Journal of Foundations of Physics and Chemistry, 2011, vol. 1 (2) 127–137

Further refutation of the de Broglie–Einstein theory in the case of general Compton scattering

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The de Broglie postulates of 1922–1924 and the de Broglie–Einstein theory are refuted using their own equations for the general case of Compton scattering of any two interacting particles. It is shown that the textbook equation for Compton scattering is correct only if the mass of the incoming particle is identically zero. If the calculations are carried out correctly the theory fails in several ways, meaning that special relativity is wholly incompatible with quantum theory. This is a major turning point in natural philosophy requiring a new theory such as the Einstein–Cartan–Evans unified field theory for progress to be made.

Keywords: The de Broglie postulates of 1922–1924, Compton scattering, refutation of the de Broglie–Einstein theory.

1. Introduction

Natural philosophy in the twentieth century was based to a large extent on the de Broglie–Einstein theory, which uses the principles of special relativity and quantum theory. Special relativity and quantum theory, when used independently, appeared to give agreement with experimental data, so were accepted as rigorous and correct. Louis de Broglie made an attempt to put these two fundamental, but disparate, aspects of nature together in his famous wave particle duality [1, 2]. The fullest expression of wave particle duality is encapsulated in what are known as the de Broglie–Einstein equations [1, 2] for the relativistic total energy E and the relativistic momentum $\boldsymbol{p}$ of special relativity. Louis de Broglie used the Planck theory to equate E with the photon, the quantum of energy $\hbar\omega$, where $\hbar$ is the reduced Planck constant and where ω is the angular frequency

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of a wave of light or electromagnetic radiation in general. Einstein had earlier produced an equation for the E of a particle, the Einstein energy equation of special relativity. Therefore, the photon is both a particle and a wave, there is wave particle duality. Louis de Broglie famously extended this duality to linear momentum $\boldsymbol{p}$. Earlier, Einstein had introduced the idea of relativistic linear momentum in which the accepted classical momentum is multiplied by the Lorentz factor γ. In his work of 1922–1924, and in his thesis, de Broglie suggested that the momentum of a photon be defined by the quantity $\hbar\boldsymbol{\kappa}$, where $\boldsymbol{\kappa}$ is the wave vector. These ideas by de Broglie led directly to the Schrödinger equation, and shortly thereafter to the Dirac equation. Both energy and momentum were incorporated elegantly into the operator relations of quantum mechanics.

Arthur Compton [3] began a series of experiments on X-ray scattering from a metal foil in order to try to refute the quantum theory, which was by no means universally accepted at the time. However, the results of Compton's experiments appeared to confirm the quantum theory, and it was Compton's work which appeared to put the de Broglie–Einstein theory on such a firm footing that it was accepted unquestioningly for ninety years. Recently, during the development of the Einstein–Cartan–Evans (ECE) unified field theory [4–12], an investigation of the Compton effect was initiated in order to find a way of measuring the photon mass in a routine laboratory experiment. It was found in UFT 158 and 159 that the de Broglie–Einstein theory is severely self-inconsistent, thus catalysing a major turning point in natural philosophy.

In Section 2 of this paper, the theory of Compton scattering of any mass m_1 from another mass m_2 is developed straightforwardly in order to prove beyond doubt that the theory is in general severely self-inconsistent. This means that the fundamentals of the standard model of physics are incorrect because special relativity is inconsistent with the basics of the quantum theory. Special relativity and quantum theory appear to work well when used independently, but when used in the manner of de Broglie and Einstein are completely incompatible. Therefore, much of twentieth century physics is pathological science in the sense of Langmuir, in other words uncritically repeated dogma much in need of change. It is clear that the failure of the de Broglie–Einstein theory will work itself through all of physics, to begin with the theory of the photoelectric effect, a theory which is similar to that of the Compton effect. There is no easy fix for this fundamental crisis in physics, but ECE theory may be able to suggest a way forward by replacing the concept of mass with that of scalar curvature in general relativity and unified field theory. Facile pseudophysics such as string theory will not be able to address the problem because string theory cannot be tested against experimental data and is not natural philosophy. Quantum electrodynamics and its elaborate methods will not be able to address the problem either. Much better quality of thought is needed.

2. Failure of the de Broglie–Einstein theory of the Compton effect

Consider a mass m_1 colliding with an initially stationary mass m_2. The conservation of the energy equation of the de Broglie–Einstein theory is:

$$\gamma m_1 c^2 + m_2 c^2 = \gamma' m_1 c^2 + \gamma'' m_2 c^2. \tag{1}$$

The three Lorentz factors are:

$$\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2}, \; \gamma' = \left(1 - \frac{v'^2}{c^2}\right)^{-1/2}, \; \gamma'' = \left(1 - \frac{v''^2}{c^2}\right)^{-1/2}. \tag{2}$$

where v is the velocity of the incoming particle, v_1 is the velocity of particle m_1 after collision, and v_2 is the velocity of particle m_2 after collision. The de Broglie–Einstein equation for energy produces:

$$\hbar\omega = \gamma m_1 c^2, \tag{3}$$

$$\hbar\omega' = \gamma' m_1 c^2, \tag{4}$$

$$\hbar\omega'' = \gamma'' m_2 c^2. \tag{5}$$

where ω is the angular frequency in radians per second of the wave associated with particle m_1 before collision, ω' is that of m_1 after collision, and ω" that of m_2 after collision. Therefore:

$$\frac{\gamma}{\gamma'} = \frac{\omega}{\omega'}, \; \frac{\omega''}{\omega} = \frac{m_2}{m_1}\frac{\gamma''}{\gamma}, \; \frac{\omega''}{\omega'} = \frac{m_2}{m_1}\frac{\gamma''}{\gamma'}. \tag{6}$$

Express Eq. (1) in terms of γ" using:

$$\gamma = \frac{\omega}{\omega'}\gamma', \gamma'' = \frac{m_1}{m_2}\frac{\omega''}{\omega'}\gamma' \tag{7}$$

then:

$$\gamma' = \frac{m_2}{m_1}\left(1 + \frac{\omega'' - \omega}{\omega'}\right)^{-1} \tag{8}$$

Similarly express Eq. (1) in terms of γ" using:

$$\gamma = \frac{m_2}{m_1}\frac{\omega}{\omega''}\gamma'', \; \gamma' = \frac{m_2}{m_1}\frac{\omega'}{\omega''}\gamma'' \tag{9}$$

then:

$$\gamma'' = \left(1 + \frac{\omega' - \omega}{\omega''}\right)^{-1} \tag{10}$$

Finally, express Eq. (1) in terms of γ using:

$$\gamma' = \frac{\omega'}{\omega}\gamma, \; \gamma'' = \frac{m_1}{m_2}\frac{\omega''}{\omega}\gamma \tag{11}$$

then:

$$\gamma = \frac{m_2}{m_1}\left(\frac{\omega'' + \omega'}{\omega} - 1\right)^{-1}. \tag{12}$$

Therefore, the velocities can be expressed in terms of the frequencies as:

$$v^2 = c^2\left(1 - \left(\frac{m_1}{m_2}\right)^2\left(\frac{\omega'' + \omega'}{\omega} - 1\right)^2\right), \tag{13}$$

$$v'^2 = c^2\left(1 - \left(\frac{m_1}{m_2}\right)^2\left(\frac{\omega'' - \omega}{\omega'} + 1\right)^2\right), \tag{14}$$

$$v''^2 = c^2\left(1 - \left(\frac{\omega' - \omega}{\omega''} + 1\right)^2\right), \tag{15}$$

From Eq. (3):

$$m_1 = \frac{\hbar\omega}{\gamma c^2} = \frac{m_1}{m_2}\left(\omega' + \omega'' - \omega\right) \tag{16}$$

so:

$$m_2 = \frac{\hbar}{c^2}\left(\omega' + \omega'' - \omega\right). \tag{17}$$

From Eq. (4):

$$m_1 = \frac{\hbar\omega'}{\gamma' c^2} = \frac{m_1}{m_2}\left(\omega' + \omega'' - \omega\right) \tag{18}$$

so

$$m_2 = \frac{\hbar}{c^2}\left(\omega' + \omega'' - \omega\right). \tag{19}$$

From Eq. (5):

$$m_2 = \frac{\hbar}{c^2}\left(\omega' + \omega'' - \omega\right) \tag{20}$$

so:

$$m_2 = \frac{\hbar}{c^2}\left(\omega' + \omega'' - \omega\right) \text{ for all } m_1. \tag{21}$$

Therefore, energy conservation alone appears to give the self-consistent result:

$$m_2 = \frac{\hbar}{c^2}\left(\omega' + \omega'' - \omega\right) \text{three times} \tag{22}$$

for mass m_2, but cannot give an expression for m_1 algebraically. The experimentally measurable combination of frequencies ω' + ω" – ω must be constant of the mass m_2 is to be constant as it should. This finding has never been tested experimentally.

The equation of conservation of the relativistic momentum is simply:

$$\boldsymbol{p} = \boldsymbol{p}' + \boldsymbol{p}''. \tag{23}$$

where $\boldsymbol{p}$ is the relativistic momentum of m_1 before collision, $\boldsymbol{p}'$ is that of m_1 after collision, and $\boldsymbol{p}''$ is that of m_2 after collision. The total momentum is conserved. In Eq. (1) the total energy is conserved. Vector analysis gives:

$$p^2 = p'^2 + p''^2 + 2\,p'p''\cos\theta \tag{24}$$

for the components of the momentum. The famous de Broglie equations are:

$$\boldsymbol{p} = \hbar\,\boldsymbol{\kappa}, \quad \boldsymbol{p}' = \hbar\,\boldsymbol{\kappa}', \quad \boldsymbol{p}'' = \hbar\,\boldsymbol{\kappa}'', \tag{25}$$

where the relativistic momentum is proportional to the wave vector through the reduced Planck constant. It follows from Eqs. (24) and (25) that:

$$\kappa''=\kappa^2+\kappa'^2-2\kappa\kappa'\cos\theta \tag{26}$$

The de Broglie postulates for relativistic momentum [1, 2] are:

$$\hbar\boldsymbol{\kappa}=\gamma m_1 \boldsymbol{v}, \tag{27}$$

$$\hbar\boldsymbol{\kappa}'=\gamma' m_1 \boldsymbol{v}', \tag{28}$$

$$\hbar\boldsymbol{\kappa}''=\gamma'' m_2 \boldsymbol{v}''. \tag{29}$$

Therefore:

$$\boldsymbol{\kappa}=\frac{\omega v}{c^2},\quad \boldsymbol{\kappa}'=\frac{\omega' v'}{c^2},\quad \boldsymbol{\kappa}''=\frac{\omega'' v''}{c^2}, \tag{30}$$

and it follows that:

$$\omega''^2 v''^2=\omega^2 v^2+\omega'^2 v'^2-2\omega\omega' v v'\cos\theta \tag{31}$$

for all m_1 and m_2.

From Eq. (22):

$$\omega'+\omega''-\omega=x_2:=\frac{m_2c^2}{\hbar}. \tag{32}$$

The angular frequency ω" may be eliminated between Eqs. (31) and (32) to give:

$$x_2=\frac{\omega\omega'}{\omega-\omega'}-\left(\frac{x_1^{\,2}}{\omega-\omega'}+\frac{1}{\omega-\omega'}\left(\omega^2-x_1^{\,2}\right)^{1/2}\left(\omega^2-x_1^{\,2}\right)^{1/2}\cos\theta\right) \tag{33}$$

where:

$$x_1=\frac{m_1c^2}{\hbar}. \tag{34}$$

Equation (33) is the correct expression for Compton scattering from the de Broglie–Einstein theory, and was checked by computer algebra. Equation (33) reduces to the textbook expression [13, 14] for Compton scattering in the limit:

$$x_1\to 0 \tag{35}$$

whereupon

$$\frac{1}{\omega'}-\frac{1}{\omega}=\frac{\hbar}{m_2c^2}\left(1-\cos\theta\right) \tag{36}$$

In this limit:

$$\omega=2\pi f,\ f\lambda=c,\ \omega=\frac{2\pi c}{\lambda}, \tag{37}$$

so the usual textbook expression is obtained:

$$\lambda'-\lambda=\frac{\mathrm{h}}{m_2c}\left(1-\cos\theta\right). \tag{38}$$

It becomes clear that the routine data of Compton scattering experiments can be described by the de Broglie–Einstein theory only if the incoming mass is zero. This is a clear self contradiction, because m_1 is in general non-zero. For example, in electron Compton scattering m_1 is the well known mass of the electron.

The mass m_1 of the incoming particle may be found straightforwardly in terms of the target mass m_2 by solving Eq. (33). The result is:

$$m_1^{\ 2}=\left(\frac{\hbar}{c^2}\right)^2\left[\frac{1}{2a}\left(-\mathrm{b}\pm\left(\mathrm{b}^2-4\mathrm{ac}'\right)^{1/2}\right]\right] \tag{39}$$

where:

$$\mathrm{a}=1-\cos^2\theta, \tag{40}$$

$$\mathrm{b}=\left(\omega'^2+\omega^2\right)\cos^2\theta-2\mathrm{A}, \tag{41}$$

$$\mathrm{c}'=\mathrm{A}^2-\omega^2\omega'^2\cos^2\theta, \tag{42}$$

$$\mathrm{A}=\left(\omega\omega'-x_2\right)\left(\omega-\omega'\right). \tag{43}$$

In the usual and routine photon Compton scattering, m_1 is the mass of the photon. However, in UFT 158 it has been shown that m_1 is not a constant from the de Broglie–Einstein theory, thus refuting the theory in one of many possible ways recorded in UFT 158–160. In electron Compton scattering, m_1 in Eq. (39) is the mass of the electron, and again is not constant from the de Broglie–Einstein theory.

In the case of scattering at ninety degrees:

$$\cos\theta=0 \tag{44}$$

and Eq. (31) simplifies to:

$$\omega''^2 v''^2 = \omega^2 v^2 + \omega'^2 v'^2 \tag{45}$$

In this case Eq. (45) becomes:

$$\omega^2 + \omega'^2 - \omega''^2 = 2x_1^{\,2} - x_2^{\,2}. \tag{46}$$

Eliminating ω'' between Eq. (46) and the energy conservation equation (22) produces the result:

$$\omega' = \frac{\omega x_2 + x_1^{\,2}}{\omega + x_2} \tag{47}$$

The absurdity of de Broglie–Einstein theory is shown clearly in the case of equal mass scattering at ninety degrees:

$$m_1 = m_2 \tag{48}$$

in which case:

$$m_1 = \frac{\hbar\omega'}{c^2} \tag{49}$$

This is absurd because the mass m_1 is directly proportional to ω' and cannot be a constant.

It is concluded that the basics of the standard model have been thoroughly refuted, and with it the basics of string theory, quantum electrodynamics, and quantum chromodynamics. These are all elaborate contrivances of the human mind, but have nothing to do with nature.

3. Comparison with data and numerical analysis

In this paper, the general equations for Compton scattering have been derived from which the mass of the incoming particle can be derived. Required input values are the input energy or de Broglie frequency ω, the scattered frequency ω' and the scattering angle θ. The equations derived earlier in paper 158 have been simplified further so that a calculation of velocities is no longer required explicitly. With the given mass of the scattering partner m_2, Eq. (39) including the parameters in (40)–(43) can be used to calculate m_1. We started our computer algebra check with Eq. (33) and calculated the explicit form of $m_1^{\,2}$ in Eq. (39). Since a square root has to be taken for obtaining m_1, we have four solutions in total. We checked these solutions with the experimental data set used in paper

Table 1. Compton scattering data at θ = 180° from Ref. [15] and results for photon mass

E (keV)	E-E' (keV)	m_1 (a.u.)
1173.2	963.5	0.017415*(-1)^0.5
1332.5	1117.0	0.056759
661.7	477.0	0.029911
511.0	339.0	0.060614
1274.5	1061.0	0.043792
356.0	207.0	0.022258

158 and obtained the same results for m_1. So the correctness of the calculations in this paper is corroborated.

As an additional and last check in this series of papers, we calculated the photon mass from Compton scattering at θ = 180° of Ref. [15]. The experimental data and our results for m_1 are shown in Table 1. In this special case of full backward scattering, the number of solutions reduces to two, and both differ only in sign. We show only the positive values in Table 1. The first mass value is imaginary, the others are real and lie in the range of some percent of the electron mass. This is another proof of the non-constancy of m_1 resulting from standard theory.

It is interesting to inspect the behavior of the result for a wider range of parameters and to see if there are 'islands of stability'. For this purpose we re-used the experimental data of paper 158 and defined in atomic units:

$$\omega = 2.4315 \times 10^4 \tag{50}$$

$$m_2 = 1, \tag{51}$$

$$\theta = 0...180^{\circ}, \tag{52}$$

$$\omega' = 1.e^4...3\times10^4 \tag{53}$$

In general, there are four solutions for m_1, appearing in two pairs with positive and negative sign. We sorted out the negative solutions and plotted the results in a surface plot for the range of ω' and θ as listed above. The graphs are shown in Figs. 1 and 2. The areas having zero values (black) are those of imaginary mass. It can be seen that both solutions have continuous regions of well-defined values. There is even a symmetry in the angle dependence. One solution rises for increasing scattering angles while the other decreases correspondingly. All this shows that a region of constant mass does not exist, leading??? the de Broglie Einstein theory *ad absurdum*.

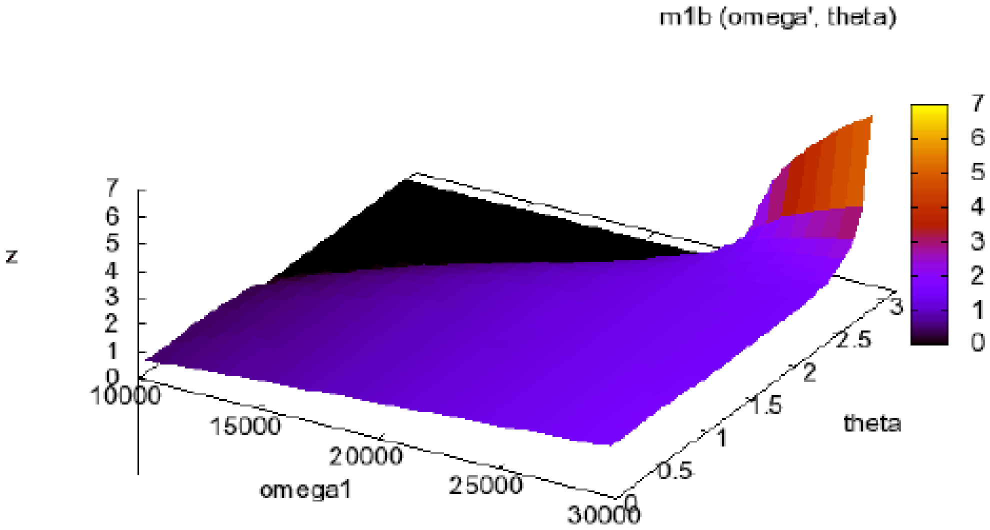

Fig. 1. Surface plot for m_1 (ω', θ), first solution.

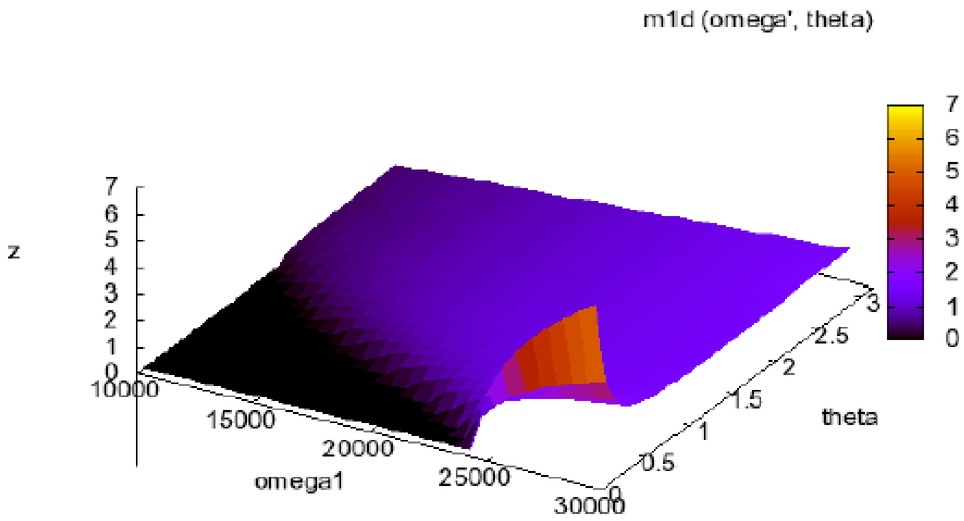

Fig. 2. Surface plot for m_1 (ω', θ), second solution.

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