# Relativistic calculations of the nuclear recoil effect in highly charged few-electron ions

N, A. Zubova[1], V. M. Shabaev[1], I.I Tupitsyn[1], G. Plunien[2]

*[1]Department of Physics, St. Petersburg State University, Ulianovskaya 1, Petrodvorets, St. Petersburg 198504, Russia*

*[2]Institut fur Theoretische Physik, TU Dresden, Mommsenstrasse 13, Dresden, D-01062, Germany*

zubova@pcqnt1.phys.spbu.ru

As is known, in the nonrelativistic atomic theory the one-electron nuclear recoil effect can be easily evaluated using the reduced electron mass. Full relativistic theory of the recoil effect can be formulated only within quantum electrodynamics [1-4]. However, the lowest-order relativistic recoil corrections can be calculated within the Breit approximation employing a relativistic nuclear recoil operator.

The main goal of the present work is to evaluate the nuclear recoil corrections to the energy levels of highly charged Li- and B-like ions by perturbation theory to zeroth and first orders in the parameter 1/Z. The calculations are restricted to the Breit approximation, where the nuclear recoil effect can be described by the following operator (see, e.g., Ref. [4]):

$$H = \frac{1}{2M}\sum_{i,k}\Big[\vec{p_i}\cdot\vec{p_k} - \frac{\alpha Z}{r_i}\Big(\vec{\alpha_i} + \frac{(\vec{\alpha_i}\cdot\vec{r_i})\vec{r_i}}{r_i^2}\Big)\cdot\vec{p_k}\Big] .$$

To simplify the derivation of formal expressions of the perturbation series, we employ the quantum field formalism with the closed shells regarded as belonging to a redefined vacuum. The numerical calculations of these expressions to zeroth and first orders in 1/Z are performed using the finite basis set method. Alternatively, the interelectronic-interaction corrections to the recoil effect can be evaluated employing the configuration-interaction and multiconfiguration Dirac-Fock methods [5,6], the results of our calculations are compared with related predictions of Ref. [5,6].

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