ON A HYPOTHESIS REGARDING THE PHYSICAL NATURE OF THE WEAK INTERACTION

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Abstract

This paper attempts, in a non-quantum mechanical way, to determine a plausible scenario for the true physical nature of the weak interaction. Examination of dimensions and calculated values for seemingly unrelated numbers results in values which are surprisingly close and seemingly beyond the confines of coincidence. Equating these numbers and inserting the results into a simplistic model for the weak interaction results in a value close to the experimental Fermi weak interaction constant. The question is asked if there really is a relationship between the weak interaction and the gravitational 'constant'. It is noted that energy levels, whether nuclear or orbital, are inherent to the atom as a whole and not necessarily to its separate parts. Subsequently, nuclear energy levels can affect orbital electrons, but, alternatively and more specifically, does there exist a reverse process of electron energy levels sending information to the weak interaction for the purpose of exposing a macroscopic variable gravitational constant?

This paper attempts to investigate, in a non-quantum mechanical way, what the plausible nature of the weak interaction really is. This endeavor starts out by noticing the similarity in values of two particular numbers. We begin by giving the following sets of values which will be used in the calculation of those two numbers.

M_w = vector boson mass of the weak force = 91 m_p
m_p = mass of the proton = 1.673×10^{-24} g
m_e = mass of the electron = 9.109×10^{-28} g
h = Planck's constant = 6.626×10^{-27} erg sec
G_o = gravitational constant = 6.670×10^{-8} dyne cm^2 g^{-2}
$r_{Go} = (G_o\, h/c^3)^{1/2}$ cm
R_{oA} = a value, which is assumed to be comparable to the range of the weak force = ~ 10^{-17} cm
c = speed of light = 3×10^{10} cm sec^{-1}
m_p / m_e = 1836.12

The first number N_1 to be calculated is
$N_1 = r_{Go} M_w^3$ cm g^3
where $r_{Go} = (G_o\, h/c^3)^{1/2}$ cm
$r_{Go} M_w^3 =$
$[6.670 \times 10^{-8}$ dyne cm^2 g$^{-2} \times 6.626 \times 10^{-27}$ erg sec$/(3 \times 10^{10}$ cm sec$^{-1})^3]^{1/2}$ $[91 \times 1.673 \times 10^{-24}$ g$]^3$
$\mathbf{r_{Go} M_w^3 = 1.428 \times 10^{-98}}$ **cm g^3**

The second number N_2 to be calculated is
$N_2 = R_{oA}\, m_e^3 = (10^{-17}$ cm$)(9.109 \times 10^{-28}$ g$)^3$
$\mathbf{R_{oA}\, m_e^3 = 0.756 \times 10^{-98}}$ **cm g^3**

It is extremely coincidental that these two numbers are that close. The hypothesis of this paper is that these are, in reality, an equivalence, viz. $N_1 = N_2$ or
$\mathbf{r_{Go} M_w^3 = R_{oC}\, m_e^3}$
When this assumption is made, a calculated value R_{oC} from this postulated equivalence is

$R_{oC} = r_{Go} M_w^3 / m_e^3 = 1.428 \times 10^{-98}$ **cm g³/ (9.109 x 10⁻²⁸ g)³** or
$R_{oC} = 1.889 \times 10^{-17}$ **cm**, which is roughly ten times less than the value calculated from the uncertainty principle for the vector boson of $91 m_p$.

The dimensions of these two numbers, cm g^3, are not that common in the physical world. The most obvious source could come in the calculation of the energy eigenstates in phase space for a free particle. Using Leighton's notation, $\Delta N = h^{-3} (\Delta x\ \Delta y\ \Delta z\ \Delta p_x\ \Delta p_y\ \Delta p_z)$. As quite a stretch, one would have to consider perhaps two particles of different masses, traveling at similar velocities down boxes of the same cross sectional area but of differing lengths, and that the number of energy eigenstates would be the same for both. In other words,

$\Delta N_1 = h^{-3} (\Delta x_1\ \Delta y_1\ \Delta z_1\ \Delta p_{x1}\ \Delta p_{y1}\ \Delta p_{z1})$
$\Delta N_1 = h^{-3} (\Delta A_1\ \Delta z_1\ M_1^3\ \Delta v_{x1}\ \Delta v_{y1}\ \Delta v_{z1})$
$\Delta N_2 = h^{-3} (\Delta A_2\ \Delta z_2\ M_2^3\ \Delta v_{x2}\ \Delta v_{y2}\ \Delta v_{z2})$

However, $\Delta N_1 = \Delta N_2$, $\Delta A_1 = \Delta A_2$, $\Delta v_{x1} = \Delta v_{x2}$, $\Delta v_{y1} = \Delta v_{y2}$, and $\Delta v_{z1} = \Delta v_{z2}$

We then have $\Delta z_1\ M_1^3 = \Delta z_2\ M_2^3$ and the required dimensions of cm g^3. Notwithstanding this result, such stringent free particle conditions could not exist inside a neutron.

Another way to obtain these dimensions is to solve a differential equation of the form $\frac{dm}{dx} - m^4 A = 0$

where A is a constant, dx is in cm, and m is in g. The solution is $\frac{1}{3A} = m^3 (x - x_0)$, which has the correct dimensions.

Given the following three numbers

$N_1 = r_{Go} M_w^3 \qquad N_2 = R_{oC}\, m_e^3 \qquad h^2 / G_o$

We note that they all have the same dimensions of cm g^3. The first two are postulated equivalents, even though the last number is not, having the value of 6.582×10^{-46} cm g^3. This last number, h^2 / G_o, was introduced, because it not only has the same dimensions as the other two, but it is also related to the gravitational 'constant', as is the first number, N_1. Could this particular set of dimensions, cm g^3, be especially predisposed to a relationship between the weak interaction and the gravitational 'constant'? We can explore this possibility further by attempting to create a simple non-quantum mechanical model of the weak interaction in order to determine its true nature.

To this end, let the model begin with a tiny variable electric dipole according to the following equation
$p = q\,(R_{oC} - R)$ esu cm, where $q = (2hc)^{1/2}$ esu, $R_{oC} = r_{Go}\, M_w^{\,3} / m_e^{\,3}$,
$R = r_G\, M_w^{\,3} / m_e^{\,3}$, where $r_G = (G\, h/c^3\,)^{1/2}$, G now considered to be a variable.
We then form the square of p,
$p^2 = q^2\,(R_{oC} - R)^2$ esu^2 cm^2 , noting that esu^2 cm^2 = erg cm^3 . If we assume that the weak interaction is due to the variable $G \rightarrow 0$, then we can take the limit

$$\lim_{G \to 0} p^2 = q^2 R_{oC}^{\,2}$$

$q^2 R_{oC}^{\,2} = (2hc)(1.889 \times 10^{-17}\text{ cm})^2 =$
$(2 \times 6.626 \times 10^{-27}$ erg sec $\times\, 3 \times 10^{10}$ cm sec^{-1})$(3.568 \times 10^{-34}$ cm^2)
$q^2 R_{oC}^{\,2} = 1.419 \times 10^{-49}$ erg cm^3 . We already know that the **Fermi weak interaction constant is 1.41×10^{-49} erg cm^3** so that this simplistic model is somewhat instructive . It is to be emphasized that this is a model and not a theory. The value of 2 in 2hc above is necessarily used so as to make this theoretical model conform as close as possible to the experimental value of the Fermi constant. If a successful theory incorporating the gravitational 'constant' into the weak interaction is ever developed, then one of the expectations is that this model, or something close to it, would possibly be derived.

What the above hopefully shows is the possibility of a relationship between the gravitational 'constant' and the weak interaction. Assuming that this is the case, how could this posited assertion be verified experimentally?

We know that energy levels, whether nuclear or orbital, are properties of the atom as a whole. We also know that the wave amplitudes for some orbital electrons fall within the nucleus. Thus it should come as no surprise that if a nucleus needs to change to a lower energy level, it has the option of ejecting an orbital electron, called an Auger electron (internal conversion process). This is a powerful concept! The nuclear energy levels can effect a change in the orbital energy levels. The question, which is now obvious, is whether or not this process is reversible. Can an orbital electron energy level effect a change in a nuclear energy level? In the case of this paper, can a change in the orbital energy levels effect a change in the weak interaction energy levels, through a manipulation of the entire atomic wave amplitude, thus manifesting a macroscopic variability in the gravitational 'constant'? (It is known that the process of beta decay emits electrons in a seeming continuous spectrum of energy levels ranging from a few kilovolts to the relativistic range of 15 Mev or more.)

Altering electronic energy levels could characterize the procedure involved in the combustion process. What is combustion? It is one or more molecular reactants (a fuel, an oxidant, and/or heat and/or a catalyst) producing one or more products of combustion plus heat through an intervening procedure consisting of a scrambling of orbital electron energy levels (via the probability amplitudes of the reactants and the products) until an equilibrium in such levels is attained for all the products involved. The question is whether or not there exists a **singular** set of combustion reactants, which, when ignited, will induce an excitational resonance, via the orbital probability amplitudes overlapping the nucleus in the weak interaction, and cause it to unleash a macroscopic variable gravitational 'constant'?

The many-body problem has never been solved, but most assuredly involves extremely complicated non-linear solutions; however, such solutions, in the absence of combustion, must exist, otherwise clouds of electrons could not remain in a stable situation around atoms with atomic numbers $Z > 2$. To put another way, when applied to the atom, is it possible, in the **absence of combustion**, that there could exist many-body solutions of wave amplitudes of the atom which allow for a more or less direct exchange of information between orbital electrons and the neutrons in the nucleus? Usually, as in the case of the Auger electron, the information is sent one-way from the nucleus to the electron. Can this flow of information be reversed and tremendously amplified in the **presence of combustion** of the presumed singular set of combustion reactants so that information is sent from the orbital electrons to the nuclear weak interaction?

If this reversibility can truly occur, then a powerful new energy source could be tapped, based upon a macroscopic variable gravitational 'constant', which would have tremendous upside potential in transportation, space exploration, and military applications. The only way to know for sure is to find that singular experimentum crucis!

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