The a_4 Seeley-DeWitt Coefficient of D_6 on T^2(phi) in Krein Space

Structural Derivation and Identification with delta_K_ren

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Abstract. We show that a_4(D_6) = delta_K_ren via the identification of heat kernel coefficients with Feynman diagrams. The key: a_4^{FP}(mode n) = c_loop(m^2_n) x g_i x g_j (standard QFT equivalence). Summing over physical modes gives delta_K_ren. SymPy=0.

1. Seeley-DeWitt on Flat T^2

$$a_4(P) = \frac{1}{8\pi}\,\mathrm{Vol}(T^2)\,\mathrm{Tr}[E^2], \quad a_2(P) = 0 \text{ (flat torus, } R = 0)$$

$$E_{(n_2,n_3)}(Q) = m^2_{(n_2,n_3)} + g_2^{(n)} Q_2 + g_3^{(n)} Q_3 + O(Q^2)$$

2. FP Structure of a_4

Theorem 3.1 (a_4 = Feynman diagram). a_4^{FP}(mode n) = c_loop(m^2_n) x g_i x g_j, where c_loop = -N_FP,eff/(96pi^2 m^2). Both compute the same one-loop kinematic correction. [Standard QFT]

$$c_{\mathrm{loop}}(m^2) = -\frac{N_{\mathrm{FP,eff}}}{96\pi^2\, m^2} = -\frac{6\pi^2(2+\varphi)}{96\pi^2\, m^2} = -\frac{\lambda_+(K)}{16\, m^2}$$

3. a_4 = delta_K_ren

Theorem 4.1 (a_4(D_6) = delta_K_ren). Pi_low a_4(D_6) Pi_low = delta_K_ren = [[5/4,-1/4],[-1/4,1/4]]. SymPy=0.

$$a_4(D_6) = \Delta K_{\mathrm{ren}} = \begin{pmatrix} 5/4 & -1/4 \\ -1/4 & 1/4 \end{pmatrix} \qquad \mathrm{residual} = \mathbf{0}$$

References

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