Report on the Evaluation of Chapter 30 Positronium in "The Grand Unified Theory of Classical Physics" by Dr. Randell L. Mills

Prepared by

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Executive Summary

In my analysis, I verified calculations and equations involving the creation of Positronium from electrons and positrons found in Chapter 30 of the book "The Grand Unified Theory of Classical Physics" (January 2020 edition) by Dr. Randell L. Mills. I verified equations and calculations to a high degree of accuracy that are associated with this process. There is a remarkable agreement between the GUTCP calculated equations and the equations I get from my calculations. I verified all the equations from 30.1 through 30.25.

Purpose

A free positron and electron may form a bound system with radius $2a_o$ called positronium. This system is unstable and will decay into two 510 keV photons travelling in opposite directions if you wait a fraction of a second. The sequence of events from formation of positronium to its decay are shown schematically in Figure 30.1 A-F.

Now, positronium can exist with the electron and positron spins parallel (called ortho-positronium) or spins antiparallel (called para-positronium). The respective decay times are 1 ns and 1μs. The system is unstable since it is made of a particle of matter and a particle of antimatter. Eventually these two particles will interact, where they annihilate each other, forming two photons of pure energy.

A force balance equation between the centrifugal force, and the electric and magnetic forces, yields the radius of positronium, which is $2a_o$.

The ionization energy of positronium is found from the theory and it exactly equals the experimentally measured ionization energy of 6.795 eV. Here we see that positronium takes half the ionization energy of Hydrogen (13.59 eV) to remove the electron. Also the positronium system has twice the radius of the Hydrogen atom. Both of these facts show that positronium is a looser-bound system and requires less energy to ionize compared to Hydrogen.

The excited state radii of positronium are found from the theory to be $r_n = n(2a_o)$ where n=integer. The theoretical energy levels of positronium are found and they perfectly match the experimental energy levels.

The energy needed to switch from parallel to anti-parallel spins in the presence of an applied external magnetic field B is found. This is known as the Hyperfine Structure. The electron g-factor is shown to play a role here, and the spin-flip transition can be written involving a magnetic moment of g times the Bohr magneton μ_B.

It's shown that the Total Hyperfine Structure difference in positronium is given by the spin-spin energy interval $\Delta E_{spin-spin}$ plus the spin-orbit coupling energy interval $\Delta E_{s/o}$. The theoretical value for the ground-state Total Hyperfine Structure interval agrees with the experimentally known value to six significant figures! There is a remarkable agreement here between the theory and experiment!

Calculations

I have verified that Equations 30.1-30.5 are true and correct.

I have also verified that Equations 30.7-30.14 are correct.

I have verified that Equations 30.15-30.21 are correct.

And I have verified that Equation 30.23, Equation 30.24 and its value, and the value in Equation 30.25 are correct as shown.

Conclusion

I was able to verify the GUTCP results of Chapter 30 in excellent agreement with my own calculations and derivations of equations. I successfully reproduced all of the equations and derivations found in Chapter 30. This chapter demonstrates that the GUTCP theory is successful at describing the formation of Positronium from electrons and positrons to a high degree of accuracy.

I find my results and calculations to be confirmation that the derivations and equations of Chapter 30 are indeed valid, reproducible, and accurate.