Problems with Einstein's Theory of Contractions

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The theory of contractions was first proposed by George FitzGerald and later by Hendrik Lorentz in order to explain the null results of the Michelson-Morley (MM) experiment from the ether point of view. Albert Einstein incorporated this theory into his theory of relativity where the contractions are due to motion not the ether. This paper elaborates upon many problems with the theory of contractions, which Einstein considered to exist as a point of view of an observer. However, contractions have to be real in order to explain the null result of the MM experiment.

The MM experiment has always been presented with one arm vertical and the other parallel relative to the motion of the apparatus. The parallel arm is supposed to contract due to motion. However, a valid objection can be raised about when the contraction of the parallel arm occurs. A better and unbiased 45^0 starting position is presented in which the lengths of the two arms are equal before the experiment starts. The new starting position and new calculations show that contraction must be accompanied by inseparable and equally important *expansion* of length; that is, neither contractions nor expansions can be a privileged phenomenon. The new concept of expansion requires corrections in the Lorentz-Einstein transformation equations, where $y=y'$ and $z=z'$ can no longer be sustained.

Problem #1
Are contractions real or only a point of view of an observer?

Many physicists consider the existence of contractions strictly as a point of view of an observer. In this view, the length of an object does not change; what does change is the observer's view of its length. That is, the contraction is the result of a view depending on whether the observer is at rest or moving. Other relativistic authors believe that the contractions must be real in every sense of the word. Why this duality of opinions?

This confusing duality—reality v. appearance depending on the observer—comes directly from Einstein. He did not state categorically that the contractions are as "real" like any other phenomenon that can be experienced with our senses. He wrote:

> "Here (in the theory of relativity) the contraction of moving bodies follows from two fundamental principles of the theory, without the introduction of particular hypotheses; and as the prime factor involved in this contraction we find, not the motion in itself, to which we cannot attach any meaning, but the motion with respect to the body of reference chosen in the particular case in point. Thus for a co-ordinate system moving with the earth the mirror system of Michelson and Morley is not shortened, but it is shortened for a co-ordinate system which is at rest relative to the sun." [1]

Of particular importance here is Einstein's last sentence:

> "Thus for a co-ordinate system moving with the earth the mirror system of Michelson and Morley *is not shortened, but it is shortened for a co-ordinate system which is at rest relative to the sun."*

Einstein is telling us that the mirror system is not shortened for the coordinate system moving with the earth, which would mean for the coordinate system of a laboratory and us as observers in the laboratory, as shown in the figure below. This also means that for us in the laboratory, the shortening does not exist and we should not be able to observe it.

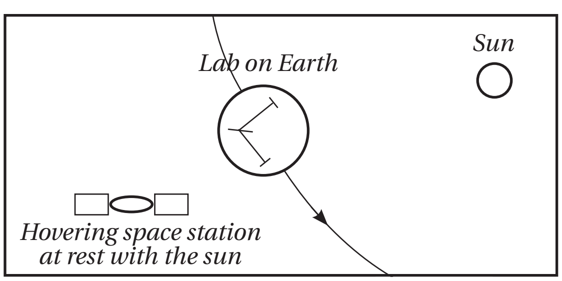

Figure 1

Only an observer in a hovering space station at rest with the sun could observe the shortening of dimensions.

However, the interpretation of the null results of the Michelson-Morley experiment from the relativistic point of view *demands that the contractions are real, not imaginary.* In other words, for the light beams in the Michelson-Morley experiment to arrive in phase at the screen, which is moving along with the earth around the sun, the length of the parallel arm must contract in a real sense. This is especially evident when the apparatus is rotated and the arms exchange their orientation relative to the motion so the arm that was oriented perpendicularly to the motion is now parallel to that motion. That is, the contraction must occur from the point of view of an observer moving with the apparatus, as the contractions play a part in the manner in which the light beams interfere on the screen. Without contractions, the observer would observe the phase shift in the experiment.

Some physicists realized this, so they switched to the concept of real contractions. They corrected Einstein without admitting or realizing that Einstein's theory of contractions needed to be amended. Wolfgang Rindler, an authority in relativity, wrote:

> "The relativistic length contraction is no 'illusion': it is real in every way. Though no direct experimental verification has yet been attempted, there is no question that in principle it could be done." [2]

An experiment to show the existence of contraction can only show a real contraction and not an opinion of it. On the other hand, such an experiment would have to be performed on earth, and if "in principle it could be done," then the contraction would have to be observed by an observer on earth, and moving together with the earth around the sun, which is in direct contradiction with Einstein's explanation of the contraction theory.

Professor Hans C. Ohanian also wrote:

> "The length contraction has not been tested directly by experiment. There is no practical method for a high-precision measurement of the length of a fast-moving body. Our best bet might be high-speed photography ..." [3]

If the concept of contraction were based only upon a point of view of an observer, as Einstein stated, no experiment could prove it. The high-speed photography considered by Ohanian could only photograph something that actually occurred while in motion, rather than how it appeared to an observer. Furthermore, where would this high-speed photography take place, in space or on earth? Ohanian is referring to earth, of course. How else could we take high-speed photographs of the occurring contractions? Certainly not when at rest relative to the sun while the earth is passing by at 30,000 meters per second. Ohanian is not proposing any such thing.

If an experiment were performed on earth, as was the Michelson-Morley experiment, then Ohanian's high-speed photography, if capable of recording minute changes in dimensions, would have detected the shortening of the arms of the apparatus as the apparatus was rotated relative to the motion of the earth. Because the changes in dimensions of the arms would affect the beams as they interfere, as seen on the screen, the contractions must be real in every sense of the word. Because the camera would travel at the same speed as the apparatus and the observation screen, then the camera would be able to record contractions as they occur.

Again, this would be in direct contradiction with Einstein's theory. The camera would be traveling at the same speed as the apparatus of the experiment. In Einstein's language this would mean that *"for the coordinate system of the camera moving with the earth, the mirror system of Michelson and Morley is not shortened."* That is, the camera should not be able to record any contractions, according to Einstein.

Problem #2
Are contractions occurring during acceleration?

Suppose the Michelson-Morley experiment is performed on a railroad car. When the train starts moving, it will take some time to reach a speed of 100 kilometers per hour, for example.

In classical mechanics, and according to the classical principle of relativity, the acceleration would equally affect both light beams and the components of an experimental setup. As the train accelerates, the phase of the arrival of the two beams at the screen would not change.

This is not the case in relativistic mechanics. During acceleration, relativistic concepts, like time dilation and length contraction, are not supposed to be active, according to the special theory of relativity. The entire special theory of relativity, including the concept of contraction and time dilation, is derived from the Lorentz-Einstein transformation equations, which are based on the concept of inertial coordinated systems where the systems are moving at constant velocities. The differences between inertial and non-inertial coordinate systems and their relationships to Einstein's special theory are eloquently described by Peter J. Nolan in his college textbook, where he explains the concept of time dilation in the "twin paradox." He wrote:

> "If the astronaut is originally moving at a velocity *v*, then in order for him to return home, he has to decelerate his spaceship to zero velocity and then accelerate to velocity -*v* to travel homeward. *During the deceleration and acceleration process the spaceship is not in an inertial coordinate system, and we cannot* ***justify*** *using the time dilation formula that was derived on the basis of inertial coordinated system* ... the Lorentz transformation equations were derived on the assumption that the two coordinate systems were moving with respect to each other at a constant velocity. The astronaut is in an accelerated coordinate system when he turns around to come home. Hence, he is not in an inertial coordinate system and is *not entitled* to use the time dilation formula." [4] (Emphasis added.)

The Lorentz-Einstein transformation equations are not only the foundation for Einstein's concept of time dilation, that is, for the changes of *t'*, but also for the changes in the length along *x'*, or for Einstein's concept of contraction of length. Therefore, we are not *"entitled,"* as Nolan puts it, to use the contraction formula in the Michelson-Morley experiment, or any experiment performed on earth, because the earth does not represent a true inertial coordinate system.

Thus, if the light traveled at a constant speed unaffected by the motion of the train, the Michelson-Morley experiment, when performed on a train, would have to show a phase shift during acceleration, because the concept of contraction cannot be applied in this case. By the magnitude of the phase shift, we could determine the train's rate of acceleration and the final speed of the train before uniform motion takes place.

Similar to the train, the earth is always either accelerating or decelerating due to the elliptical nature of the earth's orbit around the sun. The rate of change in the speed of the earth around the sun is small, yet it does exist. The theory of relativity does not specify which rates could be disregarded or considered not applicable.

Therefore, the special theory of relativity *cannot* be in agreement with the null results of the Michelson-Morley experiment. The only relativistic concept that will be acting in the experiment is the constancy of the speed of light. However, the constancy of the speed of light without the concept of contraction would inevitably produce phase shifts, which is not what the experiment has produced. Einstein's special theory of relativity would fail at this point.

On the other hand, if the contraction phenomena are not supposed to take place during acceleration, how would the contraction hypothesis act at the instant when acceleration stops and uniform motion begins? Would the length of an object instantaneously change to a new length, or would it take some time for contractions to take place? If it would take some time, what would be this time, and how would it be determined?

For example, if an object is accelerated to 0.9 of the speed of light, the object is supposed to contract to less than half its original length, according to the theory of relativity. Suppose that the acceleration was maintained up to this speed. No change in the dimensions of the object is expected until the acceleration is completed and until uniform motion begins. Therefore, at the instant when the uniform motion begins, the dimension of the object would drastically change.

A more spectacular and unexplained phenomenon is supposed to occur at the same *instant* when the length of an object shrinks. The mass of that object is supposed to increase to more than twice its original mass, according to Einstein. Where would this extra mass come from at this instant? What are the physical and chemical processes that would occur during this transformation and during this particular moment? The increase in mass cannot be a point of view of an observer. The relativistic interpretation of the increase in mass of accelerated electrons or protons in particle accelerators mandates an unambiguous notion of extra mass due to speed by whatever name this mass might be called.

Suppose the opposite happens. Suppose the object in the above example decelerates until it comes to a stop. As Nolan pointed out, we are "not entitled" to use special relativity formulas during the non-uniform motion. Therefore, at the instant when the object comes to a stop, the object will magically rebound to its original length and the extra mass will simply vanish in an instant. Where would it go? Einstein and relativists never gave an explanation or an account about the mechanics and the manner in which these important phenomena would occur at the instant when the change from acceleration to uniform motion, or from deceleration to rest takes place.

Problem #3
At what angle relative to motion do the contractions occur?

Physics textbooks and manuals of relativity are unanimous in describing the Lorentz-Einstein phenomenon of contractions as occurring "***only*** along the direction of motion."

> **Ohanian**: "The contraction effect *applies* ***only*** *to lengths along the direction of motion* of a body." [5]

Serway: "You should note that the length contraction takes place ***only*** *along the direction of motion***.**" [6]

"The observer sees horizontal length of the ship to be contracted ... The 25-m vertical height is unchanged because it is perpendicular to the direction of relative motion ..." [7]

Feynman: "He (Lorentz) suggested that material bodies contract when they are moving, and that this foreshortening is ***only*** *in the direction of the motion*, and also, that if the length is L_0 when a body is at rest, then when it moves with speed u parallel to its length, the new length, which we call L-parallel, is given by $L_{//} = L_0\sqrt{1-u^2/c^2}$." [8] (Emphases added in all three quotes.)

If the contraction occurred in any other orientations, the textbook writers would have written about it. They would have written, for example: "The contraction starts the moment one arm of the experiment begins its rotation toward the parallel position," or, "The contraction would reach one half of the total contraction when the arm is at 45^0."

But there are no such statements anywhere in the textbooks of physics or manuals of relativity. Furthermore, all textbooks show, in earnest, all sorts of diagrams of contractions of a length parallel to the motion (diagrams of rockets, airplanes, car garages, barns, poles, bars, sticks, triangles, fish, trees, etc.); however, *no physics textbook shows a drawing of contraction taking place while an object is positioned at an angle relative to its direction of motion.*

The rate of contraction related to an angle relative to the direction of motion is never mentioned. Physicists are describing the fundamentals of nature, yet one of the most important aspects of the contraction phenomenon is never mentioned.

A reader of textbooks would come to the conclusion that *Einstein's contractions are assumed to occur* ***only*** *when a length is parallel to the direction of motion and in no other orientation.*

Problem #4
Concept of length *expansion* is not mentioned in the textbooks or the manuals of relativity

According to Einstein's theory of contractions, when the MM apparatus with two arms of equal length *L at rest (Fig. 2a)* is put into motion, the vertical arm would retain its length L, while the parallel arm would contract its length from L to $L\sqrt{1-u^2/c^2}$ *(Fig. 2b)*.

According to the same theory, when the MM apparatus that is already in motion is rotated 90^0 with one contracted arm *(Fig. 2c)*, the two arms will exchange their lengths (contract or expand) so that no fringe shift would occur in the experiment.

An immediate and surprising realization emerges here. Besides the concept of contraction, there is another equally important phenomenon of ***expansion*** of length due to motion and the orientation relative to this motion.

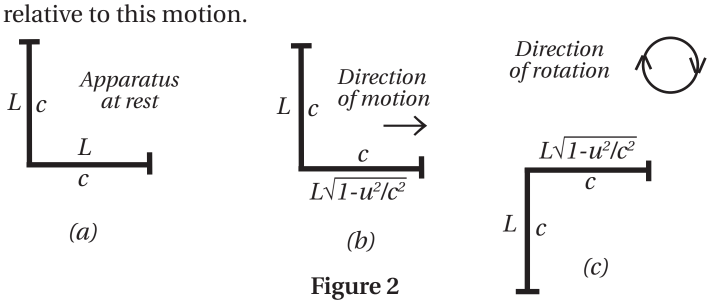

Figure 2

In other words, the contracted parallel arm in *Fig. 2b* will increase its length when rotated 90^0 relative to the motion by the same factor and become the vertical length L again *(Fig. 2c)*.

In order to explain the absence of fringe shift in the MM experiment, the concept of contraction must act on the vertical arm the moment it starts rotating toward the parallel orientation. The reverse must happen to the parallel arm. The moment the parallel arm starts moving toward the vertical orientation, it must start expanding.

In spite of this obvious fact of the existence of expansion of length in the theory of contractions, the concept of expansion is not mentioned or elaborated upon in physics textbooks.

Problem #5
There are two conflicting concepts in Einstein's theory of contractions

The analysis in Problem #4 shows that there are two distinct concepts of contractions in Einstein's theory.

One concept states that when two rods of equal length and positioned 90^0 to each other are put into motion from rest, or come to rest from the state of motion, the rod parallel to the direction of motion will *change its length* (contract or expand), while the rod oriented vertically to the motion will remain *unchanged (Fig. 3)*.

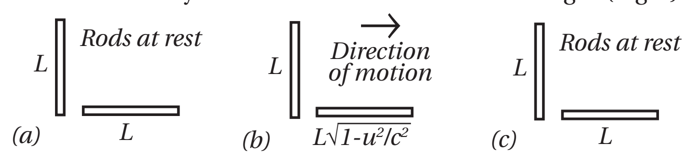

Figure 3

According to the same theory, if the speed of the two rods in *Fig. 3b* is increased or decreased, the vertical rod would remain its length L, while the parallel arm would either contract or expand its length. In other words, motion has no effect on the length of the rod oriented perpendicularly relative to the direction of motion, according to Einstein. Only the parallel rod will suffer changes.

The second concept states that when two rods that are *already in motion (Fig. 4a)* change their orientation relative to the direction of motion *(Fig. 4b)*, the rod moving toward the parallel orientation will *foreshorten*, while the rod moving toward the vertical orientation will *expand* by the same factor.

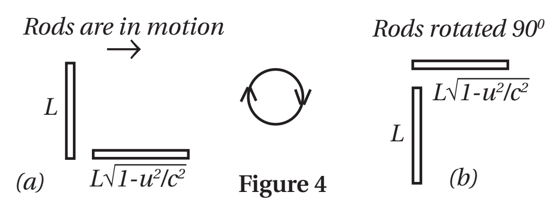

Figure 4

While the orientation relative to the direction of motion in the second concept is affecting both vertical and parallel lengths, it only affects the parallel length in the first concept, according to Einstein.

How is it possible for one arm while in motion to change its dimension as it approaches or leaves the vertical orientation, yet remain unchanged when put into motion from rest?

We are going to prove that the above two concepts are mutually contradictory and cannot exist at the same time and that the second concept mandates that when the vertical rod is put into motion from rest it cannot retain the same length.

Problem #6
Conflict of hypotheses

Besides providing a proof of the existence of the ether, the MM experiment was supposed to provide experimental proof of the constancy of the speed of light. So the experiment is suppose to begin with a hypothesis that needs to be verified and proved by this experiment.

Because the constancy of the speed of light would produce a phase shift in the MM experiment, which is contrary to actual results, a new hypothesis of contractions was invented to prove the first one.

Therefore, there is a conflict of hypotheses here—one hypothesis is made possible by another hypothesis. The objection that the concept of contraction "was invented for the express purpose of explaining away the difficulty," as Feynman put it, now becomes much more justifiable.

Let us present a brief analysis of how the theory of contraction was conceived.

Problem #7 - The origin of the theory of contractions

The contraction idea was first proposed by George FitzGerald. Puzzled by the null results of the MM experiment, FitzGerald conceived his own explanation of the outcome of the MM experiment, which he unveiled in a discussion with Oliver Lodge in 1892. He said:

> "Well, the only way out of it that I can see is that the equality of paths must be inaccurate; the block of stone must be distorted, put out of shape by motion ... the stone would have to *shorten* in the direction of motion and *swell out* in the other two directions." [9]

The important point here is the idea of *shortening* and *swelling out*. Lorentz contemplated three possible outcomes in the changes of the dimensions of a body moving through the ether in order to explain the null results of the MM experiment: 1. The parallel arm would shorten by a factor, while the vertical arm would remain unchanged. 2. The parallel arm would remain the same, while the vertical arm would expand by the same factor. 3. The parallel arm would contract by half the factor, while the vertical arm would expand by the other half. All three alternatives would be in agreement with the null results of the MM experiment.

In the final analysis, however, Lorentz opted for the first option without offering a reason for it. That is why his choice is categorized as arbitrary or accidental and is labeled throughout physics literature as a purely "ad hoc" assumption. According to Lorentz, the change in the dimension parallel to the motion is due to the effect of the ether on the atoms and molecules of a body. The translation through the ether would affect the shape of the "electron spheres" so, in Lorentz's words, "all electrons are flattened ellipsoids with their smaller axes in the direction of motion," [6] while the vertical axes remain unchanged *(Fig. 5)*.

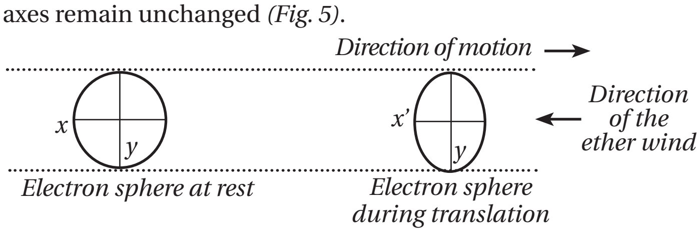

Figure 5

If the lengthening and shortening of the vertical axes occur during the rotation of the apparatus when in motion, there is no mechanical principle known or postulated by physicists concerning the ether that would maintain a compressed electron sphere flattened only along one axis *(x)*, without causing any changes along the other two axes *(y and z)*.

In other words, if the electron spheres are compressible along x axis, there is nothing to prevent them from being expandable along *y* and *z* axes. Hence, only Lorentz's third option can be in agreement with the mechanical characteristics of the ether wind and electron spheres *(Fig. 6)*.

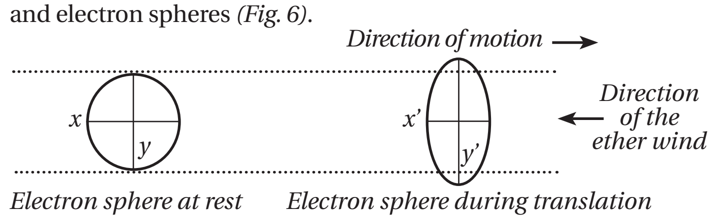

Figure 6

When a body at rest is put into motion through the ether, the dimensions along the vertical axis would have to expand (or *swell out,* as FitzGerald suggested) and the parallel ones contract by the same factor *(Fig. 6)*.

The essence of the corrected theory of contractions, or the theory of "contrary changes of the dimensions," would be *that the contraction is the result of the addition of all shortened axes of the electron spheres of a body (and the MM apparatus) found along the lengths parallel to the motion through the ether. Conversely, the expansion of length would be the result of the addition of all elongated axes along the lengths perpendicular to the same motion,* as shown in the next figures.

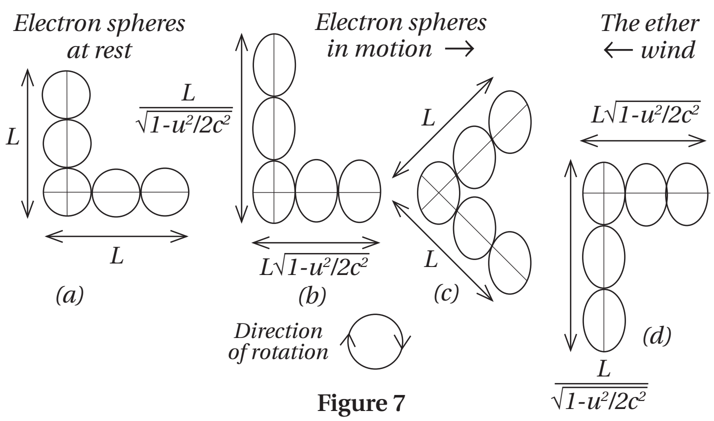

Figure 7

Fig. 7a shows the electron spheres of the arms of the MM experiment at rest. The parallel and the vertical arms are of equal length *L*. When the apparatus is put into motion *(Fig. 7b)* the vertical axis of the electron spheres would have to expand by a factor, while the parallel axis contract by the same factor.

The apparatus is now rotated 45^0 while in motion *(Fig. 7c)*. The vertical axis contract as they take 45^0 orientation, while the parallel axis expend taking the same orientation. Both axis of all electron spheres are of equal length, meaning the electron spheres take the same flattened shapes as in *Fig. 7b*.

The apparatus is once again rotated 45^0 *(Fig. 7d)*.

The axis that were vertical in *Fig. 17b* are now horizontal and contracted by a factor, while the axis that were parallel are now vertical and expanded by the same factor.

The above figure shows the only mechanically viable changes in the dimensions that would be in agreement with the mechanical characteristic of the ether, Lorentz's concept of electron spheres and the null results of the MM experiment.

If Lorentz chose the 3rd and more mechanically credible alternative in the changes of the dimensions of a body in motion, as sugested by FitzGerald, then there would have been only one theory of the changes in the dimensions of a body by the effect of the ether that would cover the bodies *put into motion from rest* and the bodies *rotated while in motion*. Hence, Lorentz's theory of contractions and his transformation equations would have taken a drastically different form.

In Lorentz's contraction theory, the contractions are due to the ether wind. Einstein incorporated Lorentz'a contraction theory and his transformation equations into his theory of special relativity. He attributed the phenomena of contraction not to the ether wind but to motion itself. The transformation equations are now called Lorentz-Einstein equations.

Let us prove that Einstein's contraction theory and his transformation equations are untenable even when the ether wind is taken out as the cause of contractions.

Problem #8 - Difficulties with the starting orientation

The Michelson-Morley experiment is universally shown with one arm vertical and the other parallel to the motion of the earth, as seen in Feynman's schematics of the experiment in the figure below. [7]

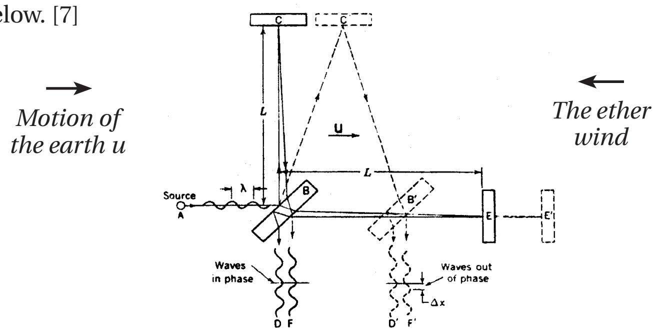

Figure 8

The contraction of the parallel arm of the apparatus in the above 90^0 orientation, while the length of the vertical arm remains unchanged, is supposed to explain the absence of the fringe shift. However, the contraction of the parallel arm in the above "starting position" raises many objections.

Because the earth, the laboratory and the optical table are already in motion, their parallel dimensions would be already contracted before the experiment is setup. If the laser beam distance devices are used to determine the length of the arms, they could be adjusted to be of equal length, in spite of contractions, which would produce fringes in the MM experiment. This vertical/parallel choice was entirely an arbitrary one. Feynman expressed the artificial aspect of the concept of contraction with the following words:

> "Although the contraction hypothesis successfully accounted for the negative result of the experiment, it was open to the objection that it was invented for the express purpose of explaining away the difficulty, and was too artificial." [8]

A better and more objective theoretical and experimental starting orientation for the MM experiment is needed in which *the lengths of the arms can be positively known before the experiment starts, before any changes in dimensions take place, and before any hypothetical theory is applied to interpret possible differences in these dimensions and interpret the results of the experiment.*

Let us present such a starting setup.

The new 45^0 starting orientation of the Michelson-Morley experiment

It must be emphasized that the choice of the starting position in the analysis of the MM experiment is critical, because what happens in the starting position determines the magnitude and the type of changes in the lengths of the arms that would have to take place when the apparatus is rotated.

It is entirely justified to assume that, when the MM apparatus is assembled, the two arms could be adjusted to be of equal length L when both arms are oriented 45^0 relative to the direction of motion of the apparatus, because both arms will be equally affected by the motion of the earth *(Fig. 9a)*. Let geometry and math tell us what kind of changes in the dimensions should take place when the MM setup is rotated 45^0.

We are beginning the experiment with the understanding that the two arms of the MM experiment are of equal length L in the 45^0 starting orientation.

The 45^0 setup of the MM experiment in *Fig. 9a* is now rotated 45^0 counter clockwise to a vertical/parallel orientation *(Fig. 9b)*.

In order to maintain the absence of fringe shift in the MM experiment when the apparatus is rotated from the 45^0 orientation, each degree of rotation would have to produce contraction in the arm that is moving toward the parallel orientation and expansion in the arm that is moving toward the vertical orientation.

If only the parallel length is contracted by half the full contraction factor in *Fig. 9b*, while the vertical length remained unchanged *(L)*, the fringe shift would occur in the MM experiment.

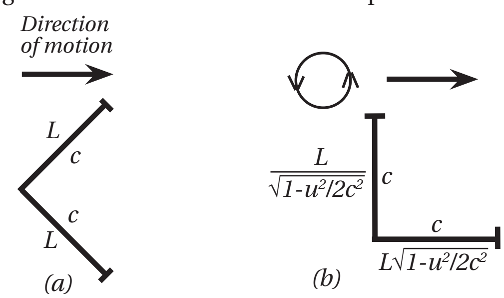

Figure 9

According to relativity theory, the full contraction/expansion factor $\sqrt{1-u^2/c^2}$ is applied during 90^0 rotation, as shown in *Fig. 9b*.

The 45^0 rotation would produce half the amount of contraction along the lengths moving toward the parallel orientation and half the amount of expansion along the lengths moving toward the vertical orientation. The new 45^0 contraction/expansion factor would be $\sqrt{1-u^2/2c^2}$.

Hence, the lengths of the arms in *Fig. 9b* must be:

$$L_{vertical} = \frac{L}{\sqrt{1-u^2/2c^2}} \qquad \text{and} \qquad L_{parallel} = L\sqrt{1-u^2/2c^2}$$

Above half contraction along the parallel arm and proportional half expansion of the vertical arm yield equal total parallel and vertical times and equal total distances traveled by the vertical and parallel beams in the MM experiment.

$$T_{VERTICAL} = T_{PARALLEL} = \frac{2L}{c\sqrt{1-u^2/c^2}\ \sqrt{1-u^2/2c^2}}$$

$$D_{VERTICAL} = D_{PARALLEL} = \frac{2L}{\sqrt{1-u^2/c^2}\ \sqrt{1-u^2/2c^2}}$$

These equalities guaranty that there would be no fringe shift in the MM experiment.

The changes in the dimensions along the vertical and parallel lengths in *Fig. 9* are expressed now not by an arbitrary and ad hoc assumption but by the above equations and geometry. The contraction and expansion in *Fig. 9* are the consequence of the motion of the experimental setup and the constancy of the speed of light.

Because changes of dimensions occur along the vertical and parallel lengths, the square root relativistic factor should be called *contraction/expansion* factor.

The above analysis does not prove the existence of the phenomena of contractions and expansion of dimensions of a body in motion, it only tells us what kind of changes in dimensions need to occur in order for the constancy of speed of light to be in agreement with the negative result in the MM experiment.

Mathematical proof of the error in Einstein's theory of contractions

In Einstein's theory, when the vertical/parallel setup of the MM experiment is put into motion from rest *(Fig. 10b)*, the vertical length remains unchanged, and is expressed as *L*. If the speed of the apparatus *u* is increased or decreased, only the parallel length is affected, because it has speed *u* in its length equation. The length difference between the parallel and vertical length is a full contraction factor.

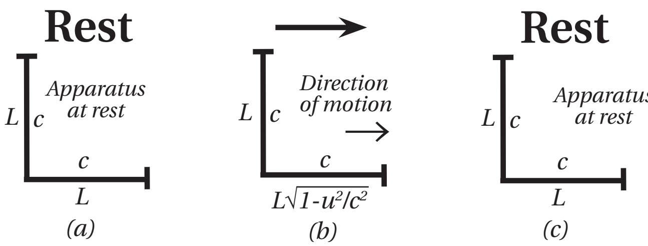

Figure 10

When the two-arm setup comes to rest, the contracted parallel arm will bounce back to its original length *L (Fig. 10c)*.

When we start with the neutral 45^0 orientation *(Fig. 11a)*, where the two arms are of equal length, then, when rotated 45^0, the vertical arm must expand by half the contraction factor and the parallel arm must contract by the same half factor *(Fig. 11b)*.

The vertical and parallel lengths are now expressed with equations that have speed *u* in them. The length difference between the two arms remains the full contraction factor. Once again, the length difference of a full contraction factor guarantees the absence of the fringe shift in the MM experiment.

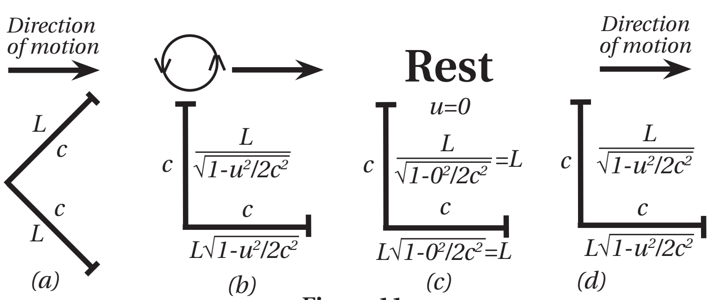

Figure 11

We have arrived at the mathematical proof of the error in Einstein's contractions theory:

The degree of contractions and expansions in the vertical/parallel orientation of the MM experiment in *Fig. 11* depends on its speed of motion *u*. If the speed *u* in the term $u^2/2c^2$ becomes slower and slower, there will be less and less contraction along the parallel length and less and less expansion along the vertical in order to maintain the absence of fringe shift in the MM experiment.

When the speed of the apparatus *u* in the two equations in *Fig. 11b* becomes zero, the two-arm system would come to rest, the term $u^2/2c^2$ in the length equations would become zero and the square roots of 1 in *Fig. 11b* would yield 1. Hence, the vertical and parallel lengths would become *L*, as shown in *Fig. 11c.*

When the apparatus is gradually put into motion *(Fig. 11d)*, the opposite must happen. The speed *u* in the square roots would become greater than zero, and the vertical arm would begin to expand, while the parallel arm would begin to contract.

Therefore, when the analysis of the MM experiment begins from a neutral and unbiased 45^0 orientation relative to the direction of motion, it would be mathematically impossible to arrive at a result where the length of the vertical arm remains unchanged when the MM apparatus comes to rest or is put into motion from rest, as Einstein proposed.

In other words, the new 45^0 starting orientation of the MM apparatus prohibits two concepts of contractions, as they are mutually contradictory. They invalidate Einstein's theory that the vertical length must remain unchanged when a body is put into motion from rest, or comes to rest from the state of motion.

The new 45^0 starting orientation of the arms of the MM experiment tells us that contractions and expansions are inseparable and reversely proportional, that is, by whatever factor one length contracts or reaches minimum or maximum contraction, the other length would expand by the same factor or reach minimum or maximum expansion. Hence, contractions and expansions of the length of a body in motion should be of equal importance in the relativistic theory; *neither one should have a privileged position among the phenomena of nature.*

The new concept of contractions mandates that the length of a rod put in motion at 45^0 would remain unchanged

The new mathematically derived changes in the dimensions of a body at rest and in motion lead to an interesting realization. Suppose we add an extra arm to the system of arms in the last figure. The extra arm would be positioned between the two arms, forming a 45^0 angle with the other two. When the three arms are at rest, all three would be of equal length *L (Fig. 12a)*.

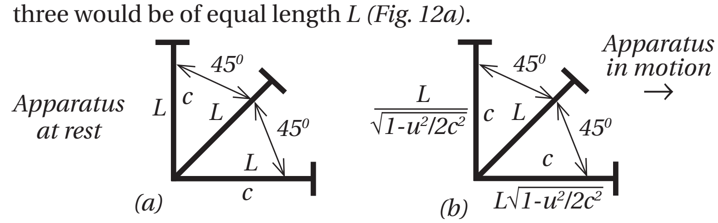

Figure 12

When this three-arm system is put into motion *(Fig. 12 b)*, the vertical arm must expand by a factor, as mandated by the new concept of contractions and expansions, while the parallel arm must contract by the same factor. However, the arm that is in between the two arms will be at an equal distance from maximum expansion and maximum contraction. Therefore, the phenomena of expansion and contraction will be non-active in this 45^0 orientation relative to the direction of motion for the three-arm system.

Hence, *the length of an arm that is oriented at 45^0 relative to the direction of motion must remain the same length whether the setup is at rest or in motion.*

Conclusion

The new relativistic concept of *contractions* mandates the existence of an *equivalent, symmetrical and inseparable* concept of *expansion* of the dimensions of a body due to motion. This means that the dimensions along *y* and *z* coordinates in the Lorentz-Einstein transformation equations cannot remain unchanged during translation *(y=y'* and *z=z')*, as postulated by Lorentz and Einstein, but they have to change in the same proportion as is the case with the changes that occur along the *x* coordinate. That is, $y \neq y'$ and $z \neq z'$. Indeed, the consequences of the new relativistic law of orientation and the mathematically derived equations for the dimensions of a body when put into motion from rest, or rotated while in motion, are enormous.

Because the contraction factor was the first modifying factor in the theory of special relativity, and because this factor was used to formulate transformation equations, from which all the concepts of the special relativity theory were formulated, the new contraction/expansion factor would dramatically change the transformation equations and all the equations of the special theory of relativity, rendering them untenable and meaningless. Einstein's theory of contraction cannot exist in the present form. If the arguments presented in this paper are sustained, the theory of relativity would fall apart from within.

References

[1] Albert Einstein, *Relativity*, Crown Trade Paperbacks, New York, NY, 1961, p. 59.
[2] Wolfgang Rindler, *Essential Relativity*, Van Nostrand Reinhold, New York, 1969, p. 51.
[3] Hans C. Ohanian, *Principles of Physics*, W. W. Norton and Co., NY, 1994, p. 767.
[4] Peter Nolan, *Fundamentals of College Physics*, Wm. C. Brown Publishers, Dubuque, IA, 2nd Edition, p. 871.
[5] Hans C. Ohanian, *Principles of Physics*, p.
[6] Raymond A. Serway, *Physics for Scientists and Engineers*, Saunders College Pub., 1990, p. 1118.
[7] Raymond A. Serway, p. 1119
[8] Rchard Feynman, *Lectures on Physics*, Allan Wydle, Reading, MA, 1963, Vol. 1, p.15.3.
[9] Dorothy Michelson Livingston, *The Master of Light*, Charles Scribner's Sons, New York, NY, 1997, p. 132.