



**HAL**  
open science

# TOWARDS A MODELING OF DE BROGLIE WAVES IN A PLATONIC QUADRIDIMENSIONAL SPACE

Alain Jégat

► **To cite this version:**

Alain Jégat. TOWARDS A MODELING OF DE BROGLIE WAVES IN A PLATONIC QUADRIDIMENSIONAL SPACE. 2015. hal-01207447

**HAL Id: hal-01207447**

**<https://hal.science/hal-01207447v1>**

Preprint submitted on 1 Oct 2015

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Alain Jégat

### Abstract

This article suggests a geometrical approach towards a De Broglie waves modeling in a regularly stratified platonic quadridimensional space ( cf pre-publication hal-01165196, version1).

The movement of the hyperplane  $H_p$  linked to a particle  $P$  here generate a succession of correlating phenomena, not linked up by a causal relationship. The regular and recurring succession of perception (by the observers linked to the envisaged systems of reference) of these phenomena leads to the illusion of the propagation of a wave whose speed seems to be superior or equal to the speed of light  $c$  and whose characteristics are those of De Broglie waves.

### Résumé

Cet article propose une approche de la modélisation géométrique de l'onde de phase de De Broglie dans un espace quadridimensionnel platonicien régulièrement stratifié (cf. pré-publication hal-01081576, version 1).

Le mouvement de l'hyperplan  $H_p$  lié à une particule  $P$  engendre ici une suite de phénomènes corrélés, mais non liés par une relation de causalité. La succession régulière et périodique de la perception (par les observateurs liés aux référentiels envisagés) de ces phénomènes conduit à l'illusion de la propagation d'une onde dont la vitesse paraît supérieure ou égale à la vitesse de la lumière  $c$  et dont les caractéristiques sont celles de l'onde de phase de De Broglie.

## 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 » (pré-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  $\vec{h}$ .

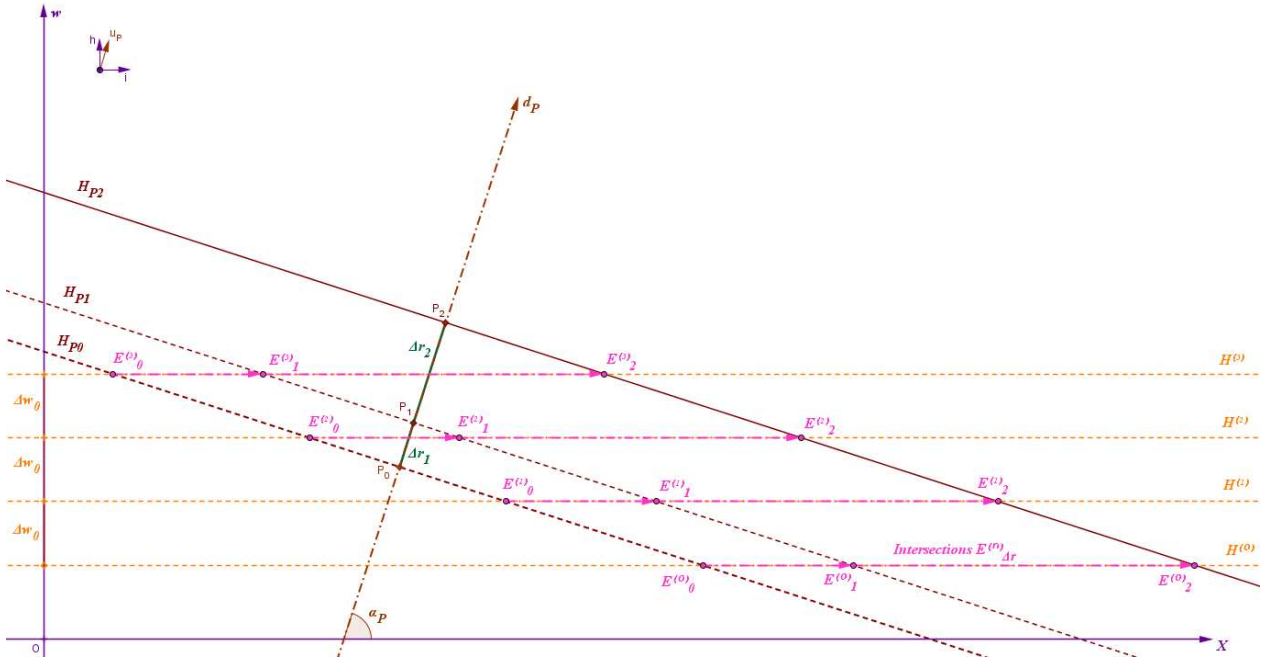
# 1. Modeling

## 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),  $\alpha_p$  the angle  $(\vec{i}, \vec{u}_p)$ . We will assume that  $\alpha_p \neq \frac{\pi}{2} [\pi]$  (this case is examined in the paragraph 2.4) and that  $\alpha_p$  is not a multiple of  $\pi$ .



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  $P$ .

So, on the diagram above, the particle  $P$ , initially in  $P_0$ , traveled the distance  $\Delta r_1$  until  $P_1$ , then traveled the distance  $\Delta r_2$  until  $P_2$ .

We name  $E_0^{(0)}, E_1^{(0)}, \dots, E_2^{(3)}$  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 are going to show that the perception of these events by a reference frame  $R_\beta$  ( $\beta$  not a multiple of  $\pi$ ) 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  $R_\beta$ .

## 2.2. Observation by a reference frame $R_\beta$ in which $P$ is motionless

### 2.2.1. Synchronicity of the events for different observers

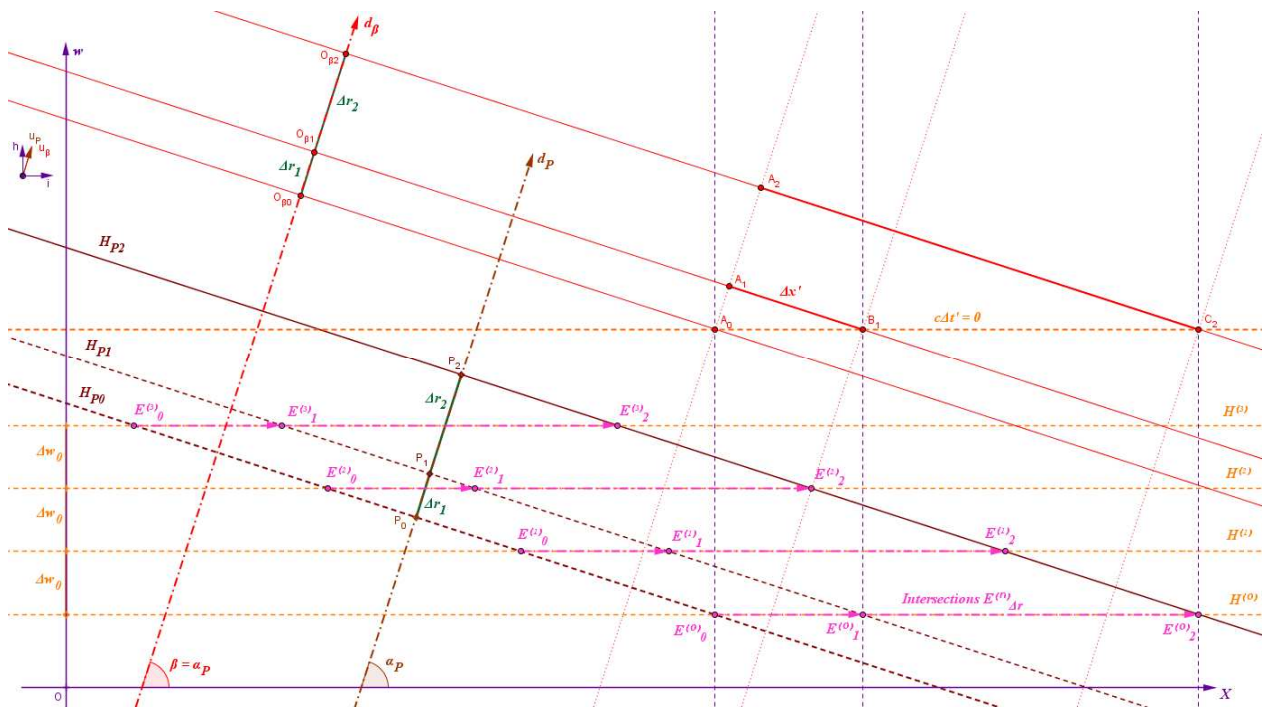
Let us consider two different observers  $A$  and  $B$  from a reference frame  $R_\beta$ , whose distance measured in  $R_\beta$  is  $\Delta x' > 0$ .

From the relation  $c\Delta t' = \frac{\Delta x'}{v'/c} = \frac{\cos \beta - \cos \alpha_p}{1 - \cos \alpha_p \cos \beta} \Delta x'$  (cf 2.3.1 : Speed of De Broglie waves  $\frac{v'}{c}$ ),

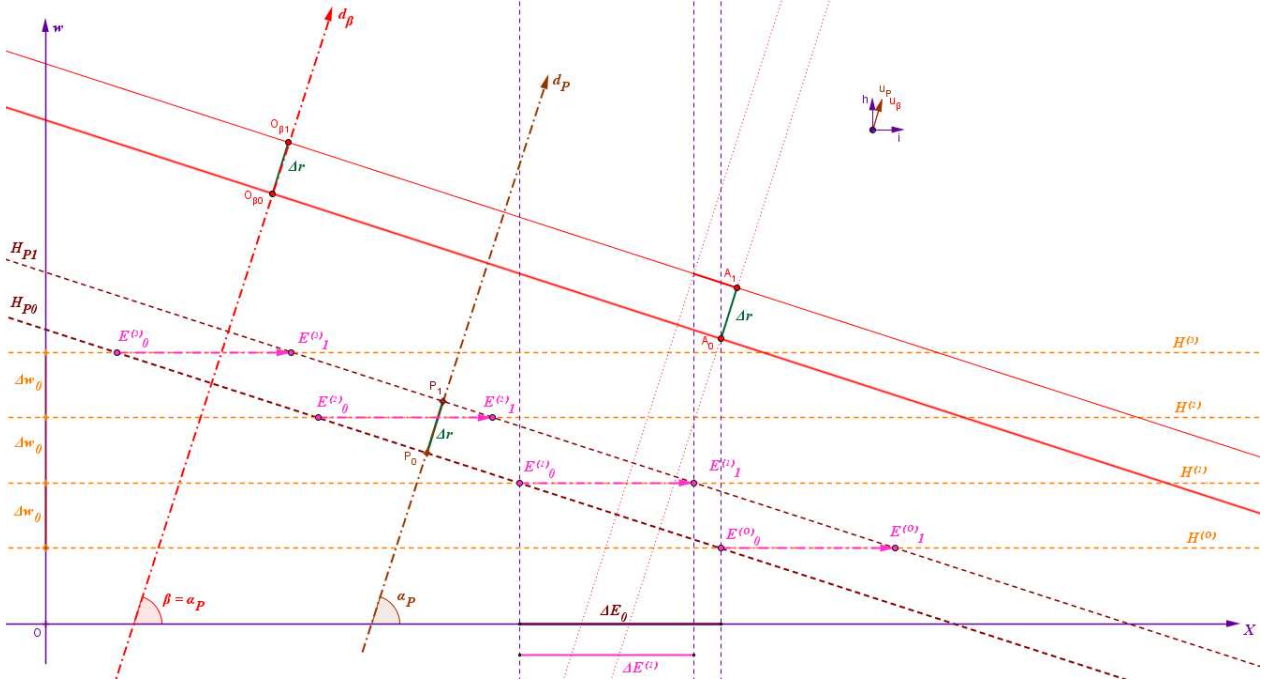
we obtain  $c\Delta t' = 0$  (with  $\Delta x' \neq 0$ ) if and only if  $\cos \beta = \cos \alpha_p$ , i.e.  $\beta = \pm \alpha_p [2\pi]$ .

The *perceptions* of the events  $E_r^{(n)}$  are thus *synchronous* for all the observers of a reference frame where the particle  $P$  is motionless and only for these rest reference frames.

N.B. : on the diagram below are represented three any observers  $A, B$  and  $C$  into a rest reference frame  $R_\beta$  perceiving respectively the events  $E_0^{(0)}$ ,  $E_1^{(0)}$  and  $E_2^{(0)}$  in a synchronous way into  $R_\beta$  at  $A_0, B_1$  and  $C_2$ .



### 2.2.2. Periodicity of the events for a given observer



Let us consider an observer  $A$  from the reference frame  $R_\beta$ .

Let us suppose that  $A$  perceives the event corresponding to the intersection  $E_0^{(0)}$  while he is at  $A_0$  and while  $P$  is at  $P_0$ .

After an any distance  $\Delta r$ , let us name  $E_1^{(1)}$  the intersection  $H^{(1)} \cap H_{P_1}$ .

The observer  $A$ , now at  $A_1$ , will perceive the event corresponding to the intersection  $E_1^{(1)}$  when we have the relation  $X(A_1) = X(E_1^{(1)})$ .

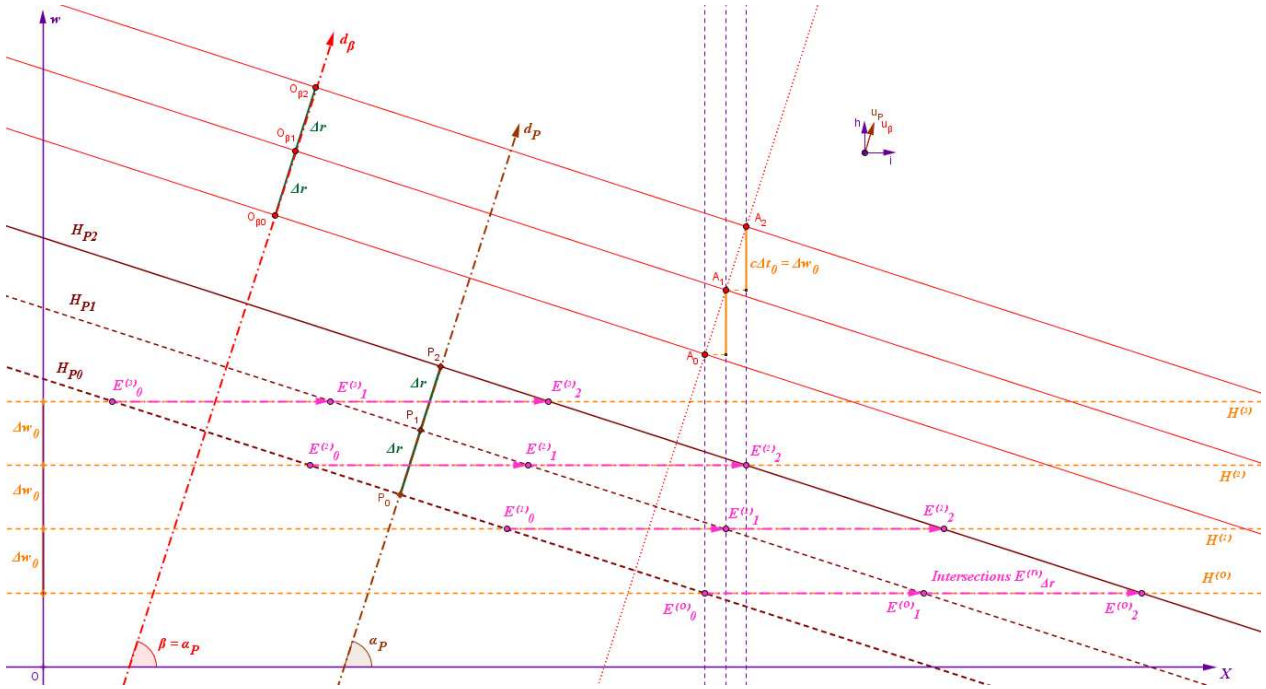
If we put  $\Delta E_0 = X(E_0^{(0)}) - X(E_0^{(1)})$  and  $\Delta E^{(1)} = X(E_1^{(1)}) - X(E_0^{(1)})$ , we obtain, for any distance  $\Delta r$ :

$$\begin{cases} X(A_1) = X(A_0) + \Delta r \cos \alpha_p \\ \Delta E^{(1)} = \frac{\Delta r}{\cos \alpha_p} \text{ thus } X(E_1^{(1)}) = X(E_0^{(1)}) + \frac{\Delta r}{\cos \alpha_p} \\ \Delta E_0 = \Delta w_0 \tan \alpha_p \text{ thus } X(E_0^{(1)}) = X(E_0^{(0)}) - \Delta w_0 \tan \alpha_p \end{cases}$$

So, when  $A$  perceives the event corresponding to  $E_1^{(1)}$ , we obtain, with  $X(A_0) = X(E_0^{(0)})$  and  $X(A_1) = X(E_1^{(1)})$ :

$$\Delta r \cos \alpha_p = -\Delta w_0 \tan \alpha_p + \frac{\Delta r}{\cos \alpha_p}, \text{ i.e. } \Delta r = \frac{\Delta w_0}{\sin \alpha_p}.$$

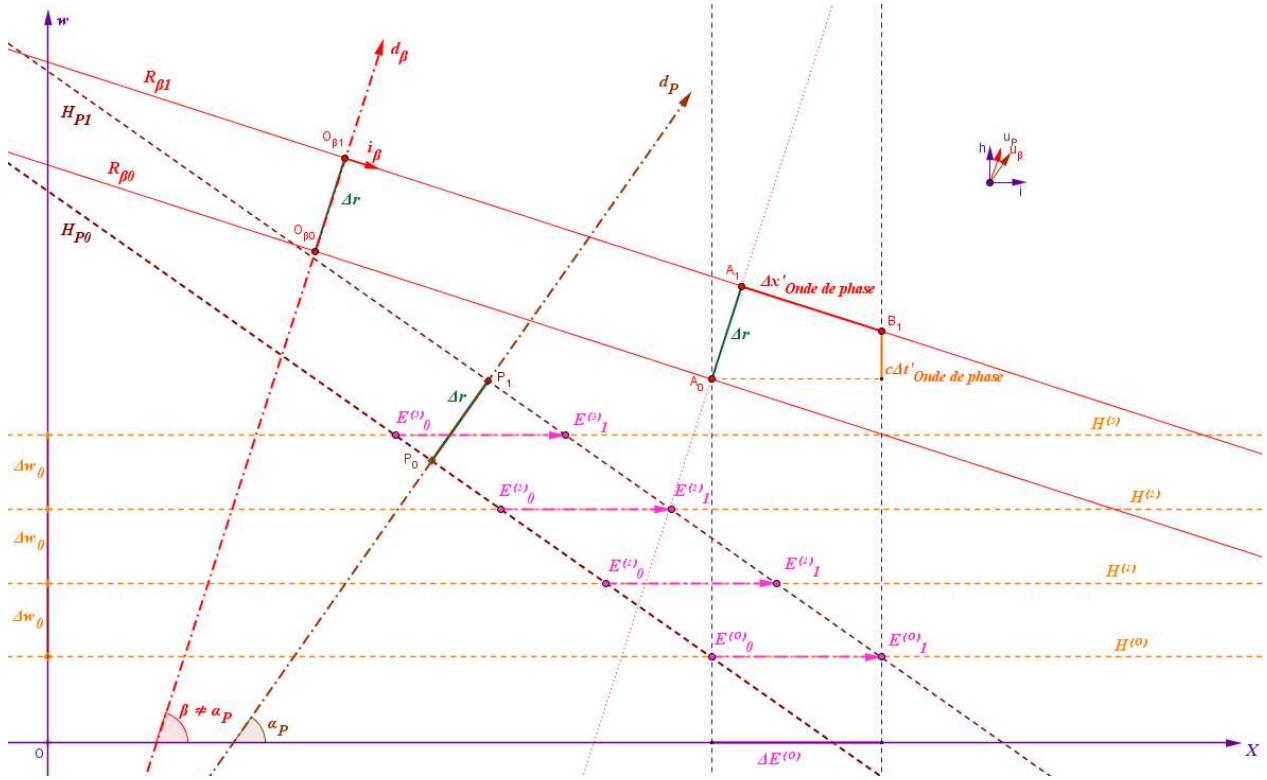
From this result, it follows, with the relation  $c\Delta t = \Delta r \sin \alpha_p$ , that the **period**  $\Delta t_0$  of De Broglie waves measured by  $A$  is:  $\Delta t_0 = \frac{\Delta w_0}{c}$ .



It should be noted that the **period**  $\Delta t_0$  of De Broglie waves measured in a rest reference frame  $R_\beta$  **does not depend on the angle**  $\alpha_p$  of the trajectory of the particle  $P$ , but only of the **distance**  $\Delta w_0$  separating two consecutive strata  $H^{(n)}$  and  $H^{(n+1)}$ .

## 2.3. Observation by a reference frame $R_\beta$ where $P$ is not at rest

### 2.3.1. Speed of De Broglie waves



For example one considers the intersection of  $H^{(0)}$  and  $H_P$ , depending on  $\Delta r$ . Initially, the observer  $A$  from  $R_\beta$  perceives the event corresponding to  $E_0^{(0)}$  while he is at  $A_0$ . After a movement of distance  $\Delta r$ , the event corresponding to the intersection  $E_1^{(0)}$  of  $H^{(0)}$  and  $H_P$  is perceived by the observer  $B$ , now at  $B_1$ .

The speed  $v'$  of De Broglie waves, measured in  $R_\beta$ , is deduced from :

$$\left\{ \begin{array}{l} \Delta E^{(0)} = \frac{\Delta r}{\cos \alpha_p} = \Delta r \cos \beta + \Delta x' \sin \beta, \text{ i.e. } \Delta x' = \frac{\Delta r}{\sin \beta} \left( \frac{1 - \cos \alpha_p \cos \beta}{\cos \alpha_p} \right) \end{array} \right. \quad (1)$$

$$\left\{ \begin{array}{l} c \Delta t' + \Delta x' \cos \beta = \Delta r \sin \beta \end{array} \right. \quad (2)$$

From (1) and (2), we obtain  $c \Delta t' = \frac{\Delta r}{\sin \beta} \left( \frac{\cos \alpha_p - \cos \beta}{\cos \alpha_p} \right)$  and finally :

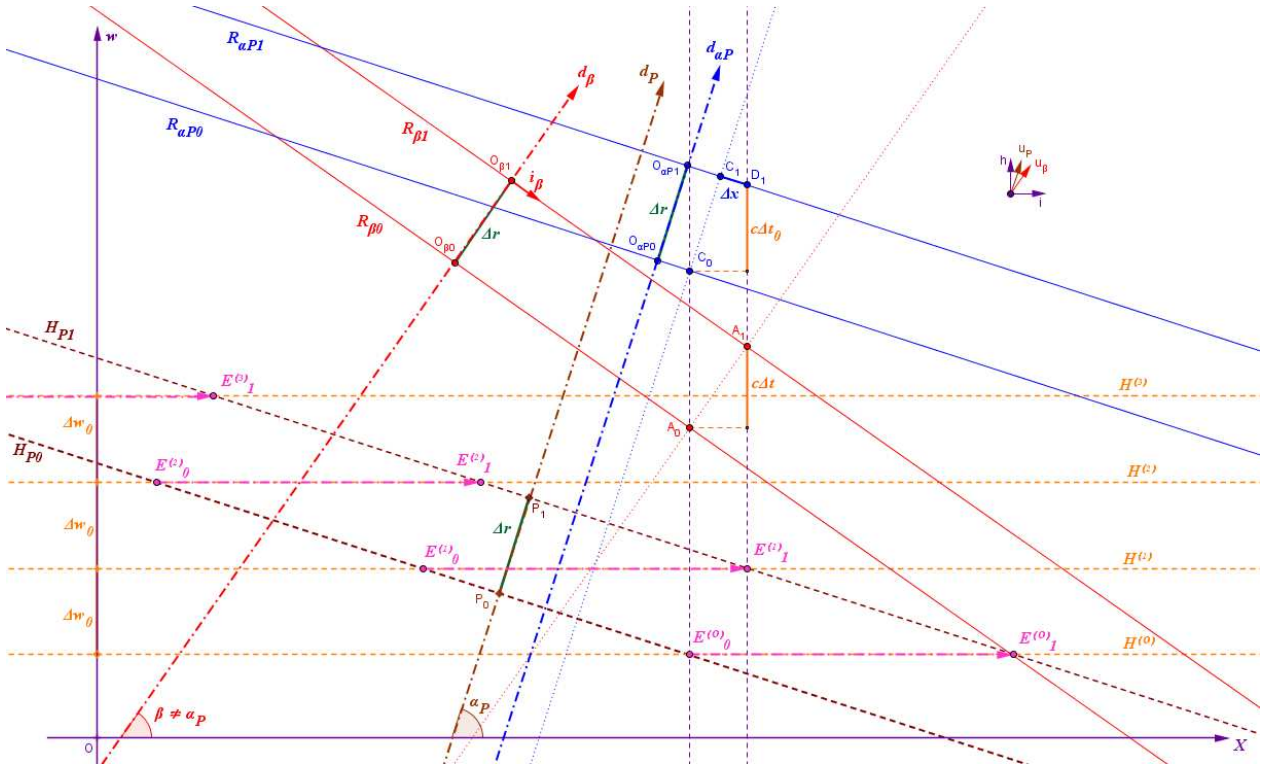
$$\frac{v'}{c} = \frac{\Delta x'}{c \Delta t'} = \frac{1 - \cos \alpha_p \cos \beta}{\cos \alpha_p - \cos \beta}.$$

It should be noticed that the speed  $v$  of  $P$  measured in  $R_\beta$  is  $\frac{v}{c} = \frac{\cos \alpha_p - \cos \beta}{1 - \cos \alpha_p \cos \beta}$

(cf pre-publication hal-01165196) and that we thus obtain the relation:  $v' = \frac{c^2}{v}$ .



### 2.3.2. Period of De Broglie waves



The observer  $A$ , from the reference frame  $R_\beta$  observes the events corresponding to intersections  $E_0^{(0)}$  and  $E_1^{(1)}$ .

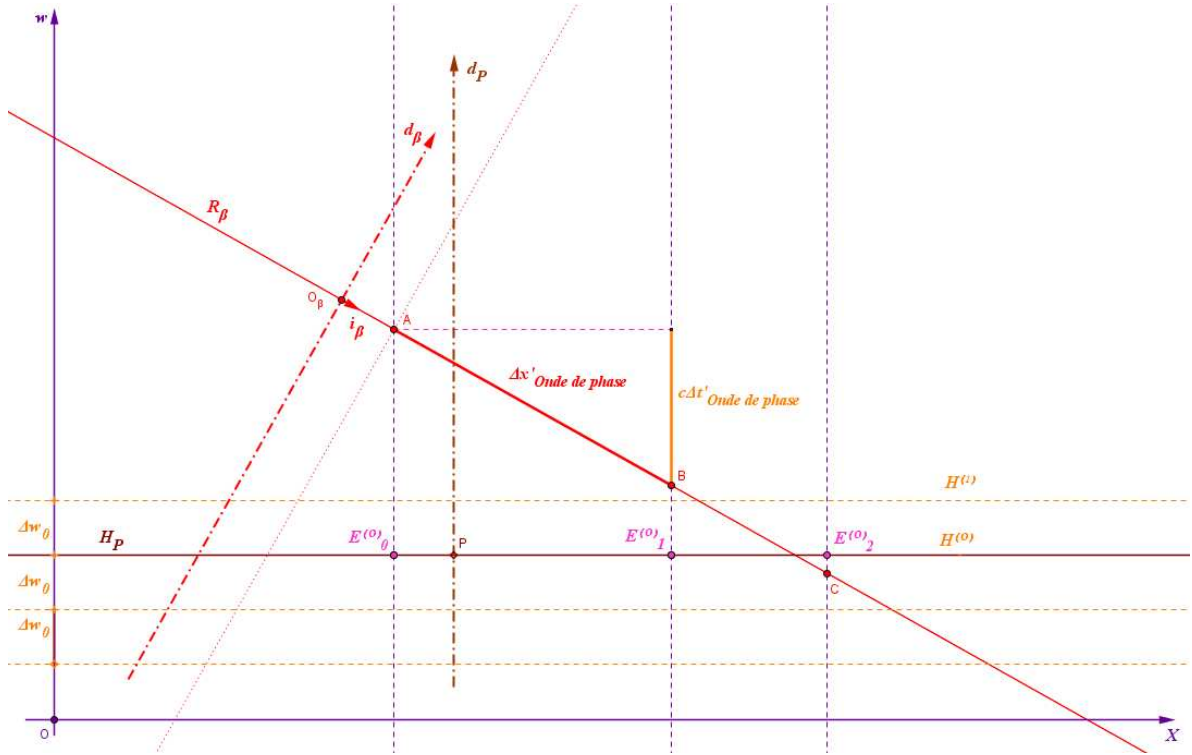
These events are separated, in a rest reference frame  $R_{\alpha P}$ , by a time interval corresponding to one period  $c\Delta t_0$ , during which the observer  $A$  has moved a distance, measured in  $R_{\alpha P}$ , equal to  $\Delta x = v\Delta t_0$ , where  $v$  is the speed of  $A$  measured in  $R_{\alpha P}$ .

We thus find a well-known situation (cf pre-publication hal-01165196) and the period  $\Delta t$  of De Broglie waves, measured in the reference frame  $R_\beta$  is given by the relation:

$$\Delta t = \Delta t_0 \sqrt{1 - \frac{v^2}{c^2}}.$$



## 2.4. Special case: modeling for $\alpha = \frac{\pi}{2} [\pi]$



In this special case, the intersections  $E_0^{(0)}$ ,  $E_1^{(0)}$ ,  $E_2^{(0)}$ , ... of the hyperplanes  $H_p$  and  $H^{(0)}$ , for instance, are obtained for the same position of the particle  $P$  but are perceived by the observers  $A, B, C$  from the reference frame  $R_\beta$  at different times.

We thus find, regardless of observers considered, the speed and the period of De Broglie waves obtained previously.

## 2. 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  $R_\alpha$  of a synchronous periodic phenomenon that has the characteristics of De Broglie waves.

Physically, of course, this raises two questions about the nature of the hyperplane  $H_p$  and stratification of Platonic space by hyperplanes  $H^{(n)}$ .

Finally, it should be noted that in the case of a mass particle at rest  $m_0 = \frac{h}{c^2 \Delta t_0}$ , the relation

$\Delta w_0 = c \Delta t_0$  leads to:

$$\Delta w_0 = c \Delta t_0 = \frac{h}{m_0 c} ;$$

which leads to, for instance:

$$\Delta w_e = \frac{h}{m_e c} \approx 2,428.10^{-12} m \quad \text{for the electron.}$$