Report on the Evaluation of Chapter 42 Retrospect: Wave-Particle Duality 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 problems with wave-particle duality and problems with Quantum Mechanics explaining the EPR and Aspect experiments, along with Bell's Theorem, found in Chapter 42 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 equations found in the chapter and the equations I get from my calculations. I verified that all the equations found in the chapter from 42.1 through 42.73 were in fact true. This is a very long chapter, so I only reviewed the first half of the chapter and the last section of the chapter. I reviewed all the equations and calculations from the first page of the chapter down to page 1654, where I stopped at the beginning of the section STATE PREPARATION AND DETECTION. Then I ended my review of the chapter by reviewing the last section of the chapter, which occurs on pages 1681-1682, entitled PHYSICS IS NOT DIFFERENT ON THE ATOMIC SCALE.

Purpose

Chapter 42 starts off with a discussion of the wave-particle duality from Quantum Mechanics. The two-slit experiment using macroscopic particles is shown in Fig. 42.1 and using waves with the two-slit experiment is shown in Fig. 42.2. Each pattern is observed to be different. Fig. 42.3 shows the two-slit experiment now using electrons, which gives an interference pattern like waves do. So electrons, that we think of as particles, also have a wave nature to them, as shown in Fig. 42.4.

Theoreticians of Quantum Mechanics have incorrectly concluded (according to Mills) that the laws of physics that are valid in the macroworld don't hold true in the microworld of the atom. But Dr. Mills' GUTCP book has shown in previous chapters that classical physics has been applied correctly and does correctly describe different structures on the atomic and subatomic level, as well as describing different processes in our world, showing that classical physics does remain valid in the microworld of the atom. Thus the postulates, models, and constructs of quantum mechanics have errors in them. Classical physics applies to the atomic level in refutation to quantum mechanics. Light has been thought of as both a wave and a particle ever since Einstein's photon theory of light of 1905. In 1923, de Broglie extended the wave-particle duality to all matter, such as electrons. Ever since, electrons have been known to have a wave nature. The hydrogen atom is the only real problem that the Schrödinger equation can solve without resorting to approximations. However, it actually fails to solve this problem, since it provides only three quantum numbers and not all four (the 4^{th} quantum number is known as the spin quantum number).

Max Born interpreted Schrödinger's $\psi(x)$ wavefunction for the electron as giving rise to the probability of finding the electron between x and x + dx. But interpretation of the wavefunction is still a source of confusion and conflict in Quantum Mechanics.

To model a moving particle in Quantum Mechanics, a wave group must be used to localize the particle. And in order to localize it, a superposition of an infinite number of waves with different wavelengths must be used. To narrow the wavegroup, the greater is the range of wavelengths that must be used to construct the wave group. This gives rise to the Heisenberg Uncertainty Principle. By this principle, both Δx (localization in space) and Δp (localization in momentum) are forbidden to be precisely known simultaneously.

It is pointed out by Dr. Mills that the wave-particle duality is not due to the Uncertainty Principle. In an experiment reported in the September 3, 1998 issue of *Nature*, performed by Durr, Nonn, and Rempe, they conclude that the "Heisenberg Uncertainty relationship has nothing to do with wave-particle duality". They say the relationship is based on entanglement and correlation. They state that the mere existence of information about a particle's path causes its wave nature to disappear. This cancellation is predicted by classical atomic theory. The Durr et. al. experiment is then described in Chapter 42 in some detail. The scheme of their atomic interferometer is shown in Fig. 42.5, and the experiment is described after this figure. A careful analysis of the experiment finds that the interference pattern has <u>not</u> been measurably distorted by a Bohr-type momentum kick. They state that such Bohr-type kicks are too small to destroy the interference. The disappearance of interference can be explained by Classical Physics, but not by Quantum Mechanics. Hence, the Heisenberg Uncertainty Principle as the basis of the wave-particle duality is shown to be experimentally invalid.

Quantum Mechanics has been shown to fail on many fronts. Quantum Mechanics failed to predict the results of the Stern-Gerlach experiment, which led to the discovery of the fourth quantum number known as spin. You see, the spin quantum number was discovered experimentally and it didn't arise as a result of the Quantum Mechanics theory at that time. In 1926, Dirac developed Quantum Electrodynamics from Quantum Mechanics but had five problems arise when he did so, including infinities in the theory that later had to be removed by renormalization techniques that were developed by Feynman. Dissatisfaction with renormalization has been expressed by many physicists, including Dirac himself. Another failure of Quantum Mechanics is that the electron is a zero-dimensional point that occupies no volume but, according to Schrödinger, are everywhere at once. One aspect of Quantum Mechanics is that no phenomenon exists until it is observed (called collapsing the wavefunction). But this gives rise to different realities depending on whether the phenomenon is observed or not. For example, Does the Moon exist? According to Quantum Mechanics, to those observing the Moon, the Moon exists. But to those not directly observing the Moon, Quantum Mechanics says the Moon may exist or may not exist. It's the old Schrödinger cat dilemma, where the cat is in a state of being alive or dead simultaneously, and you don't know which state the cat is in until you observe the cat. This aspect of Quantum Mechanics gives rise to a confusing reality where there are different realities for different people contemplating the same object. Next in the chapter, a discussion of consciousness and the brain follows.

Next in the chapter, the Einstein, Podolsky, Rosen (or EPR) experiment is discussed as well as the famous Aspect experiment. One disturbing aspect of Quantum Mechanics is that it predicts entanglement and spooky action-at-a-distance, which many people think is

not how our universe works. In the Aspect experiment, two particles that are correlated by spin, say, are moving apart from each other at a large distance from each other. When particle 1 is spin-up, say, then the way the particles are correlated means particle 2 must be spin-down. Later the particles get so far apart that it would take light or any form of communication to take a long time to transfer information between the two particles, since the fastest this information can travel is at the speed of light (by Special Relativity). But in the experiment it's observed that if you cause particle 1 to now be spin-down, then particle 2 immediately flips over and becomes spin-up. Quantum Mechanics calls this process "entanglement", but it violates Special Relativity since the information on the spins would have to travel faster than the speed of light. Quantum Mechanics fails in this case and violates a cherished tenet of Special Relativity.

The Aspect experimental results are predicted classically, as discussed in Chapter 42 (see the results of Fig. 42.9). And it is pointed out that the Aspect experimental results are not predicted by Quantum Mechanics.

Next in the chapter, Bell's Theorem is discussed. Dr. Mills points out in the chapter that the results of Bell's Theorem refute Quantum Mechanics and only Classical Physics correctly gives the right result. Also, the results of Hess and Phillips (mentioned in the chapter) eliminate the need to use spooky actions at a distance (entanglement) to explain the results of EPR-type experiments. Also, another version of the Aspect experiment, called Wheeler's delayed-choice gedanken experiment, is also discussed in detail in the chapter.

The summary of the chapter states that "The classical physical laws are unified and are shown to apply on all scales" – the macroworld and the microworld. The wave-particle duality of the photon has been shown in the chapter to be understood in terms of classical physics. The infinities of Quantum Electrodynamics are removed at once in the GUTCP theory of Dr. Mills by having a finite radius for the electron, unlike what Quantum Mechanics does - it makes the electron zero-dimensional. And the wave-particle duality of the electron can be understood in terms of classical physics from the GUTCP 2-dimensional atomic orbital (the equation of the bound electron) and from the equation of the free electron. Other successes of GUTCP over Quantum Mechanics are summarized at the end of the chapter, as well.

Calculations

I have verified that Equations 42.1-42.8 are correct.

I have also verified that Equations 42.9-42.13 are correct.

I have shown that Equations 42.15-42.17 are correct.

I have shown that Equations 42.19-42.22 are correct, as are Equations 42.25-42.26.

In Equation 42.24 – I didn't know what G1, G2, and G3 stood for. I didn't see an explanation of them in the chapter.

And I have verified that the values in Equations 42.29 and 42.33 are correct.

Next, I have verified that Equations 42.38-42.44 are right.

And I have shown that Equations 42.45-42.52 are correct as written.

Likewise, I have shown that Equations 42.53-58 are correct, as well as Equations 42.61-42.62.

Equation 42.63 and its value have been shown to be correct by me.

Equations 42.65-42.66 have also been shown to be correct.

I have shown that Equations 42.68-42.69 and Equations 42.72-42.73 are correct.

I have shown that Equations 42.70-42.71 and their values are correct as written.

And I have shown that Equation 42.189 is correct.

Conclusion

I was able to verify the results of Chapter 42 in excellent agreement with my own calculations and derivations of equations. I successfully reproduced all of the equations, derivations, and calculations found in Chapter 42, up through Equation 42.73. This chapter concerned itself with problems of the wave-particle duality and problems from Quantum Mechanics dealing with Bell's Theorem, the EPR experiment, and the Aspect Experiment.

I find my results and calculations to be confirmation that the derivations and equations of Chapter 42 are indeed valid, reproducible, and accurate.