6

Invalidity of the Special Theory of Relativity

6.1 Special Principle of Relativity

As per the Relativity Principle, all non-rotating reference frames, in which the equations of Newtonian mechanics hold good, are defined as Inertial Reference Frames (IRF). All inertial reference frames that move with uniform velocity with respect to one another constitute a group of equivalent reference frames and no particular member of this group can be considered a preferred reference frame on any ground. Albert Einstein, in his 1905 paper 'On the Electrodynamics of Moving Bodies' compares the representations in two such frames by terming one of them as a "stationary system" and the other one as a "coordinate system in uniform motion".[4]

At the outset, let us make it clear that the terms 'coordinate systems' and 'reference frames' used here and in the subsequent discussions, specifically refer to reference systems which can be physically established and used for taking physical measurements. Throughout these discussions, we do not imply to refer to similar abstract mathematical terms like coordinate spaces, coordinate manifolds and their metric representations used in abstract mathematical analysis. Quite often, a subtle mix up between abstract mathematical notions and real physical concepts can become a source of confusion.

The principle of relativity is the main founding postulate, the main pillar of the Special Theory of Relativity (SR). According to the first postulate of SR: "If a system of coordinates K is chosen so that, in relation to it, physical laws hold good in their simplest form, the same laws hold good in relation to any other system of coordinates K' moving in uniform translation relatively to K." Since in any closed volume of space with finite matter content, the CoM reference frame is always the unique preferred reference frame, the principle of relativity cannot hold any longer. Under the second postulate the requirement of constancy of velocity of light in vacuum was changed over to the requirement of constancy of the velocity of light in each of the infinitely many inertial reference frames in relative uniform motion, by sacrificing the absolute nature of space and time.

6.2 Invalidity of the Special Principle of Relativity

Basically, all laws of Nature will remain valid and operative independent of reference frames. However, in physics we quantify the

laws of Nature, so as to represent them through certain mathematical equations involving various dimensional physical parameters. If certain mathematical equation representing a law of physics is written in terms of parameters measured or defined in a particular coordinate reference frame, then we can say that the law of physics is expressed in that reference frame.

Since the domain of physics primarily involves the study of particle interactions and their associated motion in space, the physical parameters of distance, velocity, acceleration, force, momentum and kinetic energy are invariably the dominant constituents of the laws of physics. We need the structure of coordinate systems and reference frames to quantify the physical parameters of relative positions, velocities, accelerations, force, momentum and kinetic energy of various interacting particles or groups of particles. Formulation of the laws of physics in such a way that they are independent of the reference frame implies that the form of the mathematical equation representing any law of physics should not change with any change in the reference frame. Let us therefore, critically examine whether any constraints are required to be imposed on the choice of valid reference frames. If it is found that the velocity, acceleration, force, momentum or kinetic energy parameters of various interacting particles or groups of particles, changes with the change in reference coordinate frame then obviously the form of the associated mathematical equation representing a law of physics will change.

There is a well known group of coordinate reference frames, called inertial reference frames (in relative uniform motion) in which the physical parameters of acceleration and inertial force do not change with the change in reference frame. For this reason the Newton's laws of motion are found to be invariant in the whole group of inertial reference frames. However, physical parameters of velocity, momentum and kinetic energy are not invariant in the inertial reference frames in relative uniform motion. As such, some of the laws of physics, the representative equations of which include the parameters of velocity, momentum or kinetic energy, will no longer remain invariant in the inertial reference frames in relative uniform motion. Hence it is *wrong to assume* that all laws of physics are invariant in the group of inertial reference frames.

In fact the very notion of IRF is ill conceived on extremely narrow and trivial considerations of a railway carriage and the embankment. It is doubtful whether Einstein had any clear idea about the possibility of establishing a BCRF type CoM reference frame for our solar system. This is apparent from his 1916 book on Relativity,

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"If the principle of relativity (in the restricted sense) does not hold, then the Galilean co-ordinate systems K, K^1, K^2, etc., which are moving uniformly relative to each other, will not be equivalent for the description of natural phenomena. In this case we should be constrained to believe that natural laws are capable of being formulated in a particularly simple manner, and of course only on condition that, from amongst all possible Galilean co-ordinate systems, we should have chosen one (K^0) of a particular state of motion as our body of reference. We should then be justified (because of its merits for the description of natural phenomena) in calling this system *absolutely at rest*, and all other Galilean systems K *in motion*."

Of course it can be easily seen that the Barycentric Celestial Reference Frame (BCRF), with its origin at the CoM of the solar system, is essentially a preferred or an absolute reference frame (K^0). As already discussed in chapter 4,this reference system has been established with enormous international cooperation, with the use of most advanced 'cutting edge' technology. Further, on the grounds of conservation of total momentum and total mass-energy content within the solar system, it is not possible to establish any other equivalent (CoM) Galilean co-ordinate system K^1, K^2, etc., which is moving uniformly relative to BCRF. For studying the dynamics of planetary motion or for planning inter-planetary space missions we must use the BCRF out of necessity and not out of convenience. We cannot use any other co-ordinate system K^1, K^2, etc., moving uniformly relative to BCRF. That is, we cannot use the so called inertial reference frames in relative uniform motion for tracking any spacecraft without using BCRF. This constitutes a sufficient proof of the invalidity of the principle of relativity as per Einstein's own contention.

Essentially, the invalidity of the Principle of Relativity is justified on the following grounds:

(a) The notion of IRF in relative uniform motion is practically a redundant notion mainly used for conducting hypothetical thought experiments. It is practically impossible to uniquely establish two or more IRF in relative uniform motion, without reference to a CoM fixed absolute reference frame like BCRF or GCRF.

(b) If a relative velocity $\mathbf{v_{ab}}$ between two objects A and B is specifically required for certain analysis, it can be computed from their absolute velocities $\mathbf{v_a}$ and $\mathbf{v_b}$ in the relevant CoM fixed frame as $\mathbf{v_{ab} = v_b - v_a}$. But if only a relative velocity $\mathbf{v_{ab}}$ is measured in an IRF, then it is impossible to retrieve the absolute velocities $\mathbf{v_a}$ and $\mathbf{v_b}$ from $\mathbf{v_{ab}}$

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alone. All measurements of position and velocity of material particles made from IRF in relative motion, (without reference to a CoM fixed reference frame) yield only relative or apparent values which cannot be used in any scientific analysis or application.

(c) All measurements of position and velocity of material particles within a closed volume of space can be referred to a single CoM fixed reference frame like BCRF. For taking measurements through sophisticated instrumentation we may use some local reference frames (like GCRF in the solar system) the motion of which is precisely known in the absolute CoM reference frame. Use of inertial reference frames in relative uniform motion, is inadequate for this purpose.

All coordinate reference frames, the origins of which are in a state of motion with respect to the origin of the CoM reference frame, cannot be considered as valid reference frames for expression of the laws of physics through appropriate mathematical equations for the following reasons:

(a) Mathematical expression for kinetic energy of all material particles, involves terms with explicit velocity dependence. That is why all laws of physics involving kinetic energy of particles, will not remain invariant when expressed in different inertial reference frames. Foremost among such laws is the law of conservation of total mass-energy content within a closed or isolated volume of space. Since total mass-energy content within a closed volume of space does not remain constant when referred to different inertial reference frames in relative uniform motion, the validity of this law itself has been curtailed in relativity. This law is now being considered applicable for conservation of mass-energy content during particle interactions in any one specific reference frame. In fact the law of conservation of total mass-energy content within a closed volume of space should have been used to test the validity of coordinate reference frames for invariant expression of the laws of physics.

(b) The laws of thermodynamics are specific manifestations of the law of conservation of mass-energy as it relates to thermodynamic processes. As per kinetic theory of gases, the kinetic energy of a molecule depends upon the temperature of the gas. And the pressure of a gas is 2/3 of the mean transitional kinetic energy of the molecule in a unit volume. Since expression for kinetic energy of all gas molecules involves terms with explicit velocity dependence, it is obvious that the kinetic energy of gas molecules will appear to be different for observers in different inertial reference frames in

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relative uniform motion. Therefore the temperature and pressure of any portion of the gas as well as thermal equilibrium processes will appear to be different for observers in different inertial reference frames in relative uniform motion. As such the laws of thermodynamics will appear to have different form and content for observers in different inertial reference frames in relative uniform motion.

(c) Material particles of rest mass m in the solar system will appear to be of mass $\gamma.m$ (where $\gamma=1/\sqrt{(1-v^2/c^2)}$) in an inertial reference frame in relative uniform motion at velocity v, w.r.t. the BCRF. Since as per GR, the gravitational field in a certain region of space is governed by the mass-energy content (through EFE) in the vicinity, the gravitational field in the solar system will appear to be governed by $\gamma.m$ in an inertial reference frame in relative uniform motion w.r.t. the BCRF. Hence the gravitational field within the solar system will appear to be enhanced by the γ factor in an inertial reference frame in relative uniform motion w.r.t. the BCRF. This is a clear cut proof that all laws of physics do not remain invariant in different inertial reference frames in relative uniform motion w.r.t. the BCRF.

6.3 Invalidity of the Second Postulate

The second postulate of SR depicts a fundamentally and logically wrong assumption that the speed of light in vacuum is the same constant c in all reference frames in relative uniform motion. This assumption is built in to the following relation involving space-time interval dS,

$$(dS)^2 = (dx)^2 + (dy)^2 + (dz)^2 - (ct)^2 \quad \text{..... In frame K}$$
$$= (dx')^2 + (dy')^2 + (dz')^2 - (ct')^2 \quad \text{..... In frame } K^1$$
$$= (dx'')^2 + (dy'')^2 + (dz'')^2 - (ct'')^2 \quad \text{..... In frame } K^2$$

To comply with this wrong assumption, the notion of time as an absolute measure of change has been sacrificed in SR, leading to wrong notions of relative time and consequent wrong notions of length contractions. This wrong assumption has given rise to many fundamentally absurd convictions in SR. As per SR, the time intervals dt of a standard atomic clock will be seen to be different in each of the infinitely many inertial reference frames in relative motion! However, within our solar system, we use just one common CoM fixed reference frame BCRF in which the speed of light c is a constant and the measures of time and distance are absolute. The fact is that for all local reference frames K^1, K^2, etc. within our solar system, the measure of time in actual practice is the same absolute measure t (UTC) and not the relative

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measure t' or t''. Hence in actual practice, with the adoption of one common standard of time measurement, the notion of relative time as well as the second postulate of SR, are already rendered null and void within our solar system.

Quoting Albert Einstein, from his 1905 paper, "*If at the point A of space there is a clock, an observer at A can determine the time values of events in the immediate proximity of A. If there is at the point B of space another clock in all respects resembling the one at A, it is possible for an observer at B to determine the time values of events in the immediate neighborhood of B. But it is not possible without further assumption to compare, in respect of time, an event at A with an event at B. We have so far defined only an 'A time' and a 'B time'. We have not defined a common 'time' for A and B, for the latter cannot be defined at all unless* ***we establish by definition that the 'time' required by light to travel from A to B equals the 'time' it requires to travel from B to A.***" This arbitrary definition of 'common time' constitutes the fundamental mistake of Einstein, which ultimately leads to the invalidation of SR.

To demonstrate this mistake, let us assume that point A and B in space represents two Pioneer type spacecrafts in the outer region of the solar system. Let the separation distance AB, as measured in BCRF, be $6x10^{12}$ m which remains constant over a period of time. Let us construct an inertial coordinate system K with its origin at A. Obviously, B will be stationary in K. Let us further assume that a spacecraft tracking station measures the velocity of A and B as $\mathbf{v_a} = \mathbf{v_b} = 3x10^5$ m/s in BCRF, along direction AB. A signal pulse transmitted from A towards B will reach B in about 20020 seconds whereas a return signal pulse transmitted from B towards A will reach A in about 19980 seconds. The uplink and down link signal propagation times can be equal only if both spacecrafts A and B are at rest in BCRF. This shows that Einstein's fundamental assumption of equating the uplink and downlink signal propagation times between A and B inherently implies that both A and B are *assumed* to be at rest in the BCRF of the solar system. Since Einstein subsequently extended his notion of *common time* between A and B, to cover all IRF in relative uniform motion within the BCRF, it obviously implies that all such IRF *in relative uniform motion are assumed to be at rest* in BCRF. This simple contradiction shatters the facade of SR.

Further, let us assume that the uplink transmitter signal carrier frequency in the above example is 2 GHz. Due to the Doppler effect, the uplink carrier frequency in the signal path AB (as measured in BCRF) will be 2.002 GHz, representing an increase of 2 MHz. Similarly, the downlink carrier frequency in the signal path BA (as measured in BCRF)

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will be 1.998 GHz, representing a decrease of 2 MHz. This change in carrier frequency on the signal path occurs in spite of the fact that the signal frequency received at the two receivers B and A is unchanged.

6.4 Shift in Viewpoint

Rejection of the PoR calls for a major shift in our world view of the inertial reference frames and the associated fictitious observers moving along with them. In this regard, let us review some pertinent points related to the reference frames.

- *Why do we need reference frames?*

  Primary domain of Physics includes the study of interactions, interrelations and relative movements of particles or groups of particles within a closed volume of space. For this, we need to define a coordinate reference frame to quantify or assign measure numbers to the relative positions and velocities of these particles.

- *What physical constraints need to be imposed on the choice of a valid reference frame?*

  In a closed volume of space, the enclosed particles will possess a certain temperature and pressure distribution and contain some finite amount of total mass-energy content. The choice of a valid reference frame must be constrained to ensure that the physical content, the physical attributes or properties of the enclosed particles do not get altered by a change of the reference frame.

- *Why do we need very many reference frames?*

  In any particular physical situation we do not need very many reference frames. We need only one CoM fixed absolute reference frame and one local reference frame which is well defined within the absolute reference frame.

- *Why should reference frames be in relative uniform motion?*

  No, reference frames need not be in relative uniform motion although the particles or groups of particles referred to these frames could be in relative uniform motion. Only the non-rotating reference frames with their origins at rest in BCRF can be considered as equivalent to the BCRF.

- *Why do we need to attach a reference frame with every group of particles which are co-moving in external space?*

  Such local reference frames are required to define, measure and study the relative positions of all particles within the group and for further reference to a bigger CoM fixed absolute reference frame.

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- *What is the notion of an observer located on a reference frame?*

  This is a fictitious notion intended to imply the measurements taken in that particular reference frame. This can be replaced by a sensor, detector or an instrumentation set used to record the measurements.

With this paradigm shift in our conceptual viewpoint regarding coordinate reference frames, we can logically discard the principle of relativity which was the founding postulate of the special theory of relativity. Purely relative reference frames, popularly known as inertial reference frames in SR parlance, can neither be uniquely established in physical space nor can be practically utilized for real life applications. These are only useful for conducting hypothetical thought experiments and hence constitute a practically redundant notion. Secondly, as shown above, the relative velocities observed from all inertial reference frames in relative uniform motion, are inherently the apparent velocities.

Hence, in any such hypothetical inertial reference frame, the apparent speed of light cannot logically be a universal constant c. Further with the adoption of one common standard of time (UTC or TAI) the second postulate of SR is practically and logically rendered invalid. However, as shown earlier, the universal constant speed c of light propagation is an inherent property of the physical space which can be verified through experimental detection of the Universal Reference Frame. Therefore, with the collapse of both founding postulates, the Special Theory of Relativity is rendered redundant and invalid. However as discussed earlier, due to the inertial property of all forms of energy, including kinetic energy, the dynamic relations of mass and momentum still remain valid, in spite of the invalidation of the Special Theory of Relativity.

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