To Elias and Aaro Mahogold

Fractional Field Theory and Physics of the Dark Sector

Ervin Goldfain

Advanced Technology and Sensor Group, Welch Allyn Inc., Skaneateles Falls, NY 13153

Abstract

Derived from the Peccei-Quinn (PQ) mechanism, axions are hypothetical pseudo-Goldstone bosons that restore the charge-parity (CP) symmetry of quantum chromodynamics (QCD). As of today, the mainstream view is that the PQ mechanism offers the most plausible explanation on the puzzle of preserving CP symmetry in QCD. Moreover, several astrophysical models postulate that axions are likely components of Cold Dark Matter (DM). For example, a recent study argues that DM behaves as a strongly coupled superfluid phase consisting of axion-like particles with mass in the eV range or below [1]. Despite these attractive features, experimental searches have either ruled out some axion-based models or placed them under stringent exclusion limits. The object of this work is to show that the concept of spacetime equipped with minimal fractality (the so called *minimal fractal manifold*, MFM in short [2-5]) solves the CP problem of QCD without invoking the PQ paradigm. Rather than discarding axions as superfluous complications of the theory, we conclude that they may be seen as *topological signature* of the MFM, which we suggestively refer to as "*Cantor Dust*". We tentatively find that the properties of "*Cantor Dust*" fall in line with current observations of DM on both cosmological and galactic scales. They are also consistent with the idea that Dark Energy arises from the dynamics of neutrino oscillations on cosmological scales [6].

Key words: Strong CP problem, Peccei-Quinn mechanism, Axion, Minimal Fractal Manifold, Cold Dark Matter.

...Text to follow...

References:

[1] http://arxiv.org/pdf/1507.01019v1.pdf

[2] Goldfain E., "*Fractal Spacetime as Underlying Structure of the Standard Model*", Quantum Matter, **3**(3), (2014), pp. 256-263. A draft of this article can be located at: http://www.researchgate.net/publication/268391330_Fractal_Space-Time_as_Underlying_Structure_of_the_Standard_Model

[3] Goldfain E., "*Introduction to Fractional Field Theory*", (2015), Aracne Editrice (in press). A copy of this reference can be located at: https://www.researchgate.net/publication/278849474_Introduction_to_Fractional_Field_Theory_%28consolidated_version%29

[4] http://vixra.org/pdf/1305.0101v1.pdf

[5] http://prespacetime.com/index.php/pst/article/view/818 A copy of this article can be located at: http://vixra.org/pdf/1509.0113v2.pdf

[6] Goldfain E., "*Dynamics of Neutrino Oscillations and the Cosmological Constant Problem*", Prespacetime Journal **2**(3), (2011), pp.442-446. A copy of this article can be located at: http://vixra.org/pdf/0910.0050v1.pdf