

Multifractal Foundation of Effective Field Theory

Ervin Goldfain

Abstract

It was recently shown that, regardless of initial conditions and in the long-run, multi-variable Renormalization Group flows evolving outside equilibrium are prone to settle to *strange attractors*. In this context, multifractals (MF) become suitable means for the characterization of effective field theories, in particular the Standard Model of particle physics (SM). It is known that typical MF's are studied using concepts such as singularity spectrum and Rényi entropy. Exploiting the definition of canonical mass dimension, here we show that the separation of gauge bosons and the Higgs scalar from fermions stems from breaking the underlying geometry of the singularity spectrum. Our analysis supports the view that, near the electroweak scale, SM emerges as topological condensate of multifractal dimensions and that Dark Matter is a manifestation of Cantor Dust.

Key words: Renormalization Group, multifractals, singularity spectrum, Rényi entropy, Minimal Fractal Manifold, Cantor Dust, Fractional Field Theory.

1. Introduction and Motivation
2. SM as self-contained multifractal set.
3. Hausdorff dimensions and the SM Lagrangian.
4. Asymptotic limit of the singularity spectrum.
5. Extending of the spin-statistics theorem beyond effective field theory.

6. Dark Matter as manifestation of Cantor Dust.

7. Concluding remarks.

References

[1] Available at the following sites:

<http://www.aracneeditrice.it/aracneweb/index.php/pubblicazione.html?item=9788854889972>

https://www.researchgate.net/publication/278849474_Introduction_to_Fractional_Field_Theory_consolidated_version

[2] Available at:

https://www.academia.edu/37998358/Fractional_Field_Theory_and_High_Energy_Physics_-_New_Developments

[3] Available at:

https://www.academia.edu/37997756/Fractional_Field_Theory_and_Physics_Beyond_the_Standard_Model

[4] Available at:

https://www.academia.edu/37977625/Fractional_dynamics_and_the_TeV_regime_of_field_theory

[5] Available at:

https://www.academia.edu/22828041/Fractional_dynamics_and_the_Standard_Model_for_particle_physics

[6] Available at:

<https://www.academia.edu/16945263/Ghost->

[Free Formulation of Quantum Gauge Theory on Fractal Spacetime](#)

[7] Available at:

[https://www.academia.edu/37997555/Multifractal Analysis and the Dynamics of Effective Field Theories](https://www.academia.edu/37997555/Multifractal_Analysis_and_the_Dynamics_of_Effective_Field_Theories)

[8] Available at:

[https://www.academia.edu/17785596/Fractional Field Theory and Physics of the Dark Sector](https://www.academia.edu/17785596/Fractional_Field_Theory_and_Physics_of_the_Dark_Sector)

[9] Available at:

[https://www.academia.edu/37635182/Bifurcations and the Dynamic Content of Particle Physics](https://www.academia.edu/37635182/Bifurcations_and_the_Dynamic_Content_of_Particle_Physics)

[10] Available at:

[https://www.academia.edu/29519375/Emergence of Standard Model Symmetries from Multifractal Theory](https://www.academia.edu/29519375/Emergence_of_Standard_Model_Symmetries_from_Multifractal_Theory)

[11] <https://arxiv.org/pdf/cond-mat/0207707.pdf>

[12] <https://arxiv.org/pdf/1606.02957.pdf>

[13] Available at:

[https://www.academia.edu/13641327/Fractal measures and their singularities The characterization of strange sets](https://www.academia.edu/13641327/Fractal_measures_and_their_singularities_The_characterization_of_strange_sets)

[14] Available at:

[https://www.researchgate.net/publication/272400210 Fractals Multifractals and Thermodynamics](https://www.researchgate.net/publication/272400210_Fractals_Multifractals_and_Thermodynamics)

...