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BOUND ENERGY MASSES OF MESONS CONTAINING THE FOURTH GENERATION AND ISO-SINGLET QUARKS

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The fourth Standard Model (SM) family quarks and weak iso-singlet quarks predicted by E_6 GUT are considered. The spin-average of the pseudoscalar $\eta_4(n^1S_0)$ and vector $\psi_4(n^3S_1)$ quarkonium binding masses of the new mesons formed by the fourth Standard Model (SM) family and iso-singlet E_6 with their mixings to ordinary quarks are investigated. Further, the fine and hyperfine mass splittings of the these states are also calculated. We solved the Schrödinger equation with logarithmic and Martin potentials using the shifted large-N expansion technique. Our results are compared with other models to gauge the reliability of the predictions and point out differences.

Keywords: Fourth family; bound state energy; logarithmic potential; Martin potential; shifted large N-expansion method; quarkonia, mesons.

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1. Introduction

The toponium quark does not form hadronic states because of its large mass value ($m_t \approx 175$ GeV) and full strength of tbW vertex. On the other hand, there are strong reasons that the fourth Standard Model (SM) family should exist.[1,2] The flavor democracy (Democratic Mass Matrix approach)[2] favors the existence of the nearly degenerate fourth SM family, whereas the fifth SM family is disfavored both by the mass phenomenology and precision tests of the SM.[3] The fourth SM family fermions and also the isosinglet quarks production at $\mu^+\mu^-$ colliders have been investigated.[3] Thus, SM may be treated as an effective theory of fundamental interactions rather than fundamental particles. The multihundreds GeV fourth generation up-type quark (u_4), if exist, will be produced at the CERN Large Hadron Collider (LHC)[3,4] via gluon–gluon fusion.[4] Hence, the observation of the fourth SM family quark in ATLAS has been considered in Refs. 4 and 5. It is expected