Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

Übungen zur Vorlesung

Theoretische Teilchenphysik

SS 08

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Blatt 5
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Präsenz-Aufgabe 9 ϕ^4 **theory**

Take the perturbative series in terms of the generating functional

$$Z[J] = \frac{1}{Z[0]} \exp\left[i \int d^4x \, \mathcal{L}_{\text{int}} \left(\frac{\delta}{i\delta J(x)} \right) \right] Z_0[J]. \tag{1}$$

Expand for a scalar field theory $\mathcal{L} = \mathcal{L}_0 + \mathcal{L}_{\text{int}}$ with $\mathcal{L}_0 = \frac{1}{2}\left((\partial\phi)^2 - m^2\phi^2\right)$ and $\mathcal{L}_{\text{int}} = -\frac{g}{4!}\phi^4$ to order g and determine the corresponding Feynman diagrams.

Hausaufgabe 7 **crossing symmetry**

Employ the crossing symmetry to derive the differential cross section $d\sigma/d\cos\theta$ for $e^-(p_1)e^+(p_2) \to \gamma(k_1)\gamma(k_2)$. Take the high energy limit $E \gg m$ to obtain

$$\frac{d\sigma}{d\cos\theta} = \frac{2\pi\alpha^2}{s}\left(\frac{1+\cos^2\theta}{\sin^2\theta}\right). \tag{2}$$

Where is this limit valid? How does the differential cross section behave as a function of the scattering angle? Could you explain this from the behavior of the electron propagator?