Nonlinear Zeeman effect in boronlike highly charged ions

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The significant progress in the g-factor studies of highly charged ions was achieved in the last two decades, as a result of both experimental and theoretical work [1, 2]. The substantial accuracy improvement of the electron mass determination has been reached in these studies [3]. It's expected that high-precision g-factor measurements in hydrogen-, lithium- and boronlike ions will provide an independent determination of the fine structure constant α [4, 5]. The ARTEMIS experiment being carried out in GSI is an important step to this goal [6]. It aims at measurement of the Zeeman splitting in boron-like argon. It will be sensitive not only to the linear Zeeman effect (g factors) of the ground and first excited states, but also to the nonlinear effects in magnetic field. At present, the g factor has been well investigated theoretically including the QED, interelectronic-interaction and nuclear effects. The leading order of the quadratic Zeeman effect, the one-loop QED correction, and the one-photon-exchange correction for boronlike argon have been calculated in Ref. [7]. The leading order of the cubic Zeeman effect has been evaluated in Ref. [8]. We present *ab initio* QED calculation of the quadratic Zeeman effect for the ground and first excited states of boronlike ions in the wide range of Z including the first-order corrections: one-photon exchange, self-energy and vacuum polarization. Moreover, we evaluate the one-photon-exchange correction to the cubic Zeeman effect [9]. We employ both the perturbation theory in the magnetic interaction and the nonperturbative approach based on the numerical solution of the Dirac equation in the presence of external magnetic field. Both methods are fully relativistic, i.e., exact to all orders in αZ.

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