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The element Hydrogen: Energy-Energy Equivalence

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Abstract

Hydrogen, an atom composed of a single proton and electron, is the fundamental and most abundant element in the universe. Hydrogen composes approximately 90% of the visible universe. As we all know there are different types of energies linked with proton –electron system due to the fundamental forces in any atom such as Kinetic energy, Electrostatic energy, Gravitational energy etc. In quantum framework, Gravity is a very weak force and it's equivalence with other forces were once thought impossible. I strongly believe that all energies are one or the other forms of a single energy and to prove that all energies are a fraction or part of rest mass energy $m_e c^2$. In this paper, I've tried to define a new equation unifying all the energies of a hydrogen atom.

Keywords: Hydrogen Atom, Fundamental Forces, Fine Structure Constant, Rest Mass Energy, Gravitation, Electrostatics.

Introduction

Hydrogen, an atom composed of a single proton and electron, is the fundamental and most abundant element in the universe[1-3]. Hydrogen composes approximately 90% of the visible universe. As we all know there are different types of energies linked with proton –electron system due to the fundamental forces in any atom such as Kinetic energy, Electrostatic energy, Gravitational energy etc. It is illogical to consider different forms of energy distinct rather consider it to be a part of its rest mass energy. Each and every form of energy has a specific reason to be of that particular value maybe due to particle's relative velocity with respect to **C**, speed of light in vacuum. In this paper, I've tried to show the relation between: i. forms of energy such as Gravitational, Electrostatic, Kinetic energies as a function of Rest mass energy. ii. My sole contribution to the equation is the relation between Gravitational Energy and Rest mass Energy while others are just rearrangement of the existing equations but shown in a different way. iii. A hypothetical but possible relation between the three famous constants: Fine structure constant (α) , pi(π) and Euler's constant (e).

It's a necessary and sufficient condition that my first scientific paper should be a reader interactive one. So the readers can or should check the validity of the equations and get them verified yourselves with your own calculators as each and every constants and symbols used in the equation have specific values assigned by CODATA and stored on your calculator[4].

Energy-Energy Equivalence Equation

The interactions in physical systems that cannot be reduced to more simpler interactions are known as Fundamental interactions or fundamental forces. Gravitational, Electromagnetic, Strong Nuclear and Weak Nuclear are four conventionally accepted fundamental interactions. There are different energies associated with the physical system due to these fundamental forces such as Gravitational energy, Kinetic Energy, Electrostatic potential energy etc[5].

The equation unifying all the energies are:

$$m_e c^2 = h\nu = \left[\frac{2}{\alpha^2}\right]\left(\frac{m_e v_e^2}{2}\right) = \left[\frac{1}{\alpha^2}\right]\left(\frac{1}{4\pi\varepsilon_0}\frac{q^2}{a_0}\right) = \left[\frac{1}{\alpha^2} + e^{\left(\frac{\frac{1}{\alpha^2} - \frac{m_p N_A}{M_P}}{\pi}\right)}\right]\left(\frac{G m_p m_e}{a_0}\right)$$

Where, m_e - Mass of Electron in kg, c – Speed of Light in Vacuum in m/s, h-Planck's Constant in Js, ϑ -Frequency in Hz, α - Fine Structure Constant, v_e– Velocity of Electron in first orbit in m/s , q- Elementary Charge in C, a_0 - Bohr radius in m, ε_0 - vacuum permittivity in C^2/Jm, m_p - mass of proton in kg, N_A - Avogadro number, G – Gravitational constant in Jm/kg^2, e – Euler's number/base of natural logarithm, π- pi, M_P-Planck Mass in kg, $M_P = \sqrt{\frac{hc}{G}}$

Gravity is the weakest of the four fundamental forces, yet it is the dominant force in the universe for shaping the large scale structure of galaxies, stars etc. Like Coulomb's law, Gravity is also an inverse square law force which depends upon the product of the two interacting sources[6]. So, unification of fundamental forces is a great area of research.

$$m_e c^2 = \left[\frac{1}{\alpha^2} + e^{\left(\frac{\frac{1}{\alpha^2} - \frac{m_{pN_A}}{M_P}}{\pi}\right)}\right]\left(\frac{Gm_p m_e}{a_0}\right)$$

$$= \left[\frac{1}{\alpha^2} + e^{\left(\frac{\frac{1}{\alpha^2} - \frac{m_{pN_A}}{M_P}}{\pi}\right)}\right] E_G$$

Fine Structure Constant, α

The **fine-structure constant**, also known as Sommerfeld's constant, commonly denoted α , is a fundamental physical constant characterizing the strength of the electromagnetic interaction between elementary charged particles. It is related to the elementary charge (the electromagnetic coupling constant) *e*, which characterizes the strength of the coupling of an elementary charged particle with the electromagnetic field[7]. α , π and e are the most common constants that occur naturally in many cases. A hypothetical relation but possible relation connecting all three are:

$$\sqrt{\alpha} \approx \frac{\pi e}{100}$$

Results and Discussion

An equation unifying all the energies related to electron-proton system has been found out and the equation is[8-9]:

$$m_e c^2 = h\nu = \left[\frac{2}{\alpha^2}\right]\left(\frac{m_e v_e^2}{2}\right) = \left[\frac{1}{\alpha^2}\right]\left(\frac{1}{4\pi\varepsilon_0}\frac{q^2}{a_0}\right)$$

$$= \left[\frac{1}{\alpha^2} + e^{\left(\frac{\frac{1}{\alpha^2} - \frac{m_{pN_A}}{M_P}}{\pi}\right)}\right]\left(\frac{Gm_p m_e}{a_0}\right)$$

Relation between weak Gravitational Energy to the other forms of energy is still unknown. Here is my contribution to the Physical Science. Through my equation, I've equated Gravitational Energy to other forms of energy.

$$m_e c^2 = \left[\frac{1}{\alpha^2} + e^{\left(\frac{\frac{1}{\alpha^2} - \frac{m_{pN_A}}{M_P}}{\pi}\right)}\right]\left(\frac{Gm_p m_e}{a_0}\right)$$

$$= \left[\frac{1}{\alpha^2} + e^{\left(\frac{\frac{1}{\alpha^2} - \frac{m_{pN_A}}{M_P}}{\pi}\right)}\right] E_G$$

A hypothetical but possible relation between Fine Structure Constant, Euler's number and pi.

$$\sqrt{\alpha} \approx \frac{\pi e}{100}$$

Conclusion

In physical theories prior to that of special relativity, mass and energy were viewed as distinct entities. Each body of rest mass m_e possesses rest mass energy which potentially is available for conversion to other forms of energy[10].

It is illogical to consider different forms of energy distinct rather consider it to be a part of its rest mass energy.

$$m_e c^2 = h\nu = \left[\frac{2}{\alpha^2}\right]\left(\frac{m_e v_e^2}{2}\right) = \left[\frac{1}{\alpha^2}\right]\left(\frac{1}{4\pi\varepsilon_0}\frac{q^2}{a_0}\right)$$

$$= \left[\frac{1}{\alpha^2} + e^{\left(\frac{\frac{1}{\alpha^2} - \frac{m_{pN_A}}{M_P}}{\pi}\right)}\right]\left(\frac{Gm_p m_e}{a_0}\right)$$

This equation shows that all energies are a fraction or part of rest mass energy $m_e c^2$. Thus, each and every forms of energy has a specific reason to be of that particular value maybe due to its relative velocity with respect to C, speed of light in vacuum. The equations prove that energies can be equated with the help of Fine Structure Constant. Almost all of the nuclear matter in our Universe is composed of Hydrogen and Helium. So these equations can help us to know more about Black holes and to predict the beginning of Universe.

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