

Canonical mass dimension of the various Green's functions in dimensional regularization

Starting with $[\phi] \equiv [\text{Energy}]^{1-\epsilon}$, and $G_C^{[n]}(x_1, \dots, x_n) = \langle 0 | T(\phi(x_1) \dots \phi(x_n)) | 0 \rangle$
 we have for the Bosonic Green's Functions

In $d = 4 - 2\epsilon$ dimensions.

<u>object</u>	<u>Mass Dimension</u>
$\phi(x)$	$1 - \epsilon$
$G_C^{[n]}(x_1, \dots, x_n)$	$n(1 - \epsilon)$
$\tilde{G}_E^{[n]}(p_1, \dots, p_n)$	$n(-3 + \epsilon)$
$G_C^{[n]}(p_1, \dots, p_n)$	$(4 - 3n) + (n - 2)\epsilon$ ← $G_C^{[2]}(p, -p) = \frac{i}{p^2 - m^2 - \Sigma(p^2) + i\epsilon}$
$\Gamma^{[n]}(x_1, \dots, x_n)$	$n(3 - \epsilon)$
$\tilde{\Gamma}^{[n]}(p_1, \dots, p_n)$	$n(-1 + \epsilon)$
$\Gamma^{[n]}(p_1, \dots, p_n) = -i G_{1PI}^{[n]}(p_1, \dots, p_n)$	$(4 - n) + (-2 + n)\epsilon$ ← $G_{1PI}^{[n]}(p_1, \dots, p_n)$ Quantity for which I know Feyn. Rules.

When calculating $\Gamma^{[n]}$ in Dim. Regs, pull $(-2 + n)$ factors of μ^ϵ to the front. Keep all excess factors of μ^ϵ inside ← these will turn into $\ln(\mu^2/\Delta^2)$ when the expansion around $\epsilon \approx 0$ is performed.

$\mathcal{M}(p_1 p_2 \rightarrow p_3 \dots p_n)$	$(4 - n) + (-2 + n)\epsilon$
$d(\text{LIPS})_{n-2}$	$2(-4 + n) + (6 - 2n)\epsilon$
$(\text{Flux})_2$	2

Cross sec.

$$\sigma = \frac{1}{\text{Flux}} \underbrace{|\mathcal{M}|^2}_{\substack{n\text{-dependence} \\ \text{cancels.}}} d(\text{LIPS}) \quad -2 + 2\epsilon$$

[only ϵ remains]