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Electromagnetic coupling of spins and pseudospins in bilayer graphene[1] R. WINKLER, Northern Illinois University, U. ZÜLICKE, Victoria University of Wellington, New Zealand — We present a theoretical study of bilayer-graphene's electronic properties in the presence of electric and magnetic fields. In contrast to known materials, including single-layer graphene, any possible coupling of physical quantities to components of the electric field has a counterpart where the analogous component of the magnetic field couples to exactly the same quantities. For example, a purely electric spin splitting appears as the magneto-electric analogue of the magnetic Zeeman spin splitting. The measurable thermodynamic response induced by magnetic and electric fields is thus completely symmetric. The Pauli magnetization induced by a magnetic field takes exactly the same functional form as the polarization induced by an electric field. Although they seem counterintuitive, our findings are consistent with fundamental principles such as time reversal symmetry. For example, only a magnetic field can give rise to a macroscopic spin polarization, whereas only a perpendicular electric field can induce a macroscopic polarization of the sublattice-related pseudospin in bilayer graphene. These rules enforced by symmetry for the matter-field interactions clarify the nature of spins versus pseudospins. We have obtained numerical values of prefactors for relevant terms.

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