

**Title:           Continuous Axion Photon Duality, Axion Photon Oscillations,  
Solitons and Splitting**

Name:           E.I. Guendelman

Affiliation:    Dep. of Physics, Ben-Gurion University of the Negev ,Beer- Sheva, Israel

Email:           [guendel@bgu.ac.il](mailto:guendel@bgu.ac.il)

Abstract

The axion photon system in an external magnetic field, when for example considered with the geometry of the experiments exploring axion photon mixing (which can be represented by a 1+1 effective model) displays a continuous axion-photon duality symmetry in the limit the axion mass is neglected. The conservation law that follows from this symmetry is obtained. The magnetic field interaction is seen to be equivalent to first order to the interaction of a complex charged field with an external electric potential, where this fictitious "electric potential" is proportional to the external magnetic field. This allows one to solve for the scattering amplitudes using already known scalar QED results. Axion photon oscillations can be understood as violations of a charge symmetry in the scalar QED language. Going beyond the linear theory, the axion photon system in a self consistent magnetic field is shown, using this formalism, to have interesting soliton solutions that represent new non gravitational ways of trapping light. Finally, generalizing the scalar QED formalism to 2+1 dimensions makes it clear that a photon and an axion split into two components in an inhomogeneous magnetic field, an effect that reminds us of the Stern Gerlach experiment.

References:

1) Photon and Axion Splitting in an Inhomogeneous Magnetic Field.

E.I. Guendelman (Ben Gurion U. of Negev) . Feb 2008. 9pp.

e-Print: arXiv:0802.0311 [hep-th]

Phys. Lett. B.(2008)

2) Localized Axion Photon States in a Strong Magnetic Field.

E.I. Guendelman (Ben Gurion U. of Negev) . Jan 2008. 9pp.

e-Print: arXiv:0801.0503 [hep-th]

Phys. Lett. B.(2008)

3) Axion photon oscillations from a 'particle-antiparticle' view point.

E.I. Guendelman (Ben Gurion U. of Negev) . Nov 2007. 6pp.

e-Print: arXiv:0711.3961 [hep-ph] ( complement to ref. 4)

4) Continuous axion photon duality and its consequences.

E.I. Guendelman (Ben Gurion U. of Negev) . Nov 2007. 7pp.

Published in Mod.Phys.Lett.A23:191-196,2008.

e-Print: arXiv:0711.3685 [hep-th] ?