THE RELATIVISTIC LOWERING OF THE GROUNDSTATE ENERGY OF HEAVY ATOMS: THE SCOTT CORRECTION

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ABSTRACT. We will start with an overview of spectral results for models of relativistic many particle quantum systems in general. In particular we will discuss a Hamilton operator introduced by Brown and Ravenhall (1950) in more detail. Among other properties, we will present a recent result and show that the infimum $E_{\mathrm{BR}}(Z)$ of the spectrum of the relativistic Hamiltonian of a neutral atom of charge Z has the asymptotic expansion

$$E_{\mathrm{BR}}(Z) = E_{\mathrm{TF}}(Z) + (1/2 - s(Z/c))Z^2 + o(Z^2)$$

uniformly in $Z/c \in [0, 2/(2/\pi + \pi/2)]$. Here c is physically the velocity of light, $E_{\mathrm{TF}}(Z) = E_{\mathrm{TF}}(1)Z^{7/3}$ is the Thomas-Fermi energy of the atoms, and $s(\kappa) := \kappa^2 \mathrm{Trace}(-B(\kappa)_- + S(\kappa)_-)$ where $B(\kappa)$ and $S(\kappa)$ are the hydrogenic Brown-Ravenhall (with velocity of light equal to one) and the hydrogenic Schrödinger operator of coupling constant κ, respectively.

This is joint work with Rupert Frank (Princeton) and Simone Warzel (München).