The proton Charge radius of muonic-hydrogen

Abstract: from Einstein's theory of general relativity we can calculate the proton radius of muonic-hydrogen.

Introduction. From equation Einstein's theory of general relativity, for one particle \( n \) of mass \( M_n \),

\[
\rho = \frac{8\pi}{3} \frac{M_n}{N_m \cdot G}
\]

then we obtain:

\[
V = \frac{1}{8\pi} a_0^2 \frac{4\pi}{3} \frac{M_n}{(a_0)^2} = \frac{V_0}{G} \frac{M_n}{(a_0)^2} = \frac{V_0}{G} \frac{M_n}{(a_0)^2} = J_0 M_n
\]

From \( J^{(0)} \) we obtain:

\[
\frac{V_0}{G} M_n = \frac{4\pi}{3} \frac{1}{a_0^2} (\text{meters}) = V
\]

If in \( J^{(0)} \) we exchange the volume by mass, such as \( |J_0| = |J_0| \), we obtain:

\[
\frac{J_0}{V_0} = \frac{M_n}{V_0} = M
\]

From \( \frac{J_0}{V_0} \) (the mass \( M \) for unit of time), we can to interpret \( \frac{J_0}{V_0} \) like flux of mass for every unit of time elapse.

Because the \( J^{(0)} \) analogous to the \( J_b \), then the \( J^{(0)} \) or \( J^{(0)} \) is the flux of volume \( 4\pi a_0^2 \), to cross the surface \( 4\pi c^2 \) for every unit of time elapse.
The flux of mass or volume for every unit of time elapse is constant in the
time and we can to represent it geometrically.

We exams geometrically $4\pi C^2 \alpha (\text{meters})^3$.
Be given in the space 4D a orthogonal quarter of unit vectors $\hat{i}, \hat{j}, \hat{k}, \hat{\omega}$,
such as the $\hat{i}, \hat{j}, \hat{k}$ individualise the Cartesian axes System $Ox_1, x_2, x_3, x_4$.
In the plane $Ox_2, x_3$ we trace two circumference $\gamma_1, \gamma_2$ of origin $O$ and
radius respectively $r_1 = \gamma_1^\prime, r_2 = \gamma_2 + \alpha'$. 
Let $\left[ 0 \leq \alpha \leq \pi \right] C = \frac{1}{2} \int \delta \phi$ be the area of surface $\gamma$.
Let $\gamma'$ be any point of surface $\gamma$ origin of vector $\vec{\phi}$ parallel to $x_1$ axes;
then in the $Ox_2, x_3, x_4$ must be $V_\gamma = \vec{b} \cdot \vec{d}$ because is $\vec{b} \parallel \vec{d}$.

We image to place for each point of surface $\gamma$ a vector equal to vector $\vec{d}$ and
if we image to rotate the vectors simultaneously of $90^\circ$, then the vector $\vec{b}$
must rotate of $90^\circ$ simultaneously along all the direction in the $Ox_1, x_2, x_3$ and
after this rotation $\vec{b}$ will must be simultaneously perpendicular to axes $x_1, x_2, x_3$.

Then only possible rotation for $\vec{b}$ in this case is the rotation of $90^\circ$ along
the $x_4$ axis.
Because $\vec{b} \parallel \vec{d}$ after this rotation the volume $V_\gamma$ is in the $Ox_2, x_3, x_4$.
Then we can write $4\pi C^2 (\text{meters})^2 \alpha (\text{meters}) = \vec{b} \cdot \vec{d} = V_\gamma \quad \gamma (3)$
$\vec{b} = 4\pi C^2 \hat{\omega}, \quad \vec{d} = \alpha \hat{\omega}$.
\( \vec{B} \) is a vector perpendicular to the spherical surface \( 4\pi c^2 \) and \( \vec{e} \parallel \vec{d} \).

For \((1^{(4)})\), \((2^{(v)})\), \((1^{(v)})\), the volume \( 4\pi c^2 \omega \) must be subtracted from the original volume in the \( \mathcal{O}x_1x_2x_3 \) because \( V^i_0 \) is rotate of 90° along the \( x_4 \) axis, and after this rotation \( V^i_0 \) is in the \( \mathcal{O}x_3x_2x_4 \) space.

The cause of this decrease of initial volume \( V^i_0 = \frac{4}{3}\pi \omega \) is the particle through its mass \( M_n \).

For \( M_n = 1 \) we obtain \( 4\pi c^2 \omega = |J_\omega| \); i.e. \( J_\omega \) is the volume density for unit of mass of the \( V^i = \frac{4}{3}\pi \omega \).

Then \( V^i = V^i_0 - V^i_0 \) \((1^{(v)})\).

If in \((1^{(v)})\) we replace \( J_\omega \) by \( J_p = \frac{V_p}{M_p} \) and \( M_n \) by \( M_\mu \).

\[ M_\mu \text{ is muon mass, } V_p \text{ is proton volume and } M_p \text{ is proton mass.} \]

Then for \((1^{(v)})\) we obtain: \( V^i_p = V^i_0 - J_p M_\mu \) \((1^{(v)})\).

To calculate the value of proton radius in the muonic-hydrogen we have replaced the electron by muon; then, the value of proton radius must reduce because \( M_\mu >> M_e \);

\[ M_e \text{ is the electron mass.} \]

\[ M_p = 1.672621898 \times 10^{-13} \text{ Kg}, \quad M_\mu = 1.8835315 \times 10^{-25} \text{ Kg}, \quad r_p = 0.8751 \text{ m} \]

\[ V_p = 2.8071244 \times 10^{-45} \text{ m}^3, \quad J_p M_\mu = 3,16108934 \times 10^{-45}, \quad V^i_p = V^i_0. \]

\[ V^i - J_p M_\mu = 2,49101566 \times 10^{-45} \text{ then, } r^i_p = \left( \frac{3}{4\pi} V^i_p \right)^{\frac{1}{3}} = 0.840935 \times 10^{-15} \text{ m}. \]

To obtain \((1^{(v)})\) we have replace in the \((1^{(v)})\) the value of Gravitational Constant \( G = J_\omega / (1 \text{ sec})^2 \) by \( G_p = J_p / (1 \text{ sec})^2 \).
Trough this replacement, we can to conceive the particle \( n \) as if it were contained into a space with volume density \( \lambda_0 \), whereas the muon into a space of volume density \( \lambda_p \gg \lambda_0 \).

We make use of concept of ether, to understand the reason of this decrease in the proton radius, when we change electron by muon.

Why did Michelson-Morley's experiment not detect the ether?
In the reference frame \( Oxyz \) of ether \( J \), a particle \( n \) of mass \( M_n \) and volume \( V_n \) is in motion to velocity \( \mathbf{v}_n \).
We can note that volume \( V_n \) is not the volume of particle \( n \), but is a portion of volume take by particle \( n \) in the ether \( J \).

For Einstein's theory of special relativity we obtain:
\[
V_n' = V_n \left(1 - \frac{v_n^2}{c^2}\right)^{1/2}
\]
Because the motion of particle \( n \) is relative, then in the reference frame \( O'x'y'z' \) of particle \( n \) ( \( O' \) origin of particle \( n \) ), the ether is in motion to velocity \(- \mathbf{v}_n\), so relatively to ether \( J \) the volume \( V \) of particle \( n \) must be \( V' = V \bigcap \) (the value of the volume \( V \) is unknown).
Instead for the mass of particle \( n \) we obtain \( M_n = M_n \bigcap \).
Then
a) the volume (mass) density of particle \( n \) don't is function of its motion relative to reference frame of ether \( J \)
b) because the motion of particle \( n \) is relative, we can imagine the ether in motion relative to reference frame of particle \( n \); then for a) the value of ether don't is function of its motion relative to particle \( n \).