Report on the Evaluation of Chapter 39 Nuclear Forces and Radioactivity 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 nuclear forces, beta decay, alpha decay, and radioactivity found in Chapter 39 of the book "The Grand Unified Theory of Classical Physics" (January 2020 edition) by Dr. Randell L. Mills. There is a remarkable agreement between the GUTCP calculated equations and the equations I get from my calculations. I verified that all the equations found in the chapter from 39.1 through 39.96 were in fact true. It is seen in the chapter that there is an excellent agreement of the energy of the n → p beta decay found from the GUTCP theory and the experimental value. The chapter also finds good agreement between the mass of deuterium from the GUTCP theory and the NIST experimental mass of deuterium. Also, Eqn. 39.96 on alpha decay is found to be in excellent agreement with the experimental data and straight line slope shown in Figure 39.12. This alpha-decay data can also be used to find R_o, the nuclear radii, which agree with the results from nuclear scattering experiments. This shows the remarkable agreement between the GUTCP theory and known measured values.

Purpose

In Chapter 39, the first topic considered is the weak nuclear force and beta decay of a neutron decaying to a proton. The energy of the beta decay is found and compared to its known experimental value. These are found to be in excellent agreement.

Next, the radii of the neutron and proton are found. And a procedure from the GUTCP theory for finding the beta decay energy is outlined, detailing the energy components that go into finding it. Each component of the energy is found, and the GUTCP calculated value of the beta decay energy is found. This result is in excellent agreement with the known experimental value.

Next, neutrinos and anti-neutrinos are discussed in the chapter. The latter are produced in beta decay of neutrons decaying into protons and also in other radioactive decays governed by the Weak Force. The antineutrino is found to be a unique elliptically polarized photon that is either Left-hand elliptically polarized or Right-hand elliptically polarized. A neutrino is also known to be (almost) massless and travels at (almost) the speed of light c. The neutrino and antineutrino have opposite handedness. The nature of the handedness is determined by the quark/gluon functions and the change in the quark/gluon functions during the transition from a neutron to a proton (or a proton decaying to a neutron) with the emission of an electron (or positron). In the case of a neutron decaying into a proton, on a fundamental level, a down quark is converted to an up quark, with the emission of an electron and an antineutrino in order to conserve energy and linear momentum.

The matrices to generate the electric and magnetic vector fields (e&mvf) for neutrinos are the same as those for right- and left-circularly-polarized and linearly polarized photons with the exception that the magnitude of the basis element field is not constant over the spherical surface, but is instead modulated by a trigonometric function that's squared. The right-hand-$\cos^2\theta$-polarized neutrino is given in the chapter. And the field pattern for this case is presented in Figure 39.1. Also the left-hand-$\cos^2\theta$-polarized neutrino is given in the chapter and the field-line pattern for this case is presented in Figure 39.2. Figure 39.3 shows the electric and magnetic field lines of a cosine-squared neutrino. Using an equation from Appendix V, an equation for E_o can be derived.

Next, the equation for the e&mvf for a right-hand-$\sin^2\theta$-polarized neutrino is given in the chapter. And the field-line pattern for this case is shown in Figure 39.4. Likewise the equation for the e&mvf for a left-hand-$\sin^2\theta$-polarized neutrino is given in the chapter. And the field-line pattern for this case is shown in Figure 39.5. Next, Figure 39.6 shows the electric and magnetic field lines of a sine-squared neutrino. Again, using Appendix V, an equation for E_o can be derived for this case.

Due to its unusual angular momentum, the neutrino and the antineutrino interact extremely weakly with matter. There currently are known to be three classes of neutrinos (antineutrinos): the electron neutrino (electron antineutrino), the muon neutrino (muon antineutrino), and the tau neutrino (tau antineutrino).

It's been known that the multi-polarities and polarizations of photons of visible light change when the light interacts with a dichroic material they propagate in. Likewise the interconversion of neutrinos from one type of neutrino to another may also be possible when neutrinos propagate through condensed matter, thereby causing their multi-polarities and polarizations to change. This effect is known as "neutrino oscillation" and corresponds to an oscillation in neutrino flavor.

Deuterium is made of a neutron and a proton with a bound electron. The neutron and proton quarks form a deuterium atomic orbital. In the chapter the deuterium binding energy is found. And there is good agreement between the corresponding mass of deuterium that results from the binding energy and the NIST experimental mass of deuterium.

The multipole moments Q_{lm} and Q'_{lm} can be found for the case of nuclear and X-ray multipole radiation. Likewise the transition probability for electrical multipole and magnetic multipole transitions are found in the chapter. An easier equation is found in the chapter for the long-wavelength limit. It's found that the electric dipole transitions are predicted to be the most intense, with electric quadrupole and magnetic dipole transitions a factor of $(\alpha Z)^2$ weaker, where α=the fine structure constant and Z=the nuclear charge. Figure 39.7 gives a log-log plot of the lifetimes of electric multipole transitions versus energy. There are well-defined bands lying in the vicinity of the straight lines of Figure 39.7. This graph indicates that shorter lifetimes result for higher energies.

Using values in the relationship for the magnetic lifetimes as a function of the electric lifetimes, it's found that electric transitions are 25-120 times more intense than the magnetic transitions. And for most multipoles, this relationship has been experimentally confirmed. Yet for l=1 transitions, magnetic dipole transitions are much more commoner and equally intense as the electric dipole transitions. For energetic transitions in heavy elements, the electric quadrupole amplitude is about 5% of the magnetic dipole amplitude. In addition to emission of radiation, a resonant absorption of nuclear radiation, known as the Mössbauer Effect, is also possible.

The nuclear charge produces a high electric field at the radius of the inner shell electrons of heavy atoms, and the nuclear magnetic moment of a nucleus produces a magnetic field there that is also substantial. Hence K capture is quite high, as well as the emission just discussed above.

Lastly the chapter discusses alpha decay, which can be modeled as electron transmission and reflection by a plane wave at an energy barrier. A Snell's Law for electrons is derived in the chapter. Figure 39.10 shows the allowed wave-vector surfaces for the incident, reflected, and transmitted plane wave vectors. It is shown that total internal reflection can set in for $\theta > \theta_{ic}$.

In alpha decay, the potential barrier height V_B is higher than the energy E of the alpha particle trapped in the nuclear well. This alpha particle can overcome this barrier even though $V_B > E$ by a process known as tunneling.

An equation for the logarithm of the Alpha Decay Constant as a function of $ZK^{-1/2}$ is derived next in the chapter, where Z=charge on the nucleus minus 2 (due to the alpha particle leaving the nucleus) and K=kinetic energy of the alpha particle. This equation is in excellent agreement with the experimental data and straight line given in Figure 39.12. This can also determine R_o, the nuclear radius, which agrees with the results from nuclear scattering experiments.

Calculations

I have verified that Equations 39.1-39.5 are correct.

I have also verified that Equations 39.6 – 39.11 and their values are correct.

I have verified that the Equations 39.12-39.14 are correct.

And I have verified that Equations 39.18-39.27 are true and correct.

I have also shown that Equations 39.31-39.35 are correct.

And I have shown that Equations 39.36-39.41 are correct as written.

I have also shown that Equation 39.42 and its value are correct.

I have verified that Equations 39.43-39.49 are correct as written.

Equations 39.51 and 39.52 are also correct as shown in the book.

Furthermore, Equations 39.54-39.64 are verified as correct by my calculations.

And Equations 39.66-39.76 are correctly written.

Equations 39.77-39.85 are correct as written, as are Equations 39.87-39.90.

I have shown that the values in Equation 39.91 are true.

And lastly, I have shown that Equations 39.92-39.96 are correct.

Conclusion

I was able to verify the GUTCP results of Chapter 39 in excellent agreement with my own calculations and derivations of equations. I successfully reproduced all of the equations, derivations, and calculations found in Chapter 39. It is seen in the chapter that there is an excellent agreement of the energy of the n $\rightarrow$ p beta decay found from the GUTCP theory and the experimental value. The chapter also finds good agreement between the mass of deuterium from the GUTCP theory and the NIST experimental mass of deuterium. Also, Eqn. 39.96 on alpha decay is found to be in excellent agreement with the experimental data and straight line slope shown in Fig. 39.12. This alpha-decay data can also be used to find R_o, the nuclear radii, which agree with the results from nuclear scattering experiments. This shows the remarkable agreement between the GUTCP theory and known measured values of Nature.

I find my results and calculations to be confirmation that the derivations and equations of Chapter 39 are indeed valid, reproducible, and accurate.