First Draft

Fractional Renormalization Group and Physics Beyond the Standard Model

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Abstract

A key premise of perturbative Renormalization Group (PRG) equations is that all flows connecting the ultraviolet (UV) and the infrared (IR) sectors of field theory are free from long-range spatial or memory effects. Here we explore a non-equilibrium setting where long-range coupling between consecutive flow states is enabled through the use of fractional operators. We tentatively find that this approach a) opens the door for a non-perturbative removal of the Landau pole, b) provides unforeseen insights into the g-2 and flavor anomalies of the Standard Model (SM), c) hints that the conventional tools of PRG and effective field theory are unable to fully uncover phenomena lying beyond the SM scale.

Key words: Fractional Field Theory, Beyond the Standard Model Physics, Renormalization Group, Fractional Calculus, Landau pole, g-2 anomaly, flavor anomalies.

6. Limitations of low-energy effective SM (SMEFT) and its predictions.

7. Summary and conclusions.

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