

Title of abstract

Andreev Oleg
e-mail@address.ru

Scientific adviser: Dr. Ivanov A.A., Department of Quantum Mechanics, Faculty of Physics, Saint-Petersburg State University

Investigations of the hyperfine structure of highly charged ions are motivated by a possibility to test quantum electrodynamics in extremely strong electric and magnetic fields. In order to eliminate the uncertainty of the theoretical prediction due to the nuclear structure effects simultaneous study of hydrogenlike, lithiumlike and boronlike ions with the same nucleus is required. While the one-electron quantum-electrodynamic correction to the hyperfine structure was evaluated to high enough accuracy the screening effects on it were calculated in effective potential approach only.

The aim of the present work is to evaluate the inter-electronic interaction effects of order $1/Z$ on the vacuum-polarization correction to the hyperfine structure of highly charged lithium and boronlike ions within the rigorous QED approach. These calculations were accomplished so far only in the Uehling approximation for the vacuum polarization potential.

The significant progress in the present research has been achieved. Wichmann-Kroll contributions calculation has been carried out, and electric and magnetic vacuum-polarization loop Wichmann-Kroll corrections evaluation has been finished by now. These corrections have already been calculated before, but it was important to repeat them, improving numeric technique and testing Green functions for different nuclear charge distributions. For magnetic loop and light-by-light scattering diagram only analytical approximate Green functions for shell model of nuclear charge distribution were used before. Now electric and magnetic vacuum-polarization loops have been calculated employing numerically-generated Green functions for arbitrary nuclear charge distribution model. Now it is already possible to compile the most precise theoretical values for screened vacuum-polarization correction to the hyperfine splitting, employing the discussed Wichmann-Kroll contributions, as it has been done so far in the Uehling approximation only. Two more contributions are to be calculated to complete the investigation - the Wichmann-Kroll part of light-by-light scattering diagram and the light-by-light scattering diagram with a magnetic vacuum-polarization loop.

References

1. J.E.Rowe, I.L. Shay // Phys. Rev. B, v. 3, № 2, p. 163, (1971).