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B_c MESON SPECTRUM AND HYPERFINE SPLITTINGS IN THE SHIFTED LARGE-N-EXPANSION TECHNIQUE

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In the framework of potential models for heavy quarkonium, we compute the mass spectrum of the bottom-charmed B_c meson system and spin-dependent splittings from the Schrödinger equation using the shifted-large-N expansion technique. The masses of the lightest vector B_c^* and pseudoscalar B_c states as well as the higher states below the threshold are estimated. Our predicted result for the ground state energy is 6253^{+15}_{-6} MeV and are generally in exact agreement with earlier calculations. Calculations of the Schrödinger energy eigenvalues are carried out up to the third order of the energy series. The parameters of each potential are adjusted to obtain best agreement with the experimental spin-averaged data (SAD). Our findings are compared with the observed data and with the numerical results obtained by other numerical methods.

Keywords: B_c meson; hyperfine splittings; heavy quarkonium.

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1. Introduction

Recently, theoretical interest has risen in the study of the B_c meson, the heavy $c\bar{b}$ quarkonium system with open charm and bottom quarks composed of two non-relativistic heavy quarks. The spectrum and properties of the $c\bar{b}$ systems have been calculated various times in the past in the framework of heavy quarkonium theory.[1] Moreover, the recent discovery of the lightest vector B_c^* meson[2] has inspired new theoretical interest in the subject.[3–6] For the mass of the lightest vector meson, the CDF Collaboration quotes $M_{B_c} = 6.40 \pm 0.39 \pm 0.13$ GeV. This state should be one of a number of states lying below the threshold for the emission of B and D mesons. Such states are very stable in comparison with their counterparts in $c\bar{c}$ and $b\bar{b}$ systems. A particularly interesting quantity should be the hyperfine splitting that for the $c\bar{c}$ case, seems to be sensitive to relativistic and subleading corrections in α_s. For