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PHENOMENOLOGICAL TREATMENT OF THE MESON MASSES $\rho \longrightarrow A_{N1}(q_1q_2), g \longrightarrow B_{N1}(q_1q_2), h \longrightarrow c_{N1}(q_1q_2$ WITH THE BREIT-FERMI TYPE HAMILTONIAN

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Abstract.

We use the Breit Fermi type Hamiltonian to estimate the masses of mesons taken as bound states of quark and antiquark interacting via a central potential. We find a reasonably good agreement of the model results with the available experimental information . We further find that the results are not altered much if we take the quark- antiquark potential to harmonic oscillator type.

INTRODUCTION

In previous two papers we used the harmonic oscillator (H.O.) model with the Breit-Fermi type relativistic corrections to study the mass spectums of baryons[1] and mesons[2] and found reasonably good agreement with the available experimental data[3]. In this paper we have not used the H.O. states for mesons but have parametrised all the correction terms in the Breit Fermi type Hamiltonian for a general central potential between the quark and antiquark[4] as shown in the following section. The spectroscipic $N\ {}^{2s+1}l_j$ assignment of the mesons[5] ($q_1\bar{q}_2$ states) given in App.A is obtained by using the energy levels of the h.o. potential given by $E_N = (N+3/2)\omega$ with $N = 2n+l$ .For each sublevel specified by n and l, $(l\neq0)$. we have, in addition to the quarks masses, three parameters, i.e.$M_{Nl}(q_1q_2)$,$B_{Nl}(q_1q_2)$ and$C_{Nl}(q_1q_2)$ while for $l = 0$ states (with fixed values of n) we have only two parameters, namely $M_{N0}(q_1q_2)$ and $A_{N0}(q_1q_2)$

In order to take the annihilation processes (through emission of gluons) in $q\ \bar{q}$ states we have to treat these states separately from the $q_1\bar{q}_2$ states $(q_1 \neq q_2)$. However, due to the large number of parameters, predictions which can be compared with the presently available experimental information can not be made for this sector of mesons in the model except the 1P charmonium states. The mass of the $1^1P_1(1^{+-})$ state is predicted to be 3.578 GeV to be compared with future experimental mass of this state when it is discovered.

For the lowest mass $l = o$ states, there are only two parameters, in addition to the quarks masses, namely M_{00} (q_1q_2) and $A_{00}(q_1q_2)$ (the subscripts stand for $n = 0$, $l = 0$ while q_1q_2 indicates that these parameters depend upon the masses of the quark (q_1) and antiquark (q_2)) .The dependence of $A_{00}(q_1q_2)$ on masses of q_1 and q_2 enters through the states and hence is assumed to be not very sensitive. Therefore, we use the some value of A_{00} for all the mesons considered . $M_{Nl}(qq)$ on the other hand, includes the contributions of a number of spin independent correction terms and as such , its dependence on masses of q_1 and q_2 is very sensitive and as such we use different, values of this parameter for different sectors of mesons (see the following rections). As for the quarks masses, we have used the values lying in the conventional range[6], i.e. $m_u = m_d = 0.336$ GeV, $m_s = 0.51$GeV $m_c = 1.6$GeV,$m_b = 4.76$GeV. We have used the same values in the previous two papers [1,2]