COORDINATES TRANSFORMATION FROM THE PRINCIPLE OF RELATIVITY

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SUMÁRIO

Apresentamos neste trabalho uma dedução das leis de transformação das coordenadas cartesianas ortogonais associadas a referenciais de inércia. Apenas se recorre ao princípio de relatividade. Assim se obtém uma forma geral dependente de uma constante, "a" determinável a partir do conhecimento da velocidade $\bar{v}$ em $\bar{S}$ $(\bar{x}^i)$ e sua transformada v em S (x^i).

A obtenção de "a" é, portanto, matéria de experiência directa ou de hipótese consistente com anteriores factos experimentais.

SUMMARY

We present a derivation of the transformation law of ortogonal Cartesian coordinates associated with inertial frames. Using only the principle of relativity, we have obtained general transformations depending on a constant "a". The determination of "a" is possible after the knowledge of a velocity $\bar{v}$ in $\bar{S}$ $(\bar{x}^i)$ and the transformed value v in S (x^i). So, the correct value of "a" is a matter of a direct experiment or results from a hypothesis consistent with experimental facts.

The space-time transformations of Special Relativity result necessarily from the two basic assumptions:

1 — Equivalence of inertial frames in uniform relative motion: special principle of relativity;

2 — Independence of light velocity from source inertial frame and observer inertial frame: in the Special Relativity this velocity is a universal constant "c".

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From these two postulates we may conceive different situations from which result the Lorentz Transformations [1].

If we use only the first postulate it is possible to obtain a more general form of space-time transformations including Lorentz transformations or any other. The correct option is a matter of experience.

This fact has been pointed out by others, namely Aharoni [2] and Lee-Kalotas [3].

The aim of this paper is the same and we believe that the new fact is the derivation of the correct law on the basis of an experimental determination of a constant, depending on the knowledge of the two correspondent values of the velocities $[\bar{v}, S(\bar{x}^i)]$ and $[v, S(x^i)]$. We have obtained the analytical expression of this constant. On the other hand, we think, the derivation of the results is particulary simple.

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The homogeneity and isotropy of space-time are implicitly contained in the principle of relativity restricted to inertial frames [4].

From the homogeneity — translation invariance — we can impose the same coordinates to the origins of the space-time: O [o,o,o,o] $\rightleftarrows$ $\bar{O}$ [o,o,o,o].

From the isotropy — rotation invariance — we can impose at t = o, the coincidence of the homonymous axis of ortogonal Cartesian coordinates:

$$t = o, \; xx \equiv \bar{x}\bar{x}, \; yy \equiv \bar{y}\bar{y}, \; zz \equiv \bar{z}\bar{z}.$$

We supose now a uniform relative motion parallel to the x-axis: relative velocity $\bar{O}/S = v_r e_x$.

Under the circumstances we are led, [2], [4], to the set of linear transformation equations: