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Many-body study of g factor of boron-like argon

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Experiments on few-electron ions of heavy atoms are of great importance to test bound-state QED. In particular, the most accurate value of the electron mass (almost by two orders of magnitude more precise than the value from the independent measurements) has been obtained in the study of g factor of highly charged ion. An independent determination of the fine-structure constant α is expected from the g-factor measurements in few-electron ions. Combined experimental and theoretical studies of the g factor and hyperfine structure can be used to obtain the values of the nuclear magnetic moments. In the present work we consider boronlike argon $40Ar^{13+}$ ion. Experimental study of its g factor at ground and first excited states are in preparation at the Max-Plank-Institut für Kernphysik. Previously three different theoretical values of g factor have been reported with difference in order of 10^{-4}, which is within the accuracy of experiment. So, independent calculation of boronlike argon g factor was necessary.

We performed g-factor calculation of $40Ar^{13+}$ within Dirac-Coulomb-Breit Hamiltonian. To consider electron correlation effects at high level of accuracy coupled cluster approach was applied with single and multiple reference determinants. All electronic excitations up to full CI approach were considered, and fast convergence was achieved. Dirac-Fock calculations were performed within Gaussian basis sets. Breit interaction matrix elements were calculated by using four-index transformation technique, to reduce formal complexity of algorithm. Result of the present work proves one of three mentioned g-factor values and thus can be considered as independent confirmation.

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