A blunder anatomy or the modern cosmology's "winding and rugged road"

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Amicus Plato, sed magis arnica veritas

There exists a contradictory understanding of so called cosmological constant Λ. One links it with a *repulsion* force, while Einstein himself clearly pointed out that this constant has to correspond to the *attraction* force which could in his opinion equilibrate the repulsion between the same electric charges. Such the representation is very popular in the scientific literature. However, I propose an alternative viewpoint that explains the physical meaning of the matter negative pressure.

Einstein's static Universe model and modern cosmology's statement

At the 20th century beginning Albert Einstein proposed the cosmological model like the closed on itself 3D hyperspherical shell. The initial Einstein's model was *static*, i.e., the shell radius R was supposed to be constant and not depending on time. It follows from Einstein's cosmological equations:

$$d^2R/dt^2 = - (4\pi GR/3)(\rho + 3P/c^2), \quad (1)$$

where ρ is mean matter density, P is the matter pressure, G is the Newtonian gravitational constant, c is velocity of light. If the shell radius does not change[1], then the left side is equal to zero, hence, right side has to be equal to zero too. If density ρ is positive, then the pressure P has to be negative.

Einstein believed such the decision to be incorrect. In the chapter IV of his book **[Einstein, 1953]** he wrote that *there is no any physical reasons* to introduce the negative pressure. Instead of that he introduced a (formally accessible) *additional term*[2], so the equation (1) became

$$d^2R/dt^2 = - (4\pi GR/3)(\rho + 3P/c^2) + R\Lambda c^2/3, \quad (2)$$

where Λ is so called cosmological constant. Einstein also proposed to neglect the matter pressure P, i.e., to set is to zero.

It is clearly, such the quantity Λ should really be linked in any case with some physical phenomenon that creates a negative pressure. Einstein completely understood that this mysterious negative pressure had to generate the *attraction*. He wrote in the above book (Addition 1) that one had include an additional members into Maxwell's theory in order to obtain the charged particles stability regardless the mutual repulsion of their similar charges. Poincaret supposed that inside of these particles there exists a negative pressure which compensates such the electric repulsion. Einstein suggested that such the attractive forces exist outside from the particles too.

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[1] Or changes linearly.

[2] One often wrongly states that the original Einstein's solution without this additional term *exists, but is not stable*. However, Einstein himself pointed out **[Einstein, 1933]** that an instability is just specified for the solution with such the term. Hi referred to Lemaitre and Friedmann; see also the detailed analyzis in **[Eddington, 1930].**

So, Einstein here says *clearly* that an *effective* pressure corresponding with the constant Λ should be *negative* in order to compensate some repulsion and to provide an *attraction*.

In practice, all the modern cosmologists ascribe to Einstein the exactly *opposite* statement that parameter Λ is connected with a *repulsive* force which he introduced in his theory in 1917 in order to compensate the gravity force.

Particularly, one of the authors writes: since the force action is universal like gravity, we can call them the 'vacuum gravity', though usually gravity is associated with an attraction, not with repulsion.

Another author even cites Einstein's words about his "winding and rugged road" to such the idea. However, in the sourcebook **[Einstein, 1917]** Einstein talks (see §2) about absolutely another (genial) idea when one replaces a flat world and its boundary conditions by a world closed on itself without where a boundary condition is avoided. What about the cosmological constant, Einstein talks about it only in §4, and there is no any word about repulsion forces in this paper.

The proposed paradox solution

So, we have the explicit *contradiction*. On the one hand, there is a *negative* pressure in the Einstein's equation (1) that denotes the negative energy volumetric density and that Einstein himself associated with a *contraction*. On the other hand, *if one considers the equation (2) as a motion equation*, then the member having the positive Λ (as well as a negative pressure P) should really lead just to the repulsion *phenomenon*. It seems to be paradoxical, although generally a negative energy density of a body generates a contraction only if an environment's density is more than body's one (but it may be negative too).

But could we consider the equation (1) as a motion equation? In my opinion, the paradox origin is connected just with the incorrect interpretation of this equation. This interpretation treats the cosmological evolution as a *process of obtaining* some balance between contraction energy and repulsion one. At this one associates the contraction with the matter density ρ and believes that the repulsion corresponds to the pressure P or cosmological constant Λ. In other words, in the non-stationary model the kinetic energy of Big Bang competes with the gravity potential energy, and they obtain an equilibrium in the source steady-state Einstein's model[3]. Note, that in the non-relativistic version of the equation (1) that was proposed by E. Milne there is in brackets single density matter ρ only, not ($\rho+3P/c^2$). This is a reason for many authors to say something like "pressure has a weight in General Relativity!" that should mean that the transition from Newton's physics to Einstein's one we have to replace the matter density by the sum "density plus three times pressure"[4].

I believe, all is not so: there is no some *internal* cause determining evolution or statc state of the Universe. In fact, the Milne's hypothesis who considered the Newtonian universe as Euclidean and infinite is *contradictory* as such. Let us consider a virtual sphere in such the universe where radius is R, matter density is ρ. When the radius R increases, its mass M increases as R^3, hence its gravitational radius R_G increases as R^3 too. Because of that after some R we will have $R_G > R$ and all this sphere

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[3] Such the approach was formulated by E. Milne in the work **[Milne, 1934]** and the following paper **[McCrea and Milne, 1934]**.
[4] Such the sentences one usually are added by the reference to the monograph **[Tolman, 1934]** without any precision. I studied this monograph and found out that the statement may be related with §65 where the author says on *electromagnetic radiation energy density* exclusively (it is equal to aT^4 while the pressure is $aT^4/3$, *a* is constant).

mass will collapse. Thus, our Universe *cannot not be a black hole* in some external world containing a matter (see more details in **[Shulman, 2011b]**).

But it is well known that a black hole rises irreversibly absorbing a matter and energy from outside. Namely this *external* cause determines the evolution of our Universe. Hence, such the evolution does not depend at all on its *internal* state. Contrary, just the actual values of its mass and radius determine unambiguously the average matter density ρ and pressure P in it[5]. It turns out that the pressure is in fact *negative* and corresponds with the negative energy volumetric density (see, e.g., **[Shulman, 2011a]**). And practically we can observe the absolutely real phenomenon – the universal matter (gravitational) attraction.

The paradox absence in such the model may be explained by that the equation (1) *is not* "a motion equation", since the motion (and the gravity phenomenon) is determined *inside of* hyperspherical shell, and the Universe expansion (its curvature radius evolution) happens normally to this shell, i.e., outside its 3D space. "The center" of 3D shell cannot to be a gravitation source relative to material bodies of the shell. So, I think that the Milne's analogy between a particle cloud explosion and the Universe expansion has not any physical meaning.

Thus, the gravity law that Newton introduced to the classical physics "by hand" appears as a *natural* consequence of the proposed model. It is very important that we do not need in the cosmological constant use. Note, Newton introduced the gravity law as an *addition* to its second law that connects inertial mass with acceleration. When one considers some "usual body" he ignores "the gravity pressure" P_g because it is very small; however, such the pressure tends to contract even a smallest drop of matter. Meanwhile, one cannot ignore this phenomenon for large astrophysical objects, and physicists use the special term "self-gravitation" for them. In the equation (1) one should understand the quantity P as sum of P_g and all the remaining sorts of the pressure (for example, the dynamical pressure of moving particles); namely P_g predominates in the cosmological domain.

Of course, the rejection of the Standard Cosmological model unambiguously leads to the necessity to show that a new cosmological model is possible and able explain all the real cosmological observations. The results of my own investigations since 1993 hardly assure me that this problem is effectively solved (see my articles on the web-page at http://timeorigin21.narod.ru/eng_time/eng_time.html).

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[5] I.e., a fixed balance between the "kinetic" energy and "potential" (gravitational) one of any particle in the reference frame of an arbitrary observer. Note, the more curvature radius of the Universe, the less modulo of the average matter density and the pressure.

[Shulman, 2011a] Shulman M. Time origin and Universe uniform expansion. See http://timeorigin21.narod.ru/eng_time/Universe_expansion_eng.pdf

[Shulman, 2011b] Shulman M. Can the Universe not be a black hole? See http://www.timeorigin21.narod.ru/eng_time/Universe_must_be_bh_eng.pdf

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