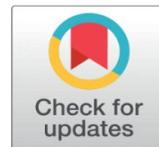


THE PRINCIPLE OF EQUIVALENCE OF ENERGY SPENT ON PROCESS AND OF STEP OF TIME



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ABSTRACT

It was formulated the physical principle of the equivalence of the energy expense during the process of the Universe spreading and of the step of time. It was also shown that physical time is a material quantity connected with expending our Universe at constant velocity. A parallel was carried out between the increase of the size of the drops and bubbles and the expending of the Universe. The above principle is in full agreement with SR and GTR. It was shown as well that physical time could quantize.

Keywords: Space, Time, Universe, Principle of Equivalence, Power, Relativity

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1. INTRODUCTION

As we know from special relativity (SR), there is the principle of equivalence of the energy E and the mass “ m ” of the body, i.e., mc^2 . We know as well the nature of the energy and body mass however, we know nothing about the nature of physical time. The physical parameter T is the most important physical one in science but peoples did not know up to 21th century about its origin.

In [Veitsman \(2019\)](#) it was exposed the connection between the long-ranged interaction forces of the dimension $n=1, 2, \dots, i$ and the dimension of the isotropic space $m=1, 2, \dots, j$. It was shown: $j=n+1$ (Veitsman's theorem on spaces and forces forming these spaces). In [Veitsman \(2019\)](#) was studied as well weakly anisotropic spaces. It was established that such object being as an ellipsoid could not be in equilibrium. Here we must add the following. It was shown in [Veitsman \(2002\)](#) that drops of liquid and bubbles of gas cannot be in equilibrium. The smaller the sizes of the drops and bubbles the further they from equilibrium. In such case, the pressure in the drop or bubble p (spherical form) equals [Nitza et al. \(1977\)](#) :

$$P=2\sigma/R, \tag{1}$$

where σ is surface tension; R the radius of drop or bubble,

There are electromagnetic attractive interactions between microparticles in bubbles and drops. Our Universe can be by sphere form but the main interaction in it between masses is gravitationally, i.e., also attractive interaction. Bubbles and drops increase like the Universe. Here we have a certain analogy between them – gravitation is the result of the surface curvature of given volume.

In [Veitsman \(2021\)](#) we shown that the physical time was generated by the energy expense during the process of the expansion of our Universe. This



expansion must be stationary. The energy expense at the expansion of our Universe is much more the sum expenses of all processes in our space-time. If the expansion of the Universe is not stationary, there will be information chaos in it and, as a result, the breach of the causal connection in the system under study. Then we can formulate the principle of the equivalence between of energy expense during the physical process and the step of time, primarily the energy expense and the step of time in our Universe. It is the main problem, which we have to solve in this scientific work.

2. MATERIALS AND METHODS

Now we can write down using stated above and in [Veitsman \(2019\)](#), [Veitsman \(2002\)](#), [Nitza et al. \(1977\)](#), [Veitsman \(2021\)](#):

$$\Delta E = M\Delta T \tag{2}$$

where M is a Lorentz Invariant, a certain analog of power.

However, if the parameter M in F.2 is the Lorentz invariant, then the parameters ΔE (the expense of energy on a certain process) and the parameter ΔT (the step of time) are equivalent. As a conclusion, formula (2) expresses an equivalence between energy and time in nature.

The above formula (in essence a hypothesis) does not contradict neither SR, nor GR. Let's start with SR.

Let us write down the expression for the transformation of the time interval Δt_0 in the frames of Lorentz transformations having remembered that they are correct only in inertial reference systems, i.e., moving uniform and rectilinearly.

$$\Delta t = \frac{\Delta t_0}{\sqrt{1 - \left(\frac{v^2}{c^2}\right)}} \tag{3}$$

where Δt_0 is the interval of time for an observer being in the laboratory frame of reference, let it be fixed "(it is also the proper time in the moving reference frame)"; v the speed of the moving frame of reference; c the speed of light in vacuum.

Let Δt_0 be a unit time step when $v_0 = 0$, then Δt is the step of time when the speed of the reference frame is equal to v .

I emphasize once more that the velocity of the moving system is uniform and rectilinearly

Now let us turn to the transformation formula of spending the energy ΔE of the system in dependence from the velocity v :

$$\Delta E = \frac{\Delta E_0}{\sqrt{1 - \left(\frac{v^2}{c^2}\right)}} \tag{4}$$

Taking into account (2 – 4) and considering power as a relativistic invariant, we came to the equivalence of energy and time (let us remember mc^2).

Let us now come to General Relativity, in particular, to cosmology. Friedman's solutions of Einstein's equation lead to the case of homogeneous and isotropic Universe for different cases of its changes during time beginning from its static state

and finishing by stationarity of different kinds. If the object under study is in static existence, then cosmology constant $\Lambda = \Lambda_c$ reaches of its critic value. In turn, certain coefficient k from the solutions of Einstein's equation has to be equal unit. It means that this equation is found for a sphere. There is no the parameter "time" in it, and, i.e., there is no any time in the system studied. Here we have in view the general time for the all Universe.

In case, when $\Lambda > 0$ and $k \leq 0$, the Universe monotonously expands itself, if its radius does not reach great values. At last, if Λ is more than Λ_c slightly, i.e., more than certain critic value, then the velocity of the Universe expanding does not change during certain time. That is, the process of the evolution of our Universe may be stationary on that or another line segment of its existence but at this step of the universal time will be constant. However, this step has possibility to change itself in those or others subspaces e.g., according to the formula (3) and not only according to it.

Here we must draw a parallel between hydro- aerodynamics, and physical time. If the process of the gas or liquid moving is near to equilibrium then a following dependence takes a place for the moving of the viscous liquid and gas for a stationery case according to thermodynamics of irreversible processes [Veitsman \(2021\)](#):

$$P_{ij} = P_{ji} = -\eta \left(\frac{\partial v_i}{\partial z_j} + \frac{\partial v_j}{\partial z_i} \right) + \left(\frac{2}{3\eta} - \xi \right) \delta_{ij} \operatorname{div} \mathbf{v}, \quad (i, j=1,2,3), \quad (5)$$

Where $P_{ij} = P_{ji}$ is the stress tensor of the viscosity forces; \mathbf{v} velocity vector;

v_i, v_j the components of \mathbf{v} ; η the coefficient of viscosity; ξ the coefficient of bulk viscosity; δ_{ij} Kronecker symbol,

Expression (5) is correct only for the laminar flow of liquid and gas. If our systems under study are far from equilibrium, then we have turbulent flows, i.e., there is chaos takes a place, e.g., tornado.

In turn, if Universe is expanding uniformly and enough slowly, then there are causal relationships in it. However, if the Universe is expanding unevenly and very quickly, then these relationships will be broken, and information chaos will take a place in our system under study.

At last, the once more important conclusion follows from the above formula (2): the physical time is a parameter, which can quantize itself because energy, as we know, also quantizes.

Using F. (2), we can show why the time for the old peoples going more quickly than for the younger human beaning's.

Write down the expression (2) for a certain process in our Universe:

$$\Delta E' = M' \Delta T' ; \Delta E \gg \gg \Delta E' ; \Delta T' = \Delta T + \Delta T'' ; \Delta T \gg \gg \Delta T'' , \quad (6)$$

$$M' \ll \ll M , \quad (7)$$

$$\Delta T = \frac{\Delta E}{M} , \Delta T' = \Delta T + \Delta T'' = \frac{\Delta E'}{M'} . \quad (8)$$

Taking into consideration (6) – (8) we can see that the second equation from (6) can be observed.

3. CONCLUSIONS

- 1) The physical parameter time T has material nature.
- 2) The principle of equivalence was formulated of energy spent on a process and time.
- 3) Physical time can quantize like energy.

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