FINE STRUCTURE CONSTANT

ELECTRIC CHARGE

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Is usefulness a reliable indicator of the degree of correctness of a theory? I will test fundamental theory by changing its derivation. The results will help to answer this question. I choose to use the theory of electric charge. Electric charge has been an important part of every comprehensive theory. If electric charge has been misinterpreted, it would change a great deal of theory. Therefore, the stakes are high for theoretical physics that electric charge be real. I will proceed to change the interpretation of electric charge. I will show the effect this change causes to the definitions of electric permittivity and the fine structure constant.

I will make a radical change that will be in contradiction to its current interpretation. I will use this example to demonstrate a principle that, I believe, should always be adhered to in physics theory. It is: Every phenomenon must be expressible in units of distance, time, or combinations thereof or it is not yet correctly understood. The reason for this requirement is that all of our information comes to us through the observation of changes of velocity. Changes of velocity contain units of distance and time only.

Since a common origin exists for the real world, then theoretical physics should need only one given for all of its needs. Not a given invented as an afterthought or as evidence of symmetries among diverse sub-theories, but a single given right from the start. All theory should be derivable from it. Although I am not attempting to do that at this time, I mention it because; I will use the theory of electric charge to demonstrate, in an introductory way, how this kind of approach would work. So, I choose electric charge to represent something expressible in terms of distance and/or time.

Without explanation or justification, I change electric charge to be represented theoretically as simply a measure of time. This change should be sufficient to give the appearance of having no orthodox chance of achieving successful theoretical results. It will serve to demonstrate how a radically different, seemingly incomprehensible, interpretation can be successful.

Electric charge will no longer be the mysterious source of electrical and magnetic forces. In this example, it is a period of time and carries the units of seconds. Therefore, instead of the magnitude and units of electron charge being represented as:

$$e = 1.602x10^{-19}\ coulombs$$

It will be represented by:

$e = 1.602x10^{-19}\ seconds$

Since electric charge is a very important fundamental concept and since the speed of light is a very important fundamental property, I will see what association might exist between them. The units for the speed of light are meters/sec. The units of electric charge are seconds. Therefore, in this example, it is proper to multiply them:

$eC = 4.8x10^{-11}\ meters$

This distance is very much like the size of the radius of the hydrogen atom. Therefore, I will take advantage of this and use a simple model of the hydrogen atom as the vehicle to test this interpretation of electric charge. I will allow Δx to represent this small increment of length:

$\Delta x \cong r_H$

I take the liberty of expressing this relation as equality:

$$\frac{\Delta x}{e} = C$$

I will put this interpretation to the test and use it to derive electric permittivity in the *mks* system of units. This system of units is chosen because of the manner in which electric charge is defined. An explanation of the importance of this definition is given in the essay **Fundamental Truth and the Units of Physics**. In the following example, I will introduce the new derivation of electric permittivity into the formula for the fine structure constant. It will help to demonstrate the physical basis of the fine structure constant.

Electric Permitivity

The common formula for electric force contains two quantities that do not have clear physical explanations. The cause of charge q is unknown. Also, permittivity is only understood as a part of k, the constant of proportionality for the formula. I will derive an expression for permittivity using electric charge as a period of time. This result will be used to interpret the physical origin of the fine structure constant. The formula for electric force is:

$$f = \frac{qq}{4\pi\varepsilon\, r^2}$$

I substitute the new interpretation for electric charge. I do not include polarity, because, the new cause of polarity is not included in this essay. The force acting on the electron of the hydrogen atom becomes:

$$f = \frac{e^2}{4\pi\varepsilon\, r^2}$$

For the first energy level of the hydrogen atom:

$r = \Delta x$

Force is also expressed as:

$$f = \frac{\Delta E}{\Delta x}$$

For this example, the increment of distance in the denominator is the length Δx that is used to represent the radius of the hydrogen atom. I will use this same increment of distance Δx in the denominator. Setting the two expressions for force equal to each other gives:

$$\frac{\Delta E}{\Delta x} = \frac{e^2}{4\pi\varepsilon\ \Delta x^2}$$

Simplifying:

$$\Delta E = \frac{e^2}{4\pi\varepsilon\ \Delta x}$$

Solving for permittivity:

$$\varepsilon = \frac{e^2}{4\pi\ \Delta E\ \Delta x}$$

I want time to show clearly in this equation. I substitute an increment of time for electric charge:

$$e = \Delta t$$

Making this substitution:

$$\varepsilon = \frac{\Delta t^2}{4\pi\ \Delta E\ \Delta x}$$

My Δx and Δt have specific values:

$$\frac{\Delta x}{\Delta t} = C$$

Substituting:

$$\varepsilon = \frac{\Delta t}{4\pi\ \Delta E\ C}$$

Multiplying by unity:

$$\varepsilon = \frac{\Delta x}{\Delta x}\ \frac{\Delta t}{4\pi\ \Delta E\ C}$$

Yielding:

$$\epsilon = \frac{\Delta x}{4\pi\ \Delta E\ C^2}$$

Rearranging terms:

$$\varepsilon = \frac{1}{4\pi \frac{\Delta E}{\Delta x} C^2}$$

The proportionality constant of the electric force equation is:

$$k = \frac{1}{4\pi\varepsilon}$$

Substituting the above expression for permittivity into this equation:

$$k = \frac{\Delta E}{\Delta x} C^2$$

Using the equation:

$$f = \frac{\Delta E}{\Delta x}$$

Then k can be expressed simply as:

$$k = fC^2$$

The proportionality constant of the Coulomb electric force equation is equal to the product of the force being exerted on the first energy level electron and the speed of light squared. Next I apply the results from this work to the definition of the fine structure constant.

Fine Structure Constant

The magnitude of the fine structure constant is the ratio of the speed of an electron in the first energy level of a hydrogen atom to the speed of light. However, it has a definition that contains particularly important constants. Its definition contains constants that come from electromagnetic theory, relativity theory and quantum theory. There must be an incredibly important clue to fundamental unity contained in the definition of the fine structure constant.

I will use my new interpretations for e and k to show a physical origin for the fine structure constant. The formula defining the fine structure constant is:

$$\alpha = \frac{2\pi k e^2}{hC}$$

I have previously redefined each expression on the right side with the exception of h Planck's constant. For the purposes of this section, I use Planck's constant as it would normally be used. This use mixes new interpretation with old interpretation. I will show how this mix can offer a physical explanation for the fine structure constant.

With the exception of Planck's constant, I substitute the terms in the equation with expressions derived using electric charge as a measure of time. The expression derived for k is:

$$k = \frac{\Delta E}{\Delta x}\, C^2$$

Substituting an earlier expression for C:

$$k = \frac{\Delta E}{\Delta x}\left(\frac{\Delta x}{\Delta t}\right)^2$$

Canceling Δx:

$$k = \Delta E\ \frac{\Delta x}{\Delta t^2}$$

My expression for e is:

$$e = \Delta t$$

Therefore:

$$ke^2 = \Delta E\ \Delta x$$

Using the equation:

$$C = \frac{\Delta x}{\Delta t}$$

The normal use of h is:

$$h = \frac{E}{\omega}$$

Where: ω represents frequency. Since I am considering the hydrogen atom, I use incremental symbols to represent values. Distance is Δx. Time is Δt. The energy for which the frequency is to be calculated is ΔE. Substituting:

$$h = \frac{\Delta E}{\omega}$$

Substituting all of the above expressions into the equation for the fine structure constant gives:

$$\alpha = \frac{2\pi\ \Delta E\ \Delta x}{\frac{\Delta E}{\omega}\ \frac{\Delta x}{\Delta t}}$$

Canceling terms:

$$\alpha = 2\pi\omega\ \Delta t$$

This suggests the fine structure constant is a measure of an angle in radians. Since the fine structure constant appears to relate in a direct way to the properties of the hydrogen atom, then I expect this result to pertain directly to the hydrogen atom. The frequency of this motion can be calculated from the above result. Solving for frequency:

$$\omega = \frac{\alpha}{2\pi\, \Delta t}$$

I know the numerical value of Δt. So, substituting the numerical values for each term:

$$\omega = \frac{7.299x10^{-3}}{2\pi\,(1.602x10^{-19}\, sec)} = 7.25x10^{15}\, sec^{-1}$$

This frequency solution is close, within about ten percent, to the orbital frequency of the electron. The interpretation of the fine structure constant may be deduced as: The angle in radians moved by the electron during the time required for light to travel from the nucleus to the electron. The angle, in radians, is the distance the electron has moved divided by the radius of the orbit:

$$\alpha = \frac{\Delta x_e}{\Delta x}$$

Dividing the numerator and denominator by Δt, the same period of time used previously:

$$\alpha = \frac{\Delta x_e / \Delta t}{\Delta x / \Delta t} = \frac{v_e}{C}$$

It is known that the fine structure constant does equal the speed of the hydrogen electron divided by the speed of light. My original change had to do with a radical change in units. The result has units that match. In my theoretical work, I show that: Most units of physics are theoretical and are subject to the possibility of revision. They are theoretical by virtue of being introduced for the purpose of substituting for missing knowledge. They allow us to proceed with the development of higher level theory, while, the natures of fundamental properties remain unexplained. They have been very useful, but they may also be wrong. They play an obstructionist role by preventing fundamental physics theory from showing unity from its start.