A Further Inspection of Quantum Theory

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ABSTRACT

I spend time with the peculiar idea that the de Broglie hypothesis is a major implication of the oscillation of mass. Little time is spent in the development of the characteristics of an oscillation, but rather the fundamental resultants of the implication. To be proposed is a correction to the Coulomb force, and by that same token, a physical support to the hypothesis of Quantum theory. In further interest, research zitterbewegung, Dirac's hypothesis of relativistic oscillating masses.

Indexing terms/Keywords

Quantum mechanics, Zitterbewegung, Non-Relativistic Oscillation, Oscillation, Radiation Force, Correction to Couomb Force

On the Need for a Certain Physicality from Quantum Theory

Many attempts have been made at the unification of General Relativity (GR) and Quantum Theory (QT), but there is a fundamental error made with these attempts, as we will discuss. What is the point of such theories? Well, obviously to describe the physical world we live in. QT describes what happens on the tiny scale, and GR describes what happens to bodies on a large scale. The fundamental error in unifying the two subjects is that QT doesn't provide the physical happenings for GR to work, or in other words, QT describes why the world is the way it is, but not how, and this does not philosophically suffice in GR. Must we simply give up, in that the subjects are two different entities? I think the answer is that we mustn't. I think that we should put one theory in terms of the basic mechanics of the other, perhaps by simplifying, or perhaps by taking the physical reality to be our guide. Do I believe QT describes the world? Accurately. Do I believe that QT is the physical truth? Of course not… it is simply a mathematical construct to provide a model that allows for us to predict future outcomes. I will begin very simplistic, but the goal for the first part of the paper is to Classically describe the physical mechanics of QT. I will stick with particles in their ground state, and hence no translational motion.

Mass has a Characteristic Oscillation

Though supported by the de Broglie thesis, I wish to shed some light on what will be the premise of this paper. I begin with a mathematical abstract: there is no difference between an oscillating point in motion, and a traveling wave that represents that point. In other words, if I have, say, a point mass oscillating with respect to the y axis of some known frequency, and this mass were to also have a constant first derivative of time in the x direction, the trajectory of the particle would be that of a sinusoid. This is obvious to me, and perhaps the reader, but it is this fact alone that drove me to investigate the subject of quantum theory due to the introductory explanation of de Broglie waves. I offer the proof of such an abstract:

Let a particle oscillate in the y direction, of some known omega:

$y = y_0\text{Sin}(\omega t)$, and let this particle have a constant first derivative of its position function along the x axis, after some time Δt,

$y = y_0\text{Sin}(\omega(t + \Delta t))$,

and since $\Delta t = \frac{x}{v}$,

$y(x,t) = y_0\text{Sin}(kx + \omega t)$,

where we know that this represents a traveling wave in the negative x direction, and if we change the sign of omega, we obtain a traveling wave in the positive x. We have now deduced that an oscillating particle (in the y) of constant first derivative velocity (in the x) can also be represented as a traveling wave, and vice versa. Whether or not this oscillation is of real or virtual characteristic, I take it to be true that masses oscillate for the remainder of the paper.

Correction to the Coulomb law

The first obvious deduction from our premise is that the Coulomb force must be corrected (I find only for small distances), which will be proven using classical electrodynamics. We must first begin by defining an arbitrary oscillation. The next step is to realize that the charge is accelerating, and thus a radiation field will be created. It is the resulting emission of electromagnetic radiation that creates a net energy flux over an imaginary sphere calculated via the Poynting vector. We next use the Einstein momentum - energy relation to show that there is a force on a nearby particle.

If we imagine a particle oscillating at the origin of a Cartesian coordinate system, the most elementary oscillation that comes to mind is given by the vector position function $\vec{\boldsymbol{R}}$:

$\vec{\boldsymbol{R}}$ = sin(ωt)$\langle \boldsymbol{A}, \boldsymbol{B}, \boldsymbol{D} \rangle$ | constants A,B,D,ω $\in \mathbb{R}$

If we imagine this particle to have charge q, the electric field at some distance r away from the origin is given by the electrodynamic equations derived by the Lie'nard-Wiechert potential. The electric field is given by E,

E = $\frac{q}{4\pi\epsilon}\frac{J}{(r\cdot u)^3}$[($c^2 - v^2$)u + r *x* (u *x* a)] eq1) (Introduction to Electrodynamics, David J Griffiths, page 459, equation 10.72)

r = $\langle \boldsymbol{x}, \boldsymbol{y}, \boldsymbol{z} \rangle$ + sin(ωt)$\langle \boldsymbol{A}, \boldsymbol{B}, \boldsymbol{D} \rangle$

J = |r|

c = speed of light

ϵ = permittivity constant

v = ωcos(ωt) $\langle \boldsymbol{A}, \boldsymbol{B}, \boldsymbol{D} \rangle$

a = - ω^2sin(ωt) $\langle \boldsymbol{A}, \boldsymbol{B}, \boldsymbol{D} \rangle$

u = c$\hat{r}$ – v

$\hat{r}$ = r/|r|

I'm essentially going to follow the standard textbook derivation (specifically Griffiths) of the Larmor equation, then near the end, we insert our premise that masses oscillate

Using the familiar vector algebra rules,

a *x* (b *x* c) = b(a·c) – c(a·b),

this produces the equation:

E = $\frac{q}{4\pi\epsilon}\frac{J}{(r\cdot u)^3}$[(r·a)$\hat{r}$ - a] eq2),

where this represents the radiation part of the field. We can approximate u = c$\hat{r}$ because the constants make v≪c

The Poynting vector,

S = ϵ c($\hat{r}$ (E^2) – E($\hat{r} \cdot \boldsymbol{E}$)) eq3) ,

Where the second term will zero due to the dot product of r,

S = ϵ c$\hat{r}$ (E^2), thus

S = $\frac{q^2H^2\omega^4}{16\pi^2c^2R^2\epsilon}\sin^2(\omega t)\sin^2\theta\ \hat{r}$ eq4)

where theta is the angle between r and a, R is the distance to the mass, and H is the amplitude of the straight line oscillation. We must now make an assumption about the oscillation again. Since we would expect to see a consistent radiation field, meaning symmetric in all directions, we must make theta a function of time. I therefore make the proportionality: θ α t, or θ = Gt for some constant G, thus:

S = $\frac{q^2H^2\omega^4}{16\pi^2c^2R^2\epsilon}\sin^2(\omega t)sin^2(Gt)\hat{r}$

A time average over the period will reduce the sines to ¼ (you can recognize this by $\sin^2(\alpha)$ =- ¼ ($e^{2i\alpha}$ - 2 + $e^{-2i\alpha}$) averaging the exponentials equals zero, and the only terms that survive are ½ * ½) , so-

<S> = $\frac{q^2H^2\omega^4}{64\pi^2c^2R^2\epsilon}\hat{r}$ eq5)

<S> is the power flux leaving the mass. So, the energy passing a point is simply given by the vector. The force is the rate of momentum change per unit time, and this can be found by Einstein's energy equation:

$U^2 = p^2c^2 + m^2c^4$

When m = 0 for the quanta passing the point in observation,

$$S = \frac{dU}{dt} = c\frac{dp}{dt},$$

and now we have the force on nearby test particles.

The force on a nearby particle is thus F = <S>/c

$$F_{radiation} = \frac{q^2H^2\omega^4}{64\pi^2c^3R^2\epsilon}\hat{r} \quad eq6)$$

Clearly now, the correction to the Coulomb force would be this term added to the traditional coulomb term.

$F = F_{coulomb} + F_{radiation}$

$$F = \frac{1}{4\pi\epsilon r^2}Qq\hat{r} + \frac{q^2H^2\omega^4}{64\pi^2c^3R^2\epsilon}\hat{r} \quad eq7)$$

Keep in mind that H^2 is small, and we're dividing by c^3, so Unless R is very small, this radiation force is of neglect.

We have radiation from an oscillating monopole. The equations seem to take the same mathematical form as that of a stationary acoustical monopole. In essence, it seems as though if this oscillation feature is correct, we have created a mechanism by which the great quantum electrodynamic theory is founded. The exchange of "virtual" photons between particles is due to the fact that mass oscillates. This is the physical reality I spoke of earlier. Instead of virtual photons, we have a mechanism by which real photons can be exchanged constantly. What about the violation of conservation of Energy you ask? I will discuss that later.

On the Observation of Quantum Effects

My next assumption is that similar to quantum electrodynamics: the slit experiment can be explained by the fact that subatomic particles radiate. It seems as though these particles, when encased in small areas will have a radiation field that would actually interfere with itself, ultimately creating a potential function that the particle would sit in. Such a potential would dictate the observation of the famous interference patterns, in the sense that the particle will oscillate between these potential squalls. For electromagnetic waves, the interference patterns are an obvious conclusion from waves traversing in the direction of the slit apparatus. Here is my approach: the radiation (in the form of spherical waves) from the electron seeps through the slits. It is essentially the waves in a box problem, in the sense that the waves will be trapped in between the screen and the slit of the traditional slit apparatus. The electron will approach one of the slits, where the probability of going through one slit is the same as going through the second slit, then travel through the waves in a box. As an aside: keep in mind that the wavelength of the EM radiation will be dependent on the velocity of the particle, so we could naturally extend this to relativity.

Let us now think about what the electric field of such a wave would be. I take another approach:

The uncoupled Maxwell equations read:

$$(\nabla^2 - \frac{1}{c^2}\frac{\partial^2}{\partial t^2})E = 0,$$

$$(\nabla^2 - \frac{1}{c^2}\frac{\partial^2}{\partial t^2})B = 0,$$

where one may use the traditional means of solving the equations, or one may convert to spherical coordinates, and obtain the spherical wave equations:

$$(\frac{\partial^2}{\partial r^2} + \frac{2}{r}\frac{\partial}{\partial r} - \frac{1}{c^2}\frac{\partial^2}{\partial t^2})(E) = 0,$$

$$(\frac{\partial^2}{\partial r^2} + \frac{2}{r}\frac{\partial}{\partial r} - \frac{1}{c^2}\frac{\partial^2}{\partial t^2})(B) = 0, \text{ or}$$

$$(\frac{\partial^2}{\partial r^2} - \frac{1}{c^2}\frac{\partial^2}{\partial t^2})(rE) = 0,$$

$$(\frac{\partial^2}{\partial r^2} - \frac{1}{c^2}\frac{\partial^2}{\partial t^2})(rB) = 0,$$

Which tells us that the form of the solution will be

$$E = \frac{Sin(kr-\omega t+\delta)}{r}E_0\hat{\theta},$$

$$B = \frac{Sin(kr-\omega t+\delta)}{r}B_0 = \hat{r} \times E/c = \frac{Sin(kr-\omega t+\delta)}{cr}E_0\hat{\phi},$$

If you don't believe that we can make spherical EM radiation, use the solution as

$$E = \frac{e^\wedge i(kr-\omega t+\delta)}{r} E_0 \hat{\theta},$$

Then verify it with Maxwell's law:

$$\nabla x E = - \frac{\partial B}{\partial t}$$

You will get a real part, and an imaginary part. Simply take the real part.As for the slit experiment, the best approach I see for now is to think simply, and propose that the energy at any point in the box will be proportional to the intensity of an incoming stream of EM waves due to the fact that as an electron enters the slit, it will want to "sit at lowest energy" which would make it more likely that an electron is near lower potential than higher potential.

U α E^2 α I, therefore,

$$I \,\alpha\, \frac{Sin(kr)^2}{r^2} \Rightarrow I = \frac{Sin(kx)^2}{x^2} \beta$$, for some constant beta

This is the most general way to see the relationship without an in depth derivation. When I imagine the oscillation of a mass, I see that the direction of oscillation can't be of concern, thus we can't have a straight-line oscillation, but if we take, as we did earlier that the straight-line oscillation were twirling about the axis, producing a strange spherical shape, we have the simplest oscillation that a mass could have. Let us think fundamentally about what we should do. What quantity must be conserved? Of course, Energy. Earlier we said that energy was leaving the mass in terms of radiation. In order to fix this, I suggest that the oscillation be caused by the fact that the mass is radiating, and vice versa. Thus the energy of oscillation is equal to the energy leaving the mass.

Conclusion

In conclusion, we have created the classical mechanism by which GR and QT can be related. Mass oscillates in its ground state, causing classical radiation to emanate from it. This classical radiation is responsible for the interference patterns in slit experiments, and is a physical mechanism by which QED can be recreated. The generalization to Special Relativity is straight forward, and follows in a similar fashion to that of the Lie'nard generalization. In fact, one can show the similarity of the quantum electrodynamic coulomb correction to the Lie'nard generalization by simply expanding the powers of the relativistic factor. This is the analysis of zitterbewegung.

REFERENCES

1. Griffiths, David J, Introduction to Electrodynamics edition 5, page 459, equation 10.72