Time and Cosmos

A New Cosmological Worldview

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Dedicated to all those who are actively combating global warming in an effort to preserve the earth - our only home in the Cosmos – for humanity.

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Foreword

This book describes the scientific adventure I embarked upon in search of a physical interpretation of the theory of relativity, which has fascinated me since my student days. So, as the day of my retirement approached and I was jokingly warned "not to fall into a black hole", I saw a perfect opportunity to gain a deeper understanding of Einstein’s famous theory.

However, the more I delved into it, the more a feeling came over me that the theory of relativity relies too heavily on mathematics and has become disconnected from the science of physics. For example, Einstein's first paper from 1905 introduced the Lorentz contraction (or *length contraction*): the shortening of the length of an object due to its speed. I could understand length contraction as a mathematical derivation, but it remained incomprehensible to me as a physical phenomenon.

In addition to consulting the serious textbooks from my student days, I read several popular books that might shed light on the scientific–philosophical aspect of that contraction. It was somewhat disappointing to come to the conclusion that they were all simplified versions of a popular booklet written by Einstein himself in 1916. Generally they used the same examples and I didn’t gain deeper insight into the Lorentz contraction.

I therefore delved into the original articles written by Einstein, which were mainly published in the German scientific journal ‘*Annalen der Physik*’ at the beginning of the last century. It was enjoyable to follow his thought process and it was a relief to discover that he himself had struggled with the theory. The derivation that would result in the Lorentz contraction, was particularly confusing. I even wondered if there could be any mistakes.

Via my website* about the theory of relativity I have had many discussions about the Lorentz contraction, in particular about the *Ladder and Barn Paradox*. The mathematical proof was often presented to me triumphantly. However, a mathematical calculation can be correct but still lead to an incorrect physical result if the wrong data is entered. The suggestion that Einstein might have made that mistake was dismissed out of hand. I therefore decided to carefully re-examine Einstein's derivations.

I began by formulating the "*Constitution of Physics*", which essentially states that every physical event must be characterized as the same event by every observer, regardless of location or state of motion. Using this principle, my derivations showed that there was no

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* www.Einsteingenootschap.nl

need at all for a moving object to shrink in the direction of motion. A moving object simply retains its length.

This book introduces a new concept, namely that of ‘*travelled distance’*: the product of velocity and duration. Although my derivations lead to the conclusion that the length of a moving object remains the same, the travelled distance of the object does become shorter. The significant difference from the accepted theory is that neither a moving object nor space shrink, but the value of the physical quantity 'travelled distance' decreases as a result of the time dilation.
In this way the physical quantity of ‘time*’* is better reflected in the dynamics of freely moving objects and problems, such as the perihelion precession of Mercury, can be explained in a more simple way.

When Einstein introduced a larger unit of time for the *slower time* in a moving system, he immediately assumed that the unit of length must also have increased. Just as the length of time in the moving frame actually becomes shorter, the length of an object would have become shorter as well. This might seem logical, but it is not correct. From this wrong starting point, Einstein arrived at the wrong result.

➢ In this context, I propose to establish a virtual museum, "*The Museum of False Notions,*" in which scientific ideas are exhibited, such as the flat Earth, the aether theory, or the nebula theory for galaxies; notions that dominated the worldview in a particular period but later turned out to be a misconception. The Lorentz contraction can be included as a showpiece in the collection.

Rejecting the notion of the shortening of a moving object seems to be an insignificant change to the theory of relativity, but in fact it has major consequences. In the established theory it is not only the object that becomes shorter, but the space moving with it also contracts. The important cosmological concept of four–dimensional Curved space-time is based on this contraction. In other words, our current cosmological worldview is based on a wrong idea.
This would mean that also the notion of Curved space-time can be despatched to the aforementioned virtual museum.

However, when you remove one of the foundations of the current scientific worldview, you suddenly find yourself faced with the task of designing an entirely new theory for cosmology. In this endeavour, I felt encouraged by Einstein's own statement: “*We cannot solve our problems with the same thinking we used when we created them*”.

So, the next step I had to take was to further examine the phenomenon of *gravity*. Science grapples with the nature of gravity, because it does not fit into the *Standard Model* of particle physics. Moreover, in large galaxies, the orbital velocities of distant stars indicate that the force of gravity from the center of the galaxy must be much greater than the measured mass could justify. Since the cause of this phenomenon is neither known nor understood, scientists have given it the name '*dark matter*'. However, simply naming it does not solve the problem.

As long as we don't understand gravity, we cannot comprehend the Cosmos. Thinking about this, I had to conclude that *space cannot possess any physical properties*. Furthermore, the accelerations that celestial bodies undergo arise from the (philosophical) requirement that a freely moving object must experience a symmetric universe.

Taking into account the symmetry properties of light rays, the bending of light near a mass can be understood as solely a consequence of variations in the 'time rate'. This is contrary to the established theory in which mass is attributed to the photon.

By chance, I stumbled upon the equivalence between time dilation at a point near a mass and the solid angle that the mass occupies according to the path of light rays at that point (c.q. the Einstein ring). This led me to formulate the '*Obstruction Theory'*, an alternative to Newton's theory of gravity. The obstruction created by an object is equal to the size of the solid angle of the object's Einstein ring. The experienced gravitational acceleration minimizes the time rate differences in and on a freely moving object to a minimum: this creates symmetry.
The normal *state of motion* for an object in space is, therefore, that of *acceleration*.

A new *gravity formula* can be found from the derivative of time dilation with respect to location. This formula deviates from Newton's theory of gravity, particularly at short distances from a mass. Gravity does not rely on a force located in a mass itself, but is caused by the geometric solid space that a mass occupies. It goes without saying that this different understanding of the phenomenon of gravity does not fit into the Standard Model.
It is a geometric theory.

Furthermore, the *obstruction theory* shows that two or more masses aligned in a straight line will strengthen each other's gravity. This provides an alternative explanation for the phenomena that led to the concept of *dark matter* in galaxies.
It also gives a comprehensible interpretation of the so-called mass increase of a (rapidly) moving object by referring to this as an increase in obstruction size.

In the final part of the book I question whether a Big Bang is necessary to explain the cosmic microwave background radiation and the redshift of light from distant galaxies, which are regarded as strong evidence for the current concept of an expanding universe. I propose the idea that the cosmic microwave background radiation and the redshift of light can be understood as a special way in which light is scattered by the abundant protons in the universe. It would only require one well–defined experiment to determine whether this idea is valid or not.

It may be worth mentioning here that Part I is about the improvements on Einstein's theory and Part II is about the consequences for our ideas about gravity and the cosmos. Anyone who is sufficiently familiar with the subject of cosmology can start studying the material directly in Part II. This reader will then have to ‘believe’ that the Lorentz contraction does not exist.

Henk Dorrestijn
The Hague
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Part I

A Shaky Worldview

Time, Light and Relativity

The Constitution of Physics

1. Introduction

Our earthly existence takes place in space and time. This cliché statement is confirmed in our history books, which are filled with data about the year and location of an event. Magnitudes like humidity, sound level, or temperature are not mentioned, even though they also play a role. Remarkable, since space and time are the most abstract concepts.
An hour can be measured with a clock, but that hour also disappears. You can't retrieve it. An hour takes on the meaning of how you experienced that hour. Most hours fade away after a short time.
A cubic meter of space without the box it's in has no meaning at all. The box has meaning as a volume, but not the space itself because it is intangible. When a box is opened, we cannot extract the space from it.
With measuring tools like rulers and clocks, we obtain knowledge about space and time, but the concepts of space and time remain ***abstract***. It's different for temperature or the mass of an object. The object can always be measured and weighed again.

It becomes even more challenging when you think about the infinity of the universe. Established science provides clear answers: the age is **13.8** billion years, and the diameter is **27.6** billion light-years. The universe originated **13.8** billion years ago with the ***Big Bang*** and has expanded at the speed of light. Thus, the universe forms a sphere with a diameter of **27.6** billion light-years. How simple can it be!
Established science bases these confident answers on the discovery of the redshift of distant galaxies, which was interpreted by the American astronomer *Edwin Hubble* in the 1930's as a result of the speed at which these galaxies are moving away from us. If all galaxies are moving away from each other, they must have been very close to each other at an earlier time. That's when it all started! The universe was born with a tremendous explosion, the Big Bang. Additional evidence supporting this interpretation was found in the 1950's: the cosmic microwave background radiation. It fit perfectly into the picture; the evidence seemed conclusive.
This theory seems set in stone. The slightest criticism is fiercely contested, but still... no one was there at that time, so how can science be so doggedly determined to cling to its own truth?

We want to know more about the universe! In earlier times, the main task of astronomers was to predict the appearance of a celestial body in the sky or to explain an unknown phenomenon. Usually, those predictions didn't bode well.
The meaning of all the dots of light in the celestial sphere and why some objects moved formed the basis for ancient religions.

In the late 17th century, thanks to the work of *Copernicus, Kepler, Galileo, Newton* and others, we gained an understanding of the orbital motion of celestial bodies in the solar system. Driven by the gravitational force of the Sun, a celestial body had to follow an orbit that obeyed the strict laws of mechanics.
Scientific knowledge grew.
The role of celestial bodies in Western religions had diminished.

In 1905, ***Albert Einstein*** caused a sensational leap forward in the progress of science. He assumed that the speed of light should always yield the same value ($c \approx 3.10^8$ m/s) in any measurement. Based on an example, he showed that the duration of a second on a moving object depends on the velocity of the object. A clock on the moving object would tick slower than a clock next to the observer. The moving clock falls behind. He developed this further (**Ref. 1**) into the theory of ***special relativity***, with the culmination being the '*equivalence of mass and energy* ' (**Ref. 2**) expressed in the formula $E=mc^2$.

Over ten years later, he also incorporated the influence of accelerations due to gravity into the theory. Due to its much broader applicability than the special theory of relativity, Einstein called this expansion of his theory the ***general relativity***.
We will not make this distinction: there is only one theory, the ***theory of relativity***.

The power and outcomes of the theory have had far-reaching consequences for our daily lives. There is a long list of technological applications where the theory of relativity has played a small or large role. However, we will limit ourselves to the scientific aspect of the theory of relativity.
The improved understanding brought about by the theory of relativity in astrophysics has caused a shift in our worldview. It became clear where a star gets all its energy from to continue shining for billions of years, as well as the influence of time dilation on the orbit of planets and the role of time in the occurrence of supernovae that can lead to the formation of black holes. Furthermore, the theory is of great importance in the development of Cosmological Theories.

However, the problem with the theory of relativity is that it has been made so difficult by the unrestrained tinkering of mathematicians with curved space-time that many physicists lament that it surpasses their imagination.
In this book, we will propose a fact-based improvement of the theory of relativity. The key step is to provide evidence that the contraction of a moving object – the ***Lorentz contraction*** – is a nonexistent physical phenomenon. This undermines the foundation of all theories that assume that time and space form a four-dimensional entity inextricably

intertwined with each other. Thus, the theory of relativity returns within the bounds of our imagination and becomes manageable for ordinary people.
Through this adjustment, we can offer a clear explanation for the phenomenon of *gravity*. In our theory, gravity is an *obstruction* that disrupts symmetry in the universe. With simple mathematical means, we can demonstrate that the acceleration of gravity is the response of an object attempting to take its place in the center of a symmetric universe. Further development of this idea (in part II) shows that it may potentially resolve the problem of ***dark matter***.

2. The Constant Speed of Light and the Slow Clock

The groundbreaking assumption made by *Albert Einstein* that the speed of light is a fundamental constant allowed him to embark on theoretical investigations into the elusive phenomenon: *'**time**'*. He wondered how much time a light beam would take to travel a certain round-trip distance in *a **moving frame***, such as a train. The round-trip distance is plotted along the direction of motion of the moving frame.

- The term ***'frame'*** is used for all objects that move at the same speed in the same direction. They are in the same frame. A frame in which an observer is located, observing another (usually moving) frame, is referred to as the ***rest frame***. All objects in the rest frame of this observer, are stationary relative to him.
  It is evident that an observer situated in the moving frame considers themselves to be in a rest frame. The frames are interchangeable.

In the rest frame, the time duration for a light beam to first travel forward then return, between two points, at a distance ℓ is equal to $\mathbf{2\ell/c}$ seconds.
Einstein demonstrated that the duration of time for a light beam traveling back and forth between two points in a moving frame is longer for someone measuring in the rest frame than for someone who is stationary in that moving frame and is measuring the same event. The conclusion is that time in the moving frame passes slower than in the stationary frame.

- It is difficult to imagine how time could go slower in the moving frame than in our rest frame! Everyone is struggling with this problem because it goes against our intuition.

With the constant speed of light, denoted as c m/s, one can easily calculate how much time a light beam would need for the round-trip distance in either the rest frame or the moving frame. The time duration on the clock in the moving frame between two points located at a distance of ℓ meters should also be equal to $\mathbf{2\ell/c}$ seconds.

After all, the clock cannot tell that it is in a moving frame, so it indicates the period of time that applies in the rest frame. It is just a name given to the moving frame.
However, observers in the rest frame, who are not in the what they call moving frame, find that their clocks display a longer time duration. This is because the outbound journey becomes longer as the light beam has to catch up with the moving front point, while the return journey becomes shorter as the starting point is already moving towards the light beam. Consequently, the outbound journey takes longer than the return journey.
However, these time differences do not cancel each other out. Since the outbound journey takes longer than the return journey, the *extra* time for the outbound journey is greater than the *extra time* for the return journey. Therefore, on the clocks of observers in the rest frame, the time duration for the round-trip in the moving frame is more than **2*ℓ/c*** seconds. The time duration is greater.

The clocks of observers in the rest frame must have run faster than the clocks of observers in the moving frame, or vice versa: the clock in the moving frame runs slower than the clock in the rest frame. The degree of this time dilation depends on the velocity of the moving frame. The time dilation increases with velocity.

3. Time

Time is an **abstract concept**, and the question of why time exists can only be pondered philosophically. The physical properties of an object can be expressed in various quantities, such as mass, temperature, and so on. Time is one of those quantities because these properties are valid only at specific moments in time. Time, in this sense, is an exception as it constantly progresses. This is convenient because it allows us to unambiguously record the moment at which the properties of an object were valid. Thanks to this characteristic, we can maintain a physical logbook for every object.

When *Einstein* began his research, the prevailing belief was that time ticked at the same rate throughout the entire universe, even in the farthest corners. It was thought that two clocks of the same reliable type would always run at the same speed, whether they were located in different places or moving at different velocities. Additionally, according to the ideas at that time, space was filled with an extremely rarefied substance called the *aether*, which allowed light to propagate as a wave through space. This was known as the "***aether theory***".
By assuming that the speed of light has the same value for every observer, *Einstein* dismissed the aether theory and provided a new perspective on the concept of time. In this book, we will demonstrate that his work is not yet finished.

The idea that time runs slower in a moving frame, such as a train, seems strange because it is understandable that observers in that frame would consider the so-called rest frame – the platform along the railway track – as a moving frame as well. From the perspective of the train, the platform is moving in the opposite direction with the same velocity.
The motion is relative, and therefore, we can assume that the train passengers would perceive the clock on the platform as running slower. And that is correct, it turns out to be true! For constant velocities, the frames are interchangeable as both the rest frame and the moving frame. The frame in which one is situated has the fastest clock.

- We will indicate the speed at which a clock runs in a frame with the term ***time rate*** in sec/sec in that frame.

In the moving frame, this lower time rate applies to every clock in that frame. Even when the moving frame changes direction, once a constant velocity is reached, every clock in the moving frame will still run slower than the observer's clock. It has nothing to do with the frame approaching or receding.
When an observer in a third frame, which has a different velocity compared to the other two, measures the time rates of the two frames, both will again be slower than his own time rate. The frame with the highest velocity relative to the observer will exhibit the strongest ***time dilation***. However, it is incorrect to assume that two different frames exhibiting the same time dilation must have synchronized clocks. No, because those frames can also move compared to each other and seen from one frame, time is delayed in the other frame.
The time rate of the other clock is assessed from the rest frame. Time dilation is a property that arises from the relative velocity between two frames.

It's nice when the clocks in one system indicate the same time.

For the thought experiments we are engaged in here, we must use the same clocks everywhere and at all times. These clocks, when placed side by side and initially synchronized, will always remain in sync. We refer to them as ***identical clocks***.

- Identical clocks located in one frame have the same time rate.

One consequence of clocks running slower in the moving frame is that a physical event, such as tossing and catching a ball in the moving frame, takes longer on our clocks compared to their clocks. Yet the event in the moving frame lasts as long on the clocks in that frame as the same event in our frame would last on our clocks.
The clocks in the moving frame are referred to as running slower, even though they measure a "faster" time for the event in the moving frame than our clocks. This can be confusing. Keep in mind that in the moving frame, a second lasts longer than in the rest frame.
For *example,* if someone bounces a ball on the ground twice per second, and they perform the same action in a moving train, observers in the rest frame will perceive that the ball bounces twice within a time span of more than one second on their clocks. The ball bounces slower. However, the people in the train see the ball bouncing twice per second on their clocks. They are experiencing their longer second.

The conclusion that a slower time rate exists in the moving frame leads to the, for some, unacceptable deduction that a chicken takes longer to hatch an egg than the time it "should" take, and that a person in the moving frame lives longer. However, for the chicken and the person in the moving frame, everything unfolds at a normal pace.
Despite the fact that every event in the moving frame occurs at a slower rate than in the rest frame, it also means that the same event in the rest frame has already concluded while it is still ongoing in the moving frame, if they started simultaneously.

But in the reverse case, where the observer in the moving frame assesses the moment at which the event in the rest frame is completed, it is also true that the event in the latter frame was completed later. This may seem contrary to all logic, but we will eventually understand. We will come back to this.
The lower ***time rate*** of a clock in a moving frame compared to the observer's clock is daily confirmed by the clocks placed in satellites for navigation systems used in road traffic, shipping, and aviation. The calculations required to guide traffic to the correct location must constantly be corrected for the time difference with the fast-moving satellite.
In the case of small particles, such as atoms or elementary particles, which can be accelerated to very high speeds in a particle accelerator, the lower time rate can indeed be measured by precisely determining the decay time of unstable particles (**Section 13**)

The only *physical property* of "time" that we can change is its "speed". We can alter the time rate in a frame by giving the frame velocity or, as we will see later, by placing the frame in an acceleration field (**Section 15**).

4. Space

The concept of ***'space'*** can be interpreted in two ways.
Firstly, as the measurable volume occupied by an object or a collection of objects. Space as a volume can be observed in the dimensions of a room or a building, but it can also be calculated for a solar system or a galaxy.
Secondly, it refers to the boundless stage within which physical events take place. Space as *the playground of physical entities*. Viewed in this way, *space* is an abstract concept.
Let us emphasize here: ***Abstract space does not possess physical properties!***
It is the objects and fields present in space that have physical properties and can influence each other. Space itself does not exert any influence on the interactions occurring between physical entities.

This description strongly contradicts the property of space formulated in the theory of relativity, which suggests that space can be *curved*. In this book, we will demonstrate that this perspective is based on a faulty calculation by Einstein and a series of misinterpretations that followed his discovery of time dilation in a moving frame.
As a result, the ***aether theory*** essentially still exists. Although space is no longer filled with an immeasurable, rarefied medium, it is now believed to be filled with something else that can become “curved” in the presence of mass. From the slight curvature, one infers that the elastic modulus of space has an unprecedentedly high value. This space, filled with "something" possessing an elastic modulus, is not intended – as it was in the pre-Einstein era – to explain the ***propagation* of *light*** in empty space, but rather to account for the ***bending*** of light rays.
Einstein believed he had eradicated the aether theory. Of course, with the assumption of the constant speed of light, he could easily explain why no differences could be found in measurements of the speed of light when approaching a light beam with different velocities.
At the current state of science, the property of ***curvature of space*** should explain why a light ray bends near a mass. However, that is again an *aether theory*! Once again, a physically *unexplained phenomenon* has been invoked to explain the still unexplained behavior of light.

It was *Einstein* himself who, as a result of a faulty calculation, proclaimed the "*contraction"* of a moving frame. When presented with a contradiction in his theory by ***Ehrenfest***, *Einstein* introduced the mathematical concept of ***curved space*** as an explanation in his theory. Although the "*contraction*" and the "*curved space*" have proven useful in practice by compensating for each other's errors, they do not hold up scientifically.
We will clearly indicate the errors in Einstein's theory (**Sections 7 and 8**) and demonstrate how the theory should be modified. It is quite a task, but after these improvements, the theory of relativity gains clarity.

5. The Clocks

If we have measured with a clock that the time rate in the moving frame is slower than in the rest frame, the slower time applies to every event and therefore to every other clock present in the moving frame. Thus, we are free to choose the most convenient clock for our thought experiments.

- Currently, there are *atomic clocks* that, as it is claimed, if they can tick undisturbed and without interruption, will only show a deviation of one second after millions of years!

We will often choose a ***light clock*** for the description of our experiments. This is essentially a setup as envisioned by Einstein to demonstrate that a clock in a moving frame runs slower. In such a setup, a light pulse moves back and forth between two mirrors within a fixed time interval. It becomes a clock when the number of times this occurs is counted using a *'counter'* (**Fig. 1**).
The light clock operates in a vacuum. The distance between the mirrors is ∂ meters. The clock is adjusted so that when the pulse has gone back and forth **N** times, one second has elapsed. This can be read on a scoreboard.
In this case, we have $\mathbf{N \times 2\partial/c = 1}$ sec. This allows us to measure time.
Using this type of clock provides insight into what happens and is therefore the most convenient clock for our purposes.

When a light clock is placed in a moving frame, it will still indicate **1** second when the light pulse has gone back and forth **N** times.
An observer in the rest frame can use a regular clock or his own light clock to verify whether he also measures the duration of **1** sec if he reads **1** second on the moving clock, but he will then read more time on his clock – for example **1.001** sec – because in the moving frame a slower time rate prevails.