

Investigation of the Transition of a Bound $\pi^+\pi^-$ State into Two Neutral Pions

G. G. Bunatian*

Joint Institute for Nuclear Research, Dubna, Moscow oblast, 141980 Russia

Received July 1, 1998

Abstract—The decay of pionium ($\pi^+\pi^-$ bound state) into two neutral pions has been studied, pion–pion interaction inducing this decay being described by the Weinberg Lagrangian. In performing calculations with this Lagrangian, it proved necessary to take into account the dimensions of the pion, and this quantity appears in the final result. It has been assumed that the formation of a bound $\pi^+\pi^-$ system is due to instantaneous Coulomb interaction, this system being considered on the basis of a consistent nonrelativistic approach employing the Bethe–Salpeter equation. Only the lowest order terms in the fine-structure constant α and $\ln(r_0)$ terms have been retained in the calculations. The dependence of the results on the parameters of the effective Lagrangian has been clarified. The results of the present investigation give grounds to believe that the pionium lifetime is determined by the total pion–pion interaction and not by the $\pi\pi$ scattering lengths. Investigation of pionium decay makes it possible to establish the viability of various descriptions of pion–pion interaction.