

PARTICLE PHYSICS 2 : EXERCISE 1

1) Symmetries of the $\Omega^-(sss)$

Explain under the consideration of the wavefunction symmetry, why the existence of the $\Omega^-(sss)$ L=0 baryon provides evidence for a degree of freedom in addition to space \times spin \times flavour.

2) Running couplings

From the expression for the running of α_S with $N_f = 3$, determine the value of Q^2 at which α_S appears to become infinite. Comment on this result.

3) QCD Feynman diagrams lowest-order

Draw the lowest-order QCD Feynman diagrams for the process $p\bar{p} \rightarrow 2\text{jets} + X$ where X represents the remnants of the colliding hadrons.

4) Drell-Yan production

Drell-Yan production of $\mu^+\mu^-$ pairs with an invariant mass Q^2 has been studied in π^\pm interactions with Carbon (which has equal numbers of protons and neutrons). Explain why the ratio

$$\frac{\sigma(\pi^+C \rightarrow \mu^+\mu^-C)}{\sigma(\pi^-C \rightarrow \mu^+\mu^-C)} \quad (1)$$

tends to unity for small Q^2 and tends to 1/4 as Q^2 approaches s.