Strange sea quark-gluon effect to the charge radii and quadrupole moment of nuleons

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Abstract

Characterizing the internal structure of nucleons in terms of sea quarks and gluons is a challenging task in hadronic physics. Both theoretical and experimental studies have validated the impact of valence and sea on different properties of nucleon. We employed the statistical model to investigate the contribution of strange sea to the charge radii and quadrupole moment of nucleons. Here, baryons are assumed to be expanded in terms of various quark-gluon Fock states as $|q\bar{q}g\rangle, |q\bar{q}gg\rangle, |q\bar{q}q\bar{q}\rangle$, $|ggg\rangle$. The statistical approach along with the detailed balance principle is used to find the relative probabilities of Fock states in flavor, spin and color space. The probabilities are computed by including subprocesses like g$\rightleftharpoons$ $q\bar{q}$, g$\rightleftharpoons$ gg, q$\rightleftharpoons$ qg which rely on the chances of splitting and recombination of gluon into $q\bar{q}$ pairs and vice-versa. Due to heavy strange quark, a strangeness suppression factor $(1 - C_l)^{n-1}$ is introduced to address the generation of $s\bar{s}$ pairs from gluon. It depends upon the no. of $s\bar{s}$ pairs present in the sea and the free energy of gluons. The present work also studied the contribution of sea in terms of scalar, vector and tensor sea. We compared our results with available experimental data and found to influenced almost 30% after considering the strange sea. Our results may provide useful information for upcoming experimental findings.