The Universal Quantum Fluid

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The quantization of gravity showed that the matter is also quantized, and that there is an *elementary quantum of matter*, indivisible, whose mass is $\pm 3.9\times10^{-73}kg$. This means that any body is formed by *a whole number* of these particles (quantization). It is shown here that these elementary *quanta* of matter should fill all the space in the Universe forming a *Quantum Fluid continuous and stationary*. In addition, it is also explained why the Michelson-Morley experiment was not able to detect this Universal Quantum Fluid.

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1. Introduction

Until the end of the century XX, several attempts to quantize gravity were made. However, all of them resulted fruitless [1, 2]. In the beginning of this century, it was clearly noticed that there was something unsatisfactory about the whole notion of quantization and that the quantization process had many ambiguities. Then, a new approach has been proposed starting from the generalization of the *action function*[*]. The result has been the derivation of a theoretical background, which finally led to the so-sought quantization of gravity and of *matter* [3]. The quantization of matter shows that there is an *elementary quantum of matter* whose mass is $\pm 3.9\times10^{-73}kg$. This means that there are no particles in the Universe with masses smaller than this, and that any body is formed by *a whole number* of these particles. Here, it will be shown that these elementary *quanta* of matter should fill all the space in the Universe, forming a *quantum fluid continuous and stationary*. In addition, it is also explained why the Michelson-Morley experiment found no evidence of the existence of the universal fluid [4]. A modified Michelson-Morley experiment is proposed in order to observe the displacement of the interference bands.

2. The Universal Quantum Fluid

The quantization of gravity showed that the matter is also quantized, and that there is an *elementary quantum of matter*, indivisible, whose mass is $\pm 3.9\times10^{-73}kg$ [3].

Considering that the inertial mass of the *Observable Universe* is $M_U = c^3/2H_0G \cong 10^{53}kg$, and that its volume is $V_U = \frac{4}{3}\pi R_U^3 = \frac{4}{3}\pi\left(c/H_0\right)^3 \cong 10^{79}\,m^3$, where $H_0 = 1.75\times10^{-18}s^{-1}$ is the *Hubble constant*, we can conclude that the *number of these particles in the Observable Universe* is

$$n_U = \frac{M_U}{m_{i0(\min)}} \cong 10^{125}\,particles \qquad (1)$$

By dividing this number by V_U, we get

$$\frac{n_U}{V_U} \cong 10^{46}\,particles/m^3 \qquad (2)$$

Obviously, the dimensions of the *elementary quantum of matter* depend on its state of compression. In free space, for example, its volume is V_U/n_U. Consequently, its "radius" is $R_U/\sqrt[3]{n_U} \cong 10^{-15}m$.

If N particles with diameter ϕ *fill all space* of $1m^3$ then $N\phi^3 = 1$. Thus, if $\phi \cong 10^{-15}m$ then the number of particles, with this diameter, necessary to fill all $1m^3$ is $N \cong 10^{45}\,particles$. Since the number of *elementary quantum of matter* in the Universe is $n_U/V_U \cong 10^{46}\,particles/m^3$ we can conclude that these particles *fill all space* in the Universe, forming a *Quantum Fluid continuous and stationary*, the density of which is

$$\rho_{CUF} = \frac{n_U\, m_{i0(\min)}}{V_U} \cong 10^{-27}\,kg/m^3 \qquad (3)$$

Note that this density is smaller than the

[*] The formulation of the *action* in Classical Mechanics extends to Quantum Mechanics and has been the basis for the development of the *Strings Theory*.

density of the *Intergalactic Medium* $\left(\rho_{IGM} \cong 10^{-26}\, kg/m^3\right)$.

The density of the Universal Quantum Fluid is clearly *not uniform* along the Universe, since it can be strongly compressed in several regions (galaxies, stars, blackholes, planets, etc). At the normal state (free space), the mentioned fluid is *invisible*. However, at *supercompressed* state, it can become *visible by giving origin* to the *known matter*, since matter, as we have seen, is *quantized* and consequently, formed by an *integer number* of elementary quantum of matter with mass $m_{i0(\min)}$. Inside the proton, for example, there are $n_p = m_p / m_{i0(\min)} \cong 10^{45}$ *elementary quanta of matter* at supercompressed state, with volume V_{proton}/n_p and "radius" $R_p / \sqrt[3]{n_p} \cong 10^{-30} m$.

Therefore, the solidification of the matter is just a *transitory state* of this Universal Quantum Fluid, which can turn back into the primitive state when the cohesion conditions disappear.

Due to the cohesion state of the *elementary quanta of matter* in the *Universal Quantum Fluid*, any amount of *linear momentum* transferred to any elementary *quantum* of matter propagates totally to the neighboring and so on, in such way that, during the propagation of the *momentum*, the elementary *quanta* of matter do not move, in the same way as the intermediate spheres in Newton's *pendulum* (the well-known device that demonstrates conservation of *momentum* and energy) [5, 6]. Thus, whether it is a photon that transfers its *momentum* to the elementary *quanta* of matter, then the momentum variation due to the incident photon is $\Delta p = h/\lambda$, where λ is its wavelength. As we have seen, the diameter of the elementary *quantum* of matter is $\Delta x \approx 10^{-15} m$. According to the *Uncertainty Principle* the variation Δp can only be detected if $\Delta p \Delta x \geq \hbar$. In order to satisfy this condition we must have $\lambda \leq 2\pi\Delta x \approx 10^{-14} m$. This means that *momentum* variations, in the elementary *quanta* of matter, *caused by photons with wavelength* $\lambda > 10^{-14} m$ *cannot be detected*. That is to say that the propagation of these photons through the Universal Quantum Fluid is equivalent to its propagation in the *free space*. In practice, it works as if *there was not the Universal Quantum Fluid*. This conclusion is highly important, because it can easily explain why in the historical Michelson-Morley experiment there was no displacement of the interference bands namely because the wavelength of the light used in the Michelson-Morley experiment was $\lambda = 5\times10^{-7} m$ fact that led Michelson to conclude that the hypothesis of a stationary ether was incorrect. Posteriorly, several experiments [7-13] have been carried out in order to check the Michelson-Morley experiment, but the results basically were the same obtained by Michelson.

Thus, actually there was no displacement of the interference bands in the Michelson-Morley experiment because the wavelength used in the experiment was $\lambda = 5\times10^{-7} m$, which is a value clearly much greater than $10^{-14} m$, and therefore, does not satisfy the condition $\lambda \leq 2\pi\Delta x \approx 10^{-14} m$ derived from the Uncertainty Principle. The substitution of light used in the Michelson-Morley experiment by radiation with $\lambda \leq 10^{-14} m$ is clearly impracticable. However, the Michelson-Morley experiment can be partially modified so as to yield the displacement of the interference bands. The idea is based on the generalized expression for the *momentum* obtained recently[3], which is given by

$$p = M_g V \tag{4}$$

where $M_g = m_g / \sqrt{1 - V^2/c^2}$ is the relativistic gravitational mass of the particle and V its velocity; $m_g = \chi\, m_{i0}$ the *general expression of the correlation between the gravitational and inertial mass*; χ is the correlation factor[3].Thus, we can write

$$\frac{m_g}{\sqrt{1 - V^2/c^2}} = \frac{\chi\, m_{i0}}{\sqrt{1 - V^2/c^2}} \tag{5}$$

Therefore, we get

$$M_g = \chi M_i \tag{6}$$

The Relativistic Mechanics tells us that

$$p = \frac{UV}{c^2} \tag{7}$$

where U is the *total* energy of the particle. This expression is valid for *any* velocity V of the particle, including $V = c$.

By comparing Eq. (7) with Eq. (4) we obtain

$$U = M_g c^2 \tag{8}$$

It is a well-known experimental fact that

$$M_i c^2 = hf \tag{9}$$

Therefore, by substituting Eq. (9) and Eq. (6) into Eq. (4), gives

$$p = \frac{V}{c}\chi\frac{h}{\lambda} \tag{10}$$

Note that this expression is valid for *any* velocity V of the particle. In the particular case of $V = c$, it reduces to

$$p = \chi\frac{h}{\lambda} \tag{11}$$

By comparing Eq. (10) with Eq. (7), we obtain

$$U = \chi hf \tag{12}$$

Note that only for $\chi = 1$ Eq. (11) and Eq. (12) are reduced to the well=known expressions of DeBroglie $(q = h/\lambda)$ and Einstein $(U = hf)$.

Equations (10) and (12) show, for example, that *any* real particle (material particles, real photons, etc) that penetrates a region (with density ρ, conductivity σ and relative permeability μ_r), where there is an electromagnetic field (E, B), will have its *momentum* p and its energy U reduced by the factor χ, given by[3]:

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1 + \left(\frac{\Delta p}{m_{i0}c}\right)^2} - 1\right]\right\} =$$

$$= \left\{1 - 2\left[\sqrt{1 + 1.758\times10^{-27}\left(\frac{\mu_r\sigma^3}{\rho^2 f^3}\right)c^4 B_{rms}^4} - 1\right]\right\} \tag{13}$$

where B_{rms} is the *rms* value of the magnetic field B.

The remaining amount of *momentum* and *energy*, respectively given by $(1-\chi)\left(\frac{V}{c}\right)\frac{h}{\lambda}$ and $(1-\chi)\,hf$, are *transferred to* the *imaginary* particle associated to the *real* particle† (material particles or real photons) that penetrated the mentioned region.

It was previously shown that, when the *gravitational mass* of a particle is reduced to a range between $+0.159M_i$ to $-0.159M_i$, i.e., when $\chi < 0.159$, it becomes *imaginary*[3], i.e., the gravitational and the inertial masses of the particle becomes *imaginary*. Consequently, the particle disappears from our ordinary space-time. It goes to the Imaginary Universe. On the other hand, when the gravitational mass of the particle becomes greater than $+0.159M_i$, or less than $-0.159M_i$, i.e., when $\chi > 0.159$, the particle return to our Universe.

Figure 1 (a) clarifies the phenomenon of reduction of the *momentum* for $\chi > 0.159$, and Figure 1 (b) shows the effect in the case of $\chi < 0.159$. In this case, the particles become imaginary and, consequently, they go to the *imaginary space-time* when they penetrate the electric field E. However, the electric field E stays in the *real* space-time. Consequently, the particles return immediately to the real space-time in order to return soon after to the *imaginary* space-time, due to the action of the electric field E. Since the particles are moving at a direction, they *appear* and *disappear* while they are crossing the region, up to collide with the plate (See Fig.1) with a *momentum*, $p_m = \chi\left(\frac{V}{c}\right)\frac{h}{\lambda}$, in the case of a *material particle*, and $p_r = \chi\frac{h}{\lambda}$ in the case of a *photon*.

If this photon transfers its *momentum* to elementary *quanta* of matter $\left(\Delta x \approx 10^{-15}m\right)$, then the momentum variation due to the incident photon is $\Delta p = \chi h/\lambda$. According to the *Uncertainty Principle* the variation Δp can only be detected if $\Delta p\Delta x \geq \hbar$, i.e., if

$$\lambda \leq 2\pi\chi\Delta x \tag{14}$$

We conclude, then, that the *interaction* between the light used in the Michelson-

† As previously shown, there are *imaginary particles* associated to each *real particle*[3].

Morley experiment $\left(\lambda = 5\times10^{-7}m\right)$ and the Universal Quantum Fluid *just can be detected*, and to produce of the displacement of the interference bands, if

$$\chi \geq 8\times10^{7} \qquad (15)$$

In order to satisfy this condition in the Michelson-Morley experiment, we must modify the medium where the experiment is performed (for example substituting the air by *low-pressure Mercury plasma*), and apply through it an electromagnetic field with frequency f. Under these conditions, according to Eq. (13), the value of χ will be given by

$$\chi = \left|\left\{1-2\left[\sqrt{1+1.758\times10^{-27}\left(\frac{\mu_r\sigma^3}{\rho^2 f^3}\right)c^4 B_{rms}^4}-1\right]\right\}\right| \qquad (16)$$

If the *low-pressure Mercury plasma* is at $P = 6\times10^{-3}Torr = 0.8N.m^{-2}$ and $T \cong 318.15\ K$ [14], then the mass density, according to the well-known *Equation of State*, is

$$\rho = \frac{PM_0}{ZRT} \cong 6.067\times10^{-5}\,kg.m^{-3} \qquad (17)$$

where $M_0 = 0.2006kg.mol^{-1}$ is the molecular mass of the Hg; $Z \cong 1$ is the *compressibility factor* for the Hg plasma; $R = 8.314\,joule.mol^{-1}.^{0}K^{-1}$ is the *gases universal constant*.

The electrical conductivity of the Hg plasma, under the mentioned conditions, has already been calculated [15], and is given by

$$\sigma \cong 3.419\ S.m^{-1} \qquad (18)$$

By substitution of the values of ρ and σ into Eq. (16) yields

$$|\chi| = \left|\left\{1-2\left[\sqrt{1+1.5471\times10^{17}\frac{B_{rms}^4}{f^3}}-1\right]\right\}\right| \qquad (19)$$

By comparing with (15), we get

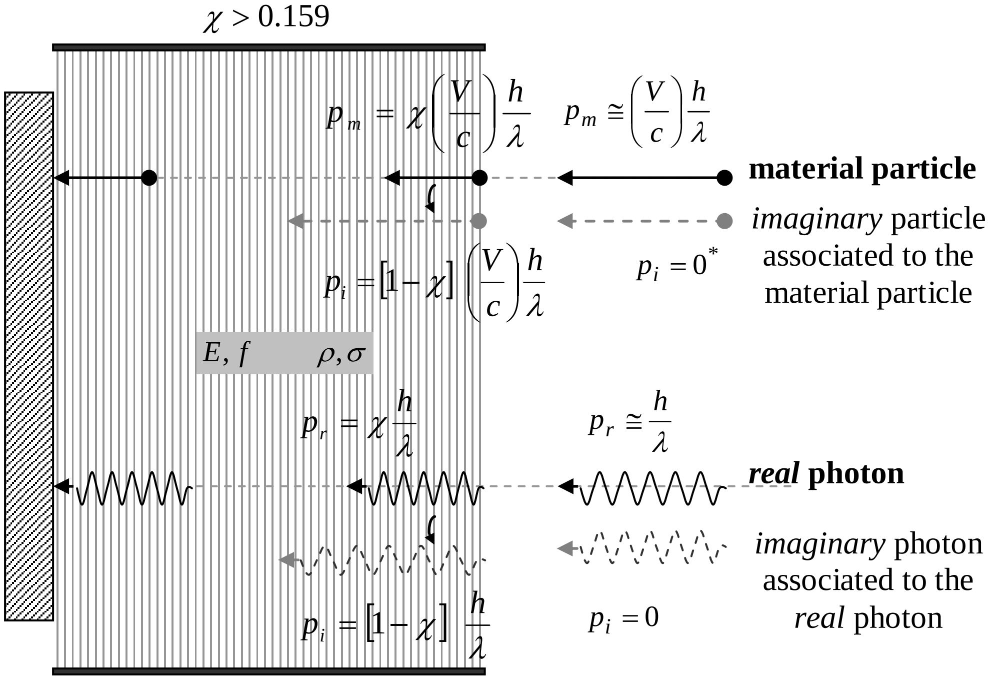
$$\frac{B_{rms}^4}{f^3} \geq 0.01037 \qquad (20)$$

Thus, for $f = 1Hz$, the ELF magnetic field must have the following intensity:

$$B_{rms} \geq 0.32T \qquad (21)$$

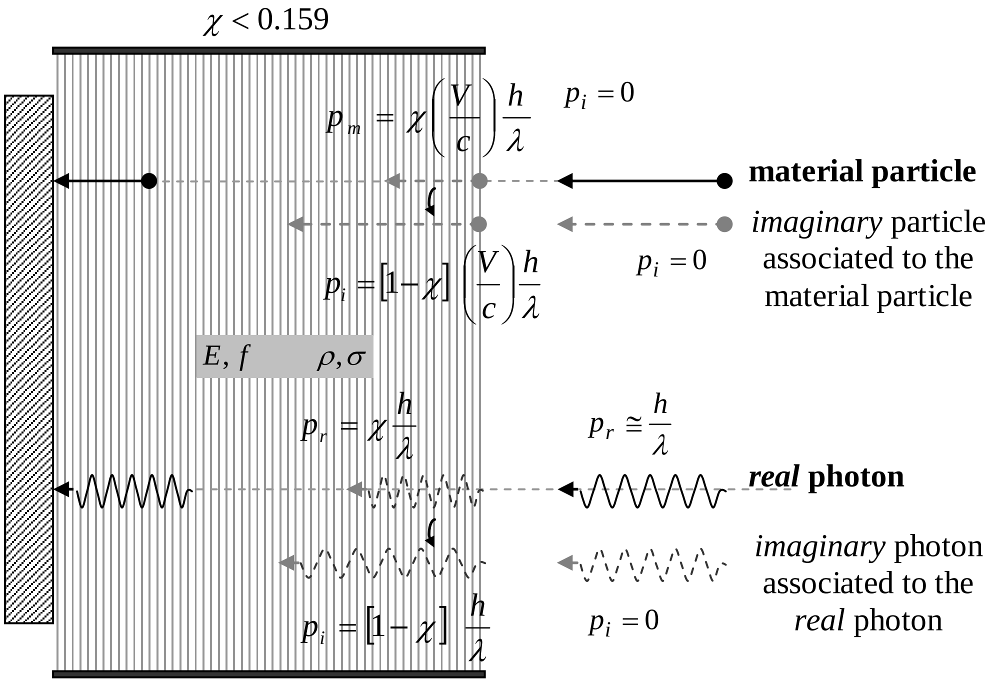
This means that, if in the Michelson-Morley experiment the air is substituted by *Hg plasma* at $6\times10^{-3}Torr$ and $318.15\ K$, and an ELF magnetic field with frequency $f = 1Hz$ and intensity $B_{rms} \geq 0.32T$ is applied through this plasma (Fig. 2), *then the displacement of the interference bands should appear*.

It is important to note that due to the *Gravitational Shielding effect* [3], the gravity above the magnetic field is given by $\chi\ g \geq 7.8\times10^{8}m.s^{-2}$. This value, extends above the vacuum chamber for approximately *10 times* its length. In order to eliminate this problem we can replace the ELF magnetic field, B, shown in Fig. 2, by two ELF magnetic fields, B_1 and B_2, sharing the same frequency, $f = 1Hz$. The field, B_1, is placed vertically through the region of the experimental set-up. The field, B_2, is also placed vertically, just above B_1 (See Fig. 3). Thus, the gravity above B_2 is given by $\chi_1\chi_2 g$ where $\chi_1 = m_{g1}/m_{i1}$ and $\chi_2 = m_{g2}/m_{i2}$ are respectively, the correlation factors in the Gravitational Shieldings 1 and 2, produced by the ELF magnetic fields B_1 and B_2, respectively. In order to become $\chi_1\chi_2 g = g$ we must make $\chi_2 = 1/\chi_1 = 1/-8\times10^{7}$. According to Eq. (19), this value can be obtained if $B_{rms(2)} = 5.331481522\times10^{-5}T$ and $B_{rms(1)} = 0.32T$. Note that the value of $B_{rms(2)}$ is less than the value of the Earth's magnetic field ($B_{\oplus} \cong 6\times10^{-5}T$). However, this is not a problem because the steel of the vacuum chamber works as a magnetic shielding, isolating the magnetic fields inside the vacuum chamber.



(a)

* There are a type of neutrino, called "ghost" neutrino, predicted by General Relativity, with *zero mass* and *zero momentum*. In spite its *momentum be zero*, it is known that there are wave functions that describe these neutrinos and that prove that really they exist.



(b)

Fig. 1 – *The correlation factor in the expression of the Momentum* (a) Shows the *momentum* for $\chi > 0.159$. (b) Shows the effect when $\chi < 0.159$. Note that in both cases, the *material* particles collide with the cowl with the *momentum* $p_m = \chi(V/c)(h/\lambda)$, and the photons with $p_r = \chi(h/\lambda)$.

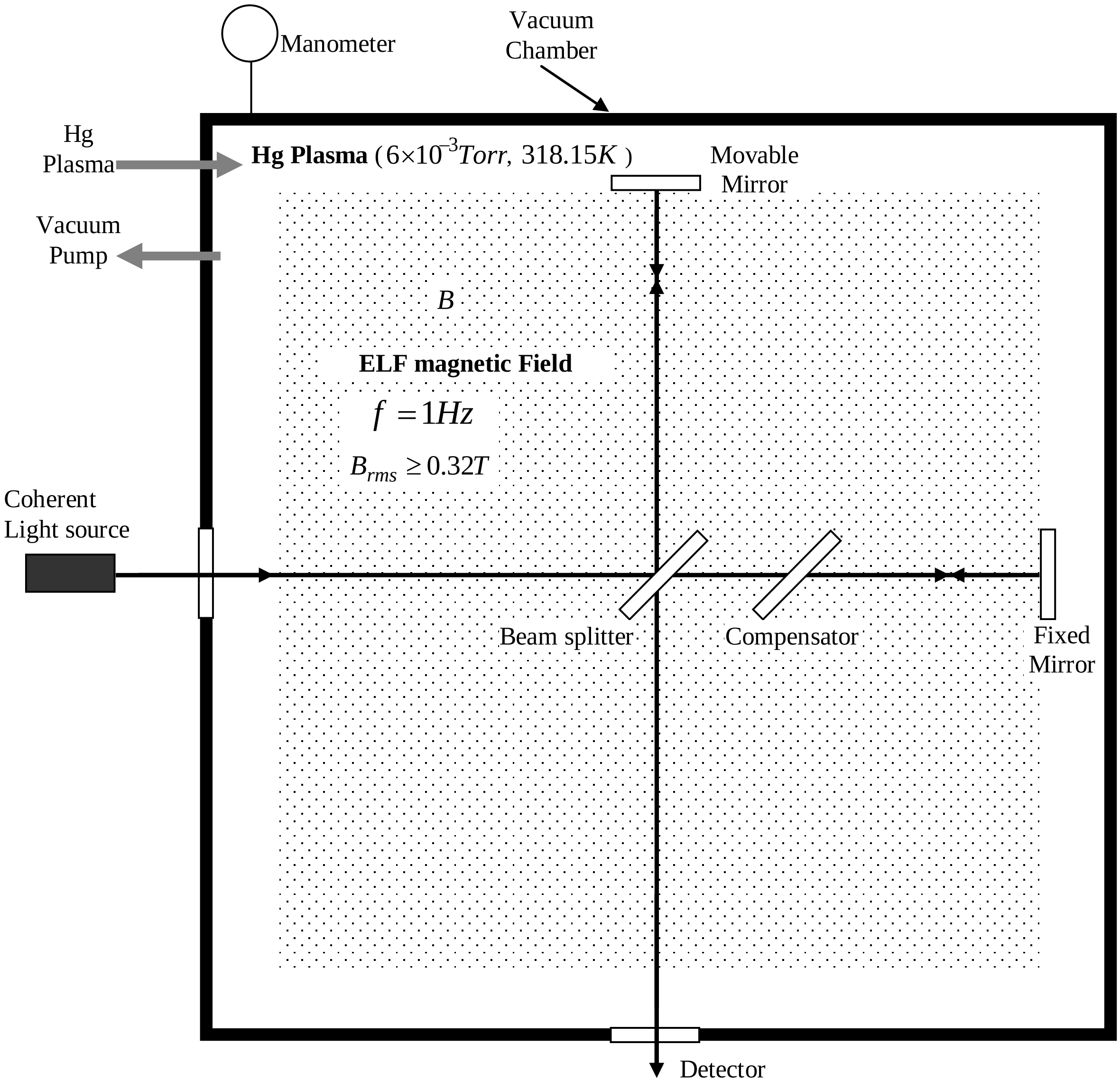


Fig. 2 - *The modified Michelson-Morley experiment*. The air is substituted by *Hg plasma* at $6\times10^{-3}Torr$ and $318.15\ K$, and an ELF magnetic field with frequency $f = 1Hz$ and intensity $B_{rms} \geq 0.32T$ is applied through this plasma, *then the displacement of the interference bands should appear*.

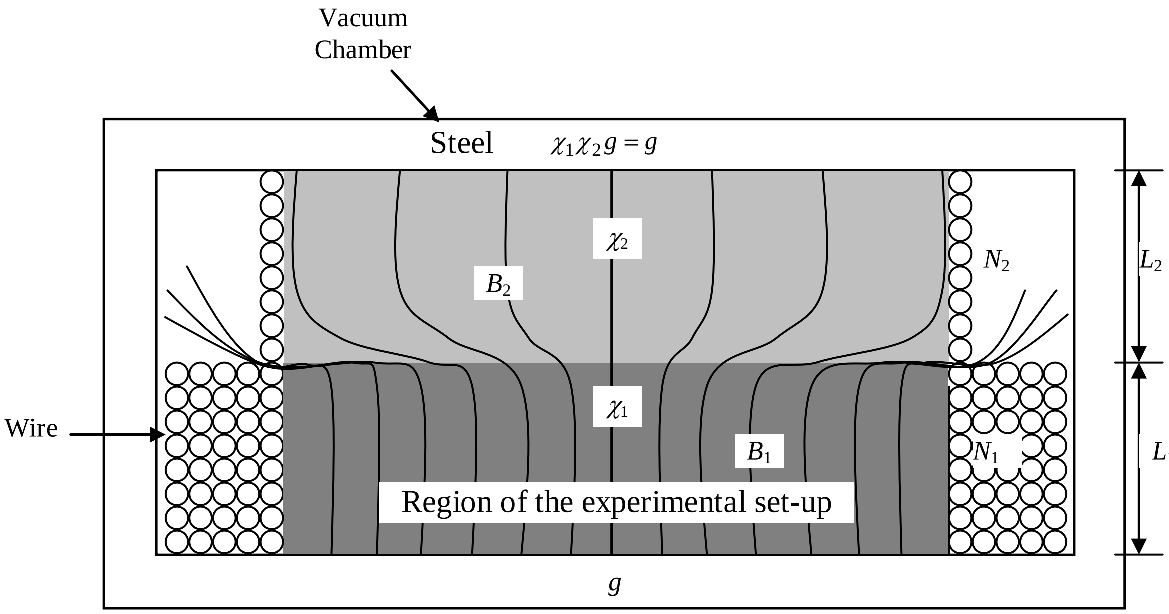


Fig. 3 – *Cross-section of the vacuum chamber showing the magnetic fields* B_1 and B_2.

$$B_1 = \mu_0 \left(\frac{N_1}{L_1} \right) i_1 \; ; \; B_2 = \mu_0 \left(\frac{N_2}{L_2} \right) i_2$$

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