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Time Like Money is a Mental Product: Does Space-time Really Exist?

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***Abstract* – In Minkowski's diagrams time is associated with space, treating it as a fourth dimension in which objects can move. This association allows for descriptions of relativistic phenomena but has generated debates on time travel and made the concept of synchronicity relative. The purpose of this paper is to present a viewpoint according to which there is an absolute, Newtonian, synchronicity in the universe. The nature of time will be discussed and its direction will be justified with the help of set theory. Finally it will be pointed out that in the hypothesis of the existence of a privileged inertial system, here sustained, Minkowski's diagrams show only an apparent motion in time. In fact, while the configurations of the universe and their changements are physical phenomena, time is a descriptive dimension of these changes. Time is to changes in universe configurations as money is to goods: as money is a means that makes it easier to compare and then exchange goods, time is a means of the mind to compare two or more series of events. Both money and time, although they can influence real phenomena through the actions of organisms, are not of the same nature as the phenomena they describe and therefore can not be combined with them in physical entities. Therefore space-time does not exist.**

***Keywords* – Minkowski's Diagrams, Relativity, Sinchronicity, Space-Time, Time Like Money.**

I. INTRODUCTION

The debate on the nature of time was already active in Ancient Ages: according to Aristotle [1], time exists only in the presence of change. Newton [2] instead believed also in the existence of an absolute time, even if nothing changes. Einstein [3] opened the way to the thesis of the relativity of time and simultaneity, while McTaggart's [4] supported the unreality of time. The relativity of time has been verified but the principle of strong relativity, that implies the relativity of simultaneity, is not accepted by all scientists [5]. Furthermore, the same nature of time and its structure, continuous or granular, is at the center of a debate ([6], pp. 74-77) that, despite having begun in ancient times [7], is still far from being conclusive ([8], pp. 78-81).

In Minkowski's diagrams time is associated with space, treating it as a fourth dimension in which objects can move. If on the one hand this association allows for descriptions of relativistic phenomena, on the other hand it generates errors in the understanding of the nature of time and in the logical consequences that derive from it. Treating time almost as a spatial dimension has generated debates about the possibility of travelling in it and made the concept of synchronicity relative.

In this paper we will present a viewpoint according to which the whole universe has a unique configuration in every single moment: in other words there is an absolute synchronicity in the universe, and there is always only one present in it. According to this viewpoint time is the relation among two or more series of changements. The configurations of the universe and its changements are physical phenomena. Time is a descriptive dimension of these changes. It is to these changes as money is to goods: as money is a means that makes it easier to compare and then exchange goods, time is a means of the mind to compare a series of events with another, chosen for its presumed regularity. In the former and in the latter case, however, both money and time, although they can influence physical phenomena by means of actions of organisms, are only measurement means of them, that is they are another kind of object that can not be combined with physical phenomena: therefore space-time does not exist as a physical object.

The popular saying is that "time is money". Here we add that "time is like money": a mental creation.

II. On the Nature of Time

2.1. *Nature of Time*

As we saw above, the debate on the nature of time has continued for millennia and is still not over. However, there is a general consensus that time can not be separated from space.

Minkowski's diagrams show the motion of a body in space and time. They give us descriptions of relativistic phenomena, but at the basis of these descriptions there is a logical error: bodies do not move in space and time, they move in space taking time. The fact that mathematical objects can have more than three dimensions does not imply that all these dimensions can be regarded as spatial dimensions, even if they can be treated by means of geometrical methods. Confusing a descriptive greatness (time) with the real phenomenon (a series of objects that we can say *events*, or universe configurations) has generated paradoxical debates such as that on the possibility of time travel. Time travels are not possible because time is part of the description of a journey (for example in a diagram of Minkowski) and not the journey itself.

We know that time flows more slowly as gravity increases. To illustrate this phenomenon Rovelli ([6], p. 19) observes that due to the differences in gravity, time flows faster in the mountains than in the plains. This is true but it does not imply that the mountains go into the future while the plains remain in the past. This only implies that all the processes in the mountains are faster than those in the plains but both the mountains and the plains are in the same present moment. It is therefore not appropriate to say that time passes faster in one place than in another: we must say that in one place a series of events is denser than an analogous series in another place. Hence the nature of one of the dimensions of a Minkowski's diagram, time, needs to be clarified: it is not a dimension in which it is possible to travel, but it is only a descriptive dimension that links a series of events to another series of events (for example the motion of a clock) chosen for its presumed regularity.

2.2. *The Time Arrow*

It is often sustained that the direction of the time arrow is determined by the increase in entropy. However we know that entropy can locally decrease (increasing syntrophy). On Earth life evolves and organizes itself and nevertheless we perceive the passage of time by recording a succession of events.

The growth of entropy is not the cause of the direction of the time arrow: even if matter organizes itself and entropy decreases (which happens locally), an observer whose perceptual field was limited to that place in which entropy decreases would still have the perception of the passage of time. Obviously the organization process of matter would not take place, as it is naively represented, by means of the inversion of the time arrow. The reassembly of a cup (for example) takes place through procedures that can not consist in the inversion of events, which is conceptually simple but impossible in practice, as noted by Clausius [9] and Boltzmann [10]. However even in this unlikely case the observer would still detect a succession of events and therefore the passage of time. Entropy or syntropy increasing does not alter the reality of a series of changes. In any case ther-

-e is a succession of events that can be represented on a straight line only in one direction.

This series of events can also be represented by means of sets nested one inside the other, each of which showing the different configurations of a universe. In Figure 1 it is shown a universe consisting of the single object *O*, whose configurations are therefore the configurations of the universe. Each set U_i differs from the previous one (that is its subset U_{i-1}) for the event E_i. The set U_i therefore shows the history of the universe up to the time *i*, starting from the innermost (sub) set U_0.

Looking at Figure 1 it becomes clear that going back in time is like wanting that a set is the proper subset of its proper subset. For example by following the E_4 event the event - E_4, we do not get the U_3 again, but a set U_5 which, while showing a universe equal to that represented by U_3, shows a different history of it, consisting of non-corresponding events. In fact the set U_4 can not be a proper subset of the set U_3 (as pointed out by Paolilli [11], a set can not even be an improper subset of itself).

Trivially, if an event has happened, it can not subsequently have not happened.

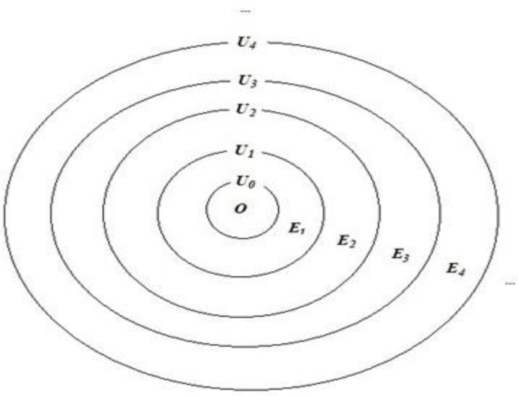

Fig. 1. The series of sets nested one inside the other represents, starting from the innermost one, the history of a universe consisting of the single object *O*. The set U_i shows the history of the universe up to the time *i* and it differs from the previous one (U_{i-1}) for the event E_i.

2.3. *Time Like Money*

Mutations can be registered giving the perception of time but time does not exist in itself. What exists is only change: to say it with Heraclitus, everything flows [12]. Time, as we have pointed above, is therefore a descriptive ordering criterion of the configurations of the universe. This criterion is not internal to the structure of the universe but it is a representation of its configurations, even if this representation takes place in a mind that resides in a brain that in turn is within the universe.

Time therefore is to the universe what money (in its purest sense, that is, non-commodity money) is to an economic system. Just as money, replacing barter, allows the exchange ratios between goods to be reduced to the number of goods, so time calculated by means of a clock or the apparent motion of the sky allows us to easily measure the movements or changes which surround us. As money exists if there are goods, so time exists if there are mutations.

The analogy between time and money is certainly not new. As mentioned above, the popular saying is that "time is money". Some researchers [13] have even pointed out that people are more averse to the risk of wasting time than money. However, returning to the discussion of the concept of the physicality of time, Carroll [14] states that time is more concrete than space. Here we have shown that this is not true, but we must admit that, if not time, at least what it measures, namely change, is the basis of everything. Without change there would be no perception, no consciousness and perhaps not even the universe, which is the result of movement and dynamic relations at all levels, primarily at the atomic and subatomic levels, as well as at the level of the void itself, with its fields and its energy. Maybe the essence of being is precisely in change, in never remaining the same as oneself.

III. THE ROLE OF MINKOWSKI'S DIAGRAMS

According to the principle of strong relativity the sequence of events can be different for observers who are in different inertial systems. The vision of Einstein, as we can note by reading his letter of condolence written to the children and to the sister of Michele Besso on the occasion of his death [15], is similar to Parmenides' that: "For us, militant physicists, the separation between past, present and future has only the meaning of an illusion, however tenacious." (translation from the Italian text). The Relativity Theory shows a world in which an event can be in the past for an observer and in the future for another observer if they are in two different inertial systems. A world like that which is described by Minkowski diagrams does not admit absolute synchronicities.

As it has been told above, diagrams are used to represent relativistic phenomena. In Figure 2 it is shown a classical example of relativity of synchronicity.

In Minkowski's diagram of Figure 2 the abscissas represent the only spatial dimension taken into consideration (for the sake of simplicity), while the ordinates represent time, expressed in terms of *c t*. The observer O_1 and the mirrors *A* and *B* are moving to the right at the speed of *0.5 c* with respect to the observer O_o. The lines indicated by *L* (with O_0, O_1, *A* and *B* as a pedix) are respectively the world lines of the two observers (O_0 and O_1) and the mirrors (*A* and *B*). Note that the world lines of O_0 and O_1 coincide respectively with the axes of the ordinates $c\ t_0$ and $c\ t_1$. Due to the Lorentz factor the scale (not shown in the figure) of the axes x_1 and $c\ t_1$ is different from that of the axes x_0 and $c\ t_0$ (the lengths in x_1 are approximately 0.866 times the lengths in x_0). Two light pulses r_A and r_B start from O_1 towards *A* and *B* in the same instant t_0 (O_0, O_1) in which O_1 is in the same position of O_0. They reach the mirrors *A* and *B* in the same instant t_1 (O_1) for O_1 (the oblique dotted line, which links synchronous events for O_1, is parallel to the abscissas axis x_1). From the viewpoint of O_0, *A* and *B* are instead reached by the light pulses in t_1 (O_0, A) and t_1 (O_0, B) respectively. The events that are synchronous for O_0 are in fact individuated by the axis x_0 and its parallels.

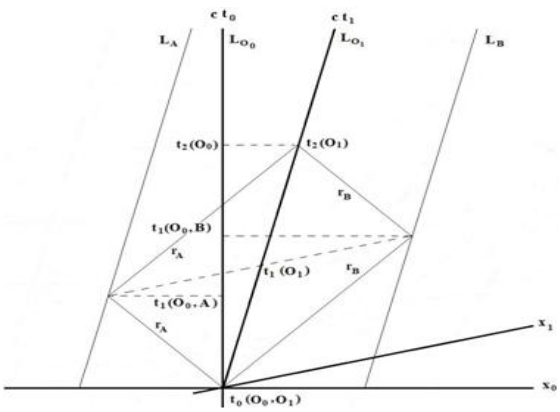

Fig. 2. Two light pulses r_A and r_B start from O_1 when O_1 is in the same position of O_0. They reach the mirrors *A* and *B* in the same instant for O_1 (the inclined dotted line, which links synchronous events for O_1, is parallel to the abscissas axis x_1) but not for O_0, for whom synchronous events are individuated by the x_0 axis and its parallel lines. The two light pulses return to O_1 in the same instant (both for O_0 and for O_1).

However, what is more relevant according to the principle of strong relativity is that the situation shown in Figure 2 can be reversed and then we can assume that O_1, A and B are at rest while O_0 is moving (to the left). Also in this case the lines which represent the two light pulses have a 45 degree tilt due to the second postulate of relativity. The consequence is the relativity of synchronicity: the two scenarios, O_1, A, B in motion and O_0 at rest or vice versa, are both equally valid.

Various forms of objection have been raised against the second postulate of relativity [5] [16] [17] [18]. Moreover, due to the result of the experiment of Hafele and Keating [19] [20], it has been noted that time can slow down but can also accelerate [5] [16], contradicting the strong relativity principle. Finally, as exposed above, a journey takes place only in space and not in space and time, time being only a descriptive dimension.

We can therefore conclude that the graph in Figure 2 shows a phenomenon of only apparent relativity of synchronicity.

IV. A Representation of Motion in the Hypothesis of the Existence of a Privileged Inertial System

Some scholars have noted that it is more probable the existence of a privileged inertial system. Selleri [5], basing on phenomena as the Sagnac effect, the stellar aberration and the result of the experiment of Hafele and Keating [19] [20], presented a new relativistic theory which does not imply all the paradoxes of the Einstein's Special Relativity Theory.

The nature of the privileged inertial system could be discussed: it could be constituted by space itself or by the inertial field of the universe (in combination with a local gravitational field). Whatever its nature, if we admit the existence of a privileged inertial system, there is only one world configuration which is constantly evolving in successive configurations.

The speed of the processes which take place in a system slows down if the system moves with respect to the privileged inertial system while it reaches its maximum value when the system has no motion with respect to the privileged inertial system.

The presence of a privileged inertial system restores credibility to an absolute synchronicity, already highlighted by various scholars [7] [21].

Figure 3 illustrates the relation (curved line) between the speed of the local processes (S_1ps) which happen in a system S_1 and the motion, or external speed (S_1es), of this system with respect to the privileged inertial system S_0, taking into account the Lorentz transformations (possible alternatives to these transformations are beyond the scope of this paper).

The external speed is expressed in relation to the speed of light in S_0: so the abscissa 1 refers to the light speed c. The speed S_1ps of the internal processes in S_1 is expressed in terms of the internal speed of the same processes if they happen in the privileged inertial system S_0 (coordinate 0, 1). In other words the ordinates can indicate the local time in relation to the time in S_0: when $S_1es / c = 0$ then $S_1ps / S_0ps = 1$ and then time flows in S_1 at the same speed as in S_0. All the speeds of the bodies (and also electromagnetic waves, or photons) which are in the moving inertial system are slowed in the same proportion.

The ordinates of the two points indicated in the graph are the velocities of the local processes for an inertial s-

-ystem which is moving with respect to S_0 at *0.8 c* or *0.6 c* respectively. Note that S_1es is an absolute value of the speed with respect to the privileged inertial system, whatever is its direction. Growing S_1es, S_1ps decreases (and then the local time slows down) according to the Lorentz transformations.

The same relation can be observed between the speed of the internal processes and the escape velocity from the gravitational field in which the system is immersed.

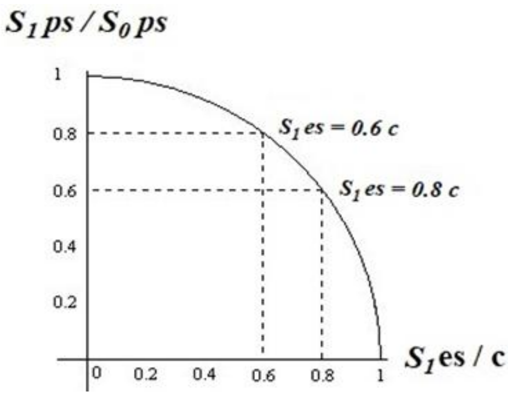

Fig. 3. The abscissas measure the speed of the inertial system S_1 with respect to the privileged inertial system S_0 in terms of the light speed *c* in S_0. The ordinates measure the ratio between the speed of the local processes in S_1 and the speed of analogous processes in S_0 (giving a measure of slowing down of local time).

V. Conclusion

In Einstein's world synchronicity is relative. In our opinion this scenario is not realistic: an event happened or didn't happen: *tertium non datur*. Minkowski's diagrams, used to describe relativistic phenomena, are affected by the non realistic combination of space and time, space being a physical greatness, time a descriptive greatness. Furthermore, the phenomena represented in Minkowski's diagrams are based on the principle of strong relativity and on the second principle of relativity, both subject to surveys. The description of the phenomena in the chronotope made by the Minkowski diagrams is analogous to the description of the motion of the stars in the celestial sphere made by the Ptolemaic system: it is effective in describing an apparent motion but it does not describe the real structure and functioning of the universe. However, even if time is only a descriptive greatness, what it measures, that is change, is the origin of every manifestation of reality.

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