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A First Calculation of Density of the Ether Based on the Variation of the Mass of Microparticles with the Magnitude of Their Velocity *v* in the Ether

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Abstract: We build on our previous results starting with the discovery of **Errors 1 and 2** in Michelson's analysis of his 1881/87 interferometer experiments. By correcting these errors, it was possible to reintroduce the ether into physics by our model HM16, with a number of important consequences, including establishing the origin of the interaction between the submicroparticles (SMPs) as percussion forces created by the vibrations of the SMP transmitted through the fundamental vibrations of the ether. Therefore, the increase in the mass of the SMP by m_s due to its speed v is physically constituted by the energy E_s accumulated in the surrounding Ether driven by the displacement of the SMP. Here, we calculate the value of the density ϱ_E of the ether surrounding the SMP on the basis of the equivalence between the additional mass m_s created by the movement of the surrounding ET and the analogous increase by m_{sL} of the mass of the SMP on the basis of a Lorentz-type formula. The density ϱ_E of the ether, resulting for the barium atom at $v = 0.3c$, yields a credible value of 1.748×10^{-4} kg/m^3. Previously, in none of the numerous models or theories about the Ether was the problem of Ether's density resolved.

Keywords: errors in Michelson's analysis; new ether model; moving ether's mass increase; Lorentz's mass increase; ether hydrodynamics; density of ether

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1. Brief Review of Our Previous Results Concerning the Ether

In this article, we build on our previous results starting with the discovery of Errors 1 and 2 in Michelson's analysis of his interferometer experiments of 1881/87 (ME1881/87).

By correcting **Errors 1 and 2** in Michelson's analysis of his interferometer experiments ME1881/87, it was possible to reintroduce the ether (ET) into physics in 2016 in the form of our ether model (HM16) [1], which was subsequently completed and improved [2–5], an operation that will inexorably continue.

However, the presence of ether in physics has already led, in our previous work, to a series of important consequences, including the establishment of the origin of the interaction between submicroparticles (SMPs), as periodic percussion forces p_i created by the vibrations of any SMP, transmitted through the fundamental vibrations (FVs) of the ether.

The resultant F_{CC} (completed Coulomb force) of percussion forces p_i can be expressed as a series of powers in $1/r^n$ but with the first term in $-\ln r$ [6–10].

Therefore, the interaction force between two electric dipoles (F_{DC}) also results as a series of powers in $1/r^n$ with the first term in $1/r^2$, which depend on the electrical constants of matter/SMP/ET, ε_0, p, [6–10], and not on G (from the Newton force (F_N)). This F_{DC} force is always of an attractive nature, and therefore replaces Newton's gravitational force F_N.

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Moreover, at astronomical distances, the force F_{DC} is approximately 60% greater than the force F_N, which allows us to abandon the hypothesis of dark matter (DM) [11].

However, the presence of ET was questioned, initially by Michelson's analysis/misinterpretation of the results of his ME1881/87; then, on the basis of these errors, the presence of ET was contested by the special theory of relativity (SRT) proposed by Einstein in 1905, a trend that has continued to this day by the mainstream of physics.

However, since the beginning of the ET contestation, there have been numerous other opinions and arguments supporting the presence of ET, of which, very credibly, is that of Professor Laughlin in 2005, who says, "The modern concept of the vacuum of space, confirmed every day by experiment, is a relativistic Ether. But we do not call it this because it is not accepted (taboo)" [12].

However, all such opinions in favor of the presence of ETs lacked a decisive argument, which we just discovered and demonstrated: the existence of Errors 1 and 2 in Michelson's analysis of ME1881/87, followed by their correction.

However, an error existing in a scientific document must invalidate all results based on it, which is the case for ME1881/87, which requires mandatory correction, a fact/operation that has not been carried out to date.

Importantly, the problem of the existence of ET has preoccupied thinkers since antiquity when Aether (in Greek) was considered the fifth element of nature, along with earth, water, air and fire, without knowing its physical properties, including its density.

However, this concern regarding the functioning of ET continued more intensely in the classical period of physics, when the most important scientists, including Newton, Maxwell, Lorenz, etc., approached the subject of ET by developing numerous and complex models of ET, but obviously, without being able to know its density.

However, Fresnel nevertheless addressed the problem of ET density but did not obtain any concrete results, since in his calculation, the density ρ_E was eliminated by simplification, as Barbulescu shows [13].

Notably, a more functional model of the ET can be considered the one initially proposed in 1690 by the Englishman Fatio but which was resumed, developed and completed in 1748 by the Frenchman Lesage [14]. This model actually aims to explain the F_N force, which is based on the shocks on real matter, by a continuous flow in space, of small special particles that circulate at high speeds in any direction and which constitute the universal ether itself.

This model for gravity, and therefore for Ether, was the basis for numerous additions and refinements or criticisms throughout the following period until 2005 and even today, in which numerous scientists were involved, including Cramer, Euler, Bernoulli, Laplace, Poincare, Boskovich, Kant, Kelvin, Maxwell, Thomson, Whittaker, Huygens, Lorentz, Gamow, Feynman, Larmor, FitzGerald, [14], the Romanian Popescu [15], and many others.

All these scientists were convinced that in nature, there exists a matter called Ether, but for which they could not develop a form/model that would answer all the relevant questions, including ET density.

Therefore, the present research is fully justified and useful as a step forward in physics.

However, these results were possible only after the discovery and correction of Errors 1 and 2 in Michelson's analysis within ME1881/87.

IMPORTANT NOTE. The phenomenon in [10], in which the extra mass m_s of an SMP is produced, moving at speed v through the ET but entraining the surrounding ET at a speed v_E, accumulating energy E_s equivalent to the mass m_s, constitutes the first strong evidence for the presence of ET in nature.

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2. Brief Review of Our Previous Results Concerning the Nature of Mass

However, the presence of ET showed that the mass m of any SMP is constituted by the kinetic and potential energy initially transmitted at the creation of the SMP, in the own vibrations of the constituent Ether cells (EC), from inside the SMP [6–10].

As a physical model that can reproduce the movement in the ET of an SMP with a spherical shape, a model of the flow of an ideal fluid around a circular cylinder, whose equations of motion are given by the theory of potential motions of a perfect fluid from hydrodynamics, was adopted.

The hydrodynamic spectrum of the fluid's motion, represented by the streamlines ψ and the equipotential lines φ, with the fluid moving with velocity V (as in [16] along the Ox axis around the circular cylinder of radius a), is shown in Figure 1.

This motion results from the superposition of the complex potential (as a function of $z = x + iy$) of a parallel current in the x direction (z=x), with the velocity at infinity V_∞, and that of a dipole (doublet, from 2 sources Q) of magnitude (momentum) m=2aQ, therefore with radius a, described by the following formula [16]:

$$f = V\left(z + \frac{a^2}{z}\right). \tag{1}$$

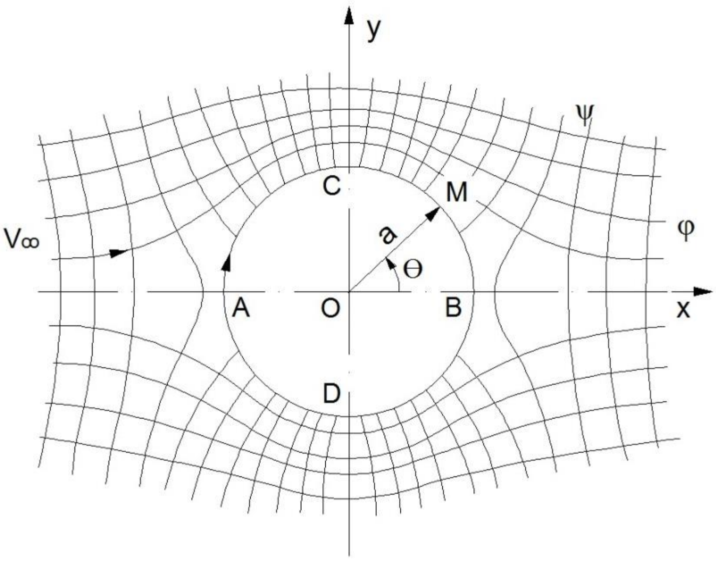

Figure 1. Hydrodynamic spectrum of a perfect fluid around a circular cylinder of radius a, with equipotential lines φ and streamlines ψ, which flow with velocity V_∞, in the CF frame.

In this case, the surface of the cylinder is acted upon exclusively by orthogonal pressure forces but is symmetrical in the x- and y-directions, so their resultants are zero in both directions, and the cylinder is not driven by the perfect fluid in motion around it.

The maximum positive pressure occurs at points A and B (Figure 1), with values of [16]

$$(p - p_\infty) = \frac{\rho V_\infty^2}{2}. \tag{2}$$

The maximum negative pressure occurs at points C and D, with values of

$$(p - p_\infty) = -\frac{3\rho V_\infty^2}{2}. \tag{2a}$$

However, it is known that in real situations, the cylinder is driven by any (real) fluid, a phenomenon known as the Euler–D'Alembert paradox.

To solve this situation, we will need to know the ET density ϱ_E.

For this purpose, we study our case of a stationary ether but with a long cylinder moving with speed V_∞ along the Ox axis. This case can be modeled by superimposing on the above case of a moving fluid (Figure 1), a new movement of equal speed but opposite direction $-V_\infty$, thus resulting in the case of moving with velocity v in the Ox direction of a cylinder in a stationary fluid. However, in this

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situation, the surrounding fluid/ether is set in local motion with velocity v around the moving cylinder (Figure 2) [16].

The component of the velocity v of the fluid in the Ox direction is [16]:

$$v = V_{\infty} \frac{a^2(y^2-x^2)^1}{(x^2+y^2)^2}. \quad (3)$$

The hydrodynamic spectrum of these cylinder movements in Ether is shown in Figure 2.

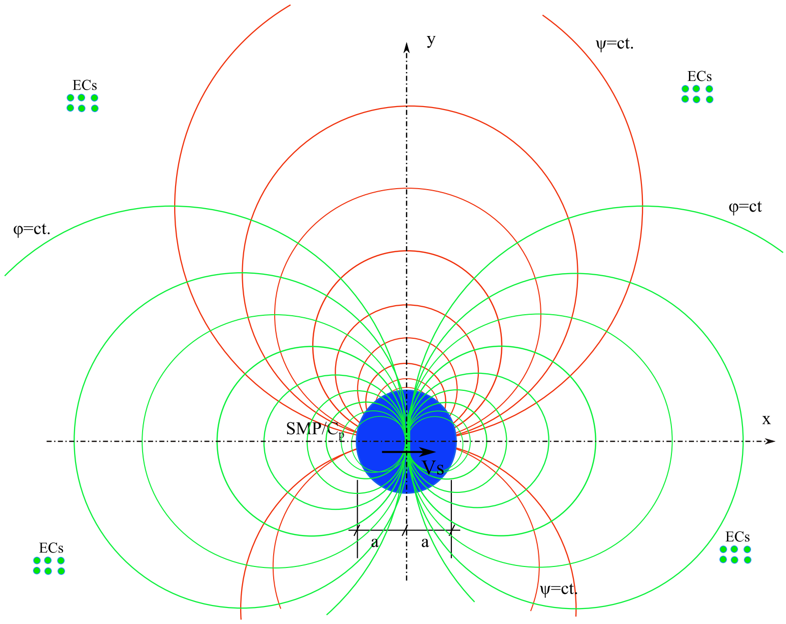

Figure 2. Representation of an SMP, as a long cylinder moving at velocity V to the right through an ideal fluid (ET/water), creating a hydrodynamic spectrum with equipotential φ and current ψ lines, in the Oxy reference frame, attached to the cylinder.

However, here (Figure 2), we can limit ourselves to the case of the problem in a plane, corresponding to a long cylinder, as being equivalent to the spatial problem of a spherical SMP.

Therefore, in [10], real streamlines with interstices having interspaces with surfaces of complicated shape (Figure 2) were replaced by circular semicrown curves with the same total surface in order to be able to carry out an approximate simplified numerical calculation of the surfaces and therefore also of the volumes C_i of the ether moving at different velocities v_i (Figure 5 from [10]).

However, here, we will leave that procedure of replacement of surfaces (Figure 3b), and we will adopt the calculation of the quantities/volumes C_i of ET around the SMP considered spherical, as volumes of tori that surround the SMP (as we do in **Methods**) and which in section correspond to the streamlines ψ (Figure 3c).

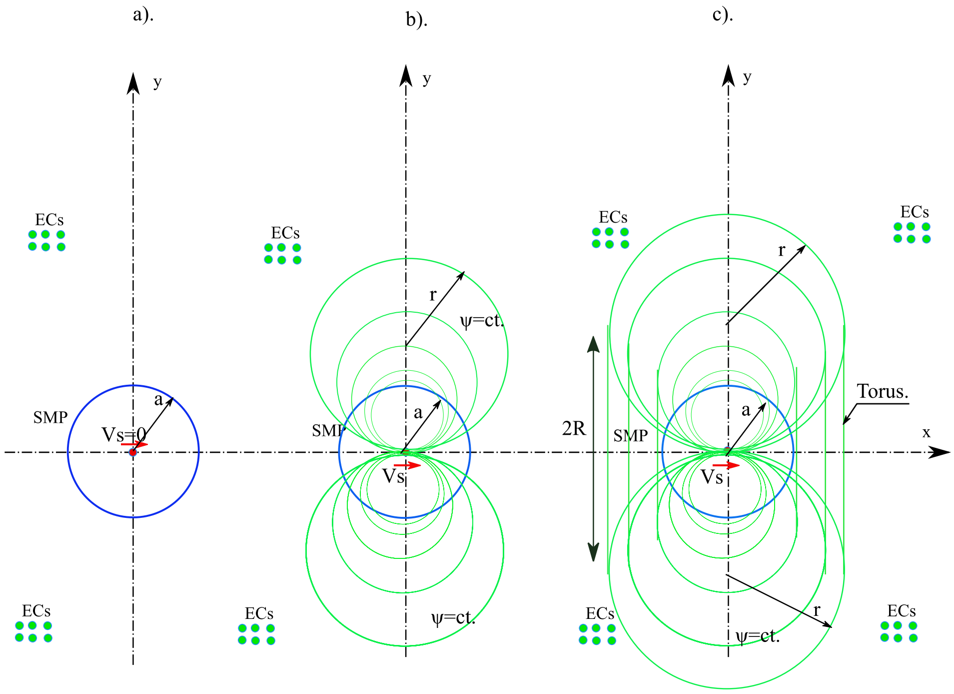

Figure 3. Representation of an SMP in an ET. a). Immovable SMP; b). A cylinder of radius a which moves with velocity vs through an ideal fluid (ET), producing outward displacement of ET along the streamlines ψ in green. c): The case of a spherical SMP moving with velocity vs and the streamlines ψ in green are in the form of a torus in the reference frame Oxyz attached to the SMP.

Therefore, the suplementary mass m_s of the SMP due to speed v is due to the kinetic energy E_c accumulated in the entrained ether surrounding the SMP, in the form of a torus, with a value of v decreasing toward zero with increasing distance r (Figure 3c).

In [10], for the total kinetic energy E_E of all surfaces/volumes of ether, Ci with velocities v_{Ei}, the following relation was obtained:

$$E_E = \Sigma C_i v_{Ei}^2 = C_t v_{me}^2 \quad (4)$$

In Equation (4), C_t represents the total quantity/mass of ET drawn by the SMP, which in [10] was considered by the total area/volume of Ether, denoted by C_t but without highlighting the density of ET.

In (4), the mean/average velocity v_{me} of the entire amount of ET in motion around the SMP was introduced for simplicity, allowing us to drop the coefficient ½ from the energy formula in classical mechanics.

In [10], we obtained the additional mass m_s due to ET motion with speed $v_E = v_{me}$ as:

$$m_s = \frac{E_E}{c^2} = C_t \frac{v_E^2}{c^2}. \quad (4b)$$

IMPORTANT NOTE. The above result in (4b) constitutes proof of the presence/existence of ET through the appearance of the supplementary mass m_s of material particle SMPs with their movement.

However, this phenomenon is studied today by applying a Lorentz-type law, from current physics, a situation where there is no other physical/material/real explanation for the appearance of this supplementary mass, but only by the simple movement of the SMP through the space/vacuum, without any intervening force, phenomenon that resembles a miracle.

3. Ether Density Calculation Through the Supplementary Mass m_s

For use in the following calculations of the density ρ_E of ET, we can write the magnitude of the mass of ET in motion as equivalent to the amount C_t of ET entrained by the SMP moving at speed v, from [10].

Now, according to the classical definition of the density ρ_E of ET, we can write, in the present case of the spatial problem, taking into account the total quantity C_t of ET in motion with its (average) speed $v = V_E$,

$$C_t = \rho_E V_E. \quad (5)$$

Inserting (5) into (4), we obtain

$$m_s = \rho_E V_E \frac{v_E^2}{c^2}. \quad (6)$$

From (6), we obtain

$$\rho_E = \frac{m_s}{V_E}\frac{c^2}{v_m^2}. \quad (7)$$

However, from classical physics, we have the Lorentz formula for the variation in mass with velocity:

$$m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}. \quad (8)$$

Moreover, for the additional Lorentz-type mass m_{sL}, using Equation (8), we can also write

$$m_{sL} = m - m_0 = m_0\left(\frac{m}{m_0} - 1\right) = m_0\left(\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} - 1\right). \quad (9)$$

Using the classic notation $v/c = \beta$ and calculating the expression in parentheses in (9), we obtain

$$m_{sL} = m_0 \frac{1-\sqrt{1-\beta^2}}{\sqrt{1-\beta^2}}. \quad (10)$$

Now, we can make the following observations, with two cases being possible:

a) If there was no ET, there would only be motion of the SMP in space/vacuum with velocity v_P, and in that case, there would be no physical/mechanical justification for the appearance of the variation in the mass of the SMP through the Lorentz effect. Therefore, m_{sL}=0, and the energy of the SMP remains $E=mv_P^2$, so m=const.

b). In the case of the presence of ET in space (HM16), the entrainment of ET around the SMP will occur, and ET (special matter) should have a mass m_E, which moves with the speed $v_E = v_P$ on contact with the SMP but with v_E=0, at infinity, and with a negligible value at a certain distance. The Lorentz effect will apply to the volume of ET in motion, resulting in the supplementary mass m_{Es} of the entrained ET by the SMP, with velocity v_E (mean).

The real case is b), and the balance of moving masses related to the SMP can be written as follows:

$$m = m_0 + m_{Es} \quad (11)$$

From Equation (11), we obtain the following expression for the supplementary mass m_{Es} of the SMP created by the ET trained by the SMP:

$$m_{Es} = m - m_0 = m_0\left(\frac{m}{m_0} - 1\right) = m_0\left(\frac{1}{\sqrt{1-\beta^2}} - 1\right) = m_0\frac{1-\sqrt{1-\beta^2}}{\sqrt{1-\beta^2}} = m_0 A_1. \quad (12)$$

In Equation (12), we define the notation:

$$A_1 = \frac{1-\sqrt{1-\beta^2}}{\sqrt{1-\beta^2}} \quad (13)$$

where the coefficient A_1 is a function that depends only on the velocity v_P of the SMP.

From (12), via the classical definition of the ether density ρ_E of volume V_E, we obtain

$$\rho_E = \frac{m_{Es}}{V_E} = \frac{m_0}{V_E}A_1 = \frac{m_0}{V_E/A_1} = \frac{m_0}{V_{Ecor}} \quad (14)$$

where V_{Ecor} represents the volume of ET entrained by the SMP but corrected according to the relative velocity $\beta = v_E/c$ (average v_E) according to (5).

For the calculation of the density of the ET in (14), we need to evaluate both the volume V_E of the ET entrained by the SMP and the expression A_1 in (13), which depends on the average velocity v_E of the ET.

To correct the volume V_E of ET with the expression A_1 in Equation (13), we will numerically calculate the values of A_1, and the results are shown in Table 1 (from **Methods).**

Table 1. Values of coefficient A_1 for the correction of V_E.

No.	β = *v*/*c*	β²	1– β²	√(1– β²)	1–√(1– β²)	*A*₁ (6) = (5)/(4)
0	1	2	3	4	5	6
1	0.005	0.000025	0.999975	0.999987	0.000012	0.000012
2	0.01	0.0001	0.9999	0.999949	0.000051	0.00005
3	0.02	0.0004	0.9996	0.99979	0.000201	0.00020
4	0.05	0.0025	0.9975	0.99874	0.00125	0.00125
5	0.10	0.01	0.99	0.99498	0.00502	0.00504
6	0.20	0.040	0.96	0.97979	0.0202	0.02062
7	0.30	0.09	0.91	0.95393	0.04607	0.04829
8	0.50	0.25	0.750	0.866	0.134	0.15519
9	0.60	0.36	0.64	0.80	0.20	0.25
10	0.70	0.49	0.51	0.7141	0.2859	0.4003
11	0.8	0.64	0.36	0.60	0.40	0.666
12	0.85	0.7225	0.2775	0.52678	0.47322	0.89832
13	0.90	0.81	0.19	0.4358	0.56412	1.2942
14	0.93	0.8649	0.1351	0.36775	0.63245	1.72071
15	0.95	0.9025	0.0975	0.31224	0.68776	2.20266
16	0.97	0.9409	0.0591	0.24310	0.7569	3.1135
17	0.98	0.9604	0.0396	0.1989	0.8011	4.0276
18	0.985	0.97022	0.029775	0.17255	0.82744	4.79528
19	0.99	0.9801	0.0199	0.14106	0.85893	6.0888
20	0.995	0.99002	0.009975	0.099874	0.90012	9.0126
21	0.999	0.9980	0.00199	0.04471	0.95529	21.3663

To find the radius r_E of the volume of Ether V_E driven with a significant speed by an SMP, we will utilize the speed variation v, with the distance r, using the theory of potential motions for the case of the movement of an SMP in the ET, which we will assimilate to the case of the movement of a cylinder of radius a, with the speed v through a perfect fluid (Figures 2 and 3).

For this case, starting from Equation (1), we can write the velocity v [16] in the horizontal Ox direction (Figure 2) as:

$$v = v_P \frac{a^2(y^2-x^2)^1}{(x^2+y^2)^2}. \quad (15)$$

The maximum of v will occur at points on the surface of the SMP, therefore having radius r=a; at point C_0 with coordinates (0, a) and the velocity here, v_{C0} will be, from (15),

$$v_{C0} = v_P \frac{a^2(a^2-0^2)^1}{(0^2+a^2)^2} = v_P \frac{a^4}{a^4} = v_P. \quad (16)$$

Thus, the velocity v_{C1} at distance 1.a from the surface of the SMP at point C_1 with coordinates (0, 2a) will be

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$$v_{C1} = v_P \frac{a^2\left((2a)^2 - 0^2\right)^1}{(0^2 + (2a)^2)^2} = v_P \frac{4a^4}{16a^4} = 0.25 v_P \quad (17)$$

To calculate the velocity v_{Ci} at points C_i located at various distances $r_i \geq a$, from the center O of the SMP, we use Equation (15), and we numerically calculate the values of the relative velocity $\beta = v_{Ci}/v_P$ along the Oy axis (Figure 2), where we have x=0 and y=ia, with i = 1, 2, 3, 4, …. :

$$\frac{v_{Ci}}{v_P} = \frac{a^2\left(y^2 - x^2\right)^1}{(x^2 + y^2)^2} = \frac{i^2 a^4}{i^4 a^4} = \frac{1}{i^2}. \quad (18)$$

The number of intervals i to the edge of the moving ET sphere/cylinder will be

$$\frac{1}{i^2} = \frac{v_{Ci}}{v_P};\ i = \sqrt{\frac{v_P}{v_{Ci}}}; \quad (19)$$

and in particular cases, the relative velocity v_{Ci}/v_p at a distance of ia from the SMP surface at points C_i with coordinates (0, ia) will be those shown in Table 2, column (7) (from **Methods).**

Table 2. Values of speed v_{Ci} at point C_i in Ether.

No. i.	$y = ia$ = rm	$(y)^2$ m^2	$a^2(y)^2$ m^4	$(y)^4$ m^4	$a^2(y^2 - 0^2)^2$ m^4	$(0^2 + y^2)^2$ m^4	$B = v_C/v_p = 1/i^2$ (5)/(6)	i
0	1	2	3	4	5	6	7	8
1	a	a^2	a^4	a^4	a^4	a^4	1.00	1.0
2	2a	4a^2	a^2 4a^2	16a^4	4a^4	16a^4	0.25	2.0
3	3a	9a^2	$a^2$9a^2	81a^4	9a^4	81a^4	0.11	3.0
4	4a	16a^2	$a^2$16a^2	256a^4	16a^4	256a^4	0.0623	4.0
5	5a	25a^2	$a^2$25a^2	625a^4	25a^4	625a^4	0.040	5.0
6	6a	36a^2	$a^2$36a^2	1296a^4	36a^4	1296a^4	0.0277	6.0
7	7a	49a^2	$a^2$49a^2	2401a^4	49a^4	2401a^4	0.0204	7.0
8	8a	64a^2	$a^2$64a^2	4096a^4	64a^4	4096a^4	0.0156	8.0
9	9a	81a^2	$a^2$81a^2	6561a^4	81a^4	6561a^4	0.012345	9.0
10	10a	100a^2	$a^2$100a^2	10000a^4	100a^4	10000a^4	0.01000	10.0
11	11a	121a^2	$a^2$121a^2	14641a^4	121a^4	14641a^4	0.00826	11.0
44	44a	1936	1936	3748096	1936	3748096	0.0005165289	44
62	62a	3844	3844	14776336	3844	14776336	0.000260145	62
76	76a	5776	5776	33362176	5776	33362176	0.000173130	76
79	79a	6241	6241	38950081	6241	38950081	0.000160230	79
80	80a	6400	6400	540960000	6400	540960000	0.00015625	80,0

Therefore, at point C_i on the Oy axis (Figure 3), which is located at increasing distances in arithmetic progression of I, the velocities of ET and v_{Ci} increasingly decrease according to Equation (19).

4. The Case of the Hydrogen Atom (from Methods)

For the first example, we consider the case of the smallest atom, H, for which we know the following:

-its mass, practically the mass of the proton:

$$m_0 = m_P = 1.6725 \times 10^{-27}\ \text{kg}$$

-the radius of the proton:

$$r_P = 1\text{fm} = 10^{-15}\ \text{m}$$

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-the radius of the H atom, r_{AH}, which, according to Wikipedia [17], is a function of the nucleus radius r_{Nu}, approx. $10^4\times r_{Nu}$.

However, there are values measured for the a-radii (Figure 2), for various elements, so that for H, we have [17]

$$a=r_H=25\text{pm}=25\times10^{-12}\text{ m}=2.5\times10^{-11}\text{ m}.$$

We chose from [17] the minimum value for the isolated atom, which is the most representative in high-speed experiments.

4.1. Case H1: β=0.01, i= 2

For the usual speeds in laboratory experiments of approx. β=0.01, the v_P of SMP/H is:

$$v_P=0.01\times300{,}000\text{ km/s}=3000\text{ km/s}.$$

The volume V_E of the torus of the ET driven by the SMP will be considered here as the theoretical volume (Figure 3c) in the form of an external torus minus the volume of the SMP.

The torus volume is as follows:

$$V_t=2\pi^2Rr^2=19.739Rr^2 \quad (20)$$

In our case (Figure 3c), the torus is the minimal one, with $R=r$, and its volume is as follows:

$$V_t=2\pi^2r^3 \quad (20a)$$

The volume of the SMP sphere is as follows:

$$V=4\pi r^3/3.$$

The ratio of the volume torus/sphere will be

$$V_t/V=2\pi^2r^3/(4\pi r^3/3)=3\pi/2=4.71238898. \quad (20b)$$

-The radius of the torus of the volume of ET driven by SMP/H, r_{ED}, we initially consider, in this case, to be double, i=2, the radius a of the particle, so $r_{ED}=i\times a=2a$.

The radius r_{ED} of the torus of the ET driven by the hydrogen atom (Figure 3c) is:

$$-\ r_{ED}=2r_H=2\times2.5\times10^{-11}=5\times10^{-11}\text{ m},$$

For this radius, here initially results a minimum speed v_{mi}, given by β=0.01, of ET driven by SMP/H, according to Table 2 (col. 6).

$$v_{mi}=0.25v_P=0.25\times3000=750\text{ km/s (nonnegligible)}.$$

Therefore, the volume of the torus of ET (Figure 3c), significantly driven by SMP/H, via (20), is as follows:

$$V_{EH}=2\pi2\text{rED}3–4\pi\times r_H^3/3=19.7392\times(5\times10^{-11})^3–4.18879\times(2.5\times10^{-11})^3)=$$

$$=19.7392\times125\times10^{-33}–4.188789\times15.625\times10^{-33}=(2467.4–65.4498)\times10^{-33}=2401.95\times10^{-33}=2.40159\times10^{-30}\text{ m}^3$$

We will now calculate the volume V_{Ecor} of the torus, corrected with the coefficient A_1, according to Equation (14) and Table 1 (col. 6), for β=0.01.

However, for the calculation of A_1, only the mean speed v_{me} of the volume of the mobile ET must be considered, assuming a linear variation in the ET velocity v:

v_{me}=1/2×(3000+750)=1875 km/s, respectively, the average speed relative to c:

$$\beta_{me}=1875/300000=0.00625.$$

The correction coefficient A_1 according to Table 1 (rows 1, 2) will be (after linear interpolations, successively for β and for A_1, resulting in the correction factor x for A_1):

β: 0.010–0.005=0.005; 0.00625–0.005=0.00125;
A_1: 0.00005–0.000012=0.000038; x=(0.000038×0.00125)/0.005=
=0.0000095; A_1=0.000012+x=0.000012+0.0000095=0.0000215, resulting in
A_1=0.0000215.

The corrected torus volume is as follows:

$$V_{Ecor}=V_{EH}/A_1=2.40159\times10^{-30}\text{ m}^3/0.0000215=111701.86\times10^{-30}=11.1701\times10^{-26}\text{ m}^3$$

Now, the basic density ϱ_E of the ET will be by definition:

$$\varrho_E=m_P/V_{Ecor}=1.6725\times10^{-27}/11.1701\times10^{-26}=0.14973\times10^{-1}\text{kg/m}^3=1.4973\times10^{-2}\text{ kg/m}^3=$$
$$=1.4973\times10^{-5}\text{ g/cm}^3.$$

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4.2. Case H2: β=0.01, i =8

Here, we take the relative speed to β=0.10, so v_P=0.10x300,000=30,000 km/s.

Here, we conduct the calculations similarly to those in Case H1 (without reproducing in detail).

To reduce the ET speed to the same minimum acceptable value of v_{mi}=46.8 km/s, we choose *i*=8, resulting in:

$$r_{EH}=2\times10^{-10}\text{ m},$$

The volume of the ET torus (Figure 3c), significantly driven by SMP/Ba, via (20) is as follows:

$$V_{EH}=15.790\times10^{-29}\text{ m}^3$$

The average speed v_{me} becomes:

$$v_{me}=1{,}523.4\text{ km/s.}$$

$$\beta_{me}=0.005078$$

The correction coefficient A_1 after interpolation is as follows:

$$A_1=0.000012592$$

The torus volume of ET, V_{Ecor} corrected:

$$V_{Ecor}=12.539707\times10^{-24}\text{ m}^3$$

The density ϱ_E:

$$\varrho_E=0.133376\times10^{-3}\text{ kg/m}^3$$

4.3. Case H3: β=0.3, i=44

Here, we take the relative speed to β=0.30, so v_P=0.30x300,000=90,000 km/s.

Here, we conduct the calculations similarly to those in Case H2 (without details), resulting in:

To reduce the ET speed to the same minimum acceptable value of v_{mi}=46.8 km/s, we calculate the required radius r_C simplified via Equation (19), resulting in:

$$\frac{1}{i}=\sqrt{\frac{v_C}{v_P}}=\sqrt{\frac{46.8}{90000}}=\sqrt{0.00052}=0.0228035. \quad (21)$$

$$i=1/0.0228035=43.8.$$

We choose *i*=44, resulting in:

$$r_{EH}=11.0\times10^{-10}\text{ m},$$

The volume of the ET torus (Figure 3c), significantly driven by SMP/Ba, via (20) is as follows:

$$V_{EH}=26.2728\times10^{-27}\text{ m}^3$$

The average speed v_{me} becomes:

$$v_{me}=90{,}046.8\text{ km/s.}$$

$$\beta_{me}=0.300156$$

The correction coefficient A_1 after interpolation is as follows:

$$A_1=0.0483733.$$

The torus volume of ET, V_{Ecor} corrected:

$$V_{Ecor}=5.43126\times10^{-25}\text{ m}^3.$$

The density ϱ_E:

$$\varrho_E=3.079349\times10^{-3}\text{ kg/m}^3$$

5. The Situation with Barium Atom B (from Methods)

For comparison, we consider the situation in which the SMP of the barium atom Ba, located in the middle of the Mendeleev Table, has an atomic number of 56, for which we know the following:

-its rest mass, as a function of the mass number A=137.34:

$$m_0=m_{Ba}=A.u=137\times1.6604\times10^{-27}=227.474\times10^{-27}\text{ kg}=2.2747\times10^{-25}\text{ kg}$$

-the radius of the Ba atom (Figure 3), which, according to classical physics, is [17]:

$$a=rBa=215\text{ pm}=215\times10^{-12}\text{ m}=21.5\times10^{-11}\text{ m.}$$

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5.1. Case Ba1, β=0,010, i=2

For low speeds, which are common in laboratory experiments of approx. β=0.01, the particle speed v_P results:

$$v_P=0.01\times300{,}000=3{,}000 \text{ km/s}.$$

The torus radius (Fg.3c) of the volume of ET entrained/driven by SMP/Ba, r_{ED}, is considered to be the double, *i*=2, of the particle radius *a*, so $r_{ED} = r_{EBa} = i\times a=2a$:

$$r_{EBa}=2r_{Ba}=2\times21.5\times10^{-11}=4.30\times10^{-10} \text{ m},$$

and where we assume that the minimum speed $v_{mi}=v_C$ of ET entrained by SMP/Ba is reached, according to Table 2 (row (2), col. (6)):

$$v_{mi}=0.25\times v_P=0.25\times3{,}000=750 \text{ km/s (25\% being nonnegligible)}.$$

However, now, we calculate the volume of the ET torus, which is significantly driven by SMP/Ba, via Equation (20):

$$V_{EBa}=2\pi^2\times r_{EBa}^3 -4/3\times\pi\times r_{Ba}^3=19.7392\times(43.0\times10^{-11})^3-4.18879\times(21{,}5\times10^{-11})^3)=$$
$$=19.7392\times79507\times10^{-33}-4.188789\times9938.37\times10^{-33}=(1569404.5-41629.73)\times10^{-33}=1527774.76\times10^{-33}=1.527774\times10^{-27} \text{ m}^3$$

However, the mean speed v_{me} of the torus volume of ET entrained results by assuming an approximately linear variation in the ET speed between the two edges/limits:

$$v_{me}=½\times(v_P+v_{mi})=1/2\times(3{,}000+750)=1{,}875 \text{ km/s}.$$

The average relative speed β_{me} results:

$$\beta_{me}=v_{me}/c=1{,}875/300000=0.00625$$

The correction coefficient A_1 according to Table 1 is as follows (after linear interpolation for β):

β: 0.010-0.005=0.005; 0.00625-0.005=0.00125;

A_1: 0.00005-0.000012=0.000038; x= (0.00125×0.000038)/0.005=0.0000095;

$$A_1=0.000012+x=0.000012+0.0000095=0.0000215$$

$$A_1=0.0000215$$

The torus volume of ET and V_{Ecor} corrected with A_1 according to eq (12) is as follows:

$$V_{Ecor}=V_E/A_1=1.527774\times10^{-27} \text{ m}^3/0.0000215=71059.2\times10^{-27} \text{ m}^3=7.10592\times10^{-23} \text{ m}^3$$

The corrected/final density according to Equation (12), ϱ_E, of ET will result by definition:

$$\varrho_{Ecor}=m_P/V_{Ecor}=2.2747\times10^{-25}/7.10592\times10^{-23}=0.320113\times10^{-2}\text{kg/m}^3=0.320113\times10^{-5}\text{g/cm}^3$$

5.2. Case Ba2: β=0.010, i=8

Here, we take the relative speed to β=0.10, so v_P=0.10x300,000=30,000 km/s.

Here, we conduct the calculations similarly to those in Case Ba1 (without reproducing in detail), resulting in the following:

To reduce the ET speed to the same minimum acceptable value of v_{mi}=46.8 km/s, we calculate the required radius r_C simplified via Equation (19), resulting in:

$$\frac{1}{i} = \sqrt{\frac{v_{Ci}}{v_P}} = \sqrt{\frac{46.8}{3000}} = \sqrt{0.0156} = 0.12489995 \qquad (22)$$

$$i=1/0.12489995=8.006$$

We choose *i*=8, resulting in:

$$r_{EBa}=17.2\times10^{-10} \text{ m},$$

The volume of the ET torus (Figure 3c), significantly driven by SMP/Ba, via (20) is as follows:

$$V_{EBa}=10.0391\times10^{-26} \text{ m}^3$$

The average speed v_{me} becomes:

$$v_{me}=1{,}523.4 \text{ km/s}.$$

$$\beta_{me}=0.005078$$

The correction coefficient A_1 after interpolation:

$$A_1=0.000012592$$

The torus volume of ET, V_{Ecor} corrected:

$$V_{Ecor}=7.972601 \times10^{-21} \text{ m}^3.$$

The density ϱ_E:

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ϱ_E=0.285192×10^{-4} kg/m^3

5.3. Case Ba3; β=0.30, i=44

Here, we increase the relative speed to β=0.30, so v_P=0.30x300,000=90,000 km/s.

Here, we conduct the calculations similarly to those in Case Ba2 (without reproducing in detail), resulting in the following:

To reduce the ET speed to the same minimum acceptable value of v_{mi}=46.8 km/s, we calculate the required radius r_C simplified via Equation (19), resulting in:

$$\frac{1}{i} = \sqrt{\frac{v_{Ci}}{v_P}} = \sqrt{\frac{46.8}{90000}} = \sqrt{0.00052} = 0.0228035 \quad (23)$$

i=1/0.0228035=43.8

We choose *i*=44, resulting in:

r_{EBa}=94.6×10^{-10} m,

The volume of the ET torus (Figure 3c), significantly driven by SMP/Ba, via (20) is as follows:

V_{EBa}=16.710978×10^{-24} m^3

The average speed v_{me} becomes:

v_{me}=45,023.4 km/s.

β_{me}=0.150078

The correction coefficient A_1 after interpolation is as follows:

A_1=0.0128421

The torus volume of ET, V_{Ecor} corrected:

V_{Ecor}=13.012652 ×10^{-22} m^3.

The density ϱ_E:

ϱ_E=1.74806×10^{-4} kg/m^3

5.4. Case Ba4 β=0.60, i=62

Here, we increase the relative speed to β=0.60, so v_P=0.60x300,000=180,000 km/s.

Here, we conduct the calculations similarly to those in Case Ba2 (without reproducing in detail), resulting in the following:

To reduce the ET speed to the same minimum acceptable value of v_{mi}=46.8 km/s, we calculate the required radius r_C simplified via Equation (19), resulting in:

$$\frac{1}{i} = \sqrt{\frac{v_{Ci}}{v_P}} = \sqrt{\frac{46.8}{180000}} = \sqrt{0.00026} = 0.0161245 \quad (24)$$

i=1/0.0161245=62.017

We choose *i*=62, resulting in:

r_{EBa}=133.3×10^{-10} m,

The volume of the ET torus (Figure 3c), significantly driven by SMP/Ba, via (20) is as follows:

V_{EBa}=46.754089×10^{-24} m^3

The average speed v_{me} becomes:

v_{me}=90,023.4 km/s.

β_{me}=0.300078

The correction coefficient A_1 after interpolation is as follows:

A_1=0.048331

The torus volume of ET, V_{Ecor} corrected:

V_{Ecor}=9.67372×10^{-22} m^3.

The density ϱ_E:

ϱ_E=2.35142×10-4 kg/m^3

5.5. Case Ba5 β=0.90, i=76

Here, we increase the relative speed to β=0.90, so v_P=0.90x300,000=270,000 km/s.

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Here, we conduct the calculations similarly to those in Case Ba2 (without reproducing in detail), resulting in the following:

To reduce the ET speed to the same minimum acceptable value of v_{mi}=46.8 km/s, we calculate the required radius r_C simplified via Equation (19), resulting in:

$$\frac{1}{i} = \sqrt{\frac{v_{Ci}}{v_P}} = \sqrt{\frac{46.8}{270000}} = \sqrt{0.000173333} = 0.0131655991. \quad (25)$$

i=1/0.0131655991=75.9.

We choose i=76, resulting in:

$r_{EBa}=16.34\times10^{-9}$ m,

The volume of the ET torus (Figure 3c), significantly driven by SMP/Ba, via (20) is as follows:

$V_{EBa}=86.1163261\times10^{-24}$ m^3

The average speed v_{me} becomes:

v_{me}=135,023.4 km/s.

β_{me}=0.450078.

The correction coefficient A_1 after interpolation is as follows:

A_1=0.1285066

The torus volume of ET, V_{Ecor} corrected:

$V_{Ecor}=6.701315\times10^{-22}$ m^3.

The density ϱ_E:

$\varrho_E=3.3944\times10^{-4}$ kg/m^3

5.6. Case Ba6, β=0.97, k=79

Here, we increase the relative speed to β=0.90, so v_P=0.97x300,000=291,000 km/s.

Here, we conduct the calculations similarly to those in Case Ba2 (without reproducing in detail), resulting in the following:

To reduce the ET speed to the same minimum acceptable value of v_{mi}=46.8 km/s, we calculate the required radius r_C simplified via Equation (19), resulting in:

$$\frac{1}{i} = \sqrt{\frac{v_{Ci}}{v_P}} = \sqrt{\frac{46.8}{291000}} = \sqrt{0.0001608247} = 0.0126816687. \quad (26)$$

i=1/0.0126816687=78.85.

We choose i=79, resulting in:

$r_{EBa}=16.985\times10^{-9}$ m,

The volume of the ET torus (Figure 3c), significantly driven by SMP/Ba, via (20) is as follows:

$V_{EBa}=96.7221661\times10^{-24}$ m^3

The average speed v_{me} becomes:

v_{me}=145,523.4 km/s.

β_{me}=0.485078.

The correction coefficient A_1 after interpolation is as follows:

A_1=0.14721419

The torus volume of ET, V_{Ecor} corrected:

$V_{Ecor}=6.5701659\times10^{-22}$ m^3.

The density ϱ_E:

$\varrho_E=3.462165\times10^{-4}$ kg/m^3

6. Systematization of the Results of Calculations of ϱ_E (from Methods)

The final results of ϱ_E from Sections 4 and 5 are systematized in Table 3 (also in **Methods).**

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Table 3. The values of the density ρ_E of ether.

No.	SMP rel, speed $\beta = v_P/c$	Ind i dist i	Ether rel. speed $\beta_C=v_C/v_P$	SMP mass m_0 kg	Atom radius r_A m	ET torus radius $r_{EA}=i.r_A$ m	ET torus volume V_E m^3	ET me speed $\beta_{me}=v_{me}/c$	Corr coef of Vol. A_1	Corr Vol. V_{Ecor} m^3	ET density ρ_E kg/m^3
0	1	2	3	4	5	6	7	8	9	10	11
					Hydrogen						
1	0.01	2	0.25	1.6725×10^{-27}	2.5×10^{-11}	5×10^{-11}	2.40159×10^{-30}	0.00625	0.0000215	11.1701×10^{-25}	1.4973×10^{-2}
2	0.01	8	0.0156	1.6725×10^{-27}	2.5×10^{-11}	2×10^{-10}	15.790×10^{-29}	0.005078	0.000012592	12.539707×10^{-24}	$0,133376\times10^{-3}$
3	0.30	44	0.000521	1.6725×10^{-27}	2.5×10^{-11}	11×10^{-10}	26.2728×10^{-27}	0.300156	0.0483733	5.43126×10^{-25}	$3,079349\times10^{-3}$
					Barium						
1	0.01	2	0.25	2.2747×10^{-25}	21.5×10^{-11}	4.30×10^{-10}	1.527774×10^{-27}	0.00625	0.0000215	7.10592×10^{-23}	0.320113×10^{-2}
2	0.01	8	0.0156	2.2747×10^{-25}	21.5×10^{-11}	17.2×10^{-10}	10.0391×10^{-26}	0.005078	0.000012592	7.972601×10^{-21}	0.285192×10^{-4}
3	0.30	44	0.000521	2.2747×10^{-25}	21.5×10^{-11}	94.6×10^{-10}	16.710978×10^{-24}	0.150078	0.0128421	13.012652×10^{-22}	1.74806×10^{-4}
4	0.60	62	0.00026	2.2747×10^{-25}	21.5×10^{-11}	13.33×10^{-9}	46.754089×10^{-24}	0.300078	0.048331	9.67372×10^{-22}	2.35142×10^{-4}
5	0.90	76	0.00017333	2.2747×10^{-25}	21.5×10^{-11}	16.34×10^{-9}	86.116326×10^{-24}	0.450078	0.1285066	6.701315×10^{-22}	3.39440×10^{-4}
6	0.97	79	0.00016082	2.2747×10^{-25}	21.5×10^{-11}	16.985×10^{-9}	96.722166×10^{-24}	0.485078	0.14721419	6.5701659×10^{-22}	3.462165×10^{-4}

Table 3 shows that for the density ρ_E of the ET, a series of three values were obtained for the hydrogen atom, and six values were obtained for the barium atom.

a). Rows 1. For both H and Ba, the values in Table 3 were calculated for a particle velocity $\beta=v_P/c=0.01$ ($v_P=3000$ km/s) and an initial torus radius of the ET volume, which was chosen arbitrarily initially by the distance coefficient $i=2$. However, this radius proved insufficient for reducing the marginal velocity v_C to a negligible value compared with the velocity v_P of the SMP. This is because, from Table 2, $v_C/v_P=0.25=25\%$ (vC=750 km/s), a percentage far too high to be negligible. Therefore, for this case, a density ρ_E of ET on the order of 1.0×10^{-2} kg/m^3 is not realistic.

b). Rows 2. Then, for both H and Ba, the values were also calculated for $\beta=0.01$, but for a radius of the torus of volume V_E of ET, given by the distance coefficient $i=8$. This coefficient was determined by calculation to obtain a minimum marginal speed $v_{min}=v_C=46.8$ km/s.

This value of v_C was negligible compared with the velocity v_P of the SMP (vP=3000 km/s), i.e., $v_C/v_P=0.0156=1.56\%$. The velocity $v_C=46.8$ km/s, or a percentage of 1.56%, was then considered negligible compared with v_P (in the sense of engineering, since it was less than 2%). Therefore, for

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this case, a density ϱ_E of ET on the order of 0.30×10^{-4} kg/m^3 (for Ba) and 0.130×10^{-3} kg/m^3 (for H) can be considered realistic.

c). Rows 3. Then, for both H and Ba, the values were calculated for β=0.30 (v_P= 90000 km/s). However, we now calculate for a torus radius of volume V_E of ET given by the distance coefficient i=44, which was determined by calculation, precisely to obtain the same marginal velocity v_C = 46.8 km/s, which can be considered negligible. Therefore, for this case, the density ϱ_E of ET on the order of 1.80×10^{-4} kg/m^3 (for Ba) and 3.0×10^{-3} kg/m^3 (for H) can be considered realistic.

d). Row 4. Then, for Ba, the values were calculated for β=0.60 (v_P=180000 km/s) but for a torus radius of volume V_E given by the distance coefficient i=62, which was determined by calculation, precisely to obtain the same marginal velocity v_C=46.8 km/s. Therefore, for this case, the density ϱ_E, which is on the order of 2.35×10^{-4} kg/m^3, can be considered realistic.

e) Row 5. Then, for Ba, the values were calculated for the velocity β=0.90 (v_P= 270000 km/s), but for a torus radius of volume V_E given by i=76, which was determined by calculation, precisely to obtain the same marginal velocity v_C=46.8 km/s. Therefore, for this case, the density ϱ_E, which is on the order of 3.30×10^{-4} kg/m^3, can be considered realistic.

f). Row 6. For the Ba atom, the values were subsequently calculated for the velocity β=0.97 (v_P=291000 km/s), but for a torus radius of volume V_E given by i=79, which was determined by calculation, precisely to obtain the same marginal velocity v_C = 46.8 km/s. Therefore, also for this case, the density ϱ_E of the ET, which is on the order of 3.40×10^{-4} kg/m^3, can also be considered realistic.

In Table 3, a slight monotonic increase in the calculated density ϱ_E with increasing speed β (from 0.01 to 0.97) is observed. However, the density of ET remains near ϱ_E=2.0×10^{-4} kg/m^3, which can be considered realistic.

This small increase in the calculated density ϱ_E of ET can be explained by increased pressures in the surrounding ET as an effect of the increased ET speed toward limit c.

Of course, the method presented above for calculating the ET density ϱ_E also contains several insignificant approximations, which are necessary for evaluating the ET volumes entrained by the SMP; however, calculus can be considered correct, and the mean ET density value from Table 3 ϱ_E≈2.0×10^{-4} kg/m^3 appears realistic.

7. Conclusions

In this article, we are based on our previous results starting with the discovery of Errors 1 and 2 in Michelson's analysis of ME1881/87.

By correcting **Errors 1 and 2** in Michelson's analysis, it was possible to reintroduce Ether into Physics in 2016 in the form of our model HM16, which was subsequently completed and improved.

However, the presence of Ether in Physics has already led, in our previous work, to a series of important consequences, as in Sec. 1.

In 2021 [10], we presented and described a new explanation of the intimate, physical/mechanical nature of the rest mass m_0 of submicroparticles.

At the same time, we also presented an explanation for the phenomenon of the increase in the rest mass m_0 of the SMP once a speed v of movement through the ET of the SMP is reached. However, the SMP entrains a certain volume C_E of the ET surrounding the SMP, whose kinetic energy E_E constitutes even suplementary mass of m_s.

This result was obtained by identifying the mass m_s with the kinetic energy E_E of ET, which accumulated in the volume C_E/V_E of Ether entrained around the SMP, moving with speed v through the ET.

In 2021 [10], the calculation was carried out without explicitly working with the density ϱ_E of the ET.

However, in this work, we have gone from the volume C_i of the ET to the related mass m_i of the ET by introducing the density ϱ_E of the ET and a formula for calculating the density ϱ_E of the ET, resulted, containing the coefficient A_1 as a function of the relative velocity β=v/c of the SMP.

The ϱ_E calculation was initially performed for the simplest atom, Hydrogen, and subsequently also for the complex atom, Barium, which was subjected to a wide range of velocities β through the ET.

Therefore, we obtained a ET density ϱ_E of approx. 2.0×10–4 kg/m³

However, the above results for ϱ_E are credible and also useful for future research on this topic, including practical applications in the field of space flight or physical experiments.

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