Physics > Atomic Physics

Bound state properties of four-body muonic quasi-atoms

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Total energies and various bound state properties are determined for the ground states in all six four-body muonic $a^{+} b^{+} \mu^{-} e^{-}$ quasi-atoms. These quasi-atoms contain two nuclei of the hydrogen isotopes p^{+}, d^{+}, t^{+}, one negatively charged muon μ^{-} and one electron e^{-}. In general, each of the four-body muonic $a^{+} b^{+} \mu^{-} e^{-}$ quasi-atoms, where $(a, b) = (p, d, t)$, can be considered as the regular one-electron (hydrogen) atom with the complex nucleus $a^{+} b^{+} \mu^{-}$ which has a finite number of bound states. Furthermore, all properties of such quasi-nuclei $a^{+} b^{+} \mu^{-}$ are determined from highly accurate computations performed for the three-body muonic ions $a^{+} b^{+} \mu^{-}$ with the use of pure Coulomb interaction potentials between particles. It is shown that the bound state spectra of such quasi-atoms are similar to the spectrum of the regular hydrogen atoms, but there are a few important differences. Such differences can be used in future experiments to improve the overall accuracy of current evaluations of various properties of hydrogen-like systems, including the lowest-order relativistic and QED corrections.

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