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A new approach to relativity
Edition II

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A new approach to relativity
based on the understanding
of
Hendrik Lorentz (1853-1928)

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Declaration of authorship

I, Simon FOSSAT, declare that this document research "A new approach to relativity - Edition II" and the work presented in it are my own.

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Abstract

This second edition of A new approach to relativity aims at interpreting over the physics concept of relativity. It sets on giving an alternative meaning to the one that has been commonly understood since the works of Einstein (1879-1955) on special relativity.

At the crux of our thinking; we will challenge one of the central tenets of special relativity, the one which consists in positing invariance in speed of light in every Galilean reference frame and its consequence of the relativity of time and space.

To reach our conclusion, we shall look at the difference between the set of mobile reference frames and those resting reference frames in an absolute space. This absolute space is not a geometrical locus but rather a physical environment to which one can apply geometry's rules. We shall call this space the Wave middleware. Speed of light would be an intrinsic property of the Wave middleware.

The observations one can make in those mobile referential frames would thus be relative, as opposed to the absolute nature of the observed phenomena.

The privileged position of the still observer in a Wave middleware being by definition not achievable, we will assume it a priori. We will see that this seemingly gratuitous, even out of date assumption will enable us to come up with a renewed principle of special relativity that will give us a new way of describing physical phenomena.

I wish to stress now that this article stems from the reinterpretation and summary of some of the works of the independant researcher Gabriel Lafréniere (1942-2016) [1] .

As a tribute to Hendrik Lorentz (1853-1928) and his works upon which I build mine, I will name mobile reference frames "Lorentz reference frames".

Note: See also the french original version "Le principe de relativité revisité - Edition II".

[1] http://web.archive.org/web/20110901222346/http://glafreniere.com:80/matter.htm

Acknowledgements

- To Paul Meier[3] , whose epistemologic works drove me to explore again the fascinating history of the ideas in science.

- Special thanks to the administrators of the General Science Journal[4] , and the enthusiastic reception of Thierry De Mees in particular.

[3] http://sys.theme.free.fr/
[4] http://www.gsjournal.net/

Contents

Chapter 1

Overview

1.1 Historic

From Newton's time up to Albert Einstein's special relativity in the early 20th century, scientists were admitting the existence of a middleware for wave propagation, called ether. It was considered to have some physical properties making propagation possible, like an acoustic wave needs the atmosphere, for example.

The Michelson and Morley interferometer, aiming at showing the influence of ether on light's movement, failed for it. A consensus was established on the non-existence of ether, as Albert Einstein's theories could explain these experimental results without ether. Thus, the assumption of its non-existence was accepted, even if the question was not really definitively decided [5] .

The Dutch physicist Hendrik Lorentz, who lived at the same era, had other intuitions and was supposing that matter could be influenced by speed like light was [6] . He had to let his intuitions down, as he hadn't any ways or facts to prove it.

Nevertheless, this assumption became relevant again with the works of the French physicist Louis De Broglie (1892-1987), and his theories on wave mechanics [7] . If matter was made of waves, then we should consider again the Lorentz assumptions mentioned above and postulate that matter - and thus the interferometer itself - was influenced by movement like would be light.

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[5] Albert Einstein - Ether and the Theory of Relativity (1920)

[6] Hendrik Lorentz - The Michelson-Morley Experiment and the Dimensions of Moving Bodies (1921)

[7] Louis de Broglie - Recherches Sur La Théorie Des Quanta (1925)

1.2 Schematic presentation of the Michelson and Morley interferometer

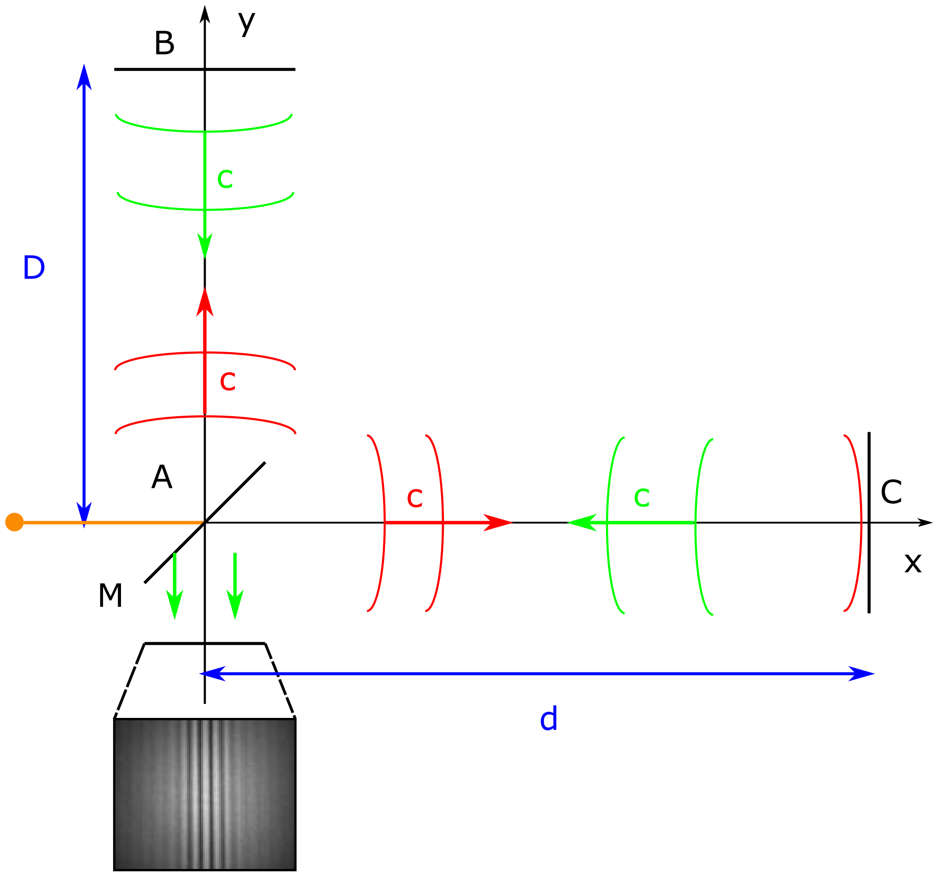

Figure 1.1: The Michelson and Morley experiment

The Michelson and Morley experiment features two paths for light, represented by [AB] and [AC]. A semi-reflecting mirror split the light source into two beams having the same frequency and in phase. As they go back to the semi-reflecting mirror after their whole course within the two interferometer's arms, they are driven to a screen where they form an interferometric pattern.

Once the optical bench has been finely tuned, the pattern turns to a typical one for two beams in phase. Then we have to make the optical bench turning, we have to observe the resulting pattern at different times in order to highlight the influence of the position or movement of the optical bench on light's movement.

The Michelson and Morley experiment always failed to prove such an influence. A conclusion was made about light and its speed being the same in any direction, whatever the speed of the emitter. As the experiment couldn't prove the existence of ether, a consensus was made about its non-existence, although not proving its existence was not synonymous with proving its non-existence. However, the whole special relativity theory was built, compatible with the results of the experiment and avoiding to refer to the existence of an ether.

Chapter 2

The Lorentz equations

2.1 Overview

We willl now expose an alternative expression of the historical Lorentz equations and transformations [8] , and consider the meaning of the variables representing space and time like Hendrik Lorentz did. We will see how this interpretation makes us consider the Lorentz equations a different way than Albert Einstein and his successors did.

The alternative expression for the Lorentz equations is as follows :

$$x' = g.x + \beta.ct$$
$$ct' = g.ct - \beta.x$$
$$y' = y$$
$$z' = z$$

With :

$$\beta = \frac{v}{c}$$

β : Normalized speed according to c

$$g = \sqrt{1 - \beta^2}$$

g : Lorentz factor

2.2 Change of variable

Let us write : $ct = \tau$ and also $ct' = \tau'$

This leads to :

$$x' = g.x + \beta.\tau$$
$$\tau' = g.\tau - \beta.x$$

[8] Hendrik Lorentz - Electromagnetic Phenomena in a System Moving with Any Velocity Smaller than that of Light (1904)

2.3 Trigonometric representation

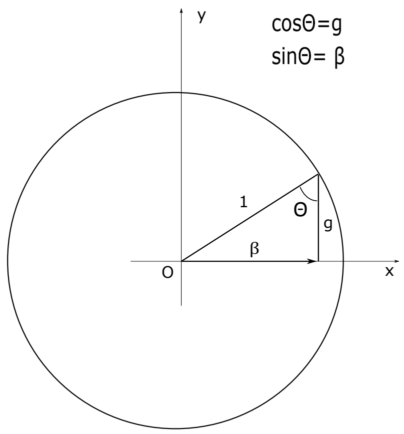

Figure 1.2 : Trigonometric circle
$g^2 + \beta^2 = 1$

For our further presentation, let us consider the following expressions :

$$cos(\theta) = g$$
$$sin(\theta) = \beta$$

2.4 Invariant expression

Let us consider the Lorentz equations and rise the variables into their squared value :

$$x' = g.x + \beta.\tau$$
$$\tau' = g.\tau - \beta.x$$

$$x'^2 = (g.x + \beta.\tau)^2$$
$$\tau'^2 = (g.\tau - \beta.x)^2$$

$$x'^2 = g^2.x^2 + \beta^2.\tau^2 + 2.\beta.g.x.\tau$$
$$\tau'^2 = g^2.\tau^2 + \beta^2.x^2 - 2.\beta.g.x.\tau$$

$$x'^2 + \tau'^2 = (g^2 + \beta^2).x^2 + 2.\beta.g.x.\tau + (g^2 + \beta^2).\tau^2 - 2.\beta.g.x.\tau$$

$$x'^2 + \tau'^2 = x^2 + \tau^2$$

2.5 Meaning of the variables

The Lorentz equations operate for the mechanic systems like for the undolatory ones, we have to consider the physical meaning of the variables, which is different in each case. We will study both of them.

Chapter 3

Application to the mechanic systems

3.1 The Lorentz reference frame

According to the Lorentz equations, the variable x corresponds to the coordinate of a material dot in a static reference frame. The variable x' also corresponds to the coordinate of a moving material dot in the same static reference frame.

The variable t corresponds to the time for a material dot of x coordinate. The variable t' also corresponds to the time for an observer moving with the object and its reference frame.

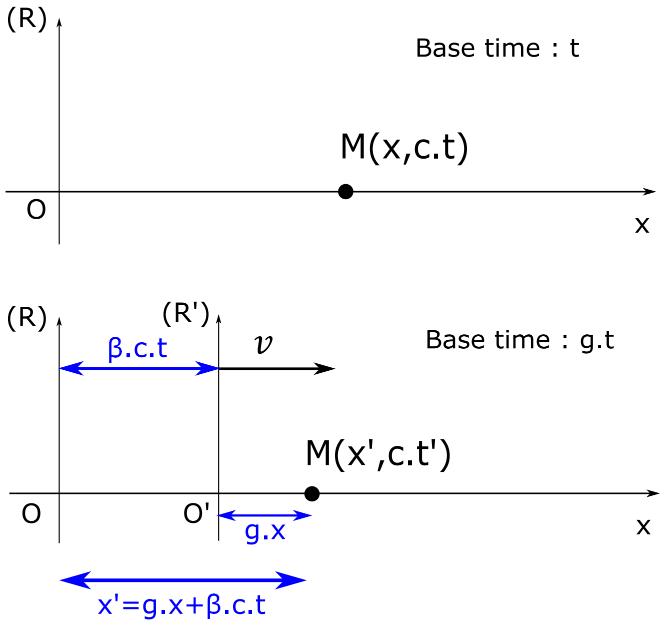

Figure 1.3:
1.3.1: (x, τ) : Coordinates of the material dot M, static, in the static reference frame.
1.3.2: (x', τ') : Coordinates of the same material dot M, moving at the speed β, in the static reference frame.

- Length unit : the second-light

- Duration unit : the second

- The unit for $c.t$ is the second-light too.

3.2 Lengths contraction

If we consider a material object as a set of n material dots physically connected to each other, having (x_n) for spatial coordinates when it is at rest then we have, according to the Lorentz equations, a set of n material dots with the (x'_n) coordinates in a static reference frame when the object is in movement.

The variable t corresponds to the time measurement for the x coordinate of each dot of the object. The variable t' also represents the time measurement that can be made by an observer associated with the movement of the object.

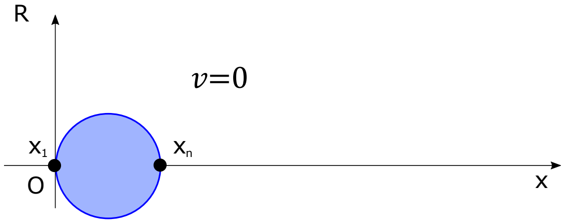

Figure 1.4 :
$t = 0$
$(x_1, \tau) = (0, 0)$
$(x_n, \tau) = (x_n, 0)$

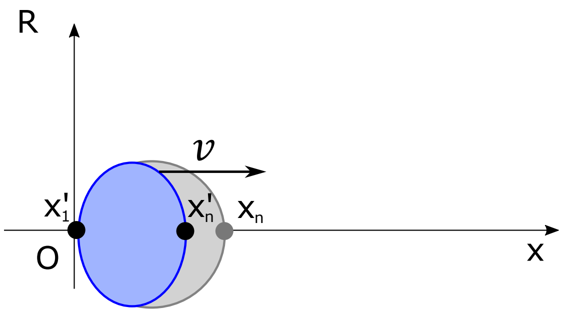

Figure 1.5 :
$t = 0$
$(x'_1, \tau') = (0, 0)$
$(x'_n, \tau') = (g.x_n, -\beta.x_n)$

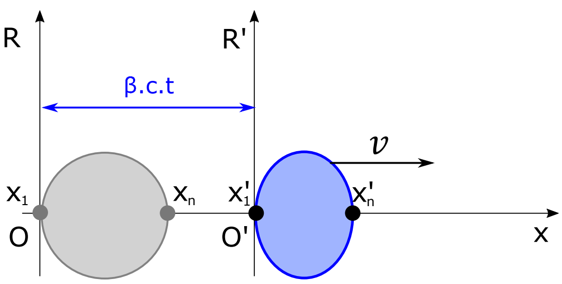

Figure 1.6 :
Whatever t
$(x'_1, \tau') = (\beta.\tau, g.\tau)$
$(x'_n, \tau') = (g.x_n + \beta.\tau, g.\tau - \beta.x_n)$

- Dot coordinates of a moving object in the static reference frame :

$$(x'_n, \tau)$$

- Dot coordinates of a moving object in the moving reference frame :

$$(g.x_n, \tau')$$

- Let us consider the object in its whole length, then we have in the static reference frame :

$$x'_n - x'_1 = g.x_n + \beta.\tau - (g.x_1 + \beta.\tau)$$
$$x'_n - x'_1 = g.(x_n - x_1)$$

- Let us consider the object in its whole length, then we have in the moving reference frame :

$$g.x_n - g.x_1 = g.(x_n - x_1)$$

=> The length of the moving object is then :

$$d' = g.d$$

We won't consider that space contracts or dilates, but rather more basically that the dimensions of the material object are influenced by its movement, more precisely contracted in the direction of its movement.

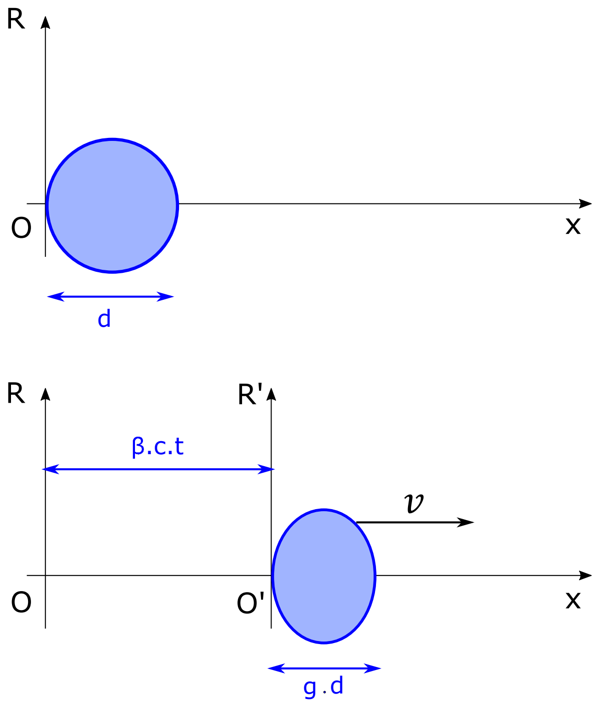

Figure 1.7 : Contraction of the object in the alignement of its movement.

3.3 Clock slowdown and time delay

Let us consider the time measurements, then we have in the moving reference frame :

$$\tau'_{x'_n} - \tau'_{x'_1} = g.\tau - \beta.x_n - g.\tau$$
$$\tau'_{x'_n} - \tau'_{x'_1} = -\beta.x_n$$
$$t'_{x'_n} - t'_{x'_1} = -\beta.\frac{x_n}{c}$$

There should be a time delay between two clocks positioned at two different locations of the object. This time delay is synonymous with a phase difference between the time count of the two clocks, and given by the following expression if we consider the entire length of the material object:

$$\phi = -\beta.\frac{d}{c}$$

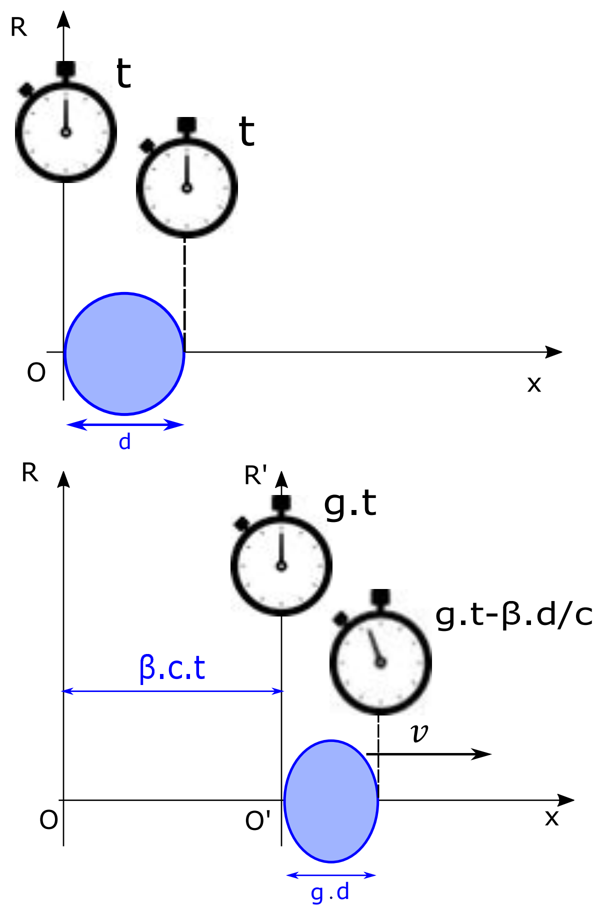

Figure 1.8 : Time delay between two clocks positionned at two different locations of the moving object.

We won't consider that time contracts or dilates, but rather more basically that the physical mechanisms within matter slow down when it is in movement. If the base time in the static reference frame is t, then the base time in the moving reference frame will be : $g.t$.

As a consequence of the mechanisms slowdown within matter, we will assume that the frequency of an emitter given by f when it is at rest, should be given by $g.f$ when it is in movement, g being the Lorentz factor.

$$f' = g.f$$

The corresponding wavelength is then given by:

$$\lambda' = \lambda/g$$

3.4 Relativity of the observations

The Lorentz equations and their reverse form lead to :

$$x' = g.x + \beta.\tau$$
$$\tau' = g.\tau - \beta.x$$

$$x = g.x' - \beta.\tau'$$
$$\tau = g.\tau' + \beta.x'$$

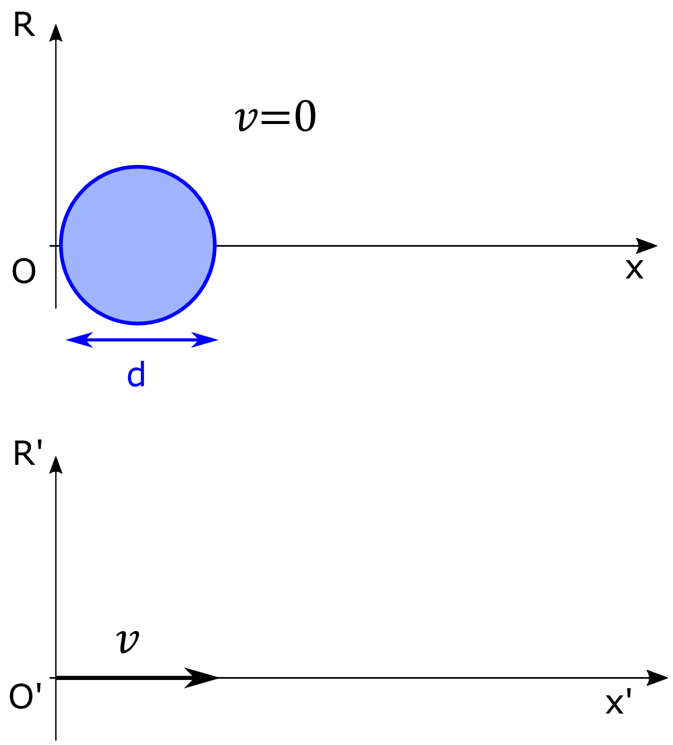

Figure 1.9 : The observer is moving and the object is static

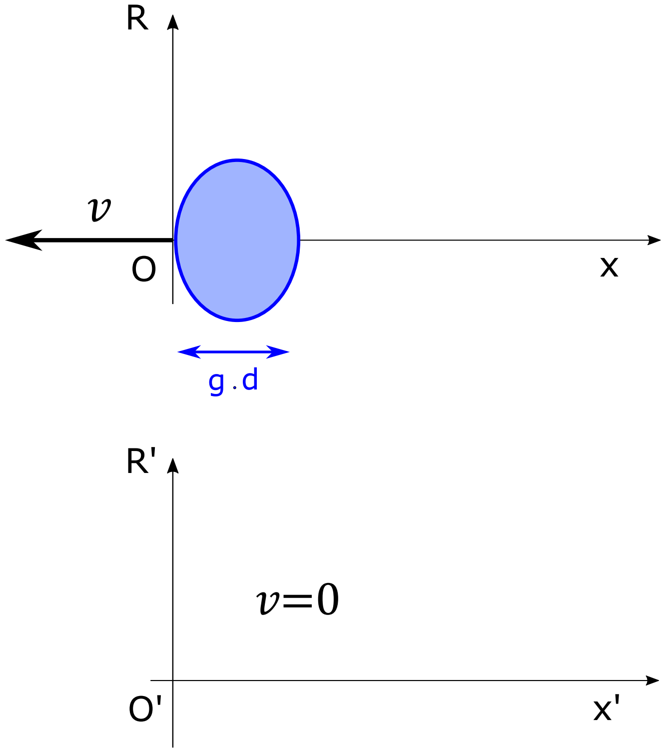

Figure 1.10 : Relativity of the observations : The observer consider himself as static and consider the object as moving and contracting

From the observer's point of view moving at the speed v, the static object is moving away at the speed v' with $v = v'$

The estimated length of the static object is given by :

$$d' = v'.t'$$

$$d' = v'.g.t$$

Considering that $v' = v$ leads to :

$$d' = v.g.t(1)$$

Moreover we have :

$$d = v.t$$

$$t = \frac{d}{v}(2)$$

Combining (1) and (2) leads to :

$$d' = v.g.\frac{d}{v}$$

$$d' = g.d$$

Here is our first highlight on the relativity principle according to our alternative understanding of the Lorentz equations :

- A static observer considers the length of a moving object as contracting to $g.d$

- A moving observer is allowed to consider, in the name of the relativity principle, that he is static whereas the object is moving away from him and is contracts to $g.d$

More over:

- A moving object actually contracts to the length $g.d$

- An object keeps its length unchanged when it is static, whatever the moving observer would measure or consider.

=> There is an equivalence of the observations, though the cases are different.

3.5 Speeds

$$x' = g.x + \beta.\tau(1)$$
$$\tau' = g.\tau - \beta.x(2)$$

$$x = g.x' - \beta.\tau'(3)$$
$$\tau = g.\tau' + \beta.x'(4)$$

Considering (1) and (2) leads to :

$$x = \frac{1}{g}.(x' - \beta.\tau)(5)$$

And :

$$\tau = \frac{1}{g}.(\tau' + \beta.x)(6)$$

Considering (3) and (4) leads to :

$$x' = \frac{1}{g}.(x + \beta.\tau')(7)$$

And :

$$\tau' = \frac{1}{g}.(\tau - \beta.x')(8)$$

The differential expression based on (7) followed by a $d\tau'$ factorization leads to :

$$dx' = \frac{1}{g}.(\frac{dx}{d\tau'} + \beta).d\tau'$$

The differential expression based on (6) followed by a $d\tau'$ factorization leads to :

$$d\tau = \frac{1}{g}.(1 + \beta.\frac{dx}{d\tau'}).d\tau'$$

Dividing the two last expressions leads to :

$$\frac{dx'}{d\tau} = \frac{\frac{dx}{d\tau'} + \beta}{1 + \beta.\frac{dx}{d\tau'}}$$

That is :

$$\frac{dx'}{dt} = c.\frac{\frac{dx}{dt'} + c.\beta}{c + \beta.\frac{dx}{dt'}}$$

We can simplify this equation as far as the reference frame is static :

$$\frac{dx}{dt'} = 0$$

We find again the speed of a moving object in the static reference frame :

$$\frac{dx'}{dt} = \beta.c$$

Chapter 4

Change of Lorentz reference frame

We will now consider the equations of transformation which make the link between two different moving reference frames.

4.1 Relative lenghts

Let us consider the (x_n, τ) coordinates of an object in a static reference frame, and consider its coordinates (x'_{n1}, τ') when it is moving at the speed β_1. Let us also consider its (x'_{n2}, τ') coordinates when it is moving at the speed β_2.

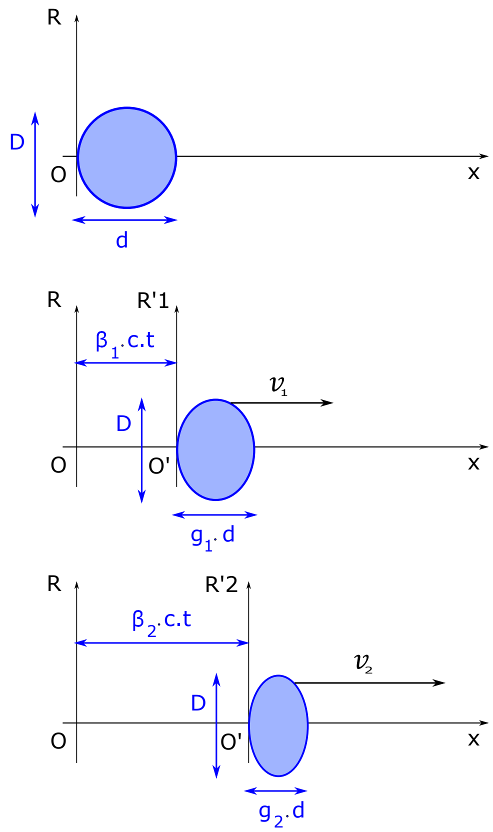

Figure 1.11 : The object is at rest, moving at the speed β_1, and moving at the speed β_2

Considering the dimensions of the object, we can write :

$$d'_1 = g_1.d$$
$$d'_2 = g_2.d$$

$$d'_1 = \frac{g_1}{g_2}.d'_2$$

As the coordinates of the object moving at the speed β_1 and at the speed β_2 can be reported to the static reference frame, we can write the following expressions :

$$x'_1 = g_1.x + \beta_1.\tau(1)$$
$$\tau'_1 = g_1.\tau - \beta_1.x(2)$$

$$x'_2 = g_2.x + \beta_2.\tau(3)$$
$$\tau'_2 = g_2.\tau - \beta_2.x(4)$$

Reverse equations :

$$x = g_1.x'_1 - \beta_1.\tau'_1(5)$$
$$\tau = g_1.\tau'_1 + \beta_1.x'_1(6)$$

$$x = g_2.x'_2 - \beta_2.\tau'_2(7)$$
$$\tau = g_2.\tau'_2 + \beta_2.x'_2(8)$$

With :

$$\beta_1 = \frac{v_1}{c}$$
$$g_1 = \sqrt{1 - \beta_1^2}$$

And :

$$\beta_2 = \frac{v_2}{c}$$
$$g_2 = \sqrt{1 - \beta_2^2}$$

Combining (1) and (7), (2) and (8), leads to :

$$x'_1 = g_1.(g_2.x'_2 - \beta_2.\tau'_2) + \beta_1.(g_2.\tau'_2 + \beta_2.x'_2)$$
$$\tau'_1 = g_1.(g_2.\tau'_2 + \beta_2.x'_2) - \beta_1.(g_2.x'_2 - \beta_2.\tau'_2)$$

$$x'_1 = (g_1.g_2 + \beta_1.\beta_2).x'_2 + (\beta_1.g_2 - \beta_2.g_1).\tau'_2$$
$$\tau'_1 = (g_1.g_2 + \beta_1.\beta_2).\tau'_2 - (\beta_1.g_2 - \beta_2.g_1).x'_2$$

Combining (5) and (3), (6) and (4), leads to :

$$x'_2 = g_2.(g_1.x'_1 - \beta_1.\tau'_1) + \beta_2.(g_1.\tau'_1 + \beta_1.x'_1)$$
$$\tau'_2 = g_2.(g_1.\tau'_1 + \beta_1.x'_1) - \beta_2.(g_1.x'_1 - \beta_1.\tau'_1)$$

$$x'_2 = (g_1.g_2 + \beta_1.\beta_2).x'_1 - (\beta_1.g_2 - \beta_2.g_1).\tau'_1$$
$$t'_2 = (g_1.g_2 + \beta_1.\beta_2).\tau'_1 + (\beta_1.g_2 - \beta_2.g_1).x'_1$$

From these equations, we can deduce that :

* The estimated length of an object moving at the speed β_1 from the point of view of a reference frame moving at the speed β_2 is given by :

$$(g_1.g_2 + \beta_1.\beta_2).d$$

* The estimated length of an object moving at the speed β_2 from the point of view of a reference frame moving at the speed β_1 is given by :

$$(g_1.g_2 + \beta_1.\beta_2).d$$

=> The estimated length of an object moving at the speed β_1 from the point of view of a reference frame moving at the speed β_2 equals to the estimated length of an object moving at the speed β_2 from the point of view of a reference frame moving at the speed β_1.

=>This is an additional illustration of the relativity principle.

4.2 Differential study with two moving reference frames - Relative speeds

Let us write first :

$$G_{12} = g_1.g_2 + \beta_1.\beta_2$$
$$B_{12} = \beta_1.g_2 - \beta_2.g_1$$

Considering the expressions of the former section, we can write :

$$x'_1 = G_{12}.x'_2 + B_{12}.\tau'_2(1)$$
$$\tau'_1 = G_{12}.\tau'_2 - B_{12}.x'_2(2)$$

$$x'_2 = G_{12}.x'_1 - B_{12}.\tau'_1(3)$$
$$\tau'_2 = G_{12}.\tau'_1 + B_{12}.x'_1(4)$$

The relative speed of the object moving at the speed β_2 in the reference frame moving at the speed β_1 is given by :

$$c.\frac{dx'_2}{d\tau'_1}$$

The relative speed of the object moving at the speed β_1 in the reference frame moving at the speed β_2 is given by :

$$c.\frac{dx'_1}{d\tau'_2}$$

From the expression (3) we can write :

$$x'_1 = \frac{1}{G_{12}}.(x'_2 + B_{12}.\tau'_1)(5)$$

From the expression (4) we can write :

$$\tau'_1 = \frac{1}{G_{12}}.(\tau'_2 - B_{12}.x'_1)(6)$$

From the expression (1) we can write :

$$x'_2 = \frac{1}{G_{12}}.(x'_1 - B_{12}.\tau'_2)(7)$$

From the expression (2) we can write :

$$\tau'_2 = \frac{1}{G_{12}}.(\tau'_1 + B_{12}.x'_2)(8)$$

The differential of (7) followed by a factrorization of dt'_2 leads to :

$$dx'_2 = \frac{1}{G_{12}}.(\frac{dx'_1}{d\tau'_2} - B_{12}).d\tau'_2$$

The differential of (6) followed by a factrorization of dt'_2 leads to :

$$d\tau'_1 = \frac{1}{G_{12}}.(1 - B_{12}.\frac{dx'_1}{d\tau'_2}).d\tau'_2$$

Dividing the two last expressions leads to :

$$\frac{dx'_2}{d\tau'_1} = \frac{\frac{dx'_1}{d\tau'_2} - B_{12}}{1 - B_{12}.\frac{dx'_1}{d\tau'_2}}$$

$$\frac{dx'_2}{dt'_1} = c.\frac{\frac{dx'_1}{dt'_2} - c.B_{12}}{c - B_{12}.\frac{dx'_1}{dt'_2}}$$

Using (5) andt (8), we will deduce the same way :

$$\frac{dx'_1}{d\tau'_2} = \frac{\frac{dx'_2}{d\tau'_1} + B_{12}}{1 + B_{12}.\frac{dx'_2}{d\tau'_1}}$$

$$\frac{dx'_1}{dt'_2} = c.\frac{\frac{dx'_2}{dt'_1} + c.B_{12}}{c + B_{12}.\frac{dx'_2}{dt'_1}}$$

4.3 Trigonometric expression

Let us write :

$$cos(\theta_1) = g_1$$
$$sin(\theta_1) = \beta_1$$

$$cos(\theta_2) = g_2$$
$$sin(\theta_2) = \beta_2$$

then we have :

$$G_{12} = (g_1.g_2 + \beta_1.\beta_2) = cos(\theta_1).cos(\theta_2) + sin(\theta_1).sin(\theta_2)$$
$$G_{12} = cos(\theta_1 - \theta_2)$$

And :

$$B_{12} = (g_2.\beta_1 - g_1.\beta_2) = cos(\theta_2).sin(\theta_1) - cos(\theta_1).sin(\theta_2)$$
$$B_{12} = sin(\theta_1 - \theta_2)$$

The relative lenghts are then given by :

$$cos(\theta_1 - \theta_2).d$$

For the relative speeds, we have :

$$\frac{dx'_2}{d\tau'_1} = \frac{\frac{dx'_1}{d\tau'_2} - sin(\theta_1 - \theta_2)}{1 - sin(\theta_1 - \theta_2).\frac{dx'_1}{d\tau'_2}}$$

And also, the same way :

$$\frac{dx'_1}{d\tau'_2} = \frac{\frac{dx'_2}{d\tau'_1} + sin(\theta_1 - \theta_2)}{1 + sin(\theta_1 - \theta_2).\frac{dx'_2}{d\tau'_1}}$$

4.4 Invariant expression

Let us consider the two systems (x'_1, τ'_1) and (x'_2, τ'_2) :

$$(x'_2 - x'_1)^2 + (\tau'_2 - \tau'_1)^2 = {x'_2}^2 + {x'_1}^2 - 2.x'_1.x'_2 + {\tau'_2}^2 + {\tau'_1}^2 - 2.\tau'_2.\tau'_1$$

$$(x'_2 - x'_1)^2 + (\tau'_2 - \tau t'_1)^2 = {x'_2}^2 + {x'_1}^2 + {\tau'_1}^2 + {\tau'_2}^2$$

$$-2.(g.x_1 + \beta.\tau_1).(g.x_2 + \beta.\tau_2) - 2.(g.\tau_2 - \beta.x_2).(g.\tau_1 - \beta.x_1)$$

$$(x'_2 - x'_1)^2 + (\tau'_2 - \tau'_1)^2 = {x'_2}^2 + {x'_1}^2 + {\tau'_1}^2 + {\tau'_2}^2$$
$$-2.(g^2.x_1.x_2 + g.\beta.x_1.\tau_2 + g.\beta.\tau_1.x_2 + \beta^2.\tau_1.\tau_2)$$
$$-2..(g^2.\tau_1.\tau_2 - g.\beta.x_1.\tau_2 - g.\beta.\tau_1.x_2 + \beta^2.x_1.x_2)$$

$$(x'_2 - x'_1)^2 + (\tau'_2 - \tau'_1)^2 = {x'_2}^2 + {x'_1}^2 + {\tau'_1}^2 + {\tau'_2}^2$$
$$-2.(x_1.x_2 - \beta^2.x_1.x_2 + g.\beta.x_1.\tau_2 + g.\beta.\tau_1.x_2 + \beta^2.\tau_1.\tau_2)$$
$$-2..(\tau_1.\tau_2 - \beta^2.\tau_1.\tau_2 - g.\beta.x_1.\tau_2 - g.\beta.\tau_1.x_2 + \beta^2.x_1.x_2)$$

$$(x'_2 - x'_1)^2 + (\tau'_2 - \tau'_1)^2 = {x'_2}^2 + {x'_1}^2 + {\tau'_2}^2 + {\tau'_1}^2 - 2.x_1.x_2 - 2.\tau_1.\tau_2$$

We have already shown that :

$${x'_1}^2 + {\tau'_1}^2 = {x_1}^2 + {\tau_1}^2$$

And :

$${x'_2}^2 + {\tau'_2}^2 = {x_2}^2 + {\tau_2}^2$$

This leads to :

$$(x'_2 - x'_1)^2 + (\tau'_2 - \tau'_1)^2 = {x_2}^2 + {x_1}^2 + {\tau_2}^2 + {\tau_1}^2 - 2.x_1.x_2 - 2.\tau_1.\tau_2$$

$$(x'_2 - x'_1)^2 + (\tau'_2 - \tau'_1)^2 = (x_2 - x_1)^2 + (\tau_2 - \tau_1)^2$$

Chapter 5

Summary

5.1 Regular expressions

* β_1 : Normalized speed of the R′1 reference frame according to the static reference frame (speed : $\beta_1.c$)

* β_2 : Normalized speed of the R′2 reference frame according to the static reference frame (speed : $\beta_2.c$)

* g_1 : Contraction factor for the object moving at the speed β_1

* g_2 : Contraction factor for the object moving at the speed β_2

* $G_{12} = g_1.g_2 + \beta_1.\beta_2$: Composit factor contraction

* $B_{12} = \beta_1.g_2 - \beta_2.g_1$: Composit factor speed

* $v'_{r1} = c.\frac{dx'_1}{d\tau'_2}$: Relative speed of the object moving at the speed β_1 from the point of view of the R′2 reference frame.

* $v'_{r2} = c.\frac{dx'_2}{d\tau'_1}$: Relative speed of the object moving at the speed β_2 from the point of view of the R′1 reference frame.

We have the following relations :

$$v'_{r1} = c.\frac{v'_{r2} + c.B_{12}}{c + B_{12}.v'_{r2}}$$

$$v'_{r2} = c.\frac{v'_{r1} - c.B_{12}}{c - B_{12}.v'_{r1}}$$

* $d'_1 = g_1.d$: Length of the object moving at the speed β_1 from the point of view of the static reference frame, and also : Length of the static object from the point of view of the reference frame moving at the speed β_1

* $d'_2 = g_2.d$: Length of the object moving at the speed β_2 from the point of view of the static reference frame, and also : Length of the static object from the point of view of the reference frame moving at the speed β_2

* $d'_{r1} = d'_{r2} = (g_1.g_2 + \beta_1.\beta_2).d$: Length of the object moving at the speed β_2 from the point of view of reference frame moving at the speed β_1, and also : Length of the

object moving at the speed β_1 from the point of view of reference frame moving at the speed β_2

5.2 Trigonometric expressions

* $\beta_1 = sin(\theta_1)$: Normalized speed of the R'1 reference frame according to the static reference frame (speed : $sin(\theta_1).c$)

* $\beta_2 = sin(\theta_2)$: Normalized speed of the R'2 reference frame according to the static reference frame (speed : $sin(\theta_2).c$)

* $g_1 = cos(\theta_1)$: Contraction factor for the object moving at the speed β_1

* $g_2 = cos(\theta_2)$: Contraction factor for the object moving at the speed β_2

* $G_{12} = cos(\theta_1 - \theta_2)$: Composit factor contraction

* $B_{12} = sin(\theta_1 - \theta_2)$: Composit factor speed

* $v'_{r1} = c.\frac{dx'_1}{d\tau'_2}$: Relative speed of the object moving at the speed β_1 from the point of view of the R'2 reference frame.

* $v'_{r2} = c.\frac{dx'_2}{d\tau'_1}$: Relative speed of the object moving at the speed β_2 from the point of view of the R'1 reference frame.

We have the following relations :

$$v'_{r1} = c.\frac{v'_{r2} + c.sin(\theta_1 - \theta_2)}{c + sin(\theta_1 - \theta_2).v'_{r1}}$$

$$v'_{r2} = c.\frac{v'_{r1} - c.sin(\theta_1 - \theta_2)}{c - sin(\theta_1 - \theta_2).v'_{r2}}$$

* $d'_1 = cos(\theta_1).d$: Length of the object moving at the speed β_1 from the point of view of the static reference frame, and also : Length of the static object from the point of view of the reference frame moving at the speed β_1

* $d'_2 = cos(\theta_2).d$: Length of the object moving at the speed β_2 from the point of view of the static reference frame, and also : Length of the static object from the point of view of the reference frame moving at the speed β_2

* $d'_{r1} = d'_{r2} = cos(\theta_1 - \theta_2).d$: Length of the object moving at the speed β_2 from the point of view of reference frame moving at the speed β_1, and also : Length of the object moving at the speed β_1 from the point of view of reference frame moving at the speed β_2

5.3 Limit of the speeds and the relative speeds

We have defined the composit speed factor as follows :

$$B_{12} = g_2.\beta_1 - g_1.\beta_2$$

We can write as well :

$$B_{12} = \sqrt{1-\beta_2^2}.\beta_1 - \beta_2.\sqrt{1-\beta_1^2}$$

Let us consider the parameter function f_β defined as follows :

$$f_\beta(x) = \sqrt{1-\beta^2}.x - \beta.\sqrt{1-x^2}$$

A short study of this function would show that the values of $f_\beta(x)$ always range between -1 et 1 when the variable x ranges between -1 and 1 and the parameter β ranges between -1 and 1.

$$(-1 < x < 1); (-1 < \beta < 1) \Leftrightarrow -1 < f_\beta(x) < 1$$

We can then write :

$$(-1 < \beta_1 < 1); (-1 < \beta_2 < 1) \Leftrightarrow -1 < B_{12} < 1$$

With $-1 < B_{12} < 1$ we can also write :

$$\frac{dx'_1}{d\tau'_2} - 1 < \frac{dx'_1}{d\tau'_2} + B_{12} < \frac{dx'_1}{d\tau'_2} + 1$$

And :

$$1 - \frac{dx'_1}{d\tau'_2} < 1 + B_{12}.\frac{dx'_1}{d\tau'_2} < 1 + \frac{dx'_1}{d\tau'_2}$$

Dividing the two last expressions leads to :

$$\frac{\frac{dx'_1}{d\tau'_2} - 1}{1 - \frac{dx'_1}{d\tau'_2}} < \frac{\frac{dx'_1}{d\tau'_2} + B_{12}}{1 + B_{12}.\frac{dx'_1}{d\tau'_2}} < \frac{\frac{dx'_1}{d\tau'_2} + 1}{1 + \frac{dx'_1}{d\tau'_2}}$$

$$-1 < \frac{\frac{dx'_1}{d\tau'_2} + B_{12}}{1 + B_{12}.\frac{dx'_1}{d\tau'_2}} < 1$$

$$-1 < \frac{dx'_2}{d\tau'_1} < 1$$

$$-c < \frac{dx'_2}{dt'_1} < c$$

We could show as well :

$$-1 < \frac{dx'_1}{d\tau'_2} < 1$$

$$-c < \frac{dx'_1}{dt'_2} < c$$

The limit of the relative speed for a moving object from the point of view of another one equals to : c. Moreover, the speed limit for an object is given by : c

=> There is a limit for the speeds like for the relative speeds, which equals in both cases to : c

Chapter 6

Using the Lorentz equations for the Michelson and Morley interferometer

In the former paragraphs, we have already established the followings points :

- The estimated length of an object from the point of view of a static reference frame

- The estimated length of a static object from the point of view of a moving reference frame

- The estimated length of a moving object from the point of view of another moving reference frame with a different speed

We have now to study how the dimensions of an object are perceived by an observer associated with its movement. We will then use again the Lorentz transformations for the following cases:

- Durations and distances for an optical signal within the transversal path of the interferometer when it is at rest

- Comparison with the interferometer when it moves

- Durations and distances for an optical signal within the longitudinal path of the interferometer when it is at rest

- Comparison with the interferometer when it moves

6.0.1 Transversal path for the static interferometer

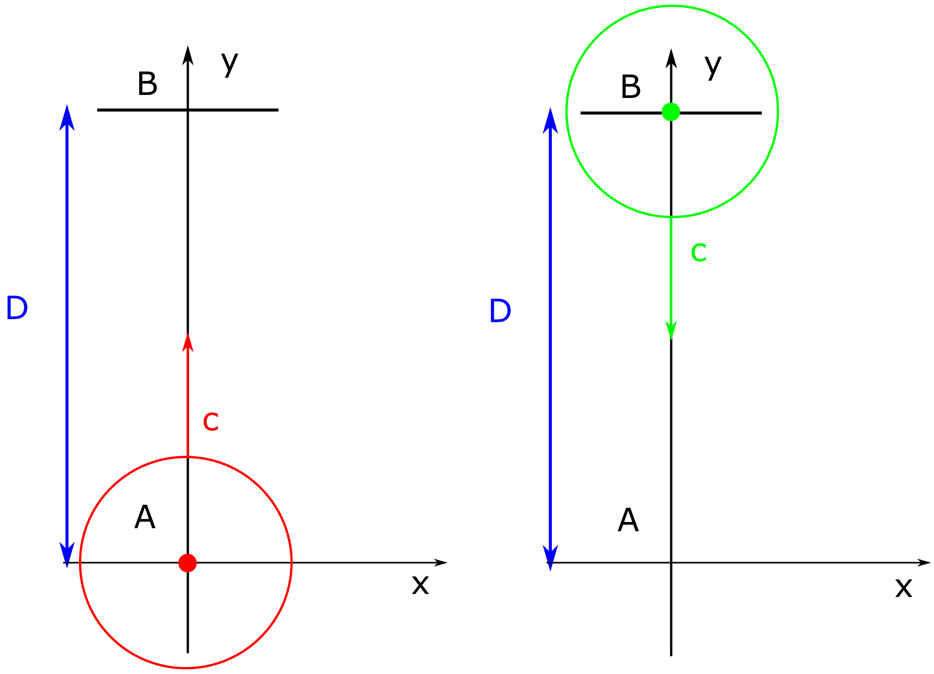

Figure 1.12: Step 1 and 2 for an optical signal to move away and go back to A

Time needed for an optical signal to go from A to B:

$$\tau_1 = D$$

$$c.t_1 = D$$

$$t_1 = \frac{D}{c}$$

Time needed for an optical signal to go back to A:

$$\tau_2 = D$$

$$c.t_2 = D$$

$$t_2 = \frac{D}{c}$$

Time for the round trip of the signal :

$$t = t_1 + t_2$$

$$t = \frac{2D}{c}$$

6.0.2 Transversal path for the moving interferometer

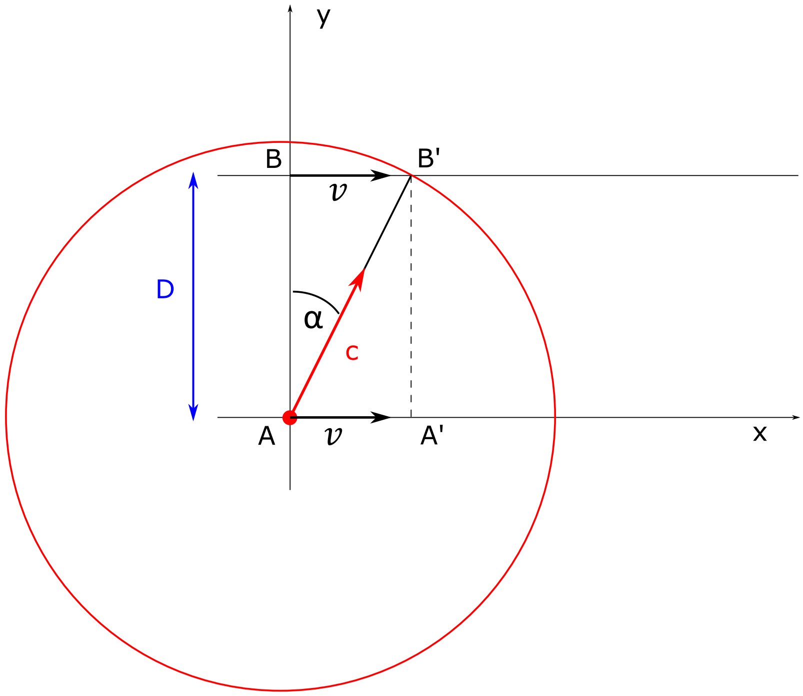

Figure 1.13: Step 1

Considering the trignometric situation:

$$\sin\alpha = \frac{v}{c} = \beta$$

$$\cos\alpha = \sqrt{1 - \sin\alpha^2} = \sqrt{1 - \beta^2} = g$$

$$\cos\alpha = \frac{D}{\tau_1}$$

$$\tau_1 = \frac{D}{\cos\alpha}$$

$$\tau_1 = \frac{D}{g}$$

Time needed, and expressed in the reference frame associated with the moving interferometer, for a signal emitted from A to reach B′. B′ is the position of B having moved during one period of the signal.

$$\tau_1' = g.\tau_1$$

$$\tau_1' = D$$

$$t_1' = \frac{D}{c}$$

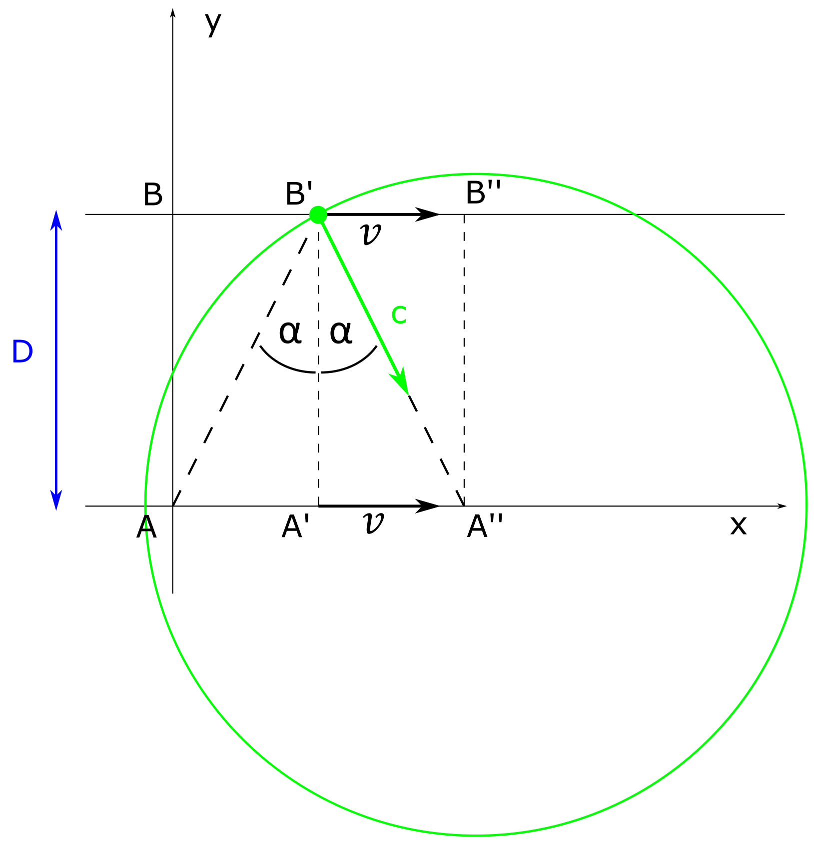

Figure 1.14: Step 2

A″ is the position of A′ after one period of the signal. Its situation compared to A′ is the same than the situation of B′ compared to B :

$$\tau_2 = \frac{D}{g}$$

Time needed, and expressed in the reference frame associated with the moving interferometer, for a signal emitted from B′ to reach A″

$$\tau_2' = g.\tau_2$$

$$\tau_2' = D$$

$$t_2' = \frac{D}{c}$$

Time for the round trip of the signal :

$$t' = t_1' + t_2'$$

$$t' = \frac{2D}{c}$$

6.0.3 Conclusion for the transversal path

The durations estimated by a resting observer are the same than the ones estimated by a moving observer associated with the moving interferometer. From the observers' point of views:

- A moving object keeps its height unchanged to the following value : D

- For a moving observer, the height of the moving object stays also unchanged to the following value : D

More over:

- A moving object actually keeps its height unchanged to the following value : D

=> This is just the particular case where the observations and measurements match with the phenomenon.

We can repeat our demonstration with the interferometer moving at the speed β_1 in a first time, and in a second time moving at the speed of β_2. The measurements of the lengths along the transversal path of the moving interferometer will then be equal in both cases to : D

6.0.4 Longitudinal path for the static interferometer

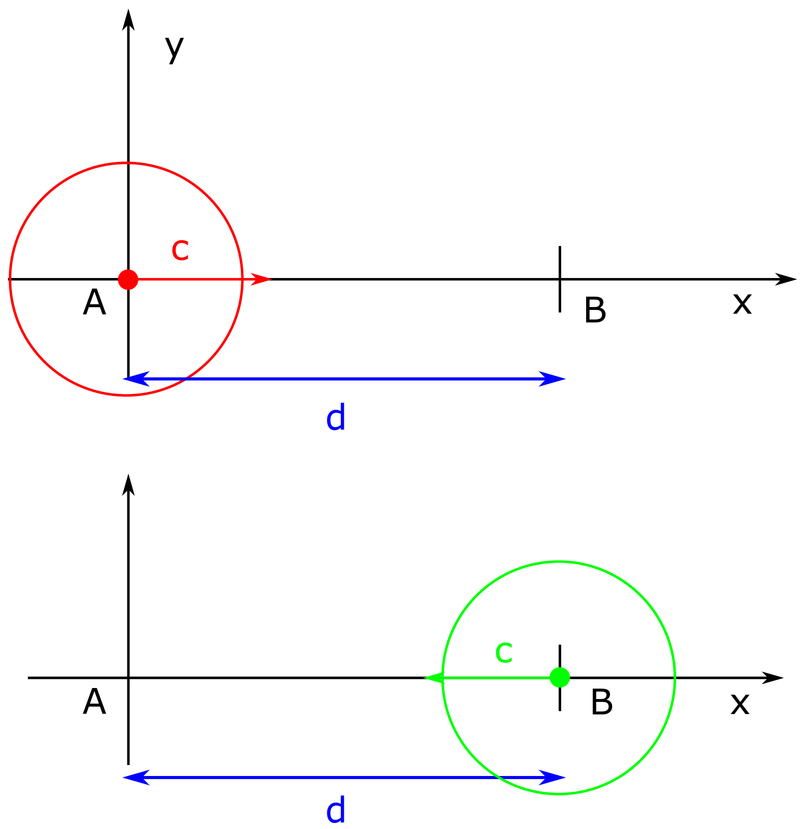

Figure 1.15: Step 1 and 2

Time needed for an optical signal to go from A to B:

$$\tau_1 = d$$

$$t_1 = \frac{d}{c}$$

Time needed for an optical signal to go back to A:

$$\tau_2 = d$$

$$t_2 = \frac{d}{c}$$

Time needed for an optical signal to move away and go back to A:

$$t = t_1 + t_2 = \frac{2d}{c}$$

6.0.5 Longitudinal path for the moving interferometer

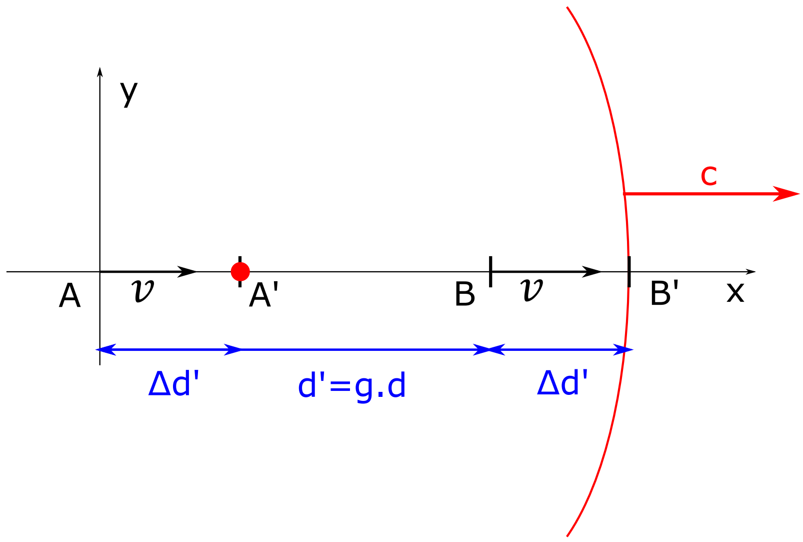

Figure 1.16: Step 1

The moving arm is contracting, according to the Lorentz transformations to the length: $d' = g.d$

As B is moving at the speed of v and the optical signal is moving at the speed of light c, the former emitted from A would need the same time to reach B′ as it would be needed to reach B at the normalized speed $(1 - \beta)$:

$$\tau_1 = \frac{g.d}{1 - \beta}$$

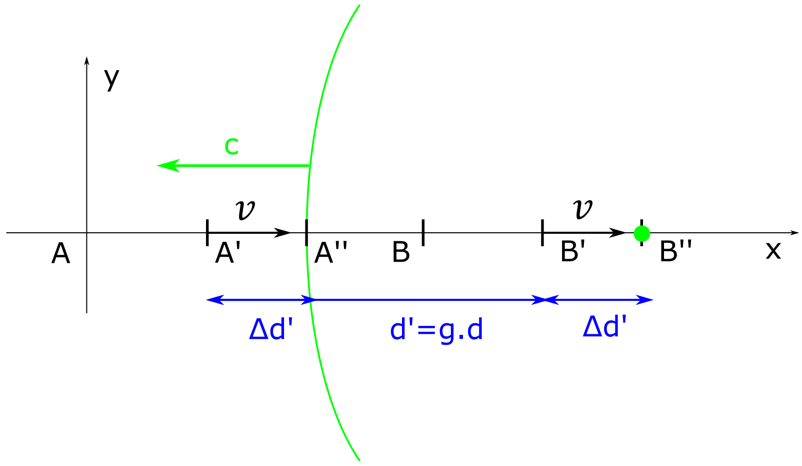

Figure 1.17: Step 2

The moving arm is contracting, according to the Lorentz transformations to the length: $d' = g.d$

As A′ is moving at the speed of v and the optical signal is moving at the speed of light c, the former emitted from B′ would need the same time to reach A″ as it would be needed to reach A′ at the normaized speed of $(1 + \beta)$:

$$\tau_2 = \frac{g.d}{1+\beta}$$

This leads to:

$$\tau_1 + \tau_2 = \frac{g.d}{1-\beta} + \frac{g.d}{1+\beta}$$

$$\tau_1 + \tau_2 = g.d.\frac{1+\beta+1-\beta}{(1+\beta).(1-\beta)}$$

$$\tau_1 + \tau_2 = \frac{2g.d}{g^2} = \frac{2d}{g}$$

And :

$$\tau_1' + \tau_2' = g.(\tau_1 + \tau_2) = g.\frac{2d}{g}$$

$$\tau_1' + \tau_2' = 2d$$

The global time needed and expressed in the reference frame associated with the moving interferometer is then:

$$t_1' + t_2' = \frac{2d}{c}$$

6.0.6 Conclusion for the longitudinal path

The estimated durations for a resting observer are the same than the ones for a moving observer. From the observers' point of views:

- A moving object contracts from d to $g.d$ from a resting observer's point of view, $g.d$ being its real length according to our assumption.

- A moving object, though being contracted from d to $g.d$, will be seen with a length of d by the moving observer. The former is allowed, in the name of the relativity principle, to say that he is at rest while the object is movig away from him.

More over:

- A moving object actually contracts from d to : $g.d$

=> Beyond the equivalence of the two different observers' point of views, the reality of the phenomenon is not the same.

We can repeat our demonstration with the interferometer moving at the speed of β_1 in a first time, and in a second time moving at the speed of β_2. The measurements of the lengths, made by a co moving observer along the longitudinal path, will then be equal in both cases to : d

In conclusion, the Michelson and Morley experiment made of two arms, one transversal, the other one longitudinal to its movement, wont' give any time difference, whatever its speed. Once the two optical signals have been put in phase, no phase difference will occur.

Chapter 7

Clock synchronization

We will now use the clock synchronization method to illustrate again the principle of relativity. Let us consider two clock systems : one being at rest and the other one moving. We will see how the dates are estimated in each system and how the systems consider each other in terms of time and spacement.

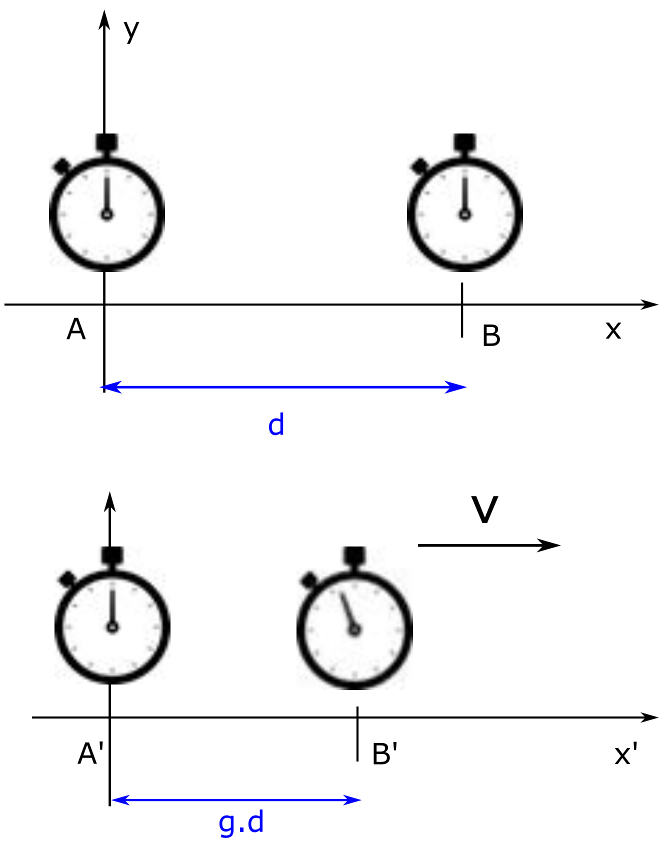

Figure 1.18 : Clock system at rest and moving

7.1 Clock system at rest

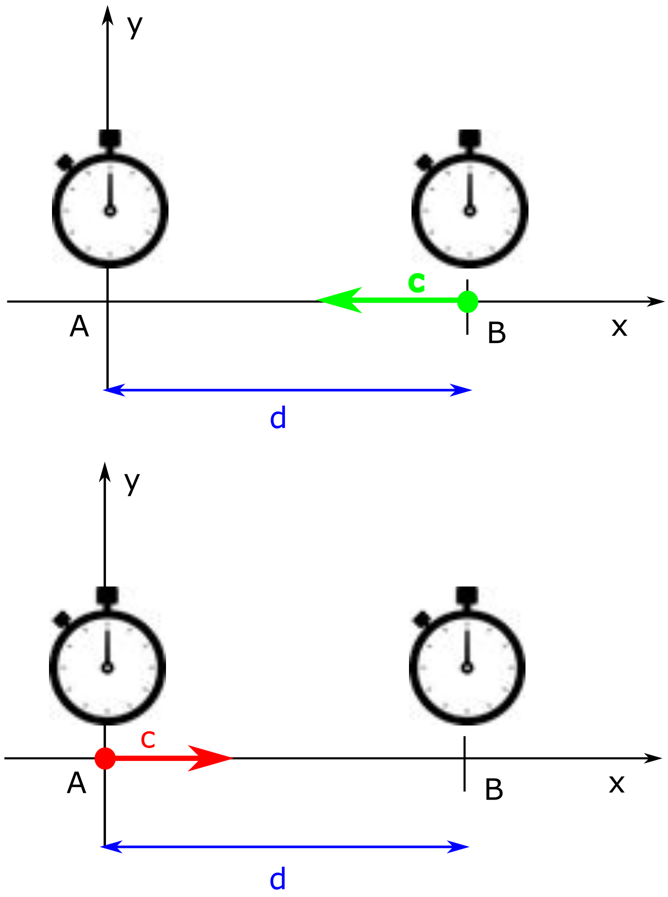

Figure 1.19 : Round trip of a signal in the clock system at rest

In the clock system at rest, let us synchronize the clock B to the clock A. B is sending a signal to A and start a chronometer.

* After a time delay of $t_a = d/c$, A receives the signal of B and send back to B the date $t_a + d/c$

* After a time delay of $d/c + d/c = 2.d/c$, B receives the date $t_a + d/c$ emitted by A.

=> An observer located at B will conclude that A is at half of a distance of $2.d$ that is d. He will be allowed to synchronize B to A by using the date :

$$t_a + \frac{d}{c} - \frac{1}{2}.(\frac{2.d}{c})$$

$$t_a$$

7.2 Moving clock system

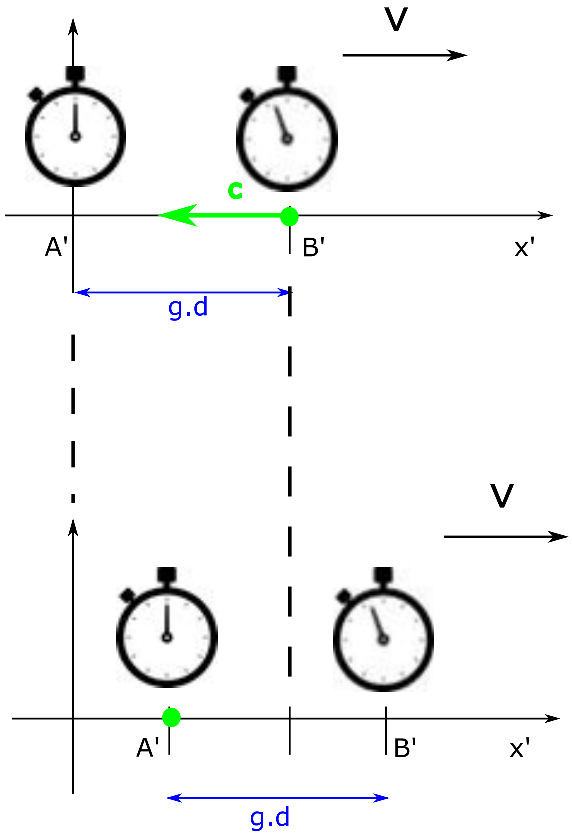

Figure 1.20 : Round trip of a signal within a moving clock system : step 1

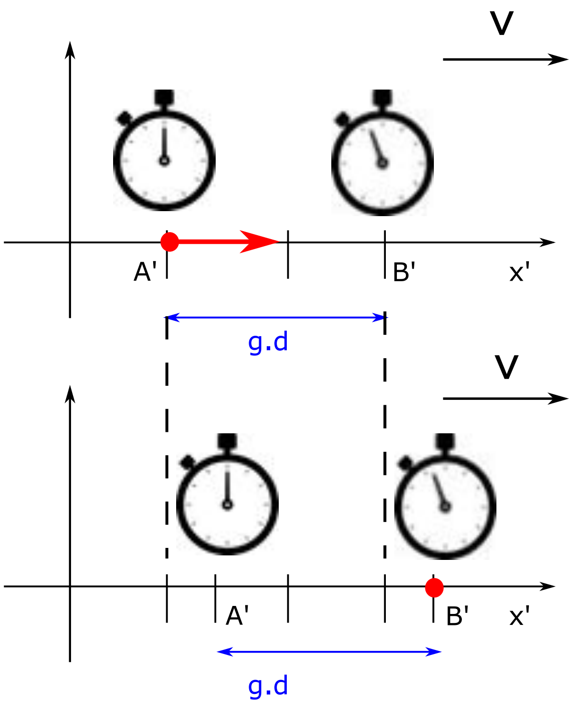

Figure 1.21 : Round trip of a signal within a moving clock system : step 2

In the moving clock system, let us synchronize the clock B′ to the clock A′. B′ is sending a signal to A′ and start a chronometer.

* Time needed for a signal emtted by B′ to reach A′ :

$$t'_{a'} = g.t_{a'} = g^2.d/c.(1+\beta)$$

$$t'_{a'} = (1-\beta).\frac{d}{c}$$

A′ receives the signal of B′ and send its date $t'_{a'} + (1-\beta).\frac{d}{c}$

* Time needed for a feedback signal emitted by A′ to reach B′ :

$$t'_{b'} = \frac{d}{c}.(1-\beta) + \frac{d}{c}.(1+\beta)$$

$$t'_{b'} = 2.\frac{d}{c}$$

B′ receives the date $t'_{a'} + (1-\beta).\frac{d}{c}$ emitted by A′

=> An observer located at B′ will conclude that A′ is at half of a distance of $2.d$ that is d. He will be allowed to synchronize B′ to A′ with the date :

$$t'_{a'} + (1-\beta).\frac{d}{c} - \frac{1}{2}(\frac{2.d}{c})$$

$$t'_{a'} - \beta.\frac{d}{c}$$

B′ has synchronized to A′ but with a time delay of :

$$-\beta.\frac{d}{c}$$

7.3 Moving system from the point of view of the static one

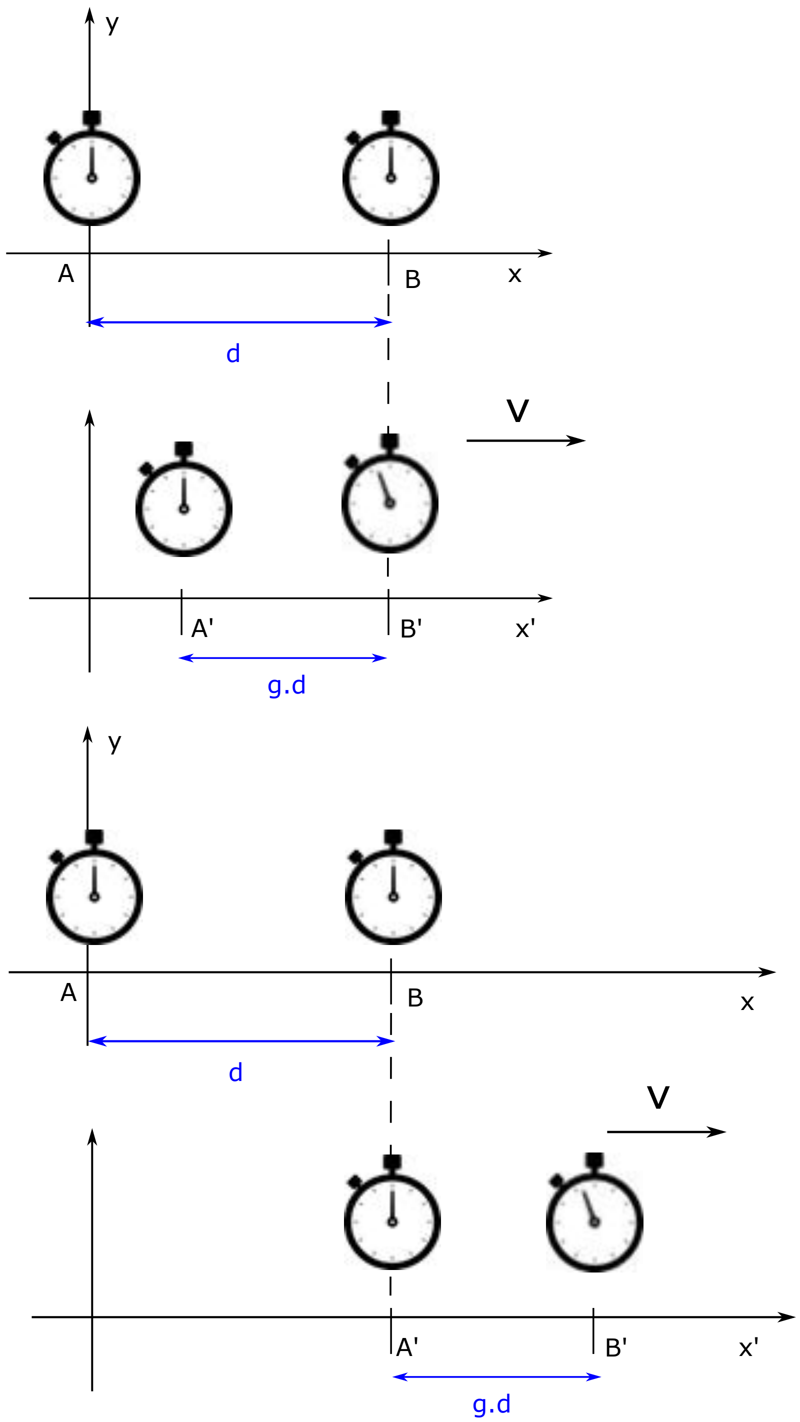

Figure 1.22 : Time delay and distances from the static clock system's point of view

The time measurement for the moving clocks B′ and A′ to reach B implies that the clock moving system has contracted from d to : $g.d$

7.4 Static system from the point of view of the moving one

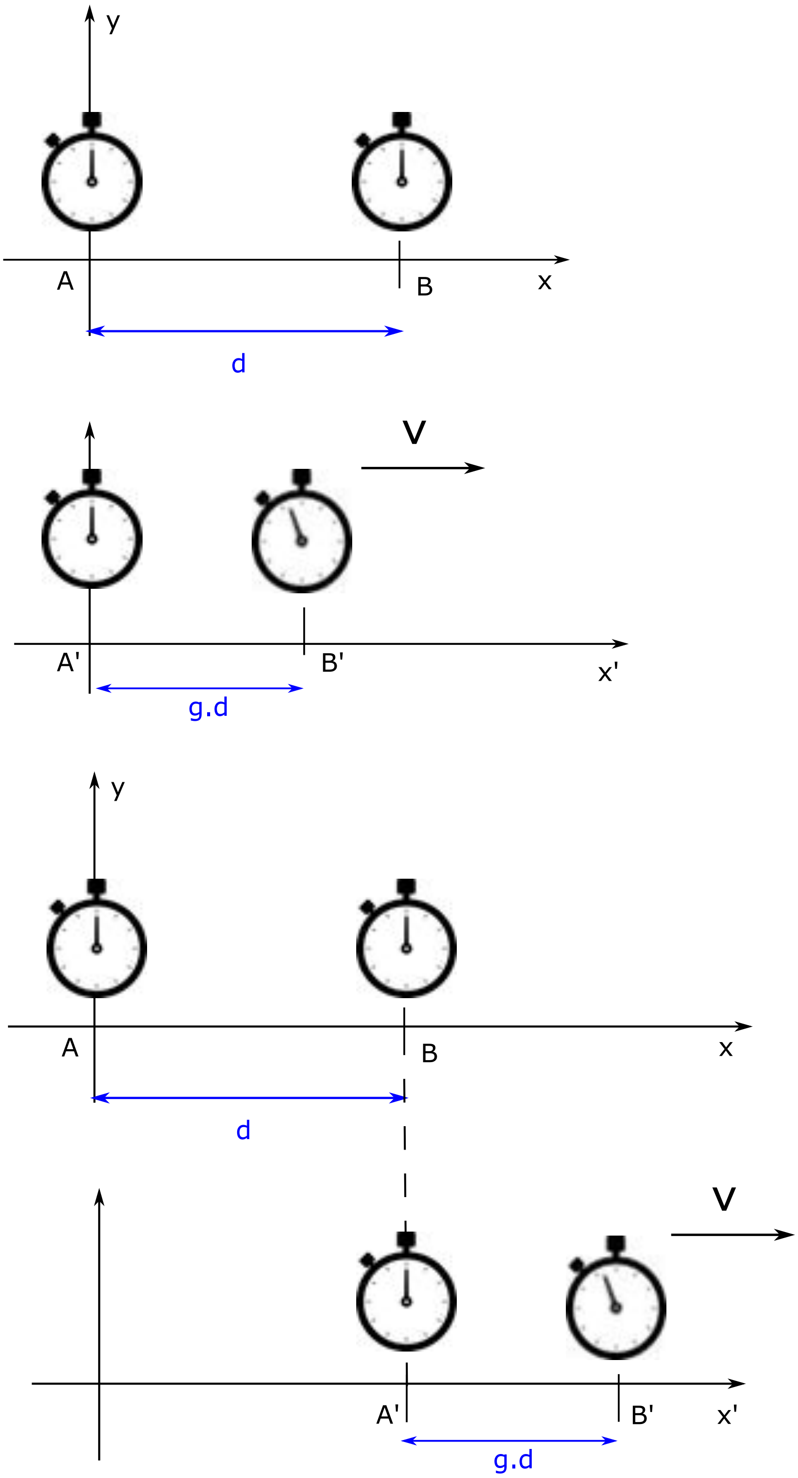

Figure 1.23 : Time delay and distances from the moving clock system's point of view

From the clock system moving at the speed v, the static clock system is moving away at the speed v' with $v = v'$

We have :

$$v = \frac{d}{t}$$

And :

$$v' = \frac{d'}{t'}$$

Considering $v = v'$ leads to :

$$\frac{d}{t} = \frac{d'}{t'}$$

$$\frac{d}{t} = \frac{d'}{g.t}$$

$$d' = g.d$$

7.5 Conclusion

* During the clock synchronization procedure, the static clocks have estimated their distances to : d

* During the clock synchronization procedure, the moving clocks have estimated their distances to : d

Moreover :

* From the static clock's point of view, the distance between the moving clocks is given by : $g.d$

* From the moving clock's point of view, the distance between the static clocks is given by : $g.d$

=> There is a full symmetry of the observation, that makes a new illustration of the principle of relativity.

Chapter 8

Discussion on the special relativity paradoxes

The mirror paradox

The mirror paradox consists in putting a moving mirror in front of a moving observer tending together to the speed of light. According to the classic rules of speed composition in a Galilean reference frame, the reflection of the observer in the mirror may disappear as the relative speed $(c - v)$ of the incoming shape of the observer to the mirror would tend to zero.

To treat this case, Albert Einstein will use the special relativity theory postulating the invariance of the speed of light and its consequence: a contraction of space and a dilatation of time.

We rather consider that we are in the same situation as the moving interferometer like exposed before.

$$\tau_1' = g.\tau_1 = \frac{g^2.d}{1-\beta} = d.(1+\beta)$$

$$\tau_2' = g.\tau_2 = \frac{g^2.d}{1+\beta} = d.(1-\beta)$$

$$\tau_1' + \tau_2' = 2.d$$

$$t_1' + t_2' = \frac{2.d}{c}$$

The time for the shape of the observer to make the round trip between the mirror and himself is then constant, whatever the speed of the mirror and the observer. Then the image reflected by the mirror will never disappear.

The twin paradox

The twin paradox consists in making travell in space one of the twin while the second one stays on earth. The question is then : if the travelling twin reached the speed of light, would he be younger than the one who stayed on earth when he will be back? As time is supposed to dilate for the travelling twin, it is supposed to be the case.
According to our new understanding of the relativity, there is neither contraction nor dilatation of time, but more basically a slowdown of the mechanisms within matter.

Any moving clock will count the time a slower way, that's why its date will be late when it will be back on earth where the second clock has stayed.

We are then tempted to conclude that the travelling twin will come back younger than his twin stayed on earth, as his biological rythms have slowed down. If we consider furthermore that not only mechanisms slow down, but also lengths contract in the way of the movement, the situation is more ambiguous. What about becoming older a faster way if biological rythms slow down whereas the dimensions of the body contract in the same time ? Let us point out that the slowdown phenomenon of the biological rythms is isotropic, unlike the body's contraction which occurs only in the way of its movement.

If the travelling twin contracted in his whole dimensions, we would assume that the travel wouldn't have any effect on him. Without any contraction, we would assume that the travelling twin would come back younger. We are here in an ambiguous situation since the slowdown of the rythms is isotropic, unlike the contraction of the dimensions. As the situation is ambiguous, we will conclude that the travelling twin will come back younger still.

Chapter 9

The Doppler Effect

9.1 Review of the classical Doppler Effect

The Doppler Effect is a physical phenomenon which makes a signal frequency being modified when the emitting source is moving (the absolute Doppler Effect), or from the point of view of a receiver when the former or the latter are moving (the relative Doppler Effect).
In a first step, we will focus on the classical Doppler Effect, that is the one concerning accoustic waves or any non-electromagnetic wave. We will then use our first study to focus on the relativistic Doppler Effect according to our new understanding of the Lorentz equations and their consequences on the frequency of a moving emitter or receiver.

Let us use the following notations for the chapter:

* λ : The wavelength when the emitter is at rest

* λ_{av} : The length of the front wave of the emitter

* λ_{ar} : The length of the backward wave of the emitter

* λ_r : The wavelength like is is perceived by the receiver

9.1.1 The emitter and the receiver are static

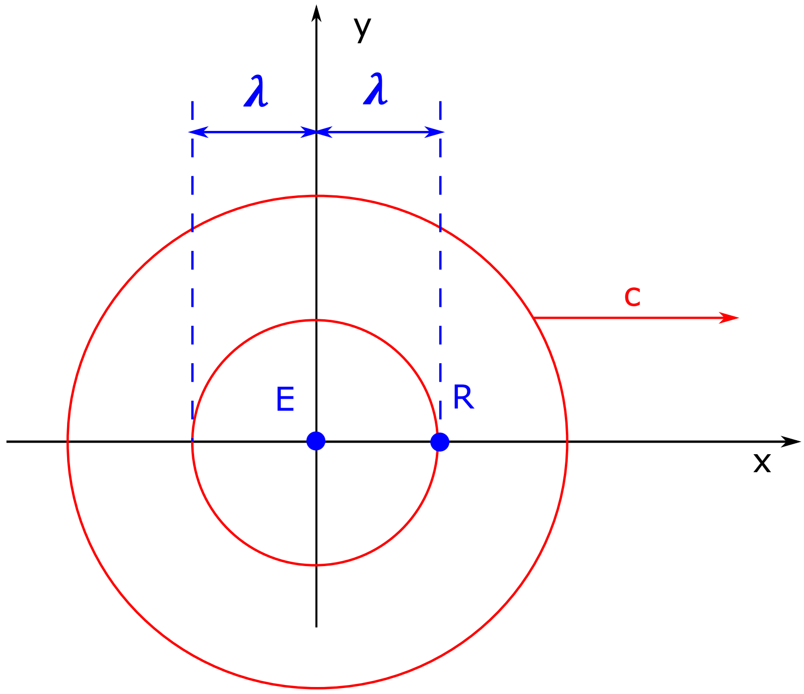

Figure 1.24: The emitter and the receiver are static

The periodic signal, having for frequency f and also for wavelength c/f, needs $2.c/f$ of time to reach the receiver. The next front has the speed of c (like every front), and covers a distance of c/f. Then we basically have:

$$f_{rec} = f_{em} = \frac{c}{\lambda}$$
$$\lambda_{av} = \lambda_{ar} = \lambda$$
$$\lambda_r = \lambda$$

9.1.2 The emitter is moving away or is coming to the static receiver

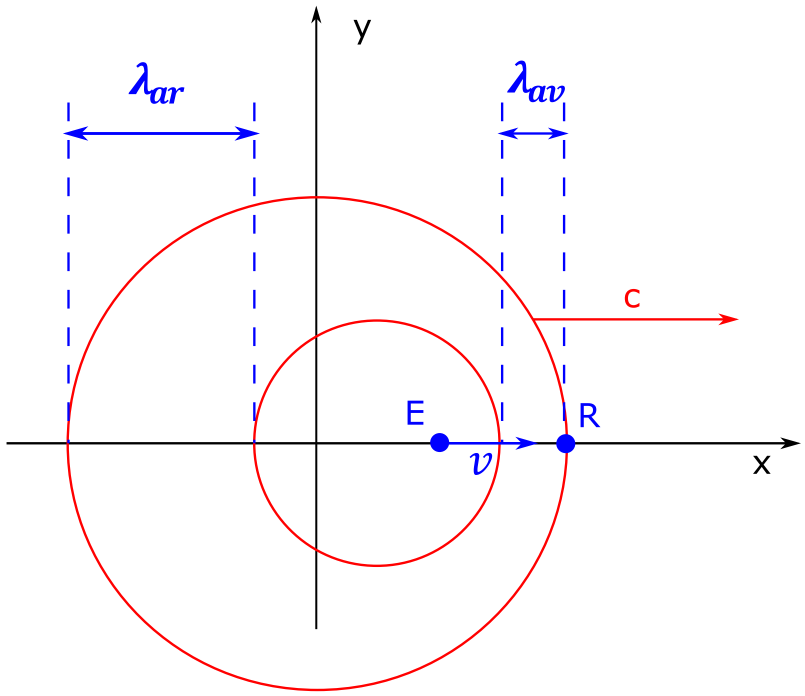

Figure 1.25: The emitter is moving away or is coming to the static receiver

The periodic signal, having for frequency f that is for wavelength c/f, needs $2.c/f$ of time to reach the receiver. The next front has the speed of c, and covers a distance of $(c+v)/f$ (approaching case). This leads to:

$$\lambda_{av} = \frac{2.c}{f_{em}} - \frac{c+v}{f_{em}} = \frac{c-v}{f_{em}}$$

More over:

$$f_{em} = \frac{c}{\lambda}$$

This leads to:

$$\lambda_{av} = \lambda.(1-\beta)$$
$$\lambda_r = \lambda_{av}$$

For the same reason, we will obtain in the case of a moving away emitter:

$$\lambda_{ar} = \lambda.(1+\beta)$$
$$\lambda_r = \lambda_{ar}$$

9.1.3 The emitter is moving, the receiver is moving the same and is located on the transversal axis of the movement

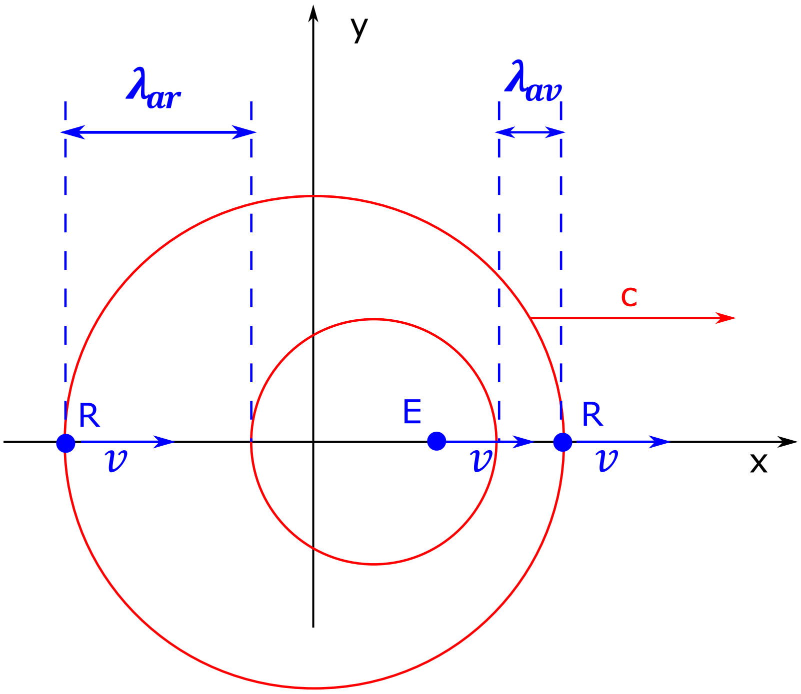

Figure 1.26:
The emitter is moving, the receiver is moving the same and is located on the transversal axis of the movement

If we focus on the received frequency of the signal to the receiver, then the Doppler Effect due to the emitter's movement is compensated by the receiver's movement. The relative Doppler Effect perceived by the receiver is nil.

$$\lambda_r = \lambda$$

The receiver won't be able to perceive any changing, though the emitter's frequency and wavelength have been actually modified by the Doppler Effect:

$$\lambda_{av} = \lambda.(1 - \beta)$$
$$\lambda_{ar} = \lambda.(1 + \beta)$$

9.1.4 The emitter is static, the receiver is moving away

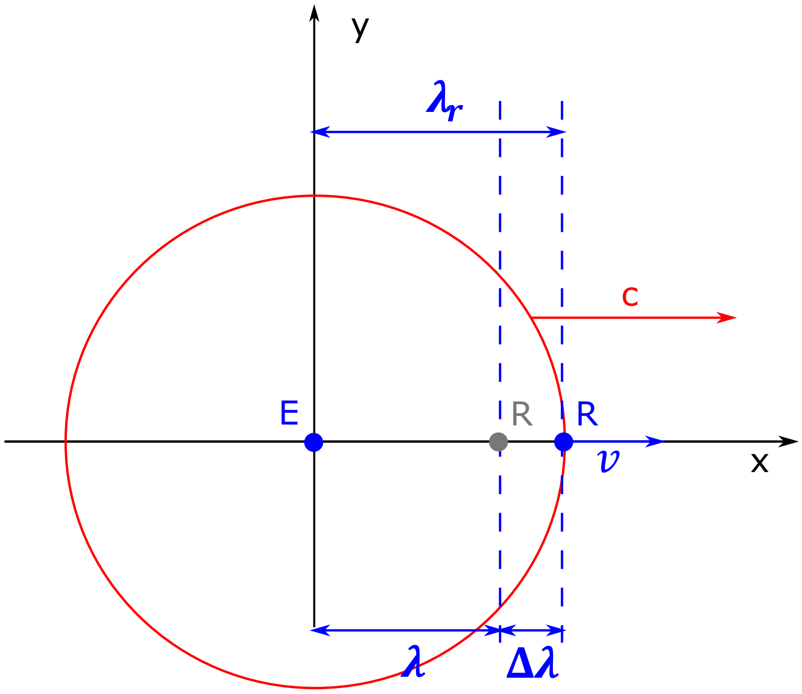

Figure 1.26: The emitter is static, the receiver is moving away

The receiver moving at the speed of v covers a $\Delta\lambda$ distance during the time of one signal period, while the front of the wave is running at the speed of c during the same time.

The time needed to cover the $\Delta\lambda$ distance is the same than the one needed to cover the λ distance at the speed of $(c - v)$

$$\Delta.t = \frac{\lambda}{c - v}$$

This leads for $\Delta\lambda$ to:

$$\Delta\lambda = v.\Delta.t = \lambda.\frac{v}{c - v}$$

The relative wavelength for the moving away receiver is then given by:

$$\lambda_r = \lambda + \Delta\lambda = \lambda(\frac{c - v + v}{c - v}) = \lambda.\frac{c}{c - v}$$

$$\lambda_r = \frac{\lambda}{1 - \beta}$$

The emitter being at rest leads also to:

$$\lambda_{av} = \lambda_{ar} = \lambda$$

9.1.5 The emitter is static, the receiver is coming to the emitter

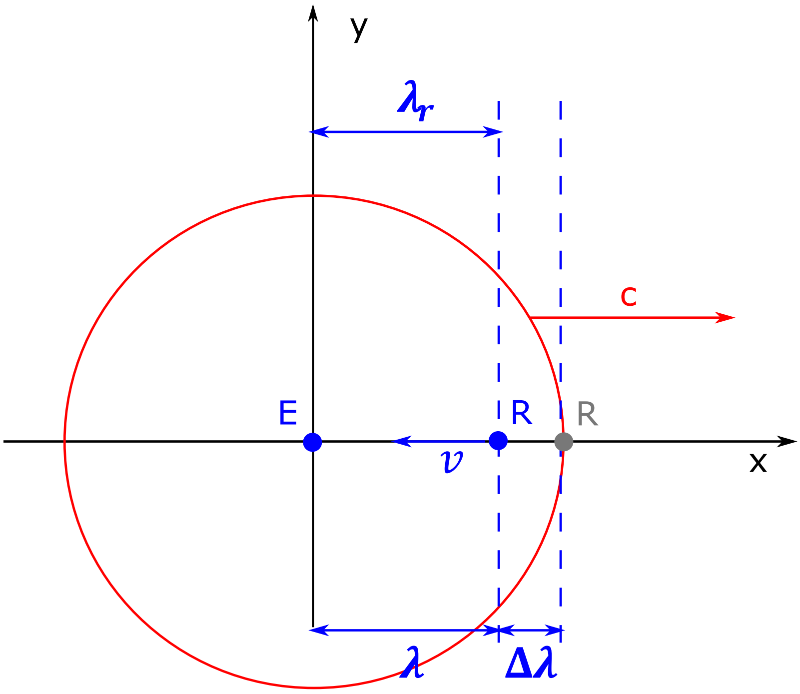

Figure 1.27: The emitter is static, the receiver is coming to the emitter

The receiver moving at the speed of v covers a $\Delta\lambda$ distance during the time of one signal period, while the front of the wave is running at the speed of c during the same time.

The time needed to cover the $\Delta\lambda$ distance is the same than the one needed to cover the λ distance at the speed of $(c+v)$

$$\Delta\lambda = \frac{\lambda}{c+v}$$

This leads for $\Delta\lambda$ to:

$$\Delta\lambda = v.\Delta.t = \lambda.\frac{v}{c+v}$$

The relative wavelength for the approaching receiver will be then:

$$\lambda_r = \lambda - \Delta\lambda = \lambda(\frac{c+v-v}{c+v}) = \lambda.\frac{c}{c+v}$$

$$\lambda_r = \frac{\lambda}{1+\beta}$$

The emitter being at rest leads also to:

$$\lambda_{av} = \lambda_{ar} = \lambda$$

9.1.6 The emitter and the receiver are moving at different speeds, the receiver is located on the transversal axis of the movement

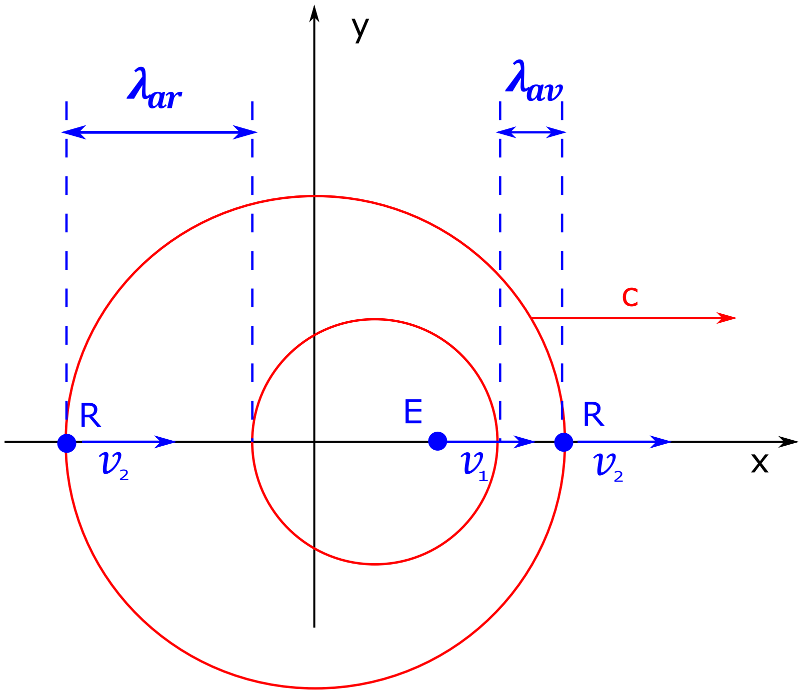

Figure 1.28: The emitter and the receiver are moving at differents seeds, the receiver is located on the transversal axis of the movement

We have to combine the absolute Doppler Effect due to the emitter's movement, and the relative Doppler Effect to the receiver

According to the absolute Doppler Effect, the wavelength for the backward wave of the emitter is given by:

$$\lambda_{ar} = \lambda.(1+\beta_1)$$

According to the relative Doppler Effect, the perceived wavelength for the receiver approaching from behind is then given by:

$$\lambda_r = \lambda.\frac{1+\beta_1}{1+\beta_2}$$

According to the absolute Doppler Effect, the wavelength for the front wave of the emitter is given by:

$$\lambda_{av} = \lambda.(1-\beta_1)$$

According to the relative Doppler Effect, the perceived wavelength for the ahead receiver moving away is then given by:

$$\lambda_r = \lambda.\frac{1-\beta_1}{1-\beta_2}$$

Note: If the emitter and the receiver have the same speed, that is $\beta_1 = \beta_2$, then we are in the case where: $\lambda_r = \lambda$

9.1.7 The emitter is moving, the receiver is moving the same and is located on the longitudinal axis passing through the emitter

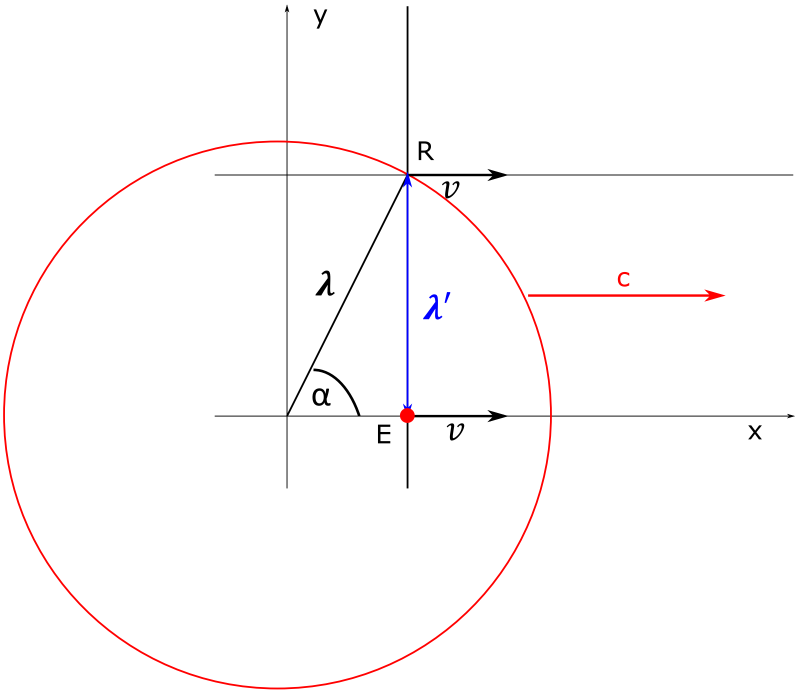

Figure 1.29: The emitter and the receiver are moving the same

At the second emitting period of time, the trigonometric situation leads to:

$$\sin\alpha = \frac{\lambda'}{\lambda}$$

More over:

$$cos\alpha = \frac{v}{c} = \beta$$

$$\sin\alpha = \sqrt{1 - \cos^2\alpha} = \sqrt{1 - \beta^2} = g$$

This leads to:

$$\lambda' = g.\lambda$$

For the received frequency of the signal to the receiver, then the Doppler Effect due to the emitter's movement is compensated by the receiver's movement: $\lambda_r = \lambda$

Nevertheless, the emitter's frequency and wavelength have been actually modified by the Doppler Effect. The wavelength of the signal on the axis is given by: $\lambda' = g.\lambda$

9.2 The relativistic Doppler Effect

By considering that mechanisms within matter slowdown according to our new understanding of the Lorentz equations, we will now focus on the relativistic Doppler Effect.

9.2.1 The emitter is moving and the receiver is static

Let us assume that a moving emitter, having f for frequency of its periodic signal, willl emit on the following frequency when it is moving at the speed β:

$$f' = g.f$$

This means that the wavelengths for the resting and moving emitter are related by the equation:

$$\lambda' = \frac{\lambda}{g}$$

The equations for the classical Doppler Effect have then to be modified to take into account the wavelength correction by the Lorentz factor g due to movement. Once this is done, we will be able to use again these equations in the relativistic context.

For the backward wave:

$$f_{ar} = \frac{g.f}{1+\beta} = f.\frac{\sqrt{(1-\beta).(1+\beta)}}{\sqrt{(1+\beta)^2}} = f.\sqrt{\frac{1-\beta}{1+\beta}}$$

$$\lambda_{ar} = \frac{\lambda}{g}.(1+\beta) = \lambda.\sqrt{\frac{1+\beta}{1-\beta}}$$

For a receiver being at rest and located behind the emitter, the perceived wavelength equals to the wavelength of the emitter:

$$\lambda_r = \lambda_{ar}$$

$$\lambda_r = \lambda.\sqrt{\frac{1+\beta}{1-\beta}}$$

For the front wave:

$$f_{av} = \frac{g.f}{1-\beta} = f.\frac{\sqrt{(1-\beta).(1+\beta)}}{\sqrt{(1-\beta)^2}} = f.\sqrt{\frac{1+\beta}{1-\beta}}$$

$$\lambda_{av} = \frac{\lambda}{g}.(1-\beta) = \lambda.\sqrt{\frac{1-\beta}{1+\beta}}$$

For a receiver being at rest and located in front of the emitter, the perceived wavelength equals to the wavelength of the emitter:

$$\lambda_r = \lambda_{av}$$

$$\lambda_r = \lambda . \sqrt{\frac{1-\beta}{1+\beta}}$$

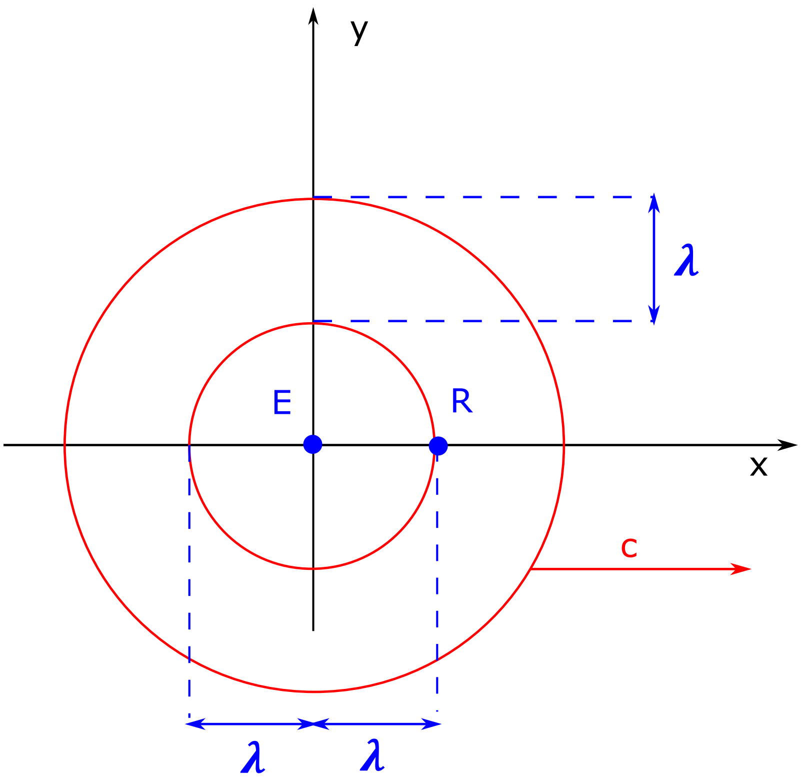

Figure 1.30: Static emitter

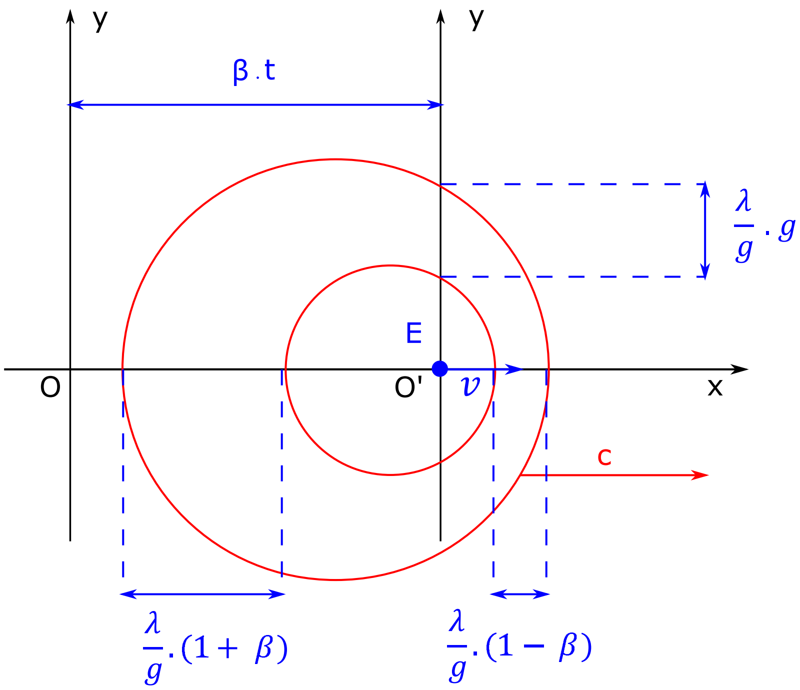

Figure 1.31: Moving emitter

Notes :

- Surprisingly but according to the combination of the classical Doppler Effect and the relativistic one, the Doppler relativistic effect implies the following wavelength for the signal on the longitudinal axis passing through the emitter:

$$\frac{\lambda}{g}.g = \lambda$$

- We should distinguish two aspects which may look similar : the relativistic effect and the relative one. The relativistic effect is connected with electromagnetic waves, and expresses the influence of the emitter's speed on the wavelength and the frequency of the emitted signal. The relative effect is about how is received a signal from the receiver's point of view. If the emitter is at rest and the receiver is moving, for example, then the real frequency of the signal doesn't change, whereas its measurement by the moving receiver does. If the emitter and the receiver are moving the same, then the receiver won't perceive any changing, though the frequency of the emitter actually changed. These are a typical examples of relative effects.

9.2.2 The emitter is static and the receiver is moving

When the receiver is moving while the emitter is staying at rest, it is the turn of the former to have its mechanisms being slowed down. We postulate that everything goes as if the receiver behaved with a $g.f$ received frequency while being at rest. We have then to use again the formula of the classical Doppler Effect and combine it with the relativistic effect on frequency:

For the receiver moving away from to the emitter:

$$g.f_r = f.(1-\beta)$$

$$f_r = f.\frac{\sqrt{(1-\beta)^2}}{\sqrt{(1-\beta).(1+\beta)}}$$

By definition: $\lambda = c/f$ and $\lambda_r = c/f_r$

$$\lambda_r = \lambda.\sqrt{\frac{1+\beta}{1-\beta}}$$

For the receiver coming to the emitter:

$$g.f_r = f.(1+\beta)$$

$$f_r = f.\frac{\sqrt{(1+\beta)^2}}{\sqrt{(1-\beta).(1+\beta)}}$$

By definition: $\lambda = c/f$ and $\lambda_r = c/f_r$

$$\lambda_r = \lambda.\sqrt{\frac{1-\beta}{1+\beta}}$$

Note: The emitter being at rest, its wavelength stays unchanged to the value λ

9.2.3 Physical interpretation of the relativistic Doppler Effect

On the one hand: The estimated wavelength from the moving receiver's point of view - while the emitter is at rest - is equal to the estimated wavelength from the resting receiver's point of view while the emitter is approaching

On the other hand: The estimated wavelength from the moving away receiver's point of view - while the emitter is at rest - is equal to the estimated wavelength from the resting receiver's point of view while the emitter is moving away.

=> There is a strict equivalence of the observations and the measurements, whatever the observer is moving and the source is staying at rest, or the former is staying at rest and the latter is moving.

=> Nevertheless, there is no equivalence of the effects. When the emitter is moving, its frequency is actually modified according to the Lorentz factor g. When the emitter is at rest while the receiver is moving, the frequency of the emitter stays the same. It would also be possible to guess which of the two ones is moving and which one is at rest, by using a second receiver and putting it at a different position. If the estimated frequency changed for him too, we could guess that the emitter is moving but the receiver doesn't, unless we would assume that the two receivers have the same relative movement compared to the emitter. This could be the case in some precise circumstances.

For the same reason, the properties of a resting receiver would stay the same when the relative movement was due to the movement of the emitter. Using a second emitter would be helpful to guess who is moving, who is staying at rest. The equivalence of the frequencies measurements hides the hiatus between the reality of the phenomena and their observations.

9.2.4 Discussion

The special relativity of Albert Einstein leads to the same arithmetical results as our new approach. There is here a common conclusion concerning the relative aspect of the observer's point of view.
Nevertheless, a "time dilatation" is convoked in the special relativity theory. We rather consider that "time dilatation" doesn't occur, but rather and more basically a slowdown of the mechanisms within matter. Among these mechanisms, we want to point out the electron's frequency. We postulate then that the electron's frequency is modified by its movement according to the Lorentz factor g.

Let us be given, for example, a radio emitter of 10 Ghz when it is at rest. Let us now speed up the radio emitter until it's reaching 30 km/s, that is a c normalized speed $\beta = 10^{-4}$.

The emitted frequency is shifting from f to f' according to:

$$f' = g.f$$

$$f' = g.f = \sqrt{1 - (10^{-4})^2}.10^{10}$$

$f - f' \approx 50$ Hz

When the emitter is moving away from the receiver, we have the following equation for the perceived frequency:

$$f_r = f_{ar} = \lambda.\sqrt{\frac{1-\beta}{1+\beta}}$$

$$f_r = f_{ar} = 10^{10}.\sqrt{\frac{1-10^{-4}}{1+10^{-4}}}$$

$f_r \approx 9.998000250$ GHz

When the emitter is approaching to the receiver, we have the following equation for the perceived frequency:

$$f_r = f_{av} = \lambda.\sqrt{\frac{1+\beta}{1-\beta}}$$

$$f_r = f_{ar} = 10^{10}.\sqrt{\frac{1+10^{-4}}{1-10^{-4}}}$$

$f_r \approx 10.002000250$ GHz

It would be also possible to build the same experiment with the emitter staying at rest and the receiver moving. The measurement would give the same shift of frequency.

Of course we have to point out that a resting position is uncertain as far as everything is in movement in the universe. We should then consider this resting situation as relative for any experiment. We would better say that an object which has been moved away may be in a different situation - in regard of the Wave middleware - than the one which has not been speeded up to be moved away. The perfect resting situation among the Wave middleware is, let us remind it, impossible to reach for any observer. Making the study of the relativistic Doppler Effect by taking into account the movement of the emitter and the receiver would deserve another full part development, partly unitiated in the annex **The relativistic Doppler Effect with a moving emitter and receiver**

Chapter 10

Numeric study of the relativistic Doppler effect

10.1 Reference frame

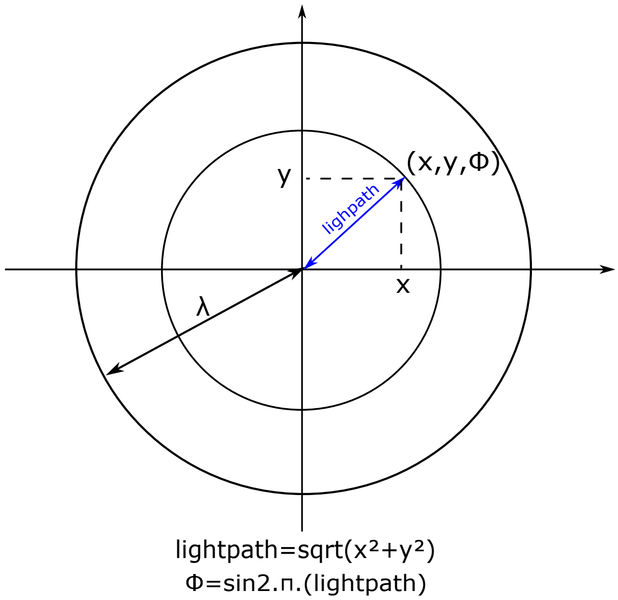

Figure 1.32 : Length unit and time unit : the wave length and the wave period

* Length unit : the wave length λ

* Time unit : the wave period T

* The wave length and the wave period are linked by the expression (for an electromagnetic signal) :

$$\lambda = c.T$$

* $lightpath$: Time delay for a signal to reach a (x, y) point.

$$lightpath = \sqrt{x^2 + y^2}$$

* ϕ : Phase of the signal at the (x, y) coordinate point

$$\phi = sin2.\pi.(lightpath)$$

10.2 Diverging concentric waves

For the emitter at rest, the phase of the signal at the point of coordinate (x, y) is given by :

$$\phi = sin2.\pi.(lightpath - \tau)$$

For the moving emitter, the phase of the signal at the point of coordinate (x', y') is given by :

$$\phi' = sin2.\pi.(lightpath - \tau')$$

With :

$$x' = g.x + \beta.\tau$$
$$\tau' = g.\tau - \beta.x$$

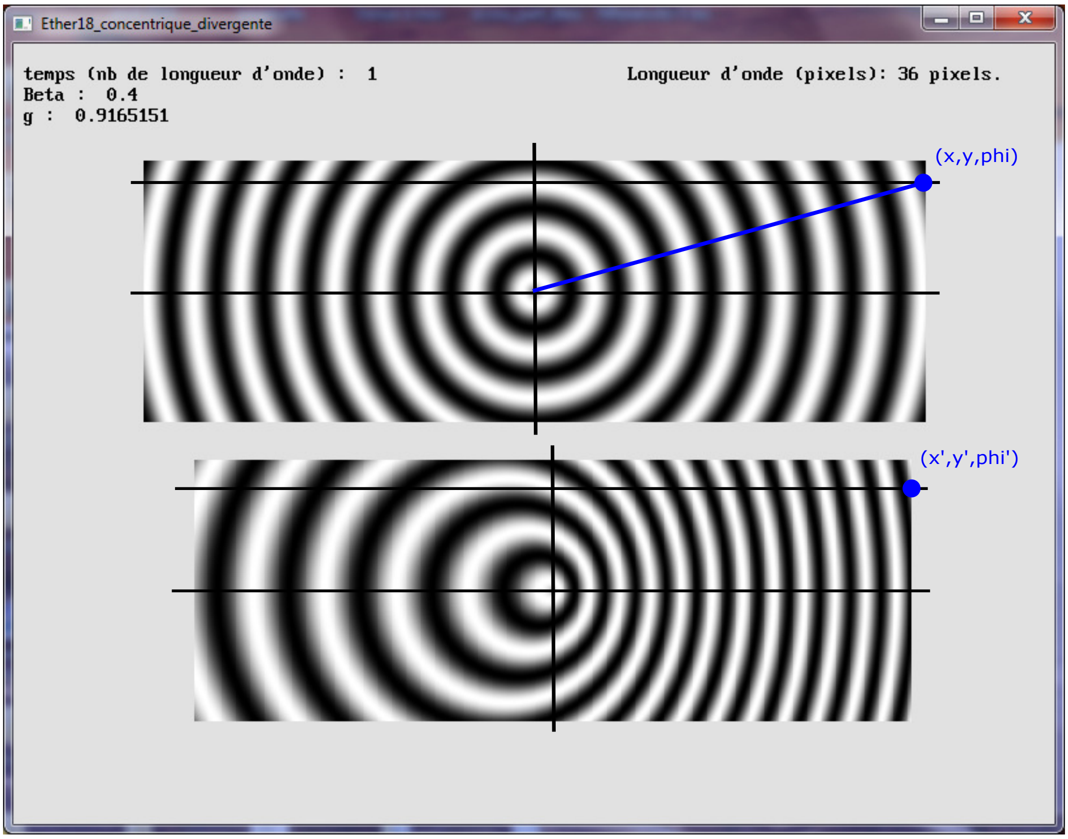

Figure 1.33 : Diverging concentric waves, at rest and in movement

10.3 Converging concentric waves

For the emitter at rest, the phase of the signal at the point of coordinate (x, y) is given by :

$$\phi = sin2.\pi.(lightpath + \tau)$$

For the moving emitter, the phase of the signal at the point of coordinate (x', y') is given by :

$$\phi' = sin2.\pi.(lightpath + \tau')$$

With :

$$x' = g.x + \beta.\tau$$
$$\tau' = g.\tau - \beta.x$$

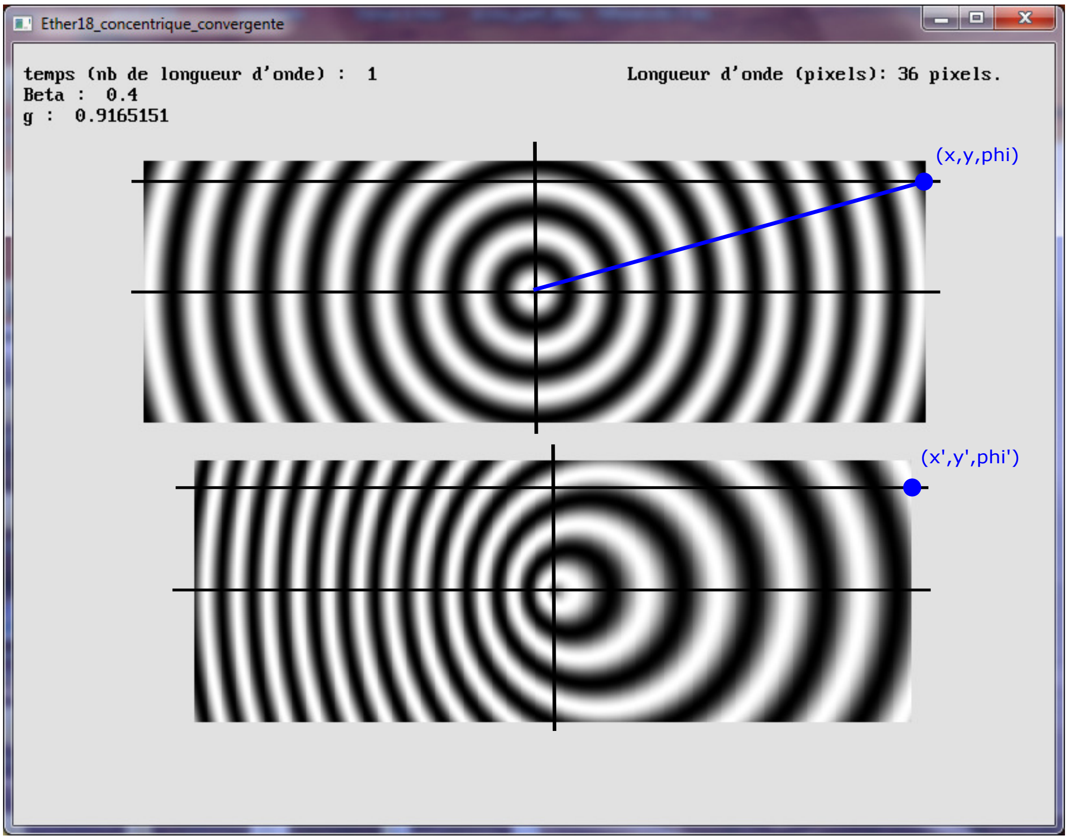

Figure 1.34 : Converging concentric waves, at rest and in movement

10.4 Standing concentric waves

For the emitter at rest, the phase of the signal at the point of coordinate (x, y) is given by :

$$\phi = sin2.\pi.(lightpath - \tau) + sin2.\pi.(lightpath + \tau)$$

For the moving emitter, the phase of the signal at the point of coordinate (x', y') is given by :

$$\phi' = sin2.\pi.(lightpath - \tau') + sin2.\pi.(lightpath + \tau')$$

With :

$$x' = g.x + \beta.\tau$$
$$\tau' = g.\tau - \beta.x$$

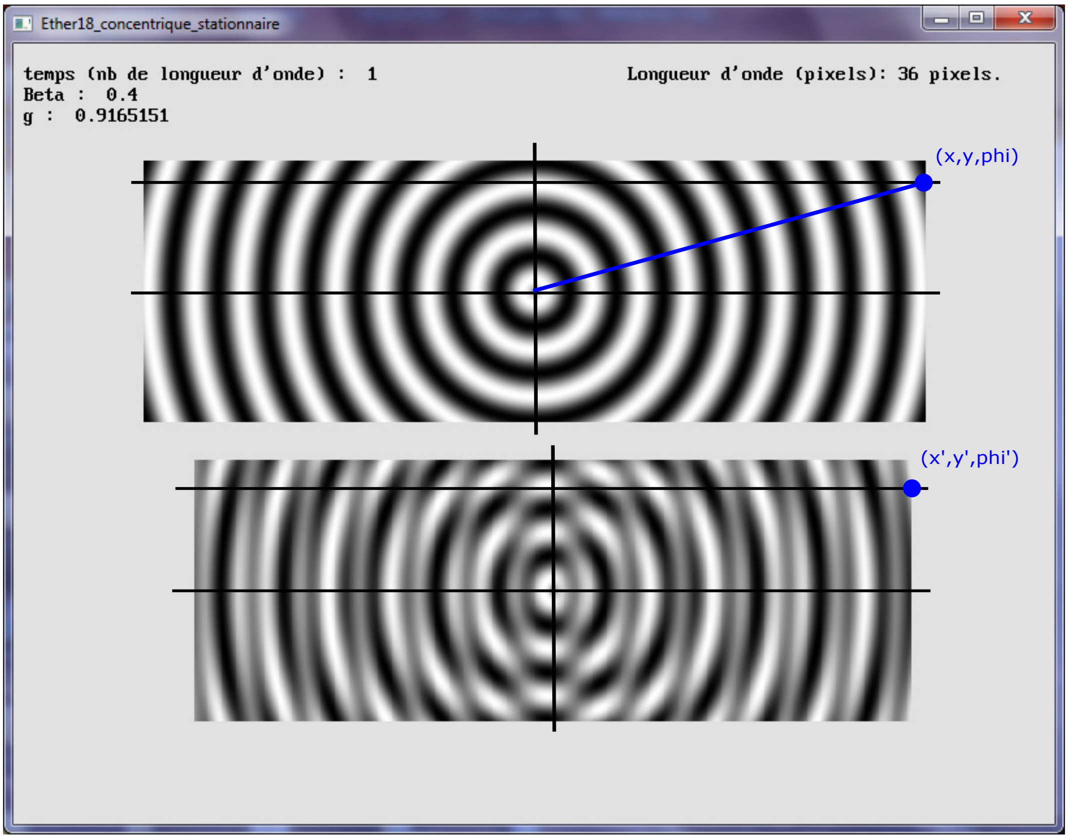

Figure 1.35 : Standing concentric waves, at rest and in movement (combination of converging and diverging waves)

10.5 The Lafreniere's wave : a model for the electron

10.5.1 Magnitude

Let us assume that the magnitude of the Lafreniere's wave is given by a modulation of the standing concentric waves magnitude according to the function :

$$\frac{sinx}{x}$$

For the resting electron :

$$\phi = \frac{sin2.\pi.(lightpath - \tau)}{2 * \pi * lightpath} + \frac{sin2.\pi.(lightpath + \tau)}{2 * \pi * lightpath}$$

For the moving electron :

$$\phi' = \frac{sin2.\pi.(lightpath - \tau')}{2 * \pi * lightpath} + \frac{sin2.\pi.(lightpath + \tau')}{2 * \pi * lightpath}$$

With :

$$x' = g.x + \beta.\tau$$

$$\tau' = g.\tau - \beta.x$$

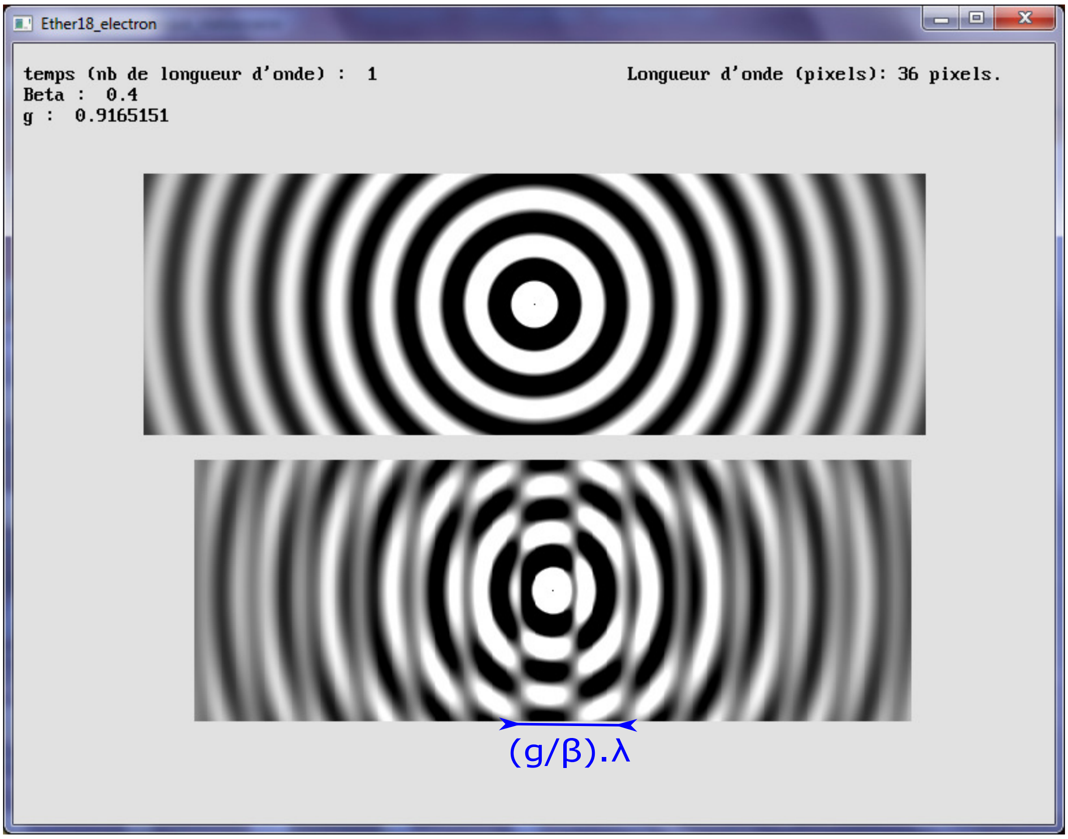

Figure 1.36 : Standing concentric waves with its magnitude modulated by $\frac{sinx}{x}$

10.5.2 Wave length

The length of the wave in its longitudinal component will be given by :

$$\lambda'_{longitudinal} = g.\lambda$$

the length of the wave in its transversal component stays unchanged :

$$\lambda'_{transversal} = \lambda$$

10.5.3 Wave period and frequency

If f is the frequency of the electron at rest, it's frequency when it moves will be given by :

$$f' = g.f$$

The electron slowdowns, and also any mechanisms connected to it.

10.5.4 Group speed

The group speed of the standing wave will be given by :

$$\beta_g = \beta$$

10.5.5 Wave phase

The wave phase is carried by the Lafreniere's wave.

The length of the phase wave is given by the relation :

$$\lambda_\phi = \frac{g}{\beta}.\lambda$$

The speed of the wave phase will be deduced from the group speed of the Lafreniere's wave according to the assumption of Louis de Broglie ($v_g.v_\phi = c^2$) :

$$\beta_g.\beta_\phi = 1$$

$$\beta_\phi = 1/\beta_g$$

$$\beta_\phi = 1/\beta$$

$$v_\phi = c/\beta$$

Notes :

* The period, the speed and the length of the wave phase are connected by the following expression :

$$v_\phi = \frac{\lambda_\phi}{T\ \phi}$$

This leads to :

$$T_\phi = \frac{\lambda_\phi}{v\ \phi}$$

$$T_\phi = \frac{\frac{g}{\beta}.\lambda}{\frac{c}{\beta}}$$

$$c.T_\phi = g.\lambda$$

=> T_ϕ represents the local time mentionned by Hendrik Lorentz in his works and studies. This local time is a consequence of the slowdown of the electron's frequency.

* As the group speed value β_g goes from 0 to 1, the speed of the wave phase will exceed the speed of light. Though, we will assume that the speed of light is a limit for any mechanic system or electromagnetic signal carrying some energy. The phase wave is not concerned as far as we will assume that it's a pure information, carried by a system which itself carry some energy.

Chapter 11

Revisiting the Michelson and Morley experiment

11.1 The transversal arm is at rest

11.1.1 Schematic representation

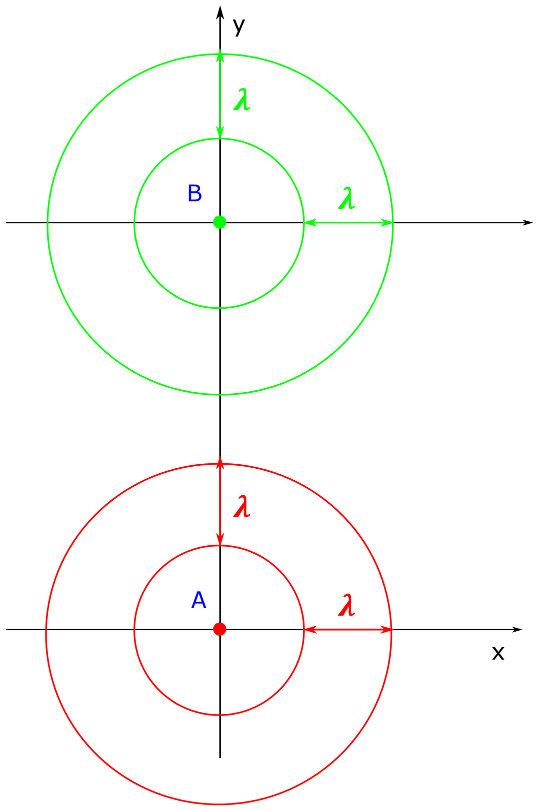

Figure 1.37 : Round trip of a signal among the longitudinal arm when the interferometer is at rest

For the forward wave, we will have :

$$\lambda_a = \lambda$$

For the backward wave, we will have :

$$\lambda_b = \lambda$$

11.1.2 Numeric representation

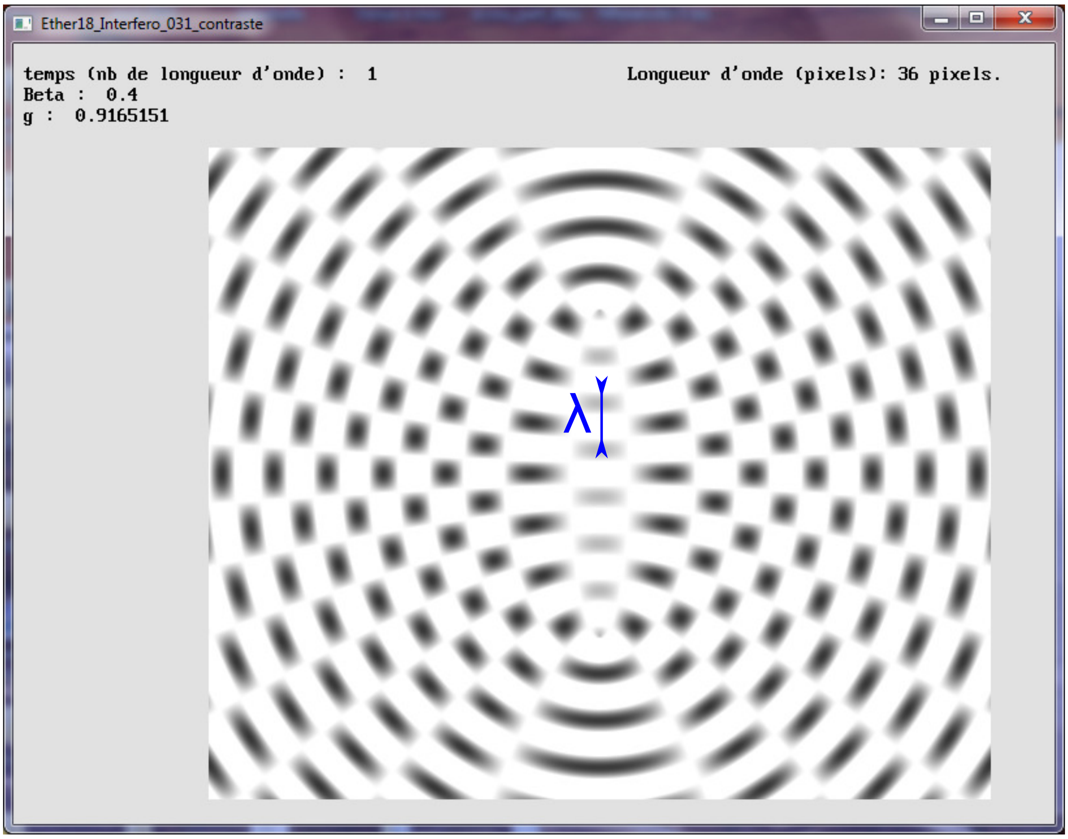

Figure 1.38 : A couple of diverging concentric waves when it is at rest, aligned on a longitudinal axis (the contrast has been enlighted)

According to our numeric representation, the length of the resulting wave will be equal to :

$$\lambda$$

Note : Let us consider the harmonic mean of λ_a and λ_b. By definition :

$$M_h = \frac{M_g^2}{M_a}$$

$$M_h = \frac{(\sqrt{\lambda_a.\lambda_b})^2}{\frac{1}{2}.(\lambda_a + \lambda_b)}$$

$$M_h = \frac{\lambda^2}{\frac{1}{2}.(2.\lambda)}$$

$$M_h = \lambda$$

11.2 The transversal arm is moving

11.2.1 Schematic representation

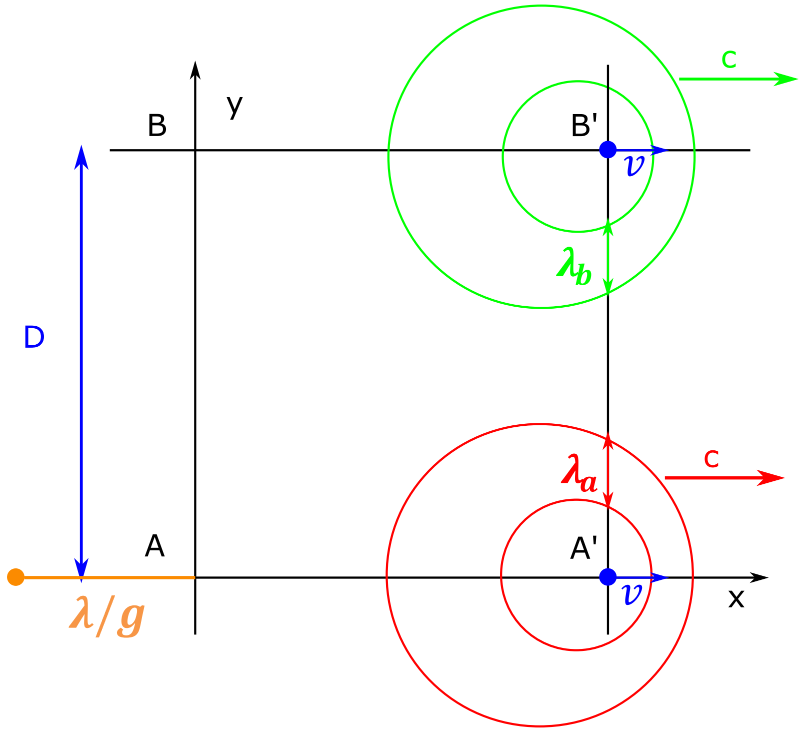

Figure 1.39 : Round trip of the signals when the interferometer is moving

The emitter A′ is moving, then the wave length evolves from λ to λ/g. Moreover, the wave is contracting according to the g factor and the Doppler effect :

$$\lambda_a = \frac{\lambda}{g}.g$$
$$\lambda_a = \lambda$$

The mirror located at B′ is behaving like a secondary source, moving at the same speed as the primary one, that is emitting on the same frequency. As there is a Doppler Effect for the returning wave too, the wavelength for it is given by:

$$\lambda_b = \frac{\lambda}{g}.g$$
$$\lambda_b = \lambda$$

11.2.2 Numeric representation

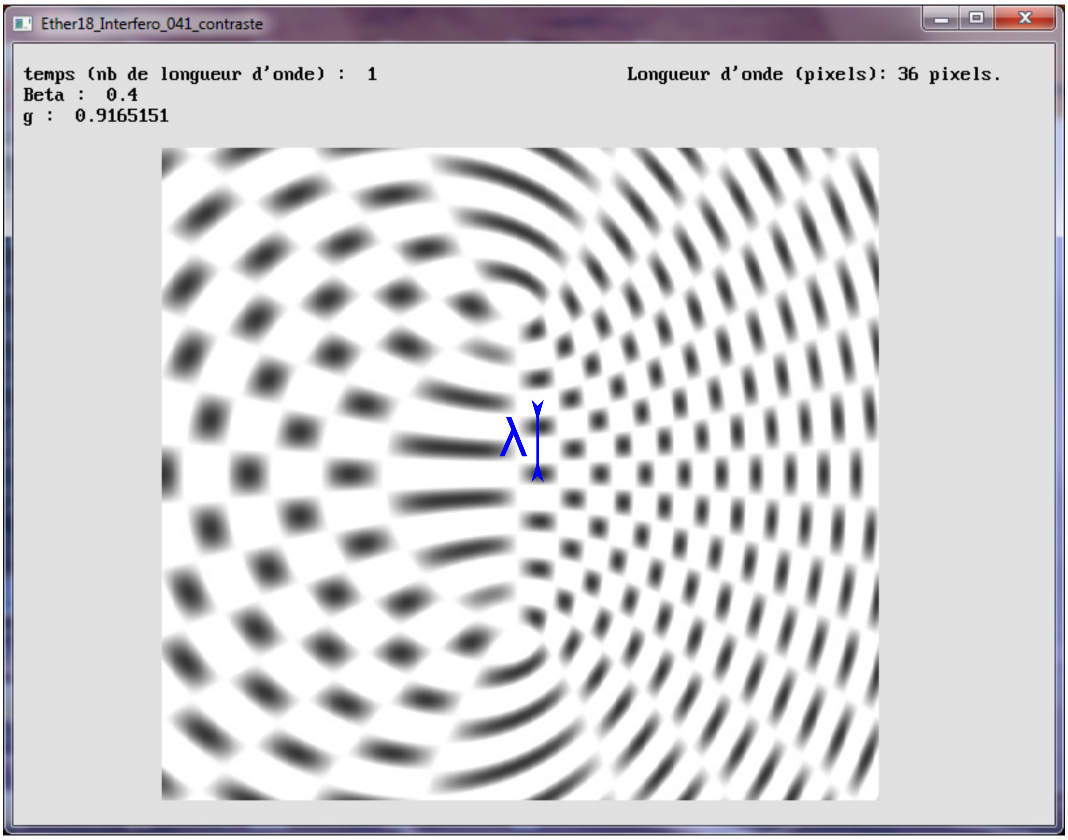

Figure 1.40 : A couple of diverging concentric waves when it is moving, aligned on a longitudinal axis (the contrast has been enlighted)

According to our numeric representation, the length of the resulting wave will be equal to :

$$\lambda$$

Note : Let us consider the harmonic mean of λ_a and λ_b. By definition :

$$M_h = \frac{M_g^2}{M_a}$$

$$M_h = \frac{(\sqrt{\lambda_a.\lambda_b})^2}{\frac{1}{2}.(\lambda_a + \lambda_b)}$$

$$M_h = \frac{\lambda^2}{\frac{1}{2}.(2.\lambda)}$$

$$M_h = \lambda$$

11.3 The longitudinal arm is at rest

11.3.1 Schematic representation

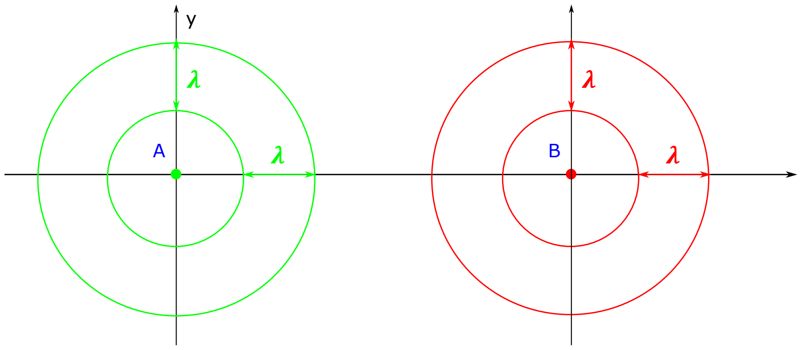

Figure 1.41 : Round trip of the signals when the interferometer is at rest

For the forward wave, we will have

$$\lambda_a = \lambda$$

For the backward wave among the interferometer, we have :

$$\lambda_b = \lambda$$

11.3.2 Numeric representation

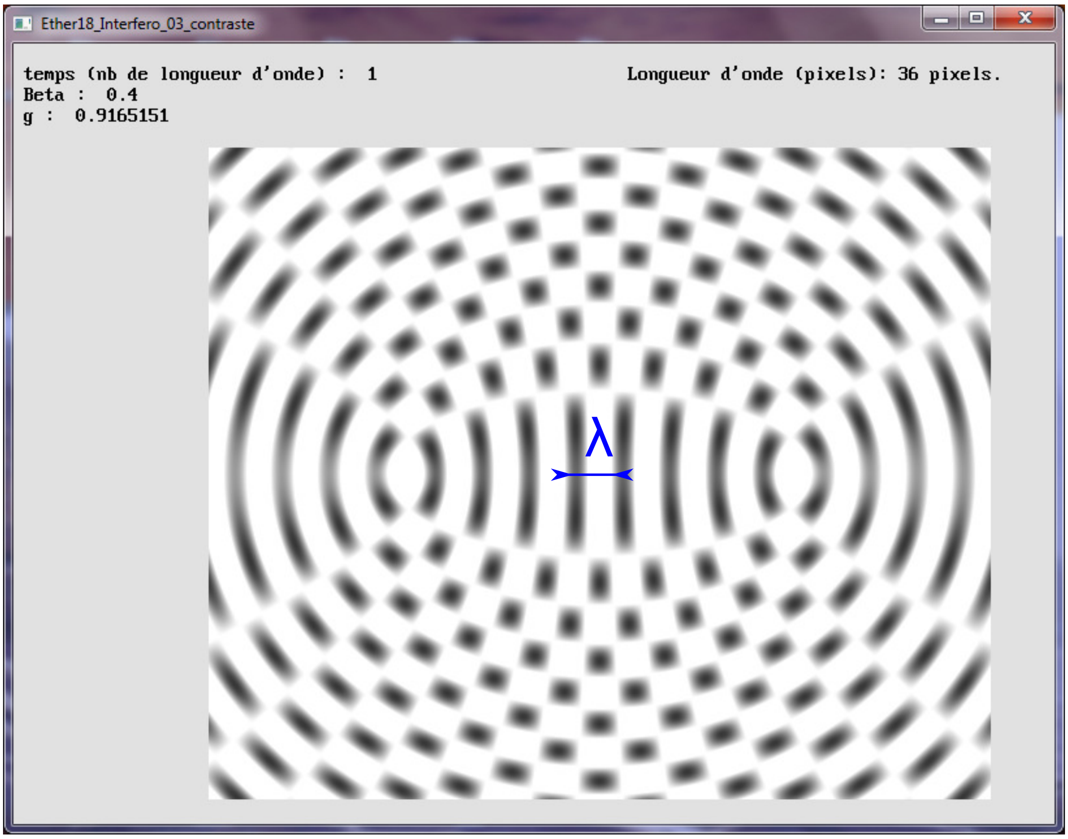

Figure 1.42 : A couple of diverging concentric waves when it is static, aligned on a transversal axis (the contrast has been enlighted)

According to our numeric representation, the length of the resulting wave will be equal to :

$$\lambda$$

Note : Let us consider the harmonic mean of λ_a and λ_b. By definition :

$$M_h = \frac{M_g^2}{M_a}$$

$$M_h = \frac{(\sqrt{\lambda_a.\lambda_b})^2}{\frac{1}{2}.(\lambda_a + \lambda_b)}$$

$$M_h = \frac{\lambda^2}{\frac{1}{2}.(2.\lambda)}$$

$$M_h = \lambda$$

11.4 The longitudinal arm is moving

11.4.1 Schematic representation

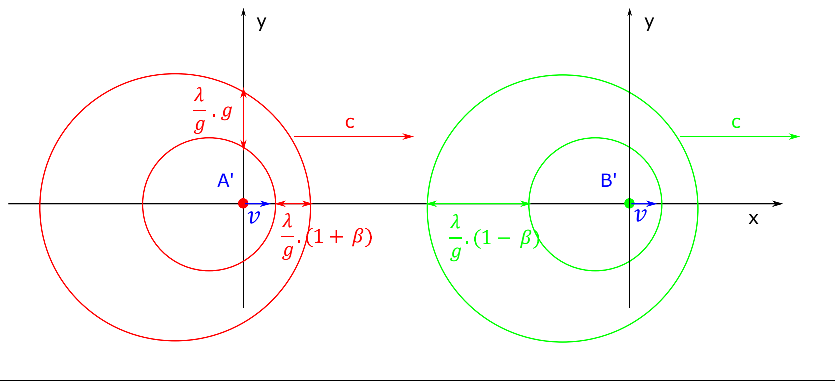

Figure 1.43 : Round trip of the signals when the interferometer is moving

The emitter A′ is moving, the the wave length evolves from λ to λ/g. Moreover, the wave is contracting according to the value of $(1-\beta)$ and the Doppler effect :

$$\lambda_a = \frac{\lambda}{g}.(1-\beta)$$

The mirror located at B′ is behaving like a secondary source, moving at the same speed as the primary one, that is emitting on the same frequency. As there is a Doppler Effect for the returning wave too, the wavelength for it is given by:

$$\lambda_b = \frac{\lambda}{g}.(1+\beta)$$

11.4.2 Numeric representation

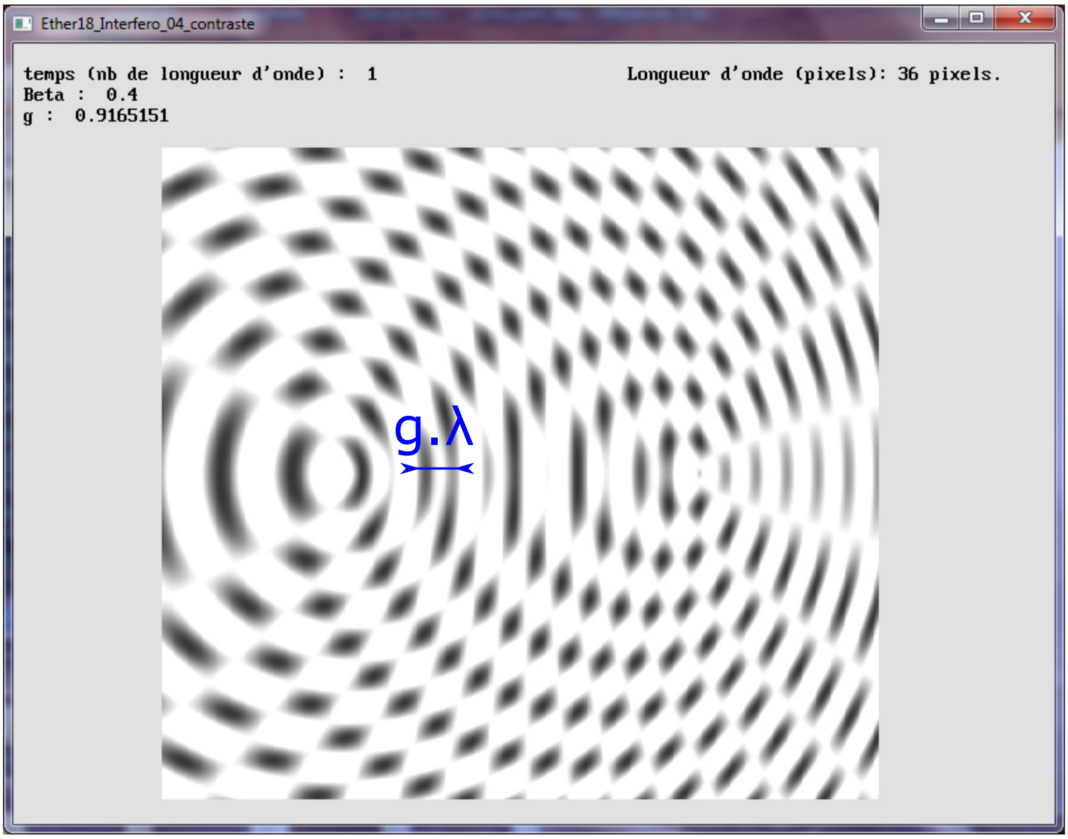

Figure 1.44: A couple of diverging concentric waves when it is moving, aligned on a transversal axis (the contrast has been enlighted)

According to our numeric representation, the length of the resulting wave will be equal to :

$$g.\lambda$$

Note : Let us consider the harmonic mean of λ_a and λ_b. By definition :

$$M_h = \frac{M_g^2}{M_a}$$

$$M_h = \frac{\frac{\lambda}{g}.(1-\beta).\frac{\lambda}{g}.(1+\beta)}{\frac{1}{2}.(\frac{\lambda}{g}.(1-\beta)+\frac{\lambda}{g}.(1+\beta))}$$

$$M_h = \frac{\frac{\lambda^2}{g^2}.g^2}{\frac{\lambda}{g}}$$

$$M_h = g.\lambda$$

11.5 Conclusion

- We have already exposed in the first chapter that the time needed for the waves to move away and come back stayed unchanged for the longitudinal arm, wether the interferometer is at rest or moving. Idem for the transversal arm.

- We have now exposed the existence of a net of waves within the two arms of the interferometer. The waves are affected by the g factor for the only case of the moving stationary waves

Chapter 12

Structure of matter

12.1 Assumption about the structure of matter

For our short presentation of matter's structure, we will consider matter as a net of structured atoms connected by the covalent electrons.
We will assume that the kernels of the atoms, and also the electrons, are standing wave's emitters. The composition of these standing waves are standing waves too, for which we have established the lengths in the former paragraph.

12.2 Standing waves formed within a net of static atoms

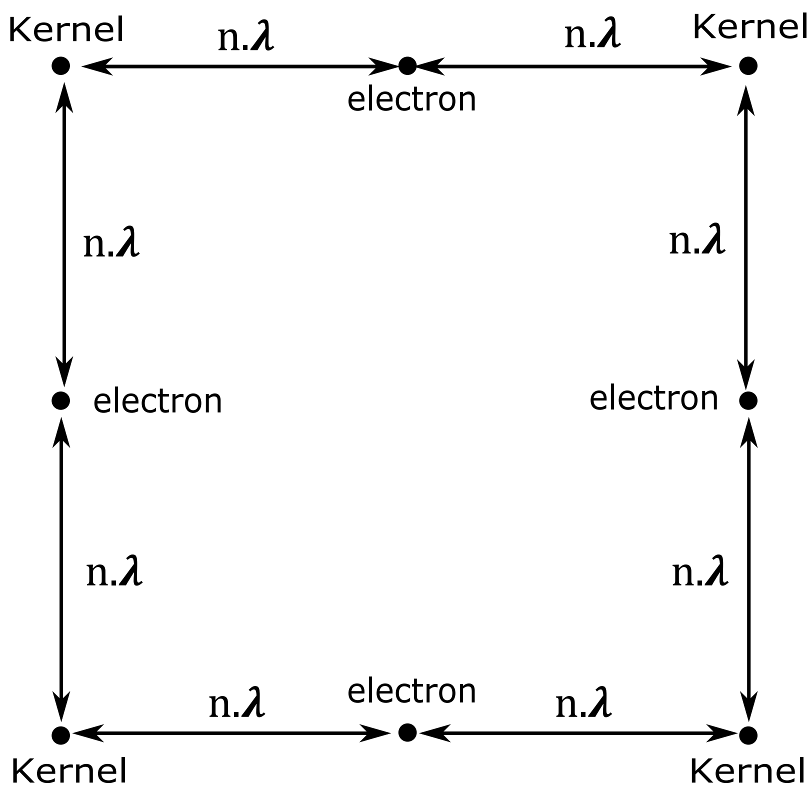

Figure 1.45 : Net of atoms at rest
The distance between the kernels and the covalent electrons is a multiple of λ

12.3 Standing waves formed within a net of moving atoms

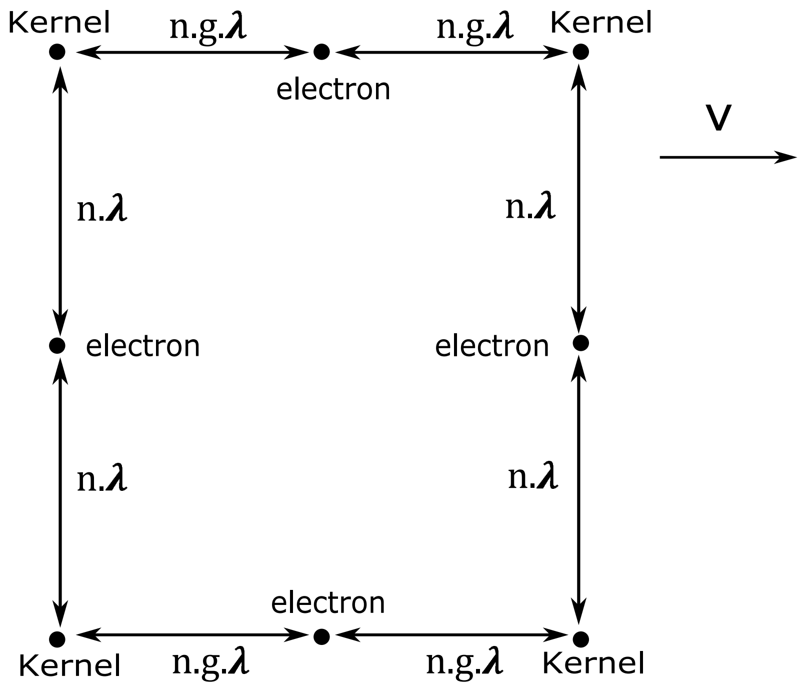

Figure 1.46 : Net of moving atoms.
The distance between the kernels and the covalent electrons is a multiple of $g.\lambda$ on the longitudinal axis of the movement.

12.4 Consequences on the matter's dimensions

The atoms are at rest, their distances to each other are linked with the wave length λ of the covalence connection.

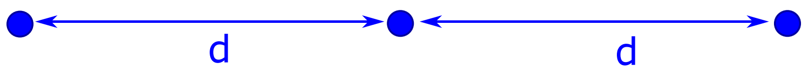

Figure 1.47 : Net of atoms at rest

The atoms are moving, their distance to each other contract according to the g factor on the longitudinal axis of the movement.

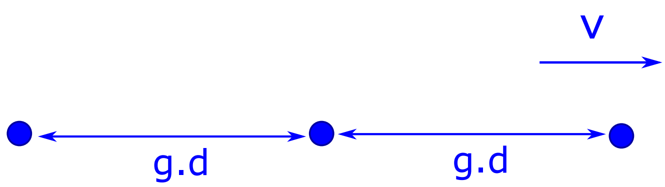

Figure 1.48 : Net of moving atoms

Chapter 13

Final conclusion

We started our presentation by exposing the relation between the Lorentz transformations on one hand, and on the other hand the contraction of matter and also the slowdown of the mechanisms within matter due to its movement.

We are now allowed to express the things a more subtle way. **The Lorentz transformations are in the first instance the mathematical expression of the influence of movement on waves** and their properties: speed, frequency, magnitude and phase though we didn't focus on the two last points. It is in the first instance an expression of the influence of the Doppler Effect on waves and their properties.

The variables x and x' on the one hand, t and t' on the other hand, express in the first instance the length of the waves and the period of the waves. As matter is made of waves, we can then use the same variables and the same Lorentz equations to measure a distance or a time, and to relate them for an object alternatively being at rest and moving. As the net of the standing waves of matter contracts, the length of matter contracts too. As the mechanisms of matter slow down, the process to make a time measurement will slow down too, making the illusion of a contraction of time itself. A moving clock won't show the same time than a resting one, two clocks moving a different way won't also give the same time.

We shouldn't consider space-time as a geometric locus, but rather space as a physical middleware and time as a variable representing the activity in the universe.

The Wave middleware has intrinsic properties: the constant speed of light or of any electromagnetic wave is one of them. Let us mention some other ones like the Planck constant or the vacuum permittivity that we would rather call the middleware permittivity.

When matter moves, it does contract in the way of its movement, its mechanisms also slow down. The seeming symmetry and the relativity of the observer's point of view hide the reality of the phenomena. We should at least not consider the point of view of an observer as a criterion of reality, but rather as the only way to make any measures in our environment to quantify it. This is whatever the only way to make some physical measurements as far as the still and resting position in the Wave middleware is impossible to reach for any observer.

There is no contraction of space, nor dilatation of time, but rather and more basically a contraction of matter and a slowdown of its mechanisms. A material object behaves like a net of standing waves connecting atoms to each other, and also emerging from the waves of matter made by the atoms themselves. The frequency and period of the waves are influenced by their movement, like is matter.

This new approach to relativity, to the Lorentz transformations, to matter and waves aims at opening a new way to model mechanics and electromagnetism. It would allow us to build some kind of neo-Newtonian approach of mechanics. Classical mechanics could be renewed by our approach and related again with the great discoveries made in the 20th century by Albert Einstein, his contemporaries and his successors (see also the annex **Doppler Mechanics** for further explanations). Our hope is to take part of the research and physics discussions, to open some new research prospects as fundamental physics faces problems to unify its two main branches built around relativistic mechanics and quantum mechanics, and to participate in a better understanding of physics.

Appendix A

Doppler Mechanics

In this annex, we will propose some new approach to wave mechanics, by highlighting the relations between waves, mass and inertia. We will use the notion of **waves of matter**.

A.1 Active and reactive mass

Let us distinguish the waves of matter located behind the associated mass, and the ones located in front of it.

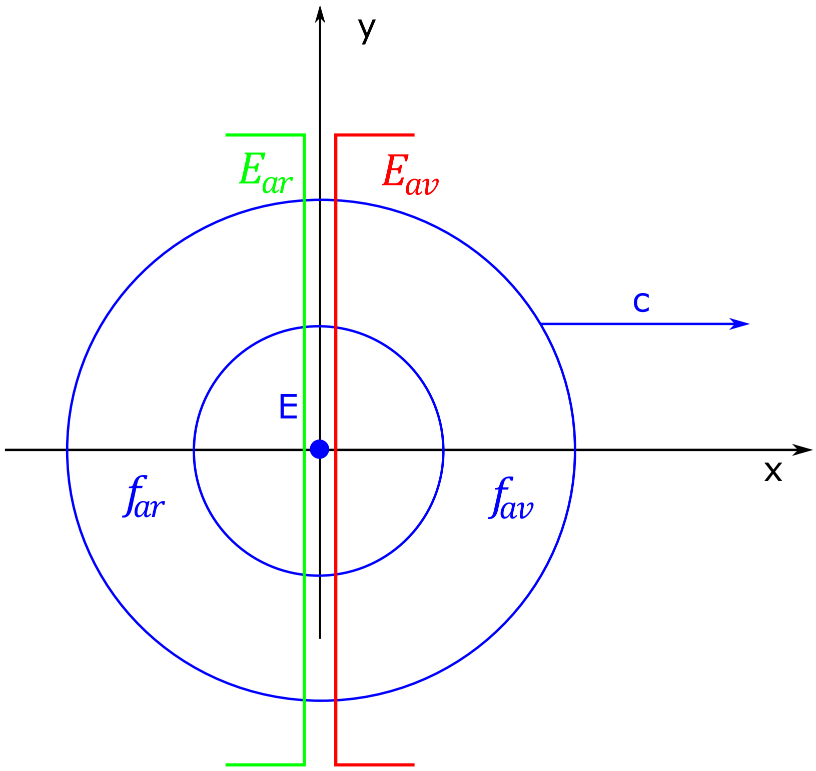

Figure 1.49: At rest mass and its associated waves

For a resting object:

$$E = E_{av} + E_{ar} = m.c^2$$

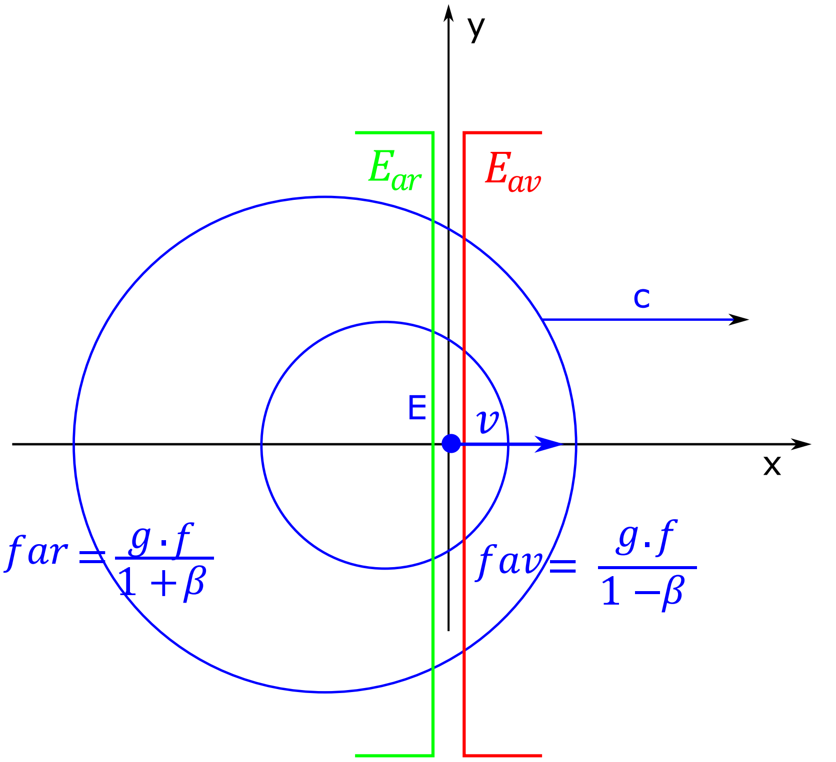

Figure 1.50: Moving mass and its associated waves

For a moving object:

$$E = E_{av} + E_{ar} = \frac{m.c^2}{g}$$

$$\beta = v/c$$

$$g = \sqrt{1 - \beta^2}$$

A.1.1 Energetic balance for an object at rest

The energy contained in an object at rest is given by the Einstein's formula giving the equivalence between energy and mass:

$$E = m.c^2$$

Let us now make the difference between active mass and reactive mass; as well as between the energy we can associate with them. The former corresponds to the energy contained in the front wave, the latter in the backward wave. They are equal for an object at rest.

When a mass is at rest, we have basically:

$$E_{av} = E_{ar}$$

$$E_{av} + E_{ar} = m.c^2$$

This leads to:

$$E_{av} = \frac{m.c^2}{2}$$
$$E_{ar} = \frac{m.c^2}{2}$$

Assuming that the energy of a signal is proportional with its frequency leads us to:

$$E_{av} = \frac{m.c^2}{2} = A.f$$
$$E_{ar} = \frac{m.c^2}{2} = B.f$$

Where: A=B for symmetric reason.

A.1.2 Energetic balance for a moving object

The energy contained in a moving object is given by the following relativistic formula:

$$E = \frac{m.c^2}{g}$$

Assuming that the energy of a signal is proportional with its frequency leads us to:

$$E_{av} = C.\frac{g.f}{1-\beta}$$
$$E_{ar} = D.\frac{g.f}{1+\beta}$$

Conservation of energy :

Let us use the principle of energy conservation to write an equation where the ratio of the front and backward energies for an object at rest equals to the ratio of the front and backward energies for a moving object:

$$\frac{E_{av_{mvt}}}{E_{av_r}} + \frac{E_{ar_{mvt}}}{E_{ar_r}} = \frac{E_{mvt}}{E_r} = \frac{\frac{m.c^2}{g}}{m.c^2} = \frac{1}{g}$$

This leads to:

$$\frac{C}{A}.\frac{\frac{g.f}{1-\beta}}{f} + \frac{D}{B}.\frac{\frac{g.f}{1+\beta}}{f} = \frac{1}{g}$$
$$\frac{C}{A}.\frac{g}{1-\beta} + \frac{D}{B}.\frac{g}{1+\beta} = \frac{1}{g}$$
$$\frac{C}{A}.(1+\beta) + \frac{D}{B}.(1-\beta) = 1$$

Let us note one particular and trivial solution for this equation:

$$\frac{C}{A} = \frac{D}{B} = \frac{1}{2}$$

This leads to:

$$E = \frac{m.c^2}{g} = (\frac{1}{2}.\frac{g}{1-\beta} + \frac{1}{2}.\frac{g}{1+\beta}).m.c^2 = (m_a + m_r).m.c^2$$

For a moving object having m for mass, its energy split into a front and backward wave due to the Doppler Effect like follows:

$$E = E_{av} + E_{ar} = m_a.c^2 + m_r.c^2$$

$m_a = \frac{1}{2}.\frac{g}{1-\beta}.m$ is the active mass

$m_r = \frac{1}{2}.\frac{g}{1+\beta}.m$ is the reactive mass

This leads to the following equation:

$$\frac{E_{av}}{E_{ar}} = \frac{f_{av}}{f_{ar}} = \frac{1+\beta}{1-\beta}$$

A.1.3 Application to the elastic collision

Classical representation

Before the collision:

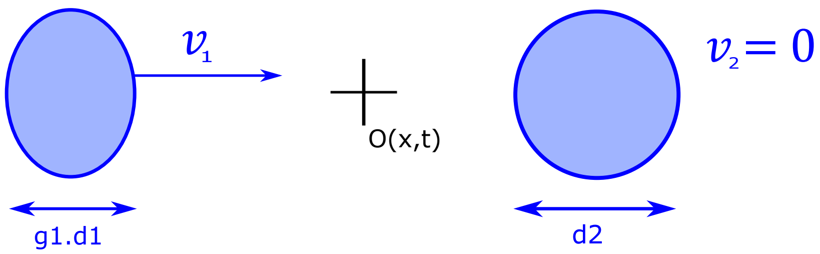

Figure 1.51:
The object M1 having for mass m_1 is moving to M2

$$E_{m1} = \frac{m_1.c^2}{g_1} = \frac{1}{2}.\frac{g_1}{1-\beta_1}.m_1.c^2 + \frac{1}{2}.\frac{g_1}{1+\beta_1}.m_1.c^2$$

$$E_{m2} = m_2.c^2 = \frac{m_2.c^2}{2} + \frac{m_2.c^2}{2}$$

After the collision:

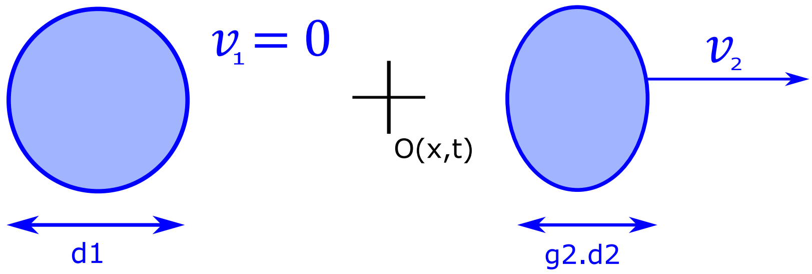

Figure 1.52:
The object M1 has been stopped by the collision with M2 while the latter has been put in movement

$$E_{m1} = m_1.c^2 = \frac{m_1.c^2}{2} + \frac{m_1.c^2}{2}$$

$$E_{m2} = \frac{m_2.c^2}{g_2} = \frac{1}{2}.\frac{g_2}{1-\beta_2}.m_2.c^2 + \frac{1}{2}.\frac{g_2}{1+\beta_2}.m_2.c^2$$

Energy balance for an elastic collision:

$$\frac{m_1.c^2}{g_1} + m_2.c^2 = m_1.c^2 + \frac{m_2.c^2}{g_2}$$

Momentum balance for an elastic collision:

$$\frac{m_1.v_1}{g_1} + \frac{m_2 * 0}{g_2} = \frac{m_1 * 0}{g_1} + \frac{m_2.v_2}{g_2}$$

$$\frac{m_1.v_1}{g_1} = \frac{m_2.v_2}{g_2}$$

Considering forces, we will use the classical expression:

$$F = \frac{dp}{dt} = \frac{d}{dt}(\frac{m.v}{\sqrt{1-(\frac{v}{c})^2}})$$

With:

$$v = \frac{dx}{dt}$$

If we consider the two dynamic masses given by $\frac{m_1}{g_1}$ and $\frac{m_2}{g_2}$, and also their reference frame having for center their mobile center of gravity, we will then be allowed to write the following equation in this reference frame:

$$F_{12} = F_{21}$$

$$\frac{dp_1}{dt} = \frac{dp_2}{dt}$$

$$\frac{d}{dt}\left(\frac{m_1.v_1}{\sqrt{1-(\frac{v_1}{c})^2}}\right) = \frac{d}{dt}\left(\frac{m_2.v_2}{\sqrt{1-(\frac{v_2}{c})^2}}\right)$$

Representation with the waves of matter

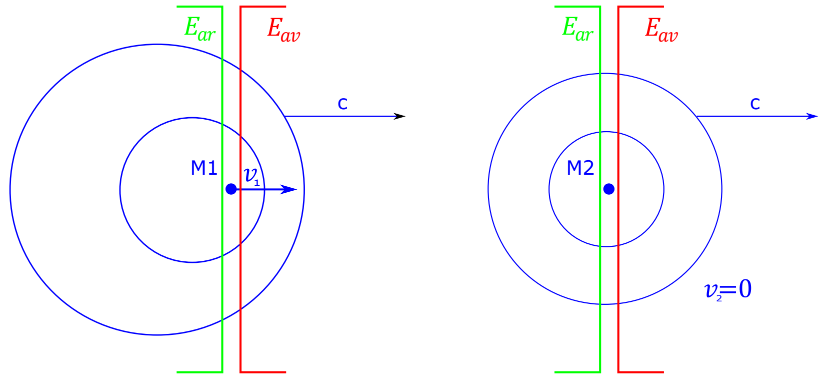

Figure 1.53: Before the collision

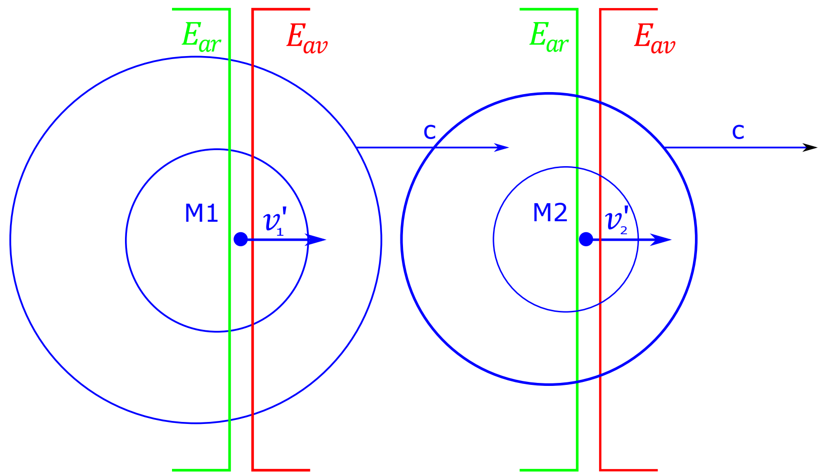

Figure 1.54: During the collision

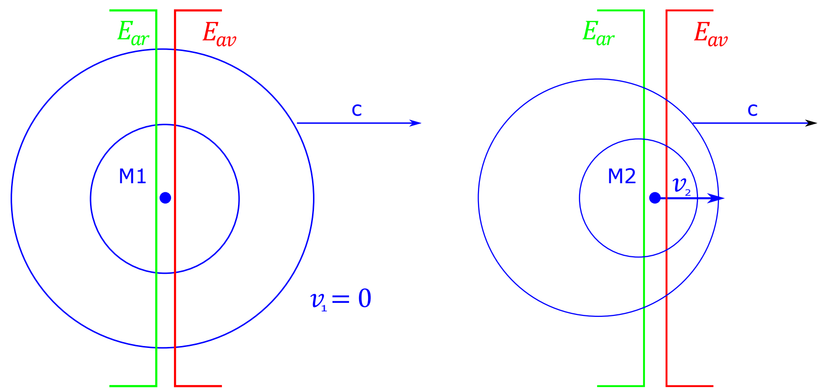

Figure 1.55: After the collision

A.2 Discussion

From our point of view, there is an equivalence between an energy transfer and a dynamic mass transfer during an elastic collision. The mass can be split into an active and a reactive one, which are increased by the momentum acquired during the collision. According to the momentum balance equation, it is possible to relate the four variables β_2, β_1, m_1 and m_2 and therefore calculate one mass according to the other one and their respective speeds before and after the collision, for example.

These equations are similar with the ones used in classical special relativity, nevertheless our physical interpretation of the phenomenon is different. We consider that the dynamic mass can be split into two masses, one active and another one reactive, like we can split the global energy of the waves into the fraction contained in the front waves and the fraction contained in the backward waves.

Moreover, let us point out the existence of an electrodynamics field between the two coexisting waves of matter, being the locus where the energy transfer is made possible. This electrodynamics field would not only be dynamic, but would also typically evolve with the reverse squared distance between the two centers of the both emitting and receiving waves of matter.

The energy transfer is not instantaneous, but rather depends on the waves of matter running at the speed of light's absolute value. The idea of an instantaneous collision of classical mechanics has to be renewed for the idea of a dynamic mass and energy transfer at the speed of light, which can be qualified as a quasi-instantaneous collision.

Let us finally notice that we have considered the periodic waves of matter, their phase and frequency, but we haven't made any assumption on their magnitude. If their magnitude quickly decreased with the distance of their emitting point, then the energy transfer would not only proceed at the speed of light, but would also proceed over very short distances, typically over interatomic distances where valence bonds occur.

A.3 Kinetic energy

We will now expose a new formula for kinetic energy, according to the energy balance in a relativistic context. The global energy for a mass m moving at the speed of β is given by:

$$E_{tot} = E_{repos} + E_c$$

This leads to:

$$\frac{m.c^2}{g} = m.c^2 + E_c$$

$$E_c = \frac{m.c^2}{g}.(1-g)$$

For relativistic speeds, we have $\frac{v}{c} \rightarrow 1$, that is: $g \rightarrow 0$, this leads to:

$$\lim_{v \to c} E_c = \lim_{g \to 0} E_c = \lim_{g \to 0} \frac{m.c^2}{g}.(1-g)$$
$$\lim_{g \to 0} E_c = \lim_{g \to 0} \frac{m.c^2}{g}$$

Let us introduce the Lorentz factor g within the classical formula of kinetic energy for a mass m moving at the speed of β. This leads to:

$$E_c = \frac{1}{2}.\frac{m}{g}.v^2$$

More over:

$$g = \sqrt{1 - (\frac{v}{c})^2}$$
$$v^2 = c^2.(1-g^2)$$

Equivalent to:

$$E_c = \frac{1}{2}.\frac{m.c^2}{g}.(1-g^2)$$

This leads when $g \to 0$ to:

$$\lim_{v \to c} E_c = \lim_{g \to 0} E_c = \lim_{g \to 0} \frac{1}{2}.\frac{m.c^2}{g}.(1-g^2)$$
$$\lim_{g \to 0} E_c = \lim_{g \to 0} \frac{m.c^2}{2.g}$$

For relativisitc speeds, we can point out a difference of the kinetic formula between the classical but revisited expression and the one in a relativistic context. This difference turns around a factor of: $\frac{1}{2}$

For non-relativistic speeds, that is when $\frac{v}{c} \to 0$ and $g \to 1$, we have:

According to the relativistic expression:

$$\lim_{v \to 0} E_c = \lim_{g \to 1} E_c = \lim_{g \to 1} \frac{m.c^2}{g}.(1-g)$$
$$\lim_{v \to 0} E_c = 0$$

According to the classical expression:

$$\lim_{v \to 0} E_c = \lim_{v \to 0} \frac{1}{2}.m.v^2$$
$$\lim_{v \to 0} E_c = 0$$

Proposition of Gabriel Lafrénière

In a surge of intuition, Gabriel Lafrénière proposes a renewed version for the kinetic energy formula, by integrating the speed of a moving mass a more subtle way.

The idea is to notice that the Lorentz factor ranges from 0 to 1. It is then possible to relate the factor of $\frac{1}{2}$ with the Lorentz factor by using the following expression:

$$E_c = \frac{m.v^2}{g}.\frac{1}{1+g}$$

Considering this new kinetic formula, we can accommodate the classical and the relativistic expression of it. Indeed:

$$\lim_{v \to c} E_c = \lim_{g \to 0} \frac{m.v^2}{g}.\frac{1}{1+g}$$

$$\lim_{g \to 0} E_c = \lim_{g \to 0} \frac{m.c^2}{g}$$

For relativistic speeds, the global energy of a moving mass is mostly its kinetic energy. The classical but revisited formula for kinetic energy is then in concordance with the relativistic expression of it.

Note: For an elastic collision we can then establish the following equivalence between:

$$\frac{m_1.c^2}{g_1} + m_2.c^2 = m_1.c^2 + \frac{m_2.c^2}{g_2}$$

And:

$$\frac{m_1.v_1^2}{g_1.(1+g_1)} + m_1.c^2 + m_2.c^2 = m_1.c^2 + \frac{m_2.v_2^2}{g_2.(1+g_2)} + m_2.c^2$$

That is:

$$\frac{m_1.v_1^2}{g_1.(1+g_1)} = \frac{m_2.v_2^2}{g_2.(1+g_2)}$$

For non-relativistic speeds, our new expression of kinetic energy allows us to retrieve the classical one. Indeed:

$$\lim_{v \to 0} E_c = \lim_{g \to 1} \frac{m.v^2}{g}.\frac{1}{1+g}$$

$$\lim_{v \to 0} E_c = \frac{1}{2}.m.v^2$$

The expression of the kinetic energy in classical mechanics may be considered as a simplified expression when the relativistic effects can be neglected.

Appendix B

The relativistic Doppler Effect with a moving emitter and receiver

In this annex, we will make a short study of the relativistic Doppler Effect when the emitter is moving away and the receiver is moving in the same direction than the emitter. This example brings us closer to the experimental conditions for a study of the cosmic Redshift.

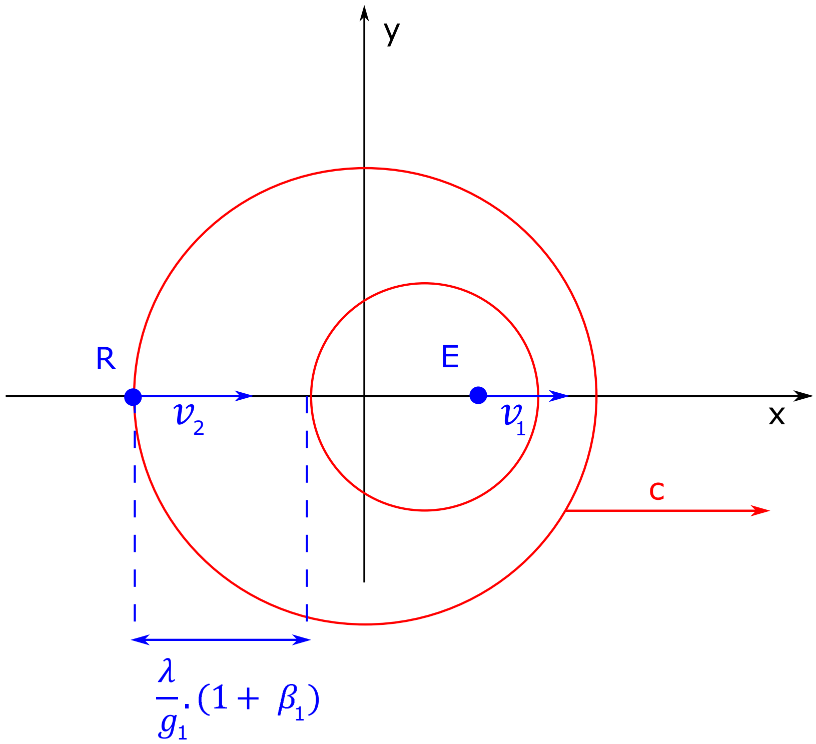

Figure 1.56: The emitter and the receiver are moving, the emitted wave is light or any electromagnetic wave

Let us call β_1 the speed ratio of the emitter, β_2 the speed ratio of the receiver, λ the wavelength of the emitter

If we consider the absolute Doppler Effect for the emitter, its movement at the speed of β_1 implies a backward wave with the following wavelength:

$$\lambda_{ar} = \frac{\lambda}{g_1}.(1+\beta_1)$$

If we consider the relative Doppler Effect for the receiver, we have to take into account the two following aspects linked with its speed:

- The speed β_2 of the receiver
- The modification of its equivalent receiving frequency from f_r to $g_2.f_r$ for any frequency, in other words for its equivalent receiving wavelength from λ_r to λ_r/g_2

This leads to the following equation for the wavelength like it is perceived by the receiver:

$$\frac{\lambda_r}{g_2} = \frac{\lambda}{g_1}.\frac{1+\beta_1}{1+\beta_2}$$

$$\lambda_r = \frac{g_2}{g_1}.\lambda.\frac{1+\beta_1}{1+\beta_2}$$

$$\lambda_r = \lambda.\frac{\sqrt{(1-\beta_2).(1+\beta_2)}}{\sqrt{(1-\beta_1).(1+\beta_1)}}.\frac{\sqrt{(1+\beta_1)^2}}{\sqrt{(1+\beta_2)^2}}$$

$$\lambda_r = \lambda.\sqrt{\frac{(1-\beta_2).(1+\beta_1)}{(1-\beta_1).(1+\beta_2)}}$$

By using the same method, we will establish that :

- When the emitter is moving away and the receiver is moving in the opposite direction (mutual distancing):

$$\lambda_r = \lambda.\sqrt{\frac{(1+\beta_2).(1+\beta_1)}{(1-\beta_1).(1-\beta_2)}}$$

- When the emitter is approaching and the receiver is moving in the same direction:

$$\lambda_r = \lambda.\sqrt{\frac{(1+\beta_2).(1-\beta_1)}{(1+\beta_1).(1-\beta_2)}}$$

- When the emitter is approaching and the receiver is moving in the opposite direction (mutual approaching):

$$\lambda_r = \lambda.\sqrt{\frac{(1-\beta_2).(1-\beta_1)}{(1+\beta_1).(1+\beta_2)}}$$

Appendix C

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Appendix D

About

This publication is based on the LaTeXmodel thesis of Sunil Patel :
http://www.sunilpatel.co.uk/thesis-template/

The graphics have been realized with Inkscape :
https://inkscape.org/

The programs are customized versions of the Gabriel Lafrénière's original programs, made with FreeBasic :
https://www.freebasic.net/