Journal of Theoretics *Vol.4-5*

Coordinate System at Absolute Rest in Einstein's Special Relativity Theory

A.C.V. Ceapa
PO Box 1-1035 R-70700
Bucharest, Romania
alex_ceapa@yahoo.com

Abstract: Against general belief, a coordinate system at absolute rest is identified in Einstein's original paper on relativity. The special relativity theory appears to be in a great measure a theory of absolute.
Keywords: coordinate system, special relativity theory, time.

Symbols:

ξ: coordinate of an event relative to the coordinate system Ξ.
η: coordinate of an event relative to the coordinate system Ξ.
ζ: coordinate of an event relative to the coordinate system Ξ.
τ: the time of the coordinate system Ξ.
ϕ: function of v of value 1.
∂: derivative function
Ξ: coordinate system at absolute rest associated to the inertial coordinate system k.

Einstein's original paper on relativity [1] was a derivation of the Lorentz Transformations (LT) which had little or no experimental basis at the time. It is the purpose of this paper to identify the true diagram of the experiment that Einstein wanted to achieve, and to show how this diagram assumes the existence of a coordinate system (CS) at absolute rest in special relativity theory (SRT).

We allow (in accordance with Einstein) that the sets ξ, η, ζ, τ and **x**, **y**, **z**, **t** determine the place and time of an event completely in relation to the parallel inertial CS's **k** and **K** respectively that at an instant of time **k** and **K** are superimposed, and then **k** moves with constant velocity **v** along the common ***x'***,***x*** axis. Also in accordance with Einstein we choose the point P(**x'**,**y**,**z**) at rest in **k**, define the time τ of **k** as function of **x'**, **y**, **z**, **t**, and proceed to calculate τ in terms of time **t** of **K** by inserting its values $\tau_O=\tau(0,0,0,\mathbf{t})$ associated to the emission of a light signal at $\mathbf{O'}_i$. $\tau_P=\tau[\mathbf{x'},0,0,\mathbf{t}+\mathbf{x'}/(\mathbf{c}-\mathbf{v})]$ associated to the reflection at **P**, and $\tau'_O=\tau[0,0,0,\mathbf{t}+\mathbf{x'}/(\mathbf{c}-\mathbf{v})+\mathbf{x'}/(\mathbf{c}+\mathbf{v})]$ associated to its

arrival at $\mathbf{O'_f}$ ($\mathbf{O'_i}$ and $\mathbf{O'_f}$ are successive positions of the origin of **k** along the common $\boldsymbol{x'}$,$\boldsymbol{x}$ axis) in the equation

$$\tau_O+\tau'_O=2\tau_P \quad , \tag{1}$$

which Einstein claimed to define clocks that were working in synchronicity at the origin of **k** and **P**. For the infinitely small **x'**, Einstein obtained the differential equation

$$\partial\tau/\partial x'+[v/(c^2-v^2)]\partial\tau/\partial t = 0$$

and on its integration he got:

$$\tau = \phi(v)[t-vx'/(c^2-v^2)] \quad . \tag{2}$$

Using this result, and taking some mathematical decisions which physics was shown in [2], Einstein further deduced the quantities ξ, η, ζ in terms of **x**, **y**, **z**, **t** (for calculation details see Section I.2 of [1]) establishing the LT.

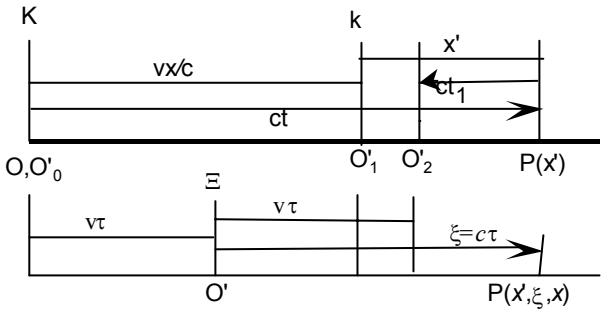

Figure 1

Since Einstein supposed that "at the origin of **k**, **t**=0 when **τ**=0", by equation

$$x'=x-vt \tag{3}$$

(that he also assumed for the coordinates of **P**), we have **x**=0 at **t**=**τ**=0, and thus the proof that the true diagram of his thought experiment to deduce the LT was the upper diagrams shown in Figure 1.

Focusing our attention on this diagram, we see that it embodies the two diagrams of Figure 1 in [3], where K is the CS at absolute rest. This remark requires two comments. The first one concerns its eventual consequences. Writing **t**=**x**/**c** in (3), then inserting (3) in (2), and putting **ξ**=**cτ** and ϕ(**v**)=1 in **τ**, in accordance with Einstein, the upper diagram in Fig. 1 predicts

$$O'_oP = x = ct = \xi+v\tau \quad . \tag{4'}$$

It also predicts $\mathbf{O'_oO'_1}$=**vx'**/(**c**-**v**) and $\mathbf{O'_1O'_2}$=**vx'**/(**c**+**v**), which by adding give:

$$O'_oO'_2/2 = v\tau \quad . \tag{4"}$$

Therefore, in view of the upper diagram in Figure 1, equation (4) predicts the existence of a fixed point **O'** situated at mid-distance **vτ** between **O** and $\mathbf{O'_2}$, relative to

which ξ is being defined as a coordinate of **P**(**x'**). Thus, as shown in the bottom diagram in Figure 1, **O'** is the origin of a CS Ξ at absolute rest associated with the inertial CS **k**. Ξ is parallel to both **k** and **K**, having the common ***x',ξ, x*** axis. The set of coordinates ξ, η, ζ is actually defined in relation to Ξ, not relative to **k** as it was initially assumed. ξ is traced by a light signal emitted by a source located at **O'**, that reaches **P**, as well as by the reflected signal reaching **O'**. So that, by (1), τ is the time of Ξ.

The second comment concerns the raising of Ξ. Equation (1) is true for clocks situated at points "of space" [1], i.e., at absolute rest. Then the path of the light signal traveling from **O** to **P** is equal to that of the light signal traveling from **P** to **O**. Otherwise, as it is evident from the upper diagram in Figure 1, the path of the light signal traveling from $\mathbf{O'_0}$ to **P** differs from that of the light signal traveling from **P** to $\mathbf{O'_2}$. The reason for this is that the ends of the line segment $\mathbf{O'_0P}$ moves with velocity **v** along the ***x',x*** axis simultaneously with and independently of the light signal (see also [3]). Einstein's extension of equation (1) to the inertial CS's was just the price he paid to those anachronistic "blind" inertial observers who -as pointed out in [3] - are supposed to perform measurements, use their results in LT, and draw correct conclusions from LT without having any a priori knowledge on the relative motion and its graphical representation. However, Einstein obtained equation (2) and finally his derivations from the LT. Therefore, we must now search for the true meaning of equation (1).

As equations (4) are the consequences of a calculation based on equation (1), and 2ξ is the path of a light signal traveling from **O'** to **P** and back to **O'** in a time 2τ equal to the time $\mathbf{t}+\mathbf{t_1}$, in which the initial signal travels from $\mathbf{O'_0}$ to **P** and back to $\mathbf{O'_2}$, Ξ was raised by equation (1). The true meaning of equation (1) is that to define synchronous clocks at **O'** and **P** in Ξ and not at the origin of **k** and **P**, as it was initially assumed.

The doubtless presence of the CS at absolute rest in Einstein's SRT by Ξ, as well as by the mathematical description of the motion of an inertial CS having imparted an additional constant velocity **v** relative to another inertial CS (as a motion of velocity **v** of a CS relative to a CS at absolute rest [4]) is essential for a correct understanding of the LT and SRT: LT appears to connect absolute quantities, and SRT to be a theory of absolute rather than one of relativity. The implications and consequences on modern physics are significant.

References

[1] A. Einstein, Ann. Phys. 17 (1905) 891.
[2] A.C.V. Ceapa, Physical Grounds of Einstein's Theory of Relativity (3rd ed., Bucharest, 1998) 19.
[3] A.C.V. Ceapa, "On the Measurement of Absolute Velocities", Journal of Theoretics, Vol. 4-5 (2002).
[4] Ibid., Physical Grounds of Einstein's Theory of Relativity, 10.

Journal Home Page