Present and future perspectives in Hadron Physics



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Supporting ³P₀ Quark-Pair Creation using Landau Gauge Green's Functions

Phenomenological evidence suggests that strong decays of low-excitation hadrons often involve the creation of a light quark-antiquark pair with zero angular momentum, known as the ${}^{3}P_{0}$ mechanism, derived from a scalar bilinear. Despite Quantum Chromodynamics being mediated perturbatively by spin-one gluons and exhibiting chiral symmetry in its Lagrangian, a scalar decay term appears spontaneously upon chiral symmetry breaking. We explore this by employing the quark-gluon vertex in the Landau gauge and the nonperturbative effects recently clarified, alongside a constant chromoelectric field similar to the Schwinger pair production in Quantum Electrodynamics. We compare this to a two-field insertion diagram in QED and argue that the relevant quantum numbers for discussing production are ${}^{3}\Sigma_{0}$, ${}^{3}\Sigma_{1}$, and ${}^{3}\Pi_{0}$, analogous to those in diatomic molecules. Our results indicate significant contributions from the third decay mechanism, supporting the ${}^{3}P_{0}$ phenomenology at momenta at or below the fermion mass scale. However, ultrarelativistic fermions predominantly exhibit ${}^{3}\Sigma_{1}$ quantum numbers. In QED, ${}^{3}\Sigma_{0}$ is dominant, whereas in QCD, ${}^{3}\Pi_{0}$ prevails at sub-GeV momenta due to the requirement to form a color singlet.

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