perfectly parallel to the plane of the cylinder basis. Consequently, the Light-Beam is reflected several times by the circular wall of the cylinder. We consider that the mirrors of the circular wall are perfect with an emitted energy of light equivalent to the absorbed energy of light.

In this work, we will use the Cartesian coordinates of a reference frame $(o, \vec{J}, \vec{K})$ in order to avoid the problems of changing reference frames at the speed of light. This problem of reference frames has been widely discussed in my previous thesis [10].

We will even try in this work to guess recurrent relations that describe this experiment if the Light-Beam is reflected infinite times by the cylinder wall of the experiment. However, we will discover a contradiction in our common formulas that persists even if we use the principles of the previous work that could propose corrections to the formulas of Michelson-Morley experiment [11].

Here is a figure describing the side view of the experiment cylinder:

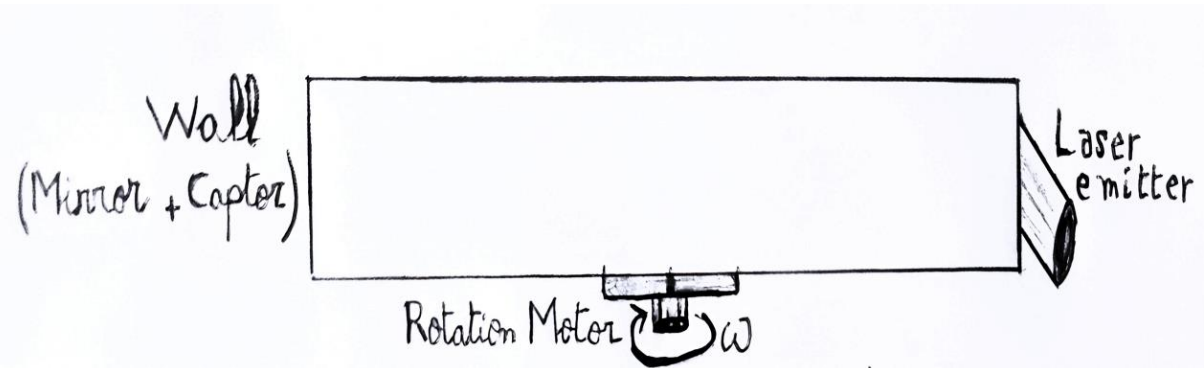


**Figure 1.** The cylinder of the experiment where the Light-Beam is trapped.

The internal wall of the cylinder is perfectly circular and covered with a perfect circular mirror. The internal wall is also covered with captors of lights that detect the impact point of the Light-Beam with the wall.

Here is a second figure that describes the apparatus of the experiment from inside:

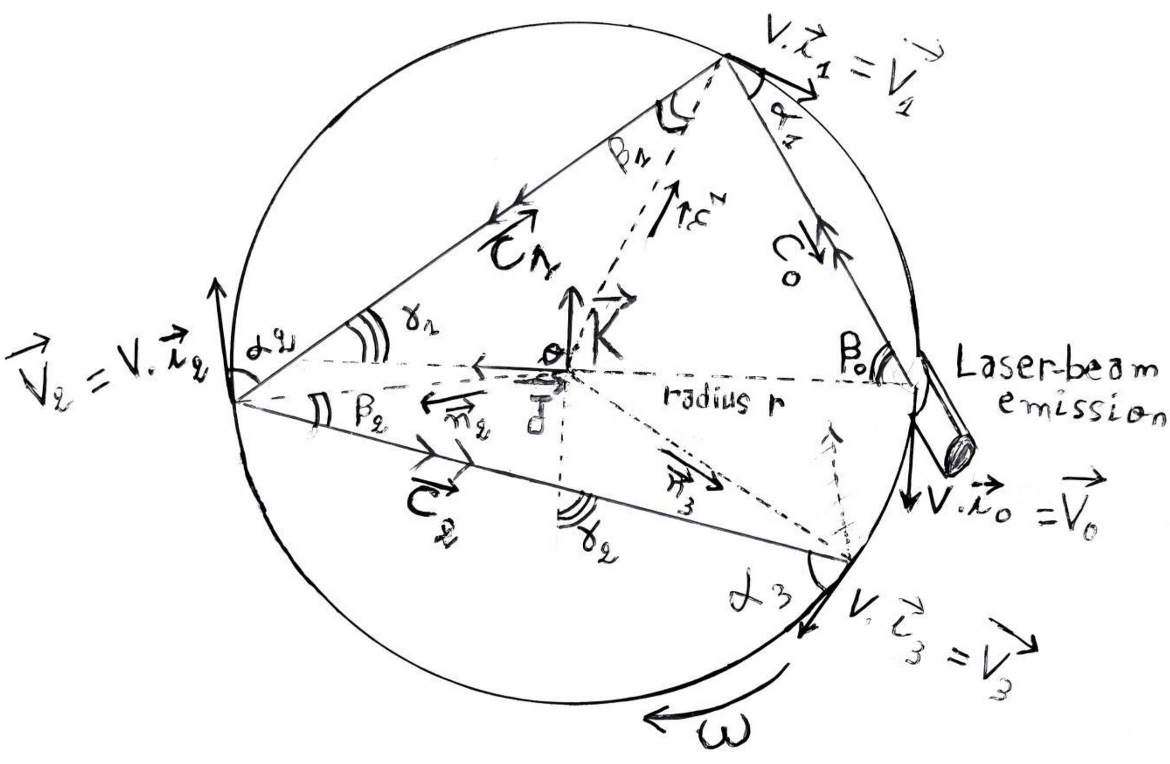


**Figure 2.** The experiment apparatus with the useful vectors and angles.

Let's consider that ***i*** is a natural number.

The vectors $\vec{V_i}$ are all tangent to the wall of the cylinder and we have $V_{i=\text{r}} \times \omega$ where ***r*** is the internal radius of the cylinder and $\omega$ is the fixed angular speed of the Motor that makes the cylinder rotate.

Each vector $\vec{n}_i$ is a unit vector that is perpendicular to the vector $\vec{V_i}$.

The vectors $\vec{C_i}$ represent the Light-Beam velocity vector after each reflection by the wall of the cylinder.

The angles $\alpha_i$ are determined immediately and easily by the captors after each impact of the light beam with the wall of the cylinder by using a simple comparison of the impact point and the reference frame $\left(\text{o}, \vec{J}, \vec{K}\right)$.

We have also:

We have:

$$\alpha_1 = \frac{\pi}{2} - \beta_0 \text{ and: } \alpha_2 = \frac{\pi}{2} - \beta_1 \text{ and: } \alpha_3 = \frac{\pi}{2} - \beta_2 \tag{1}$$

## 2. The Useful Formulas of the Experiment

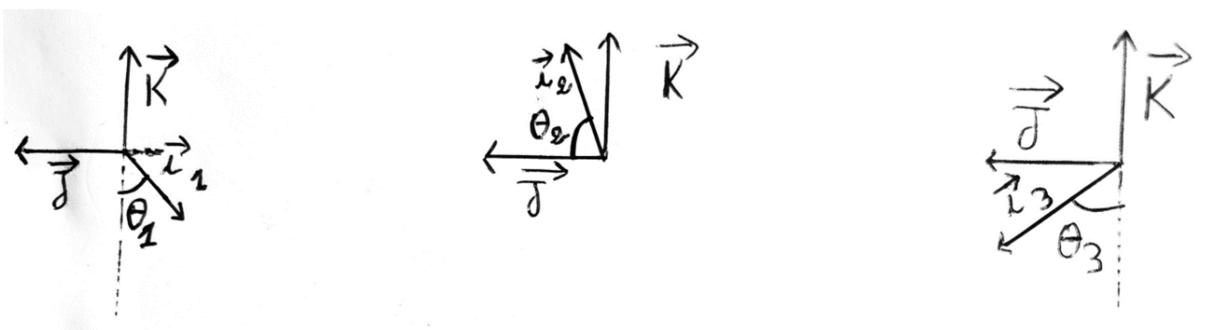


**Figure 3.** The projections useful for the study of the cylinder wall velocity

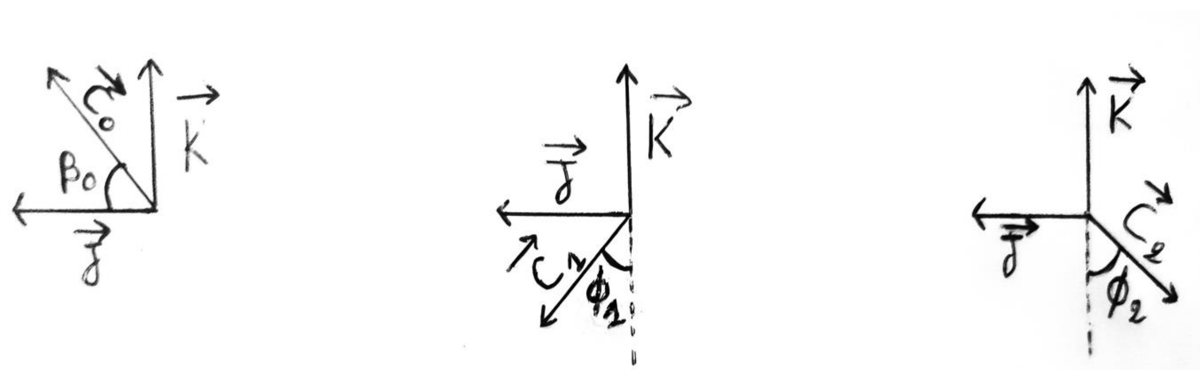


**Figure 4.** The projections useful for the study of the reflections of the Light-Beam

We have from the angles of the figure 2 and the figure 3:

$$\vec{V_1} = \text{V} \times \vec{\imath}_1 = -V \times \left(\sin(\theta_1) \times \vec{J} + \cos(\theta_1) \times \vec{K}\right) \tag{2}$$

with:

$$\theta_1 = \frac{\pi}{2} - \beta_0 + \alpha_1 \tag{3}$$

Hence:

$$\vec{V_1} = -V \times \left(\sin\left(\frac{\pi}{2} - \beta_0 + \alpha_1\right) \times \vec{J} + \cos\left(\frac{\pi}{2} - \beta_0 + \alpha_1\right) \times \vec{K}\right) \tag{4}$$

Consequently, by using formula (1) we get:

$$\vec{V_1} = -V \times \left(\sin(2\alpha_1) \times \vec{J} + \cos(2\alpha_1) \times \vec{K}\right) \tag{5}$$

And we have from the angles of the figure 2 and the figure 3:

$$\vec{V}_2 = \mathrm{V} \times \vec{\imath}_2 = \mathrm{V} \times \left(\sin(\theta_2) \times \vec{J} + \cos(\theta_2) \times \vec{K}\right) \tag{6}$$

with:

$$\theta_2 = \pi - \left(\alpha_2 + \gamma_1\right)$$

where:

$$\gamma_1 = \pi - \left(\beta_0 + \beta_1 + \frac{\pi}{2} - \alpha_1\right) \tag{7}$$

Hence:

$$\vec{V}_2 = \mathrm{V} \times \left(\cos\left(\pi - \left(\alpha_2 + \pi - \left(\beta_0 + \beta_1 + \frac{\pi}{2} - \alpha_1\right)\right)\right) \times \vec{J} + \sin\left(\pi - \left(\alpha_2 + \pi - \left(\beta_0 + \beta_1 + \frac{\pi}{2} - \alpha_1\right)\right)\right) \times \vec{K}\right) \tag{8}$$

Consequently, by using formula (1) we get:

$$\vec{V}_2 = \mathrm{V} \times \left(\cos\left(\frac{3\pi}{2} - 2\alpha_1 - 2\alpha_2\right) \times \vec{J} + \sin\left(\frac{3\pi}{2} - 2\alpha_1 - 2\alpha_2\right) \times \vec{K}\right) \tag{9}$$

And thus:

$$\vec{V}_2 = -V \times \left(\sin(2\alpha_1 + 2\alpha_2) \times \vec{J} + \cos(2\alpha_1 + 2\alpha_2) \times \vec{K}\right) \tag{10}$$

And we have from the angles of the figure 2 and the figure 3:

$$\vec{V}_3 = \mathrm{V} \times \vec{\imath}_3 = \mathrm{V} \times \left(\sin(\theta_3) \times \vec{J} - \cos(\theta_3) \times \vec{K}\right) \tag{11}$$

with:

$$\theta_3 = \pi - \left(\alpha_3 + \gamma_2\right)$$

where:

$$\gamma_2 = \pi - \left(\beta_2 + \frac{\pi}{2} - (\gamma_1 - \beta_1)\right) = \pi - \left(\beta_2 + \beta_0 + 2\beta_1 - \alpha_1\right) \tag{12}$$

Hence:

$$\vec{V}_3 = \mathrm{V} \times \left(\sin\left(\beta_2 + \beta_0 + 2\beta_1 - \alpha_1 - \alpha_3\right) \times \vec{J} - \cos\left(\beta_2 + \beta_0 + 2\beta_1 - \alpha_1 - \alpha_3\right) \times \vec{K}\right) \tag{13}$$

Consequently, by using formula (1) we get:

$$\vec{V}_3 = \mathrm{V} \times \left(\sin(2\pi - 2\alpha_1 - 2\alpha_2 - 2\alpha_3) \times \vec{J} - \cos(2\pi - 2\alpha_1 - 2\alpha_2 - 2\alpha_3) \times \vec{K}\right) \tag{14}$$

And thus:

$$\vec{V}_3 = -V \times \left(\sin(2\alpha_1 + 2\alpha_2 + 2\alpha_3) \times \vec{J} + \cos(2\alpha_1 + 2\alpha_2 + 2\alpha_3) \times \vec{K}\right) \tag{15}$$

It would be a beautiful formula if we could prove that for m>0:

$$\vec{V}_m = -V \times \left(\sin(2\sum_{n=1}^{m} \alpha_n) \times \vec{J} + \cos(2\sum_{n=1}^{m} \alpha_n) \times \vec{K}\right) \tag{16}$$

However, we will need only three impacts on the wall.
We have also from the angles of the figure 2 and figure 4:

$$\vec{C}_0 = \mathrm{C}_0 \times \left(\cos(\beta_0) \times \vec{J} + \sin(\beta_0) \times \vec{K}\right) \tag{17}$$

Consequently, by using formula (1) we get:

$$\vec{C}_0 = \mathrm{C}_0 \times \left(\sin(\alpha_1) \times \vec{J} + \cos(\alpha_1) \times \vec{K}\right) \tag{18}$$

And we have from the angles of the figure 2 and figure 4:

$$\vec{C}_1 = \mathrm{C}_1 \times \left(\sin(\varphi_1) \times \vec{J} - \cos(\varphi_1) \times \vec{K}\right) \tag{19}$$

with:

$$\varphi_1 = \beta_1 + \frac{\pi}{2} - (\pi - 2\beta_0) = \beta_1 + 2\beta_0 - \frac{\pi}{2} = \pi - 2\alpha_1 - \alpha_2 \tag{20}$$

Consequently, we get:

$$\vec{C}_1 = C_1 \times \left(\sin(2\alpha_1 + \alpha_2) \times \vec{J} + \cos(2\alpha_1 + \alpha_2) \times \vec{K}\right) \quad (21)$$

And we have from the angles of the figure 2 and figure 4:

$$\vec{C}_2 = C_2 \times \left(-\sin(\varphi_2) \times \vec{J} - \cos(\varphi_2) \times \vec{K}\right) \quad (22)$$

with:

$$\varphi_2 = \gamma_2 = \pi - \left(\beta_2 + \beta_0 + 2\beta_1 - \alpha_1\right) \quad (23)$$

Hence:

$$\vec{C}_2 = C_2 \times \left(-\sin\left(\beta_2 + \beta_0 + 2\beta_1 - \alpha_1\right) \times \vec{J} + \cos\left(\beta_2 + \beta_0 + 2\beta_1 - \alpha_1\right) \times \vec{K}\right) \quad (24)$$

Consequently, by using formula (1) we get:

$$\vec{C}_2 = C_2 \times \left(-\sin(2\pi - \alpha_3 - 2\alpha_2 - 2\alpha_1) \times \vec{J} + \cos(2\pi - \alpha_3 - 2\alpha_2 - 2\alpha_1) \times \vec{K}\right) \quad (25)$$

And thus:

$$\vec{C}_2 = C_2 \times \left(\sin(\alpha_3 + 2\alpha_2 + 2\alpha_1) \times \vec{J} + \cos(\alpha_3 + 2\alpha_2 + 2\alpha_1) \times \vec{K}\right) \quad (26)$$

It would be a beautiful formula if we prove that for m>0:

$$\vec{C}_m = C_m \times \left(\sin\left(\alpha_{m+1} + 2\sum_{n=1}^{m} \alpha_n\right) \times \vec{J} + \cos\left(\alpha_{m+1} + 2\sum_{n=1}^{m} \alpha_n\right) \times \vec{K}\right) \quad (27)$$

However, we will need only three impacts on the wall.
We have also from the angles of the figure 2:

$$\vec{n}_1 = -\cos(\pi - 2\beta_0) \times \vec{J} + \sin(\pi - 2\beta_0) \times \vec{K} = \cos(2\beta_0) \times \vec{J} + \sin(2\beta_0) \times \vec{K} \quad (28)$$

Consequently, by using formula (1) we get:

$$\vec{n}_1 = -\cos(2\alpha_1) \times \vec{J} + \sin(2\alpha_1) \times \vec{K} \quad (29)$$

And we have from the angles of the figure 2:

$$\vec{n}_2 = \cos\left((\pi - 2\beta_1) - (\pi - \beta_1 - \gamma_1)\right) \times \vec{J} - \sin\left((\pi - 2\beta_1) - (\pi - \beta_1 - \gamma_1)\right) \times \vec{K} \quad (30)$$

with:

$$\gamma_1 = \pi - \left(\beta_0 + \beta_1 + \frac{\pi}{2} - \alpha_1\right) \quad (31)$$

Hence:

$$\vec{n}_2 = \cos(\gamma_1 - \beta_1) \times \vec{J} - \sin(\gamma_1 - \beta_1) \times \vec{K} \quad (32)$$

Consequently, by using formula (1) we get:

$$\vec{n}_2 = \cos(2\alpha_1 + 2\alpha_2 - \pi) \times \vec{J} - \sin(2\alpha_1 + 2\alpha_2 - \pi) \times \vec{K} \quad (33)$$

And thus:

$$\vec{n}_2 = -\cos(2\alpha_1 + 2\alpha_2) \times \vec{J} + \sin(2\alpha_1 + 2\alpha_2) \times \vec{K} \quad (34)$$

And we have from the angles of the figure 2:

$$\vec{n}_3 = -\sin\left(\pi - \beta_2 - (\pi - \gamma_2)\right) \times \vec{J} - \cos\left(\pi - \beta_2 - (\pi - \gamma_2)\right) \times \vec{K} = -\sin(\gamma_2 - \beta_2) \times \vec{J} - \cos(\gamma_2 - \beta_2) \times \vec{K} \quad (35)$$

with:

$$\gamma_2 = \pi - \left(\beta_2 + \beta_0 + 2\beta_1 - \alpha_1\right) \quad (36)$$

Hence:

$$\vec{n}_3 = -\sin\left(\pi - \left(2\beta_2 + \beta_0 + 2\beta_1 - \alpha_1\right)\right) \times \vec{J} - \cos\left(\pi - \left(2\beta_2 + \beta_0 + 2\beta_1 - \alpha_1\right)\right) \times \vec{K} \quad (37)$$

Consequently:

$$\vec{n}_3 = -\sin\left(2\beta_2 + \beta_0 + 2\beta_1 - \alpha_1\right) \times \vec{J} + \cos\left(2\beta_2 + \beta_0 + 2\beta_1 - \alpha_1\right) \times \vec{K} \quad (38)$$

Consequently, by using formula (1) we get:

$$\vec{n}_3 = -\sin\left(\frac{\pi}{2} - 2\alpha_1 - 2\alpha_2 - 2\alpha_3\right) \times \vec{J} + \cos\left(\frac{\pi}{2} - 2\alpha_1 - 2\alpha_2 - 2\alpha_3\right) \times \vec{K} \tag{39}$$

And thus:

$$\vec{n}_3 = -\cos(2\alpha_1 + 2\alpha_2 + 2\alpha_3) \times \vec{J} + \sin(2\alpha_1 + 2\alpha_2 + 2\alpha_3) \times \vec{K} \tag{40}$$

It would be a beautiful formula if we prove that for m>0:

$$\vec{n}_m = -\cos(2\textstyle\sum_{l=1}^{m} \alpha_n) \times \vec{J} + \sin(2\textstyle\sum_{l=1}^{m} \alpha_n) \times \vec{K} \tag{41}$$

However, we will need only three impacts on the wall.
We also have in our experiment:

$$\vec{V}_1 \times \vec{n}_1 = \vec{V}_2 \times \vec{n}_2 = \vec{V}_3 \times \vec{n}_3 = 0 \tag{42}$$

## 3. Second Calculations of the Vectors of the Light-Beam Reflections

Let's use this classical formula about Mirrors without considering any effects of the movement of the reacting mirror on the Light-beam velocity vector:

$$\vec{C}_1 = \vec{C}_0 - 2(\vec{C}_0 \times \vec{n}_1) \times \vec{n}_1 \tag{43}$$

We conclude that:

$$\vec{C}_1 = \Big(C_0 \times \sin(\alpha_1) \times \big(1 + 2\cos(2\alpha_1)\big)\Big) \times \vec{J} + \Big(C_0 \times \big(\cos(\alpha_1) - 2\sin(\alpha_1) \times \sin(2\alpha_1)\big)\Big) \times \vec{K} \tag{44}$$

But we proved that:

$$\vec{C}_1 = \mathrm{C}_1 \times \big(\sin(2\alpha_1 + \alpha_2) \times \vec{J} + \cos(2\alpha_1 + \alpha_2) \times \vec{K}\big) \tag{45}$$

Hence, we have:

$$C_0 \times \sin(\alpha_1) \times \big(1 + 2\cos(2\alpha_1)\big) = \mathrm{C}_1 \times \sin(2\alpha_1 + \alpha_2) \tag{46}$$

And we have:

$$C_0 \times \big(\cos(\alpha_1) - 2\sin(\alpha_1) \times \sin(2\alpha_1)\big) = \mathrm{C}_1 \times \cos(2\alpha_1 + \alpha_2) \tag{47}$$

And thus:

$$C_1 = \mathrm{C}_0 \times \frac{\sin(\alpha_1) \times \big(1 + 2\cos(2\alpha_1)\big)}{\sin(2\alpha_1 + \alpha_2)} = \mathrm{C}_0 \times \frac{\cos(\alpha_1) - 2\sin(\alpha_1) \times \sin(2\alpha_1)}{\cos(2\alpha_1 + \alpha_2)} \tag{48}$$

In this case, we should have:

$$2\alpha_1 + \alpha_2 \neq k \times \pi \quad \forall k \in \mathbb{Z}$$

and

$$2\alpha_1 + \alpha_2 \neq \frac{\pi}{2} + \mathrm{k} \times \pi \quad \forall k \in \mathbb{Z} \tag{49}$$

However, since we have:

$$C_1^2 = \mathrm{C}_0^2 \times \frac{\sin(\alpha_1)^2 \times \big(1 + 2\cos(2\alpha_1)\big)^2}{\sin(2\alpha_1 + \alpha_2)^2} = \mathrm{C}_0^2 \times \frac{\big(\cos(\alpha_1) - 2\sin(\alpha_1) \times \sin(2\alpha_1)\big)^2}{\cos(2\alpha_1 + \alpha_2)^2} \tag{50}$$

And we know this formula:

$$\frac{a^2}{b^2} = \frac{c^2}{d^2} = \frac{a^2 + c^2}{b^2 + d^2} \tag{51}$$

where a, b, c, d are real numbers.
Then we can conclude that:

$$C_1^2 = \mathrm{C}_0^2 \times \Big(\sin(\alpha_1)^2 \times \big(1 + 2\cos(2\alpha_1)\big)^2 + \big(\cos(\alpha_1) - 2\sin(\alpha_1) \times \sin(2\alpha_1)\big)^2\Big) \tag{52}$$

## 4. The First Obvious Contradiction

By using trigonometric calculations, we conclude that:

$$C_1^2 = 4 \times C_0^2 \times \sin(\alpha_1) \times \left(\sin(\alpha_1) + \sin(\alpha_1 - 2\alpha_1)\right) = 4 \times C_0^2 \times \sin(\alpha_1) \times \left(\sin(\alpha_1) + \sin(-\alpha_1)\right) \quad (53)$$

And thus: $C_1^2 = 0$ which means that: $C_1 = 0$.
However, we have:

$$C_1 = C_0 \times \frac{\sin(\alpha_1) \times \left(1 + 2\cos(2\alpha_1)\right)}{\sin(2\alpha_1 + \alpha_2)} = 0 \Rightarrow \left(\alpha_1 = 0 \quad \text{or} \quad \alpha_1 = \frac{2\pi}{3}\right) \quad (54)$$

but we remark that with:

$$\left(\alpha_1 = 0 \quad \text{or} \quad \alpha_1 = \frac{2\pi}{3}\right) \quad (55)$$

we have also:

$$C_1 = C_0 \times \frac{\cos(\alpha_1) - 2\sin(\alpha_1) \times \sin(2\alpha_1)}{\cos(2\alpha_1 + \alpha_2)} \neq 0 \quad (56)$$

Furthermore $\alpha_1$ is a variable that we control and that we can variate as we wish in the experiment.
***We conclude that this is an impossible result and this means that we have a contradiction.***

# 5. Demonstrating the other Contradictions

By following the same steps, we have:

$$\vec{C}_2 = \vec{C}_1 - 2\left(\vec{C}_1 \times \vec{n}_2\right) \times \vec{n}_2 \quad (57)$$

Where:

$$-2\left(\vec{C}_1 \times \vec{n}_2\right) \times \vec{n}_2 = -2C_1 \times \sin(\alpha_2) \times \left(-\cos(2\alpha_1 + 2\alpha_2) \times \vec{J} + \sin(2\alpha_1 + 2\alpha_2) \times \vec{K}\right) \quad (58)$$

And thus:

$$\vec{C}_2 = C_1 \times \left(\sin(2\alpha_1 + \alpha_2) + 2\sin(\alpha_2) \times \cos(2\alpha_1 + 2\alpha_2)\right) \times \vec{J} + C_1 \times \left(\cos(2\alpha_1 + \alpha_2) - 2\sin(\alpha_2) \times \sin(2\alpha_1 + 2\alpha_2)\right) \times \vec{K} \quad (59)$$

But we proved that:

$$\vec{C}_2 = C_2 \times \left(\sin(\alpha_3 + 2\alpha_2 + 2\alpha_1) \times \vec{J} + \cos(\alpha_3 + 2\alpha_2 + 2\alpha_1) \times \vec{K}\right) \quad (60)$$

Hence, we have:

$$C_1 \times \left(\sin(2\alpha_1 + \alpha_2) + 2\sin(\alpha_2) \times \cos(2\alpha_1 + 2\alpha_2)\right) = C_2 \times \sin(\alpha_3 + 2\alpha_2 + 2\alpha_1) \quad (61)$$

And we have:

$$C_1 \times \left(\cos(2\alpha_1 + \alpha_2) - 2\sin(\alpha_2) \times \sin(2\alpha_1 + 2\alpha_2)\right) = C_2 \times \cos(\alpha_3 + 2\alpha_2 + 2\alpha_1) \quad (62)$$

And thus:

$$C_2 = C_1 \times \frac{\sin(2\alpha_1 + \alpha_2) + 2\sin(\alpha_2) \times \cos(2\alpha_1 + 2\alpha_2)}{\sin(\alpha_3 + 2\alpha_2 + 2\alpha_1)} = C_1 \times \frac{\cos(2\alpha_1 + \alpha_2) - 2\sin(\alpha_2) \times \sin(2\alpha_1 + 2\alpha_2)}{\cos(\alpha_3 + 2\alpha_2 + 2\alpha_1)} \quad (63)$$

In this case, we should have:

$$2\alpha_1 + 2\alpha_2 + \alpha_3 \neq k \times \pi \quad \forall k \in \mathbb{Z}$$

And

$$2\alpha_1 + 2\alpha_2 + \alpha_3 \neq \frac{\pi}{2} + k \times \pi \quad \forall k \in \mathbb{Z} \quad (64)$$

However, since we have:

$$C_2^2 = C_1^2 \times \frac{\left(\sin(2\alpha_1 + \alpha_2) + 2\sin(\alpha_2) \times \cos(2\alpha_1 + 2\alpha_2)\right)^2}{\sin(\alpha_3 + 2\alpha_2 + 2\alpha_1)^2} = C_1^2 \times \frac{\left(\cos(2\alpha_1 + \alpha_2) - 2\sin(\alpha_2) \times \sin(2\alpha_1 + 2\alpha_2)\right)^2}{\cos(\alpha_3 + 2\alpha_2 + 2\alpha_1)^2} \quad (65)$$

Then, we can conclude that:

$$C_2^2 = C_1^2 \times \left(\left(\sin(2\alpha_1 + \alpha_2) + 2\sin(\alpha_2) \times \cos(2\alpha_1 + 2\alpha_2)\right)^2 + \left(\cos(2\alpha_1 + \alpha_2) - 2\sin(\alpha_2) \times \sin(2\alpha_1 + 2\alpha_2)\right)^2\right) \quad (66)$$

And by using trigonometric calculations, we deduce that:

$$C_2^2 = 4 \times C_1^2 \times \sin(\alpha_2) \times \left(\sin(\alpha_2) + \sin(2\alpha_1 + \alpha_2 - 2\alpha_1 - 2\alpha_2)\right) = 4 \times C_1^2 \times \sin(\alpha_2) \times \left(\sin(\alpha_2) + \sin(-\alpha_2)\right) \quad (67)$$

And thus:

$$C_2^2 = 0$$

which means that:

$$C_2 = 0. \tag{68}$$

However, we have:

$$C_2 = C_1 \times \frac{\sin(2\alpha_1+\alpha_2)+2\sin(\alpha_2)\times\cos(2\alpha_1+2\alpha_2)}{\sin(\alpha_3+2\alpha_2+2\alpha_1)} = 0 \Rightarrow -2\sin(\alpha_2) = \frac{\sin(2\alpha_1+\alpha_2)}{\cos(2\alpha_1+2\alpha_2)} \tag{69}$$

Consequently:

$$C_2 = C_1 \times \frac{\cos(2\alpha_1+\alpha_2)-2\sin(\alpha_2)\times\sin(2\alpha_1+2\alpha_2)}{\cos(\alpha_3+2\alpha_2+2\alpha_1)} = C_1 \times \frac{\cos(2\alpha_1+2\alpha_2)\times\cos(2\alpha_1+\alpha_2)+\sin(2\alpha_1+\alpha_2)\times\sin(2\alpha_1+2\alpha_2)}{\cos(2\alpha_1+2\alpha_2)\times\cos(\alpha_3+2\alpha_2+2\alpha_1)} \tag{70}$$

Hence:

$$C_2 = C_1 \times \frac{\cos(\alpha_2)}{\cos(2\alpha_1+2\alpha_2)\times\cos(\alpha_3+2\alpha_2+2\alpha_1)} \neq 0 \tag{71}$$

And we know that $\alpha_1$ is a variable that we control and that we can variate as we wish in the experiment. Consequently $\alpha_2$ variates too.

***We conclude that this is also an impossible result and this means that we have a contradiction.***

By following the same steps, we have:

$$\vec{C}_3 = \vec{C}_2 - 2(\vec{C}_2 \times \vec{n}_3) \times \vec{n}_3 \tag{72}$$

where:

$$-2(\vec{C}_2 \times \vec{n}_3) \times \vec{n}_3 = -2C_2 \times \sin(\alpha_3) \times (-\cos(2\alpha_1 + 2\alpha_2 + 2\alpha_3) \times \vec{J} + \sin(2\alpha_1 + 2\alpha_2 + 2\alpha_3) \times \vec{K}) \tag{73}$$

And thus:

$$\vec{C}_3 = C_2 \times (\sin(2\alpha_1 + 2\alpha_2+\alpha_3) + 2\sin(\alpha_3) \times \cos(2\alpha_1 + 2\alpha_2 + 2\alpha_3)) \times \vec{J} + C_2 \times (\cos(2\alpha_1 + 2\alpha_2+\alpha_3) - 2\sin(\alpha_3) \times \sin(2\alpha_1 + 2\alpha_2 + 2\alpha_3)) \times \vec{K} \tag{74}$$

Let's guess from formula (27) and consider that:

$$\vec{C}_3 = C_3 \times (\sin(\alpha_4 + 2\alpha_1 + 2\alpha_2 + 2\alpha_3) \times \vec{J} + \cos(\alpha_4 + 2\alpha_1 + 2\alpha_2 + 2\alpha_3) \times \vec{K}) \tag{75}$$

Hence, we get:

$$C_3 \times \sin(\alpha_4 + 2\alpha_1 + 2\alpha_2 + 2\alpha_3) = C_2 \times (\sin(2\alpha_1 + 2\alpha_2+\alpha_3) + 2\sin(\alpha_3) \times \cos(2\alpha_1 + 2\alpha_2 + 2\alpha_3)) \tag{76}$$

And:

$$C_3 \times \cos(\alpha_4 + 2\alpha_1 + 2\alpha_2 + 2\alpha_3) = C_2 \times (\cos(2\alpha_1 + 2\alpha_2+\alpha_3) - 2\sin(\alpha_3) \times \sin(2\alpha_1 + 2\alpha_2 + 2\alpha_3)) \tag{77}$$

And thus:

$$C_3 = C_2 \times \frac{(\sin(2\alpha_1+2\alpha_2+\alpha_3)+2\sin(\alpha_3)\times\cos(2\alpha_1+2\alpha_2+2\alpha_3))}{\sin(\alpha_4+2\alpha_1+2\alpha_2+2\alpha_3)} \tag{78}$$

And:

$$C_3 = C_2 \times \frac{(\cos(2\alpha_1+2\alpha_2+\alpha_3)-2\sin(\alpha_3)\times\sin(2\alpha_1+2\alpha_2+2\alpha_3))}{\cos(\alpha_4+2\alpha_1+2\alpha_2+2\alpha_3)} \tag{79}$$

In this case, we should have:

$$\alpha_4 + 2\alpha_1 + 2\alpha_2 + 2\alpha_3 \neq k \times \pi \quad \forall k \in \mathbb{Z} \text{ and } \alpha_4 + 2\alpha_1 + 2\alpha_2 + 2\alpha_3 \neq \frac{\pi}{2} + k \times \pi \quad \forall k \in \mathbb{Z} \tag{80}$$

Hence, we have:

$$C_3^2 = C_2^2 \times (\sin(2\alpha_1 + 2\alpha_2+\alpha_3) + 2\sin(\alpha_3) \times \cos(2\alpha_1 + 2\alpha_2 + 2\alpha_3))^2 + C_2^2 \times (\cos(2\alpha_1 + 2\alpha_2+\alpha_3) - 2\sin(\alpha_3) \times \sin(2\alpha_1 + 2\alpha_2 + 2\alpha_3))^2 \tag{81}$$

And by using trigonometric calculations, we deduce that:

$$C_3^2 = 4 \times C_2^2 \times \sin(\alpha_3) \times (\sin(\alpha_3) + \sin(2\alpha_1 + 2\alpha_2+\alpha_3 - 2\alpha_1 - 2\alpha_2 - 2\alpha_3)) = 4 \times C_2^2 \times \sin(\alpha_3) \times (\sin(\alpha_3) + \sin(-\alpha_3)) \tag{82}$$

And thus:

$$C_3^2 = 0$$

which means that:

$$C_3 = 0. \tag{83}$$

However, we have:

$$C_3 = C_2 \times \frac{(\sin(2\alpha_1+2\alpha_2+\alpha_3)+2\sin(\alpha_3)\times\cos(2\alpha_1+2\alpha_2+2\alpha_3))}{\sin(\alpha_4+2\alpha_1+2\alpha_2+2\alpha_3)} = 0 \Rightarrow -2\sin(\alpha_3) = \frac{\sin(2\alpha_1+2\alpha_2+\alpha_3)}{\cos(2\alpha_1+2\alpha_2+2\alpha_3)} \tag{84}$$

And thus:

$$C_3 = C_2 \times \frac{(\cos(2\alpha_1+2\alpha_2+\alpha_3)-2\sin(\alpha_3)\times\sin(2\alpha_1+2\alpha_2+2\alpha_3))}{\cos(\alpha_4+2\alpha_1+2\alpha_2+2\alpha_3)} \tag{85}$$

Hence:

$$C_3 = C_2 \times \frac{(\cos(2\alpha_1+2\alpha_2+\alpha_3)\times\cos(2\alpha_1+2\alpha_2+2\alpha_3)+\sin(2\alpha_1+2\alpha_2+\alpha_3)\times\sin(2\alpha_1+2\alpha_2+2\alpha_3))}{\cos(2\alpha_1+2\alpha_2+2\alpha_3)\times\cos(\alpha_4+2\alpha_1+2\alpha_2+2\alpha_3)} \tag{86}$$

Consequently:

$$C_3 = C_2 \times \frac{\cos(\alpha_3)}{\cos(2\alpha_1+2\alpha_2+2\alpha_3)\times\cos(\alpha_4+2\alpha_1+2\alpha_2+2\alpha_3)} \neq 0 \tag{87}$$

***And we know that $\alpha_1$ is a variable that we control and that we can variate as we wish in the experiment. Consequently $\alpha_3$ variates, too.***

***We conclude that this guessed result is also an impossible result and this means that we have a contradiction by using the guessed formula.***

## 6. Investigating by Using the Principles of the Proposed Correction of the Michelson-Morley Experiment

Thanks to the formulas and principles of the article about Michelson Morley experiment [11], we know that If $\vec{C}$ is the light speed vector for a light emitted from a fixed light emitter, then $\vec{C}_0$ is the speed of the light after being emitted from the Laser Emitter and before reaching the wall of our cylinder for the first time, and we have :

$$\vec{C}_0 = \vec{C} + \vec{V}_0 = \vec{C} + \mathrm{V} \times \vec{\imath}_0 = \vec{C} - V \times \vec{K} \tag{88}$$

Hence:

$$\vec{C}_0 = (\vec{C} \times \vec{J})\vec{J} + (\vec{C} \times \vec{K} - V)\vec{K} \tag{89}$$

And we proved that:

$$\vec{C}_0 = \mathrm{C}_0 \times (\cos(\beta_0) \times \vec{J} + \sin(\beta_0) \times \vec{K}) \tag{90}$$

And thus:

$$\vec{C} \times \vec{J} = \mathrm{C}_0 \times \cos(\beta_0)$$

and:

$$\vec{C} \times \bar{K} - \mathrm{V} = \mathrm{C}_0 \sin(\beta_0) \tag{91}$$

Let's consider an angle ***B*** such as:

$$\vec{C} \times \vec{J} = \mathrm{C} \times \cos(B)$$

And

$$\vec{C} \times \vec{K} = \mathrm{C}\sin(B) \tag{92}$$

**B** is the constant angle between the axis $\vec{J}$ and the axis of the Laser Emitter which is the direction of the Laser Beam if **V=0**.

Consequently:

$$\vec{C}_{0^2} = (\vec{C} \times \vec{J})^2 + (\vec{C} \times \vec{K} - V)^2 \tag{93}$$

Hence, we have:

$$C_{0^2}=\mathrm{C}^2+\mathrm{V}^2-2\mathrm{VC}\sin(B) \quad (94)$$

And thus:

$$C_0=\sqrt{C^2+\mathrm{V}^2-2\mathrm{VC}\sin(B)} \quad (95)$$

This means that we can conclude the value of $C_0$ by using the value of **V** and of the constant angle **B**.

We know also that when the light beam reaches the wall of our cylinder for the first time, the speed of the light photon of the beam at the absorption by the reacting atom of the mirror is:

$$\vec{C'}_0=\vec{C}_0-\vec{V}_1 \quad (96)$$

Hence, the photon will be emitted with a speed $\vec{C}"_0$ relatively to the reacting atom of the wall mirror.

And we have:

$$\vec{C}"_0=\vec{C'}_0-2(\vec{C'}_0\times\vec{n}_1)\times\vec{n}_1 \quad (97)$$

Hence:

$$\vec{C}"_0=\vec{C}_0-\vec{V}_1-2(\vec{C}_0\times\vec{n}_1)\times\vec{n}_1 \quad (98)$$

Where:

$$\vec{C}_0\times\vec{n}_1=\mathrm{C}_0\times\cos(\beta_0)=\mathrm{C}_0\times\sin(\alpha_1) \quad (99)$$

And:

$$-2(\vec{C}_0\times\vec{n}_1)\times\vec{n}_1=-2C_0\times\sin(\alpha_1)\times(-\cos(2\alpha_1)\times\vec{J}+\sin(2\alpha_1)\times\vec{K}) \quad (100)$$

However, since the reacting atom of the mirror on the wall moves during the emission with the speed $\vec{V}_1$, then we have:

$$\vec{C}_1=\vec{C}"_0+\vec{V}_1=\vec{C}_0-2(\vec{C}_0\times\vec{n}_1)\times\vec{n}_1 \quad (101)$$

By following the same steps, we conclude also that:

$$\vec{C}_2=\vec{C}_1-2(\vec{C}_1\times\vec{n}_2)\times\vec{n}_2 \text{ and: } \vec{C}_3=\vec{C}_2-2(\vec{C}_2\times\vec{n}_3)\times\vec{n}_3$$

We remark that the cylinder wall velocity vectors $\vec{V}_i$ don't influence the Laser-Beam after the impact with the wall. Hence, the principles of the previous work about the Michelson-Morley experiment [11] don't prevent the formulas calculated in this work from being contradictory.

## 7. Generalizing the Results by Using the Guessed Formulas

From the formula (48) and the formula (63) and the formula (78) and the formula (79), we can guess this first formula for m>1:

$$C_m=\mathrm{C}_{m-1}\times\frac{\left(\sin\left(\alpha_m+2\sum_{n=1}^{m-1}\alpha_n\right)+2\sin(\alpha_m)\times\cos\left(2\sum_{n=1}^{m}\alpha_n\right)\right)}{\sin\left(\alpha_{m+1}+2\sum_{n=1}^{m}\alpha_n\right)} \quad (102)$$

And we can guess this second formula for m>1:

$$C_m=\mathrm{C}_{m-1}\times\frac{\left(\cos\left(\alpha_m+2\sum_{n=1}^{m-1}\alpha_n\right)-2\sin(\alpha_m)\times\sin\left(2\sum_{n=1}^{m}\alpha_n\right)\right)}{\cos\left(\alpha_{m+1}+2\sum_{n=1}^{m}\alpha_n\right)} \quad (103)$$

These two formulas define a recurrence sequence about the speed of the light beam in the cylinder.

The initial condition is:

$$C_0=\sqrt{C^2+\mathrm{V}^2-2\mathrm{VC}\sin(B)} \quad (104)$$

Where ***B*** is the constant angle between the axis $\vec{J}$ and the axis of the Laser Emitter which is equal to the direction of the Laser Beam $\beta_0$ if **V=0**.

However, the angles $\alpha_n$ are determined immediately and easily by the captors after each impact of the light beam with the wall of the cylinder by using a simple comparison of the impact point and the reference frame $(\mathrm{o}, \backslash\backslash\{\vec{J}|, \vec{K})$.

However, we should have:

$$\alpha_{m+1}+2\sum_{n=1}^{m}\alpha_n\neq k\times\pi \quad \forall k\in\mathbb{Z} \text{ and } \alpha_{m+1}+2\sum_{n=1}^{m}\alpha_n\neq\frac{\pi}{2}+\mathrm{k}\times\pi \quad \forall k\in\mathbb{Z} \quad (105)$$

We conclude from formula (102) and formula (103) that:

$$C_m^2 = C_{m-1}^2 \times \left(\sin(\alpha_m + 2\sum_{n=1}^{m-1}\alpha_n) + 2\sin(\alpha_m)\times\cos(2\sum_{n=1}^{m}\alpha_n)\right)^2 + C_{m-1}^2 \times \left(\cos(\alpha_m + 2\sum_{n=1}^{m-1}\alpha_n) - 2\sin(\alpha_m)\times \sin(2\sum_{n=1}^{m}\alpha_n)\right)^2 \quad (106)$$

And by using trigonometric calculations, we deduce that:

$$C_m^2 = 4\times C_{m-1}^2 \times \sin(\alpha_m)\times\left(\sin(\alpha_m) + \sin(\alpha_m + 2\sum_{n=1}^{m-1}\alpha_n - 2\sum_{n=1}^{m}\alpha_n)\right) = 4\times C_{m-1}^2\times\sin(\alpha_m)\times \left(\sin(\alpha_m)+\sin(-\alpha_m)\right) \quad (107)$$

And thus: $C_m^2 = 0$ which means that: $C_m = 0$.
However, we have:

$$C_m = C_{m-1}\times\frac{\left(\sin(\alpha_m + 2\sum_{n=1}^{m-1}\alpha_n) + 2\sin(\alpha_m)\times\cos(2\sum_{n=1}^{m}\alpha_n)\right)}{\sin(\alpha_{m+1} + 2\sum_{n=1}^{m}\alpha_n)} = 0 \Rightarrow -2\sin(\alpha_m) = \frac{\sin(\alpha_m + 2\sum_{n=1}^{m-1}\alpha_n)}{\cos(2\sum_{n=1}^{m}\alpha_n)} \quad (108)$$

Hence:

$$C_m = C_{m-1}\times\frac{\left(\cos(\alpha_m + 2\sum_{n=1}^{m-1}\alpha_n) - 2\sin(\alpha_m)\times\sin(2\sum_{n=1}^{m}\alpha_n)\right)}{\cos(\alpha_{m+1} + 2\sum_{n=1}^{m}\alpha_n)} \quad (109)$$

And:

$$C_m = C_{m-1}\times\frac{\cos(2\sum_{n=1}^{m}\alpha_n)\times\cos(\alpha_m + 2\sum_{n=1}^{m-1}\alpha_n) + \sin(\alpha_m + 2\sum_{n=1}^{m-1}\alpha_n)\times\sin(2\sum_{n=1}^{m}\alpha_n)}{\cos(2\sum_{n=1}^{m}\alpha_n)\times\cos(\alpha_{m+1} + 2\sum_{n=1}^{m}\alpha_n)} \quad (110)$$

Consequently:

$$C_m = C_{m-1}\times\frac{\cos(\alpha_m)}{\cos(2\sum_{n=1}^{m}\alpha_n)\times\cos(\alpha_{m+1} + 2\sum_{n=1}^{m}\alpha_n)} \neq 0 \quad (111)$$

***And we know that $\alpha_1$ is a variable that we control and that we can variate as we wish in the experiment. Consequently $\alpha_m$ variates, too.***

***We conclude that the guessed recurrence relation is also an impossible result and this means that we have a contradiction by using this recurrence.***

## 8. Summary and Conclusion

This proposed experiment can be a good solution to trap a Light-Beam in a moving environment.

Also, the formulas concerning this experiment seem to respect recurrence relations, since we could guess for m>0 that: $\vec{V}_m = -V\times\left(\sin(2\sum_{n=1}^{m}\alpha_n)\times\vec{J} + \cos(2\sum_{n=1}^{m}\alpha_n)\times\vec{K}\right)$

And that: $\vec{C}_m = C_m\times\left(\sin(\alpha_{m+1} + 2\sum_{n=1}^{m}\alpha_n)\times\vec{J} + \cos(\alpha_{m+1} + 2\sum_{n=1}^{m}\alpha_n)\times\vec{K}\right)$

And that: $\vec{n}_m = -\cos(2\sum_{l=1}^{m}\alpha_n)\times\vec{J} + \sin(2\sum_{l=1}^{m}\alpha_n)\times\vec{K}$

However, we ended by proving a contradiction about the velocity vectors of the reflected rays. This contradiction persists even in these two guessed recurrence relations for m>1:

$$C_m = C_{m-1}\times\frac{\left(\sin(\alpha_m + 2\sum_{n=1}^{m-1}\alpha_n) + 2\sin(\alpha_m)\times\cos(2\sum_{n=1}^{m}\alpha_n)\right)}{\sin(\alpha_{m+1} + 2\sum_{n=1}^{m}\alpha_n)}$$

And we can guess this second formula for m>1:

$$C_m = C_{m-1}\times\frac{\left(\cos(\alpha_m + 2\sum_{n=1}^{m-1}\alpha_n) - 2\sin(\alpha_m)\times\sin(2\sum_{n=1}^{m}\alpha_n)\right)}{\cos(\alpha_{m+1} + 2\sum_{n=1}^{m}\alpha_n)}$$

**Finally**

Since we are dealing with concave mirrors in this article, we can only suspect the correctness of the following three formulas concerning the reflection of light from concave mirrors:

The first: $\vec{C}_1 = \vec{C}_0 - 2(\vec{C}_0\times\vec{n}_1)\times\vec{n}_1$

The second: $\vec{C}_2 = \vec{C}_1 - 2(\vec{C}_1\times\vec{n}_2)\times\vec{n}_2$

The third: $\vec{C}_3 = \vec{C}_2 - 2(\vec{C}_2\times\vec{n}_3)\times\vec{n}_3$

And thus, the readers are invited to make an objective experiment of the light reflection from concave mirrors by changing the radius of curvature of the mirrors and other characteristics of the experiment in order to conclude the correct formulas of the light reflection from concave mirrors.

**Discussion of the Conclusion**

After proving experimentally the needed formulas of light reflection from concave mirrors, we can use this experiment to change and control the trajectory of the reflected light rays.

We expect that if the disk of concave mirrors rotates with a high velocity which has a linear velocity vector that makes an acute angle A with the velocity vectors of the light rays, then the angle A will become smaller and smaller. With a high velocity of the rotating mirrors and a long time of light reflection, maybe the trajectory of the light rays will seem to have circular trajectories similar to the shape of the concave mirrors in the disk.

We expect also that if the disk of concave mirrors rotates with a high velocity which has a linear velocity vector that makes an obtuse angle B with the velocity vectors of the light rays, then the angle B will become bigger and bigger. With a high velocity of the rotating mirrors and a long time of light reflection, maybe the trajectory of the light rays will become perpendicular to the shape of the concave mirrors in the disk.

The other questions that rise are:

- Will this experiment be able to generalize the concepts of the Sagnac effect to all kinds of mirrors? And by using a high rotation velocity, will this experiment be able to change the frequency of the reflected light until we transform the light into a new kind of electromagnetic wave?
- Will the light change its direction with a velocity vector that makes an acute angle with the linear velocity vector of the disk of concave mirrors?
- Can we use such an experiment to control and change the light characteristics without needing any expensive or dangerous material such as Bose-Einstein condensates?

The readers are invited to perform this easy and safe experiment in order to answer all their questions. Furthermore, if the proposed guessed recurrence relations of this article are correct, then many results will become computable with ordinary computers and this experiment will be very simple and interesting for the students and even the beginners.

# Declarations

_Ethical Approval_
This declaration is “not applicable”.

_Competing interests_
This declaration is “not applicable”.

_Authors' contributions_
This declaration is “not applicable”.

_Funding_
This declaration is “not applicable”.

_Availability of data and materials_
This declaration is “not applicable”.

# REFERENCES

[1] Karol, S., Roman, S., & Polish, I., The existence of a universal frame of reference, in which it propagates light, is still an unresolved problem of physics. *Jordan Journal of Physics*, *15*(5), 457-467, 2022. DOI: https://doi.org/10.47011/15.5.3

[2] Roman, S., Paweł, G., & Kamil, S., Gravitational waves in Newton’s gravitation and criticism of gravitational waves resulting from the General Theory of Relativity (LIGO)(w języku angielskim). *Bulletin of the Karaganda University. Physics series*, (4), 96, 2019. DOI: https://doi.org/10.31489/2019Ph4/39-56

[3] Louiz, A., Physics letter: Cosmical observations and experiments against the relativistic explanations of the Doppler effect and the Gravitational effect of the light. *Maghrebian Journal of Pure and Applied Science*, *8*(2), 106-110, 2022. DOI: https://doi.org/10.48383/IMIST.PRSM/mjpas-v8i2.38600

[4] Szostek, K., & Szostek, R., The concept of a mechanical system for measuring the one-way speed of light. *Technical Transactions*, *120*(1), 1-9, 2023. DOI: https://doi.org/10.37705/TechTrans/e2023001

[5] Houser, K. W., Wei, M., David, A., Krames, M. R., & Shen, X. S., Review of measures for light-source color rendition and considerations for a two-measure system for characterizing color rendition. *Optics Express*, *21*(8), 10393-10411, 2013. DOI: https://doi.org/10.1364/OE.21.010393

[6] Karakatsouli, N., Papoutsoglou, E. S., Sotiropoulos, N., Mourtikas, D., Stigen-Martinsen, T., & Papoutsoglou, S. E., Effects of light spectrum, rearing density and light intensity on growth performance of scaled and mirror common carp Cyprinus carpio reared under recirculating system conditions. *Aquacultural Engineering*, *42*(3), 121-127, 2010. DOI: https://doi.org/10.1016/j.aquaeng.2010.01.001

[7] Eschner, J., Raab, C., Schmidt-Kaler, F., & Blatt, R., Light interference from single atoms and their mirror images. *Nature*, *413*(6855), 495-498, 2001. DOI: https://doi.org/10.1038/35097017

[8] Scaramella, R., Amiaux, J., Mellier, Y., Burigana, C., Carvalho, C. S., Cuillandre, J. C., ... & Sirri, G., Euclid preparation-I. the Euclid wide survey. *Astronomy & Astrophysics*, *662*, A112, 2022. DOI: https://doi.org/10.1051/0004-6361/202141938

[9] Munera, H. A., Can a Michelson-Morley Experiment Designed with Current Solar Velocity Distinguish between Non-Relativistic and Relativistic Theories? *Journal of Modern Physics*, *13*(5), 736-760, 2022, DOI: https://doi.org/10.4236/jmp.2022.135043

[10] Louiz, A., A thesis about Newtonian mechanics rotations and about differential operators. *Maghrebian Journal of Pure and Applied Science*, *6*(1), 26-50, 2020. DOI: https://doi.org/10.48383/IMIST.PRSM/mjpas-v6i1.20388

[11] Louiz, A., The correct formulas of Michelson-Morley experiment. *Maghrebian Journal of Pure and Applied Science*, *6*(2), 60-64, 2020. DOI: https://doi.org/10.48383/IMIST.PRSM/mjpas-v6i2.20383