

Bound-state QED calculations for antiprotonic helium

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In our recent work [1] we have calculated the relativistic Bethe logarithm contribution at order ma^7 in the two Coulomb center approximation. These results then have been used for improved calculations of the transition energies for the hydrogen isotope molecular ions and antiprotonic helium atoms. The general formula for the one-loop self-energy contribution at the ma^7 order has been obtained in [2]. Including other theoretical contributions in a nonrecoil limit at order ma^7 , such as one-loop vacuum polarization, the Wichman-Kroll contribution, the complete two-loop contribution, etc, and the leading term of the ma^8 order one gets transition energies for the ro-vibrational transitions of the \bar{p} -He with the relative uncertainty of $\sim 4 \cdot 10^{-11}$. We show that our latest results make feasible determination of the electron-to-antiproton mass ratio m_p/m_e using antiprotonic helium spectroscopy with a fractional precision $3.6 \cdot 10^{-11}$, while from the hydrogen molecular ions the electron-to-proton mass ratio may be determined with a relative uncertainty of $1.5 \cdot 10^{-11}$.

[1] V.I. Korobov, L. Hilico, and J.-Ph. Karr, Phys. Rev. A 87, 062506 (2013).

[2] V.I. Korobov, L. Hilico, and J.-Ph. Karr, Phys. Rev. Lett. 112, 103003 (2014); V.I. Korobov, L. Hilico, and J.-Ph. Karr, Phys. Rev. A 89, 032511 (2014).

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