General m theory of the radiative corrections

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3 Computation and discussion

3.1 Comparison with Q.E.D.

The vacuum polarizations functions of QED were given in Eqs. (32-36) of section 2. These can be compared with the m function according to Eqs. (37-40). We computed the vacuum polarization factors for the limits $r/\lambda_c \ll 1$ and $r/\lambda_c \gg 1$ and the m function used in this work:

$$\mathrm{m}(r) = 2 - \exp\left(\log(2)\exp(-\frac{r}{R})\right). \tag{52}$$

Using atomic units, we have

$$\lambda_c = 0.007297\,\mathrm{a}_0 \tag{53}$$

and the parameter R was chosen as in UFT 429:

$$R = 0.0009\,\mathrm{a}_0. \tag{54}$$

The two QED functions were graphed, together with the square root of the above m function, in Fig. 1, and with an enhanced scale in Fig. 2. All three functions meet in the point $r = \lambda_c$ which is consistent. Similarly, for $r/\lambda_c \gg 1$ the limit 1 is reached in all cases. However, the QED function for $r/\lambda_c \ll 1$ goes to a limit > 1. This would mean $\mathrm{m}(r) > 1$ in our case. According to our results, an average value of $\mathrm{m}(r) > 1$ (being theoretically possible) gives a deepening of the level $2S_{1/2}$ instead of a lifting, which is the observed behaviour. Therefore the QED polarization function has to be doubted in this limit. Either not enough terms have been used in the series expansion (32), or the principal weakness of QED is revealed here.

We also evaluated the average energy of the Lamb shift obtained from QED:

$$\langle V \rangle = \alpha^5 mc^2 \frac{1}{6\pi} \log_e\left(\frac{1}{\pi\alpha}\right). \tag{55}$$

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By this formula, a Lamb shift comes out which is only half the experimental value of $4.372 \cdot 10^{-6}$eV. So far we could not resolve this discrepancy. It seems that the above formula (taken from Wikipedia) is erroneous, revealing further inconsistencies in QED literature.

3.2 Computation of Casimir force

It was shown in section 2, Eq. (20), that the Casimir force is

$$F = -\frac{d\mathrm{m}(r)}{dr}\left(\frac{\mathrm{m}(r)^{\frac{1}{2}}}{2\mathrm{m}(r) - \frac{d\mathrm{m}(r)}{dr}}\right) E_{\mathrm{kin}}. \tag{56}$$

Only the kinetic energy is involved in this expression. By defining

$$f(r) = -\frac{d\mathrm{m}(r)}{dr}\left(\frac{\mathrm{m}(r)^{\frac{1}{2}}}{2\mathrm{m}(r) - \frac{d\mathrm{m}(r)}{dr}}\right) \tag{57}$$

the expectation value of the Casimir force for atomic Hydrogen can be written:

$$\langle F\rangle = \langle f(r) E_{\mathrm{kin}}\rangle . \tag{58}$$

The corresponding integral can be evaluated in analogy to the method presented in UFT 328,3 where the factor $1/\mathrm{m}(r)^{\frac{1}{2}}$ has to be replaced by $f(r)/\mathrm{m}(r)^{\frac{1}{2}}$. Therefore we can write (omitting the potential energy):

$$\begin{aligned}\langle F\rangle = &-\frac{\hbar^2}{2m}\int \left(Y^* \nabla^2_{\theta,\phi} Y d\omega\right)\ R^* \frac{f(r)}{\mathrm{m}(r)^{\frac{1}{2}}} R\, r^2 dr \\ &-\frac{\hbar^2}{2m}\int R^* \frac{\partial}{\partial r}\left(\frac{f(r)}{\mathrm{m}(r)^{\frac{1}{2}}}\right)\frac{\partial R}{\partial r} r^2 dr.\end{aligned} \tag{59}$$

with the wave function definitions given in UFT 428. We evaluated the integrals numerically, with the m function (52) above and the parameter R given by Eq. (54). The results are presented in Fig. 3 for the states $2S_{1/2}$ and $2P_{1/2}$. The physical values can be read at $R = 0.0009$. As expected, the force of the S state is larger than that of the P state because the Lamb shift is larger for S. The force values are in atomic units, whose force unit amounts to $8 \cdot 10^{-8}$N, giving the range of 10^{-14}N for the averaged hydrogenic Casimir force.

3.3 Implications to nuclear physics

There is a resonance condition of the Casimir force, see Eq. (21). The force becomes maximal when the denominator goes to zero:

$$2\mathrm{m}(r) - r\frac{d\mathrm{m}(r)}{dr} \to 0. \tag{60}$$

This was already investigated in UFT 417,3. The resonance condition represents a differential equation for $\mathrm{m}(r)$ with the solution

$$\mathrm{m}(r) = Cr^2 \tag{61}$$

containing a constant C. In UFT 417,3 an m function was constructed which has this quadratic behaviour in the lower r range (see Fig. 5 of UFT 417). Correspondingly, the force is infinite within this range (Fig. 6 in UFT 417). From the fact that there are no infinities in nature we can assume that $\mathrm{m}(r)$ has a horizontal tangent for $r \to 0$, thus justifying the quadratic growth in this range. Applying this finding to atomic nuclei, this means that there is a huge force of Casimir type inside the nucleus. The force rapidly decreases outside, where $\mathrm{m}(r)$ changes into a different form, for example the exponential form used in this work. The inner force represents a short-ranged nuclear force, which could possibly replace the strong and weak interaction of the standard model. This could also be a way of overcoming the phenomenological particle zoo, putting particle physics on an axiomatic theoretical basis.

From numerical models of atomic nuclei it is known that a shell model describes the structure of nuclei with lower cardinal number quite well. The nuclear potential is an averaged potential made up by protons and neutrons. This is similar as in all-electron calculations of the atomic and molecular electronic hull. The fact that the shell model does not work well for heavy nuclei could be related to missing inclusion of an m function.

Another point hitherto not discussed is that the m function changes the time coordinate. Therefore, in regions with $\mathrm{m}(r)$ deviating significantly from unity, the difference between proper time and observer time may be remarkable. The inner clock of atoms will deviate from that of an external observer. Such an argument is known from explaining the lifetime of fast mesons moving with nearly light velocity. It may be that atoms have an "inner life" lapsing quite slower than we do observe. This will will impact models of radioactive decay significantly.

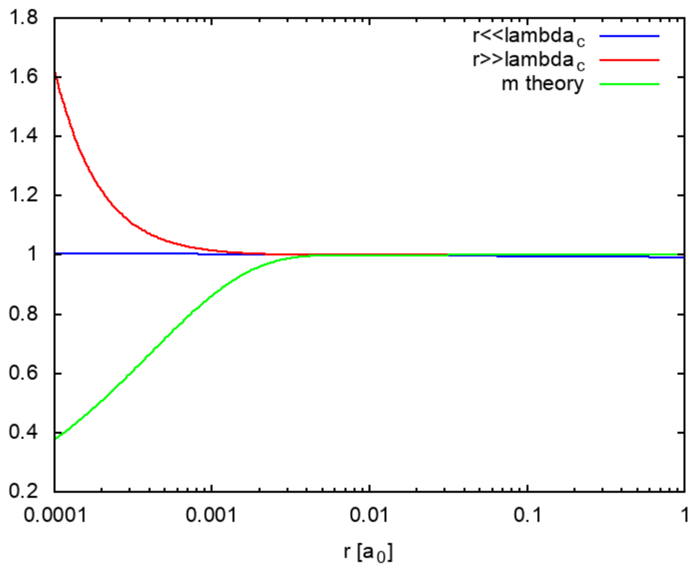

Figure 1: Comparison of vacuum polarization from QED and m theory.

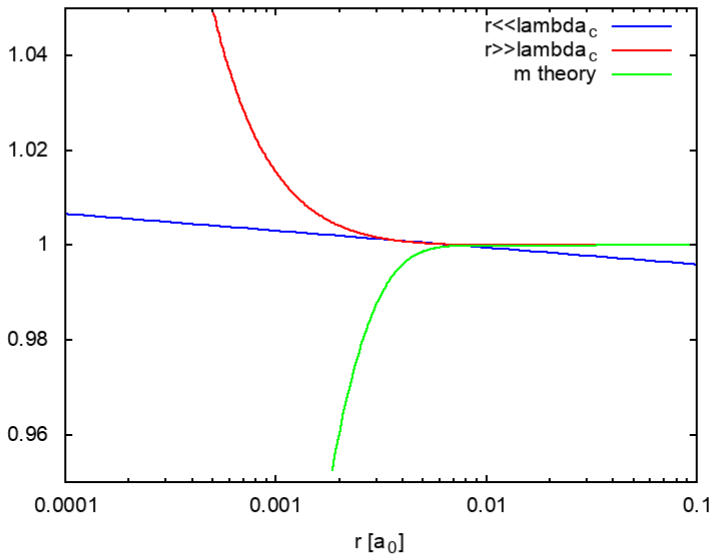

Figure 2: Comparison of vacuum polarization from QED and m theory, smaller scale.

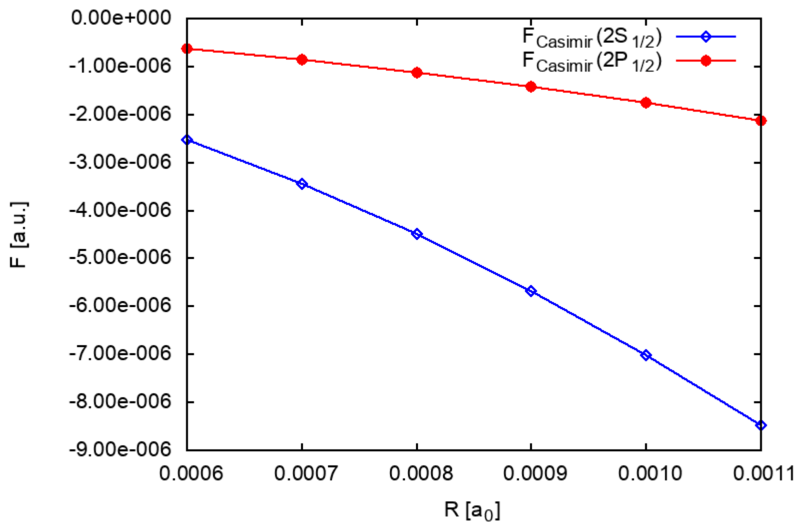

Figure 3: Casimir force of Hydrogen from m theory.