# Relativistic Interferometer and Lightspeedometer based on Relativistic Nonlocality

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***Abstract***

***This paper, the eleventh in the series of rudiments of relativity revisited, extends our efforts to speed up or slow lightspeed in a vacuum using relativistic non-localization of new relativity. In the previous paper namely 'Ultra lightspeed travel using relativistic non-localization' we had developed theory and experimental setups to realize supra and infra lightspeed travel. However, all the experimental setups were bulky to realize and their sensitivity was also low. In this paper, we design a highly sensitive interferometer and a lightspeed manipulator that work on the presumption that reflection or refraction may lead to the total collapse of the relativistic non-localized state of a photon, and the reflected or refracted beam bears no memory of the relativistic non-localized state of the incident beam.***

## 1. Introduction

Conventional special relativity (CR) relies on the relativity of simultaneity (RoS) and interprets the Lorentz transform (LT) accordingly [1,2]. New relativity (NR) on the other hand bases itself on relativistic non localization (RNL), anisotropic spatial warping (ASW), and relativity of spatial concurrence (RSC) [3-6]. Both CR and NR preserve the lightspeed normally. However, as detailed in [7], the RNL of NR can be manipulated to achieve supra and infra lightspeed travel (SILT) in a vacuum, as evident from the new transform below.

$$x' = em(x - vt)\,,\; y' = em_{\perp} y,\; z' = e\, m_{\perp} z \qquad (1)$$

$$t' = e\, t\,, \qquad (2)$$

where,

$$e = \sqrt{1 - v^2/c^2}, \qquad m = \frac{1}{1-(v/c^2)(x/t)},$$

$$m_{\perp} = em,\; g = 1/e,$$

And $v$ is the relative velocity between rest frame (RF) and moving frame (MF), $c$ is the lightspeed. At $t=t'=0$, origins of RF and MF coincide when twin photons are emitted at the common origin, both traveling to the right. Fig 1 shows the two frames at a later time $t$ when MF has moved by a distance $vt$ to the right and one of the photons is detected at point $P$ in the RF such that $x = OP = ct$. However, in the MF due to RNL, which is the nonlocality across the frames different from usual quantum nonlocality within the frame, the other photon is detected at $Q'$ a point overlapping with $Q$ in the RF and not with $P$. RNL spread or the gap between two DPDF for RF observer (RFO) $\Delta X = PQ$ and for MF observer (MFO) $\Delta X'$ = Q'P'

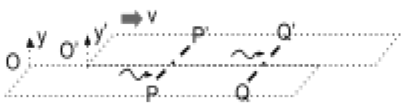


*Fig 1. In the rest frame photon is detected at P, but in the moving frame it is detected at Q' that aligns with Q of the rest frame..*

$$\Delta X \;=\; PQ \;=\; vx/c \qquad (3)$$

$$\Delta X' \;=\; Q'P' \;=\; -\,vx'/c \qquad (4)$$

Thus, the distance of the point of detection of the twin photon in the MF from $O$ for the RFO and the point of detection of the first photon in the RF from $O'$ for the MFO,

$$X = OQ = x + vx/c \qquad (5)$$

$$X' = O'P' = x' - vx'/c \qquad (6)$$

Eq (10) and (11) are the statements of supra and infra luminal travel in vacuum respectively of a photon detected in the other frame (DITOF). This phrase DITOF is the biggest catch in realizing SILT as a technology because RNL ensures the preservation of lightspeed in its own frame. However, the information or the particle DITOF is of no use unless the information and the benefit of SILT are translated back to the observer's frame. If the observer directly detects the photon in its own frame, the benefit of SILT disappears. Therefore, the key for ULT is to break the travel path into two flights unevenly, none of which violates the lightspeed limits but the combined journey results in SILT. Can nature or the light be fooled to detect the photon in the other frame and translate the benefit of SILT back to the observer's frame by dividing the photon journey into two parts?

We assumed this to be true provided 1. The vacuum is maintained during both the divided flights. 2. The combination of a detector and source, both functioning separate from each other, is used as the moving detector source (MDS) system in the cross frame, where the detector detects the photon after completing its first part of the flight and communicates this to the source which re-emits another photon for the second flight [6]. The second assumption introduces a considerable delay in the process making the setups of the previous papers less sensitive and bulky. In this paper we assume that a reflection or refraction is enough to collapse the RNL state of the photon and the re-emitted photon has no RNL memory of the previous flight before reflection, then we can make the SILT system very efficient. We present here two candidates, namely the SILT interferometer and lightspeedometer, of which the former requires a definite phase relationship as well and the other is free from it. Thus, the interferometer requires that the RNL relationship is lost at the reflection but the beams do exist in a definite relationship, which is quite of a demand.

## 2. SILT Advantage

Before we proceed to the interferometer and light speedometer let us summarize a few more facts [5]. Let $X_1$ be the distance from a stationary source (SS) to a rotating or moving detector source (MDS) combine and $X_2$ is the distance from MDS to the stationary detector (SD) in the frame of the observer as shown in fig 2. For stability, motion is achieved by rotating a series of MDS systems mounted on a wheel.

The SILT advantages in terms of distance are given in (3) and (4) for individual flights.

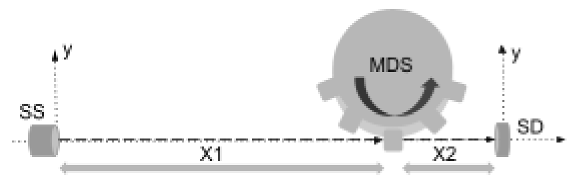


*Fig 2. Rotating MDS SILT Setup.*

The combined net advantage in terms of distance and time respectively, for the case when the wheel is rotating with a linear tangential velocity $v$ minus the case when the wheel is stationary:

$$\Delta X = \frac{-v(X_1 - X_2)}{c} \qquad (7)$$

$$\Delta T = \frac{-v(X_1 - X_2)}{c^2} \qquad (8)$$

where $v$ is positive for counterclockwise, negative for clockwise, and zero for no rotation. Of Course, there was a delay introduced by MDS itself but that cancels out when comparing the rotating and non-rotating MDS cases as it is constant in both cases.

Unless $X_1$ is extraordinarily large, it is difficult to measure or feel the SILT advantage in this basic setup. But if we can turn the device into an interferometer using the same RNL principle of NR, the sensitivity of the device will really be high to detect the slightest of SILT advantage. However, we still need to minimize $X_2$ as much as possible in comparison to $X_1$.

## 3. SILT interferometer

The basic setup of the previous section can be turned to an interferometer provided we design or develop a rotating MDS that collapses the RNL state completely but maintains a definite phase relationship between the input and output beams. This is a difficult proposition. We know that reflected light from a surface maintains the definite phase relationship with the incident beam but it is not known if it also leads to a total collapse of RNL state before it is reflected. How normal reflection and refraction play with the RNL state is unknown as relativistic non-localization is a recently developed concept from Kishori's relativity, that remained hidden behind RoS of the CR. The total collapse of the RNL state is of paramount importance to all SILT experiments based on RNL because if reflected or refracted light maintains the wave continuity then the continued RNL-state will play such that to preserve the overall speed of the light for both the combined flights, making the SILT advantage vanish. We do not know how normal reflection or refraction or transmission affect the RNL state of the incident beam, though we know that incident, reflected, and transmitted beams form a wave or field continuity a the boundary of two media, and therefore good chances are that RNL state is maintained across the flights and there no SILT advantage is observed in a system designed based on reflection or transmission, without clearly separating the functions of detector and source of the MDS.

However, for a while, assume there exists such material or reflector that collapses the RNL state but maintains a definite phase relationship between the two beams, or the normal reflection functions as the desired MDS.

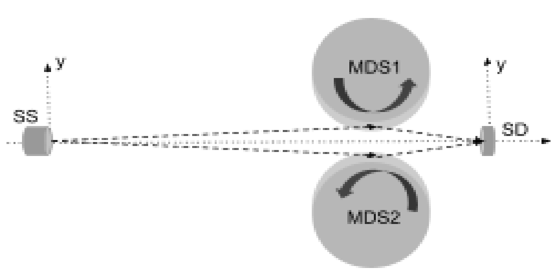


*Fig 3. Kishori's SILT Interferometer*

With this assumption, it is easy to design a SILT interferometer based on NR and the theory developed above. Fig 3 provides the simplest schematics of such an interferometer wherein a coherent laser light from SS is split into two beams one approaching MDS1 from where it is reflected to SD. The other beam travels an equal path and hits MDS2 to be diverted to SD again. When the two MDS are not rotating then the *z-axis* in the plane of SD must observe maxima.

When MDS1 rotates anticlockwise and MDS2 clockwise or vice versa then the two beams due to SILT will suffer a phase or path difference, resulting in a shift of fringe pattern at SD plane along z. For the central fringe to be dark, the path difference must be,

$$\Delta p = \frac{2v(X_1 - X_2)}{c} = \lambda/2 \quad (9)$$

where λ is the wavelength of radiation made to traverse. It is assumed that both the MDS rotate with the same speed but in opposite directions. It remains a task how to split the coherent light beam from a single coherent source SS. Various methods can be employed using beam splitters or fresnel biprism or any other novel method, it is left to the choice of the experimentalist. Also, the flights of the radiation should be ensured through a vacuum as we do not know how transmission through air affects the RNL state.

### 4. SILT Lightspeedometer

Various versions of Fizeau Foucault apparatus are used to measure the absolute lightspeed within reasonable bounds However, in their basic form, they are of little use in our case because a rotating mirror at its very axis of rotation does not conceive considerable linear motion which is a must to imitate the MF system for realizing RNL or RSC. Moreover, we need to sense the variation in speed due to SILT and not the absolute lightspeed. Therefore, the basic setup of the Fizeau-Foucault apparatus needs improvement to incorporate moving frame MDS in the system, fig 4. The setup of fig 4 incorporates a rotating octagonal mirror (ROM) with a radius $r$ that is the perpendicular distance from the center to the midpoint of one face of the mirror. This considerable diameter is to provide a linear tangential velocity $v$ to the two reflecting points of the beam. The light from stationary source SS reflects at a moving mirror that has velocity towards the fixed mirror (FM). However, the face of the reflecting mirror (RM) that receives the beam is moving away from the FM. This reversed relation of the relative velocities in the two branches cancels the SILT advantages.

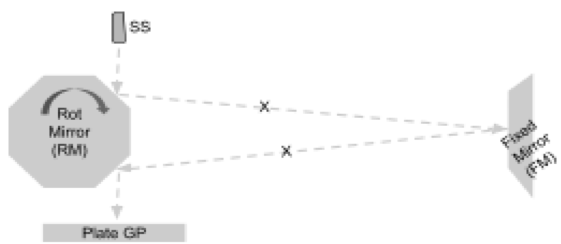


*Fig 4. Modified Facault's setup. A polygonal mirror with a considerable radius replaces a rotating mirror. But this setup is unable to record any SILT advantage.*

Before we improve this setup in fig 4, let us note the angle of reflection of the beam when the RM is rotating with an angular speed of $v/r$, from its normal angle when there is no rotation,

$$\Theta = 4vX/rc \tag{10}$$

where $X$ is the one-way trip of the beam from RM to FM, $v$ is taken positively for clockwise rotation.

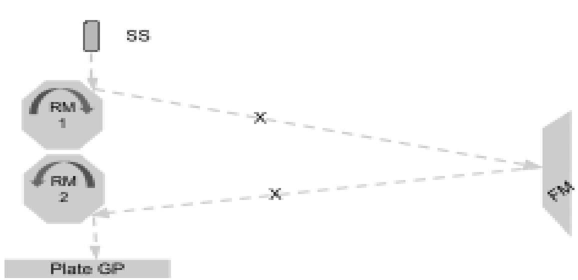


*Fig 5. Schematics of lightspeedometer. The 'X' distance between RM and FM is larger and is not shown up to scale.*

The solution is to add one more rotating octagonal mirror, adjacent to and locked with the first one, both rotating in the opposite direction with each other, see fig 5. That way both points of reflection of RM for both branches of the journey of the beam encounter the same relative velocity relationship with the FM. Thus net path will either shrink or expand owing to ASW. For example, the rotations marked in fig 5 will shrink the optical path. Using (4), due to shrunk or expanded optical path because of ASW or RNL, the angle of the reflected beam will differ from what is given in (10),

$$\theta = -4vX/rc - 2v^2X/rc^2 \tag{11}$$

where $v$ as before is positive for the clockwise motion of the RM1 as is the case shown in fig 5. The sign of $v$ does not depend on the direction of the second rotating mirror which is phase-locked or geared to always move opposite to RM1. The rotation introduces an asymmetry in the angular shift of the reflected beam about the angle when three is no rotation, i.e. positive $v$ as shown in the figure shifts the beam to a different extent compared to the negative $v$ when both wheels reverse their direction of rotation because, for negative $v$, only one term of (11) will change the sign. This asymmetry of shift on either side of the central position can also be used to estimate the SILT advantage.

The whole path of the beam from RM to FM and back is assumed to be in a vacuum as it is also true for all the experiments suggested in [7-9].

**5. Conclusion**

The theory and setups for at least two new devices have been developed in an effort to achieve SILT in a vacuum based on relativistic non localization of NR. Various causes of the failure to observe SILT are detailed. One of them is our failure to achieve complete collapse of the RNL-state on the moving reflectors which means the photon maintains its RNL state throughout the path and hence preserves the lightspeed. The other cause of failure is the applicability of soft NR where ASW is revealed internally only [10]. New transform also gives rise to static transforms of [11] with possibilities to achieve SILT using methods other than based on relative motions of source and detectors.


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