A Bound on Binding Energies and Mass Renormalization in Models of Quantum Electrodynamics

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We study three well known models of matter coupled to the ultraviolet cutoff, quantized radiation field and to the Coulomb potential of arbitrarily many nuclei. Two are nonrelativistic: the first uses the kinetic energy $(p + eA(x))^2$ and the second uses the Pauli-Fierz energy $(p + eA(x))^2 + e\sigma \cdot B(x)$. The third, no-pair model, is relativistic and replaces the kinetic energy with the Dirac operator $D(A)$, but restricted to its positive spectral subspace, which is the "electron subspace". In each case we are able to give an upper bound to the *binding* energy – as distinct from the less difficult ground state energy. This implies, for the first time we believe, an estimate, albeit a crude one, of the mass renormalization in these theories.