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6TH WONPAQCD FLASH TALKS

Effect of Magnetic Fluctuations on the Renormalons of a Self-Interacting Scalar Theory

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What are Renormalons?

- Renormalons are a type of divergence that arises from the multiplicity of diagrams that contribute to a physical process [2].
- In a specific set of diagrams, the contribution can come from the IR or UV region when integrating in momenta space.

$$D[x] = \sum_k a_k x^k \quad , \quad a_k \propto k!$$

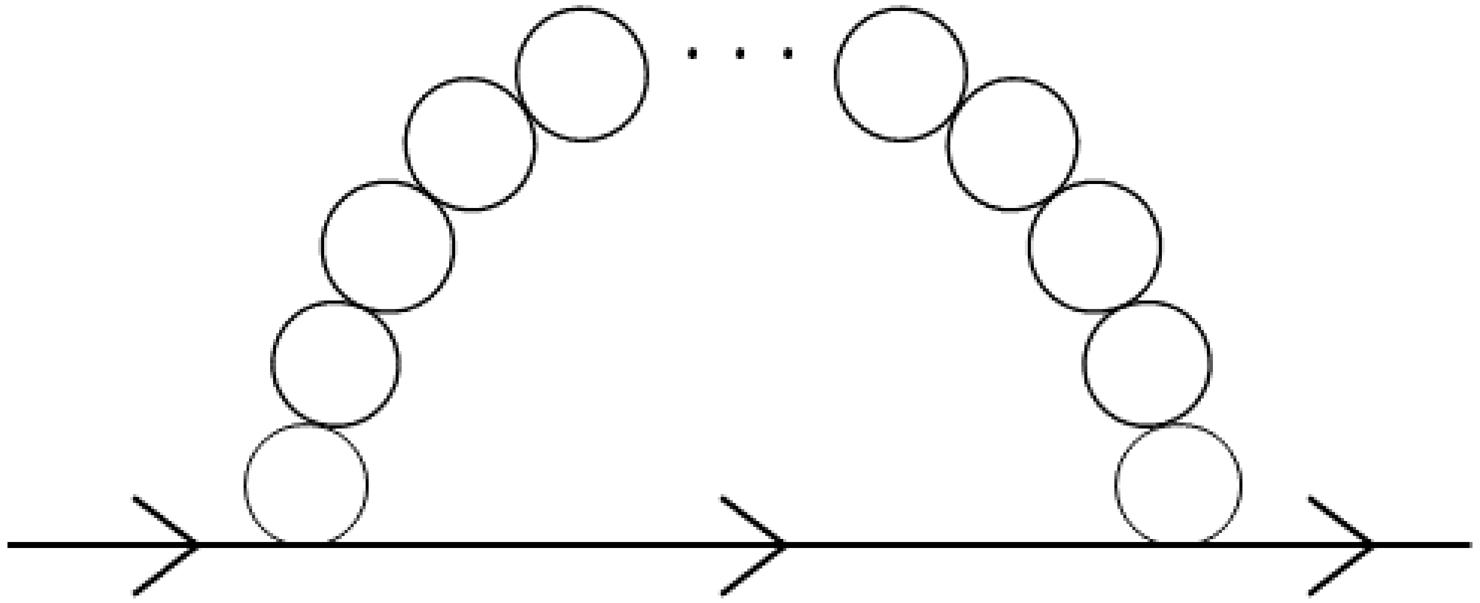

Figure 2: Diagram of the Renormalon-type correction to the propagator in the $\lambda\phi^4$ theory.

Borel Transform Method
(very briefly)

Considering a Divergent expansion:

$$D[a] = \sum_{n=1}^{\infty} D_n a^n$$

Defining the Borel transform as:

$$B[b] = \sum_{n=0}^{\infty} D_{n+1} \frac{b^n}{n!}$$

The Inverse Transform is given by:

$$D[a] = \int_0^{\infty} db\; e^{-b/a} B[b]$$

Sometimes *B[b]* has poles in the positive real axis, spoiling the technique altogether...

In the literature…

- Renormalons in the vacuum and with a constant magnetic field background have been studied…
- They found positive real poles in the Borel plane

$$b_n = n \cdot 32\pi^2, \quad n \in \mathbb{N}$$

- Let us implement magnetic noise!

Magnetic noise as White noise

- A new term is added to the gauge field!

$$A^\mu(x) \to A^\mu(x) + \delta A^\mu(x)$$

- Modeled as static white noise following the theory from [5].

$$\langle \delta A^\mu(x) \delta A^\nu(x') \rangle = \Delta_B \delta^{\mu\nu} \delta^{(4)}(x - x')$$

$$\langle \delta A^\mu(x) \rangle = 0$$

Fluctuations are random. The probability distribution is given by Gaussian white noise.

$$dP[\delta A^\mu] = \mathcal{N} e^{-\int d^4x \frac{[\delta A^\mu(x)]^2}{2\Delta_B}} \mathcal{D}[\delta A^\mu(x)].$$

FMF Renormalon

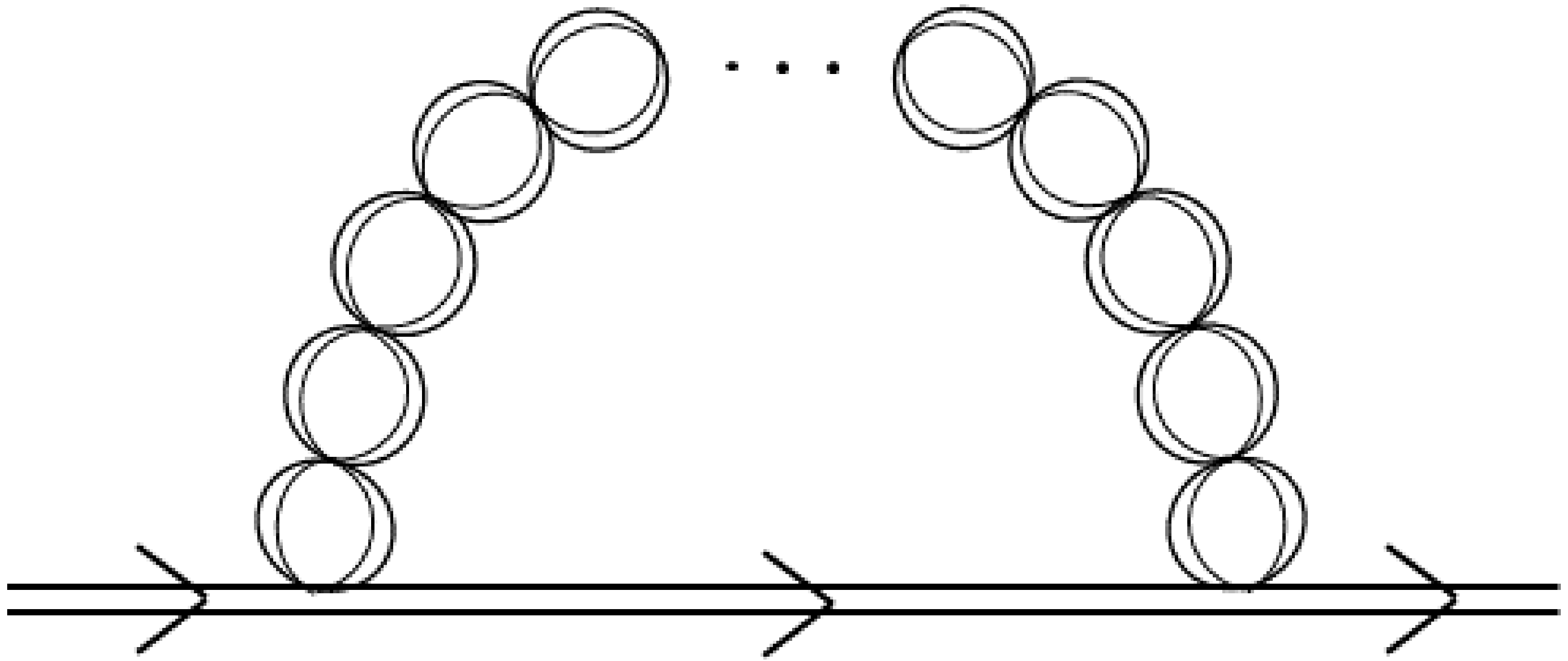

Figure 10: Fluctuating magnetic field dressed k-bubble chain diagram.

$$R_{\Delta,k}(p) = \frac{1}{(-i\lambda)^{k-2}} \int \frac{d^4q}{(2\pi)^4} iD_\Delta(p+q)[B_\Delta(q)]^{k-1}$$

FMF Renormalon

- Once again we have the same behavior for the poles reported by [2] with a couple of differences...

$$\boldsymbol{b_n = n \cdot 32\pi^2, \quad n \in \mathbb{N}}$$

$$B[b] = -2i \sum_{j=1}^{\infty} \frac{g_j(\mu, eB, \Delta_B)}{j \cdot 32\pi^2 - b} + \frac{h_j(\mu, eB, \Delta_B)}{(j \cdot 32\pi^2 - b)^2}$$

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Thank You!

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