Model potential approach to calculations of the Lamb shifts in many-electron atoms and ions

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A good theoretical basis for the relativistic atomic calcuations is given by the Dirac-Coulomb-Breit (DCB) equation. Such calculations are generally performed using either the configuration-interaction Dirac-Fock methods or the relativistic many-body perturbation theory methods. In many cases the precision of these calculations has reached a level that requires evaluations of quantum electrodynamics (QED) effects. It can be shown [1] that the QED effects can be included into the DCB equation with the help of an effective QED operator whose matrix elements with one-determinant wave functions are derived order by order from the first principles of quantum electrodynamics. In Ref. [1] this operator was derived to the lowest order approximation that includes one-electron self-energy and vacuum-polarization diagrams. In the present paper we model this operator by a sum of short-range local and nonlocal potentials which are determined using the results of *ab initio* calculations of the QED corrections with the hydrogenlike wave functions. Efficiency of the method is demonstrated by comparison of the model potential results for the Lamb shifts in many-electron ions and atoms with the rigorous QED calculations.

References:

[1] V.M. Shabaev, J. Phys. B **26**, 4703 (1993).