The coupling of the Pontryagin density to gauge theories

Abstract

The Pontryagin density can be defined for any connection theory and has played an important role in modern physics. We briefly recall some of its previous applications and emphasize its recent emergence in non-dynamical axion electrodynamics, as an effective theory describing the electromagnetic response of topological insulators. The static Green's functions are obtained for the cases of plane, cylindrical and spherical symmetries by exploiting the delta-like axionic contributions at the domain wall. For a plane symmetric domain wall some consequences of the magneto-electric effect are discussed in the case of Casimir forces and in the shifting of the energy spectra of hydrogen-like ions. Preliminary extensions to Yang-Mills theories and linearized gravity are also mentioned.

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