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Doubly charmed baryon mass and wave function through a random walks method

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The first detection of a baryon Ξ_{cc}^{++} containing two charm quarks (i.e., having the structure ccu) has been made at CERN by LHCb Collaboration this summer [1]. Its mass was measured to be 3621 MeV. The existence of such a baryon is an inevitable consequence of the existence of the c-quark itself. Calculations of the double charmed baryon mass and wave function may be performed using different approaches, e.g., the quark-diquark model, potential model, QCD sum rules, etc. In the present work evaluation of the (ccu) baryon mass and its wave function is made via the Green Function Monte-Carlo method to solve the three-body problem. This method is based on the idea that the imaginary time Schrödinger equation is equivalent to the diffusion equation. The latter can be solved by random walks, and the Green Function Monte-Carlo method is in its essence the refined version of random walks. For the interquark potential we have chosen the well-known Cornell one with spin-spin δ-function type interaction included. Without any additional input the system gets the structure of the quark-diquark type. The spin-averaged value was calculated to be 3632.8 ± 2.4 MeV with hyperfine splitting taken into account the mass of $S = 1/2$ state is 3601 MeV, that of $S = 3/2$ 3660 MeV. The mean-square radius of the baryon is $\rho \cong 0.5{-}0.6$ fm. The mass of the strange partner (ccs) is predicted to be $m[\Omega_{cc}] = 3760.7 \pm 2.4$ MeV.

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