

# Multifractal Foundation of Effective Field Theory

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## Abstract

It was recently shown that, regardless of initial conditions, the long-run of multi-variable Renormalization Group flows is prone to end up on 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 and the Higgs bosons from fermions stems from 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. The SM Lagrangian as function of Hausdorff dimensions.
4. Asymptotic limit of the singularity spectrum.
5. Extending of the spin-statistics theorem beyond effective field theory.
6. DM 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](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](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](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](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](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](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)