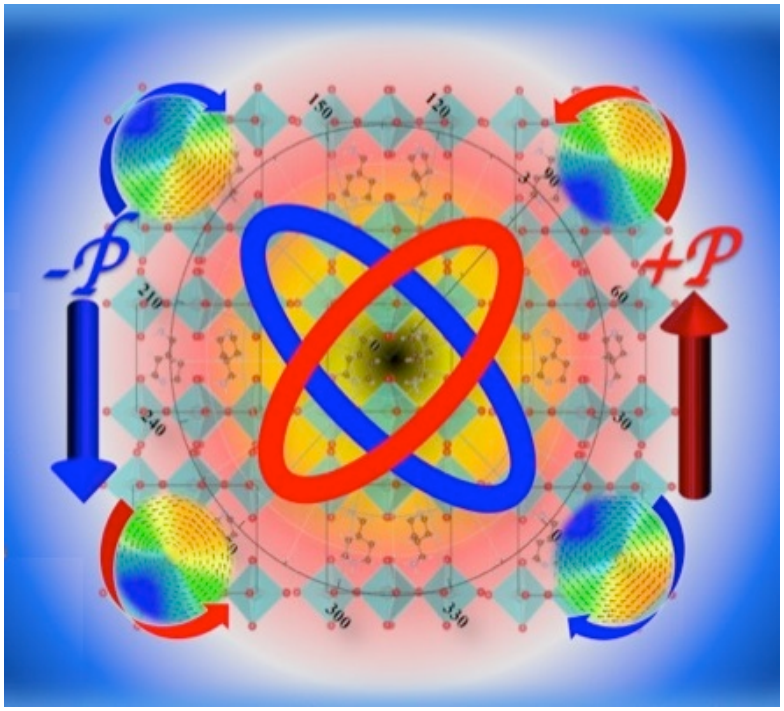

Figure 1