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Preface to Conjecture Based Postulates in Modern Physics

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Abstract: *The theory of relativity is very important to atomic and nuclear physics. Hence, it needs to be examined quite thoroughly, considering relativistic kinematics, or the relativity of space and time (spacetime) and subsequently considering relativistic dynamics, or the relativity of momentum and energy. This paper addresses some challenges and issues regarding those conjecture-based postulates and their consequences.*

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I. Introduction

As per my understanding the “absolute” true law in physics is supposedly to be “nothing is absolute in this universe”, and apparently subsequently it implies “everything is relative”. Hence, these two postulates in their own way differentiates “nothing” from “everything”. The theory of special relativity, set forth by Albert Einstein in 1905, unarguably is one of the greatest achievements of human intellect. Often regarded as esoteric and recondite its prime features ascendfrom the well-known two fundamental postulates. The brilliance of Albert Einstein reconciled the two postulates in a self-consistent theory of physical universe, quite different from that of the universe presented in classical physics. However, the theory of relativity is not hypothetical, numerous experiments firmly confirmed.

Postulate-1: The principle of relativity, is basic also to classical (Newtonian) mechanics. That is, the laws of physics are same, or constraint, in all inertial systems – means, the mathematical form of physical law remains the same – or, the laws of physics take the same form in all inertial frames of reference.

Now this implies we can never say whether an object is moving or where else the object is in rest. It all depends on the above-mentioned inertial frame of reference. And it’s quite difficult as well considering the second law of thermodynamics, that says, “the entropy of the universe is always increasing” which in return gives us an ever-increasing universe.

Postulate- 2: The speed of light in vacuum is absolutely constant, the only cosmological constant of nature independent of inertial system, source, and observer – means, measured in any inertial frame of reference, light is always propagated in empty space with a definite velocity c that is independent of the state of motion of the emitting body – or, the speed of light in free space has the same value “c” in all inertial frames of reference.

The second postulate of relativity is actually an experimental fact. Now based on these postulates we will scrutinize relativistic kinematics, or the relativity of spacetime as well as relativistic dynamics, or the relativity of momentum and energy.

II. Literature Review

Historically, Hendrik Lorentz and Henri Poincaré (1892–1905) derived the Lorentz transformation from Maxwell's equations. A more modern example of deriving the Lorentz transformation from electrodynamics, was given by Richard Feynman. [1].

Meanwhile, Albert Einstein found his postulates contradicting with Sir Isaac Newton’s law of gravitation. Newtown described gravity as a force with his famous equation:

$$F = G\frac{m_1 m_2}{r^2}$$

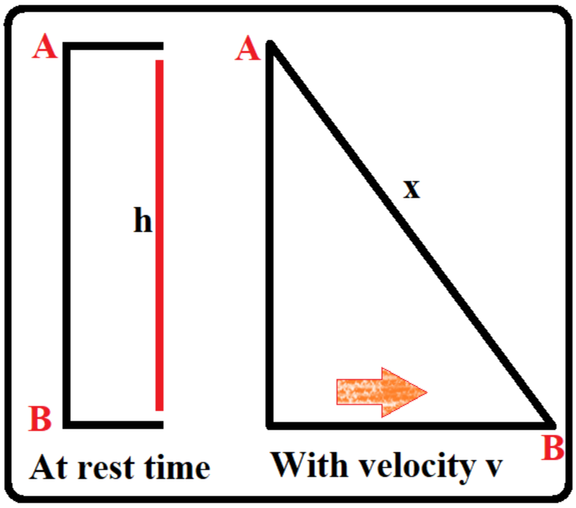
Where, F is the force, m1 and m2 are the masses of the objects interacting, r is the distance between the centers of the masses and G is the gravitational constant.But Einstein’s theory of special relativity described gravity not as a force but as the phenomenon caused by the geometric curvature of spacetime:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu}$$

Where,$R_{\mu\nu}$ is the Ricci curvature tensor, R is the scalar curvature, $g_{\mu\nu}$ is the metric tensor, Λ is the cosmological constant, G is Newton's gravitational constant, c is the speed of light in vacuum, and $T_{\mu\nu}$ is the stress–energy tensor.

III. Mathematical Evidences

Nearly during the era of mythical character Jesus, a Greek mathematician named Eratosthenes calculated the circumference of the earth using nothing but a stick and his brain. We will follow the similar approach while finding these mathematical evidences.



From the diagram beside let us assume one frame is relatively in rest & another frame is moving with velocity v. Now a "photon" particle travels from top to bottom.

So, at rest: $c = h/t_o$. That is, $h = c.t_o$.

On the other hand, while the frame moves: $c = x/t$

So, $x = \sqrt{h^2 + (vt)^2}$ = ct. Or, $h = \sqrt{(ct)^2 - (vt)^2}$

From both the expression of h it can be implied that,

$c.t_o = \sqrt{(ct)^2 - (vt)^2} = c.t\sqrt{1 - (v/c)^2}$

That is, $t_o = t.\sqrt{1 - (v/c)^2}$.

We know, $(1/2)mv^2 = F.r = G\frac{m.M}{r^2}.r = G\frac{m.M}{r}$

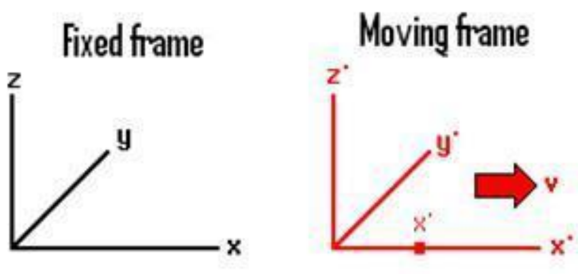
Therefore, $v^2 = 2G\frac{M}{r}$. Hence, $t_o = t.\sqrt{1 - 2GM/rc^2}$

Here, we need to remember that t_o is the time measured at rest and t is time measured at moving reference frame.Similar deduction can be done for length & mass as well.

The formulae go like this:

$L = L_o.\sqrt{1 - (v/c)^2}$ and $m = m_o/\sqrt{1 - (v/c)^2}$

Where, L is the length observed by an observer in motion relative to the object, L_0 is the proper length (the length of the object in its rest frame), m is the mass observed by an observer in motion relative to the object, and m_0 is the proper mass (the mass of the object in its rest frame).



$$\begin{cases} x' = \dfrac{x - vt}{\sqrt{1 - \dfrac{v^2}{c^2}}} \\ y' = y \\ z' = z \\ t' = \dfrac{t - \dfrac{vx}{c^2}}{\sqrt{1 - \dfrac{v^2}{c^2}}} \end{cases} \qquad \begin{cases} x' = \dfrac{x' + vt'}{\sqrt{1 - \dfrac{v^2}{c^2}}} \\ y = y' \\ z = z' \\ t = \dfrac{t' + \dfrac{vx'}{c^2}}{\sqrt{1 - \dfrac{v^2}{c^2}}} \end{cases}$$

As mentioned earlier, $m_0 = m.\sqrt{1 - (v/c)^2}$. That is, $(m_0c)^2 = (mc)^2 - (mv)^2$. Now, as m_0 and c both are constant so, by differentiation, $0 = 2mc^2dm - 2mv^2dm - 2m^2vdv$. Dividing by 2m, $\Rightarrow c^2dm - v^2dm - mvdv = 0$. So, the equation takes a form: $(c^2dm = mvdv + v^2dm)$. We know, d(K.E.) = dW = Fds [as, w = FScosΘ]. As per second law of motion provided by Sir Isaac Newton,

$$F = ma = \frac{d}{dt}(mv) = m\frac{d}{dt}v + v\frac{d}{dt}m$$

Hence, the d(K.E.) equation can be written in the following form:

$$d(K.E.) = m\frac{dv}{dt}ds + v\frac{dm}{dt}ds = m\frac{ds}{dt}dv + v\frac{ds}{dt}dm = mvdv + (v.v)dm = mvdv + v^2dm = c^2dm.$$

Which means,

$$\int_0^K d(K) = \int_{mo}^{m} c^2dm$$

Which means, K.E. = E – m_0c^2 = (m – m_0).c^2. Which gives the famous Einstein equation E = mc^2 = mc(c) = pc. Where, p is the momentum of photon. But as plank's concept, E = hf = h.(c/λ) = (h/λ).c. Which means, p = h/λ. This equation is known as the De Broglie equation, λ = h/p. Here, h is Plank's constant 6.626 × 10^{-34} m^2kg/s. Hence, we only need the value of momentum p to figure out the wavelength of the particle. Say if the particle is a photon, then the velocity of photon will be equal to the speed of light which is c. Now as per Maxwell's: Speed of light= $1/\sqrt{Permeability\ X\ Permittivity}$ = $1/\sqrt{\mu 0\ X\ \varepsilon 0}$ = $3\ X\ 10^{10}\ cm/s$. The velocity of photon. But photon doesn't have any mass, hence, p = mc = 0.

Hence, let us do the verification with an electron particle:

Mass:
Mass of an electron = (Mass of a proton / 1835) = (Mass of a H^+ Hydrogen ion / 1835). Or, M_{e-} = M_{p+} / 1835.
It means, 1835.M_{e-}= $M_{p+.}$ Or, (1835.M_{e-} + M_{e-})= 1836.M_{e-}= M_{p+}+M_{e-}= M_{H+}+M_{e-}= Mass of a Hydrogen atom.
Means 1836.M_{e-}= [Hydrogen one mole (Gram atomic mass) / Number of atoms inside one mole of Hydrogen]
Means 1836.M_{e-}= [1.00784 gm /Avogadro constant] = [1.00784 /6.02214076×10^{23}] = 1.6735576934×10^{-24}.
So, the mass of electron, M_{e-}=(Mass of a proton / 1836) = (1.6735576934×10^{-24}/ 1836) = **9.11×10^{-28} gm**. [2]

Velocity:
Again, 2πr = n λ = n(h/p) ⇒pr = (nh/2π) ⇒mvr = (nh/2π) ⇒Angular Momentum, L = (nh/2π). As per Coulomb's law, F = [(e) × (e)] / (4π.ε_o.r^2) = e^2/ (4π.ε_o.r^2) = centripetal force = mv^2/ r
⇒mv^2/ r = e^2/ (4π.ε_o.r^2)
⇒mv^2 = e^2/ (4π.ε_o.r)
⇒mvr = e^2/ (4π.ε_o.v)
⇒(nh/2π) = e^2/ (4π.ε_o.v)
⇒nh = e^2/ (2.ε_o.v)
⇒**v = e^2/ (2nhε_o)**
So, v = e^2/ (2hε_o)as for first orbital n = 1. [3]

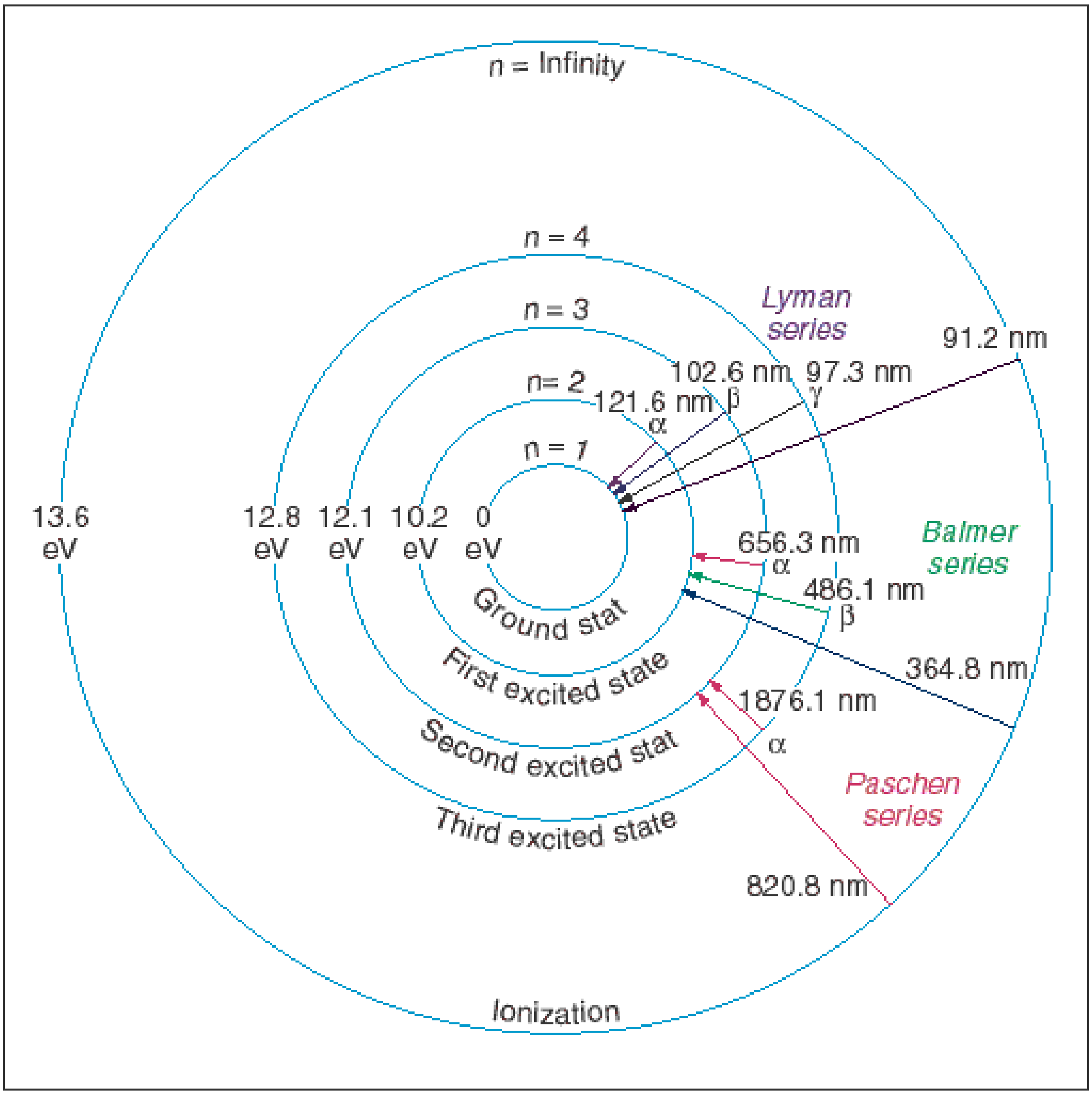
Charge:
Now we need to figure out the charge of an electron to figure out the velocity. As in the above equation only the value of e is unknown. Now from electrochemistry, Faraday's first law of electrolysis says that, W = Zit = ZQ. Where, Z = M/nF, here, M =atomic weight, n = number of electrons, F = Faraday's constant= 96500 Coulomb. Z is widely known as electrochemical equivalent. From this information we can say that, **W = (MQ)/n.96500**. Now, let's consider after electrolysis one mole H_2 got liberated, hence, W = M/n. Or, Q = 96500 Coulomb. As one hydrogen atom consists only one electron, thus, charge of 6.02214076×10^{23}electrons are 96500 Coulomb. Hence, charge of only one electron is (96500 / 6.02214076× 10^{23}) Coulomb = **1.60217662 × 10^{-19}** coulomb. [4]

Radius:
Now by putting this value into the equation, **v = e^2/ (2hε_o)** we can get the value of v. as h = 6.626 × 10^{-27} cm^2gm/s, e = 1.60217662 × 10^{-19} coulomb, ε_o = 8.8541878128×10^{-10} F/cm. Hence, the velocity 2.3 × 10^8 cm/s.
Again, 2πr = n λ = n(h/p)
⇒ r = nh/2πp = (nh)/(2πmv) = (nh×2nhε_o)/ (2πm × e^2) = ($n^2h^2\varepsilon_o$) / (πme^2) = ($h^2\varepsilon_o$) / (πme^2), for 1st orbital n = 1.
Now, for the first orbital r = h / 2πmv = [6.626 × $10^{-27}$$cm^2gm/s$] / [2π (9.11×$10^{-28}$ gm) × (2.3 × 10^8 cm/s)]. Hence, the radius r = 0.5× 10^{-8}cm = 0.5 °A. The actual value is about 0.53 °A. [5]

Energy:
Now we will calculate the total energy of an electron to see whether it matches with the E = mc^2 equation.
Kinetic Energy K.E. = (1/2).mv^2 = (me^4) / ($8n^2\varepsilon_o^2h^2$), as we know, v = e^2/ (2nhε_o). Now, r = ($n^2h^2\varepsilon_o$) / (πme^2).
Potential Energy (potential difference) FScosϴ = [{(e)×(e)} / (4π.ε_o.r^2)].r = [e^2/ (4π.ε_o.r)] = (me^4) / ($4n^2\varepsilon_o^2h^2$).
Which means the potential energy is twice as much high as the kinetic energy. As the direction of these energies are opposite to each other,so, total energy: E = (me^4) / ($8n^2\varepsilon_o^2h^2$) – (me^4) / ($4n^2\varepsilon_o^2h^2$) = – (me^4) / ($8n^2\varepsilon_o^2h^2$).
Now if an electron jumps from n_1 orbital to n_2 orbital, then the energy emitted will be ΔE = E_1 – E_2 = hf. Therefore,

$$f = \frac{me^4}{8\varepsilon o^2 h^3}\left(\frac{1}{{N_2}^2} - \frac{1}{{N_1}^2}\right)$$

In the hydrogen atom, the energy of the emitted photon can be found using:E = (13.6 eV) [$1/n_f^2$ - $1/n_i^2$], Z = 1.



IV. Conclusion

Though it has been observed that most of the calculated values matches perfectly with the experimental values of Bohr's atomic model yet there is a limitation in this calculation due to the fact of uncertainty principle as mentioned by another German physicist Werner Karl Heisenberg in the year 1927. The uncertainty principle states that the more precisely the position of some particle is determined, the less precisely its momentum can be predicted from initial conditions, and vice versa [6]. As mentioned before There is reason to believe that violating the uncertainty principle also strongly implies the violation of the second law of thermodynamics.

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