QED theory of the g factor of Li-like ions

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Measurements of g-factors of light few-electron ions are combined with advanced *ab initio* theoretical calculations to provide one of the most stringent tests of the bound-state QED theory and the most accurate determination of the electron mass [1, 2, 3]. For light hydrogen-like ions such as C^{5+} and O^{7+}, the current theoretical predictions are capable of matching the 10^{-11} relative precision level achievable in modern experiments. For lithium-like ions, however, the theoretical precision is on the level of 10^{-9} which is an order of magnitude less accurate than the experimental results. Moreover, there was some tension reported in the literature between the theoretical values [4, 5, 6, 7] and experimental results for lithium-like ions.

We here discuss the present status and recent advances in the QED theory of g-factor of light lithium-like ions. *Ab initio* calculations are reported for the electron-structure, self-energy screening, and vacuum-polarization screening effects, without any expansion in the nuclear binding strength parameter $Z\alpha$. Calculations are carried out for different screening potentials, thus varying the starting zeroth-order approximation of the perturbation theory. Comparison of the results obtained with different starting potentials allowed us to access the theoretical uncertainty due to omitted higher-order electron-correlation effects. A subset of higher-order effects for the Coulomb starting potential was calculated and found to yield a surprisingly large numerical contribution. The resulting theoretical values of the g factor of Li-like silicon and calcium are found to be in good agreement with the experimental results.

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