Asymptotic lower bound for the Brown-Ravenhall operator

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We present our result [1] on relativistic many-particle operators which – according to Brown and Ravenhall – describe the electronic states of heavy atoms. Their ground state energy is investigated in the limit of large nuclear charge and velocity of light. We show that the leading quasi-classical behavior given by the Thomas-Fermi theory is raised by a subleading correction, the Scott correction. Our result is valid for the maximal range of coupling constants, including the critical one. As a technical tool, a Sobolev-Gagliardo-Nirenberg-type inequality is established for the critical atomic Brown-Ravenhall operator. Moreover, we prove sharp upper and lower bound on the eigenvalues of the hydrogenic Brown-Ravenhall operator up to and including the critical coupling constant.

Eventually we compare with similar results by Solevej et al. [3] and Frank et al. [2] for the Chandrasekhar operator.

[1] R. L. FRANK, H. SIEDENTOP, and S. WARZEL. The energy of heavy atoms according to Brown and Ravenhall: The Scott correction, *http://arxiv.org/abs/0805.4441*, 2008.
[2] R. L. FRANK, H. SIEDENTOP, and S. WARZEL. The ground state energy of heavy atoms: relativistic lowering of the leading energy correction. *Comm. Math. Phys.*, 278(2):549–566, 2008.
[3] J. P. SOLOVEJ, T. ØSTERGAARD SØRENSEN, and W. L. SPITZER. The relativistic Scott correction for atoms and molecules, *http://arxiv.org/abs/0808.2163*, 2008.