Remarks on Theory of Relativity
(Rev. 1.23, Feb 2009, J.Rasper)

Summary

In the derivation of his Special Theory of Relativity Einstein uses a definition of simultaneity and a way of determining it which are not compatible. Although the way of determining simultaneity is adequate for common daily problems, it is in contradiction to the concept of synchronized clocks given by himself. Einsteins method of determining simultaneity is some kind of "habit of thinking" while a different method is a "necessity of thinking".

The observations predicted by the theory are artefacts produced by this incompatibility.

Introduction

Most people know the name of Albert Einstein and his Theory of Relativity. Comparably few, however, may be assumed to understand this theory. While there are only basic mathematical skills required, the lack of understanding seems to arise from logical difficulties. The deduction of the Special Theory of Relativity (SRT) raises questions which shall be asked here. In the literature these questions are not known in the shortness and precision we try to give here. It will depend on answers to these questions whether the SRT can be deduced in a way free of contradictions. We refer only to Einsteins book [1] which is fairly understandable even for non-professionals in this matter. We do not consider the General Theory of Relativity (GRT) directly. As of the SRT being a special case of the GRT the latter is affected by problems of the SRT, too.

1. Special Theory of Relativity (SRT)

The SRT starts from the following:

A1: There is no absolute space and no means to determine motion relative to such space (absolute motion).
A2: All observers reside in inertial systems which move with constant speed and on straight lines relative to each other.
A3: There are neither masses nor gravitation.
A4: Each observer measures the same speed of light independently from his state of motion relative to the source of light.
A5: Principle of relativity ([1], Par.5):
Ist K' ein in bezug auf K gleichfoermig und drehungsfrei bewegtes Koordinatensystem, so verlaeuft das Naturgeschehen in bezug auf K' nach genau denselben allgemeinen Gesetzen wie in bezug auf K.
Let K and K' be coordinate systems which are moved with constant speed on straight lines
with no rotation relative to each other. Then the same general laws determine the behaviour of nature in both systems.

We state without further consideration the following
Remarks:
R1: The preliminaries were never observed and won't be ever.

(In reality there is no space free of gravitation and thus of curvature having impact on the speed of light, which is claimed by the General Theory of Relativity).

R2: Can light propagate in an environment like this at all and if so, how ?

2. Problems in Thought Experiments

Experiment 1 (E1):

This experiment is the train-experiment described by Einstein in [1],Par.8,9. We use a partially different notation because we need a little more than in [1].
In [1] appear:

1. An observer O at a point M in a resting coordinate-system K (ground).
2. An observer O' at a point M' in the moving coordinate-system K' (train).
   The notation resting and moving is of course arbitrary and interchangeable. It serves only for easier talking.
3. In K the points A,M,B are given such that M is in the mid of A and B. The latter can be ensured by using a pocket ruler. Similarly the point M' shall be in the mid of A' and B' in the system K'. A is assumed to be left, B right of M while K' moves to the right.
4. A prescription for measuring time ([1], Par.8):
   Every event has a time stamp from a given system. This is the state of the clock in the point where the event took place. A definition of synchronous clocks along with a way of achieving the synchronicity within a system is given.
5. A definition for simultaneity of events:
   If an observer O in M sees two events in A resp. B at the same time, he will consider them to be simultaneous. An analogue statement holds for O' in M' with respect to A' and B'.
6. Two events (lightnings) in A and B, which O considers to be simultaneous according to 5.

A.E. is not very precise here, i.e. the following two items:

I1: "Den Stellen A und B entsprechen aber auch Stellen A und B auf dem Zuge."
The points A and B match points A and B in the train. This is not precise as we are not told whether A and B denote coordinates (i.e. distances from M or M') or whether they are just names for points. If points are meant, these should be named A' and B' for the train rather.
If coordinates are meant, there is not clear in advance, whether they are the same for the train as for the ground. In this case we should assume an A' resp. B'. Without proof of the contrary we have to assume that A may differ from A' and B from B'.

We shall drop this imprecision. We state that according to A1 no point can be defined independently from one of the systems K or K' . Therefore Einstein cannot have in mind names for points (e.g. fixed in space). In each system a point can be defined only by means of its coordinate (=distance from the origin M). In the train (system K') we cannot talk about A and B but we have to use A' and B' until further evidence.

I2: In [1], Par.8 each point in K or K' is associated with a clock . For each event

occurring at a point there is a time stamp which is the state of the clock at this point when the event took place.
This implies a definition for simultaneity of events (as seen from one system) which is independent from the times when the observer sees the events. We have to consider two events as simultaneous if (and only if) they have the same time stamps. This is clearly a different definition than in 5. Einstein leaves it open, why he doesn't use this straightforward definition. This is simply a necessity of thinking because the main purpose of syncing clocks is to compare time stamps of events. His way of determining simultaneity is just (to speak in his words) a habit of thinking, not a necessity. While this method of determining simultaneity is common use in daily problems it is simply not acceptable and not compatible with the definition implied by the synchronization method for clocks.

Additionally to the clocks at each point in a system (K resp. K') we assume milestones bearing the distance from the origins M or M'. Let's look a bit closer to what happens when the lightnings take place:

At A and A' the clocks with stamps Ta (in K) resp. T'a and the milestones with labels A resp A' will show up. At B and B' the clocks with stamps Tb and T'b and the milestones with labels B and B' will show up. This needs some explanation. Einstein sees the lightnings as events taking place on the ground (thus in system K). As we see, there are exactly 4 events (caused by two lightnings totally), two events at each side, which are the showing up of clocks and milestones in each system. It shouldn't be any problem to consider the two events at A and A' as simultaneous as they take place at the same point. Also the events at B and B' are simultaneous. Of course the numerical values (A,Ta) and (A',T'a) of their coordinates and times need not be the same. According to the principle of relativity each of the observers has the same right to claim the lightnings (which are only 2 !) having taken place in his own system. The kind of event considered here is called a point event because it is a mathematical point in a 4-dimensional space having neither extension in space nor in time.

While an event has no extension in time there is no motion state of it which could justify the association with one of the two systems. According to A4 the speed of the light coming from each of the 4 events to O and O' is the same for all 8 combinations of source-observer we have. The only solution here is, that both observers state the simultaneity of all 4 events. Einstein's conclusion that O' will see the events at B and B' earlier because of his moving towards the source of the light is not understandable. Even if this would be true, the next problem would be, why he should consider the events not to be simultaneous. The only consistent method would be to compare the time stamps of the events and not the time of the light reaching the observer. What else should be the reason for putting clocks at each point ?

It is not difficult to track down the issue to the arbitrary association of point events to one system without mentioning any property of the events which could justify such a doing.

Experiment 2 (E2):

We look at the following situation:

1. Observer A is alone in space and sends a sphere-symmetric lightning of some non-zero duration. This might be achieved by using some defined clock, for example a

certain kind of atom.
Thus, the lightning would also consist of light having a defined frequency (as judged from A).

2. Observer A has disappeared. Observer B shows up. Assume that both observers don't know of each other.
3. Observer B sends an identical lightning as A did before.

What can we conclude from this sequence ? As no observer has priority and no motion state can be stated for any of them we must assume that the lightnings have no property making them distinguishable.

Next we assume that both observers may know about each other. Will this allow to distinguish the lightnings ? Most probably not. Even if the observers should detect a relative motion between them, there is no reason how this should affect any property of the lightnings each one sends.

Now have a third observer C to whom the lightnings get eventually. Which difference would he detect between them ? Since they are totally identical, he would judge them being equal. This would be independent from the fact whether A and B state a relative motion between them. In this case C would have a different motion state compared to A than he has compared to B. According to common relativistics this would imply that he sees a different frequency-shift (relativistic Doppler-Effect) for both lightnings.
Hard to understand while the lightnings not being distinguishable.

Searching for a possible solution there must be a difference at the place and time where the lightnings originate. As long as we don't consider gravitation we could postulate a kind of absolute space (Einstein himself used the term “Lichtaether” in his speech in Leiden in the year 1920). Different motions of A and B relative to this space would explain a difference of the lightnings which would be detectable by C. We can interpret the situation like this:
Without difference in the lightnings there would be no “memory” for a different motion of A and B such that C could detect this different motion.

Of course this explanation is in contradiction to the SRT which negates the existence of any absolute space, because no way exists to detect it or to measure motion relative to it. This proceeding, however, is somewhat astonishing, because physical phenomena (e.g.: gravitational waves, gravitons, dark matter, ...) are not banned from some theory just because of being invisible.

Absolute space would explain two things:

1. The above problem:
   Differences of the lightnings arise from different motion relative to space (let's call this absolute motion).
   The noticed frequency by C depends on both the absolute motion of the sender and the observer.

2. The speed of light in absolute space is constant and independent from the absolute motion of the sender.

This second experiment is not so directly a problem of the SRT but of the environment

assumed by the SRT. This environment shows up to have very little physical meaning and affects therefore physical meaning of any theory based on it.

While in practice SRT is claimed to apply to real world (GPS, Mu-mesons), without having answers to the questions in discussion, it may be tempting to retract on a statement like this: “SRT is theory. For real environments we need of course the GRT. For this the problems don't apply”. They do not so clearly, of course. But Einstein states ([1], Par. 22) that the SRT lives on in the GRT as a special case. This makes a problem of the SRT a problem for the GRT also.

3. Possible solution ?

So far, we have that:
1. We probably need some absolute coordinate system. This is not only from E2, as we will see later, this could be implicated by E1, too.
2. Einstein's deduction of the SRT has logical problems making it not acceptable. Despite this, many observations seem to confirm the SRT. There are, however, experiments like Sagnac [2], which are in contradiction to the SRT.

We have to remember that the constancy of light speed in vacuum is not as proven as Einstein uses it. It is just a postulate. When trying to prove it, we have to distinguish two different situations:

1. Small scale. We have something like a pocket ruler to measure a distance. Then we can measure the time that light needs for a given distance. This situation applies for the Sagnac Experiment, which votes for a dependency of light speed from the receiver's motion state.

2. Large scale as for cosmic observations. There we measure distances by use of a clock assuming the constancy of light speed . This leads to a circular logic and is therefore highly problematic.

We will have a revised look at E1 now. If we cannot associate a point event with one of the two Systems K or K', what else ? As suggested by E2, we assume an absolute system K0. Light moves with constant speed c in K0. K' moves to the right of K as before, while the linear motion state of K and K' relative to K0 is arbitrary with constant speeds v or v' lesser than c. The two events are simultaneous in K0, i.e. they have the same timestamps.

If K is resting with respect to K0, O will see the events at the same time and state the same timestamps. This would be no problem for him. If he would move with speed v to the right compared to K0, he would still see the timestamps being the same. But will he see the events at the same time ?
Probably not, if we assume that the speed of the light in K coming from B (this is at the right of O) is c+v and the speed of the light coming from A is c-v. This will not be a logical problem for O in the sense that there is no contradiction between the timestamps and his observation times. Using the light speeds mentioned he would be able to correctly dating back the time of the events.

Experiments which apparently confirm the SRT at large scales work a different way. They assume light speed being constantly c in any system for light coming from any event and there are no timestamps which could be compared. Dating back of the events works like this:

A and B are at the same distance from O' when the events take place. As O' sees the event at B earlier and assumes c being always the same, O' must conclude that the event at B must be earlier than the one at A. This makes simultaneity dependent on the observer's motion state.

We have to explain why we don't have timestamps as described in E1. In practice, we cannot synchronize clocks at A and B, because we would have either to

1. Assume a constant c (which has to be proven still), if the clocks are already in place.

or

2. Synchronize the clocks at a common location and bring them to A and B. This involves effects of acceleration and gravitation which might disturb synchronization we need.

4. Conclusion

The questions mentioned in the introduction are:

1. Why does Einstein use two different methods to determine/define the simultaneity of events ?
2. Why resp. how can point events be associated with a given inertial system ?

The deduction of the SRT contains unresolved logical problems. Without satisfying answers the SRT cannot be founded in a logically clean manner. Apparent experimental confirmation cannot be a remedy for logical problems and is based on the same not proven assumption of light speed being independent from source and receiver's motion state.
Although the SRT seems to be confirmed by quite a number of experiments there are contradictory ones, too (e.g. [2]).

While the discussion pro and contra SRT is as old as SRT the SRT is widely accepted today. Simple logical problems prevent from understanding the SRT, but there are basic problems, too. The theory maps observation from real world to an oversimplified hypothetical environment (cf. R1, R2). While simplification for clarifying the kernel of problems is not unusual, it must not change the whole situation. We are not talking of losing some precision in calculations but assuming facts we never observed. Results deduced in this environment in a doubtable manner are mapped back to real world where experiments claim to prove the results in the hypothetical environment. This is not the kind of scientific work people believe into and money is spent for. It's high time to present SRT as what it is: Interesting thoughts but not the base we can expect progress being based on.

Searching for unification or at least contradiction-free coexistence of Quantum Theory and Theory of Relativity still seems far away. Progress is expectable not before each of them leaves no open questions.

References:

[1] A.Einstein: Ueber die spezielle und allgemeine Relativitaetstheorie
Akademie Verlag Berlin, Vieweg + Sohn, Reihe WTB Band 59
21. Auflage des Verlages Friedr.Vieweg + Sohn Braunschweig

[2] G. Sagnac: L'ether lumineux demontre par l'effet du vent relatif d'ether dans un

interferometre en rotation uniforme, in: Comptes Rendus 157 (1913), S. 708-710

Appendix:
Short description of Sagnac's experiment.
A light source emits on the periphery of a rotating circle light tangentially to both directions forth and back. Some mirrors keep both light rays on a polygonal track along the circle until they will meet eventually at a common point on the periphery. Depending on the rotation there is a different phase shift which Sagnac explains by different times the light takes to go the same distance forth or back, thus giving different speed of light for both rays (as judged from the rotating circle considered as a resting system).