On Aberration of Light and Reflection from Moving Mirrors

by

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Abstract

This paper challenges the possibility of electromagnetic waves might be reflected differently by moving mirrors in comparison to resting mirrors following a logic conclusion on Huygen's principle [1], thus the common law upon which the incident angel would equal the reflected angle would be not valid on such systems. A modified static ether concept [2] will be tested on the assumption that angles will be deflected in correlation of relative velocities of the transversal movement of the observation setup against the emerging center of one particular light wave front. Further on it will be demonstrated that reflection angles from any ray emerging from sources laying at the focal point of a parabolic mirror then will not be reflected parallel to the parable's axis but on a distinct differing angle that proves to be identical with the resultant angle of both velocity components of ray and mirror at any transversal movement of source and observer. Moreover it will be shown that this applies on multiple reflection between two parabolic mirrors with congruent focal point as in principle being used for laser arrays as well. Based on the results thereof and based on a modified static ether concept a possible approach to explanation of terrestrial and stellar aberration [3] will be shown, as well as an alternative solution for the results of the Michelson- Moreley-experiment [4] without stressing special relativity [5].

1. Introduction

The whole study is testing the assumption of a modified static ether concept. According to this concept, electromagnetic waves solely propagate with light velocity relative to the emission point of the wave front that is assumed to be resting in an absolute space [6]. Hence if the source is moving, each singular wave front will be undisturbed from the source's movement concerning its velocity and direction (in case of sectional wave fronts, beams). Therefore the reference system is based on the emission point of one wave front and will roam with the source's movement for any subsequent emission point. The concept, in the following being called absolute space concept, will contrarily to classic ether concepts need no medium to carry light waves for its feasibility.

All following examinations are based on the assumption that electromagnetic waves propagate as follows, and particularly as waves at all, whereby conclusions from the special relativity [5] will be excluded. Merely classic mechanic and dynamic principles will be applied:

- Individual light wave fronts move relatively to their emission point regarding velocity and direction, independently from the source's and observer's movement.

- Individual light wave fronts are not affected from each other and not tied together by a medium, contrarily to sound waves.
- The fixed reference system for each light wave front is only the emerging point of the said light wave front in space, not to be confused with the source's position or velocity.
- The classic Doppler- effect applies for any moving light source [7].
- The relative velocity between one wave front and the moving observer is varying accordingly to the observer's velocity against absolute space.
- The classic Doppler- effect applies for any moving observer [7].

2. Reflection from moving mirrors

A wave front is moving against a mirror that is tilted by 45 degrees and resting against the emerging point of the wave. The first edge of the front reaches the mirror prior to the adjacent edge and therefore will be reflected sooner. Considering the paths of four differing points on the wave front, those will be reflected displaced in time and thus we obtain the classic reflection angle according to Huygen's principle [1].

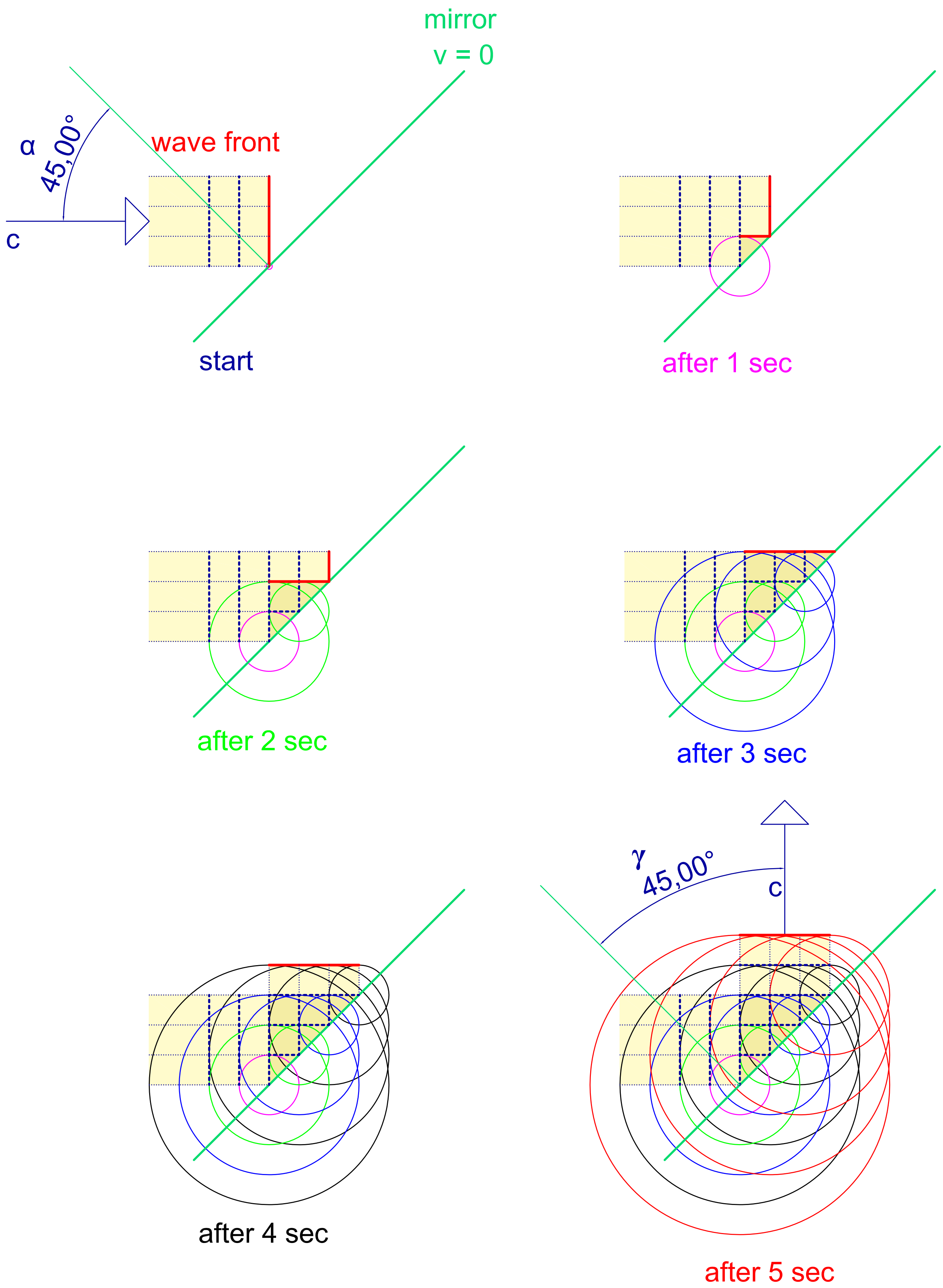

Fig. 1: Principle of classic reflection based on Huygen's principle

A merely logical derivation from this principle must be that if now the mirror is moving off the light wave front, the later edge of the wave front will be reflected with additional time compared to the prior edge because the mirror has again moved forward after the first edge has already met. The meeting point can be easily calculated using the Doppler principle [7], hence the wave front must catch up with the mirror. Using a graphic representation with cad, it already becomes visible that the reflection angle of the wave front has varied, whereby no change of wave length occurs. The issue was in the past already worked out by Paul Marmet [8] and also by Aleksandar Gjurchinovski [9], but with either significantly different mathematic results.

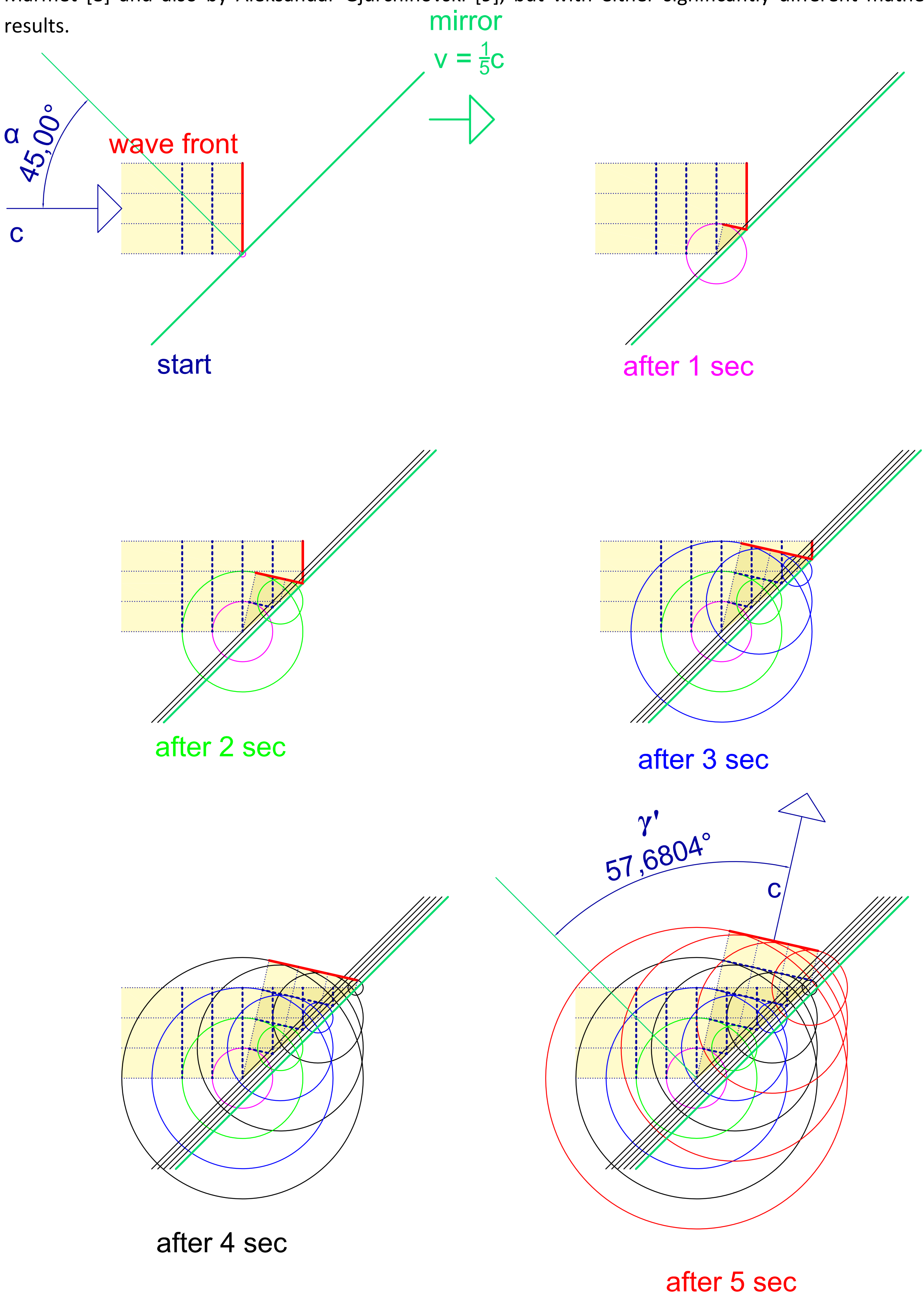

Fig. 2: Principle of reflection from moving mirror, based on logical derivation from Huygen's principle

Upon the geometric consideration the change of reflection angle in dependence of mirror’s velocity against the emerging point of wave can be obtained as follows:

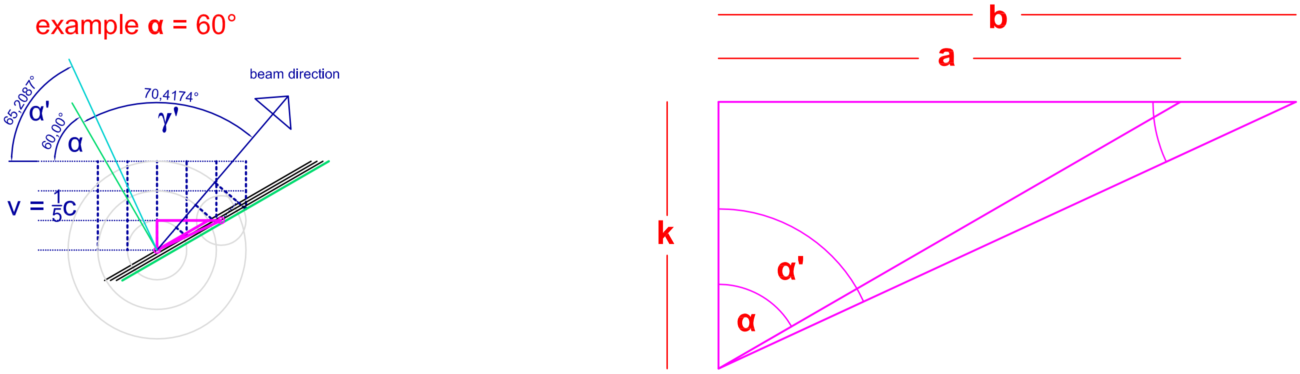

Fig. 3: Geometric situation at moving mirror and effective tilt angle

Due to the time shift of wave front points hitting the mirror we can assume a new, virtual or effective tilt angle of the mirror as shown in fig. 3 to calculate the reflection angle.

(1) $$\tan(\alpha)=\frac{a}{k}\Rightarrow k=\frac{a}{\tan(\alpha)}$$

(2) $$\tan(\alpha')=\frac{b}{k}\Rightarrow k=\frac{b}{\tan(\alpha')}$$

(3) $$b=\frac{a}{1-\frac{v}{c}}$$

(1) and (2) results:

$$\frac{a}{\tan(\alpha)}=\frac{b}{\tan(\alpha')}\Rightarrow a\cdot\tan(\alpha')=b\cdot\tan(\alpha)\Rightarrow a\cdot\tan(\alpha')=\frac{a}{1-\frac{v}{c}}\bullet\tan(\alpha)$$

$$\tan(\alpha')=\frac{a}{1-\frac{v}{c}}\bullet\tan(\alpha)\cdot\frac{1}{a}=\frac{\tan(\alpha)}{1-\frac{v}{c}}$$

$$\alpha'=\arctan\left(\frac{\tan(\alpha)}{1-\left(\frac{v}{c}\right)}\right)$$

α‘ is the new effective tilt angle of the mirror. Thus we obtain for the new reflected angle towards the perpendicular to the mirror:

$$\gamma'=2\cdot\alpha'-\alpha$$

$$\boxed{\gamma'=2\cdot\arctan\left(\frac{\tan(\alpha)}{1-\left(\frac{v}{c}\right)}\right)-\alpha}$$

The formula was double-checked by means of a cad image for several angles.

3. Refraction on a moving body

A similar principle applies for refraction of a wave front from a moving body with a different refraction coefficient. According to classic physics (Snellius's law) [10] the refraction can be inspected again by considering four points on the wave front.

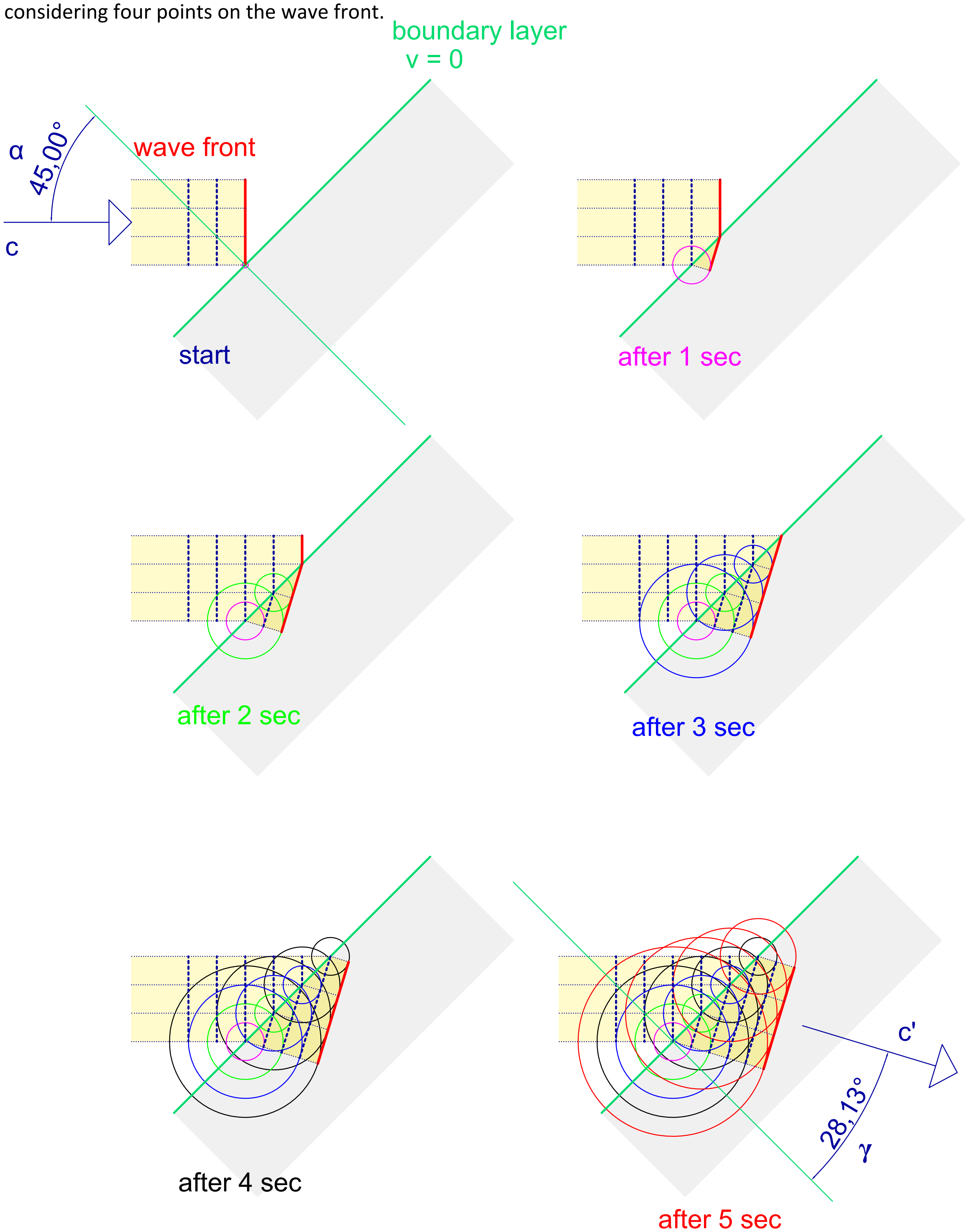

Fig. 4: Principle of classic refraction based upon Snellius's law

We can easily obtain Snellius's formula:

$$\sin(\gamma) = \sin(\alpha) \cdot \frac{n_1}{n_2}$$ whereby n_2 is the refraction coefficient of the refracting medium [10].

The situation changes analogically when the medium is moving:

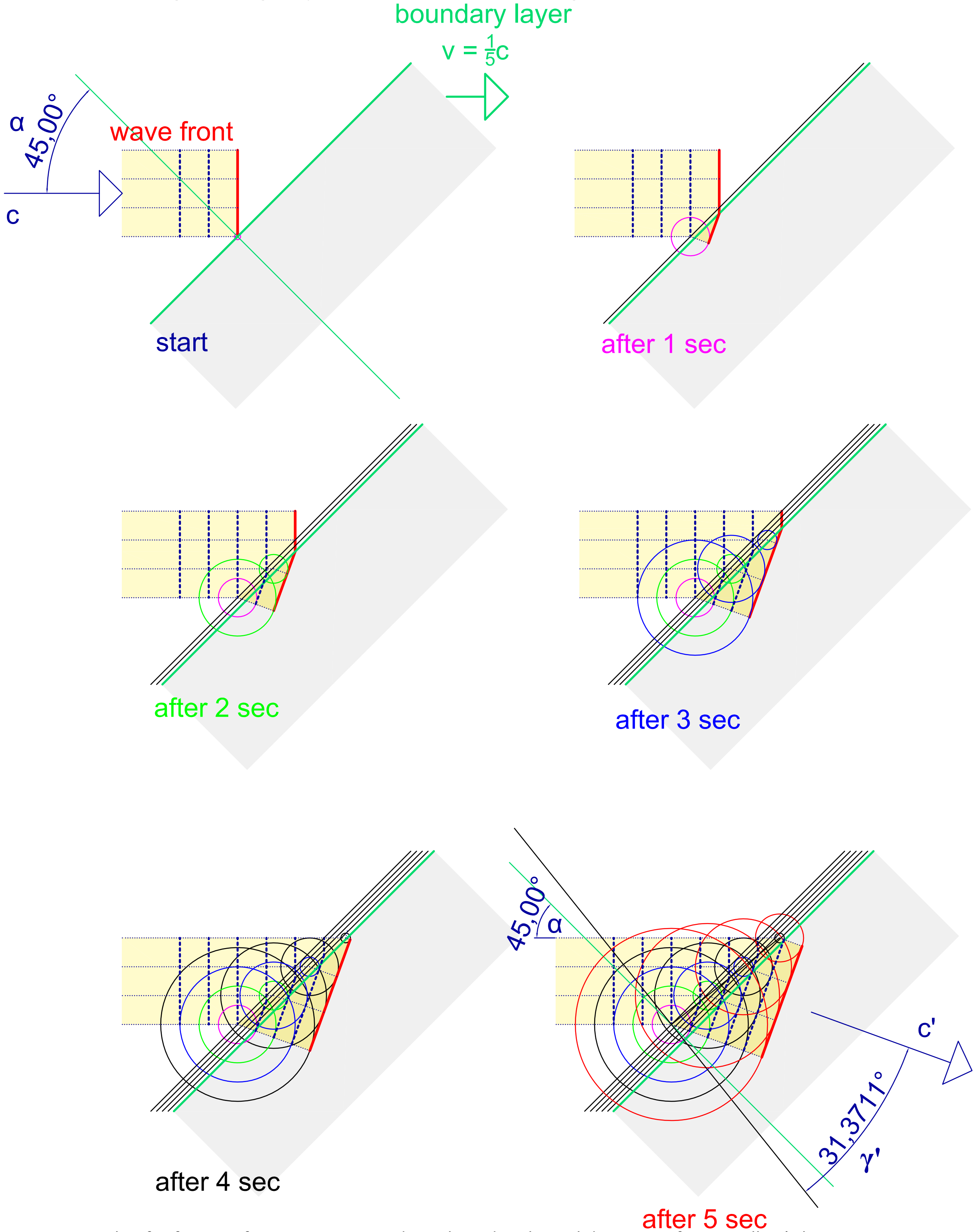

Fig. 5: Principle of refraction from a moving medium, based on logical derivation from Snellius's law

Again applying the angle α‘ of the effective perpendicular on the refracting surface in analogy to the reflection principle above we obtain:

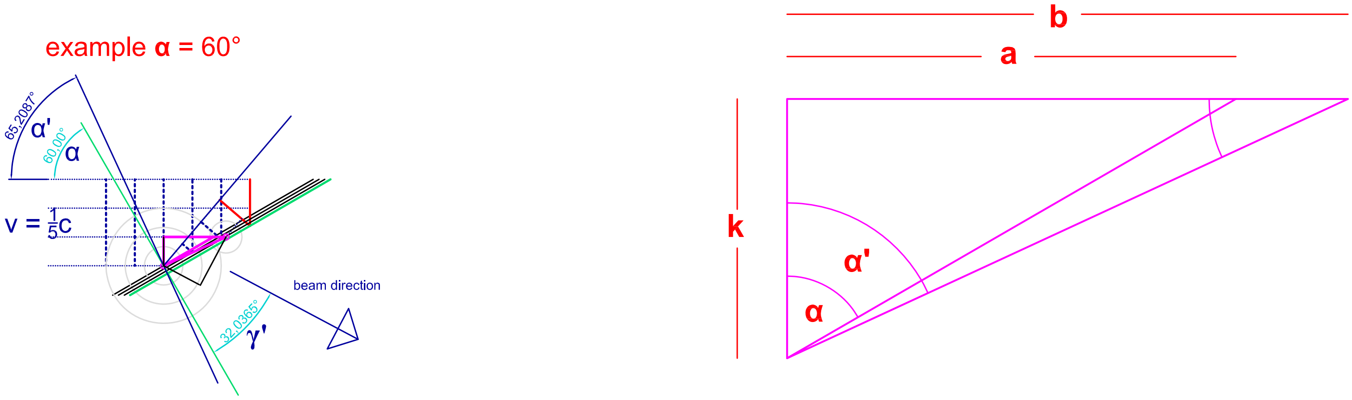

Fig. 6: Geometric situation on moving body and effective tilt angle

$$\sin(\gamma') = \sin(\alpha') \cdot \frac{n_1}{n_2} - \alpha' + \alpha$$

And α‘ inserted:

$$\sin(\gamma') = \sin\left(\arctan\left(\frac{\tan(\alpha)}{1-\frac{v}{c}}\right)\right) \cdot \frac{n_1}{n_2} - \arctan\left(\frac{\tan(\alpha)}{1-\frac{v}{c}}\right) + \alpha$$

Thus the new refraction angle to the actual perpendicular to the surface:

$$\boxed{\gamma' = \arcsin\left(\sin\left(\arctan\left(\frac{\tan(\alpha)}{1-\left(\frac{v}{c}\right)}\right)\right) \cdot \frac{n_1}{n_2}\right) - \arctan\left(\frac{\tan(\alpha)}{1-\left(\frac{v}{c}\right)}\right) + \alpha}$$

The formula was double-checked by means of a cad image for several angles.

4. Reflection from moving parabolic mirrors

We have established, that reflection angles vary upon the relation of c and v. Now we have to clear the interesting question, what this means for reflections on parabolic mirrors with a light source on its focal point. According to classic physics we would expect any beam to be reflected exactly parallel to the axis of the parable.

The following survey shows it is not:

First for better understanding an image with the setup of mirror and source (arbitrary dimensions):

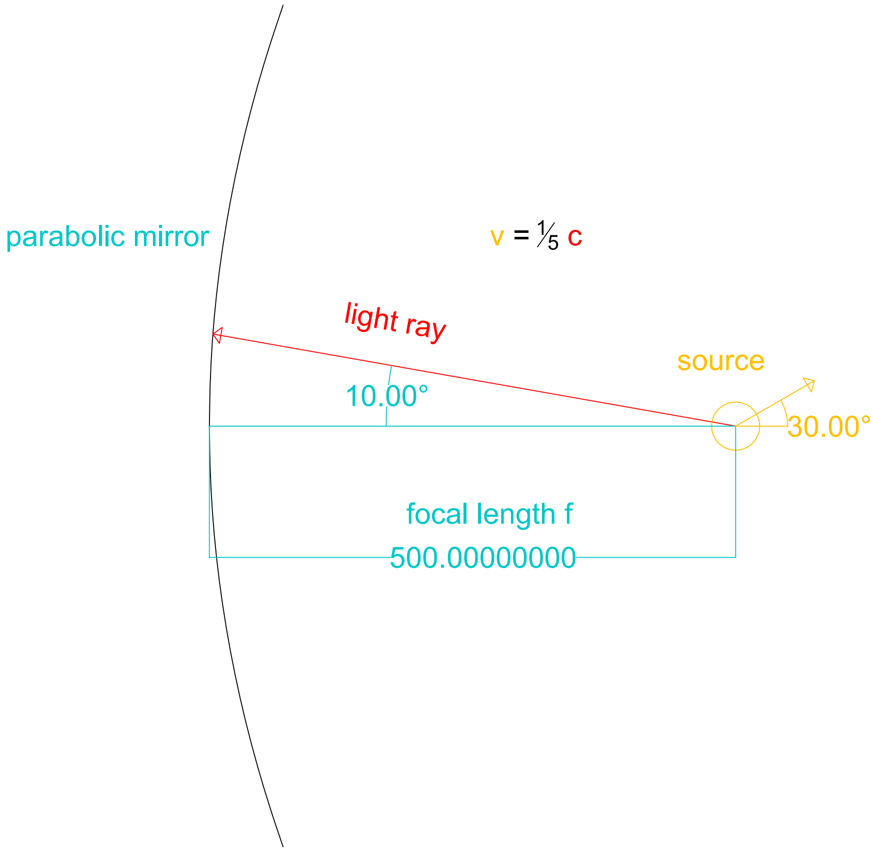

Fig. 7: Systematic layout of a lamp with parabolic mirror

Now we consider a light beam moving to the left under an angle α, whereby the whole setup is moving to the right under an angle β.

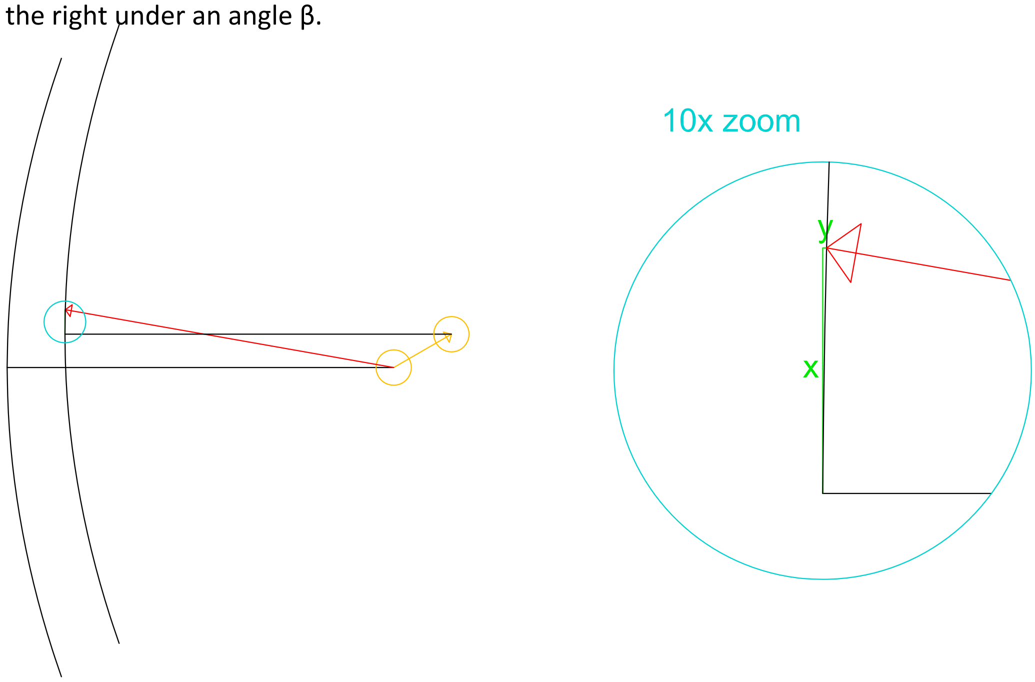

Fig. 8: Principle of the beam propagation and movement of the mirror

The determination of the meeting point now causes some trouble, since the mirror is roaming and additionally "bending" towards the beam.

The problem can be solved if we define functions for the respective movements. l is the distance the light beam is travelling, s the distance of the transversally moving setup, α the angle of the beam to the parable's axis, β the angle of the transverse movement of the setup to the parable's axis. f is the distance between focal point and vertex of the parable.

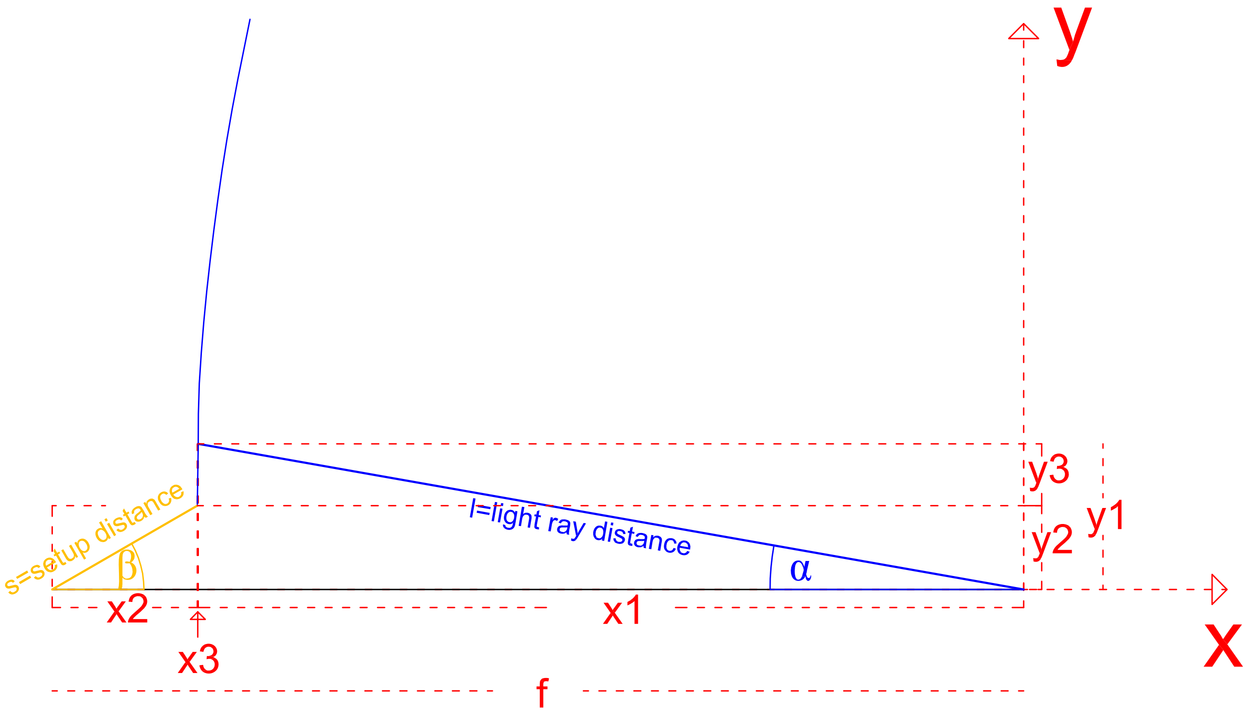

Fig. 9: Definition of the geometric conditions using functions

(1) is the function for the light beam propagation

(2) is the function for the transversal movement of the mirror

(3) is the function for the parable's curve

(1) $y_1 = x_1 \cdot \tan(\alpha)$ and hence $\boxed{x_1 = l \cdot \cos(\alpha)}$ and $\boxed{y_1 = l \cdot \sin(\alpha)}$

(2) $y_2 = x_2 \cdot \tan(\beta)$ and hence $x_2 = s \cdot \cos(\beta) = \boxed{l \cdot \frac{v}{c} \cdot \cos(\beta)}$ and $y_2 = s \cdot \sin(\beta) = \boxed{l \cdot \frac{v}{c} \cdot \sin(\beta)}$

(3) $y_3 = \sqrt{x_3 \cdot 4 \cdot f} \quad x_3 = \frac{y_3^2}{4 \cdot f}$

From the mutual dependence of the functions we can derive the following equation, targeting the determination of l:

$$x_1 = f - x_2 - x_3$$

$$x_1 = f - l \cdot \frac{v}{c} \cdot \cos(\beta) - \frac{y_3^2}{4 \cdot f} \text{ und: } y_3 = y_1 - y_2 = l \cdot \sin(\alpha) - l \cdot \frac{v}{c} \cdot \sin(\beta)$$

thus:

(4) $$x_1 = f - l \cdot \frac{v}{c} \cdot \cos(\beta) - \frac{\left(l \cdot \sin(\alpha) - l \cdot \frac{v}{c} \cdot \sin(\beta)\right)^2}{4 \cdot f}$$

(1) and (4) will now be equated and resolved:

$$l\cdot\cos(\alpha) = f - l\cdot\frac{v}{c}\cdot\cos(\beta) - \frac{\left(l\cdot\sin(\alpha) - l\cdot\frac{v}{c}\cdot\sin(\beta)\right)^2}{4\cdot f}$$

$$-4\cdot f\cdot\left(l\cdot\cos(\alpha) - f + l\cdot\frac{v}{c}\cdot\cos(\beta)\right) = (l\cdot\sin(\alpha))^2 - 2\cdot l\cdot\sin(\alpha)\cdot l\cdot\frac{v}{c}\cdot\sin(\beta) + \left(l\cdot\frac{v}{c}\cdot\sin(\beta)\right)^2$$

$$-l\cdot 4\cdot f\cdot\cos(\alpha) + 4\cdot f^2 - l\cdot 4\cdot f\cdot\frac{v}{c}\cdot\cos(\beta) - l^2\cdot\sin(\alpha)^2 + l^2\cdot 2\cdot\sin(\alpha)\cdot\frac{v}{c}\cdot\sin(\beta) - l^2\cdot\frac{v^2}{c^2}\cdot\sin(\beta)^2 = 0$$

$$l^2\cdot\left(-\sin(\alpha)^2 + 2\cdot\sin(\alpha)\cdot\frac{v}{c}\cdot\sin(\beta) - \frac{v^2}{c^2}\cdot\sin(\beta)^2\right) + l\cdot\left(-4\cdot f\cdot\cos(\alpha) - 4\cdot f\cdot\frac{v}{c}\cdot\cos(\beta)\right) + 4\cdot f^2 = 0$$

And after resolving the quadratic equation:

$$l = \frac{-\left(-4\cdot f\cdot\cos(\alpha) - 4\cdot f\cdot\frac{v}{c}\cdot\cos(\beta)\right) - \sqrt{\left(-4\cdot f\cdot\cos(\alpha) - 4\cdot f\cdot\frac{v}{c}\cdot\cos(\beta)\right)^2 - 4\cdot\left(-\sin(\alpha)^2 + 2\cdot\sin(\alpha)\cdot\frac{v}{c}\cdot\sin(\beta) - \frac{v^2}{c^2}\cdot\sin(\beta)^2\right)\cdot 4\cdot f^2}}{2\cdot\left(-\sin(\alpha)^2 + 2\cdot\sin(\alpha)\cdot\frac{v}{c}\cdot\sin(\beta) - \frac{v^2}{c^2}\cdot\sin(\beta)^2\right)}$$

$$l = \frac{4\cdot f\cdot\left(\cos(\alpha) + \frac{v}{c}\cdot\cos(\beta)\right) - \sqrt{16\cdot f^2\left(\cos(\alpha) + \frac{v}{c}\cdot\cos(\beta)\right)^2 + 16\cdot f^2\cdot\left(\sin(\alpha)^2 - 2\cdot\sin(\alpha)\cdot\frac{v}{c}\cdot\sin(\beta) + \frac{v^2}{c^2}\cdot\sin(\beta)^2\right)}}{-2\cdot\left(\sin(\alpha)^2 - 2\cdot\sin(\alpha)\cdot\frac{v}{c}\cdot\sin(\beta) + \frac{v^2}{c^2}\cdot\sin(\beta)^2\right)}$$

$$l = \frac{4\cdot f\cdot\left(\cos(\alpha) + \frac{v}{c}\cdot\cos(\beta)\right) - 4\cdot f\cdot\sqrt{\left(\cos(\alpha) + \frac{v}{c}\cdot\cos(\beta)\right)^2 + \left(\sin(\alpha) - \frac{v}{c}\cdot\sin(\beta)\right)^2}}{-2\cdot\left(\sin(\alpha)^2 - 2\cdot\sin(\alpha)\cdot\frac{v}{c}\cdot\sin(\beta) + \frac{v^2}{c^2}\cdot\sin(\beta)^2\right)}$$

$$\boxed{l = -2\cdot f\cdot\frac{\left(\cos(\alpha) + \frac{v}{c}\cdot\cos(\beta)\right) - \sqrt{\left(\cos(\alpha) + \frac{v}{c}\cdot\cos(\beta)\right)^2 + \left(\sin(\alpha) - \frac{v}{c}\cdot\sin(\beta)\right)^2}}{\left(\sin(\alpha) - \frac{v}{c}\cdot\sin(\beta)\right)^2}}$$

Following determination of l all other dimensions can now be determined:

$$\boxed{s = l\cdot\frac{v}{c}}$$

$$\boxed{y_{Parabel} = l\cdot\left(\sin(\alpha) - \frac{v}{c}\cdot\sin(\beta)\right)}$$

$$x_{Parabel} = \frac{l^2 \cdot \left(\sin(\alpha) - \frac{v}{c} \cdot \sin(\beta) \right)^2}{4 \cdot f}$$

Using the dimension of l and its angle und assuming values for c and v we can now determine the reflection angle on the moving parabolic mirror. The perpendicular to the tangent on the parable's curve at the meeting time now is essential for determination of the meeting point.

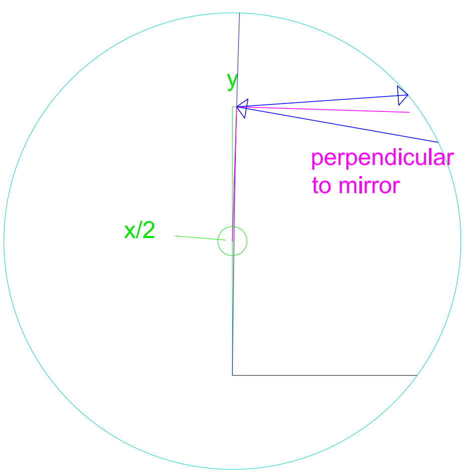

Fig. 10: Zoomed situation on parable's tangent

The tangent can be created by drawing a line from half of the x- dimension to the meeting point of parable and beam. In the following $x_{Parabel}$ and $y_{Parabel}$ is meant by x and y. We obtain the angle between tangent and perpendicular:

$$\tan(\text{perpendicular}\sphericalangle\text{tangent}) = \frac{x}{y/2} = 2 \cdot \frac{x}{y}$$

$$\text{perpendicular}\sphericalangle\text{tangent} = \arctan\left(2 \cdot \frac{x}{y}\right)$$

And resultant the angle between perpendicular on the tangent and the beam:

$\text{perpendicular}\sphericalangle\text{beam} = \alpha - \arctan\left(2 \cdot \frac{x}{y}\right)$ whereby α again is the angle of the beam to the parable's axis.

the above formula for reflection on moving mirrors

$$\gamma' = 2 \cdot \arctan\left(\frac{\tan(\text{perpendicular}\sphericalangle\text{beam})}{1 - \left(\frac{v'}{c}\right)}\right) - \text{perpendicular}\sphericalangle\text{beam}$$

now must be completed with the appropriate values for c and v. For v we have to find the respective velocity component v' of the tilted mirror directional to c. This is:

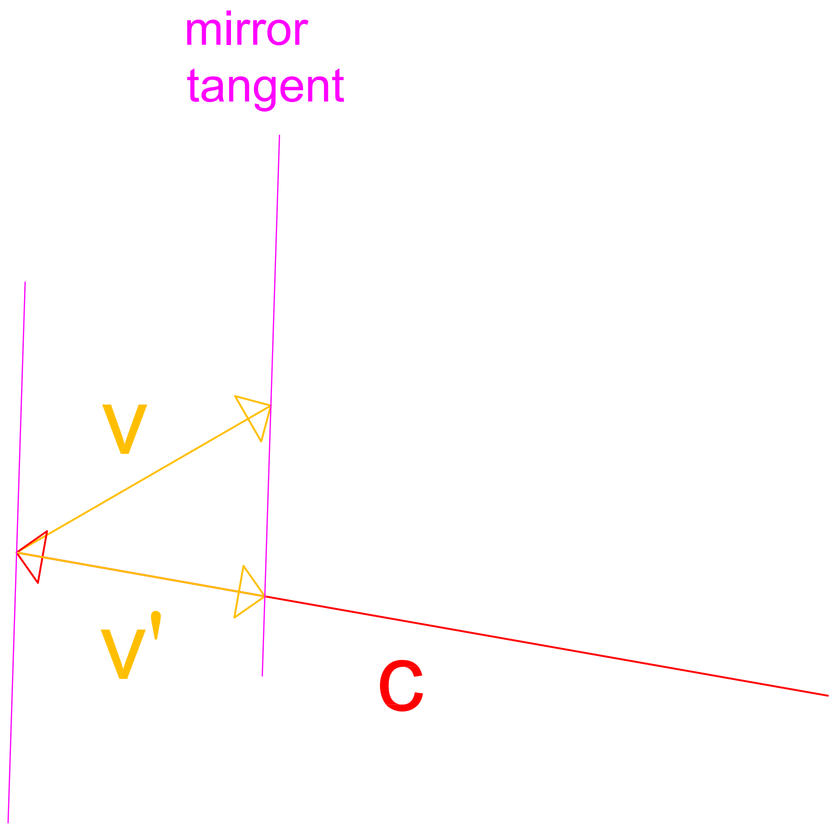

Fig. 11: Geometry of mirror movement directional to beam

$$v' = v \cdot \frac{\sin(90° - \beta - \text{perpendicular}\sphericalangle\text{tangent})}{\sin(90° - \alpha + \text{perpendicular}\sphericalangle\text{tangent})}$$

Thus the angle between reflected beam and perpendicular to the mirror is:

$$\gamma' = 2 \cdot \arctan\left(\frac{\tan\left(\alpha - \arctan\left(2 \cdot \frac{x}{y}\right)\right)}{1 + \left(\frac{v}{c} \cdot \frac{\sin\left(90° - \beta - \arctan\left(2 \cdot \frac{x}{y}\right)\right)}{\sin\left(90° - \alpha + \arctan\left(2 \cdot \frac{x}{y}\right)\right)}\right)} \right) - \alpha + \arctan\left(2 \cdot \frac{x}{y}\right)$$

The accuracy of the above approach was double-checked with cad. In particular the calculated relations of v and c must be correctly readable from the drawing.

Further on the above formula was now used for an excel- routine. Realistic values were set for c = 300.000 km/s and v = 350 km/s. The focal length is irrelevant since the whole geometry is then just zooming appropriately. The movement angle of the setup to the parable's axis was chosen with 30 degrees. Now the reflection angles for varying angles of the starting ray towards parable's axis were calculated. According to classic physics all angles would be expected to be equal and zero. Here is the output.

Starting ray angle to parable's axis degree	reflected ray angle to parable's axis degree	Deviation to average degree	Deviation to average µrad
0°	0,033355093022000	-0,000012863110222	-0,224503625424836
10°	0,033349902302000	-0,000018053830222	-0,315098779973943
20°	0,033348129868000	-0,000019826264222	-0,346033589048231
30°	0,033349831918000	-0,000018124214222	-0,316327212514724
45°	0,033358258536000	-0,000009697596222	-0,169254983606830
60°	0,033371869592000	0,000003913459778	0,068302758266498
70°	0,033382422981000	0,000014466848778	0,252494143560169
80°	0,033393087636000	0,000025131503778	0,438627486899431
90°	0,033403009335000	0,000035053202778	0,611793801841256
Average	0,033367956132222	0,000000000000000	0,000000000000000

According to the calculation the reflection angle is different from 0°. But also it becomes obvious that all angles diverge by less than 1 µrad!

Of even more interest is to calculate the reflection angles now with varying angles of transverse mirror movement:

The starting angle of the beam is now for convenience set to zero degrees, being of no much relevance as we have seen from the above table.

transversal mirror movement angle degree	reflected ray angle to parable's axis degree
0°	0,000000000000000
10°	0,011580898419696
20°	0,022812313440984
30°	0,033355093033177
45°	0,047188690356774
60°	0,057822006159651
70°	0,062763663542204
80°	0,065802812190023
90°	0,066845000284998

Now the time has come for discussion of the actual topic.

5. Terrestrial aberration

Without applying the special relativity, the fact of absence of terrestrial aberration is hard to explain with common ether theories. This is the major topic of this paper, offering a new approach on the issue.

First, neglecting the experimental facts, we should reflect now, how aberration would look like in classic physics if it would exist.

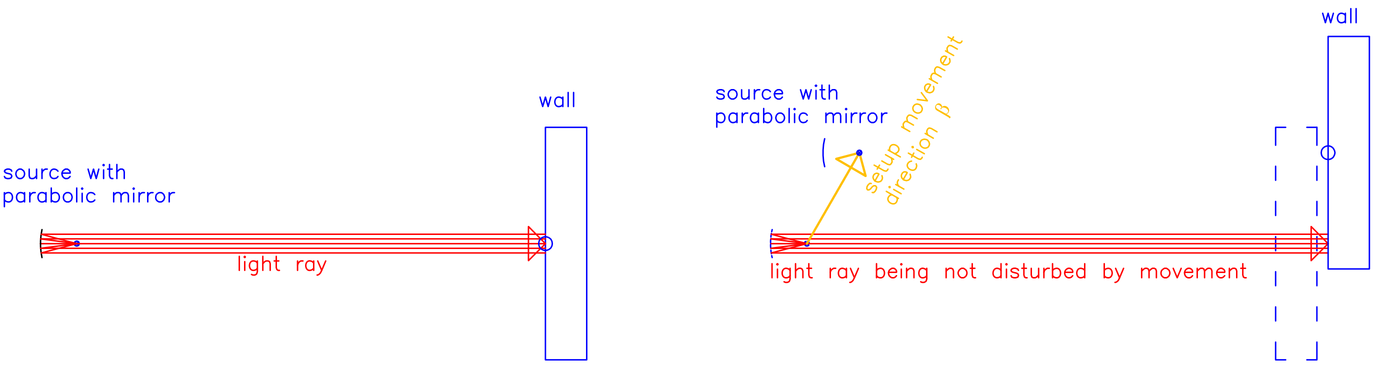

Fig.12: Theoretical principle of terrestrial aberration in classic physics

We imagine a light ray consisting of only one wave front section that would be projected against a wall from a parabolic mirror lamp. While the ray is proceeding, the wall together with the lamp would be shifting along the rotating direction of earth. We assume that the ray is not disturbed during this process regarding its velocity and direction, in respect to the emerging point and absolute space. That means, when the wave front section arrives at the wall, the wall has shifted transversely so the ray would hit on a differing point. Dependent on the direction of transversal movement, the meeting point would roam well distinguishable to one and the other side. Therefore aberration should be visible under such circumstances.

Now we imagine, the ray would be arbitrarily going along another inclined path, so that it would meet at the same point as if the wall would not have shifted relatively, in other words, would compensate this theoretic aberration angle:

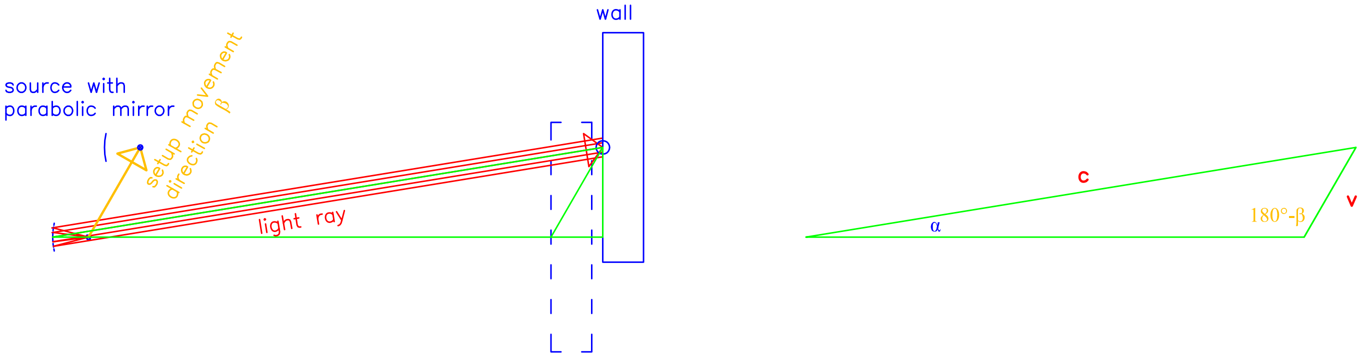

Fig. 13: Geometry of a theoretic ray compensating aberration

No we have to identify its necessary angle to do so.

According to the sine rule:

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

$$\sin(\alpha) = \frac{v}{c} \cdot \sin(\beta)$$

With the same settings as before for c and v the excel- routine gives the following comparison:

transversal setup movement angle degree	Reflected angle from parabolic mirror lamp degree	Aberration compensating angle degree	deviation in µrad
0°	0,000000000000000	0,000000000000000	-0,000000000000000
10°	0,011580898419696	0,011607525729929	-0,464734234513533
20°	0,022812313440984	0,022862363114547	-0,873531593220237
30°	0,033355093033177	0,033422539944790	-1,177170677946250
45°	0,047188690356774	0,047266611959508	-1,359988526152570
60°	0,057822006159651	0,057889543868554	-1,178755389612020
70°	0,062763663542204	0,062813837328296	-0,875697765486524
80°	0,065802812190023	0,065829563675850	-0,466901507486992
90°	0,066845000284998	0,066845091262535	-0,001587857555416

Thus the ostensible non- existence of terrestrial aberration explains itself easily although it might exist. Even the best laser arrays probably have divergence angles of approx. 100 µrad and the above determined deviation lays almost two orders of magnitude below. For this reason terrestrial aberration is simply not detectable by means of any state of the art technique.

To what extend the performed calculations might be infected by rounding failure due to the excessive use of trigonometric methods is also questionable, perhaps the angles could even be equal. A mathematical proof would have to be conducted.

It can be summarized that the deflection on moving parabolic mirrors makes any angle fit to compensate terrestrial aberration in any transversal movement direction.

6. Reflection between two parabolic mirrors inside a laser array

Now it should be undeceived in what behavior the emission angle would arise from a laser array, using some simplifications.

Commonly rays are being reflected back and forth for a ten thousand times between two mirrors with identical focal points before they can escape from the one half translucent of the mirrors. We want to determine now the angle that the ray would have when leaving the instrument.

In analogy to the formerly conducted principle we determine the path of the wave front section having been reflected from the first mirror to meet the second mirror and produce the formula for calculation.

2nd ray:

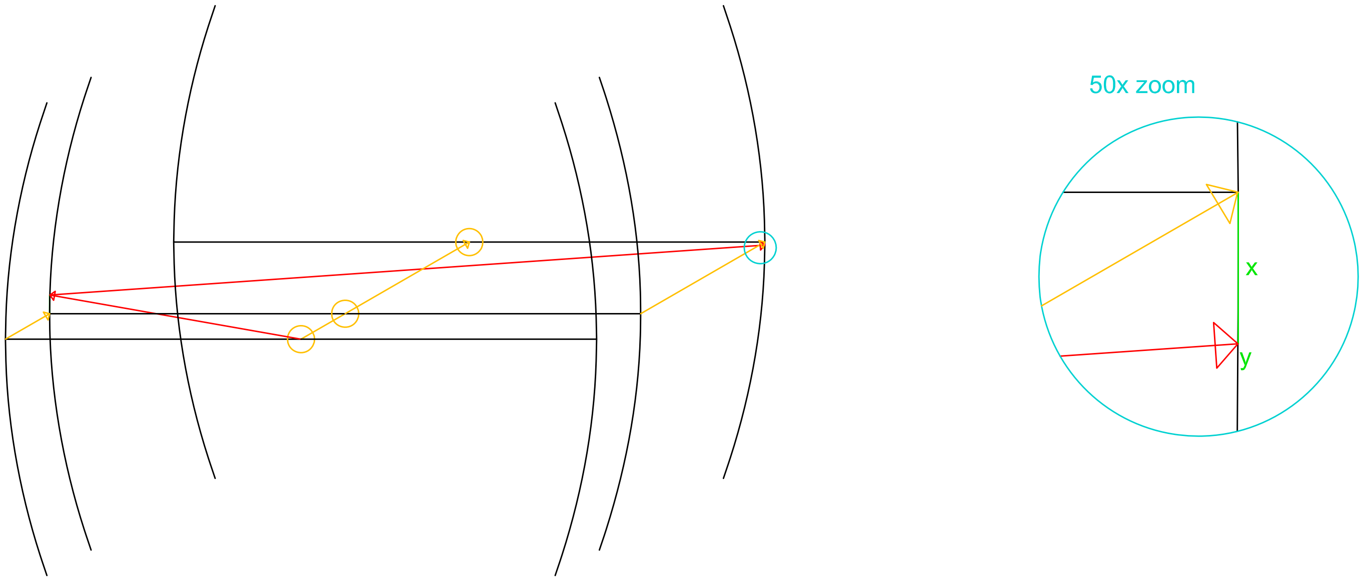

Fig. 14: Geomety of the 2nd ray inside an array with two parabolic mirrors, v = 1/5 c

Similarly to the above we can identify three functions for the movements:

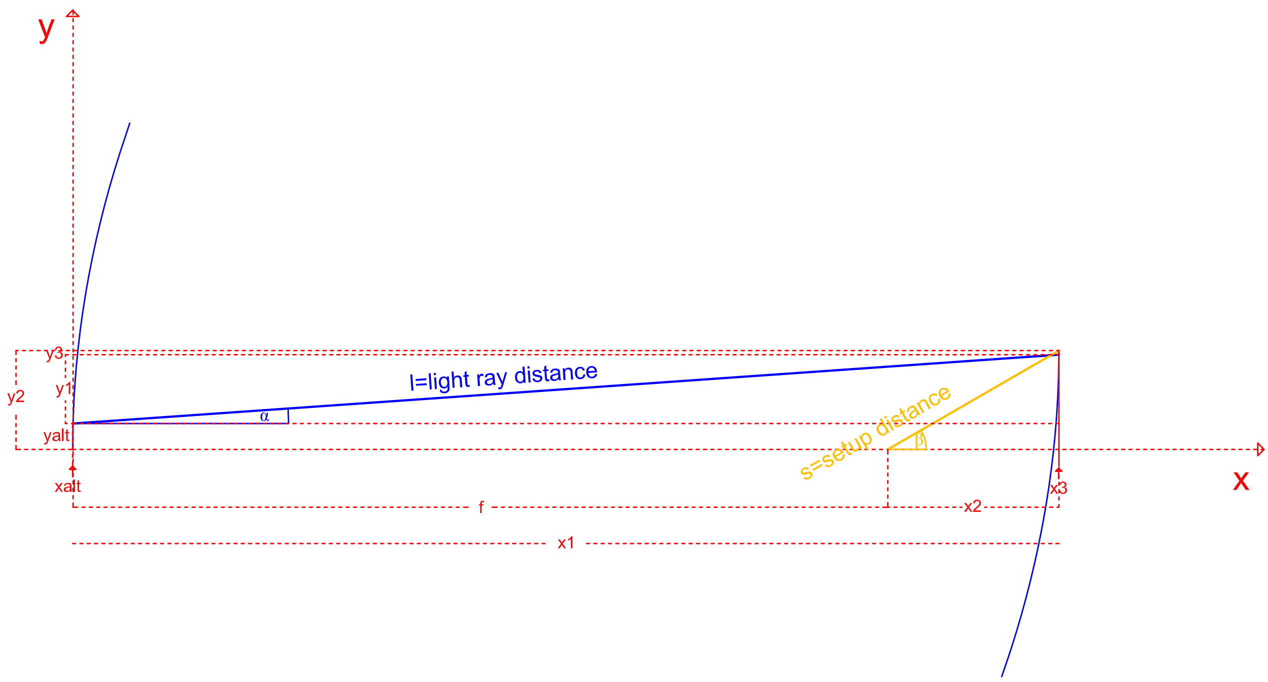

Fig. 15: Definition geometric relationships with functions

(1) is the function for the ray

(2) is the function for the transversal movement of the mirror

(3) is the function for the parable's curve

(1) $y_1 = x_1 \cdot \tan(\alpha)$ and resulting $\boxed{x_1 = l \cdot \cos(\alpha)}$ and $\boxed{y_1 = l \cdot \sin(\alpha)}$

(2) $y_2 = y_2 \cdot \tan(\beta)$ and resulting $x_2 = s \cdot \cos(\beta) = \boxed{l \cdot \frac{v}{c} \cdot \cos(\beta)}$ and $y_2 = s \cdot \sin(\beta) = \boxed{l \cdot \frac{v}{c} \cdot \sin(\beta)}$

(3) $y_3 = \sqrt{x_3 \cdot 4 \cdot f}$ $\qquad x_3 = \frac{y_3^2}{4 \cdot f}$

From the mutual dependence of the functions we can derive the following equation, targeting the determination of l:

$$x_1 = 2 \cdot f + x_2 - x_3 - x_{alt}$$

$$x_1 = 2 \cdot f + l \cdot \frac{v}{c} \cdot \cos(\beta) - \frac{y_3^2}{4 \cdot f} - \frac{y_{alt}^2}{4 \cdot f}$$ und:

$$y_3 = y_1 - y_2 + y_{alt} = l \cdot \sin(\alpha) - l \cdot \frac{v}{c} \cdot \sin(\beta) + y_{alt}$$

Therefore:

(4) $$x_1 = 2 \cdot f + l \cdot \frac{v}{c} \cdot \cos(\beta) - \frac{\left(l \cdot \sin(\alpha) - l \cdot \frac{v}{c} \cdot \sin(\beta) + y_{alt} \right)^2 + y_{alt}^2}{4 \cdot f}$$

(1) and (4) now be equated and resolved:

$$l \cdot \cos(\alpha) = 2 \cdot f + l \cdot \frac{v}{c} \cdot \cos(\beta) - \frac{\left(l \cdot \sin(\alpha) - l \cdot \frac{v}{c} \cdot \sin(\beta) + y_{alt} \right)^2 + y_{alt}^2}{4 \cdot f}$$

$$-4 \cdot f \cdot \left(l \cdot \cos(\alpha) - 2 \cdot f - l \cdot \frac{v}{c} \cdot \cos(\beta) \right) = \left(l \cdot \sin(\alpha) - l \cdot \frac{v}{c} \cdot \sin(\beta) + y_{alt} \right)^2 + y_{alt}^2$$

$$-4 \cdot f \cdot \left(l \cdot \cos(\alpha) - 2 \cdot f - l \cdot \frac{v}{c} \cdot \cos(\beta) \right) = \left(l \cdot \frac{v}{c} \cdot \sin(\beta) \right)^2 + \left(l \cdot \sin(\alpha) \right)^2 + y_{alt}^2 - 2 \cdot l^2 \cdot \frac{v}{c} \cdot \sin(\beta) \cdot \sin(\alpha) - 2 \cdot l \cdot \frac{v}{c} \cdot \sin(\beta) \cdot y_{alt} + 2 \cdot l \cdot \sin(\alpha) \cdot y_{alt} + y_{alt}^2$$

$$l \cdot \cos(\alpha) \cdot 4 \cdot f - 8 \cdot f^2 - l \cdot 4 \cdot f \cdot \frac{v}{c} \cdot \cos(\beta) + \left(l \cdot \frac{v}{c} \cdot \sin(\beta) \right)^2 + \left(l \cdot \sin(\alpha) \right)^2 + y_{alt}^2 - l^2 \cdot 2 \cdot \frac{v}{c} \cdot \sin(\beta) \cdot \sin(\alpha) - 2 \cdot l \cdot \frac{v}{c} \cdot \sin(\beta) \cdot y_{alt} + 2 \cdot l \cdot \sin(\alpha) \cdot y_{alt} + y_{alt}^2 = 0$$

$$l^2\left(\frac{v^2}{c^2}\cdot\sin(\beta)^2+\sin(\alpha)^2-2\cdot\frac{v}{c}\cdot\sin(\beta)\cdot\sin(\alpha)\right)+l\left(\cos(\alpha)\cdot 4\cdot f-4\cdot f\cdot\frac{v}{c}\cdot\cos(\beta)-2\cdot\frac{v}{c}\cdot\sin(\beta)\cdot y_{alt}+2\cdot\sin(\alpha)\cdot y_{alt}\right)-8\cdot f^2+2\cdot y_{alt}^2=0$$

$$l^2\left(\frac{v}{c}\cdot\sin(\beta)-\sin(\alpha)\right)^2+l\left(4\cdot f\cdot\left(\cos(\alpha)-\frac{v}{c}\cdot\cos(\beta)\right)+2\cdot y_{alt}\cdot\left(\sin(\alpha)-\frac{v}{c}\cdot\sin(\beta)\right)\right)-8\cdot f^2+2\cdot y_{alt}^2=0$$

And after resolving the quadratic equation:

$$\boxed{l=\frac{-\left(4\cdot f\cdot\left(\cos(\alpha)-\cos(\beta)\cdot\frac{v}{c}\right)+2\cdot y_{alt}\cdot\left(\sin(\alpha)-\sin(\beta)\cdot\frac{v}{c}\right)\right)-\sqrt{\left(4\cdot f\cdot\left(\cos(\alpha)-\cos(\beta)\cdot\frac{v}{c}\right)+2\cdot y_{alt}\cdot\left(\sin(\alpha)-\sin(\beta)\cdot\frac{v}{c}\right)\right)^2-4\cdot\left(2\cdot y_{alt}^2-8\cdot f^2\right)\cdot\left(\sin(\beta)\cdot\frac{v}{c}-\sin(\alpha)\right)^2}}{2\cdot\left(\sin(\beta)\cdot\frac{v}{c}-\sin(\alpha)\right)^2}}$$

$$\boxed{y_{Parabel}=l\cdot\sin(\alpha)-l\cdot\frac{v}{c}\cdot\sin(\beta)+y_{alt}}$$

On the basis of the determined values we now find the reflection angle form the moving mirror, this time with modified operation signs due to the opposite direction of ray movement.

$$\boxed{\gamma'=2\cdot\arctan\left(\frac{\tan\left(\alpha-\arctan\left(2\cdot\frac{x}{y}\right)\right)}{1-\left(\frac{v}{c}\cdot\frac{\sin\left(90°-\beta+\arctan\left(2\cdot\frac{x}{y}\right)\right)}{\sin\left(90°+\alpha-\arctan\left(2\cdot\frac{x}{y}\right)\right)}\right)}\right)-\alpha+\arctan\left(2\cdot\frac{x}{y}\right)}$$

3rd ray

In analogy to the above, again with modified operation signs, the relevant difference is here:

$$x_1=2\cdot f-x_2-x_3-x_{alt}$$

After this modification for l:

$$\boxed{l=\frac{-\left(4\cdot f\cdot\left(\cos(\alpha)+\cos(\beta)\cdot\frac{v}{c}\right)+2\cdot y_{alt}\cdot\left(\sin(\alpha)-\sin(\beta)\cdot\frac{v}{c}\right)\right)-\sqrt{\left(4\cdot f\cdot\left(\cos(\alpha)+\cos(\beta)\cdot\frac{v}{c}\right)+2\cdot y_{alt}\cdot\left(\sin(\alpha)-\sin(\beta)\cdot\frac{v}{c}\right)\right)^2-4\cdot\left(2\cdot y_{alt}^2-8\cdot f^2\right)\cdot\left(\sin(\beta)\cdot\frac{v}{c}-\sin(\alpha)\right)^2}}{2\cdot\left(\sin(\beta)\cdot\frac{v}{c}-\sin(\alpha)\right)^2}}$$

Reflection angle to be calculated according to the former ray.

Now we have run through the whole cycle, follow-up rays to be determined in analogy. The image shows as this would look like:

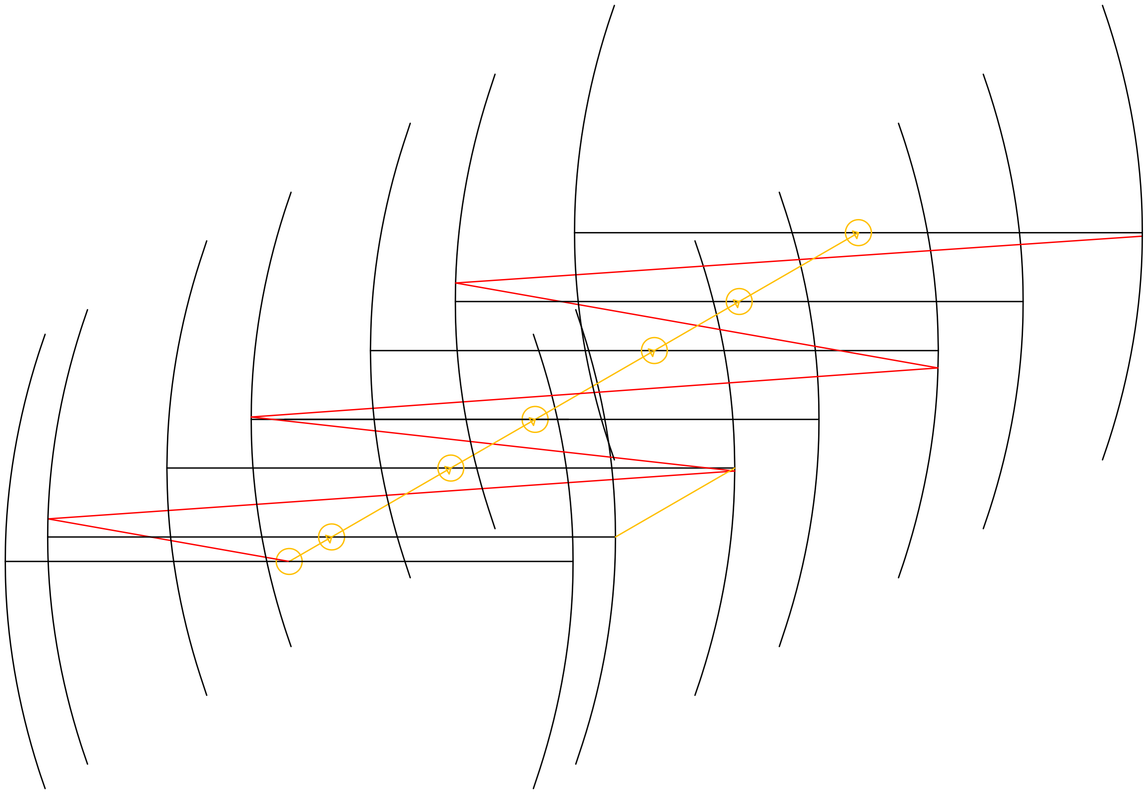

Fig. 16: multiple ray sequence, v = 1/5 c

On basis of above formula another excel- routine reveals the deviation after 10.000 reflections.

We can see that the ray now performs an increasing divergence from the first ray.

transversal setup movement angle degree	Reflected angle from parabolic mirror degree 1st ray	Reflected angle from parabolic mirror degree 10.000th ray	Divergence of rays in µrad
0°	0,000000000000000	0,000000000000000	0,000000000000000
10°	0,011580898419696	0,011729368557654	-2,591292748256260
20°	0,022812313440984	0,023050775846591	-4,161954120065270
30°	0,033355093033177	0,033582638557864	-3,971418603977660
45°	0,047188690356774	0,047188689080904	0,000022268131600
60°	0,057822006159651	0,057427868292055	6,879003496334780
70°	0,062763663542204	0,062108446861657	11,435688389528900
80°	0,065802812190023	0,064960527944279	14,700633325914100
90°	0,066845000284998	0,065934815523929	15,885720882128500

A further result is another divergence of two following rays:

transversal setup movement angle degree	Reflected angle from parabolic mirror degree 10.001st ray	Reflected angle from parabolic mirror degree 10.003rd ray	Divergence of rays in µrad
0°	0,000000000000000	0,000000000000000	0,000000000000000
10°	0,011729309206553	0,011432428229051	5,181550543944580
20°	0,023050680474458	0,022573851002817	8,322244250688590
30°	0,033582547565273	0,033127547520961	7,941248869971810

45°	0,047188689077823	0,047188691633885	-0,000044611695743
60°	0,057428025888063	0,058216144009675	-13,755256116761000
70°	0,062108708835951	0,063418880216460	-22,866804355283500
80°	0,064960864716920	0,066645096415956	-29,395388514639900
90°	0,065935179438785	0,067755185028176	-31,765089939572100

But there is a much smaller divergence between two rays leaving out one:

transversal setup movement angle degree	Reflected angle from parabolic mirror degree 10.001st ray	Reflected angle from parabolic mirror degree 10.005th ray	Divergence of rays in µrad
0°	0,000000000000000	0,000000000000000	0,000000000000000
10°	0,011729309206553	0,011729368557654	-0,001035872132266
20°	0,023050680474458	0,023050775846591	-0,001664557736470
30°	0,033582547565273	0,033582638557864	-0,001588120310114
45°	0,047188689077823	0,047188689080904	-0,000000053760891
60°	0,057428025888063	0,057427868292055	0,002750569231121
70°	0,062108708835951	0,062108446861657	0,004572313978761
80°	0,064960864716920	0,064960527944279	0,005877791412633
90°	0,065935179438785	0,065934815523929	0,006351512425397

Summarizing it can be stated that the beam has split in two diverging rays well below resolution of any laser array, whereby the mean of both is again extremely close to the aberration angle as before:

transversal setup movement angle degree	Reflected angle from parabolic mirror degree 10.001st ray	Reflected angle from parabolic mirror degree 10.003rd ray	Average degree	Aberration compensation angle degree	deviation in µrad
0°	0,000000000000	0,000000000000	0,000000000000	0,000000000000	0,000000000000
10°	0,011729309207	0,011432428229	0,011580868718	0,011607525730	-0,465252630362
20°	0,023050680474	0,022573851003	0,022812265739	0,022862363115	-0,874364156236
30°	0,033582547565	0,033127547521	0,033355047543	0,033422539945	-1,177964629265
45°	0,047188689078	0,047188691634	0,047188690356	0,047266611960	-1,359988542197
60°	0,057428025888	0,058216144010	0,057822084949	0,057889543869	-1,177380258335
70°	0,062108708836	0,063418880216	0,062763794526	0,062813837328	-0,873411663395
80°	0,064960864717	0,066645096416	0,065802980566	0,065829563676	-0,463962784669
90°	0,065935179439	0,067755185028	0,066845182233	0,066845091263	0,001587742528

These results can be estimated as equal to the deviation of a standard parabolic mirror lamp as shown above.

7. On the aberration again

Thus we can conclude that also laser sources supply emergence angles of rays that fit at any time the appropriate angle to compensate the terrestrial aberration due to the transversal earth rotation, and thus terrestrial aberration cannot be detected.

Consequantly terrestrial aberration might exist. Merely it might be impossible to detect the aberration by means of technical possibilities, since we do not dispose of any focusing light source that would not be subject to the deviations by moving mirrors, lenses and prisms.

Further below though we will be able to determine how nevertheless terrestrial aberration could be detected in theory.

On this occasion now we want to assort the whole complex of aberration and scrutinize any of the historic and existing partially misleading interpretations on the subject under strict logical terms. For convenience we will assume in the following analysis that emission angles of sources using parabolic mirrors and lasers be equal to the aberration angle at any transversal mirror movement. The images to come were produced upon regular calculation of propagation of light wave fronts using the classical Doppler effects [7].

Basically there are two different cases to be strictly distinguished:

1. The light is being emitted in terms of a focused and directed ray, e.g. laser, that meets on a diffuse screen. Hence light already would be emitted as a section of wave fronts.
2. The light is being emitted diffusely in terms of spherical wave fronts centering on the respective emission point, but detected with focusing device such as telescope. Hence only a section of the spherical wave fronts will be observed.

Terrestrial aberration

We have already concluded that for the first case terrestrial aberration is not detectable. For the following analysis it is essential to keep in mind that for the reverse case of observations of spherical wave fronts with telescopes the same context applies regarding reflection on moving mirrors, since telescopes usually have parabolic or hyperbolic mirrors, lenses and prisms that reflect rays in just the same way vice versa.

1. Source and observer move uniformly relatively to the absolute space

For the second above case now we have to clear up the behavior of aberration if the source is moving uniformly with the observer:

$c = 1{,}5$

$v_{observer} = v_{source} = 0{,}5$

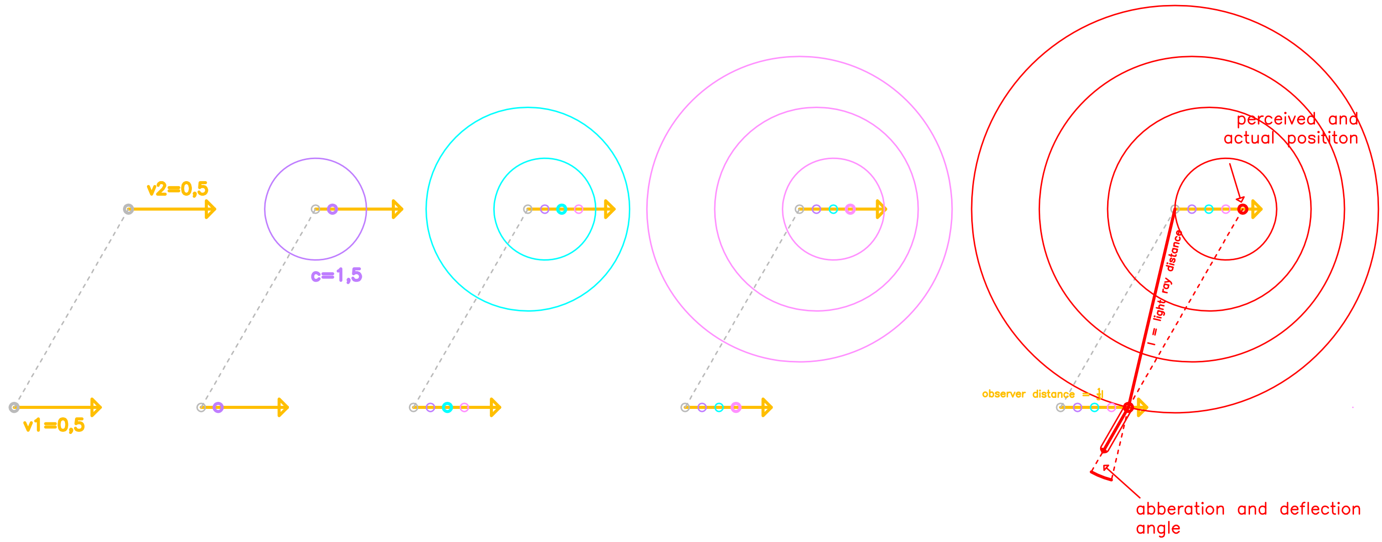

Fig. 17: Aberration; source and observer moving uniformly

At the moment of emission of the wave front the source's position is offset from the observer by a deliberately chosen angle of 60 degrees (as for all the images to come). Whilst the spherical wave front is propagating towards the observer, source and observer move to the right. Wave front and observer meet at one point that can be calculated considering the transversal Doppler- effect [7].

The angle of the wave front normal route (interestingly only wave normals will meet the telescope in any possible case) emerging from the past emerging point (not the actual position of source) is being deflected by the telescope optics by the aberration angle, hence equaling to the angle between source and observer at the moment of emission of the wave front. For the true velocities of c=300.000 km/s and v=368 km/s this angle will amount to ca. 253,02 arcseconds.

But now the telescope will perceive the ray direction parallel to the parable's axis, mistaking the position of source at the time of emission with the position at the time of observation, because in this special case the source has also moved just the same distance. Considering the light's traveling time, the perceived position of the source is wrong by the full aberration angle. Nonetheless the perceived position is the true position of the source at the time of observation.

If the whole setup moves along now for one second, the observer will receive the next wave front that has been emitted way in the past one second after the first. And therefore there will be no additional parallax.

If now the transversal velocity or movement direction of both would change, also the aberration angle would change accordingly dependent on transversal velocity and also the reflection angle being perceived by the telescope. The telescope's tilt angle still remains in the direction between observer and source at time of emission as before.

Conclusion: The true source's position at the time of observation is being perceived correctly, although it is mistaken with the true position at the time of emission. The actual error amounts to the full aberration angle.

Stellar aberration

Regarding stellar aberration commonly just the second case with spherical emitted wave fronts is of relevance.

2. Source is resting in absolute space, observer is moving

The principle for a source resting in absolute space and a moving observer can be illustrated by the following sketch:
C = 1,5
$V_{source} = 0$
$V_{observer} = 0,5$

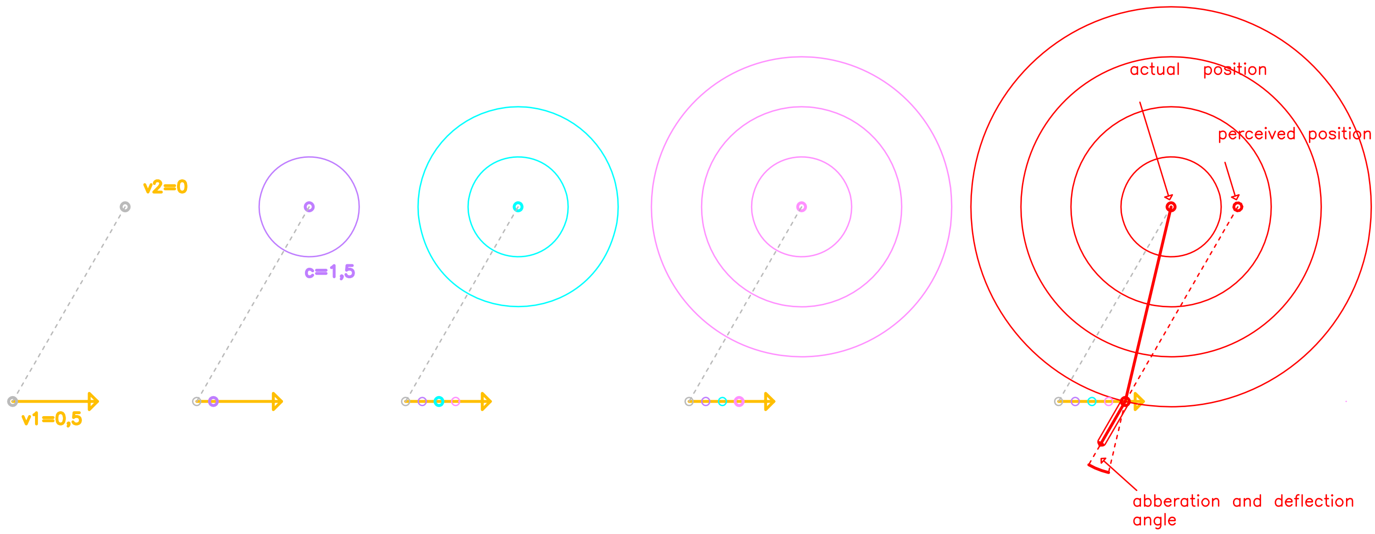

Fig. 18: Aberration; source is resting against emission point, observer moving regularly

Obviously the actual aberration angle remains the same, since it is exclusively dependent only from the relative velocity of the observer to the absolute space.

Also the telescope's tilt angle remains the same. If the observer would move along now, yet an additional angle of parallax would occur.

But now we have an important difference to the former case: The positions of source at the moment of emission and at the moment of observation are always identical and the error compared to the perceived angle on both will be the full aberration angle.

If now the transversal velocity of the observer changes, both the aberration and the reflection angle will be changing alike, and also again the error will be the full aberration angle. The telescope remains tilted in the same position as before.

Conclusion: The true position of source at the moment of emission and observation at any time will depart from the perceived angle by the full aberration angle.

2. Source and observer move against absolute space, but differing velocities

We now come to the most interesting case that applies for the observation of objects e.g. inside the milky way from earth. Due to the annual orbit course the velocity of the earth relatively to the galaxy varies by ca. +/- 29,78 km/s.

In our first thought experiment we assume the observer's velocity against the source being -0,1, in order to obtain presentable conditions:
c = 1,5
$v_{source, galaxy} = 0,5$
$v_{observer, earth} = 0,4$

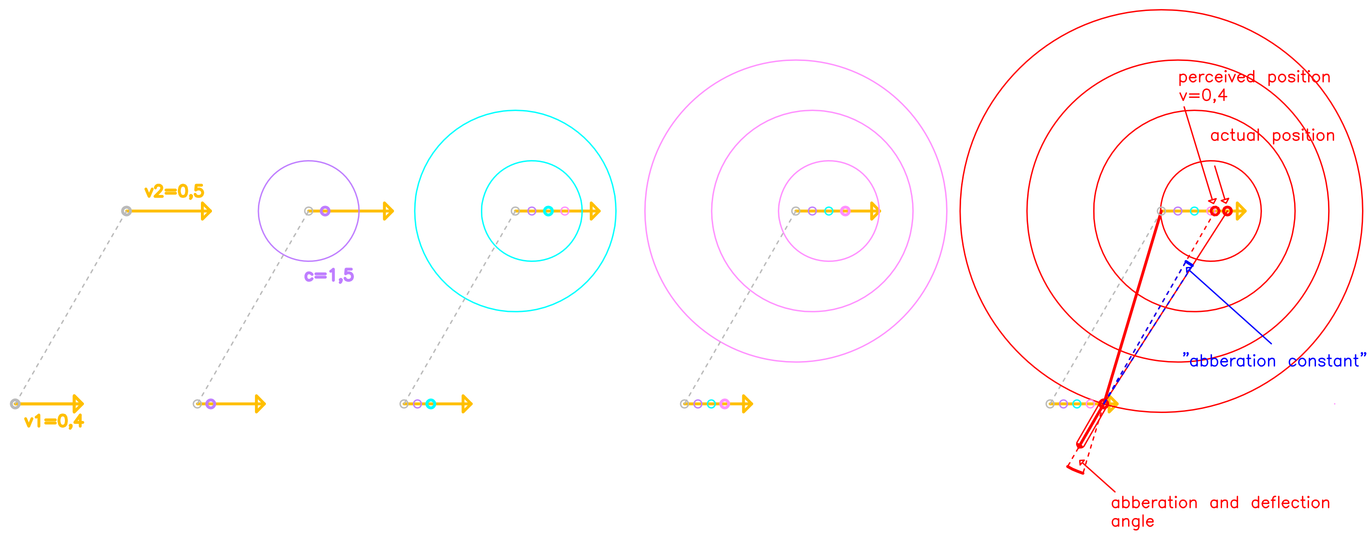

Fig. 19: Source and observer moving relatively to absolute space but source is faster than observer

The telescope is now moving slower against the absolute space, hence aberration angle and reflection angle have changed: According to the galaxy's absolute velocity of 368 km/s minus 29,78 km/s resulting to 338,22 km/s for the velocity of earth, the angle will amount now to ca. 232,54 arcseconds.

The telscope's tilting angle still remains as before, namely the direction between observer and source at the time of wave front emission.

But in difference to the first case of uniformly moving source and observer, the perceived angle though still implies the error of the full aberration angle to the true position of emission, but is also no more equal to the true position of source at the moment of observation, but deviating by an angle that represents the relative velocity of earth to galaxy at this moment. As we will find out later, this angle is equal to the so called "aberration constant" [3]. For now nonetheless this deviation is not detectable by the observer.

We assume now with the next image that earth is moving with a velocity of +0,1 relatively to the galaxy on its orbital course.
c = 1,5
$v_{source, galaxy} = 0,5$
$v_{observer, earth} = 0,6$

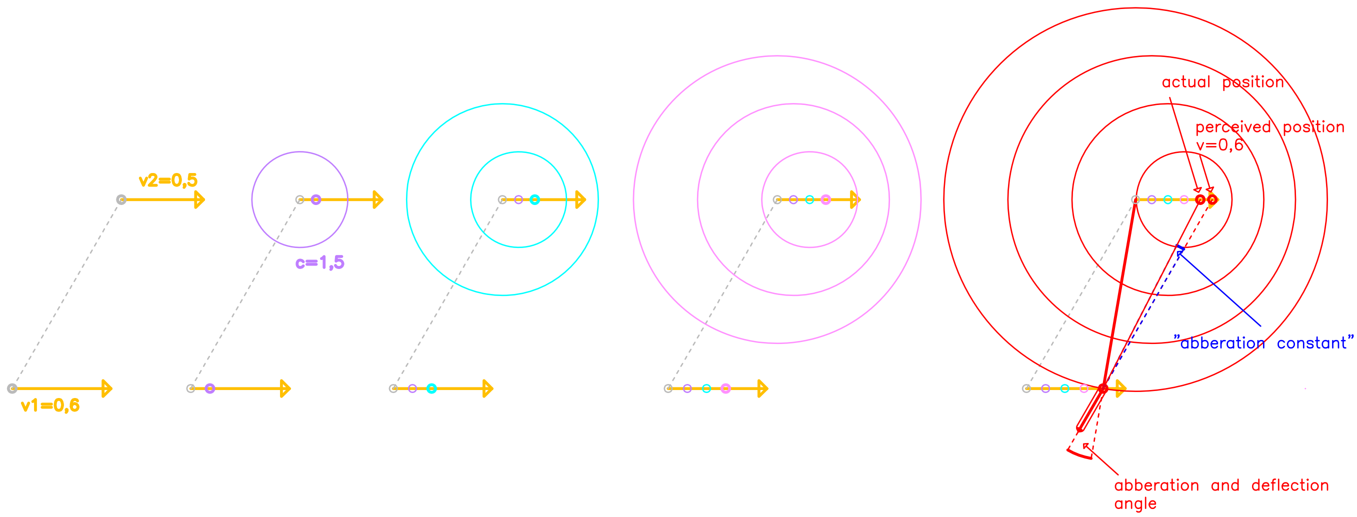

Fig. 20: Source and observer moving relatively to absolute space but source is slower than observer

Aberration as well as reflection angle change according to the observer's velocity against absolute space, still with no change of telescope's tilt angle. Again the perceived position of the source at the moment of observation is incorrect, but this time to the opposite direction by functionally the same angle. Still the observer is not able to detect this deviation.

Only by comparison now of the perceived positions at the same "point of time" on opposite orbital locations, the different angles become obvious, leading to a mostly elliptic roaming of the perceived source's position. If it is intended now to keep this position in place of the telescope's view, the telescope has to be additionally tilted, namely up to the aberration constant [3] according to the respective observer's position and relative velocity.

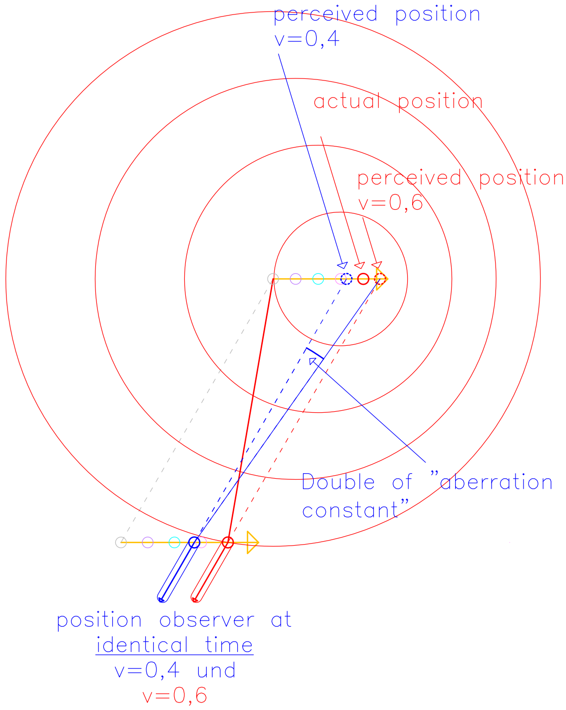

Fig. 21: Comparison of both situations at an identical moment on opposite orbital locations

Incidentally the above is also valid for all former cases. Therefore the same perceptive deviation by the aberration constant exists regarding all objects that rest in absolute space or move at any possible velocity. All perceptions are subject to the same aberration constant, representing indeed just the relative velocity between two points of observation, nothing more. Thus also the behavior of double star systems becomes rather trivial.

Also the aberration constant therefore certainly has nothing to do with the true aberration.

Coming back to the first case with source and observer moving uniformly, hence terrestrial aberration, we have the same fact. Terrestrial aberration exists and can be detected theoretically, but only if measured against the absolute space or against any object with decisively differing velocity. Practically any performed measurements tried to find terrestrial aberration from inside the observer's reference system, which is impossible!

Yet we have to prevent from another commonly used misunderstanding. One could suppose our whole explanation does not represent anything but a parallax effect. This is not the case, because the deviation exclusively results from variance of the velocity of the observer relatively to the absolute space. The concept can as well be checked assuming the triple distance between observer and source, whilst keeping the same velocities. Obviously all angles remain the same and it is proofed to be no parallax effect:

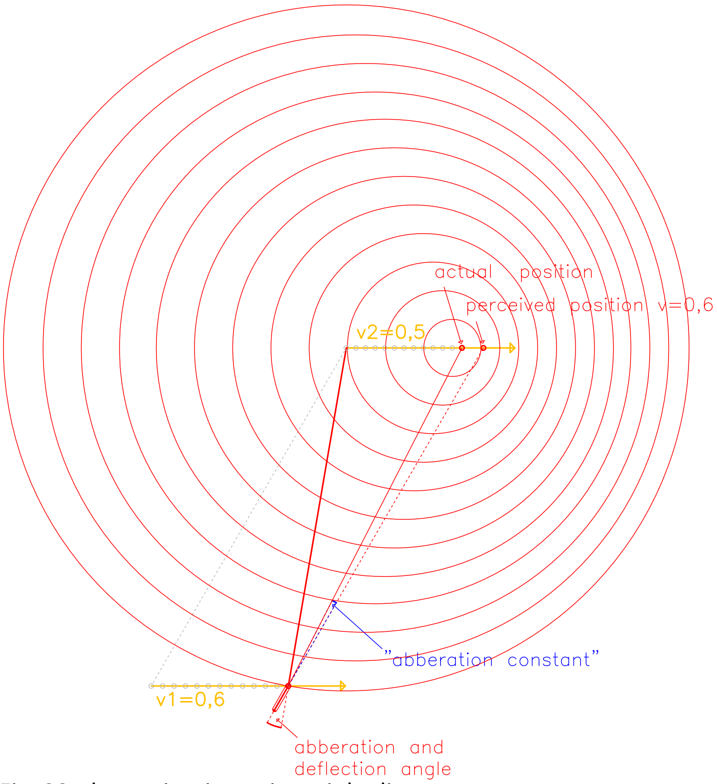

Fig. 22: determination using triple distance

As well the aberration constant in fact therefore has nothing to do with the difference of runtime of one ray inside a telescope. In so far as denser media inside the telescope such as water were used, e.g. at the experiment of George Biddell Airy [11], no change of the aberration angle should have to be expected. The whole issue is not dealing with the vanishingly short distance of light traveling inside the telescope's tube but the total distance of travel from star to earth.

8. The Michelson/Moreley interferometer

The historic attempts to explain the outcome of the Michelson/Moreley experiment [4] under terms of ether theories principally may presume wrong prerequisites.

First: Approaches according to classic static ether theories must involve the validity of Doppler's principle for source and observer [7]. Doing so, no phase shift at all should appear to the separated rays on even different paths through the array after being once adjusted at the beginning. Also whilst movement of the array thru differing transversal directions and velocities no phase shift has to be expected, because for each ray the Doppler effect for moving observers always must exactly compensate the Doppler effect for moving sources [7]. Hence there should not be any phase shift according to classic physics.

Second: Even if a time delay between two separated partial rays after the respective runtimes result from classic calculations, but do not exist upon experiment outcome, this fact may have no relevance. Namely the question is: how could at all be ensured, that two wave fronts split from different rays might not be able to interfere? In other words, if the first wave front has just started sooner, it might always, and for any transversal movement, find any other second wave front split from a different ray that has been started later, to meet at the same moment. Different runtime lengths therefore may not be detected at all by means of interferometers, since it cannot be ensured that two partial rays from one common beam could or must at all interfere.

Fatally the historic explanations have a substantially much more serious problem. Namely the fact that rays would always meet at the center of the mirror they aim to is not persuasive. Though this would be correct applying the special relativity, in classic physics it would be a contradiction, especially if assuming a sharply focusing light source. According to static ether theories the light in terms of a narrow light wave front section should not follow the transversal direction of the array at all, but, in order to keep its native velocity and direction, meet the mirrors quite eccentrically, then being reflected under 90 and 180 degrees respectively. Also attempts to correct this fact with "dragged ether" theories (e.g. as per George Stokes) [12] were finally without success.

Historical explanations therefore simply imply that the two separated rays, though at least being parallel, cannot meet at the same point at all at any transversal movement but must hit the final screen with remarkable offset. Assuming an array with 2 m length this offset would have to be up to 5 mm, considering Dayton C. Miller's experiment [13] this offset even would increase to up to 4 cm. And if tested by means of satellite arrays the beams just could not ever meet the satellite. In any case certainly there is no clue of two rays interfering with each other.

The following image can give an impression, using v = 1/10 c and a transversal movement angle of the setup of 70 degrees:

transversal movement 70°, mirror tilt 45°, $v = \frac{1}{10} c$

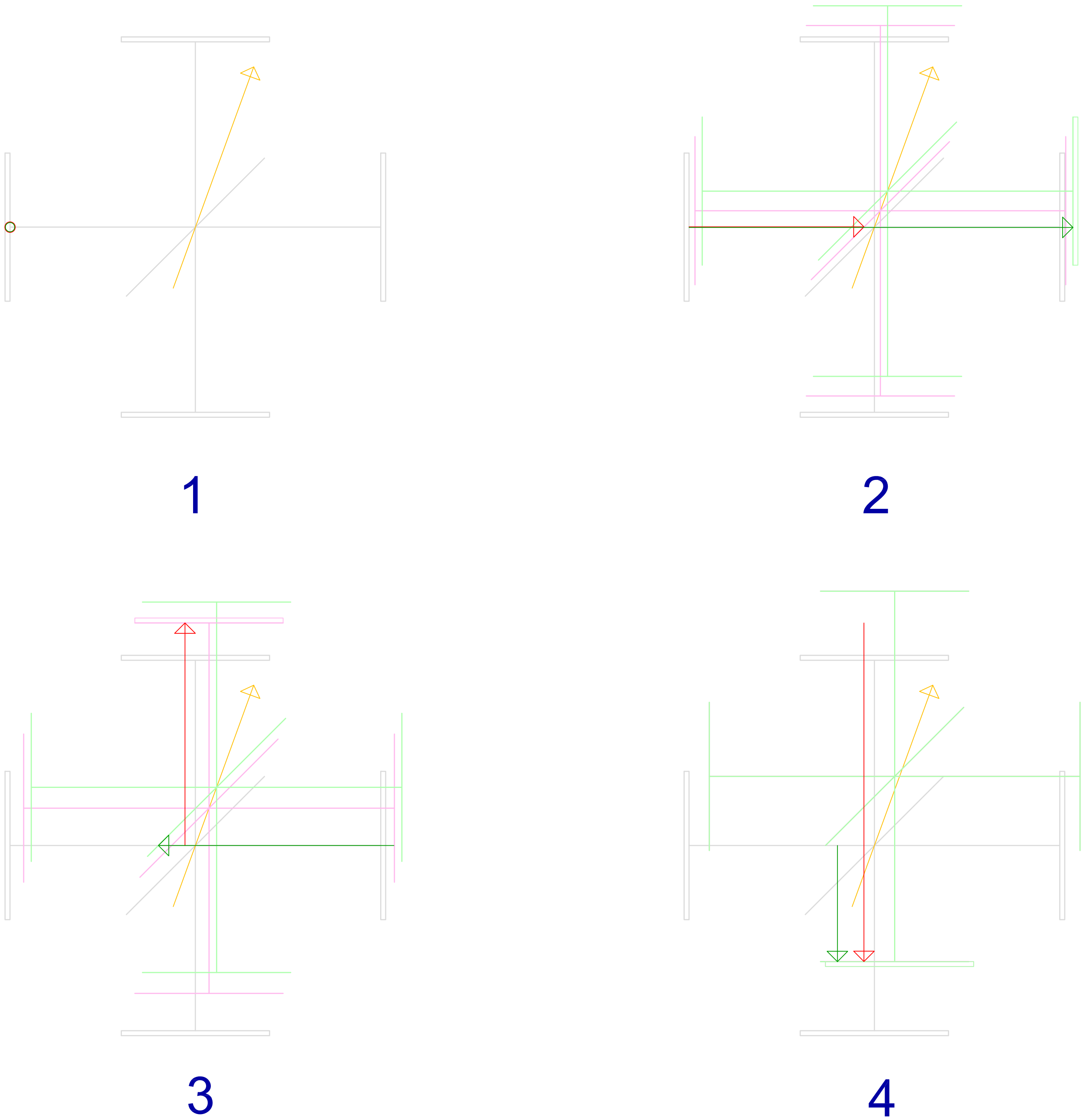

Fig. 23: Principle of the process on interferometers assuming classic physics

But now it comes to the point what would happen now, if light rays would be reflected not strictly according to Huygen's principle [1], but to differing angles, depending on the respective transversal movement, in other words, if angles would be kept automatically to always suit the requirements.

Let us outline the scenario:

1. The first ray's angle will be determined upon our formulae for moving parabolic mirrors. Therefore we assume, ignoring the divergence of ca. 1,36 µrad, that this first, still unified ray, will meet centrically on the by 45 degree tilted first mirror. Since the emission angle suits to the aberration at any transversal movement direction, this will apply for any rotation angel of the array. While calculating the correct length of the ray in order to meet the mirror it has to be considered that the already tilted mirror is moving away from the beam and additionally presents, due to the shift, a different point on its surface as well.

2. Now the beam is being split by the half translucent mirror. Partial ray 1 will be reflected according to reflection on moving mirrors. Apparently this ray does not meet the mirror exactly centrically as well. Therefore another shift effect on this mirror has to be taken into account. Partial ray 2 now will penetrate the mirror and later on meet the opposite mirror tilted by 90 degrees. Again the shift effect has to be taken into account.

3. Ray 1 now will aim towards the observer after being reflected by the top mirror, again using the formulae. Ray 2 has been reflected lately by the mirror tilted by 45 degrees, and finally both rays hit on the screen.

transversal movement 70°, mirror tilt 45°, $v = \frac{1}{10}\,c$

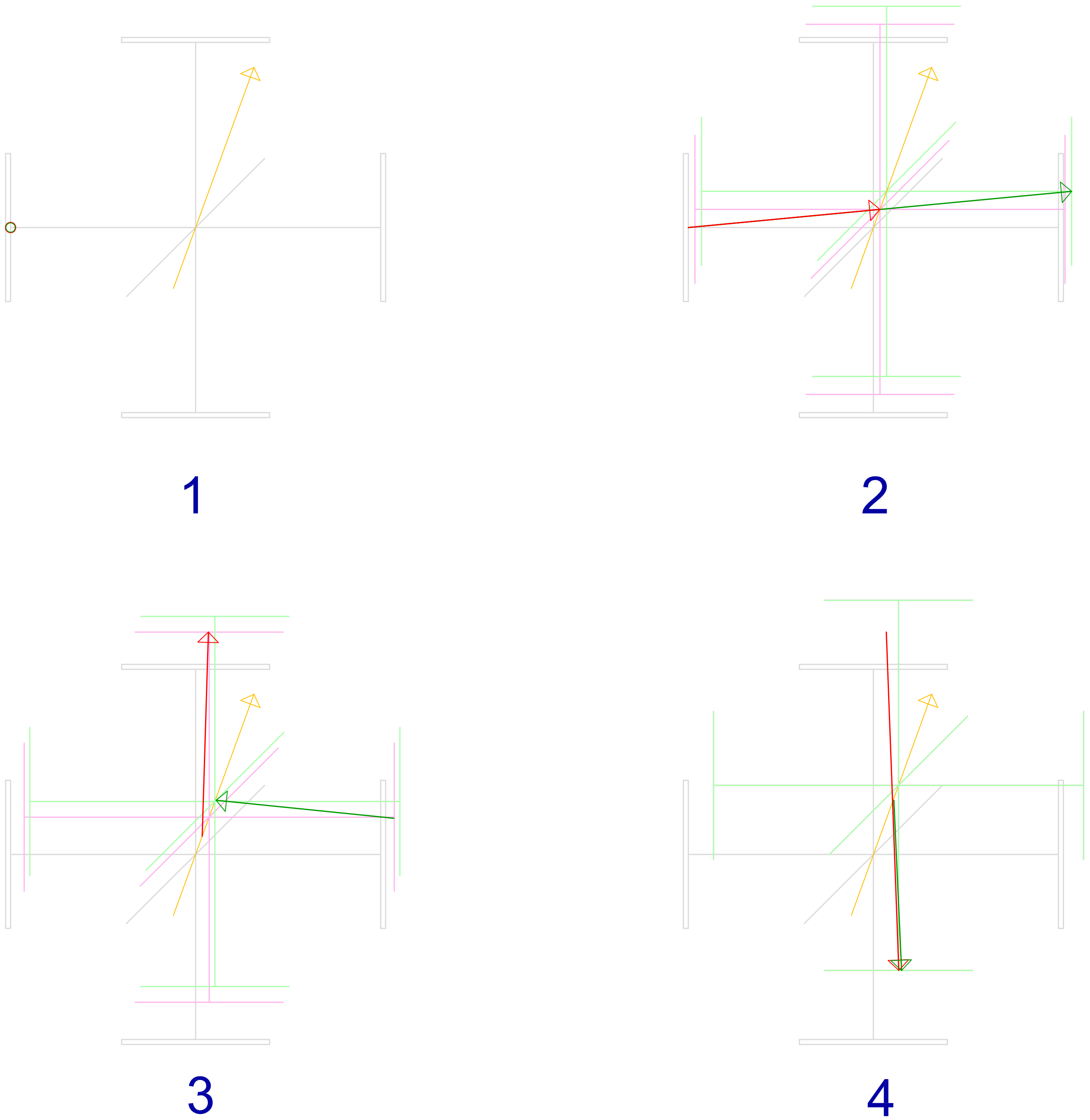

Fig. 24: Principle of the process on interferometers assuming reflection on moving mirrors. The image is based on accurate calculations from below.

Apparently even for v=1/10c the angle and offset between the two rays becomes hardly visible. Now all the individual ray paths have to be determined. Again it is useful to define functions for the differing movements. The following sketches will illustrate this procedure, setting is v=1/5c, 1st ray's angle 10 degrees, mirror tilt 40 degrees, angle of transversal movement 30 degrees.

1st ray, 1st route

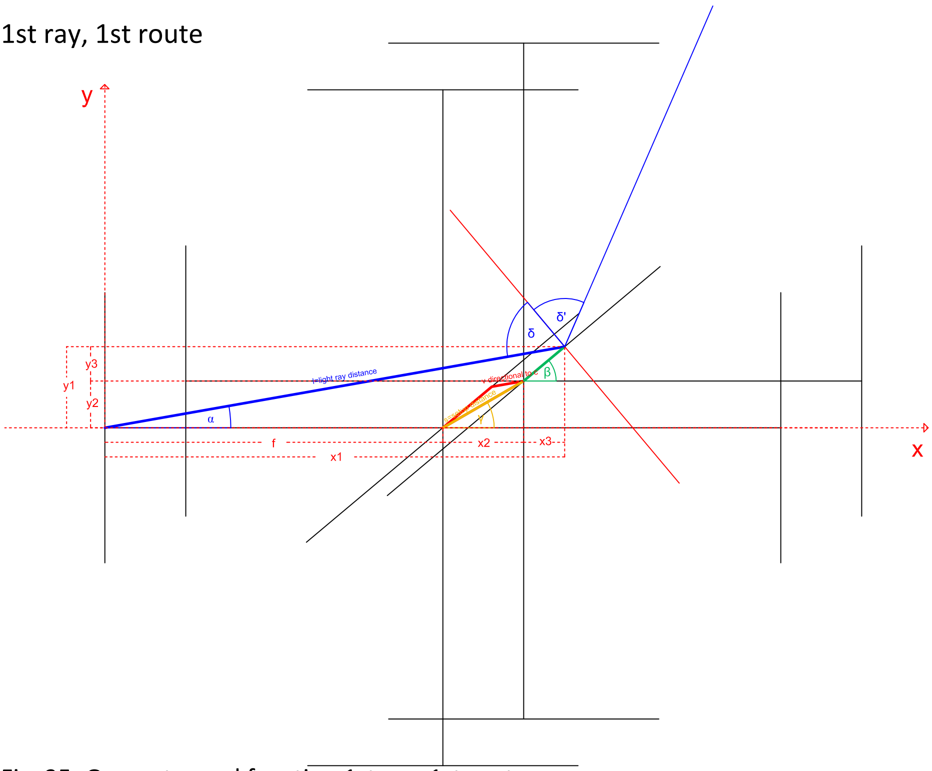

Fig. 25: Geometry and function 1st ray, 1st route

(1) $y_1 = x_1 \cdot \tan(\alpha)$ $\quad y_1 = \sin(\alpha) \cdot l$ $\quad x_1 = \cos(\alpha) \cdot l$

(2) $y_2 = x_2 \cdot \tan(\gamma)$ $\quad y_2 = \sin(\gamma) \cdot s$ $\quad x_2 = \cos(\gamma) \cdot s$

(3) $y_3 = x_3 \cdot \tan(\beta)$

$$x_1 = f + x_2 + x_3 \text{ und } x_3 = \frac{y_3}{\tan(\beta)} = \frac{y_1 - y_2}{\tan(\beta)} = \frac{\sin(\alpha) \cdot l - \sin(\gamma) \cdot s}{\tan(\beta)} = \frac{\sin(\alpha) \cdot l - \sin(\gamma) \cdot l \cdot \frac{v}{c}}{\tan(\beta)}$$

and for x_1 and x_2 inserted from above:

$$\cos(\alpha) \cdot l = f + \cos(\gamma) \cdot s + \frac{\sin(\alpha) \cdot l - \sin(\gamma) \cdot l \cdot \frac{v}{c}}{\tan(\beta)}$$

$$\cos(\alpha) \cdot l - f - \cos(\gamma) \cdot l \cdot \frac{v}{c} = \frac{\sin(\alpha) \cdot l - \sin(\gamma) \cdot l \cdot \frac{v}{c}}{\tan(\beta)}$$

$$\cos(\alpha)\cdot l\cdot\tan(\beta)-f\cdot\tan(\beta)-\cos(\gamma)\cdot l\cdot\frac{v}{c}\cdot\tan(\beta)=\sin(\alpha)\cdot l-\sin(\gamma)\cdot l\cdot\frac{v}{c}$$

$$l\cdot\left(\cos(\alpha)\cdot\tan(\beta)-\cos(\gamma)\cdot\frac{v}{c}\cdot\tan(\beta)-\sin(\alpha)+\sin(\gamma)\cdot\frac{v}{c}\right)=f\cdot\tan(\beta)$$

$$\boxed{l=\frac{f\cdot\tan(\beta)}{\cos(\alpha)\cdot\tan(\beta)-\cos(\gamma)\cdot\frac{v}{c}\cdot\tan(\beta)-\sin(\alpha)+\sin(\gamma)\cdot\frac{v}{c}}}$$

All the rest of x and y values can then be determined from above equations.

We now have the length and angle of the ray and the array movement, thus the whole geometry of the meeting point on the mirror.

Now again, in order to determine the reflection ray on the moving mirror, we first have to find the appropriate velocity the mirror has directional to the beam (as shown above several times):

$$\boxed{v_{\rightarrow c}=v\cdot\frac{\sin(\gamma-\beta)}{\sin(\beta-\alpha)}}$$

And hereafter the final formula to get the angle of reflection.

$$\boxed{\delta'=2\cdot\arctan\left(\frac{\tan(\delta)}{1-\left(\frac{v_{\rightarrow c}}{c}\right)}\right)-\delta}$$

1st ray, 2nd route

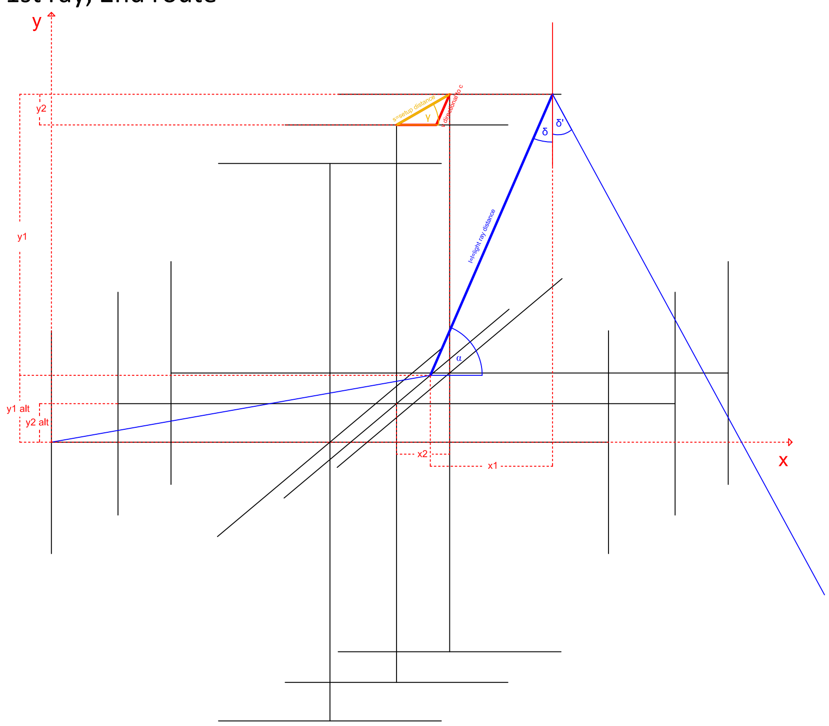

Fig. 26: Geometry und function 1st ray, 1st route

(1) $y_1 = x_1 \cdot \tan(\alpha)$ $y_1 = \sin(\alpha) \cdot l$ $x_1 = \cos(\alpha) \cdot l$

(2) $y_2 = x_2 \cdot \tan(\gamma)$ $y_2 = \sin(\gamma) \cdot s$ $x_2 = \cos(\gamma) \cdot s$

$$y_1 = f + y_2 + y_{2alt} - y_{1alt}$$

And for y_1 and y_2 inserted from above:

$$\sin(\alpha) \cdot l = f + \sin(\gamma) \cdot s + y_{2alt} - y_{1alt}$$

$$\sin(\alpha) \cdot l - \sin(\gamma) \cdot l \cdot \frac{v}{c} = f + y_{2alt} - y_{1alt}$$

$$l \cdot \left(\sin(\alpha) - \sin(\gamma) \cdot \frac{v}{c} \right) = f + y_{2alt} - y_{1alt}$$

$$\boxed{l = \frac{f + y_{2alt} - y_{1alt}}{\sin(\alpha) - \sin(\gamma) \cdot \frac{v}{c}}}$$

$$\boxed{v_{\rightarrow c} = v \cdot \frac{\sin(\gamma)}{\sin(\alpha)}}$$

1st ray, 3rd route

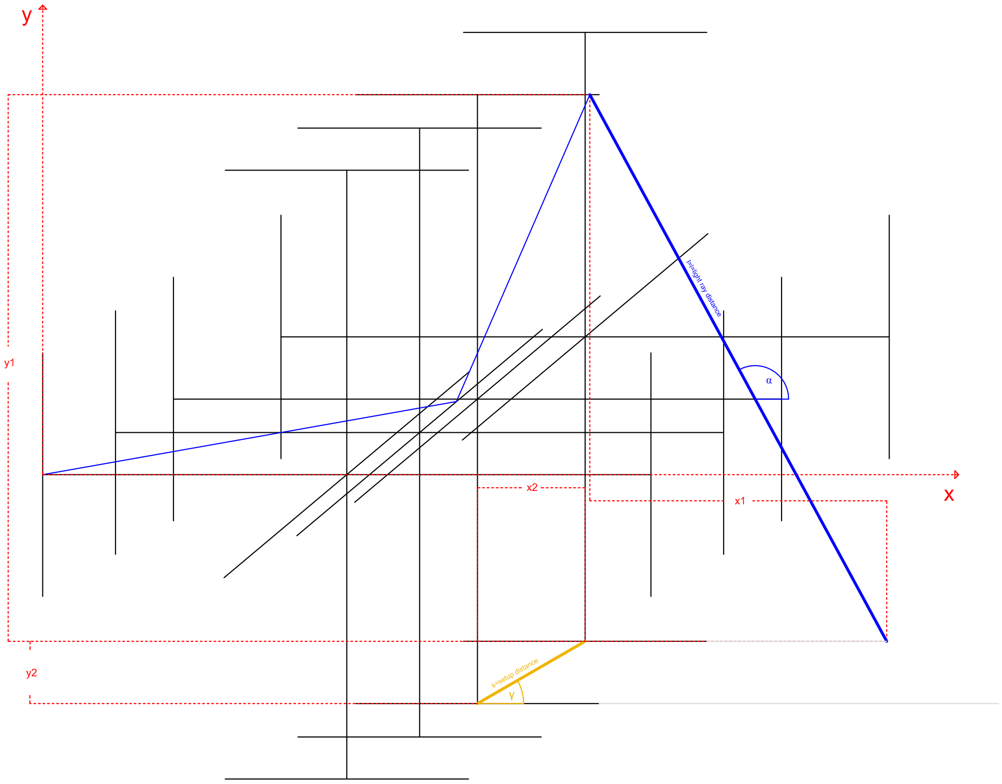

Fig. 27: Geometry und function 1st ray, 3rd route

$$(1)\qquad y_1 = x_1 \cdot \tan(\alpha) \qquad y_1 = \sin(\alpha)\cdot l \qquad x_1 = \cos(\alpha)\cdot l$$

$$(2)\qquad y_2 = x_2 \cdot \tan(\gamma) \qquad y_2 = \sin(\gamma)\cdot s \qquad x_2 = \cos(\gamma)\cdot s$$

$$y_1 = 2\cdot f - y_2$$

And for y_1 and y_2 inserted from above:

$$\sin(\alpha)\cdot l = 2\cdot f - \sin(\gamma)\cdot s$$

$$\sin(\alpha)\cdot l + \sin(\gamma)\cdot l \cdot \frac{v}{c} = 2\cdot f$$

$$l\cdot\left(\sin(\alpha) + \sin(\gamma)\cdot\frac{v}{c}\right) = 2\cdot f$$

$$\boxed{l = \frac{2\cdot f}{\sin(\alpha) + \sin(\gamma)\cdot\frac{v}{c}}}$$

The reflection angle as before.

2nd ray, 1st route

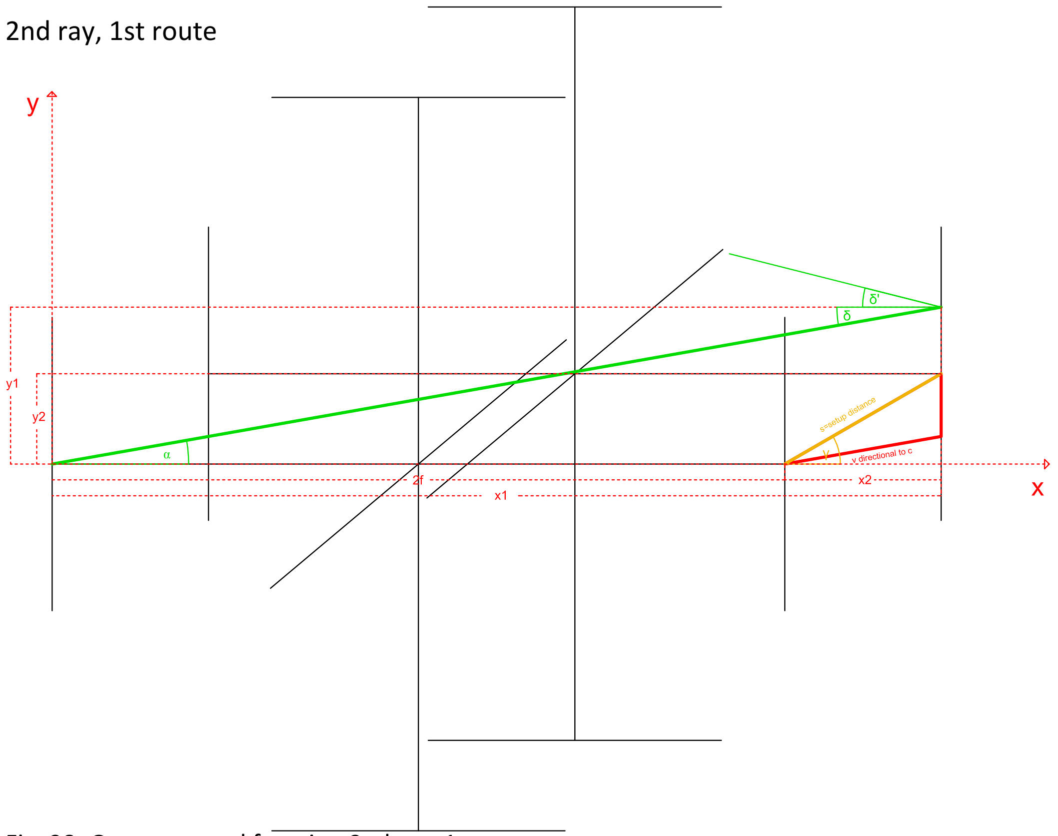

Fig. 28: Geometry und function 2nd ray, 1st route

(1) $y_1 = x_1 \cdot \tan(\alpha)$ $\qquad y_1 = \sin(\alpha)\cdot l$ $\qquad x_1 = \cos(\alpha)\cdot l$

(2) $y_2 = x_2 \cdot \tan(\gamma)$ $\qquad y_2 = \sin(\gamma)\cdot s$ $\qquad x_2 = \cos(\gamma)\cdot s$

$$x_1 = 2\cdot f + x_2$$

And for y_1 and y_2 inserted from above:

$$\cos(\alpha)\cdot l = 2\cdot f + s\cos(\gamma)\cdot s$$

$$\cos(\alpha)\cdot l - \cos(\gamma)\cdot l\cdot \frac{v}{c} = 2\cdot f$$

$$l\cdot\left(\cos(\alpha) - \cos(\gamma)\cdot \frac{v}{c}\right) = 2\cdot f$$

$$\boxed{l = \frac{2\cdot f}{\cos(\alpha) - \cos(\gamma)\cdot \frac{v}{c}}}$$

$$\boxed{v_{\rightarrow c} = v\cdot \frac{\cos(\gamma)}{\cos(\alpha)}}$$

The reflection angle as before.

2nd ray, 2nd route

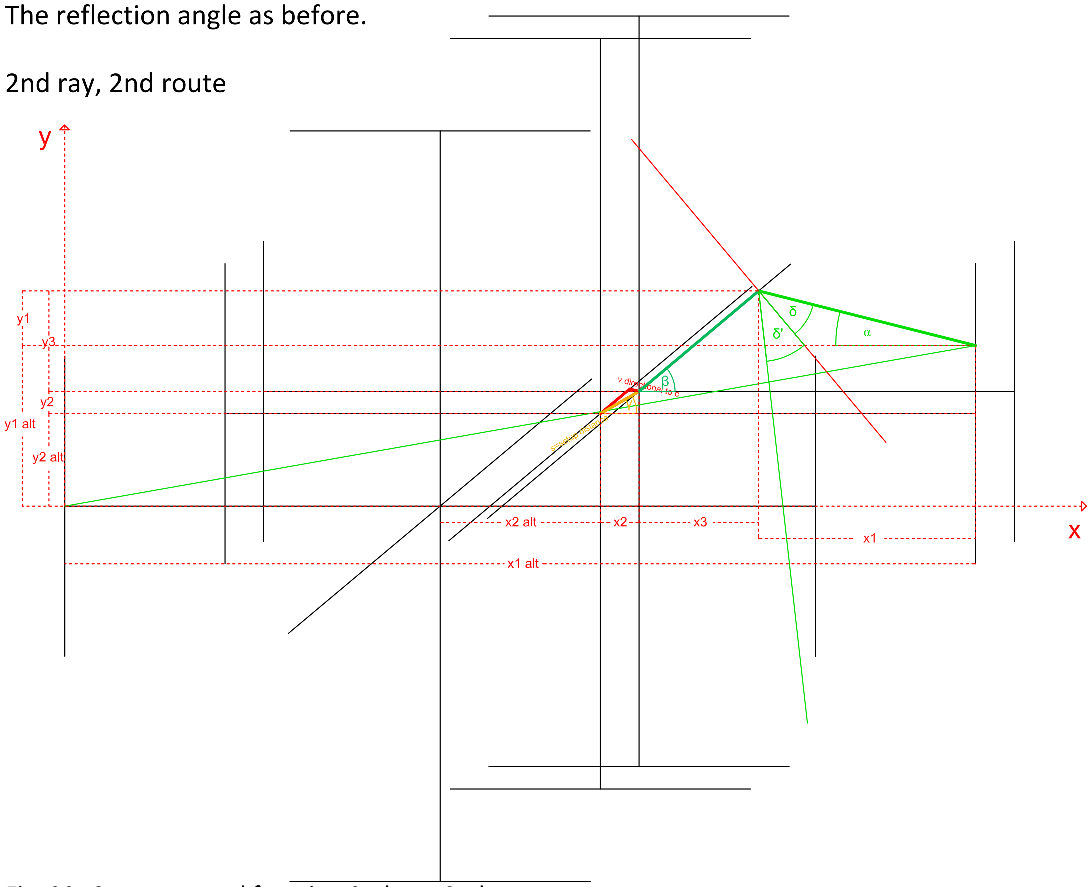

Fig. 29: Geometry und function 2nd ray, 2nd route

(1) $y_1 = x_1 \cdot \tan(\alpha)$ $y_1 = \sin(\alpha) \cdot l$ $x_1 = \cos(\alpha) \cdot l$

(2) $y_2 = x_2 \cdot \tan(\gamma)$ $y_2 = \sin(\gamma) \cdot s$ $x_2 = \cos(\gamma) \cdot s$

(3) $y_3 = x_3 \cdot \tan(\beta)$

$x_1 = f - x_2 - x_3$

and

$$x_3 = \frac{y_3}{\tan(\beta)} = \frac{y_1 + y_{1alt} - y_2 - y_{2alt}}{\tan(\beta)} = \frac{\sin(\alpha) \cdot l - \sin(\gamma) \cdot s + y_{1alt} - y_{2alt}}{\tan(\beta)} = \frac{\sin(\alpha) \cdot l - \sin(\gamma) \cdot l \cdot \frac{v}{c} + y_{1alt} - y_{2alt}}{\tan(\beta)}$$

And for x_1 and x_2 inserted from above:

$$\cos(\alpha) \cdot l = f - \cos(\gamma) \cdot s - \frac{\sin(\alpha) \cdot l - \sin(\gamma) \cdot l \cdot \frac{v}{c} + y_{1alt} - y_{2alt}}{\tan(\beta)}$$

$$\cos(\alpha) \cdot l + \cos(\gamma) \cdot l \cdot \frac{v}{c} - f = -\frac{\sin(\alpha) \cdot l - \sin(\gamma) \cdot l \cdot \frac{v}{c} + y_{1alt} - y_{2alt}}{\tan(\beta)}$$

$$\cos(\alpha) \cdot l \cdot \tan(\beta) + \cos(\gamma) \cdot l \cdot \frac{v}{c} \cdot \tan(\beta) - f \cdot \tan(\beta) = -\sin(\alpha) \cdot l + \sin(\gamma) \cdot l \cdot \frac{v}{c} - y_{1alt} + y_{2alt}$$

$$\cos(\alpha) \cdot l \cdot \tan(\beta) + \cos(\gamma) \cdot l \cdot \frac{v}{c} \cdot \tan(\beta) + \sin(\alpha) \cdot l - \sin(\gamma) \cdot l \cdot \frac{v}{c} = -y_{1alt} + y_{2alt} + f \cdot \tan(\beta)$$

$$l \cdot \left(\cos(\alpha) \cdot \tan(\beta) + \cos(\gamma) \cdot \frac{v}{c} \cdot \tan(\beta) + \sin(\alpha) - \sin(\gamma) \cdot \frac{v}{c} \right) = -y_{1alt} + y_{2alt} + f \cdot \tan(\beta)$$

$$\boxed{l = \frac{f \cdot \tan(\beta) - y_{1alt} + y_{2alt}}{\cos(\alpha) \cdot \tan(\beta) + \cos(\gamma) \cdot \frac{v}{c} \cdot \tan(\beta) + \sin(\alpha) - \sin(\gamma) \cdot \frac{v}{c}}}$$

$$\boxed{v_{\to c} = v \cdot \frac{\cos(\beta - \gamma)}{\cos(\beta + \alpha)}}$$

The reflection angle as before.

2nd ray, 3rd route

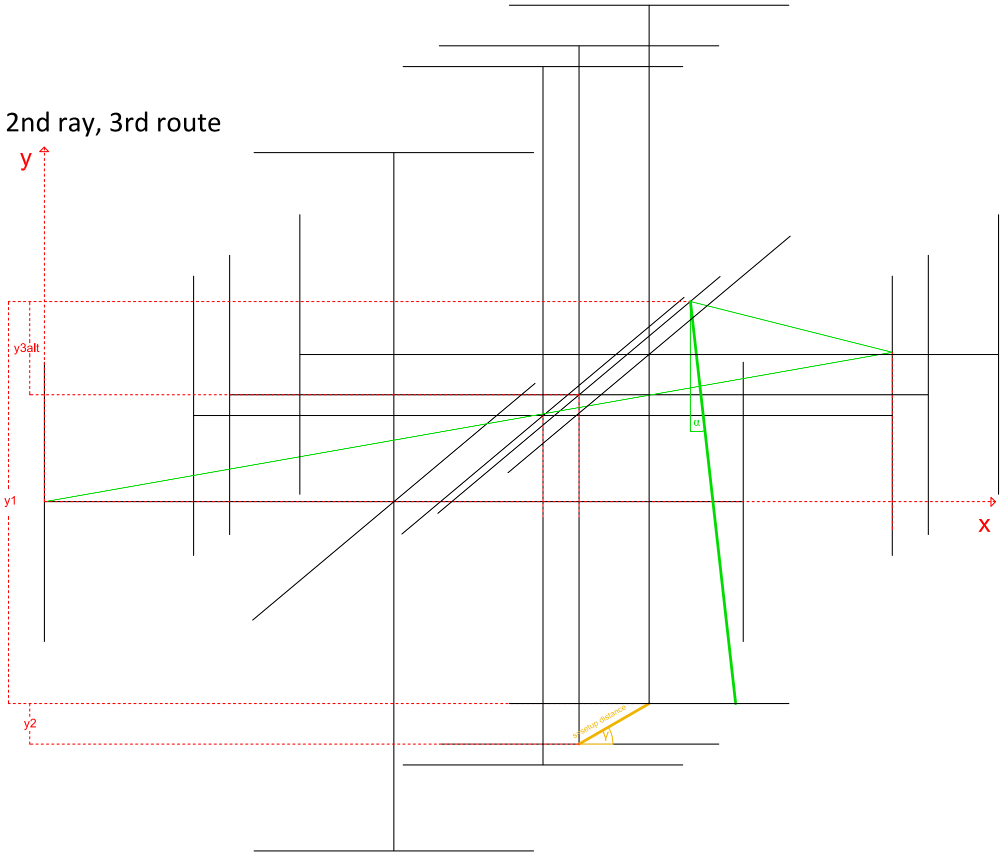

Fig. 30: Geometry und function 2nd ray, 3rd route

(1) $y_1 = x_1 \cdot \tan(\alpha)$ $\qquad y_1 = \sin(\alpha) \cdot l$ $\qquad x_1 = \cos(\alpha) \cdot l$

(2) $y_2 = x_2 \cdot \tan(\gamma)$ $\qquad y_2 = \sin(\gamma) \cdot s$ $\qquad x_2 = \cos(\gamma) \cdot s$

(3) $y_3 = x_3 \cdot \tan(\beta)$

$$y_1 = f - y_2 + y_{3alt}$$

And for y_1 and y_2 inserted from above:

$$\sin(\alpha) \cdot l = f - \sin(\gamma) \cdot s + y_{3alt}$$

$$\sin(\alpha) \cdot l + \sin(\gamma) \cdot l \cdot \frac{v}{c} = f + y_{3alt}$$

$$l \cdot \left(\sin(\alpha) + \sin(\gamma) \cdot \frac{v}{c} \right) = f + y_{3alt}$$

$$\boxed{l = \frac{f + y_{3alt}}{\sin(\alpha) + \sin(\gamma) \cdot \frac{v}{c}}}$$

The total ray course was now processed by another excel routine for different transversal angles. The sketches were based upon results thereof and cad imaging confirmed the correctness of the approach.

For the values set to c = 300.000 km/s und v = 350 km/s we obtain the following results, based on a interferometer length of 2 m:

Transversal movement angle of array	Final angle 1st ray	Final angle 2nd ray	deviation µrad	offset both rays on observer µm
0°	90,066884084223600	90,066806098301500	1,361111110919710	5,44127592289056
10°	90,065892890650700	90,065819593022900	1,279284938890330	5,11317039143117
20°	90,062893867974900	90,062834103471400	1,043087362465980	4,16840317297995
30°	90,057976628926900	90,057937613229700	0,680952376304514	2,72084830664140
45°	90,047344662269800	90,047344662269800	-0,000000000248026	0,00000000000000
60°	90,033470629853700	90,033509662228600	-0,681243456881569	-2,72142953875246
70°	90,022882643404400	90,022942449626500	-1,043815489521580	-4,16985724855518
80°	90,011597545630400	90,011670912703400	-1,280496987144860	-5,11559121365440
90°	89,999960961494000	90,000039038506000	-1,362700929126150	-5,44445185593143

The whole thought experiment thus results in a maximum deviation of both rays of 1,36 µrad for the most inconvenient case of 90 degrees. Assuming an array length of 2 m again, this would be an offset of both rays by only 5 µm. This result again is two orders of magnitude below the smallest divergence of laser beams and almost equals the difference between aberration and emerging beam angle off parabolic mirrors.

Consequently both rays of the Michelson/Moreley interferometer [4] may interfere according to classic physics. Also partial rays from different native rays to be found meeting at the same moment would have a further divergence of less than 1 nrad.

9. Conclusion and prospectives

For no apparent reason the assumption, that reflection laws will not apply identically to moving mirrors and reflection angels could be subject to relative velocities of light and mirror, is neglected by the literature almost throughout. At the same time this assumption is simple and obvious, having thoroughly contemplated on the native reason for reflection as such. Some scattered approaches, e.g. arguing with particle emission theories (Norbert Feist) [14], consider ballistic effects to be reasoning deviating reflections but none of the algorithms derived thereafter are suitable to explain the outcome of the notorious experiments. Also any attempts of criticizing the special relativity known to the author have flaws, at least to the point that they cannot satisfactorily explain absence of terrestrial aberration and/or existence of stellar aberration.

The approach used in this paper is inducing logical and consistent, at the same time offering simple and obvious solutions to the understanding of aberration and the Michelson/Moreley experiment, claiming an absolute space that behaves similar like the “static ether” [2], yet without necessity of any medium. The premise regarding independence of light speed from source is wave- typical and well known from sound and any other waves. As well as the dependence on and addition of observer's velocity, and subsequently the classic Doppler effects [7].

There would be a possible experiment to verify the whole statement, since, at least based on above calculations, reflection on a tilted moving mirror still will result in a tiny eccentricity of the targeting point dependently from the transversal moving direction. The setup could be a laser beam directed towards a 45 degrees tilted mirror and measurement of the reflected ray at 12 hours difference. Using a distance of 1 m the offset would be just around 0,75 µm, hence hardly detectable, but at 5 km this would amount to around 4 mm and should be detectable though any laser beam would already have diverged 1/2 m.

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Berlin 2013

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