Non-minimal coupling of photons and axions

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Abstract

We establish a new self-consistent system of equations accounting for a non-minimal interaction of gravitational, electromagnetic and axion fields. The procedure is based on a non-minimal extension of the standard Einstein-Maxwell-axion action. The general properties of a ten-parameter family of non-minimal linear models are discussed. We apply this theory to the models with pp-wave symmetry and consider propagation of electromagnetic waves non-minimally coupled to the gravitational and axion fields. We focus on exact solutions of electrodynamic equations, which describe quasi-minimal and non-minimal optical activity induced by the axion field. We also discuss empirical constraints on coupling parameters from astrophysical birefringence and polarization rotation observations. © 2010 IOP Publishing Ltd.