# Revised Report on the Evaluation of Chapter 9 in "The Grand Unified Theory of Classical Physics" by Dr. Randell L. Mills

Prepared by

Randy A. Booker, Ph.D.
57 Azalea Drive
Weaverville, NC 28787
(828) 251-6269
Booker@unca.edu

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# Executive Summary

In my analysis, I verified calculations and equations involving the Excited States of Helium found in Chapter 9 of the book “The Grand Unified Theory of Classical Physics by Dr. Randell L. Mills. I verified all of the values in Tables 9.1, 9.2, 9.3, 9.4, 9.5, and 9.6 to a high degree of accuracy.
There is a remarkable agreement between the CP calculated values for the excited Helium energy levels and the experimental energy levels for the excited states of Helium. Every single value in Tables 9.2 and 9.6 were found to be true and accurate based on the CP theory. All of the values in Tables 9.1, 9.3, 9.4, and 9.5 were found to be exact based on the CP theory.

# Purpose

In Chapter 9, all excited states of Helium can be solved exactly in closed form solutions unlike traditional quantum mechanics which must resort to approximation methods. The radius of electron 2 is found by balancing forces, namely the outward centrifugal force on electron 2 is balanced by the electric force and the magnetic force on electron 2. This corresponds to a minimum energy of the system. The excited-state energies are then computed, which are in fact the electric energies at the radius of electron 2. All singlet and triplet states with $l = 0$ and $l \neq 0$ are solved from closed form equations. For over 100 energy levels, the agreement between the predicted results and the experimental results are utterly outstanding. This is one of the great successes of CP: that it predicts the excited states of Helium and gets them right.

Once the radius of electron 2 is determined, then the radius of electron 1 can be solved using the equal and opposite magnetic force of electron 2 on electron 1. This results in a balance of forces between the centrifugal and electric and magnetic forces. $r_1$ is determined after solving a cubic equation in $r_1$.

Table 9.1 compiles these radii $r_1$ and $r_2$ for the singlet excited states of Helium with $l = 0$, the term symbol for the excited states, the CP predicted energy level, the experimental NIST energy level, the difference between the CP and NIST values for the energy level, and the relative difference (Theoretical – Experimental)/Experimental. The agreement between the theoretical energy levels and the experimental energy levels for the excited states of Helium is amazing. Mills calculations are in exceptional agreement with the known experimental energy levels.

Next, the triplet excited states of Helium with $l = 0$ are discussed. The radius of electron 2 is once again found by balancing forces, namely the outward centrifugal force on electron 2 is balanced by the electric force and the magnetic force on electron 2. The excited-state energies are then computed, which are again the electric energies at the radius of electron 2.

Once the radius of electron 2 is determined, then the radius of electron 1 once again can be solved using the equal and opposite magnetic force of electron 2 on electron 1. This results in a balance of forces between the centrifugal and electric and magnetic forces. $r_1$ is again determined after solving a cubic equation in $r_1$.

Table 9.2 compiles these radii $r_1$ and $r_2$ for the triplet excited states of Helium with $l = 0$, the term symbol for the excited states, the CP predicted energy level, the experimental NIST energy level, the difference between the CP and NIST values for the energy level, and the relative difference (Theoretical – Experimental)/Experimental. Once again the agreement between the theoretical energy levels and the experimental energy levels for the excited states of Helium is amazing. Mills calculations are once again in exceptional agreement with the known experimental energy levels.

Then the singlet excited states of Helium with $l \neq 0$ are discussed. The radius of electron 2 is found by considering the force balance equation that achieves the condition that the sum of the mechanical momentum and electromagnetic momentum is conserved. The excited-state energies are then computed, which are in fact the electric energies at the radius of electron 2.

Once the radius of electron 2 is determined, then the radius of electron 1 once again can be solved using the equal and opposite magnetic force of electron 2 on electron 1. This results in a balance of forces between the centrifugal and electric and magnetic forces. $r_1$ is determined after solving a cubic equation in $r_1$.

Table 9.3 compiles these radii $r_1$ and $r_2$ for the singlet excited states of Helium with $l \neq 0$, the term symbol for the excited states, the CP predicted energy level, the experimental NIST energy level, the difference between the CP and NIST values for the energy level, and the relative difference (Theoretical – Experimental)/Experimental. Once again the agreement between the theoretical energy levels and the experimental energy levels for the excited states of Helium is amazing. Mills calculations are in wonderful agreement with the known experimental energy levels.

Then the singlet excited states of Helium with $l \neq 0$ are discussed. The radius of electron 2 is found by considering the force balance equation again. The excited-state energies are then computed, which are again the electric energies at the radius of electron 2.

Once the radius of electron 2 is determined, then the radius of electron 1 is again solved using the equal and opposite magnetic force of electron 2 on electron 1. This results in a balance of forces between the centrifugal and electric and magnetic forces. $r_1$ is determined after solving a cubic equation in $r_1$.

Table 9.4 compiles these radii $r_1$ and $r_2$ for the triplet excited states of Helium with $l \neq 0$, the term symbol for the excited states, the CP predicted energy level, the experimental NIST energy level, the difference between the CP and NIST values for the energy level, and the relative difference (Theoretical – Experimental)/Experimental. Once again the agreement between the theoretical energy levels and the experimental energy levels for the excited states of Helium is remarkable. Mills calculations are in exceptional agreement with the known experimental energy levels.

Table 9.5 lists all of the excited energy levels of Helium, together with the ground state of Helium. Table 9.5 is just a compilation of Tables 9.1-9.4 into one large table. It compiles the radii $r_1$ and $r_2$ for the various states of Helium, the term symbol for the states, the CP predicted energy level, the experimental NIST energy level, the difference between the CP and NIST values for the energy level, and the relative difference (Theoretical – Experimental)/Experimental. In all cases (for over 100 states of Helium), the agreement between the theoretical energy levels and the experimental energy levels for the excited states of Helium is remarkable. Mills calculations are in exceptional agreement with the known experimental energy levels.

Figure 9.1 is a plot of the predicted and experimental energy levels of Helium. The result is a straight line, whose r-squared value is 0.999994, which indicates an exceptional agreement between the predicted and experimental results for Helium.

The chapter concludes with a discussion of spin-orbit coupling of excited states with $l \neq 0$. This discussion is similar to a discussion of this topic found in Chapter 2. Table 9.6 lists the radius $r_2$, the term symbol, and spin-orbit coupling energy of electron 2 for singlet excited states of Helium with $l = 1$.

## Calculation

I have verified that Equations 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, and 9.8 are correct.

I also have verified that Equations 9.10, 9.11, 9.12, 9.14, 9.15, and 9.16 are correct.

I had trouble in calculating $a_{He}$ in order to give me the correct CP values of the energy levels listed in column 5. I deduced that the value Dr. Mills was using for $a_{He}$ was $5.29261 \times 10^{-11}$ m, but was never really sure how to calculate $a_{He}$. My deduced value of $a_{He}$ gave me wonderful agreement between my values and Dr. Mills' values, however, for Table 9.1 as well as the other tables in Chapter 9. I now know that Dr. Mills' calculated $a_{He}$ to be $5.29249 \times 10^{-11}$ m using Eqs. (1.252-1.255 and 1.259).

I have verified that Equations 9.30a, 9.30b, 9.31, 9.32, 9.33, 9.34, 9.35, and 9.36 are in fact correct.

I carefully checked every value in Table 9.2 and find them all to be correct as stated.

I verified that Equations 9.52, 9.53, 9.54, 9.55, 9.56, and 9.57 are correct.

I carefully checked every value in Table 9.3 and find them all to be correct as stated.

I carefully checked every value in Table 9.4 and find them all to be correct as stated.

I carefully checked every value in Table 9.5 and find them all to be correct as stated.

I have verified that Equation 9.70 and its value, Equation 9.71 and its value, and Equations 9.72, 9.73, 9.74, and 9.75 are correct.

I carefully checked every value in Table 9.6 and find them all to be correct as stated.

## Conclusion

I was able to verify the CP results of Chapter 9 in excellent agreement with my own calculations. I verified all of the values in Table 9.1, 9.2, 9.3, 9.4, 9.5, and 9.6 to a high degree of accuracy. There is an exceptional agreement between the CP calculated values for the energy levels and the experimental values for these energy levels. Every single value was found to be true and accurate in these six tables based on the CP theory. I find this to be confirmation that the calculations of Chapter 9 and the values listed in Tables 9.1-9.6 are indeed valid and reproducible. CP can successfully predict the energy levels of the excited states of Helium using closed form solutions (and without resorting to approximation methods as quantum mechanics does to find them).