Relativity of Spatial Concurrence and Relativistic Non-Localization

Avibhajya Gajendra Singh Solanki
avi@muktmind.com

In the current framework of special relativity, the unique time of a frame does not transform to a unique time of the other frame, which is taken as an inherent principle as simultaneity of relativity. In the first paper 'Rudiments of relativity revisited', the setup is devised to show how these transformed times can be self contradictory and can not be associated with any real clock. This endeavor is an investigation if it is possible to develop an alternative mathematical framework of special relativity under the same two postulates, guided by Kishori's axioms, that relates the unique times of two frames. This paper succeeds to lay down the foundation of such a framework that adopts relativity of spatial concurrence. Further, this new formulation contains relativistic non-localization, exhibiting quantum physical attributes as an inherent aspect of relativity.

1. Introduction

Current special relativity (CR), which by now is more than a hundred year old well established theory in physics [1,2], is critically analyzed under Kishori's axioms. In our first paper "Rudiments of relativity revisited" the two axioms of Kishori, namely Kishori's first axiom (KFA) for avoiding undesirable effects (UE) of finite signal speed (FSS) and Kishori's second axiom (KSA) to save the moving frame time from being self contradictory, are established [3]. The UE of FSS are divided into two categories in-frame and cross-frame depending upon if they are encountered in the in-frame or the cross-frame observations, of which seems to suffer from the latter. Also, the relativity of simultaneity (RoS) is scrutinized under KFA, which paves the way for relativity of spatial concurrence (RSC), the topic of this paper. Kishori's two axioms, the result of a debate between Lali and Kishori, are summarized below before we proceed to establish the third axiom and lay down the mathematical framework of the new theory of relativity.

1. KFA: *To avoid any undesirable effect of FSS from creeping into measured distances and times of one or more events, we must rely on a set of well synchronized detectors and clocks positioned infinitesimally closer to the event-locations.*

2. KSA: *To save the transformed time to the other frame from being self contradictory or illusory, the linear or odd order terms in relative velocity between the two frames cannot appear in the temporal transforms but spatial transforms*. Further, the transformed *time also can not depend upon the location of the clock or observer such as x.*

The quest and motivation

Kishori's axioms are used as guidelines to lay down an alternative mathematical framework of relativity from the same two famous postulates of relativity. The quest behind this endeavor is the finding that the current framework of relativity does not relate the unique times of the two frames. It does take up as input the unique time of one frame but does not output a unique time of the other frame, despite the fact that there exists a unique time of the other frame as there exists one for the first, exhibited by their respective synched clocks. One of the inherent principles of CR is that unique time of one frame can not be associated with the other's without degenerating to many, as many as there are points on the x coordinate, because of relativity of synchronisation and simultaneity. However, many transformed times have been shown to be self contradictory. Can we atleast develop a mathematical framework of relativity that relates the very unique times of the two frames? Will that just be a mathematical alternative or experimentally distinguishable as well? This quest does lead us to a framework that is explicitly free from RoS, synchronization term, but embraces anisotropic spatial warping (ASW), RSC and RNL as the foundation of relativity. Besides, this paper also finds a trace of quantum physics in relativity or vice versa. The debate of Kishori and Lali continues in the next section from [3]. Founded thus, Kishori's transforms (KT) are finally fully derived in [4], and in [5] it is shown that new relativity can produce all the so far tested tenets of special relativity besides predicting some new ones. Subsequent papers show that the two formulations are just not two different mathematical forms but experimentally distinguishable from each other.

2. Kishori's symmetry consideration

Recall from [3] where it is shown how a single flow rate of time in one frame bifurcates into as many transformed times rates in the other frame as there are points or observers on x coordinates. By placing two observers Lali and Lata equidistant from moving krishna whose clock radiates a pulse at a rate every second it was shown that these two so bifurcated time rates are self contradictory. Lali makes one last attempt to save the CR's transformed time from being self contradictory. Consider a pulse of light emitted by a moving clock when it was exactly in the middle of Lata and her, fig 1. "As photons progressed towards us from Krishna we both moved to the left w.r.to the moving clock. So, shouldn't the pulse hit me first before Lata?" Lali asks herself but soon realises that now she is commiting what Kishori calls the 'overlapped positions syndrome' (OPS) of CR i.e. she is directly mapping the photon's positions of Krishna's frame to their own frame, ignoring any cross frame ASW at play. Finally, Lali is left with no option but to accept that the transformed time of CR can not be attributed to the rate of flow of the frame it is transformed to, but the time of the previous frame that was transformed was very much the time of the frame that represented the unique flow of time associated to the previous frame. Thus temporal transforms of CR are not the transforms between the unique times of the respective frames. Further, the so transformed time can not be associated with any real physical clock without taking into account the odd order spatial warping or ASW. Curious to learn how the form of Kishori's transform would look like, Lali puts forth the LT in (3) and (4) before Kishori.

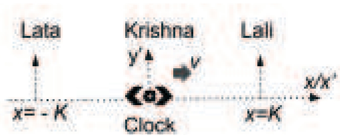

Fig 1. A moving clock in the middle of Lali and Lata ticks light.

$$x' = g(v^2/c^2)\,(x - vt)\,,\ y' = y\,,\ z' = z \qquad (3)$$
$$t' = g(v^2/c^2)\,(t - vx/c^2) \qquad (4)$$

where $g(v^2/c^2)$ is the famous gamma factor that encapsulates the second or even order dependence in v, the relative velocity between the two frames. Here c, the speed of light, plays the same role as played by s in Kishori's love-world [3].

Kishori is astonished at the asymmetry of spatial transforms of LT in $g(v^2/c^2)$ terms wherein this even order factor just appears in x transforms and not in that of y and z. She observes, *a factor like g containing only even order terms is devoid of any directionality and hence is supposed to symmetrically affect all the spatial dimensions.* Let us call this observation of Kishori as *even order factor's symmetry consideration* or Kishor's third axiom (KTA).

3. The mathematical framework of KT

With the advent of her three axioms, now Kishori is ready to write the expected form of Kishori's transforms of special relativity in compliance with her axioms and observations.

$$x' = e(v^2/c^2)\, m(v/c, x)(x - vt)\,,$$
$$y' = e(v^2/c^2)\, m_{\perp}(v/c, x)\ y\ ,$$

$$z' = e(v^2/c^2)\, m_\perp(v/c, x)\; z \qquad (7)$$
$$t' = e_t(v^2/c^2)\; t \qquad (8)$$

where all e-factors are function of v^2/c^2 carrying second or even order dependence alone, whereas all m-factors carry linear or odd order dependence as well in addition to others, if any. Absence of any m-type factor in equation (8) saves a moving clock or time from being self contradictory. The spatial transforms may be asymmetric in m but they are expected to be symmetric in e. It remains a task for the next paper [4] to derive the expressions for various e and m factors appearing in the four equations and complete the derivation of new transforms of relativity. When a body or frame is in motion w.r.t another the latter sees the former at a different momentum and energy potential, whose impact on the space time relativity is encapsulated by Kishori in e and m factors respectively. While e terms affect all coordinates, KSA inspired m terms are supposed to affect only the spatial ones giving rise to phenomena like ASW, RSC and relativistic non localization (RNL). The (8) is free from any synchronisation term and thus relates time of one frame to the time of the other frame, and ASW as an effect m in (7) has already been discussed in [3].

To understand other effects of m like RSC and RNL we need not have complete mathematical expressions for all the e and m factors in (7) and (8). A bit of wit paves our way and we shall leave the full derivation of KT to the next papers [4,5]. The first trick is to limit our observations to low relative velocities $v << c$. Let us call it a linear order regime where only first order in v/c is of any significance to retain. Secondly, we also know that if v is too low i.e. $v/c \sim 0$, then Galilean relativity should prevail. In such a regime of Galilean relativity the e and m factors in (7) and (8) must reduce almost to 1 i.e. $e, e_t \sim 1$ and $m \sim 1$, giving the Galilean transforms of relativity:

$$x' = (x - vt),\; y' = y,\; z' = z \qquad (9)$$
$$t' = t \qquad (10)$$

However, we wish to reduce KT not to the classical regime, but to the first order one, where we can ignore the second and higher orders dependent factors like e but not the m factors which also carry on the first order dependence. Thus, Kishori to appreciate RSC and RNL carefully chooses this regime where $v << c$ such that $e, e_t \sim 1$ but m factors are retained in (7) and (8),

$$x' \simeq m\,(x - vt),\; y' \simeq m_\perp\, y,\; z' \simeq m_\perp\, z \qquad (11)$$
$$t' \simeq t \qquad (12)$$

The above simplified equations carry the linear order effects of Kishori's relativity like ASW, RSC and RNL. Now we shall focus only on x coordinate and temporal transforms to understand first RSC and then RNL.

4. Relativity of spatial concurrence

We define motion as change in position of a body with time. But the process of measuring position involves recognising spatial concurrence. Consider a particle, say photon, moving on a very long ruled scale. To read its position at any time we look for its 'spatial concurrence' or its overlap or alignment with the ruling marks on the scale at that particular time. *Now, this spatial concurrence is relative is the revolutionary statement being made over here.* Before proceeding further, note that any second or higher order effects of relativity have been ignored for this paper. We assume to be operating in a linear or first order regime of relativity when velocities involved are such that factors g or e approach one but linear order effects are still considerable.

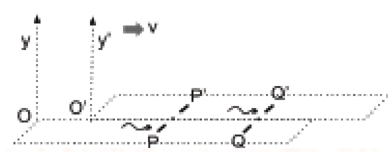

Fig 2. Relativity of spatial concurrence: When photon is detected at P in the rest frame, it is not detected at an aligned point P' in the moving frame but at Q' that aligns with Q.

Let the origins of two frames, O and O' coincide at the time of emission of a sharp burst of photons at $t=t'=0$, fig 2. Consider one of many simultaneously emitted photons, traveling a length x in the rest frame from origin O to a point say P on x axis in time t. The presence of the photon at P in the rest frame triggers CR to assume the presence of the photon in the moving frame at a point P' that coincides or overlaps or concurs with the point P of the rest frame or vice versa, also termed by Kishori as overlapped position syndrome (OPS) of the CR. But, for a true believer in relativity of space, there is no reason to assume so. This assumption of CR leads to reduction of photon's path-length in the moving frame by a linear term vt. Thus, the only way left for CR to save the constancy of light-speed is to tweak the time t' by a linear term accordingly in the name and pretext of RoS. However, for Kishori's relativity of spatial concurrence (RSC) if the photon is at P in the rest frame at any instant, it does not mean it is also available at the coincident point P' for detection in the moving frame at that instant. A detector in the moving frame is in relative motion with the detector of the rest frame and hence finds or meets the same photon at a different position other than point P' which concurs with P, owing to RSC. In the moving frame, instead of P', the photon is detected at Q', a point in alignment with point Q of the rest frame. Whereas we leave the exact expression of m factors for the next paper, it is easy to estimate the shift PQ to a first order approximation. For the photon of Fig 1,

$$OP = x = ct \tag{13}$$

$$O'Q' = x' = ct' \tag{14}$$

From (12-14) to a first order approximation as $t' \sim t$, it implies $x' \sim x$, and therefore the shift in position in two frames,

$$PQ = vx/c \tag{15}$$

where v is the relative velocity of the moving frame w.r.t rest frame. Photon concurs with P in the rest frame but with Q' in the moving frame is the relativity of concurrence. It is interesting to note that for a photon viewed from two frames to a first order approximation, $m=c/(c-v)$ as deduced from (11-14), justifying our assumption that m takes on linear or odd order dependencies.

5. Different positions in different frames

The availability of the photon (or any particle) for detection at different positions in different frames (DPDF), incompatible with the frame's mutually agreed overlap at that instant, is a strange aspect of an externally revealed RSC. There is nothing special about the choice of photon here as a particle except that the amount of shift due to RSC is pronounced for a photon. This non localized cross frame presence of a particle, also called 'relativistic non localization' (RNL), is a strange phenomenon but is experimentally verifiable. To widen the gap between DPDF, imagine in fig 4 another moving frame O'' having the same speed v w.r.t O but in $-x$ and a detector installed in this frame would detect the photon at R'' a point coinciding or aligned with point R in the rest frame, giving a gap in positions of detection as $RQ \sim 2vx/c$. Refer to [5] for an experiment to test externally revealed RSC.

6. Relativistic non localization

Consider RSC again from the perspective of the rest frame observer (RFO), who detects the only emitted photon at P of rest frame at an instant t after its emission by a distant stationary source that keeps on emitting a single photon periodically. Using progressively incremented values of velocity of the

Fig 3. The positions of detection vary from T' to T" about P with various positive and negative v of the detector.

detector, RFO detects the photon at the same instant at Q', R', S', T' and so on, all progressively shifted to the right of P and by using incremented negative velocities of the detector, he detects the particle at Q'', R'', S'', T" and so on, all progressively shifted to the left of P. The points from T" to Q' denote the DPDFs of the particle at a given instant as shown in fig 3. From the particle's perspective, all these DPDF namely Q', Q'', R', R'', S', S'', T', T'' relativistically concur owing to OSW and the particle has no difficulty to occupy each at an instant or to instantly communicate across them. But for RFO these points are quite separate in space and thus the particle's simultaneous availability for detection at them, just depending upon the velocity of the detector, seems to defy the classical behaviour of a localized particle in many ways: First, the outcome that is the particle's position at the instant of detection is influenced by the state of motion of the detector. Second, the simultaneous presence at multiple widely separated positions in space defies the localized nature of the particle. Further, once the particle is detected at any of the above positions, its presence for other locations has to vanish immediately to avoid its multiple detections. It implies the particle is capable of communicating instantly across all the possible cross frame detection positions. Unable to escape relativistic non localization, RFO is ready to lay down the various tenets of the in-frame and cross-frame detection process of the particle.

1. The particle before being detected exists in some strange non-localized non-classical super state encompassing all possible cross frame detection locations, superposing all possible detection states in all possible frames.
2. The very process of detection of the particle results in the collapse of that superstate. Particle instantly withdraws its possibility of detection from other possible locations and makes itself available as a whole at the detected location.
3. The outcome i.e. position of detection for a given time or the time of detection for a given position of detector or both, is influenced by the state of motion of the observer. For a stationary detector, the position of detection is P for moving detectors positions of detection shift in accordance with their speed. State of motion of the observer affects the outcome.

Anyone familiar with quantum mechanics can see that the above mechanism contains the basic tenets of quantum physics. For the first time to our knowledge, relativistic and quantum physics are shown here to be connected so inherently to the extent of interdependence. Had the KSA and phenomena like RSC not been ignored or hidden under the mathematical elegance or symmetry of LT, the genius of Einstein would have not missed the quantum physical attributes of relativity and would have not stood against quantum mechanics in its very infancy.

From the discussion of previous section we can write an expression in first order for 'relativistic spread' in detected position of a photon using equation (15) ,

$$\Delta x_{rel} = \frac{\Delta v\, x}{c} \qquad (16)$$

where, $\pm\Delta v/2$ is the spread in relative velocity of the detector at a distance x from the source of the photon and c is the speed of light. It is assumed here that inherent quantum mechanical uncertainty or spread of the particle is negligible in comparison to one due to RNL. Importance of this formulation can be from the fact that emission and detection of microscopic particles involves microscopic phenomenon and it's not always possible to control the relative speed involved.

7. Conclusion

This paper puts forth one more axiom of Kishori on symmetry or isotropicity of even order warping, and it succeeds to give the mathematical form of temporal transform devoid of synchronisation term that splits the unique time of a frame to as many times as there are points on x coordinate in the other frame. Though it still remains a task to find out the algebraic expressions for the various *e* and *m* factors, this inquiry culminates at least into a mathematical framework for the new transforms of relativity. Complete derivation of KT is left for the next paper [4], here we could successfully reduce the mathematical form to their first order approximation in v/c. This small relative velocity regime is used to demonstrate the linear order phenomena such as the RSC and the RNL. RNL is a glimpse of quantum mechanics in relativity, indicating their hidden closer relations. In [5] it is shown that new transforms can produce all the verified results of relativity, however the experiments proposed in [6-13] show that two formulations are experimentally distinguishable. In [14] the various interpretations of two transforms are compared, in [15] KR is extended for static energy fields devoid of motion.

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