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Estimating the radiative part of QED-effects in systems with supercritical charge

In view of the planned experiments on heavy ions collisions at FAIR (Darmstadt), HIAF (China) and NICA (Dubna), the study of QED-corrections in the systems with large Z turns out to be of a special interest. The supercritical region, when the total charge of the sources exceeds 170, deserves a separate attention, since in this case QED predicts the non-perturbative vacuum reconstructions, which should be followed by the vacuum positron emission. The recent essentially non-perturbative computations show that the vacuum polarization energy demonstrates substantially non-linear behavior in the supercritical region and, under certain conditions, can compete with the Coulomb repulsive forces between colliding nuclei [1, 2]. Hence, an actual problem is the study of the possibility of compensating these effects due to fermionic loops by processes with virtual photon exchange.

Since the fully non-perturbative analysis of these processes in the supercritical region is very difficult, the effective interaction of the electron's magnetic anomaly (AMM) with the Coulomb field of superheavy nuclei by taking into account its dynamical screening at small distances have been investigated. The shift of the electronic levels, caused by this interaction, have been considered for H-like atoms [3, 4] and for compact nuclear quasi-molecules [5]. It is shown that the levels shift has a non-monotonic behavior and near the threshold of the lower continuum decreases both with the increasing the charge and with enlarging the distance between nuclei [3-5].

And although the shift due to AMM is just a part of the whole radiative correction to the binding energy, the behavior of the levels shift due to AMM qualitatively reproduces the behavior of the self-energy shift for the lowest electronic levels [4]. Thus, there appears a natural assumption, that in the overcritical region the decrease with the growing Z and the size of the system of Coulomb sources should take place also for the total self-energy contribution, and so for the other radiative QED-effects with virtual photon exchange.

1. Davydov A., Sveshnikov K., Voronina Y. Vacuum energy of one-dimensional supercritical Dirac–Coulomb system // Int. J. Mod. Phys. A. 2017. V. 32 (11). P. 1750054.
2. Davydov A., Sveshnikov K., Voronina Y. Nonperturbative vacuum polarization effects in two-dimensional supercritical Dirac–Coulomb system II. Vacuum energy // Int. J. Mod. Phys. A. 2018. V. 33 (01). P. 1850005.
3. Roenko A., Sveshnikov K. Perturbativity vs non-perturbativity in QED-effects for H-like atoms with $Z\alpha > 1$ // Int. J. Mod. Phys. A. 2017. V. 32 (22). P. 1750130.
4. Roenko A., Sveshnikov K. Dynamical screening of AMM and QED-effects for large-Z Hydrogen-like atoms // Phys. Part. Nucl. Lett. 2018. V. 15 (1). P. 20—28.
5. Roenko A. A., Sveshnikov K. A. Estimating the radiative part of QED effects in superheavy nuclear quasimolecules // Phys. Rev. A. 2018. V. 97 (1). P. 012113.

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