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# Chapter Two, Part A: Einstein's Two Postulates

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**Abstract:** We try to speculate upon and explore the logic which guided Einstein into declaring his two postulates, as well as speculate and explore what those postulates mean, individually. This is a speculative paper, and it presumes that the reader has already read the relevant passages by Galileo, Newton, Einstein, Berkeley, and Poincare (Appendices one through five, respectively), my paper titled "A Brief Overview of SRT", and Einstein's book, "Relativity." The appendices provide information related to the justification of Einstein's first postulate, The Principle of Relativity.

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## 1. Introduction

In "A Brief Overview of SRT" we found that Einstein began his theory of relativity with the introduction of two postulates which, when taken together, produce his "assumption" about the velocity of light. There we noted that the distinction between Einstein's "assumption" about the velocity of light and his second postulate is not clear. We found that by adding the term "It is a law of physics (electrodynamics and optics) that.." to Einstein's second postulate, the distinction becomes clear, and the relationship between the first and second postulates becomes clear as well. (For more details, see notes to my paper "A Brief Overview of SRT)."

The first postulate states that the laws of physics remain the same/valid in all inertial frames of reference. The second postulate states that 'It is a law of physics that'…light travels through empty space with the definite speed c. Combination of these two postulates produces Einstein's 'assumption' about the velocity of light, which states: light travels through empty space at the definite velocity c with respect to all inertial frames of reference.

The first postulate, or the Relativity principle, is itself comprised of two mini-postulates, or principles. One is called the relativity principle for mechanics and the other is called the relativity principle of electrodynamics and optics. The former states that the laws of mechanics remain valid in all inertial frames of reference; the latter states that all laws of electrodynamics and optics remain valid in all inertial frames of reference. If we can accept that all laws of physics are comprised of laws of mechanics, electromagnetics and optics, it follows from these two mini-postulates that the laws of physics (all of them) remain valid in all inertial reference frames. This is the Principle of Relativity.

It is evident from the way that Einstein introduces his first postulate in his 1905 paper that he takes it for granted that the reader is aware of the relativity principle of mechanics, and believes in it, but that the same reader does not believe (yet) in the relativity principle of electromagnetics and optics. Specifically, Einstein states "Examples of this sort…lead to the conjecture that… for every reference system in which the laws of mechanics are valid, the laws of electrodynamics and optics are also valid." This marks Einstein's shift in the formerly known relativity principle of mechanics to the relativity principle (first postulate), in general. Since Einstein knows that the relativity principle of electrodynamics and optics is a new idea, he tries to justify the shift.

We will explore Einstein's justification for this shift, in this paper, as well as justifications for asserting his second postulate. To the extent that this is our goal, it will be sometimes necessary to speculate as to what Einstein considered his justification as being, and what it was that led Einstein to believe in the two postulates himself. What follows is the author's portrayal of what he believes to be, the sequential steps in logic that led Einstein into creating his postulates.

## 2. The Ether

Einstein initially believed in a stationary ether. He envisioned a big absolute reference frame glued to this ether. He thought Newton's laws and Maxwell's equations would only be valid in the absolute reference frame. (This is before he began to further explore the relativity principle of mechanics).

But then Einstein took note of the Michelson Morley Experiment, which failed to detect an ether. So he abandoned the ether hypothesis and the notion of an absolute reference frame. But this left open the question: With respect to what reference frame or group of reference frames Do Newton's Laws and Maxwell's Equations remain valid?

## 3. Newton's First Law

In the case of mechanics, Einstein turned to Newton's First Law for guidance. Newton's First Law states that a mass will not accelerate unless it is acted upon by an external force. But within which reference frames does this Law remain valid? Einstein most likely envisioned a single mass, stranded in space, far removed from any other masses which could be acting on it. Einstein thought this mass must be viewed to travel in a reference frame to travel without acceleration because acceleration would imply the existence of forces which were known not to be present. He labeled the set of reference frames traveling without acceleration, relative to the isolated mass, "inertial reference frames." Only in such reference frames would Newton's laws remain valid. Newton's laws would not remain valid in a reference frame chosen to accelerate relative to the mass. Einstein called this the relativity principle of mechanics.

## 4. Maxwell's Four Equations

In the case of electromagnetism, Einstein turned to Maxwell's Four Equations for guidance. Einstein knew that Maxwell's Four equations were based on magnet and conductor experiments. In some cases, the magnet and the conductor moved relative to one another at a constant velocity. But they never accelerated relative to one another (Einstein's thought-see note 1). The magnet and the conductor could be moved arbitrarily, relative to one another, as long as they weren't chosen to accelerate relative to one another. Let us now glue a reference frame to the magnet and to the conductor. Insofar as the magnet and the conductor can be moved arbitrarily (without acceleration) so can the reference frames glued to them. The set of reference frames described, namely, those moving at a constant velocity relative to the magnet (conductor frame) or relative to the conductor (magnet frame), are nothing other than the non-accelerating frames previously found to retain validity for Newton's Laws.

Einstein knew that Maxwell's Equations offered one explanation in the reference frame glued to the conductor, and another explanation in the reference frame glued to the magnet. In either frame, Maxwell's Equations remained valid. It followed that Maxwell's Equations should remain valid in all non-accelerating reference frames. Einstein called this the relativity principle of electromagnetics and optics.

## 5. The Laws of Physics Overall-Einstein's First Postulate

It was argued that Newton's Three Laws (e.g. First Law, and consequently all three) remain valid in non-accelerating frames. It was argued that Maxwell's Four Equations remain valid in the same. It seems logical that the territory for validity of Newton's Laws should be the same as the territory for validity of Maxwell's Equations, since they are both laws of physics. That is, it seems logical that the territory of validity of all laws of physics should be the same, be they laws of mechanics or laws of electrodynamics and optics. And in 1905, Einstein found that this territory was all non-accelerating reference frames. Hence it is asserted in 1905 that all laws of physics remain valid only in non-accelerating reference frames. Einstein called this the relativity principle, or principle of relativity. This relativity principle is Einstein's first postulate in SRT.

## 6. Maxwell's 'Fifth Equation'-Einstein's Second Postulate

Einstein knew that Maxwell could derive the electromagnetic wave equation from the two dynamic equations. As such, this electromagnetic wave equation represents a new law of electrodynamics and optics. This 'fifth equation' says that light travels at c. Thus it is a new law electrodynamics and optics that light travel at c.

## 7. Einstein's Two Postulates, Taken Together=Einstein's Assumption

Einstein's first postulate asserts that Newton's Three Laws and Maxwell's 'Five Equations' remain valid in all non-accelerating reference frames. Einstein's second postulate asserts that Maxwell's 'fifth equation' is nothing other than the statement that light travels at c. It follows that the rule that light travels at c must be valid in all non-accelerating reference frames.

## 8. Conclusion

Admittedly, the author has employed a considerable level of liberty to speculate about what Einstein was getting at with his postulates. First, the author had to controversially state that there exists a difference between Einstein's second postulate and his 'assumption' about light. Second, the author took the liberty of restating the second postulate by inserting the term 'It's a law of physics (electrodynamics and of optics) that…' before the common full statement for the second postulate, which states: light travels through empty space at the definite velocity c. This was done to obtain a simple relationship between postulates one and two. Third, the author promoted a completely speculative interpretation of Einstein's magnet/conductor illustration, to make some sense out of how that illustration was used to justify the relativity principle of electrodynamics and optics. Fourth, the author speculated that the second postulate arises because Einstein considers it to be a 'fifth' equation of Maxwell. And fifth, the author event unnecessarily went so far as to guess what it was that Einstein was thinking about to develop his belief in the relativity principle of mechanics.

In general, there is a lot of speculation in this paper. However, this writer has found it necessary to speculate when it comes to issues concerning Einstein's two postulates. Some of the reasons for making these speculations are discussed in the notes section to this paper and to the paper "A Brief Overview of SRT." The author is undoubtedly wrong about some of these speculations, but even if he is right about one or two of them, such speculation has probably been worthwhile. Such speculation into what it was that was going on in Einstein's head will be necessary if we are ever to understand what he was getting at with these two postulates, and how he came to believe they were justified.

Fortunately, if one is to accept his theory as valid, which most of us are (present author not included) not too much focus needs to be spent on these postulate, and we can begin with the 'assumption' about the velocity of light, upon which the remainder or SRT is built.

## 9. Notes to Various Sections

### 9.1. Introduction-Notes

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Note 1: It is argued that Newton modified his presentation of the first and second postulates. It is this author's opinion that Einstein, throughout the entirety of his life, never changed his mind about the meaning of these postulates. The source of the confusion stems from the fact that 1) Einstein never made a clear distinction between his second postulate and his "assumption" about the velocity of light (which follows from mutual employment of postulates one and two, and 2) Einstein, for reasons unknown to this author, was reluctant to phrase his second postulate in the way that he meant for it to be stated, namely, as follows : '*It is a law of physics that*…light always propagates through empty space at the definite velocity c.'

These issues were discussed at length in the notes to the various sections of the author's first paper "A Brief Overview of SRT".

Considering the above, no qualification is necessary as to the version of SRT we are dealing with in this paper. We are dealing with all versions of SRT. The context of some sections may have changed throughout Einstein's life (e.g. clock readings versus frequency vibrations as implied by the 1905 and 1907 versions of the theory), but the context of Einstein's first two postulates does not change throughout his life. Primary sources consulted to make this interpretation are Einstein's original 1905 paper and his book, "Relativity".

Since we are discussing SRT in this paper (not GRT) it should be taken as implied that we are not considering Einstein's 1916 version of his theory.

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Note 2: As mentioned, this author clarifies a distinction between Einstein's second postulate and his 'assumption' about the velocity of light. There are several reasons for this, and they were discussed in the notes to the relevant sections in my paper "An Overview of SRT". But for now, just take note of the fact that this distinction can be noticed from the way Einstein presents his ideas. Whenever he introduces his second postulate, he is referring to a single arbitrary frame. When he discusses his 'assumption' about the velocity of light, he is referring to more than one frame of reference. This treatment is analogous to Einstein's treatment of the notions of space, time and simultaneity, namely, he defines the absoluteness of such notions to be retained in a given arbitrary reference frame, and then he modifies the notions when he compares the notions between frames.

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### 9.2. The Ether-Notes

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Note 1: The prevailing idea of the day was that of the stationary ether. It doesn't require too much speculation to say that this probably had a profound effect upon Einstein, to the extent that he looked for reference frames with respect to which the laws of physics remain valid.

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**9.3. Newton's First Law-Notes**

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Note 1: Note the second quote in appendix two. This quote is added here because it is relevant, but the present author finds it unfortunate that Newton ever said such a thing. This is because the current author interprets that Newton felt the same way that Berkeley did about the relative motion of objects in the real physical world, namely, that the motion of a single body can only be described with respect to a second body-the motion with respect to a coordinate system is irrelevant.

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Note 2: Note that it was not until later, in 1916, that Einstein interpreted that Newton's laws could be valid in accelerating frames too. Einstein demonstrated this via his very peculiar equivalence principle. Had Einstein believed, in 1905, that Newton's laws remained valid in accelerating frames too, his first postulate would read: Laws of physics remain valid in all accelerating frames of reference. But he doesn't say this until 1916.

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Note 3: Note that Einstein thought that every one believed in the relativity principle of mechanics, including Newton. We know that Einstein felt this way because of the way he nonchalantly introduced it in his 1905 paper (i.e. "…for every reference system in which the laws of mechanics are valid…"[Miller, pg 370]). He introduces it as if everybody takes it as a given that it is true. He made no attempts to justify it, much less clarify it. The real question here is, did Newton really believe in the relativity principle of mechanics, as enunciated by Einstein? For more details, see note 4.

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Note 4: Let us recall Einstein's 1905 interpretation of Newton's First Law. As mentioned, Einstein believed that Newton's First Law did not remain valid in accelerating reference frames. Moreover, Einstein thought that everybody felt the same way he did, including Newton. But did Newton really believe that his First Law was not valid in accelerating reference frames? Let us attempt to answer this question.

Paragraph 1) Newton's First Law states that a mass will not accelerate unless acted upon by an external force. This seems to make sense. Let us consider that the universe consists of only two masses, freely floating in space. One mass will be a small rock. Let us call this our test mass. The other mass will be the earth. Let us call this our source mass. First, let us place the rock and the earth a billion miles away from one another. At this distance, the gravitational force supplied by the source mass on the test mass is negligible. The acceleration of the test mass with respect to the source mass is zero. Now let us position the rock 100 feet away from the earth's surface. Now the gravitational force exerted by the source mass on the test mass is not negligible. As such, the test mass accelerates at 9.8 m/s/s with respect to the source mass. In the first case, when the masses were far removed from one another, the test mass was not acted upon by an external force and no acceleration was experienced by the test mass. In the second case, when they were placed very close to one another, the test mass was acted upon by an external force and the test mass consequently suffered acceleration. These results are consistent with Newton's First Law.

Paragraph 2) Let us now say that we wish to view this situation on paper via the use of a coordinate reference frame. In each case, we will place the origin of the reference frame at the center of the earth. We will place the rock on the positive side of the x-axis. At time t=0 we will let the reference frame accelerate at 10 m/s/s with respect to the earth in the positive x-direction. In the first case, shows both the source and test mass as accelerating at -10m/s/s along the x-axis. In the second case, the reference frame shows that the source mass accelerates at -10m/s/s along the x-axis, while it shows that the test mass accelerates at -19.8 m/s/s along the x-axis.

Conversation between me and Newton:

Jeff: So, Newton, what did you think of my analysis of your First Law in that first paragraph?

Newton: It was perfect. That's an accurate application of my First Law.

Jeff: What do you think of my second paragraph?

Newton: Well…um…Coordinate reference frames can sometimes serve as useful tools, like translating Kepler's observed orbits to a more convenient system in which the origin is tied to the center of mass of a system of masses, or that sort of thing, but this simple 2-body system hardly warranted it's usage. And why the heck did you most inconveniently choose for the system to accelerate with respect to the earth?

Jeff: Do you think your First Law remains valid in this coordinate system?

Newton: What? What are you talking about?

Jeff: What if I glued an observer to the reference frame? Would the First Law remain valid to him?

Newton: What? I don't get it. I'm lost.

Jeff: OK. One last question. What if I now placed the observer in a cage so that he couldn't see what was going on outside? Would that make a difference?

Newton: Dude, I'm outta here.

Conversation with Einstein:

Jeff: So Einstein, what did you think of my first paragraph?

Einstein: It's OK. But I don't really think you have enough information to confirm or deny the validity of Newton's First Law for the given situation. We can only ascertain such validity for a reference frame or observer. So you need to put one of those in there.

Jeff: Do you think Newton's First Law is valid in the reference frame in paragraph 2?

Einstein (1905): No, not for either case. Newton's First Law states that a mass will not accelerate with respect to a given observer/reference frame unless acted upon by an external force. The -9.8 m/s/s suffered by the test mass is due to the gravitational pull of the source mass. That component of acceleration is fine. However, the remaining -10 m/s/s suffered by both masses is not seen to be due to any external force. This is a clear violation of Newton's First Law. We can proceed further. Since there are no external forces, one can only interpret that it is the coordinate system which is accelerating at 10 m/s/s. We can say that Newton's First Law does not remain valid in accelerating coordinate systems. This is a special case of the more general rule that laws of physics do not remain valid in accelerating coordinate systems.

Jeff: Do you think Newton would agree with your assessment of his First Law?

Einstein: Certainly he would. This is nothing more than the Galilean Principle of Relativity.

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Note 5: For more details concerning Newton's first law, the role of the reference frame in laws of physics, and how Newton's First Law led Einstein into claiming the relativity principle of mechanics, please see a paper I wrote about 10 years ago, called "The Mechanical Part of Einstein's First Postulate in SRT". It remains unaltered. The author still subscribes to the same opinions contained in the paper.

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Note 6: Note the second, and third quotes in appendix three. These quotes help to illustrate how this author interprets the apparent incompatibility (see first quote, third paragraph) between Einstein's first and second postulates, and why he has found it necessary to a) add the term 'It is a law of physics (electrodynamics and optics) that…' in front of the second postulate, and b) emphasize the discrepancy between Einstein's second postulate and his 'assumption' about light (which follows from mutual employment of the two postulates). The third quote further reinforces the author's idea that Einstein was thinking about Newton's First Law, and a mass stranded in empty space, when he considered the relativity principle of mechanics.

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Note 7: Note the absurdity of what Einstein is saying in the fourth quote of appendix four. He is saying that the laws of mechanics are no longer valid on a train when the train decelerates.

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**9.4. Maxwell's Four Equations-Notes**

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Note 1: To be sure, the magnet and conductor most definitely did accelerate relative to one another. But remember, we are looking here at Einstein's logic, and to the extent that we wish to interpret how it is that Einstein used his magnet/conductor illustration to justify his first postulate, this author takes the view that Einstein believed that the magnet and conductor always moved at a constant velocity with respect to one another. Take a look at the first paragraph in the 1905 paper. This interpretation is suggested from the way in which he described the relative motion of the magnet and the conductor. Current literature fails to account for what Einstein was getting at with this illustration, so I am taking the liberty of interpreting in the way that makes the most logical sense to me.

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Note 2: Note that Einstein believed that his relativity of electromagnetics and optics was a new idea. We can tell this from the way he introduced it in his 1905 paper. There, he felt it necessary to clarify it and justify it. He clarified it as an extension of the relativity principle of mechanics (see next section). He justified it via the magnet conductor description in appendix three.

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Note 3: For a discussion of Einstein's magnet and conductor illustration, see Cushing , pgs 229-231 or Miller, pgs 138-142.

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**9.5. The Laws of Physics Overall-Einstein's First Postulate-Notes**

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Note 1: Note that the reasoning illustrated here, in this section, can be considered yet another justification argument for Einstein's first postulate. The two other arguments for the first postulate are 1) the magnet conductor illustration, and 2) the inability to detect the ether. Einstein found no need to defend or justify the relativity principle of mechanics; just the crossover to the relativity principle of electrodynamics and optics (i.e. the generalization of the relativity principle of mechanics to the relativity principle). Note that when we say "relativity principle", we mean the relativity principle of mechanics plus the relativity principle of electrodynamics and optics.

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**9.6. Maxwell's 'Fifth Equation'-Einstein's Second Postulate-Notes**

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Note 1: Note that at this point, when defining postulate two, no mention needs to be mentioned about the reference frames it's valid in. Sometimes Einstein would say that it is valid in some single arbitrary reference frame, but he never defined postulate two, itself, to remain valid in all non-accelerating frames of reference. Hence the apparent equivalence between Einstein's second postulate and his "assumption" about light, which we have already discussed.

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Note 2: Note that, in a purely historical or scientific context, it is probably at the very least inaccurate to call the electromagnetic wave equation a fifth equation of Maxwell. However, this paper is about considering the logic Einstein used to derive his postulates. To the extent that that is our present goal, it makes sense to classify the electromagnetic equation with the other four equations. The classification stems from the author's attempt to relate Einstein's first postulate, and justifications for the first postulate, with his second postulate, and justifications for the second postulate.

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Note 5: One might question the legitimacy of claiming that the electromagnetic wave equation suggests that waves travel at the speed of c, without respect to any particular reference frame. This question will be explored in greater detail in the authors paper 'Future Considerations-After SRT is Ruled Out.'

**9.7. Einstein's Two Postulates, Taken Together=Einstein's Assumption-Notes**

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Note 1: Again, the present author wishes to emphasize the importance of distinguishing Einstein's second postulate from his 'assumption' about light. In the author's opinion, this is the reason for the introduction of the first postulate. If the second postulate stated, 'light travels through empty space with the definite speed c relative to all inertial reference frames', then what would be the point in Einstein introducing the first postulate? This question, plus the fact that Einstein claims his two postulates are 'apparently irreconcilable', leads the author into interpreting that there most be an intimate connection between the first and second postulate. When we add the statement 'It is a law of physics (electrodynamics and optics) that…' in front of 'light travels at c through empty space', the connection between the two postulates clears up and we realize the need for the distinction between the second postulate and the 'assumption'. Hence, the reason for this section.

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**9.8. Conclusion-Notes**

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No notes

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## 10. Appendix One: Galileo

In his Treatise Dialogues, Galileo States (Cushing, pg. 84):

> *"There can be no doubt but that one and the same body moving in a single medium has a fixed velocity which is determined by nature and which cannot be increased except by addition of momentum or diminished except by some resistance which retards it."*

## 11. Appendix Two: Newton

Newton's first law is stated as follows, in its original wording in the Principia (Cushing, pg 98):

> *"Every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it."*

Newton also stated (Zapffe, pg 38):

> *"The motions of bodies included in a given space are the same among themselves, whether that space is at rest or moving uniformly forward in a right line, without any circular motion."*

## 12. Appendix Three: Einstein

First quote)The first three paragraphs of the introductory section of Einstein's 1905 paper, "On the electrodynamics of Moving Bodies" are reproduced here (Miller, pgs 370-1):

> *"That Maxwell's electrodynamics-the way in which it is usually understood-when applied to moving bodies, leads to asymmetries that do not appear inherent in the phenomena is well known. Consider, for example, the reciprocal electrodynamic interaction of a magnet and a conductor. The observable phenomenon here depends only on the relative motion of the conductor and the magnet, whereas the customary conception draws a sharp distinction between these two cases in which on or the other of these bodies is in motion. For if the magnet is in motion and the conductor at rest, there arises in the neighborhood of the of the magnet an electromagnetic field with a certain definite energy, producing a current at the places where parts of the conductor are situated. But if the magnet is at rest and the conductor in motion, no electric field arises in the neighborhood of the magnet. In the conductor, however, we find an electromotive force, to which*

*in itself there is no corresponding energy, but which gives rise-assuming equality of relative motion in the two cases discussed- to electric currents of the same path and intensity as those produced by the electric forces in the former case.*

*Examples of this sort, together with the unsuccessful attempts to discover any motion of the earth relative to the 'light medium,' lead to the conjecture that to the concept of absolute rest there correspond no properties in the phenomena, neither in mechanics, nor in electrodynamics, but rather that as has already been shown to quantities of the first order, for every reference system in which the laws of mechanics are valid, the laws of electrodynamics and optics are also valid.*

*We will raise this conjecture (whose content will from now on be referred to as the 'Principle of Relativity') to a postulate, and moreover introduce another postulate, which is only apparently irreconcilable with the former: light is always propagated in empty space, with a definite velocity c which is independent of the state of motion of the emitting body. These two postulates suffice in order to obtain a simple and consistent theory of the electrodynamics of moving bodies taking as a basis Maxwell's theory for bodies at rest. The introduction of a 'luminiferous ether' will prove to be superfluous because the view here to be developed will introduce neither an 'absolutely resting space' provided with special properties, nor a velocity-vector with a point of space in which electromagnetic processes occur."*

Second quote) In his book "The Theory of Relativity", Einstein states:

*"Classical Mechanics is based on Galileo's principle: A body is in rectilinear and uniform motion as long as other bodies do not act on it. This statement cannot be valid for arbitrary moving systems of coordinates. It can claim validity only for so-called 'inertial systems.' Inertial systems are in rectilinear and uniform motion with respect to each other. In classical physics laws claim validity only with respect to all inertial coordinate systems (special principle of relativity)."*

Third quote) In his book "Relativity", Einstein states:

*"…classical mechanics starts out from the following law: Material particles sufficiently far removed from other material particles continue to move uniformly or continue in a straight line of rest…this fundamental law can only be valid for bodies of reference K which possess certain unique states of motion, and which are in uniform translational motion relative to each other. Relative to other reference-bodies K' the law is not valid. Both in classical mechanics and in the special theory of relativity we therefore differentiate between reference-bodies K relative to which the recognized 'laws of nature' can be said to hold, and reference-bodies K' relative to which these laws do not hold."*

Fourth quote) In his book "Relativity", Einstein states:

*"If the motion of the carriage is now changed into a non-uniform motion, as for instance by a powerful application of the brakes, then the occupant of the carriage experiences a correspondingly powerful jerk forwards. The retarded motion is manifested in the mechanical behaviour of bodies relative to the person in the railway carriage. The mechanical behaviour is different from that of the case previously considered, and for this reason it would appear to be impossible that the same mechanical laws hold relatively to the non-uniformly moving carriage, as hold with reference to the carriage when at rest or in uniform motion. At all events it is clear that the Galilean law does not hold with respect to the non-uniformly moving carriage."*

**13. Appendix 4: Berkeley**

Berkeley, in The Principle of Human Knowledge, stated (Wahlin, pg 1):

*"If every place is relative then every motion is relative, and as motion cannot be understood without the determination of its direction which in its turn cannot be understood except in relation to our or some other body, up, down, right, left. All directions and places are based on relations and it is necessary to separate a stationary body distinctly from a moving one. Let us imagine two globes, and that besides them nothing else material exists, then the motion in a circle of these two globes round their common center cannot be imagined. But suppose that the heaven of fixed stars was suddenly created and we shall be in a position to imagine the motion of globes by their relative position to the different parts of the heaven."*

**14. Poincare**

From Ricker (Why No Einstein's Laws-Part IV, section 3, paragraph 2), Poincare stated the principle of relativity in 1904, as follows:

*"The principle of relativity, according to which the laws of physical phenomenon should be the same, whether for an observer fixed, or for an observer carried along in a uniform motion of translation; so that we have not and could not have any means of discerning whether or not we are carried along in such a motion."*

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