The proton radius in muonic hydrogen and the rest mass of proton is consistent

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ABSTRACT

The charge radius ($r = 2\lambda/\pi$) of Fermion closes at $\pm 1/2$ spin from the Compton wavelength ($\lambda = h/mc$) of Photon (Boson). These $\pm 1/2$ spin means having the axiality to space-time. "The proton radius (0.841 fm) was calculated from the proton mass" and "The proton radius obtained by measuring the Lamb shift in muonic hydrogen" are consistent. Closed Yukawa potential at charge radius is going to reduce the linear density in accordance with $1/r$ potential, and become material density of mass (1.672E-27 kg/m), which is published on the 1 meter scale. How the fermion to acquire the radius and mass pave the way for quantum gravity.

Key words: charge radius, fermion, spin, compton wavelength, photon, boson, axiality, space-time, mass, lamp shift, muonic hydrogen, Yukawa potential, linear density, material density, gravitational, quantum gravity.

INTRODUCTION

Are the proton radius puzzle and "the electronic size and spin" a problem of fermion commonness? Also, how will it have to do with quantum gravity? They are a big theme this paper tries to solve.

What is the proton radius puzzle?

The proton radius 0.84185(fm)[1] obtained by measuring the Lamb shift in muonic hydrogen is 4% less than the commonly accepted theory 0.8768(fm)[2]. The same experimental results have been published by additional tests 0.84087(fm)[3]. For muon is very heavy, orbiting the doorstep of the proton. In other words, influence with the size of the proton becomes easier to undergo for muonic hydrogen than electronic hydrogen, and charges radius of a proton can be measured precisely. The muon is completely the same elementary particle, but the mass is about 200 times as big as an electron. An experimental result of muon has a possibility of the new physical development which can't be explained by the present standard model.

What is the electron size and spin?

Zeeman effect was discovered by the sodium D line was placed in a magnetic field is split into two. Uhlenbeck and Goudsmit in 1925[4], the electrons in addition to the orbital angular momentum, which revolves around the nucleus, was hypothesized that have rotation with a size. Quantum freedom of the binary was called spin angular momentum of electrons. However, when the spin angular momentum is assumed to electron rotation, electrons have a size, and that they are rotating in ultra-light velocity would be consistent with special relativity. Therefore the hypothesis were denied by Pauli. Pauli, discard the classical picture

that must be considered rotation, and the eigenvalues of the half-integer spin angular momentum. Standard theory, but is dealing with electrons as mass points of size 0, it is not known whether there are origin to internal degrees of freedom such as spin angular momentum[5].

METHODS

The Compton wavelength and charge radius of the relationship.

Relationship of gravitational mass (M_p : 1.67262178E-27 kg) and inertial mass of the proton from the equivalence principle of light momentum (The mass of the definition represents the speed of energy and momentum)[6] is

$$m_p = M_p c/w = \gamma M_p \quad \text{(kg)}. \tag{1}$$

The Compton wavelength of the proton as where $\gamma = 1$ is

$$\lambda_p = h/(m_p c) \fallingdotseq 1.321 \quad \text{(fm)}. \tag{2}$$

The ratio of the Compton wavelength and proton radius ($\mu_p \fallingdotseq 0.841$ fm) of the muonic hydrogen is

$$i = \lambda_p/\mu_p = \pi/2 \fallingdotseq 1.571 . \tag{3}$$

Formula of Quantum charge radius from above can assume

$$r_x = \lambda_x/i = h/(im_x c) = h/(i\gamma M_x c) \quad \text{(m)}. \tag{4}$$

Coupling of $1/r$ potential and Yukawa potential.

Yukawa potential[7] is a central force potential.

$$\alpha \frac{1}{r} e^{-r\frac{1}{\kappa}} . \tag{5}$$

The potential of $1/\kappa = 1/r_x$ to $\boldsymbol{\kappa}$ is (effective) an amount corresponding to reaching distance, Quantum mass to the coefficient $\boldsymbol{\alpha}$, Radial coordinate from the potential center to $\boldsymbol{r}$,
It is a unit of linear density (kg/m) and Applying more. Quantum is the mass in meters order by Newtonian potential is closed a short distance that matches the mass.

$$\frac{(-2G)M_x}{r}(1 - e^{-\frac{ir}{\lambda_x}}) . \tag{6}$$

Planck mass[8] to match the radius divided by the Compton wavelength by π and the Schwarzschild radius. The Planck length is the length is

$$l_p = \lambda/\pi = 2GM/c^2. \tag{7}$$

This paper assumes that radius to close by Gx that combines the gravitational constant and the charge radius matches.

$$r_x = \lambda_x/i = l_x = (2)G_x M_x/c^2. \tag{8}$$

RESULTS AND DISCUSSION

Fine structure of the hydrogen atom in the ground state.

If electrons radius classical, so that spin angular momentum must be in rotation at ultra-light velocity. Therefore Pauli was discarded classic picture that must be considered the rotation itself. But there than the wave nature of quantum has decided the radius of the fermion, it is not a classical theory of particle properties. Considering that the wave nature of the quantum is the fermions that with axial close the traveling direction of the particulate, it is r_p (charge radius of a proton) that come naturally. This is consistent with the experimental results of muonic hydrogen μ_p (charge radius of a proton). **Figure 1** is a relationship between fermions models of hydrogen atoms in the ground state.

Fine-structure constant : $\alpha = v_x/c$

Hydrogen atom in the ground state

Bohr radius : $a_x = \lambda_x/(2\pi\alpha)$

Circumference : $C_x = 2\pi a_x = \lambda_x/\alpha$

Rydberg constant :
$R_x = \alpha^2/(2\lambda_x) = \lambda_x/(2C_x^2)$

Charge(-) quantum

Gravitational mass : M_x

Particle speed : $v_x = e^2/(2\varepsilon_0 h)$

Wave speed : $w_x = (c^2 - v_x^2)^{1/2}$

Inertial mass : $m_x = M_x c/w_x$

Compton wavelength : $\lambda_x = h/(m_x c)$

Charge radius : $r_x = \lambda_x/i$

Proton(+) quantum

Gravitational mass : M_p

Inertial mass : $m_p = M_p$

Compton wavelength : $\lambda_p = h/(m_p c)$
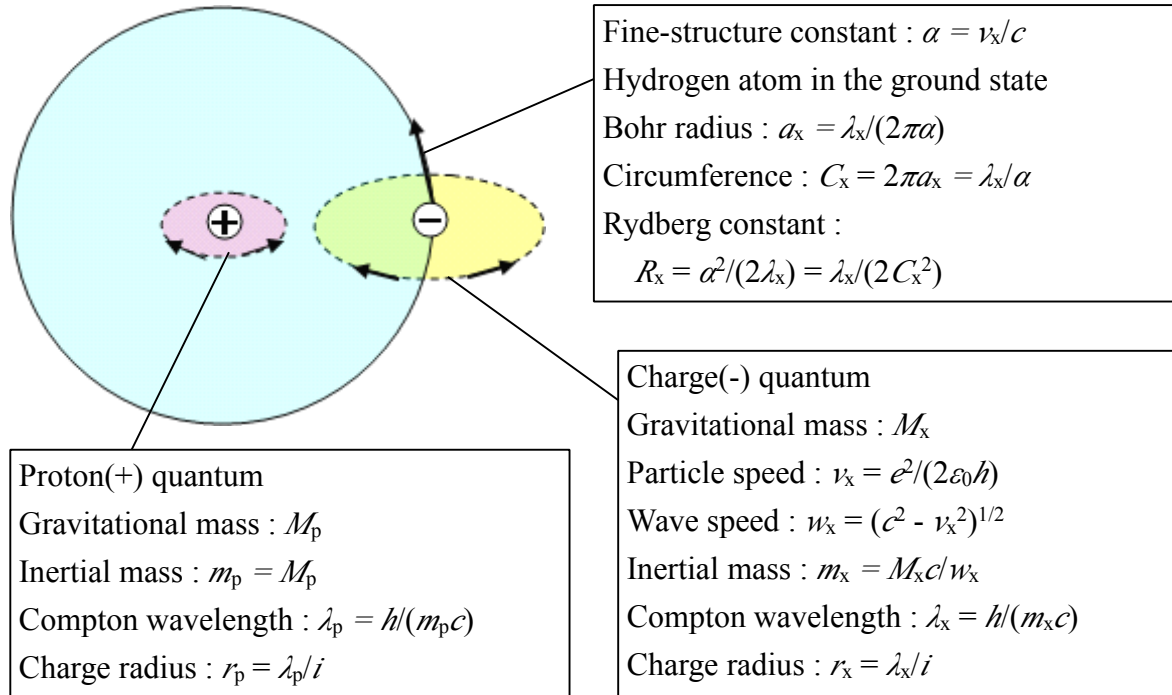
Charge radius : $r_p = \lambda_p/i$

Figure 1 is a model of the hydrogen atoms in the ground state (Blue), and the proton (+Red), and the charge particle (-Yellow) that revolves around the proton.

In **Table 1** is the calculated value of the relationship of **Figure 1**.

Constant			
Fine-structure constant : α	1.37035998E+02		
Planck constant : h (m²kg⁻¹s⁻¹)	6.62606957E-34		
Speed of light : c (m/s)	2.99792458E+08		
Charge(-) particle speed : v_x (m)	2.18769128E+06		
Quantum	Proton	Electron	Muon

Gravitational mass : M_x (kg)	1.67262178E-27	9.10938291E-31	1.88353139E-28
Inertial mass : m_x (kg)	1.67262178E-27	9.10962546E-31	1.88358155E-28
Compton wavelength : λ_x (m)	1.32140985E-15	2.42624563E-12	1.17341291E-14
Wave radius : r_x (m)	8.41235640E-16	1.54459594E-12	7.47017859E-15
Hydrogen atom radius : a_x (m)		5.29163117E-11	2.55920845E-13
Hydrogen atom Circumference : C_x (m)		3.32482992E-10	1.60799809E-12
Rydberg constant : R_x (m^{-1})		1.09740239E+07	2.26908000E+09

Table 1, physical constants, and the values (Blue) of quantum appearing in Figure 1, is such as the size (Red) of the hydrogen atom by a combination of the proton(+) and the charge quantum (-).

Individual "proton and electron, muon" particle velocity and charge radius of is decided. To change the difference in electronic hydrogen and muonic hydrogen is the Bohr radius and Rydberg constant.

Linear density and gravitational potential.

Fermion mass and charge radius is inversely proportional. Closed Yukawa potential at charge radius is going to reduce the linear density in accordance with $1/r$ potential, and become material density of mass, which is published on the 1 meter scale. **Figure 2** is a state.
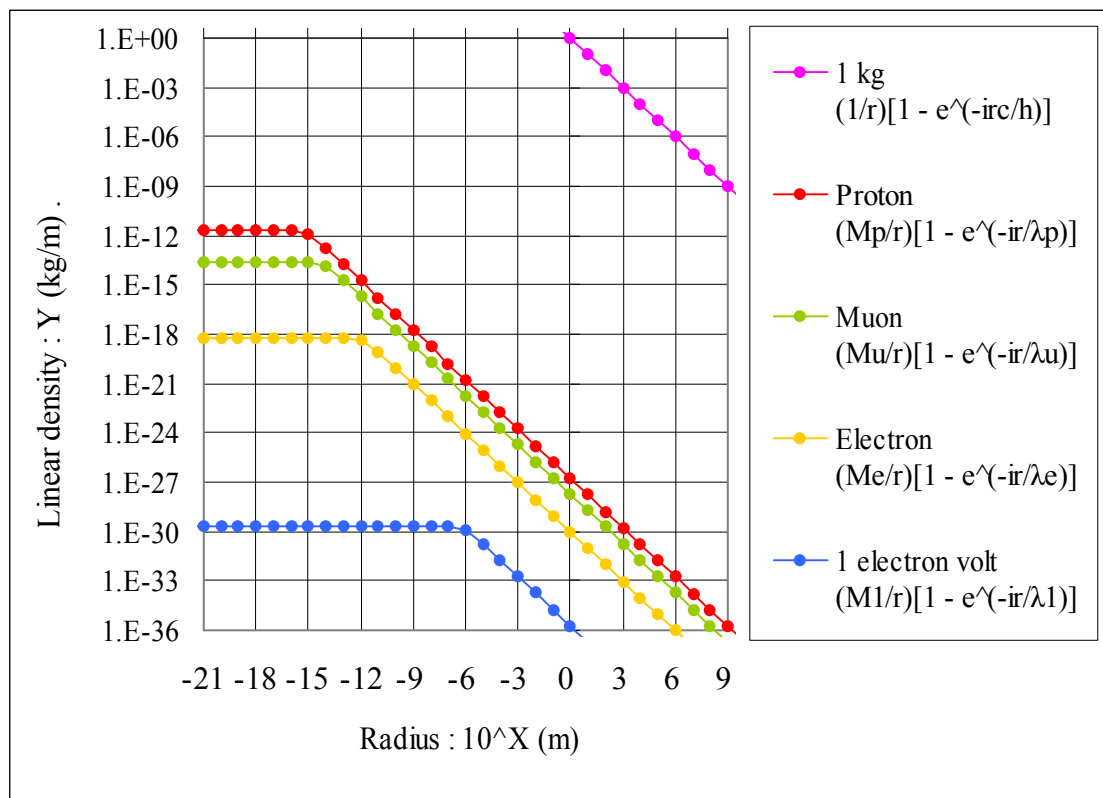

Figure 2, Each fermions closed in charge radius is inversely proportional to the mass, distance is how to reduce the linear density with the increase of r. 1kg object of (Pink) is a reference for comparison.

Therefore, even the inverse square law works mathematically accurate in micro, Since the mechanism is in the vacuum, Energy is closed with a charged radius by Yukawa potential,

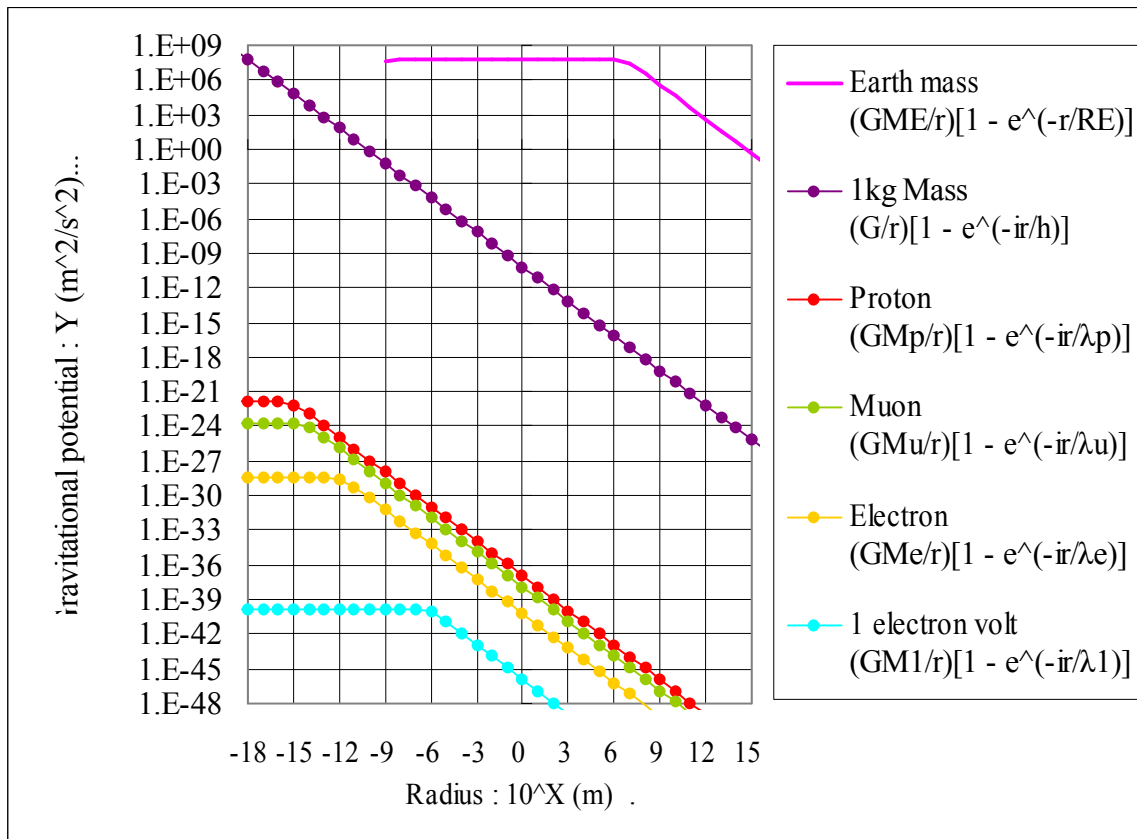This Paper thinks that its influence has spread by gravity and electromagnetic force. **Figure 3** is a state.

Figure showing gravitational potential. Y-axis: gravitational potential : Y (m^2/s^2)... ranging from 1.E+09 down to 1.E-48. X-axis: Radius : 10^X (m) from -18 to 15.

Legend:
- Earth mass $(GME/r)[1 - e^{(-r/RE)}]$
- 1kg Mass $(G/r)[1 - e^{(-ir/h)}]$
- Proton $(GMp/r)[1 - e^{(-ir/\lambda p)}]$
- Muon $(GMu/r)[1 - e^{(-ir/\lambda u)}]$
- Electron $(GMe/r)[1 - e^{(-ir/\lambda e)}]$
- 1 electron volt $(GM1/r)[1 - e^{(-ir/\lambda 1)}]$

Figure 3 is a graph that is the gravitational potential multiplied by the gravitational constant for each item in **Figure 2**. It is a reference for comparison, Earth's gravitational potential the (Pink).

CONCLUSION

Once the mass of micro quantum, charged radius by Yukawa potential, the linear density of the radial distance determined. This means that it can be handled micro quantum at the same stage as the changes and gravitational potential linear density by macro objects. This is the first step to the road of quantum gravity. Also the charge radius r of Fermion is close to $2/\pi$ times the photon (Boson) Compton wavelength, which has an axis with respect to $2GM/r$ of the gravitational potential. It polarization of electromagnetic field, with attributes similar to "Or orientation of the electromagnetic field is rotated clockwise, or rotated in the counterclockwise". A charge radius calculated from the mass of the proton, the charge radius experimental results of the proton by Myuonikku hydrogen coincide. Thus, this is the original radius of the proton.

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And that came to be touched anyone many academic information on the net, Thanks to people who cheering.

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