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

B. Campbell¹, F. Wang², H. Gao³, C. de Graaf⁴, J. M. Poblet⁵, A. Stroppa⁶

¹Brigham Young University ²Universitat Rovira i Virgili, ³Institute of Physics CAS, ⁴Universitat Rovira i Virgili, ⁵Universitat Rovira i Virgili, ⁶University of L’Aquila

branton.campbell@gmail.com

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.