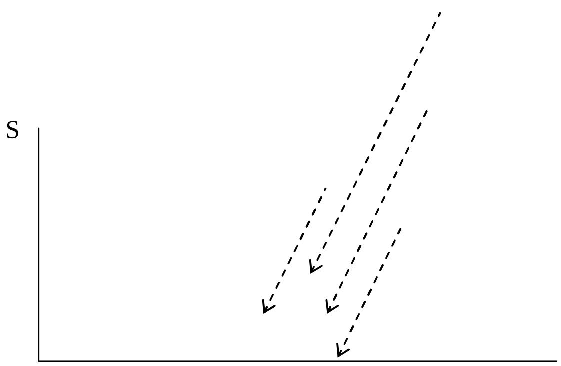
8 - Aberration of light.

This section will study some consequences of assuming the "Assertion c" about the speed of light introduced in Section 6. Summarizing the idea behind such assertion:
According to the model, a standard light source emits simultaneously many "lights" (equally modulated disturbances) of different speeds relative to the emitter but "only the light-type disturbance of speed c *relative to the elementary physical detector* manifests its features (wavelength, modulation, polarization,…) at the detector". The light detectable by an *elementary* physical detector (e.g. by an electron) is of course that of speed c ($\cong 3*10^8$ m s^{-1}) relative to the elementary detector. With those assumptions, the observed *constancy of the speed of light* can be explained within a model in which the Galileo transformation is assumed to be valid.
Note: such supposition is called an *assertion* (instead of an *hypothesis*) because it can be deduced from more fundamental hypothesis of the model.

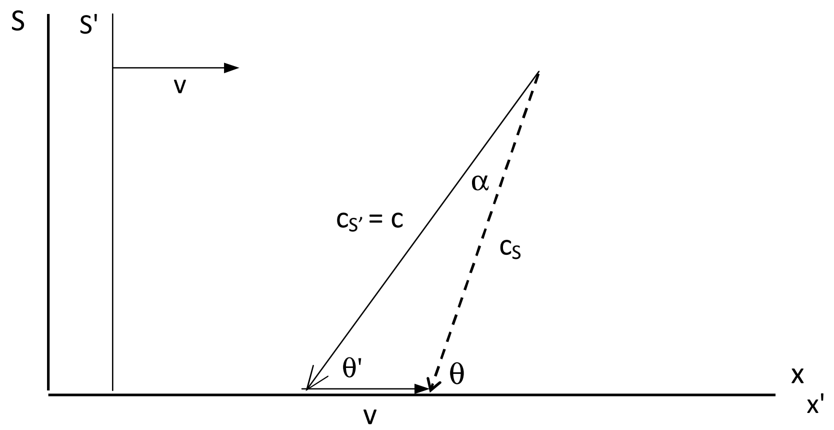
Angular aberration.

(The analysis will be limited to two dimensions).
Let θ be the direction in which a telescope sitting in a reference frame S must be pointed to see a given star. θ is the angle that the axis of the telescope makes with the x axis of S.
It is asked: in which direction θ' must be aligned a telescope sitting in another reference frame S' to see the same star ?.
Suppose that S' moves at speed v along the x axis of S.

- In the simple case in which the reference frame S is also the rest frame of the observed star, the sought direction θ' of the telescope associated with S' is easily deduced with the assumption that the "photons" detected by the telescope sitting in S' are those of speed c relative to S' (assertion c):



Fig[8-1]



Fig[8-2]

The Fig[8-1] represents, in the reference frame S, "lights" of different speeds arriving to a telescope sitting in S. Those light-type disturbances have been emitted at different epochs from a given star. Since they all reach the observer S with the same angle it must be supposed that the star has not moved sensibly relative to S during all the time interval in which those lights were emitted.

The Fig[8-2] shows a light of velocity $\mathbf{c_S}$ relative to S that has therefore a velocity $\mathbf{c_{S'}} = \mathbf{c_S} + (\mathbf{-v})$ relative to S'. To be detected by S' this light must have a speed $|\mathbf{c_{S'}}| = c$ relative to S'. The angle θ' that this light, detectable by S', makes with the axis x' can be obtained from:

The sine theorem gives

$$\frac{\sin\alpha}{v} = \frac{\sin(\pi - \theta)}{c} \qquad [8\text{-}1]$$

but $\alpha = \theta - \theta'$ and $\sin(\pi - \theta) = \sin\theta$ therefore:

$$\sin(\theta - \theta') = \frac{v}{c}\sin\theta \qquad [8\text{-}2]$$

Notice here (and below) that the formulas for the aberration proposed by the model do not take into account the velocity of the reference frames S and S' relative to the aether. The formulas do depend on the velocity of the observed star relative to these frames used in the discussion.

Eq[8-2] is different from the classical expression of the aberration that assumes an aether associated with S and therefore a light speed c in S but not in S'.

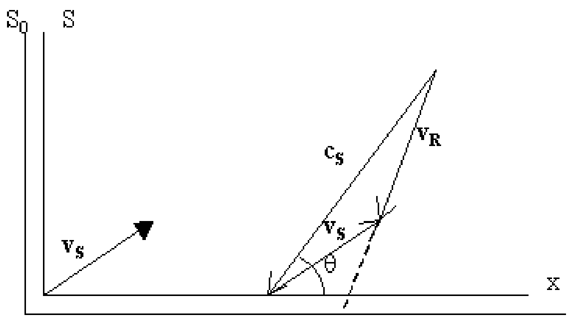
The following is an expression giving the angular aberration according to the Special theory of Relativity:

$$\operatorname{Sin}\theta' = \frac{\operatorname{Sin}\theta\sqrt{1-v^2/c^2}}{1+\frac{v}{c}\operatorname{Cos}\theta} \qquad [8\text{-}3]$$

It can be seen that for $\theta = \pi/2$ the proposed expression [8-2] predicts the same value of θ' as the relativistic formula of angular aberration. For v/c of the order of say 0.1 or smaller the Eq[8-2] does also give very similar predictions to the relativistic formula whatever θ.

- In a more general case let S_0 (different from S) be the reference frame in which the observed star is at rest. Let this star be somewhere in the XY plane of S_0. Suppose that S moves at a velocity $\mathbf{v_S}$ relative to S_0 and that again S' moves relative to S at a velocity $\mathbf{v}$ along its X axis. Let the X and Y axis of the 3 frames be aligned.
Let the x and y components of $\mathbf{v_S}$ and $\mathbf{v}$ be respectively:
Components of $\mathbf{v_S}$ in S_0 $\quad \mathbf{v_S} = \{v_{SX}, v_{SY}\}$ $\quad$ with $v_{SY} \neq 0$
Components of $\mathbf{v}$ in S $\quad \mathbf{v} = \{v, 0\}$

A first part of the problem consists in finding some vector of S_0 whose direction joins the star with the position of S_0 in which the detection will simultaneously be made by both the S and the S' telescopes. Let $\mathbf{v_R}$ be such vector representative of the direction along which travel in S_0 all the radiation flows (lights of different speeds) and in particular those that will be detected by the telescopes sitting in S and in S'.



Fig[8-4]

$\mathbf{c_S}$ is the vector of modulus c (assertion c) representing the velocity of the light detected in S (that makes an angle θ with the x axis) . From Fig[8-4]:

$$\mathbf{v_R} = \mathbf{c_S} + \mathbf{v_S} \qquad [8\text{-}5]$$

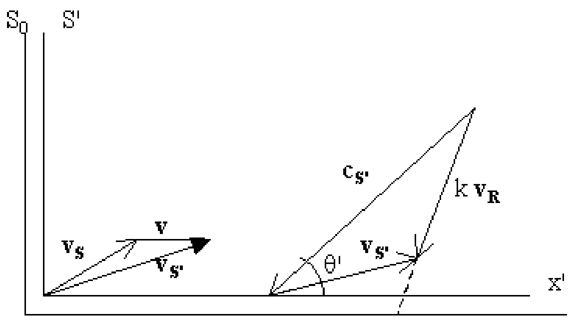
whose components are:

$$v_{RX} = -\,c\operatorname{Cos}\theta + v_{SX}$$
$$v_{RY} = -\,c\operatorname{Sin}\theta + v_{SY} \qquad [8\text{–}6]$$

According to the above suppositions, the velocity of the frame S' relative to the frame S_0 associated with the observed star is:

$\mathbf{v}_{S'} = \mathbf{v}_S + \mathbf{v}$ [8-7]

From the knowledge of this velocity and of the direction of $\mathbf{v}_R$ along which travel the radiation flows in S_0 it can now be deduced the direction θ' of S' along which must be aligned its telescope. It will again be admitted (assertion c) that the radiation flows detected by the telescope of S' are those of speed c relative to S'.



Fig[8-8]

$\mathbf{c}_{S'}$ is the vector of modulus c (assertion c) representing the velocity of the light detected in S' (that makes an angle θ' with the axis X'). Therefore from Fig[8-8]:

$\mathbf{c}_{S'} = k\,\mathbf{v}_R - \mathbf{v}_{S'}$ [8-9]

with the condition:

$|\,\mathbf{c}_{S'}| = c$ [8-10]

from the knowledge of the x and y components of $\mathbf{v}_R$ and $\mathbf{v}_{S'}$ and therefore of $\mathbf{c}_{S'}$ the condition [8-10] takes the form:

$c^2 = [k\,(- c \,\mathrm{Cos}\,\theta + v_{SX}) - v_{SX} - v]^2 + [k\,(- c\,\mathrm{Sin}\,\theta + v_{SY}) - v_{SY}]^2$ [8–11]

which allows to express the accessory constant k in terms of given magnitudes.

Finally the angle θ' of aberration observed by S' can be given by:

$$\mathrm{Sin}\,\theta' = \frac{-c_{S'Y}}{c} = -\frac{k\,(v_{SY} - c\,\mathrm{Sin}\,\theta) - v_{SY}}{c}$$ [8-12]

where k must be obtained from [8-11].

NOTE 8-1

Two different expressions for Sin θ' can be obtained (corresponding to the 2 possible solutions of k in Eq[8-11]). These expressions are a bit lengthy to be included here. One of them predicts aberration angles in S' *similar* to those predicted by the Special Theory Relativity (Eq[8-3]) as can be seen in the following table:

	θ = 45°	θ = 90°	θ = 135°	θ = 180°
$v_{SX}=0,\ v_{SY}= c/3$	20.174	41.253	20.175	-13.751
$v_{SX}=c/3,\ v_{SY}= 0$	38.167	41.254	23.606	0
$v_{SX}=0,\ v_{SY}= 0$	29.170	41.253	29.170	0
Relativity [8-3]	29.168	41.253	29.172	0

Aberration (θ–θ') in seconds of arc for $v = 2.10^{-4}\,c \cong 60\ Km\ s^{-1}$

Notice that the first two rows of the table give the prediction for very high speeds (1/3 c) of the observed star (or rather galaxy) relative to the frame S in which θ is measured. The prediction is in some of these values very different from that of Relativity. Nevertheless to check this prediction the astronomer must be sure that the observed star is (was) moving at very high speeds relative to the Earth. In section 9 it is defended that according to the model the red shift by itself is not a guarantee of relative speed.

Temporal aberration.

Let θ be the direction in which a telescope sitting in a reference frame S must be pointed to see a given star. θ is the angle that the axis of the telescope makes with the x axis of S.
Let t_E be the epoch of emission of the star's light that the S telescope is detecting at t=0.
It is asked: at what epoch t'_E was emitted the star's light that a second telescope sitting in another reference frame S' detects also at t=0 and at the same position?. (The time increment t_E - t'_E can be called "the temporal aberration" of the star between the frames S and S').
Suppose that at S' moves at speed v along the x axis of S.
Suppose that the telescope of S is placed at its origin of coordinates and suppose that at t=0 the telescope of S' is passing through this position (i.e. the origin of coordinates of S).
It will be supposed that the observed star has no significant movement relative to S, or more precisely that the star was in the same position of S at both passed pertinent epochs t_E and t'_E. Let then be *d* the distance of the star to the origin of S.

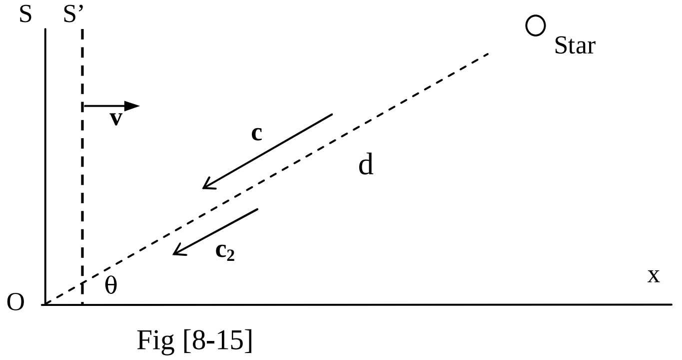


Fig [8-15]

The **c** of Fig [8-15] represents a “light” (also called "radiation flow" in the model) of velocity **c** relative to S.

The $\mathbf{c_2}$ is **also** a velocity relative to S. It represents a slower radiation flow also emitted by the star at an earlier epoch. The x and y components of this velocity relative now to S' are: $\{-c_2 \, \mathrm{Cos}\,\theta - v,\ -c_2 \, \mathrm{Sin}\,\theta\}$

The radiation flow (of aetherinos) detected by S at the epoch t=0 was emitted by the star at the epoch:

$$t_E = -\frac{d}{c} \qquad [8\text{-}16]$$

The radiation flow (of aetherinos) detected at the epoch t=0 by the 2nd telescope moving with S' was emitted by the star at an epoch t'_E that can be calculated solving the two following equations:

$$(c_2 \, \mathrm{Cos}\,\theta + v)^2 + (c_2 \, \mathrm{Sin}\,\theta)^2 = c^2 \qquad (\text{assertion c for S'}) \qquad [8\text{-}17]$$

$$t'_E = -\frac{d}{c_2} \qquad [8\text{-}18]$$

which gives:

$$t'_E = -d \, \frac{2v\,\mathrm{Cos}\,\theta + \sqrt{2}\sqrt{2c^2 - v^2 + v^2\,\mathrm{Cos}\,2\theta}}{2(c^2 - v^2)} \qquad [8\text{-}19]$$

For a given *d* and v, the absolute value of $| t_E - t'_E |$ takes its maximum values for $\theta = 0$ and $\theta = \pi$.

For example, for $\theta=0$ using [8-16] and [8-19] the "temporal aberration" adopts the simple expression:

$$t_E - t'_E = d\frac{v}{c^2 - c\,v} \qquad (\text{for } \theta = 0) \qquad [8\text{-}20]$$

Examples of observation of the temporal aberration.

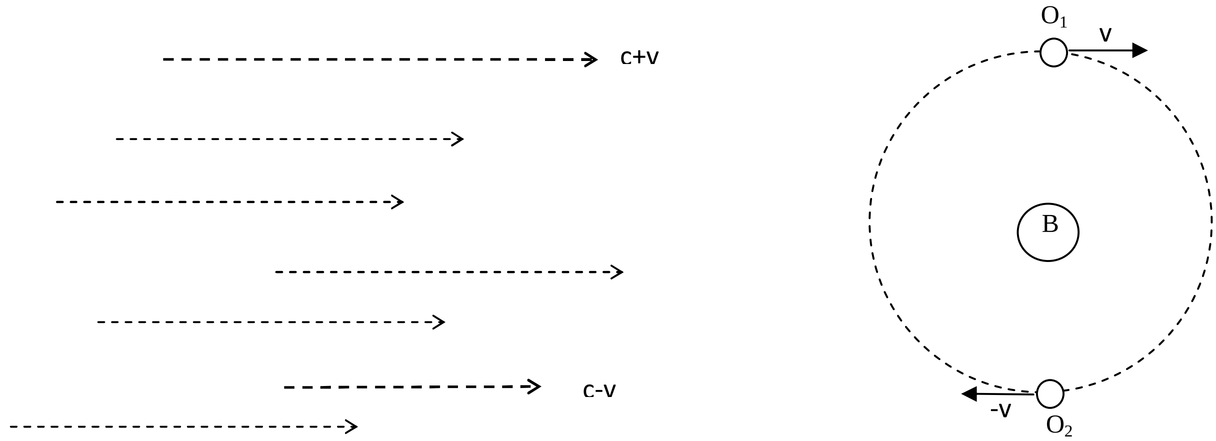


Fig [8-22]

Fig[8-22] represents "lights" of different speeds (broken lines), emitted at a distant star, arriving at two telescopes (O_1 and O_2).
Suppose for example that these telescopes (radiation detectors) are orbiting a central body B at a constant speed v.
Suppose for simplicity that the central body B is at all epochs at rest relative to the emitting star and at a distance *d* from it. Let B define the reference frame of description.
Suppose that t=0 is the epoch at which the telescopes are observing the distant star and suppose that at this epoch t=0 the telescope O_1 is moving at a speed v directly away from the star while the telescope O_2 is moving at a speed v directly towards the star. According to the "assertion c", the telescope O_1 will detect the light that has speed c relative to it and hence a speed c+v relative to the description frame B. Similarly the telescope O_2 will detect the light that has speed c relative to it and hence speed c-v relative to the description frame B.
The light being detected at t=0 by O_1 has travelled all the way from the distant star at a speed c+v relative to B. (Note: according to the model, all the "lights" move at constant velocities in the so called "rectilinear reference frames"). Similarly the light being detected at t=0 by O_2 has travelled all the way from the distant star at a speed c-v relative to B.
Therefore the light being detected by O_1 at t=0 was emitted by the star at the epoch:
$t_{E1} = 0 - d/(c+v)$
while the light being detected by O_2 at t=0 was emitted by the star at the epoch:
$t_{E2} = 0 - d/(c-v)$

The so called "temporal aberration" between the two telescopes will therefore be:

$$t_{E1} - t_{E2} = - d/(c+v) + d/(c-v) = 2 d v /(c^2-v^2) \qquad [8\text{-}22]$$

Examples:

1)
Suppose that the body B is our Sun and that O_1 is an earth-telescope observing the distant star at a given epoch $t_1=0$, while O_2 is an earth-telescope observing the distant star at an epoch t_2 , six months later than t_1, when the Earth is in the opposite side of its orbit. The time interval between the emission of the light detected by O_1 and that detected by O_2 is (subtracting half a year to the value given by [8-22]) will be, in years:

$$t_{E1} - t_{E2} = 2 d v /(c^2-v^2) - 0.5 \qquad [8\text{-}22a]$$

The orbital speed of the Earth around the sun is known to be $v = 30$ Km/sec = $1.0 *10^{-4}$ c
If the observed star (or rather galaxy) is for example at a distance $d=10^6$ light years from our solar system then the time interval between the emission of the light detected by O_1 and that detected by O_2 will be of approximately 199.5 years which is a negligible interval in the evolution time of a star or a galaxy but perhaps significant to observe changes in other celestial bodies.

2)
Suppose that the body B is the Earth and that O_1 and O_2 represent two opposite orbital positions of some earth-satellite carrying a telescope that observes the distant star.
For example suppose that the "satellite" is the ISS (International Space Station) that completes an orbit around the Earth every 92 minutes at an average speed (relative to the Earth) of approximately $v = 7.7$ Km/sec = $2.6*10^{-5}$ c
The time interval between the emission of the light detected by O_1 and that detected by O_2 is (subtracting 46 minutes (i.e. 0.000087 years) to the value given by [8-22]) will be, in years:

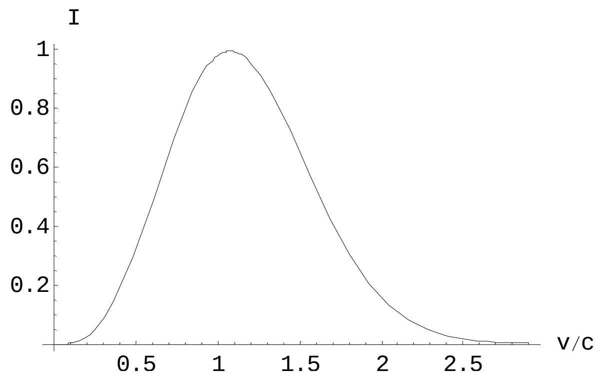
$$t_{E1} - t_{E2} = 2 d v /(c^2-v^2) - 8.7*10^{-5} \qquad [8\text{-}22b]$$

If the observed star (or rather galaxy) is for example at a distance $d=10^6$ light years from our solar system then, inputting $v=2.6*10^{-5}$ c , the time interval between the emission of the light detected by O_1 and that detected by O_2 will be of approximately 52 years which is a negligible interval in the evolution time of a star or a galaxy but perhaps significant to observe changes in other celestial bodies.

Recovering the modulation of the emitted radiation.

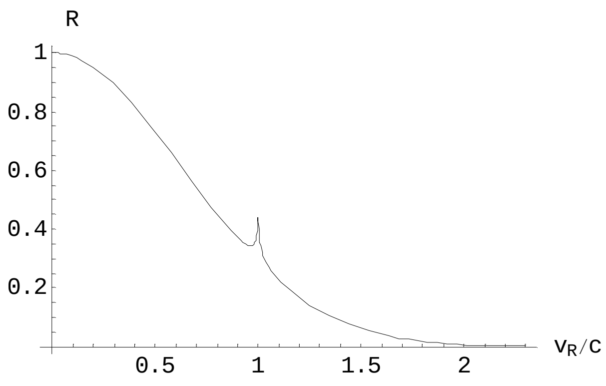
The description of light (or more generally of radiation) proposed in this work assumes that any ordinary emitter of light emits simultaneously many light-type disturbances in a wide continuum of speeds *relative to the emitter*. For the present analysis those "disturbances" can be thought as *wave trains* that move away from the emitter at different speeds.
The model also assumes that an ordinary detector of light has a response to those disturbances that depends on their speed *relative to the detector*, the reason being that the interaction cross section of the aetherinos (that are the vehicles of light) with the electrons (that are the elementary detectors) depends in a specific way on the relative speed v_R of the

colliding aetherinos. The global effect on the detector of the weighted addition of all the wave-trains is a disturbance (called light) that can be assigned a speed c relative to the detector.
Consider the emission by an ordinary emitter of a non coherent light of frequency ν.
Suppose that the emission lasts a long time.
Consider an ordinary detector of light placed at a big distance *d* away from the emitter.
Suppose that there is vacuum between the emitter and the detector. Suppose for simplicity that the emitter is at rest relative to the detector.
It can be expected, according to the model (see for example redistribs_eterinicas.pdf), that the intensities of the different light-type disturbances emitted by the emitter at the different speeds v (relative to the emitter) has a distribution similar to the one shown in the following Fig[8-24]:



Fig[8-24]

It can be expected, according to the model, that the "responsitivity" of a typical detector to a light-type disturbance of speed v_R relative to it is similar to that shown in the following Fig[8-25]:



Fig[8-25]

which is based on the hypothesis made by the model that the collision cross section of an electron with aetherinos of relative speed v_R is a function of the type:

[8-23] $\sigma[v_R] = a_1 \text{ Exp}[- b_1 v_R^2] + a_2 \text{ Exp}[-b_2 ((c-v_R)^2)^{1/4}]$

with $a_2 << a_1$, $b_1=1.255/c^2$, and b_2 of the order of $10/c^{1/2}$

Note: the cross section [8-23] is considered an *average* value *over all the directions* of space because the electron is supposed to have a non isotropic but axial structure due to which its interaction cross section with an aetherino depends on the direction of incidence of the aetherino relative to the axis of the electron. (See more in the papers redistribs_eterinicas_en.pdf and Eve11Anex.pdf).

Due to their “longitudinal” dispersion in space (because of their different speeds), the wave trains emitted during some given time interval $\{t_E, t_E+\Delta t\}$ do not all reach the distance *d* during an equally long interval $\{t, t+\Delta t\}$ at the later epoch $t=t_E + d/c$. One could then think that when adding this longitudinal dispersion to the angular dispersion (by which the intensity of a wave decays in 3-D space as $1/d^2$) the intensity of the light described by the model would decay with the distance faster than $1/d^2$, but a deeper analysis shows that, at least in the case of a non coherent monochromatic light of frequency ν, such additional decay does not take place. The reason is that in the detection interval being considered (i.e. in $\{t, t+\Delta t\}$) they arrive many other wave trains that, although they have been emitted at epochs earlier or later than $\{t_E, t_E+\Delta t\}$, they also contribute to strengthen the global wave (detected at $\{t, t+\Delta t\}$) since (1) they also have the frequency ν and since (2) the addition of a big number of waves of the same frequency but random phases creates a wave whose intensity increases as the number of component waves increases.

Note: In the case of adding a very big number n of waves of equal intensity I and equal frequency ν but random phases, it is well known that the result is a wave of the same frequency ν and of intensity n*I.

Demodulation of the radiation coming from distant emitters:

Suppose now that the carrier wave (of frequency ν) is modulated in intensity in some specific way. For example suppose that the emitter emits at all epochs a carrier wave of intensity I except during some short time interval $\{t_E, t_E+\Delta t\}$ (being $\Delta t >> 1/\nu$) in which it emits with a much higher intensity I_P. According to the model of light, the pulse of light emitted at $\{t_E, t_E+\Delta t\}$(as do all the rest of “light type” disturbances emitted by an ordinary emitter) decomposes itself into a plurality of wave trains of different speeds. All these wave trains emitted during $\{t_E, t_E+\Delta t\}$ will participate of the higher intensity (compared with the wave trains emitted in other epochs) introduced by the emitted pulse but, since they have different speeds, only a few of these intense wave trains will arrive at the detector during the observation epoch $\{t, t+\Delta t\}$. Many other wave trains emitted before and after the interval $\{t_E, t_E+\Delta t\}$ of emission of the pulse will be arriving simultaneously at the detector at the observation epoch but these other wave trains will not carry the modulation (i.e. they

will not have the high intensities of the wave trains emitted during $\{t_E, t_E+\Delta t\}$). The result is that the emitted pulse gets dispersed along the path of propagation of light and is now not reinforced by wave trains emitted in other epochs as was the case with the carrier wave of frequency ν. Nevertheless, because an ordinary detector of light has a specially high response to the wave trains of speed close to c (relative to the detector), (see the resonance peak in Fig[8-25]), it is at the epoch $t= t_E+d/c$ that one can still expect to observe some signature of the emitted pulse if it is not too much obscured by the other non-pulsed wave trains arriving at the same time. The bigger the distance *d* between the emitter and the detector, the bigger will be the relative weight of the wave trains not modulated by the pulse arriving at the more favorable observation epoch and therefore the more obscured will be the modulation of the emitted wave.
Note: perhaps the reason why the SETI project has not yet found intelligently modulated radiations coming from space is because their modulations have been obscured due to the long distances travelled by the signal.

Remodulation of the radiation coming from distant emitters:

Method 1 (technically complicated).
The goal is to detect a good number of the modulated wave trains emitted *at a given epoch* $\{t_E, t_E+\Delta t\}$ with *different speeds* (that therefore arrive at our detectors at different epochs) and then add (recombine) all these detected signals (that should all have remnants of the modulation implemented at the given emission epoch) to obtain a signal in which the modulation is no longer obscured. Notice that with a single detector the modulation of the emission epoch being observed will be blurred in a much higher proportion by the other wave trains emitted at other epochs that reach simultaneously this detector. The above comments about the *Examples of observation of the temporal aberration* (see *Fig[8-22]*) suggests a possible way of tackling the problem. For example a sketch of a simple "intelligent" receiver apparatus could be as follows:
Suppose that we want to recover the modulation (if any) of a given radiation coming from a distant solar system. Let our receiver apparatus define the reference frame of description. Let *d* be the distance at which was the distant emitter from our receiver apparatus at the epoch t_E of the emission that we want to analyze. Our receiver will consist of three primary detectors that will be labeled D_0, D_1 and D_2. The detector D_0 will remain at all epochs at rest relative to the receiver as a whole. The detectors D_1 and D_2 will be moving at high speeds relative to our receiver but nevertheless remaining in the vicinity of it (e.g. moving back and forth). The detector D_1 will be configured to detect *and record* the incoming radiation when the detector is moving directly *away* from the emitter at some stable speed v_1 relative to the receiver as a whole (and hence relative to the description reference frame). Similarly, the detector D_2 will be configured to detect *and record* the incoming radiation when it is moving directly *towards* the emitter at some stable speed $-v_2$ relative to the receiver apparatus.
As said above (assertion c) a primary detector detects the wave trains that move at a speed c *relative to it*. More precisely, a primary detector has a especially high response (a peak) to the wave trains that move at a speed c relative to it.
Therefore, at an epoch of detection t:

the detector D_0 will mainly be detecting radiation emitted at the epoch $t_{E0} = t-d/c$
the detector D_1 will mainly be detecting radiation emitted at the epoch $t_{E1} = t-d/(c+v_1)$
the detector D_2 will mainly be detecting radiation emitted at the epoch $t_{E2} = t-d/(c-v_2)$
Therefore if the detectors, with the aid of some software (or with calibrated delay cables), are able to deliver, at any wanted later epoch, the information that they received at some specific epoch, then what the receiver apparatus must do is combine the recorded signals received by its detectors corresponding to the same *emission* epoch.
For example, suppose that the receiver apparatus wants to recover the modulation of an emission that was emitted by the distant emitter at the epoch t_E. Then:
the specific detection epoch t_i at which a generic detector D_i of speed v_i detects the emission emitted at the epoch t_E will be:

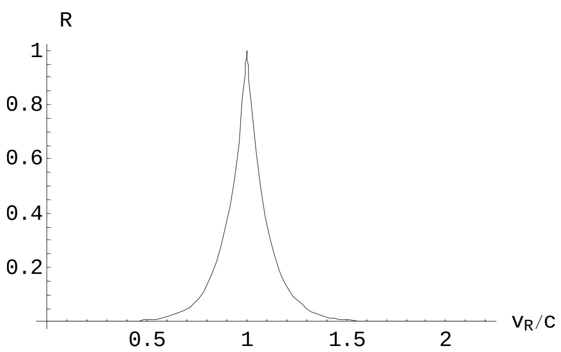
$$t_i = t_E + d/(c+v_i) \qquad [8\text{-}24]$$

(where v_i must be given a negative sign if the detector is moving directly *towards* (instead of *away from*) the emitter).

and combining the signals received by the primary detectors at their corresponding epoch t_i, it is expected that the modulation of the radiation emitted at the epoch t_E will become manifest.

Note: there should be vacuum between the emitter and a primary detector because if there is some "extinction medium" in between (like air, or water, or a thick glass,…) then the medium will be the primary detector and the speed of such medium (relative to the receiver apparatus) will condition which is the speed relative to the receiver of the light that it is detecting.

Note: There should be no suspicion by the reader that the "strange" response-function represented in Fig[8-25] (with a resonance centered at $v_R = c$) is an ad hoc hypothesis to reach the results of the present analysis. Many other simpler functions would lead to the same consequences (in what respects the present analysis) like for instance a response-function like the following Fig[8-25b] that was an old hypothesis of the model (later discarded for other reasons:



Fig[8-25b]

Method 2 (technically simpler).

Suppose now a single detector of light. Let this detector define the reference frame of description. The "more significant" light-type disturbances emitted by a distant emitter at an epoch t_E , when the emitter was at a distance *d* from the detector, will arrive at this detector at the epoch $t = t_E + d/c$ (assertion c). Those disturbances travelling at speed c relative to the detector are the "most significant" because a primary detector is highly responsive to the disturbances that reach it at a relative speed c.
Suppose that the emission being studied corresponds to a non-coherent light of frequency ν that was modulated in intensity with some specific modulation.
If the distance d emitter-detector is big, it can be expected (within the model of light propagation being defended) that the light detected at the epoch t (in spite that its more significant portion will correspond to the disturbance emitted at the epoch $t_E = t - d/c$) will have its modulation (the one implemented at the epoch t_E) hidden (obscured) by the immense majority of other disturbances (wave trains) also arriving at the detector at the same epoch (although with other, less responsive, speeds). The carrier wave of frequency ν made of the addition of a big number of non coherent wave trains of many speeds will dominate the signal at the detector. This "dominant signal" detected will appear to be a wave of frequency ν, changing phase φ, and average intensity I. Note: because the emitted wave was modulated in intensity, the instantaneous intensity I[t] detected is expected to vary in time (but in this model of light, if the emitter is very far away, those variations will be smoothed and will be relatively small at the detector).
Suppose now that, with the aid of an interferometer, a secondary wave of frequency ν, phase $\phi+\pi$ (i.e. opposite phase), and constant intensity I is added at all times to the arriving (primary) wave. (The interferometer will instantly build the secondary wave from the information of the primary wave by introducing a half-wave delay). When adding the secondary opposite phase wave to the primary one most of the primary wave will be cancelled (destructive interference). But the secondary wave must have a constant intensity I (of the same order of the *average* intensity of the primary wave). Such constant intensity will need to be implemented by some adequate intensity filter. Note: the secondary wave must not replicate the same intensity oscillations of the primary wave (i.e. it must not simply be the negative of the primary wave) because, if that was so, the destructive interference would result in a null wave. Having instead the secondary wave a constant intensity I it is expected that it will cancel most of the carrying wave letting the modulation "emerge".
Notice that *in the classic wave theory of light*, the intensity modulation of a wave "rides" completely on the (unique) carrier wave just changing here and there its amplitude but not affecting its phase. Therefore, if by some unknown reason the modulation of a *classic* wave became blurred without the carrier wave being also blurred, this method of making a primary wave interfere with a secondary opposite-phase wave of constant intensity would be useless to make the (supposedly blurred) modulation emerge because the secondary wave, being opposite in phase not only to the carrier wave but also to its amplitude changes (modulation), would also reduce the intensity of such supposed modulation. On the contrary, in the model of light proposed, the modulation to be recovered would be associated with a specific wave train (that of speed c relative to the detector) and this wave

train will not have in general the same phase as the global disturbance (made of the addition of many other wave trains) which is the one cancelled by the secondary wave.

Note: The calculations of this section have been made assuming that the pertinent radiation flows (lights) maintain during all their journey a constant speed when that speed is measured relative to a non accelerated frame.