On the Triviality of $\lambda\phi^4$ Model - Numerical studies in different dimensions

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Abstract

The aim of this thesis is to study the long standing problem of triviality of the four dimensional $\lambda\varphi^4$ model. We adopted the DeWitt's Ansatz proposed for the two-point function on the lattice: $\tilde{\Gamma}^{\bar{k}\bar{k}'} = Z\delta_{\bar{k},-\bar{k}'} \Big/ \left(\mu_{\mathrm{R}eff}^2 + K^2(\bar{k}) + \alpha \left[\mu_{\mathrm{R}eff}^2 + K^2(\bar{k}) \right]^2 \right)$ where α is a parameter that measures the departure from triviality. Our approach is different from the traditional method which relied on the analysis of the renormalized coupling constant λ_R. DeWitt's Ansatz was tested in a parallel study by L. Kuppan[46] in 2D $\lambda\varphi^4$ model and has proved to be effective. In this work, Monte Carlo simulations for the 4D Euclidean $\lambda\varphi^4$ model were performed and the simulation results were then fitted with the Ansatz; evidence of non-triviality was found upon evaluating the continuum limit. In addition, consistent preliminary simulation results for 5D $\lambda\varphi^4$ model were obtained. This together with the previous 2D results serves as consistency check on our approach. We also adopted the Chen-Ferrenberg-Landau[44] method to determine accurately the critical point μ_c^2 for different dimensions.