A good theoretical basis for the relativistic atomic calculations 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: