Method for Obtaining Quantum Vacuum

Fran De Aquino
Professor Emeritus of Physics, Maranhao State University, UEMA.
Titular Researcher (R) of National Institute for Space Research, INPE

The possibility of obtention of quantum vacuum in laboratory is shown in this work. The method consists in ward off air atoms from the surface of a solid material plate. The clearance can reach up to several nanometers, thus producing a region where there are no elementary particles.

Key words: Quantum Vacuum, Universal Quantum Fluid, Continuous Universal Fluid, Gravity Control Cells.

Even in the densest matter found in the Earth, the atoms are not together. There are spaces among them, configuring a domain region around each atom. On the bidimensional viewpoint, this region is defined for an area, S_A, around each atom. We can calculate, S_A, starting from the atoms density of the material, n, $(atoms/m^3)$, which can be calculated by means of the following expression:

$$n = \frac{N_0 \rho}{A} \qquad (1)$$

where $N_0 = 6.02 \times 10^{26} \, atoms/kmole$ is the Avogadro's number; ρ is the matter density (in kg/m^3) and A is the atomic mass.

Then, the amount of *front atoms* in a volume $S\phi_{atom}$ (plane surface area, S, and thickness ϕ_{atom} (diameter of a front atom)) of a material with density of atoms n, is given by $nS\phi_{atom}$. Therefore, we can write that $(nS\phi_{atom})S_A \cong S$, whence we obtain

$$S_A = \frac{1}{n\phi_{atom}} \qquad (2)$$

If we could see the front atoms in the surface S, we would see that behind each the area S_A, there are N_{atoms} (See Fig.1). If each one of these atoms has only one electron in its electronic external layer, then the number of electrons, N_e, in the area S_A is $N_e = N_{atoms}$. Thus, considering the volume $S_A\phi_e$ (ϕ_e is the "diameter" of one electron), we can write that

$$N_e = N_{atoms} = n(S_A\phi_e) \qquad (3)$$

Consequently, the total charge of these electrons is

$$q = N_e e = n(S_A\phi_e)e \qquad (4)$$
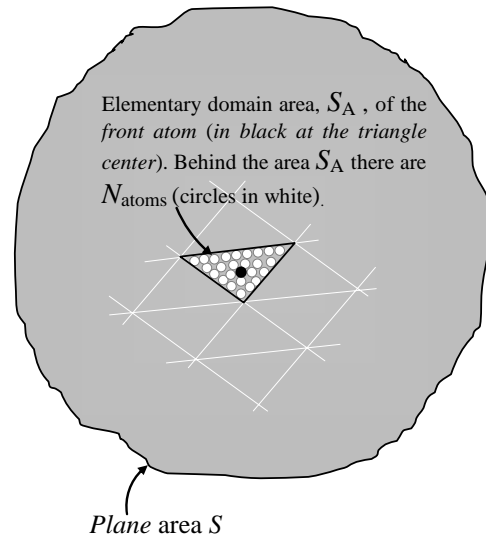
where e is the elementary electric charge.

Elementary domain area, S_A, of the *front atom* (*in black at the triangle center*). Behind the area S_A there are N_{atoms} (circles in white).

Plane area S

Fig.1 – *Elementary domain area, S_A, in a plane area* (*S*). - The amount of front atoms in a volume $S\phi_{atom}$ (thickness = ϕ_{atom}) of a material with density of atoms n, is given by $nS\phi_{atom}$. Therefore, we can write that $(nS\phi_{atom})S_A = S$. In each area S_A there are N_{atoms} (*behind* the area S_A).
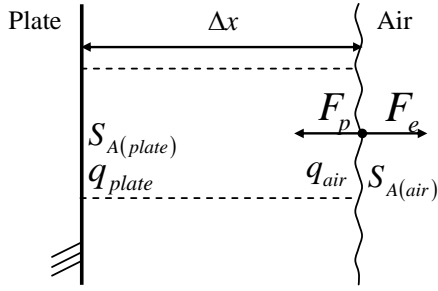
Fig.2 – The *forces* F_e *and* F_p – The force, F_p, exerted by the air pressure, p_{air}, is contrary to the repulsion force, F_e, produced by the electric charges, q_{plate}, and q_{air}. The equilibrium condition is $F_e = F_p$. Then, the air close to the plate is maintaining at a distance Δx from the plate.

Now consider a plate inside the Earth's atmospheric air (See Fig. 2). The total electric charges due to electrons of the atoms in an area, S_A, of the plate($S_{A(plate)}$), is q_{plate}, and the total electric charges due to electrons of the atoms in a same area in the *air close* to the plate is q_{air}. These charges produce a repulsion force, $F_e = (1/4\pi\varepsilon_0)(q_{plate}q_{air}/r^2)$, which is opposite to the force, $F_p = p_{air}S_{A(plate)}$, exerted by the air pressure, p_{air}. The electric charges q_{plate} and q_{air}, according to Eq. (4), can be expressed by

$$q_{plate} = n_{plate}S_{A(plate)}\phi_{e(plate)}e =$$
$$= \left(\frac{N_0\rho_{plate}}{A_{plate}}\right)S_{A(plate)}\phi_{e(plate)}e \qquad (5)$$

$$q_{air} = n_{air}S_{A(air)}\phi_{e(air)}e =$$
$$= \left(\frac{N_0\rho_{air}}{A_{air}}\right)S_{A(air)}\phi_{e(air)}e \qquad (6)$$

Thus, we can write that

$$F_e = \frac{1}{4\pi\varepsilon_0}\frac{q_{plate}q_{air}}{r^2} =$$
$$= \frac{1}{4\pi\varepsilon_0}\frac{q_{plate}q_{air}}{\left(\Delta x + r_{e(plate)} + r_{e(air)}\right)^2} =$$
$$= \left(\frac{N_0^2 e^2}{4\pi\varepsilon_0}\right)\frac{\left(\rho_{plate}S_{A(plate)}\phi_{e(plate)}\right)\left(\rho_{air}S_{A(air)}\phi_{e(air)}\right)}{A_{plate}A_{air}\left(\Delta x + r_{e(plate)} + r_{e(air)}\right)^2} \quad (7)$$

The equilibrium occurs when $F_e = F_p$. Under this circumstance, the air close to the plate is maintaining at a distance Δx from the plate. Then, by comparing Eq. (7) with $F_p = p_{air}S_{A(plate)}$, we can obtain the expression of Δx, i.e.,

$$\Delta x =$$
$$= N_0 e\sqrt{\frac{\left(\rho_{plate}\phi_{e(plate)}\right)\left(\rho_{air}S_{A(air)}\phi_{e(air)}\right)}{4\pi\varepsilon_0 p_{air}A_{plate}A_{air}}} -$$
$$- \left(r_{e(plate)} + r_{e(air)}\right) \qquad (8)$$

Equation (2) tells us that

$$S_{A(air)} = \frac{1}{n_{air}\phi_{atom(air)}} = \frac{A_{air}}{N_0\rho_{air}\phi_{atom(air)}} \qquad (9)$$

Substitution of Eq. (9) into Eq. (8) gives

$$\Delta x = e\sqrt{\frac{N_0\rho_{plate}\phi_{e(plate)}\phi_{e(air)}}{4\pi\varepsilon_0 p_{air}A_{plate}\phi_{atom(air)}}} - \left(r_{e(plate)} + r_{e(air)}\right) \quad (10)$$

For any type of solid plate we have $\phi_{e(plate)} = 2.8\times10^{-15}\,m$. For electrons in

the air we have $\phi_{e(air)} = 1.37 \times 10^{-13} m$ [1]; $\phi_{atom(air)} = 1.3 \times 10^{-10} m$. Substitution these values into Eq. (10) yields

$$\Delta x = 6.4 \times 10^{-10} \sqrt{\frac{\rho_{plate}}{p_{air} A_{plate}}} - 7.01 \times 10^{-14} m \quad (11)$$

For *Boron* (B): $\rho_{plate} = 2340 kg.m^{-3}$ and $A_{plate} = 10.81$, then Eq. (11) gives

$$\Delta x = \frac{9.4 \times 10^{-9}}{\sqrt{p_{air}}} - 7.01 \times 10^{-14} m \quad (12)$$

Thus, if $p_{air} = 1 atm = 1.01 \times 10^5 N/m^2$, we obtain

$$\Delta x = 2.9 \times 10^{-11} m \cong 0.29 \ Angstrons \quad (13)$$

This distance is insufficient to configure a region of quantum vacuum because it is much smaller than the diameter of one atom (1-3Å). Under these circumstances, the zone between the plate and the air close to the plate practically does not exist, because some atoms can penetrate partially the zone, preventing the formation of the quantum vacuum (See Fig.3 (a)).

However, if

$$p_{air} = 10^{-3} atm = 0.76 Torr = 1.01 \times 10^2 N/m^2$$

we obtain

$$\Delta x = 9.2 \times 10^{-10} m \cong 1 nm \quad (14)$$

In this case the distance Δx is greater than 3Å, which is sufficient to configure a region of quantum vacuum (See Fig.3 (b)).

The result is approximately the same in the case of *Beryllium* (Be) ($\rho_{plate} = 1850 kg.m^{-3}$ and $A_{plate} = 9.012$), at $p_{air} = 10^{-3} atm = 0.76 Torr = 1.01 \times 10^2 N/m^2$.

Also it is possible to obtain quantum vacuum if the plate is made of *Iron* ($\rho_{plate} = 7800 kg.m^{-3}$ and $A_{plate} = 55.81$), at $p_{air} = 10^{-3} atm = 0.76 Torr = 1.01 \times 10^2 N/m^2$. In this case, the result is

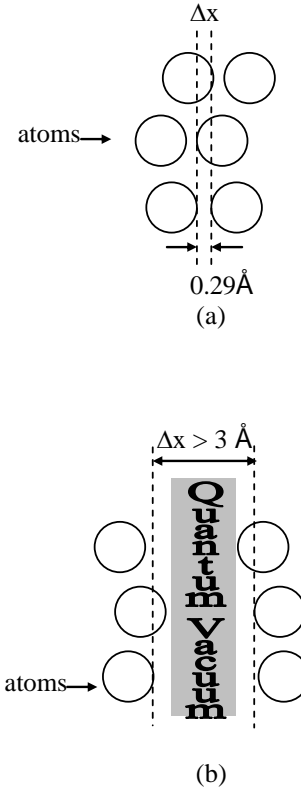$$\Delta x = 7.5 \times 10^{-10} m \cong 0.75 nm \quad (15)$$

(a)

(b)

Fig.3 – *Quantum vacuum formation*. (a) If the distance Δx is smaller than the diameter of an atom (1-3Å) the zone between the plate and the air close to the plate practically does not exist, because some atoms can penetrate partially the zone, preventing the formation of the quantum vacuum. (b) Only if Δx is greater than 3 Å is that the quantum vacuum can be configured.

It is easy to shown that, if the plate is made with a material composed of molecules with *molecular mass* M_{plate}, the equation (11) can be rewritten in the following form

$$\Delta x = 6.4 \times 10^{-10} \sqrt{\frac{\rho_{plate}}{p_{air} M_{plate}}} - 7.01 \times 10^{-14} m \quad (16)$$

For most of plastics the value of M_{plate} is too large. Thus, according Eq. (16) this makes the value of Δx too small, preventing the formation of quantum vacuum.

Consider for example an Iron plate. If one of its faces is coated with a plastic material, then there is not formation of quantum vacuum together to plasticized area. The quantum vacuum only will be formed in the neighborhood of the face not coated with plastic material.

It was shown in a previous paper that the quantum vacuum is not an empty region, but totally filled with *elementary quantum of matter*, forming a Continuous and Stationary Universal Fluid or Universal Quantum Fluid, whose density is of the order of $10^{-27} kg.m^{-3}$ [2]. This ultra-low density strongly facilitates the construction of the Gravity Control Cells (GCCs), mentioned in a previous paper [3]. Thus, the possibility of to obtain layers quantum vacuum in practice, is highly relevant for the construction of the GCCs. For example, consider the device shown in Fig. 4 (a). When the air internal pressure is 0.76 Torr, two layers of quantum vacuum are formed in the internal faces (I and II) of the device. Thus, by applying an electric or magnetic field in these layers of quantum vacuum, the device becomes a *double* GCC. On the other hand, if the internal face (I) of the device is coated with a plastic material, then the layer of quantum vacuum at the neighborhood

of this face disappears. Consequently, by applying an electric or magnetic field in the layer of quantum vacuum, the device becomes *a simple* GCC (See Fig. 4(b)).
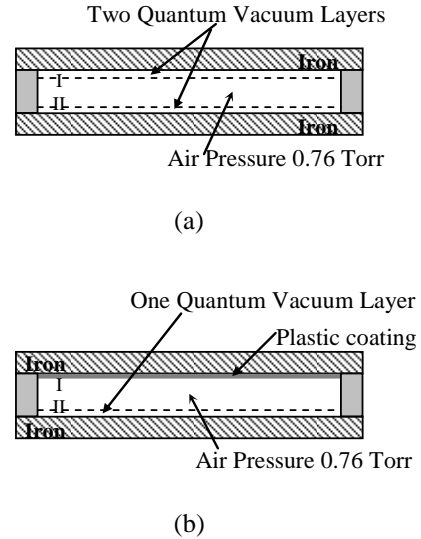

Fig.4 – *Double and Simple Gravity Control Cell*

References

[1] De Aquino, F. (2012) *Superconducting State generated by Cooper Pairs bound by Intensified Gravitational Interaction.* (See Appendix A. Available at : http://vixra.org/abs/1207.0008).

[2] De Aquino, F. (2011) *The Universal Quantum Fluid.* Available at :
https://hal.archives-ouvertes.fr/hal-01082611

[3] De Aquino, F. (2010) *Gravity Control by means of Electromagnetic Field through Gas at Ultra-Low Pressure*, Pacific Journal of Science and Technology,**11**(2) November 2010, pp.178-247, Physics/0701091. Also available at: http://vixra.org/abs/1401.0119