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Block Universe – According to the Formalism d = v x t Space-time Is Timeless

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Abstract

According to the formalism $d = v * t$ fourth dimension of space-time is spatial too. In formula $X_4 = i * c * t$ symbol t represents numerical order of material change i.e. motion running in a space. Flow of time is flow of numerical order of material change that we measure with clocks. Fundamental unit of numerical order $t_0, t_1, t_2 ... t_n$ of material change is a Planck time t_p. Numerical order of material change t_{n-1} is "before" numerical order of material change t_n equivalently as natural number $n-1$ is "before" natural number n. Flow of physical time is a flow of numerical order $t_0, t_1, t_2 ... t_n$ of material change and runs in a timeless $4D$ space.

Key words: time, space, space-time, run of clocks, velocity, numerical order, duration, psychological time

1. Introduction

Let's take photon moving from on the distance d between point A and point B of space. Distance d is composed out of Planck distances l_p: $d = \sum l_{p1} + l_{p2} ... + l_{pn}$. The smallest distance photon can do on the way from A to B is l_p. Numerical order of motion from l_{p1} to l_{p2} is a Planck time t_p. Photon is moving exclusively in space and not in time. In space "before" and "after" exist only as a numerical order $t_0, t_1, t_2 ... t_n$ of a physical event: t_{n-1} is "before" t_n equivalently to natural number $n-1$ is "before" natural number n. Numerical order of material change we measure with "ticking" of a clock where t_0 represents beginning of the measurement, t_n end of the measurement. Velocity v of a material change is derived from its numerical order t_n: $v = \frac{d}{t_n} ms^{-1}$. Frequency γ of material change is derived from its numerical order t_n: $\gamma = \frac{1}{t_n} s^{-1}$.

In Special Theory of Relativity forth coordinate X_4 of space is spatial too. X_4 is a product of imaginary number i, light speed c and numerical order t_n of an event: $X_4 = i * c * t_n$. It is more correct to imagine cosmic space as a four-dimensional $4D$ space than $3D + T$ where fourth dimension is time. In the universe flow time exists as a flow of numerical order of material change in space. Universal space is timeless in a sense that time is not fourth coordinate of space. Fundamental

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unit of numerical order $t_0, t_1, t_2 ... t_n$ of material change that runs in space is Planck time $t_p = 5{,}39124 * 10^{-44} s$ and is derived from the light speed: $t_p = \frac{c}{l_p}$ where l_p is a Planck distance. Planck time t_p exists in the universe as a fundamental physical unit that governs numerical order of material change (1).

Here physical time is understood as numerical order of material change which is measured with a clock. Material change runs in $4D$ space. In a given equation meaning of symbol t is numerical order t_n of material change obtained with a clock. Fundamental unit of numerical order Planck time t_p is constant and independent of a given inertial system in Special Theory of Relativity and independent of a given gravitational field in General Theory of Relativity. Relative is velocity v of material change. Twin in a fast spaceship is getting older slower than his twin brother remaining on the earth. Both twins are getting older in the space only and not in time. One can travel in space only and not in time. Time travel is not possible.

2. From space-time to timeless space

Some of researchers are challenged with the view that space-time where time t is the fourth coordinate is the fundamental arena of the universe. They propose a “state space” or a “timeless space”.

For example, in *A New Geometric Framework for the Foundations of Quantum Theory and the Role Played by Gravity*, Palmer underlines that, since quantum theory is inherently blind to the existence of state-space geometries, attempts to formulate unified theories of physics within a conventional quantum-theoretic framework are misguided, and that a successful quantum theory of gravity should unify the causal non-Euclidean geometry of space-time with the a-temporal fractal geometry of state space (2). In this paper, Palmer introduces a new geometric law of physics about the nature of physical reality based on an Invariant Set Postulate. The Invariant Set Postulate conjectures that states of physical reality are defined by a fractal geometry *I* , embedded in state space and invariant under the action of some subordinate causal dynamics D_I . The postulate is motivated by two concepts that would not have been known to the founding fathers of quantum theory: the generic existence of invariant fractal subsets of state space for certain nonlinear dynamical systems, and the notion that the irreversible laws of thermodynamics are fundamental rather than phenomenological in describing the physics of extreme gravitational systems. The Invariant Set Postulate posits the existence of a fractionally-dimensioned subset *I* of the state space of the physical world (namely the universe as a whole). *I* is an invariant set for some presumed-causal (namely relativistic) deterministic dynamical system D_I ; points on *I*, called also “world states”, remain on *I* under the action of D_I . World states of physical reality are those, and only those, lying precisely on *I*. It is important to underline that in Palmer’s theory, the subset *I* of the state space is more primitive than the deterministic dynamical system D_I . Given *I*, $D_I(t)$ maps some point $p \in I$, a parameter distance *t* along a trajectory of *I*. Crucially, D_I is undefined at points $\notin I$: if states of physical reality necessarily lie on *I*, then points $p \notin I$ in state space are to be considered literally “unreal”. For practically-relevant theories (such as quantum theory) the intricate structure of *I* is unknown and these points of unreality cannot be ignored. As regards the key question of how to represent quantum-theoretic states in a mathematically-consistent way for such points of unreality, the Invariant Set Postulate provides support to the search for a timeless description of physics: by treating the geometry of the invariant set as primitive introduces a fundamentally timeless perspective into the formulation of basic physics.

Clocks as a measuring system of flow of time as a numerical order $t_0, t_1, t_2 ... t_n$ can be considered the most direct and natural development of Palmer's approach: it is a description of motion in physics where velocity v of a physical event is derived from its numerical order t_n: $v = \frac{d}{t_n} ms^{-1}$.

3. Numerical order of change $t_0, t_1, t_2 ... t_n$ runs in space only and not in time

Girelli, Liberati and Sindoni have recently developed a toy model in which they have showed how the Lorentzian signature and a dynamical space-time can emerge from a non-dynamical Euclidean space, with no diffeomorphisms invariance built in. In this sense this toy-model provides an example where time (from the geometric perspective) is not fundamental, but simply an emerging feature (3). In more detail, this model suggests that at the basis of the arena of the universe there is some type of "condensation", so that the condensate is described by a manifold R^4 equipped with the Euclidean metric $\delta^{\mu\nu}$. Both the condensate and the fundamental theory are timeless. The condensate is characterized by a set of scalar fields $\Psi_i(x_\mu)$, i=1,2,3. Their emerging Lagrangian L is invariant under the Euclidean Poincarè group ISO(4) and has thus the general shape

$$L = F(X1;X2;X3) = f(X1) + f(X2) + f(X3); \; X_i = \delta^{\mu\nu}\partial_\mu \Psi_i \partial_\nu \Psi_i \quad (1)$$

The equations of motion for the fields $\Psi_i(x_\mu)$ are simply given by

$$\partial_\mu \left(\frac{\partial F}{\partial X_i} \partial^\mu \Psi_i \right) = 0 = \sum_j \left(\frac{\partial^2 F}{\partial X_i \partial X_j} \left(\partial^\mu X_j \right) + \frac{\partial F}{\partial X_i} \partial_\mu \partial^\mu \Psi_i \right) \quad (2)$$

The fields $\Psi_i(x_\mu)$ can be expressed as $\Psi_i = \psi_i + \varphi_i$ where φ_i are the perturbations around the solutions ψ_i of the above equation. The lagrangian for ψ_i is given by

$$F(\overline{X}_1, \overline{X}_2, \overline{X}_3) + \sum_j \frac{\partial F}{\partial X_j}(\overline{X})\delta X_j + \frac{1}{2}\sum_{jk} \frac{\partial^2 F}{\partial X_j \partial X_k}(\overline{X})\delta X_j \delta X_k + \frac{1}{6}\sum_{jkl} \frac{\partial^3 F}{\partial X_j \partial X_k \partial X_l}(\overline{X})\delta X_j \delta X_k \delta X_l \quad (3)$$

where $\overline{X}_i = \delta^{\mu\nu}\partial_\mu \psi_i \partial_\nu \psi_i$ and $\delta X_i = 2\delta_\mu \psi_i \partial^\mu \psi_i \partial_\mu \varphi_i \partial^\mu \varphi_i$.

Different choices of the solutions ψ_i lead to different metrics

$$g_k^{\mu\nu} = \frac{df}{dX_k}(\overline{X}_k)\delta^{\mu\nu} + \frac{1}{2}\frac{d^2 f}{(dX_k)^2}(X_k)\partial^\mu \psi_k \partial^\nu \psi_k \quad (4)$$

If one considers the specific class of equations of motion for which $\psi_i = \alpha^\mu x_\mu + \beta$, the SO(4) symmetry leads to $\overline{\psi} = \alpha x_0 + \beta$ which shows that the choice of the coordinate is completely arbitrary. Hence the Lorentzian signature can be obtained for the condition

$\frac{df}{dX}(\overline{X})+\frac{\alpha^2}{2}\frac{d^2 f}{(dX)^2}(\overline{X})<0$, $\frac{df}{dX}(\overline{X})>0$ and in this case the lagrangian becomes $L_{eff}=\sum_i \eta^{\mu\nu}\partial_\mu\varphi_i\partial_\nu\varphi_i$ where $\eta^{\mu\nu}$ is the Minkowski metric. Moreover, Girelli, Liberati and Sindoni have showed that by means of the change of variables

$$\begin{pmatrix}\varphi_1\\ \varphi_2\\ \varphi_3\end{pmatrix}=\Phi\begin{pmatrix}\phi_1\\ \phi_2\\ \phi_3\end{pmatrix} \tag{5}$$

with $\Phi^2=\sum_i \phi_i^{\,2}=l^2$ where *l* is related to Planck scale, a dynamical space-time emerges from L_{eff}, which is characterized by the Einstein-Fokker equations

$$R=2\pi G_N T \tag{6}$$

$$C_{\alpha\beta\gamma\delta}=0 \tag{7}$$

where

$$R=\frac{6}{l^2}T \tag{8}$$

$$T(\phi_i)=g^{\mu\nu}T_{\mu\nu}(\phi_i)=-\Phi^2\sum_i \eta^{\mu\nu}\partial_\mu\phi_i\partial_\nu\phi_i \tag{9}$$

$$g_{\mu\nu}=\Phi^2(x)\eta_{\mu\nu} \tag{10}$$

(which shows that the gravitational degree of freedom is encoded in the scalar field Φ) and where G_N is proportional to l^{-2}.

The toy model developed by Girelli, Liberati and Sindoni shows in a clear way that time cannot be considered a fundamental reality, at a fundamental level space is timeless: the picture of the universe provided by this model is a mathematical proof of the idea that numerical order of change runs in a space only and not in time.

4. Physical time as numerical order of material change in space resolves Zeno Problems on motion

Zeno problems of motion confronted in terms of space and time are agitating human reason for centuries. Here we see that motion exists in space only and not in time. With clocks we measure physical time that is numerical order of motion. Achilles surpasses Tortoise in space only and not in time. Velocity v of both runners is derived from the numerical order of their motion. You imagine Achilles at the point A, Tortoise at the point T. Between A and T there is a distance d. When they start running into the same direction we activate a stopwatch. When Achilles is surpassing

Tortoise we stop stopwatch. On the stopwatch we see $t_n = 10$ sec . Achilles has passed 10 meters, his speed is $v = 1ms^{-1}$. Tortoise has passed 1 meter, its $t_n = 10$ sec , velocity is $v = 0{,}1ms^{-1}$. At the starting points the distance d between Achilles and Tortoise was 9 meters. Achilles runs distance $d_1 = 10\ m$ .Tortoise runs distance $d_2 = 9\,m$ .They both move in space only and not in time. Clock is a measuring device for numerical order $t_0, t_1, t_2 ... t_n$ of their motion. Their velocities $v_a = \frac{d_1}{t_n}$ and $v_t = \frac{d_2}{t_n}$ are derived from numerical order of their motion.

Here is considered universe space is timeless, universe is timeless. Zeno and Parmenides too have been considering universe is timeless: "Quantum mechanics brings another flavour in Zeno paradoxes. Quantum Zeno and anti-Zeno effects are really paradoxical but now experimental facts. Then we discuss supertasks and bifurcated supertasks. The concept of localization leads us to Newton and Wigner and to interesting phenomenon of quantum revivals. At last we note that the paradoxical idea of timeless universe, defended by Zeno and Parmenides at ancient times, is still alive in quantum gravity. The list of references that follows is necessarily incomplete but we hope it will assist interested reader to fill in details"(4).

5. Flow of physical time experienced through psychological time creates a sensation of temporal experience

Recent neurological research shows by measuring a physical event with a clock we experience numerical order $t_0, t_1, t_2 ... t_n$ of event through psychological time "past-present-future". However numerical order of physical event runs in space and not in time. "Temporal experience" in past-present-future is the result of experiencing flow of numerical order of material change through "psychological time" that has its origin into the neuronal activity of the brain.

"Traditionally, the way in which time is perceived, represented and estimated has been explained using a pacemaker–accumulator model that is not only straightforward, but also surprisingly powerful in explaining behavioural and biological data. However, recent advances have challenged this traditional view. It is now proposed that the brain represents time in a distributed manner and tells the time by detecting the coincidental activation of different neural populations (5).

6. Conclusions

Here is shown physical time is numerical order of material change. Physical time flows in space and is not part of the space. Space itself is timeless. In space physical past and future exist only as a numerical order of material change. In order to understand fully subject of time we have to distinguish clearly between physical time and psychological time. Psychological time is a "mind frame" through which we experience flow of physical time running into the timeless universe.

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