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AN IDEA OF THE MASS OF A PARTICLE IN A PLATONIC QUADRIDIMENSIONAL SPACE

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Abstract

Consequently to the articles hal-01165196, v1 and hal-01207447, v1, the concept of the relativistic mass of a particle is described herein as a consequence of its interaction with a stratification of the platonic quadridimensional space by a sequence of hyperplanes $H^{(n)}$ orthogonal to the direction of the projection \vec{h} , regularly spaced at a distance $\Delta w_0 > 0$.

The movement of the hyperplane H_p linked to a particle P generate De Broglie waves. This article aims to clarify in this context how the distance Δw_0 geometrically determines the value of the rest mass of the particle P and model the relativistic variation of this mass measured by an observer linked to any reference frame.

Résumé

Suite aux articles hal-01081576, v1 et hal-01205805, v1, la notion relativiste de la masse d'une particule est décrite ici comme une conséquence de son interaction avec une stratification de l'espace quadridimensionnel platonicien par une suite d'hyperplans $H^{(n)}$ orthogonaux à la direction de la projection \vec{h} , régulièrement espacés d'une distance $\Delta w_0 > 0$.

Le mouvement de l'hyperplan H_p lié à une particule P engendre une onde de phase de De Broglie. Cet article vise à préciser dans ce cadre comment la distance Δw_0 conditionne géométriquement la valeur de la masse au repos de la particule P et à modéliser de même la variation relativiste de cette masse mesurée par un observateur lié à un référentiel quelconque.

1. The geometrical framework

This modeling is based on the Platonic space outlined in the following articles:

« UN MODÈLE PLATONICIEN (EUCLIDIEN-PROJECTIF) POUR LA THÉORIE DE LA RELATIVITÉ RESTREINTE » (pré-publication hal-01081576, version 1).

« A PLATONIC (EUCLIDEAN-PROJECTIVE) MODEL FOR THE SPECIAL THEORY OF RELATIVITY » (pre-publication hal-01165196, version 1).

$(O, \vec{i}, \vec{j}, \vec{k}, \vec{h})$ is a frame for the four-dimensional Euclidean space whose axes are denoted (OX) , (OY) , (OZ) , (Ow) ; the direction of the projection is that of the vector \vec{h} .

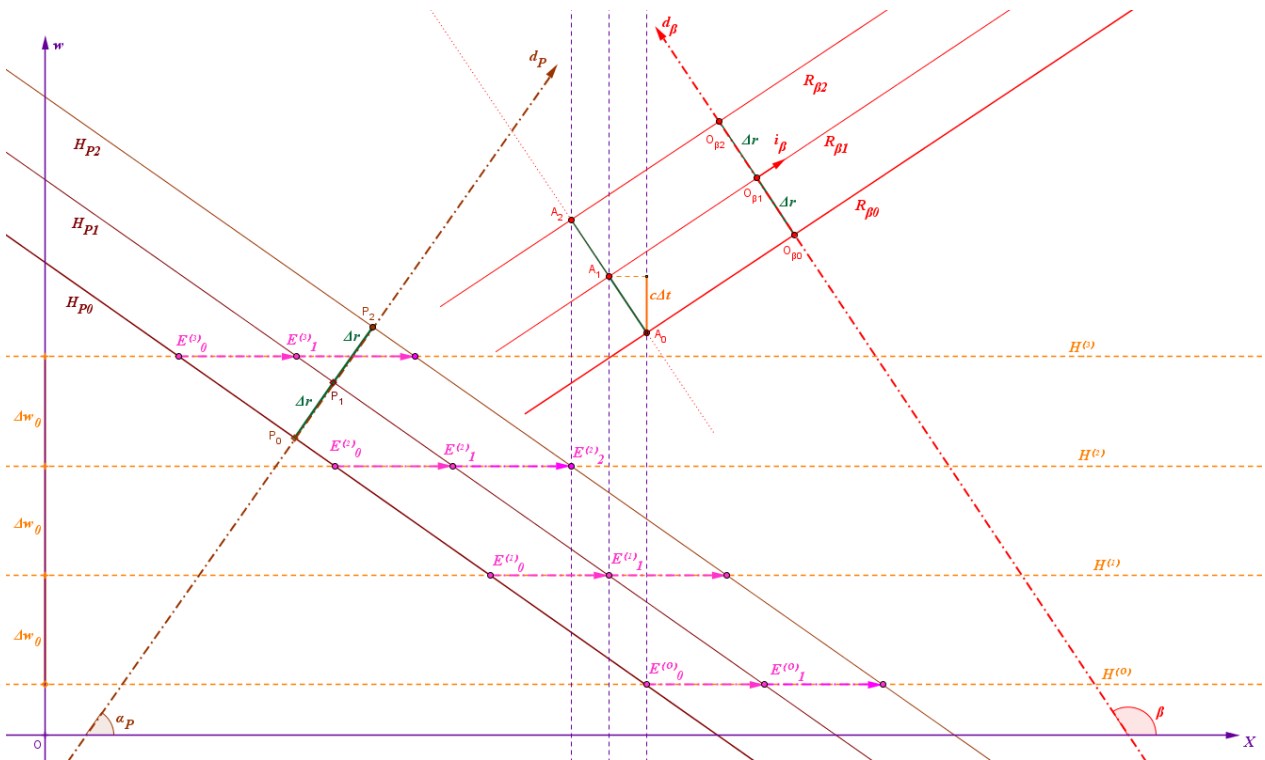
2. Modeling

2.1. Presentation of the model

We consider a stratification of the Platonic space by a sequence of hyperplanes $H^{(n)}$ which are orthogonal to the direction of the projection \vec{h} , regularly spaced out by a distance $\Delta w_0 > 0$ and a punctual mobile P in uniform rectilinear motion. We shall associate to this mobile P the hyperplane H_P which contains it and orthogonal to the direction of its motion.

To simplify the following diagrams, we shall consider only mobiles whose motion is located in the plan (XOw) .

We will name d_p the straight line traveled by P , \vec{u}_p its guiding vector (oriented in the direction of the motion), α_p the angle (\vec{i}, \vec{u}_p) . We will assume that α_p is not a multiple of π .



During the movement of the particle P , we consider the intersections of the hyperplanes $H^{(0)}, H^{(1)}, \dots, H^{(n)}$ with the hyperplane H_P linked to P .

We named $E_0^{(0)}, E_1^{(0)}, \dots, E_2^{(3)}$ the events corresponding to the intersections $H^{(n)} \cap H_{P_i}$ of the hyperplanes $H^{(0)}, H^{(1)}, H^{(2)}, H^{(3)}$ with $H_{P_0}, H_{P_1}, H_{P_2}$.

We have shown that the perception of these events by a reference frame R_β (β not a multiple of π) presents the characteristics of **De Broglie waves**.

So, **by convenience** (and misuse of language), we shall name along this article "De Broglie waves" the perception of these events $E_r^{(n)}$ by any reference frame R_β .

2.2. Mass of the particle P perceived by an observer from a reference frame R_β

Let us consider an observer A from a reference frame R_β (β not a multiple of π).

We briefly recall some results presented in the article hal-01207447, v1:

- A perceives an occurrence $E_0^{(0)}$ of the De Broglie waves generated by P while he is at A_0 and P is at P_0 ;
- then A perceives the next occurrence $E_1^{(1)}$ while he is at A_1 , after A and P traveled the distance $\Delta r = \Delta w_0 \frac{\sin \alpha_p}{1 - \cos \alpha_p \cos \beta}$.
- Furthermore, the proper time interval Δt measured by A between these two events is given by $c\Delta t = \Delta r \sin \beta$.
- The period Δt of the De Broglie waves measured by A is therefore given by :

$$\Delta t = \frac{\Delta w_0}{c} \times \frac{\sin \alpha_p \sin \beta}{1 - \cos \alpha_p \cos \beta}.$$

Thus, the **frequency** ν of the De Broglie waves measured by A is:

$$\nu = \frac{c}{\Delta w_0} \times \frac{1 - \cos \alpha_p \cos \beta}{\sin \alpha_p \sin \beta}$$

and, particularly in a rest reference frame (with $\beta = \alpha_p$), we obtain: $\nu = \frac{c}{\Delta w_0}$.

From these observations and from the equalities $E = h\nu = mc^2$, one can **define the mass** of the particle P measured in any reference frame R_β by:

$$m = \frac{h}{c\Delta w_0} \times \frac{1 - \cos \alpha_p \cos \beta}{\sin \alpha_p \sin \beta}$$

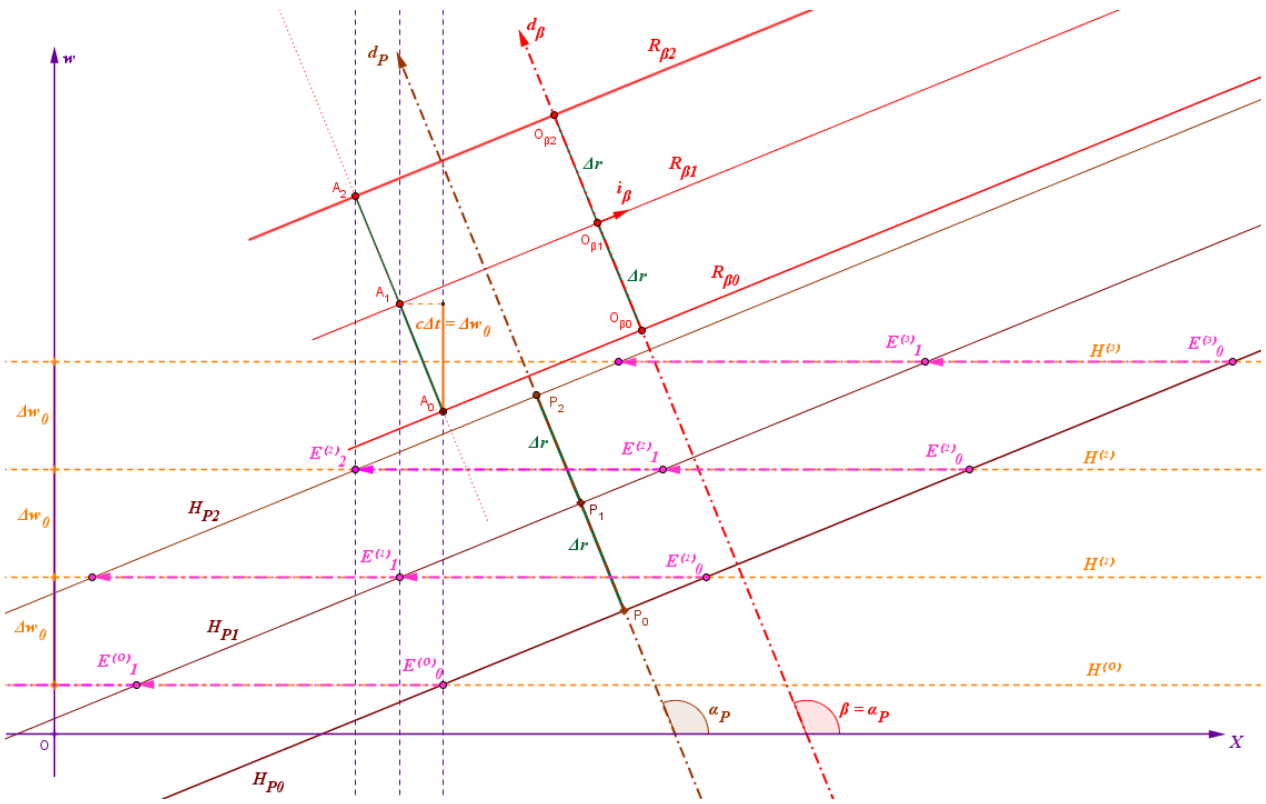
and, particularly in a rest reference frame, by : $m_0 = \frac{h}{c\Delta w_0}$.

It should be noted (with $\sin \alpha_p \sin \beta > 0$) that the relation $\frac{\sin \alpha_p \sin \beta}{1 - \cos \alpha_p \cos \beta} = \sqrt{1 - \frac{v^2}{c^2}}$

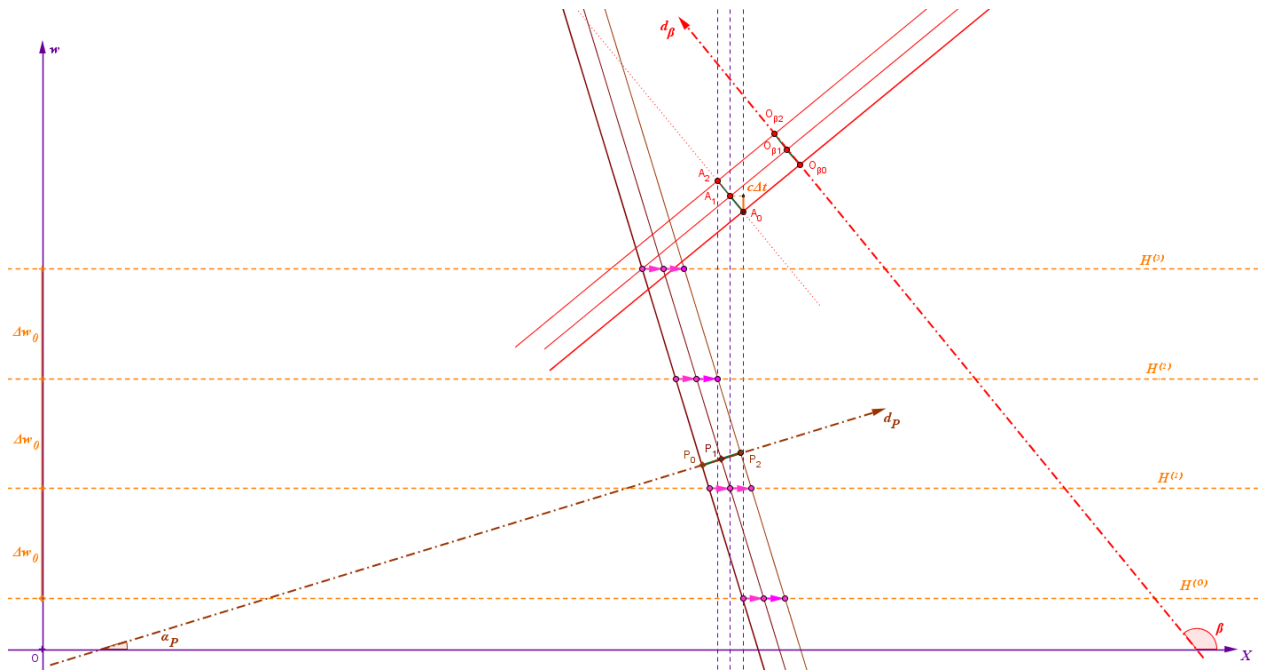
and these results lead as well to the formula: $m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$.

2.3. Illustrations

① In a rest reference frame ($\beta = \alpha_P$), we have $\Delta t_0 = \frac{\Delta w_0}{c}$, $v_0 = \frac{c}{\Delta w_0}$ and $m_0 = \frac{h}{c\Delta w_0}$:



② Here $v \approx 0.99c$; $\Delta t \approx 0.14\Delta t_0$; $v \approx 7.1v_0$ and $m \approx 7.1m_0$:



3. Conclusion

It is thus observed that, in a Platonic space regularly stratified, the motion of the particle P and of its linked hyperplane H_p may mathematically generate the perception at each point of one of its rest reference frame $R_{\alpha P}$ of a synchronous periodic phenomenon that has the characteristics of De Broglie waves.

From this observation, ***the idea of the mass*** of a particle and its relativistic measurement in any reference frame can be directly linked to spatial structures, as we just explain.

For example, for the electron, a distance between the strata equal to $\Delta w_e \approx 2,428.10^{-12} m$ leads, in a rest reference frame, to the mass $m_e = \frac{h}{\Delta w_e c} \approx 9,1 \times 10^{-31} \text{ kg}$.