A POSSIBILITY EVALUATION FOR THE
CASIMIR EFFECT TO BE A CONSEQUENCE OF THE BERNOULLI LAW

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Abstract. *Based on the early developed analytic model of the nonstationary stochastic processes and well grounded concept of the flat plane Universe originated by the Big Bang and continuing to evolve by now, the well known Casimir effect was considered as a consequent of the Bernoulli law, showing decreasing the static pressure providing the motion of cosmic fluid with increasing its velocity. Novel formula to calculate the stress acting perpendicular the flow direction was derived and the formula similarity with the known Casimir relation obtained using quantum electrodynamics was shown. The stress values calculated using the new formula is in a good agreement with the available experimental data.*
Key words: *analytic model of the nonstationary stochastic processes, concept of the flat plane Universe, Casimir effect, Bernoulli law, newel formula to calculate the Casimir stress, good agreement the calculated and the available experimental data.*

1.INTRODUCTION.

The main complication in resolving the cosmological problems is probably the experimental verification of the theoretically predicted results. Evidently that the best way to confirm a cosmological model or theory is a direct experimental proof as in the case of the General Relativity Theory. Unfortunately, this is rather an exclusion case than a rule. Contemporary theory of elementary particles and cosmology require more complex and expansive verification techniques. That is why the resolving the problems requires at least more time. However, the above complications do not decrease the role of unifying theories and models. The verification problems in such a case may be solved to our mind by at least of comparing the theoretical predictions with maximum available variety of the relevant data. Such an approach should be applied at first to the commonly accepted Big Bang model of creation of our visible Universe and its further evolution. The model is consistent with practically all contemporary notions of modern science: from physics to sociology, but is not reflected in the most existing models and theories.

Namely, today there are following terminology widely used in modern cosmology to describe our visible Universe evolution: dark fluid, Chapligin gas, cosmic fluid flow etc, which, evidently related to the fluid dynamics. Besides, numerous observations show existence of the complex net work patterns in arrangement of stars and galaxies analogous to the dislocation substructure in deformed crystals [1-4]. A possible reason is similarity of properties of the media, transferring the Big Bang energy in space to the corresponding ones for fluid fluxes. One of the relevant example which is widely discussed in the literature is the unresolved by now problem of Chapligin gas concept application in cosmology. As it was shown in numerous works [5-8, increasing density of the transferring media leads to decreasing internal stress in our Universe and vise versa. On the other hand, the Casimir effect measurement shows appearance of the attractive force between two objects separated by small distances in the course of their moving together in the Universe. Appearance of the force is now explained exclusively by decreasing the physical vacuum density between the objects, together with conserving the compressing one level outside the objects, that provides the objects attraction to each other. In other words, according to the existing explanation, decreasing physical vacuum density (between the closely arranged objects) have to lead to relative decreasing the vacuum uniform expansion stress, outside the same couple of objects, that leads to attraction of the ones due to the compression action of the outer vacuum volumes. It is easy to see that the explanation contradicts to the law of state for Chapligin gas [6] successfully used to understand numerous cosmological phenomena. Meantime, it is well known that such just mentioned phenomenon is a typical one for fluids, particularly that, which is described by the Bernoulli law [9].

2. RESULTS AND DISCUSSION

To continue our analysis, lets consider the Universe as a flat object according numerous contemporary evaluations [6-8]. Hence, we may write for the volume of the Universe: $V = h \cdot S,$ where h – is a "height" of the flat universe and S_1 is a "square" of a cross section of the universe. Besides, in accordance with our suggestion about flatness of the Universe, we suppose that $h \to 0$ and $S_1 \approx D^2$ where D – is one of the two one dimensional Universe sizes (the Universe diameter). So, we suppose that: $V \to 0$. We suggest also that the Universe is filled in by a compressible fluid, which we consider as being the physical vacuum and which moves through the whole Universe with the average velocity v_1. So, for the fluid or physical vacuum, we should write: $\rho \neq const$, but $V \approx const,$ due to the above the Universe volume features.

Additionally, we have to define parameters of the set up to measure the Casimir stress [8]. Namely, the density of the compressed fluid inside the set up - ρ_2; the "square' of the set up corresponding cross section: $S_2 \approx d^2$; volume of the Universe is limited by the set up: $V \approx S_2 \cdot h$; average velocity of the fluid moving through the measuring set up: v_2..

Based on the mass and the overall energy conservation laws together with the above quantities definition, we may write the following balance equations for a unit volume of the fluid, moving in any part of our Universe:

$$P_1 + \rho_1 \cdot v_1^2/2 = P_2 + \rho_2 \cdot v_2^2/2 \qquad \rho_1 \cdot v_1 \cdot t \cdot S_1 = \rho_2 \cdot v_2 \cdot t \cdot S_2$$

where $P_{1(2)}$ –static stress providing the fluid flow through cross sections S_1 and S_2

t – time of observation under the fluid flow.

After the elementary algebraic transformations, we obtain [9]:

$$2(P_1 - P_2) = \rho_2 \cdot v_2^2 - \rho_1 \cdot v_1^2$$

$$2(P_1 - P_2) = \rho_1 \cdot [(\rho_2/\rho_1) \cdot v_2^2 - v_1^2]$$

$$v_2 = v_1 \cdot \rho_1 \cdot S_1/S_2$$

$$P_1 - P_2 = \rho_1 \cdot [(\rho_1/\rho_2^2) \cdot v_1^2 \cdot S_1^2 / S_2^2 - v_1^2]$$

Taking into account the approximate relation: $S_1/S_2 \approx D^2/d^2$, where D is equivalent to the diameter of our visible Universe, we shall have the final relatively rigorous formula:

$$P_1 - P_2 \approx \rho_1 \cdot [(\rho_1/\rho_2^2) \cdot v_1^2 \cdot D^4/d^4 - v_1^2]$$

Considering the condition D >> d, corresponding real situations of the Casimir effect measurement, we obtain the final approximate calculation formula:

$$P_1 - P_2 \approx (\rho_1^2/\rho_2) \cdot v_1^2 \cdot D^4/d^4 \qquad (1)$$

So, we have the formula to calculate the difference of the static stress in two various parts of the Universe that is in fact the stress acting on two material objects if the distance between them is $d << D,$ that is considered to be the diameter of our visible Universe. As it follows from [9] the formula (1) is similar to the one obtained from the quantum electodynamics:

$$\sigma_{Cas} = \pi \cdot h \cdot c/240 \cdot d^4 \qquad (2)$$

where: $h = 6.6 \cdot 10^{-34}\ J/s$ –is the Planck constant

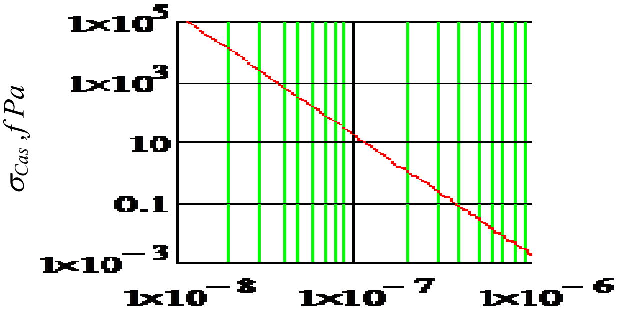
$c \approx 3 \cdot 10^8 m/s$ – is speed of light

d – is a distance between two material objects, mostly – uncharged flat planes.

Lets evaluate corresponding stress using the relations (1) and (2) and compare the results. Besides, we shall take into account the experimental data available by the direct measurement of the stress [8]. The dependencies, obtained by using the relations (1) and (2) are shown on Fig.1. As it seen from the graphs, practically the same the Casimir stress values are obtained experimentally and by the calculation in the whole most frequently used separating distance interval: from 10^{-35} m to 10^{-6} m. Based on the obtained results it may be concluded that the early developed analytic approach may be successfully used to analyze various nonstationary random processes including evolution of our visible Universe.

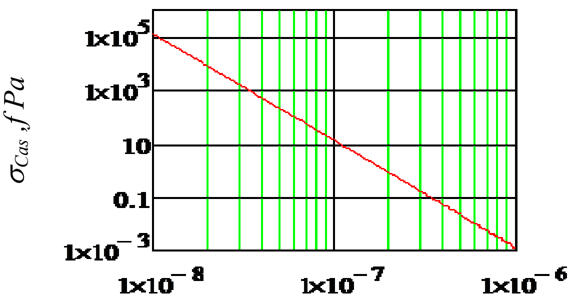
3. CONCLUSIONS

1. Based on the early developed analytic approach to analysis of nonstationary stochastic processes, the evolution of our visible Universe is considered as a cosmic fluid flow.
2. In order to obtain an accordance of the calculated and experimental values of the Casimir force, an assumption about our visible Universe as a flat plane object was made.
3. A novel relation to calculate the static stress providing attraction of two closely arranged non-charged objects was derived as a consequence of the Bernoulli law.
4. Close similarity of the new and the existing formulas for the static stress calculations was shown.
5. Fool accordance of the Casimir stress values calculated by using the new and the existing formulas in widest range of the separating distance: from the Plank length to 1 μm was shown.



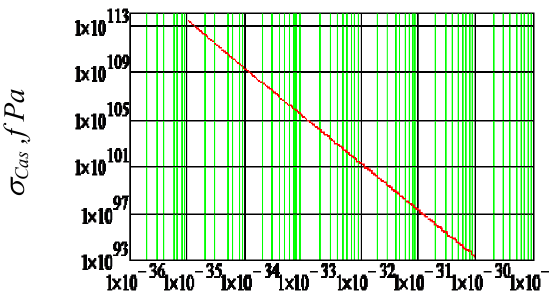
d, m

a



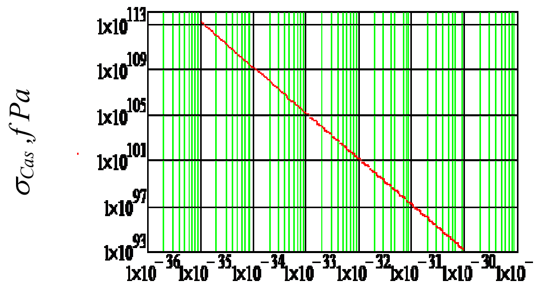
d, m

b



d, m

c



d, m

d

Fig.1. Calculated dependences of the Casimir stress, σ_{Cas}, from separating distance *d* obtained using the relation (1) (*a,c*) and (2) (*b,d*) for the various separating distance intervals. Calculation parameters for the relation (1) were taken from the literature as follows: $\rho_1 \approx 10^{-27}...10^{-25}$ kg/m^3, $\rho_2 = (7...9)\cdot 10^{94}$ kg/m^3, $v_1 \approx 10^7 m/s$, $D \approx 10^{26}...10^{27}$ m. (see Fig. 1,a, c)

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