Nuclear recoil effect on the $g$ factor of lithiumlike ions

Aleksei V. Malyshev, Vladimir M. Shabaev, Dmitry A. Glazov, Ilya I. Tupitsyn
St. Petersburg State University, Universitetskaya 7/9, 199034 St. Petersburg, Russia

The nuclear recoil effect on the $g$ factor of highly charged Li-like ions is studied [1, 2]. The fully relativistic quantum electrodynamics (QED) calculation of the one-electron recoil contribution to first order in the electron-to-nucleus mass ratio is performed. The two-electron part is evaluated within the lowest-order relativistic (Breit) approximation employing the novel four-component approach. The results for the two-electron recoil term are found to be in disagreement with the previous calculations based on the effective two-component Hamiltonian [3, 4, 5]. The obtained value for the nuclear recoil effect is used to calculate the isotope shift of the $g$ factor of lithiumlike $^{40}\text{Ca}^{17+}$ with $A = 40$ and $A = 48$ which has been recently measured [6]. As the result, the agreement between experiment and theory is significantly improved [1].

In addition, prospects for tests of the QED recoil effect on the $g$ factor in experiments with heavy ions are studied [2]. It is found that, while the QED recoil effect on $g$-factor value is masked by the uncertainties of the nuclear size and nuclear polarization contributions, it can be probed on a few-percent level in the specific difference of the $g$ factors of H- and Li-like heavy ions. This paves a way to test QED in a new region — strong-coupling regime beyond the Furry picture.

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