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Wavelet view on the Landau poles in quantum field theory

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Following the paper M. Altaisky Phys. Rev. D 93 (2016) 105043, we develop a new approach to the renormalization group, where the effective action functional $\Gamma_A[\phi]$ is a sum of all fluctuations of scales from the size of the system (L) down to the scale of observation (A). It is shown that the renormalization flow equation of the type $\frac{\partial \Gamma_A}{\partial \ln A} = X(A)$ is a limiting case of such consideration, when the running coupling constant is assumed to be a differentiable function of scale. In this approximation, the running coupling constant, calculated at one-loop level, suffers from the Landau pole. In general case, when the scale-dependent coupling constant is a non-differentiable function of scale, the Feynman loop expansion results in a difference equation. This keeps the coupling constant finite for any finite value of scale A. As an example we consider the Euclidean ϕ^4 field theory. The talk is based on the recent paper M.Altaisky and M.Hnatich, Phys. Rev. D 108 (2023)085023.

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