# Time is the other name of space A philosophical, a physical and a mathematical space-time

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### ABSTRACT

Time does not exist: there is no mysterious substance that would flow everywhere but that one would never see. Time does not flow. Time does not exist alone, time is relation. But space that matters is also relation. It is thus necessary to think time as a non separable way to think space, as relativity theory already implicitly invites us to say. Some consequences of this approach are outlined on a general standpoint and on the point of view of the equations. The difficulty in seizing this point of view puts the mind in front of an epistemological circle, the (provisional) stop of which requires a renouncement of thought: thought is not founded on itself; we cannot avoid sometime to *show* something of the reality external to thought, and to allot to it some qualities that we are not "sure" of (cf. the postulate of the constancy of light speed). One retrieves the concepts of uncompleteness, uncertainty, undecidable propositions, withdrawal of foundations etc. which are a general characteristic of the contemporary scientific and philosophical thought. Pascal already said in his "Pensées": "whatever the end at which we were aiming in order to stop and rest, it escapes, slips from our grasp and flees for an eternal run ". But does one think time better today?

## 1. INTRODUCTION

Various authors find many problems in physics to-day, even if they do not necessary agree on their nature[1]. Some physicists in particular see problems in the theory of relativity. We think that the first problem which arises is not a technical problem, nor such or such particular problem. The first problem which arises is the fundamental problem of the understanding of time in physics, and more generally in thinking. After more than two thousand years of history since the Greeks, the concept of time is always full of mystery, it always raises many questions. Basically, we think that time does not correspond to a separate substance of the world, it is not merely observed nor measured. On the contrary it results from a construction from the tangible world, which goes together with the construction of space. When the physicists wish to compute the relations between the parameters x, y, z and t, it is too late, they already separated the two concepts of time and space, even if they connect the corresponding measurements as in the theory of relativity. We think that the understanding of the construction of time is the key to all the other problems, or, in any case, the compulsory route to take again the other problems.

In this paper, we give a short summary of the various steps of this construction and its main consequences in physics. The reader is invited to refer to various papers written by the author for more details[2].

## 2. FIRST STEP: CONSTRUCTION OF A PHILOSOPHICAL SPACE-TIME: TIME AND SPACE ARE THE SAME THING.

Basically, time does not flow, nowhere: time is relation, time is change of relation. Similarly, the position of a point in space is not a property of this point, but of a relation to other points. *In short, we will say that time and space are two ways,*

*always associated, to speak about the world, i.e. to speak about the relations of the material points the ones with the others.* There is no clock independent of the world to define and measure time, there is no ruler independent of the world to define and measure space; there are only choices among the phenomena, we can only compare phenomena to other phenomena.

We need words to name this fundamental association of time and space. We can speak of *movement*, which we attach to any amplitude of tangible reality. The particular portion of space which is attached to this portion of reality corresponds to the amplitude of the movement, while the particular portion of time corresponds to the process of the movement, either that of the mind which travels along this amplitude, or that of the physical phenomenon which connects the points as a portion of space (what would be the meaning of space for points that would be juxtaposed the ones besides the others without any link?). Standard space and time (we could say global, or synchronized, space and time) are simply built by comparing the various movements of the material points the ones to the others: the constant relations allow to build space, compared to the variable relations from which we build time. We dissociate the concept of velocity from that of movement. The velocity is given by the ratio of a given movement to a reference movement.

In short, to any time interval corresponds a space interval, and reciprocally. Such is the crucial point of our approach, which we do not justify completely here, but which will be consolidated by its consequences.

### 3. STOP: A RENOUNCEMENT OF REASON TO FOUND ITSELF

It is capital to understand that, by saying that time and space are "the same thing", we are facing an epistemological circle. Indeed, in order to think the first movement, in order to think these various particular movements that we compare the ones with the others, it seems to us that we already need separate concepts of time and space. It is capital to understand how we manage with this circle, how we cope with it, how we stop it.

The stop of this circle requires a renouncement of reason: we cannot define all the concepts, nor all the words by way of other concepts nor other words, within an approach which remains above and beyond the real world. At a given moment, we must refer to the world, exterior to the words. We cannot but show something, and give it a name, without being completely sure of the good adequacy between the word and the thing, with respect to the relation of the word with the other words. We must then assume this choice in its consequences on the relations of the words with the things, and of the words between them; we may want to take again this construction by making other choices. We say for example today: a) these points have invariable relations, this is a first phenomenon, for example a metallic ruler; b) this other phenomenon (the light) defines a propagating signal at a constant speed as compared to the points of the ruler, it defines a clock. One thus pronounces these two (interrelated) decrees, even if one is not sure of the ultimate meaning of the words immobility or constant mobility for them, as if these words were defined independently from the world. This approach leads us to the very structure of the theory of relativity (which is not strictly related to the properties of light).

We are in a situation that we meet today in many fields of philosophy and physics. To speak about it, we can use various qualifiers we do not discuss the respective nuances nor the relations. We speak of uncompleteness (as required by a formal system to refer to an outside of it, or to depend on choices external to it), of uncertainty (we are

not strictly "sure" of the numerical values allotted to such physical parameter), of an assumption of the constancy of a signal speed, of coherence-truth (as opposed to correspondence-truth), of complementarity, of going beyond contradictions, of the third included assumption, of the foundation withdrawal, of undecidable propositions etc.

## 4. SECOND STEP: CONSTRUCTION OF A PHYSICAL SPACE-TIME

Let us admit, at least as a new receipt, or a new game, the association of a space interval to any time interval. The working of a clock at a given place always amounts establishing a correspondence between the "flow" of time and a travel in space. It is also to say that we can never speak of time at a given point, by reducing the space interval to zero (there would be nothing any more). It is also to say that we must always specify the orientation in space of the movement that defines the clock. Today we must wonder which is the direction of the photon movement of the photon clock. Measurements of the time and space parameters associated with various points in a reference frame are always equivalent in a final analysis to compare some movements to other movements, or, which is the same, some traveled distances to other distances: those of the photons in boxes (or clocks) with those traveled by other photons outside the box. By comparisons of these movements from one place to another, we build a physical space time where space and time co-ordinates are defined everywhere. The common time of a reference frame finally results from agreeing on the position of a photon somewhere.

## 5. THIRD STEP: CONSTRUCTION OF A MATHEMATICAL SPACE-TIME

As a consequence of the preceding step, we are led to give at least temporarily, a vectorial character to time. That is needed in order to locate in space the reference mobile (the photon) used to measure time. For the good coherence of the construction, any velocity of any mobile must be defined in the same direction as that of the time mobile which is used to quantify it. The mathematical assumption subjacent with the transformations between moving reference frames is then the constancy of the velocity of the photon in the direction of the relative movement between the various reference frames, whatever this direction (which can be oblique compared to the co-ordinate axes). We then obtain Lorentz relations that are different from the usual relations, because of the three time co-ordinates. One will find their mathematical expression for example in Franco[3] (who did not give a physical interpretation like the one here).

## 6. CONSEQUENCES OF THE POINT OF VIEW PRESENTED HERE

The two new angles of attack that we propose are: 1) the conventional character of the choice of the physical phenomenon with "decided" constant characteristics to define time and space (we could build space and time on another phenomenon than light propagation); 2) the temporarily three-dimensional character of the time parameter associated with the reference movement[4]. The consequences are very numerous.

At the conceptual level, we can discuss within this framework a whole series of questions such as the Langevin twins problem (the difference in age corresponds to a different point of view to a mobile), the problem of time irreversibility (the first problem of time is not its irreversibility but its construction; it cannot avoid an uncertainty where an ontological irreversibility comes into play; the second law is not a universal law of nature, it is valid at a probabilistic level for systems of a certain size

i.e. containing a certain number of particles[5]), philosophical problems associated to the time aporia (the distinction between future past and present) etc

At the mathematical level, it is necessary to re-examine the problems concerning the space-time metrics, the Lorentz relations and a certain number of their consequences; etc. In particular all that relate to Thomas rotations for the composition of several Lorentz transformations with different orientations. The solution is to restrict oneself to transformations where the velocity directions of the reference frames and that of the photons are the same. Certain difficulties arise on the level of the relations between quantum mechanics and relativity, where it is said that time may not exist at microscopic level: the solution is to say that time does not exist at any level, it is a simple position parameter. The existence of supraluminal displacements is not prohibited by principle. One can also establish a link with certain formulations of string theory where a three-dimensional temporal parameter appears to be useful. Etc

Let us stop there. This is to say that the point of view presented offers directions for research from which it is necessary to take again a certain number of the foundations of physics. [6]

## NOTES

[1] See NPA works (National Philosophy Alliance), the PIRT conferences (Physical interpretations of relativity theory); also see, among many other books, that recent by Lee Smolin: "The trouble with physics, the rise of string theory, the fall of science and what comes next", Dunod, 2007, 488 p.

[2] See for example Guy B. (2004) On lightning and thunder, a stroll between space and time (about the theory of relativity), Editions EPU, Paris, 224 p.
See also site www.emse.fr/~guy.

[3] Franco J.A. (2006) Vectorial Lorentz transformations, Electronic Journal of Theoretical Physics, 9, 35-64.

[4] Only scalar time is useful for us to order the events of the world; it is the curvilinear coordinate of the movement of time point, or the modulus of the time vector. Many works in literature show the use in the formalism of a three-dimensional time, in the absence of a true physical interpretation.

[5] Guy B. (2008) Particles, scale, time construction and the second law of thermodynamics, Meeting the entropy challenge, an international thermodynamics conference in honor and memory of J.H. Keenan, the MIT, Cambridge, USA, Oct. 2007, Proceedings. Videos of presentations on MIT website.

[6] Our conviction in particular is that we can reconcile criticisms on the theory of relativity with the structure of this theory, which must certainly be taken again.