Breaking Lorentz Symmetry
Proposal for an Inertial Force-Based Experiment to Detect Absolute Motion in the Universe

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Date: 28/02/2025

Abstract:

This paper proposes a novel experimental approach to detecting an absolute state of rest in space—an idea historically linked to Lorentz ether theory but largely dismissed following the Michelson-Morley experiment. Unlike previous optical interferometry methods, this experiment focuses on fictitious forces within a rotating system to identify subtle anisotropies in motion that could suggest a preferred reference frame.

The proposed setup consists of a primary platform rotating a mass at constant velocity, with a smaller, free-moving mass constrained to oscillate radially. If an absolute state of rest exists, the smaller mass should experience an unexpected fictitious force correlated with Earth's motion through space. This force would allow for the measurement of Earth's velocity relative to an underlying preferred frame.

Since conventional inertial-based experiments cannot detect absolute motion due to the equivalence of physical laws in all inertial frames, this proposal employs a non-inertial system within an inertial frame to enable such measurements. By leveraging rotational systems to probe relativistic effects, this experiment aims to detect anisotropies in the quantum vacuum.

If successful, the experiment would challenge Lorentz symmetry—which asserts that the laws of physics remain invariant for all observers regardless of velocity or orientation—by providing empirical evidence of absolute motion. More importantly, it would offer experimental validation for the Standard Model Extension (SME) and quantum gravity models, which predicts such anisotropies, thereby advancing research in this direction.

Keywords:

Breaking Lorentz symmetry, special relativity, absolute motion, standard model extension, non-inertial systems, fictitious forces.

1. Introduction:

The principle of Lorentz symmetry, a cornerstone of Einstein's relativity, asserts that the laws of physics are invariant across all inertial frames. However, the possibility of a **preferred reference frame**—such as one tied to the quantum vacuum or the Cosmic Microwave Background (CMB)—remains an open question. While experiments like Michelson-Morley and Kennedy-Thorndike found no evidence for such a frame, they relied on electromagnetic waves (massless bosons), which lack inertia in same way like mass.

This paper proposes a new approach using **fermions** (particles with rest mass and changing inertia as per its velocity) to detect absolute motion. By measuring **fictitious forces** in a rotating system, we aim to identify anisotropies in motion that could reveal a preferred frame. This experiment challenges the universality of Lorentz symmetry and aligns with predictions of the **Standard Model Extension (SME)**, which allows for Lorentz-violating effects.

2. Theoretical Foundation:

2.1. Fictitious Forces in Rotating Systems

In a non-inertial rotating system, a mass experiences fictitious forces such as:

1) **Coriolis Force** (arises in fixed angular velocity): $F_C = -2m(\omega \times v)$
2) **Centrifugal Force**(arises in fixed angular velocity): $F_{cent} = -m\omega(\omega \times r)$
3) **Euler Force** (arises in varying angular velocity): $F_E = -m\alpha r$

These forces can reveal anisotropies in motion if a preferred frame exists.

2.2. Fermions and Inertia

Unlike massless bosons (e.g., photons), fermions possess rest mass and inertia, which increases with velocity. This makes them ideal for detecting subtle anisotropies in motion. The experiment leverages the fact that **the total inertia of a system depends on both its rest mass and kinetic energy**, the latter of which is not Lorentz-invariant.

2.3. Hypothesis

We hypothesize that a small mass free to move (free-to-oscillate mass) within a rotating system will experience a **directional asymmetry** in forces if a preferred rest state exists. This asymmetry would indicate motion relative to the rest state, providing evidence for its existence. But since this asymmetry in the fictitious force we intend to measure is extremely small (in the range of 10^{-12}N). So **the alternative method is to align the rotating plane in the drifting direction then perpendicular to it** (to leverage the velocity of the rotating mass by adding the drifting velocity to it) to detect if any fictitious force due to angular acceleration (Euler force or change in the centrifugal force) will arise at each measurement.

2.4. Why this method of measurement is different from the previous experiments which tried to detect the absolute rest frame?

This method relies on detecting small changes in inertia, whereas all previous experiments attempted to identify a preferred reference frame using electromagnetic waves or electric fields (i.e., virtual photons—the force carriers of the electromagnetic interaction—to measure capacitor variations). All these methods focused on detecting changes in massless photons, their inertia is fundamentally different from the inertia of mass, and most importantly, never changes because their velocity is fixed to c, they are massless bosons whose energy arises solely from their momentum, as described by the full energy-momentum relation:

$$E^2 = m^2.c^4 + (Pc)^2$$

And because m=0, then photon energy is:

$$E = P.c$$

Since **photons are massless bosons and have no rest mass or inertia** (we specifically mean inertia which changes as per velocity), such approaches were unable to detect any changes associated with an absolute reference frame.

In contrast, this method exploits the small additional kinetic energy that a mass (**fermions, which possess inertia and changes as per its velocity**) acquires as its velocity increases. Since this increase in kinetic energy slightly alters the system's inertia owing to relativistic effect, a sufficiently sensitive measuring apparatus should be able to detect these minute changes at non-relativistic velocities.

To achieve this, the proposed experiment employs a mechanical approach to detecting velocity variations, either by directly measuring changes in angular velocity (either using accelerometer or radar detection) or by detecting non-inertial forces via piezoelectric sensor or interferometer. Given that measuring small changes in angular velocity can be challenging, the experiment benefits from the presence of fictitious forces. These forces will vary in magnitude according to the velocity of the system relative to an absolute rest frame.

The total inertia of a system depends on both its mass (which **is Lorentz-invariant**) and kinetic energy (which **is not Lorentz-invariant**). Since **different systems exhibit varying kinetic energies**, and since acceleration is absolute unlike velocity, these fictitious forces can reveal differences in inertia that correlate with motion changes through a preferred frame, thereby allowing for the measurement of absolute velocity.

Simply put, because fermions have rest mass and inertia, their inertia varies with velocity, causing them to interact differently with a preferred frame compared to massless bosons (specifically photons which have fixed velocity unlike varying velocities of fermions). So unlike massless bosons, fermions exhibit a range of kinetic energies that change with velocity, altering their inertia relative to an absolute rest frame. **Thus, using fermions in this experiment reveals effects that photon-based methods could not**.

This experiment represents the first attempt to detect absolute motion using inertial forces rather than light propagation, offering a fundamentally new test of relativity.

3. Conceptual Framework of Analogy:

To understand the phenomenon, we draw an analogy between classical drag and relativistic resistance. While classical drag arises from interactions with a fluid medium, relativistic resistance stems from the increase in an object's inertial mass as its velocity rises. Importantly, the quantum vacuum does not exert drag forces like a fluid; instead, the resistance is a relativistic effect caused by increased energy. The force we aim to detect— F_{DET} arising from the changes in angular velocity of the mass when this velocity is added or subtracted from the earth's drift velocity—is exceedingly small. So we draw an analogy between the resistance experienced by an object moving through a medium (e.g., water or air) and the increased inertia of an object moving at relativistic speeds in a vacuum. This resistance will be referred to as a "drag-equivalent force," although it is **fundamentally distinct from classical drag forces**.

3.1. Key Distinction between Classical Drag and Relativistic Resistance

It is crucial to avoid conflating classical drag with relativistic inertia. While classical drag arises due to interactions with a fluid medium, the "drag-equivalent force" in this context stems from the relativistic increase in mass and inertia as per object velocity. For conceptual purposes, we describe the quantum vacuum as analogous to a medium; however, it is essential to emphasize that the quantum vacuum does not exert drag forces like a fluid. Instead, the resistance arises from relativistic effects, specifically the increase in an object's inertial mass as its velocity increases.

To prevent confusion, we propose naming this phenomenon "relativistic resistance." However, since the analogy with classical drag is central to our framework, we retain the term "drag-equivalent force" for clarity and consistency.

3.2. Mechanism of Drag-Equivalent Force (Relativistic Resistance)

As an object's velocity increases, its relativistic mass grows according to the Lorentz factor:

$$\gamma = \sqrt{\frac{1}{1 - \frac{v^2}{c^2}}}$$

$$m' = \gamma * m$$

This increase in mass corresponds to increased inertia owing to increased energy, which manifests as a resistance to further acceleration. We equate this resistance to a "drag-equivalent force," drawing parallels to the increased drag experienced by an object moving through a medium as its velocity rises. However, classical drag results from interactions with a material medium, whereas relativistic resistance arises from Lorentz transformations owing to increased velocity and the relativistic increase in energy.

3.3. Objective of the Experiment

The primary goal of this experiment is to detect the relativistic effects caused by the increased energy of a system as it moves relative to an absolute rest frame. If all motion were purely relativistic, there would be no proportional increase in energy relative to a fixed measurement point, and objects would not exhibit differing inertias proportional to their velocities relative to that point. By detecting variations in inertia, we aim to provide evidence for the existence of a preferred rest frame.

3.4. Absolute Rest Frame and Fermionic Motion

If motion is not purely relative for fermions (particles with mass and inertia), it must instead be relative to an **absolute rest frame**. In such a scenario:

- A fermion at rest possesses only its **rest mass energy**, which is **Lorentz invariant** and remains constant across all inertial frames.

- When the fermion experiences a force or undergoes momentum exchange, it acquires additional energy, manifesting as **kinetic energy**. This energy corresponds to the velocity gained by the particle.
- According to Hasenöhrl's thought experiment (later refined by Einstein), **energy has inertia**. Thus, **the acquired kinetic energy increases the particle's inertia proportionally to its velocity, and we draw the drag-equivalent analogy from this concept.**
  This increase in inertia—comprising the fermion's **rest mass inertia** (Lorentz invariant) and **kinetic energy-induced inertia** (not Lorentz invariant)—creates an effect analogous to drag in classical mechanics. We term this phenomenon **drag-equivalent force**.

3.5. Instantaneous Power formula and Non-Linearity:

The power required to maintain a constant force increases nonlinearly with velocity due to the relationship:

$$P = F.v$$

Where: P is power, F is force, and v is velocity.
At higher velocities, the object covers more distance in the same time, performing more work and thus demanding greater energy input.
In classical mechanics, drag force acts to slow down an object moving through a medium. As the object's velocity increases, more energy is required to overcome the drag and accelerate the object further. This additional energy demand arises because the drag force grows with velocity, requiring the engine (or driving force) to provide not only the power needed to achieve higher speeds but also to counteract the increasing resistance caused by drag. So extra energy will be required due to the increased Non-linearity in force

$$P = (F + F_{drag}).v$$

Similarly, although this is analogy, but it has similar effect, in quantum vacuum, the increased inertia will impose **drag-equivalent force** and increase the demand for energy over time. The faster the mass travels in vacuum, the more energy it will demand due to increased drag-equivalent force in the instantaneous power formula:

$$P = (F + F_{DE}).v$$

Where: F_{DE} is drag-equivalent force due to increased inertia owing to increased velocity. And its function is the function of relativistic mass increase (equating mass with force via weight):

$$F_{DE} = m - m_0 = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} * 9.81 - (m_0 * 9.81)$$

And the instantaneous power formula in vacuum quantum becomes:

$$P = (F + \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} * 9.81 - (m_0 * 9.81)).v$$

Expanding the formula by concluding force via momentum:

$$P = (\frac{m_0.\Delta v}{\Delta t} + \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} * 9.81 - (m_0 * 9.81)).v$$

3.6. Drag-Equivalent Force in the Quantum Vacuum

The drag-equivalent force in the quantum vacuum doubles when the mass is doubled, as derived using the relationship between mass and force (weight, $w = m \cdot g$). For a 1 kg mass, the drag-equivalent force is approximately:

$$F \approx \frac{1000}{102} \approx 9.8N$$

To double this drag-equivalent force starting motion from rest frame, the total confined energy of the system must also double. This requires an energy input equal to the rest mass energy of the object.
For a 1 kg mass at rest in the absolute rest frame, the rest mass energy is:

$$E = m.c^2 = 9 * 10^{16} Joule$$

Thus, to double the resisting drag-equivalent force experienced by the mass during motion from absolute rest, an additional $9 * 10^{16} Joule$ of energy is required. This energy manifests as an increase in the total confined energy due to both rest mass and kinetic energy. Importantly, this energy is detectable in the experiment because it is not Lorentz invariant and will manifest as measurable fictitious forces or changes in angular velocity.

The velocity at which this doubling occurs can be calculated using the relativistic mass formula:

$$m' = \gamma * m$$

When the mass effectively doubles (γ=2), the corresponding velocity is:

$$2 = \sqrt{\frac{1}{1-\frac{v^2}{c^2}}} \rightarrow 2 = \sqrt{\frac{1}{1-\frac{v^2}{9*10^{16}}}} \rightarrow \text{v≈0.866 c (or 259,616,413 m/s).}$$

To increase the drag equivalent force from zero Newton at absolute rest to 9.8N, we need to increase the velocity to 260,000 km/s approximately, and to reach that velocity we should exert energy of $9 * 10^{16} Joule$. So in earth drifting velocity of a few hundred km/s, the drag equivalent force F_{DE} -owing to the low velocity- will be in the range of a few microNewtons only.

3.7. Energy and Directionality

3.7.1 Translational Moving Mass

When a mass is moving purely in the x-direction, its kinetic energy can be expressed as:

$$E_{Kinetic\_x} = \frac{1}{2} m. v^2{}_x$$

Since the motion is entirely along the x-axis, there is no velocity component in the y-direction ($V_y = 0$). Therefore, the kinetic energy associated with the y-direction is zero:

$$E_{Kinetic\_y} = \frac{1}{2} m. v^2{}_y$$

Thus, the total kinetic energy of the system is solely due to motion in the x-direction.

3.7.2 Rotational Mass

When a mass is rotating in a circular path, its motion is no longer confined to a single axis. Instead, the velocity vector has both x- and y-components that change continuously as the mass moves around the circle. The total velocity at any point can be decomposed into these components:

$$v_x = v. cos\theta \; and \; v_y = v. cos\theta$$

Where θ is the angle the velocity vector makes with the positive x-axis, and the kinetic energy at any point in the circular path is given by:

$$E_{Kinetic} = \frac{1}{2} m. v^2$$

At rest sate, this total kinetic energy remains constant throughout the motion because the speed v does not change in uniform circular motion. However, the energy contributions from the x- and y-directions vary as the mass rotates.

3.7.3 Energy Components in x and y Directions in Rotational System

The kinetic energy contributions from the x- and y-directions are:

$$E_{Kinetic\_x} = \frac{1}{2}m.v^2{}_x = m.(v\cos(\theta))^2$$

$$E_{Kinetic\_y} = \frac{1}{2}m.v^2{}_y = m.(v\cos(\theta))^2$$

Adding these together gives the total kinetic energy:

$$E_{Kinetic\_x} + E_{Kinetic\_y} = \frac{1}{2}m.v^2{}_x + \frac{1}{2}m.v^2{}_y = \frac{1}{2}m.(v^2{}_x + v^2{}_y)$$

Using the Pythagorean identity ($cos^2(\theta) + sin^2(\theta) = 1$):

$$v^2{}_x + v^2{}_y = 1$$

$$E_{Kinetic\_x} + E_{Kinetic\_y} = \frac{1}{2}m.v^2$$

This confirms that the total kinetic energy in rotational system is conserved and equal to the initial kinetic energy of the system and the energy is symmetric in every point on the circular path.

3.7.4 Energy Components in x and y Directions in Rotational System Drifting Linearly

Now if the entire rotating system is drifting linearly with a constant velocity in vacuum quantum, and due to the imposed drag-equivalent force, the energy distribution becomes asymmetric

The total velocity of any point in the system is now the vector sum of:

1. The drift velocity v_{drift}
2. The instantaneous rotational velocity v_{rot} due to the circular motion.

Thus, the total velocity at any point is:

$$v_{total} = v_{drift} + v_{rot}$$

In this scenario, the kinetic energy of the system is determined by the total velocity v_{total}

$$E_{kinetic} = \frac{1}{2} m. v^2{}_{total}$$

$$v^2{}_{total} = (\, v_{drift} + v_{rot}). (\, v_{drift} + v_{rot})$$

$$E_{kinetic} = \frac{1}{2} m. v^2{}_{drift} + \frac{1}{2} m. v^2{}_{rot} + 2m(v_{drift} + v_{rot})$$

The total kinetic energy has three components:

Drift energy: $E_{drift} = \frac{1}{2} m. v^2{}_{drift}$ this term represents the kinetic energy associated with the linear drift of the system. It is constant because v_{drift} is constant

Rotational energy: $E_{rot} = \frac{1}{2} m. v^2{}_{rot}$ this term represents the kinetic energy associated with the circular motion. It is also constant for uniform circular motion because v_{rot} does not change.

Coupling term: $E_{coupling} = 2m(v_{drift} + v_{rot})$ This term arises from the interaction between the drift velocity and the rotational velocity. It depends on the angle between v_{drift} and v_{rot} which arises as the mass rotates.

Asymmetry in this System

The coupling term $E_{coupling}$ introduces asymmetry into the energy distribution of the system. To see why, consider the following:

1. When v_{rot} aligns with v_{drift} (i.e. they are parallel), the dot product $(v_{rot}. v_{drift})$ is maximized, and the total energy is higher.
2. When v_{rot} opposes with v_{drift} (i.e. they are antiparallel), the dot product $(v_{rot}. v_{drift})$ is minimized, and the total energy is lower.
3. At intermediate angles, the contribution of $E_{coupling}$ varies sinusoidally.

This variation causes the energy distribution to appear asymmetric when observed in a fixed reference frame.

Conservation of Total Energy

Despite the asymmetry in the energy distribution, the total kinetic energy of the system remains conserved. This is because:

1. The drift velocity v_{drift} remains constant
2. The rotational velocity v_{rot} has a constant magnitude for uniform circular motion

3. The coupling term $E_{coupling}$ oscillates symmetrically over one full rotation, ensuring that the total energy does not change.

In other words, while the energy components fluctuate due to the coupling term, their sum remains constant and no violation of energy conservation occur during the symmetry breaking since it will be conserved globally.

To summarize the advantage of drifting rotational system:

- If a rotating system is drifting linearly, the total energy is conserved
- However, the rotational energy appears asymmetric due to the coupling term $E_{coupling} = 2m(v_{drift} + v_{rot})$, which varies as the system rotates.
- The asymmetry arises because the interaction between the drift and rotational velocities depends on their relative directions, but the total energy remains constant. The magnitude of the asymmetry depends on the difference between the values of v_{drift} and v_{rot} when these velocities are parallel and antiparallel, separated by an angle of π radians.

3.8. Benefit of Rotating System in Detecting Rest Frame

Linear acceleration from v1 to v2 requires the same energy as deceleration from v2 back to v1. According to the instantaneous power formula in a vacuum, the area under the velocity-time curve represents the total energy, which remains identical for both acceleration and deceleration. During acceleration, the slope of the curve increases, while during deceleration, it decreases. Consequently, translational motion alone reveals no unique information, as the energy at any given velocity is the same regardless of whether the system is accelerating or decelerating.
In contrast, a rotating system exhibits fundamentally different behavior due to the varying coupling term $E_{coupling}$, which depends on the interaction between rotational and drift velocities. This asymmetry in energy distribution can be exploited to detect the absolute rest frame in our experiment.

4. Experimental Design

4.1. Setup Description

The experimental setup consists of a radially constrained, frictionless small mass mounted on a gyroscope. This mass is free to oscillate back and forth in response to changes in angular velocity due to the Euler force but remains constrained within frictionless boundaries to prevent radial movement outward or inward.

1. **Main Rotating Mass (Rotating Platform):**
   The system features a large, precisely controlled, symmetric rotating mass—such as a disk or ring—spinning about a fixed axis. This platform is accelerated to a constant angular velocity ω with minimal friction. Once the desired angular velocity is reached, the applied torque ceases, and the system continues rotating, gradually slowing down according to a predictable damping pattern.

2. **Oscillating Small Mass (Free-to-Oscillate Mass):**
   A frictionless mass, free to move back and forth in a vacuum, is constrained to radial motion within a dedicated track on the rotating system.

- This mass is restricted by a frictionless confinement mechanism (e.g., magnetic or electrostatic fields) that prevents any outward movement due to centrifugal force while allowing oscillations induced by the Euler force when angular velocity changes.
- During acceleration, the oscillating mass remains coupled to the rotating platform via a magnetic field.
- Once the system reaches its target angular velocity (the rotation is aligned in the drifting direction), the mass is decoupled, and the magnetic field is adjusted to be slightly repulsive, ensuring a completely frictionless interaction with the platform.
- As the velocity being added and subtracted from the drifting velocity, the free-to-oscillate mass moves back and forth due to the Euler force while remaining constrained to a frictionless radial path.

4.2. Accelerate and Stabilize the Rotating Platform

- The large, symmetric rotating mass (platform) is brought to a fixed angular velocity and stabilized.
- Due to its continuous symmetry, the rotating platform itself will not experience the Euler force in the same way as the free-to-oscillate mass. Instead, any effects of the Euler force will manifest as internal compression and contraction within the platform's lattice structure. Because the forces will be acting oppositely from both directions.
- This stability allows the rotating platform to serve as a reliable stationary reference point for measurements.

4.3. Detecting Anisotropies in Angular Velocity

If an absolute reference frame exists, the system's drift relative to this frame should introduce a cyclic variation in acceleration and deceleration.

Consider a scenario where the system drifts in the direction of 12:00 O'clock (using an analog clock analogy, with an arrow pointing from 6:00 to 12:00) while rotating counterclockwise (CCW):

- At **6:00 O'clock**, the free-moving mass experiences no additional influence, maintaining its expected angular velocity.
- At **3:00 O'clock**, it encounters maximum resistive force, leading to deceleration, as it moves opposite to the preferred frame direction.
- At **12:00 O'clock**, its angular velocity remains unaffected.
- At **9:00 O'clock**, it experiences maximum supportive force, leading to acceleration, as it moves in the same direction as the preferred frame.

These small anisotropies in angular velocity at **3:00 O'clock** and **9:00 O'clock** should be distinguished from external noise sources (e.g., thermal fluctuations, mechanical vibrations) by analyzing their repetitive cyclic pattern, which differentiates the signal from background noise.

In other words, the rotating mass will experience varying angular momentum throughout its cycle due to its interaction with the drift direction. It accelerates from the 6:00 position to the 9:00 position, gaining additional angular momentum as the rotational velocity aligns parallel to the drift direction. From 9:00 to 12:00, it decelerates as the rotational velocity begins to oppose the drift. This deceleration continues from the 12:00 position to the 3:00 position, where the rotational velocity is entirely antiparallel to the drift. Finally, the mass accelerates again from the 3:00 position back to the 6:00 position as the velocities realign. While the total energy and angular momentum are conserved over the full cycle, their behavior and values differ significantly in each quarter of the rotation.

If no unexpected force is detected, this would support the standard interpretation of relativity -that uniform motion is purely relative-. However, detecting even a tiny force could revolutionize physics by providing direct evidence of an absolute frame of reference, aligning with Lorentzian interpretations or suggesting new physics beyond current models

However, due to the extremely small magnitude of the expected force F_{DET}, practical detection remains highly challenging, and the concept may remain largely theoretical.

4.4. Example: Measuring Free-to-Oscillate Mass

Consider a free-to-oscillate mass of 1 kg moving with a tangential velocity of 100 m/s. Its kinetic energy is:

$$E = \frac{1}{2} * 1 * 100^2 = 5{,}000\, Joule$$

The drag-equivalent force acting on the mass during acceleration from its rest state in the absolute frame can be calculated as:

$$\frac{9^{16}}{5 * 10^{3}} = \frac{9.8}{F_{DET}}$$

Or:

$$F_{DET} = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} * 9.81 - (m_0 * 9.81)$$

$$F_{DET} = \frac{1}{\sqrt{1 - \frac{100^2}{3 * 10^{8^2}}}} * 9.81 - (1 * 9.81)$$

Where F_{DET} is the drag-equivalent force due to tangential velocity of the rotating mass when the rotating system is aligned in the direction of drifting (not due the drifting velocity of the earth F_{DE}). Solving for F_{DET}:

$$F_{DET} = 5.44 * 10^{-13} N$$

Which is extremely tiny immeasurable force and that's why this method can't detect the anisotropy

4.5. Conservation of Angular momentum

If all motions are relative as per SRT, then the angular momentum will be conserved locally and globally, but in the presence of a preferred frame, the forces acting on the rotating system do not integrate to zero over arbitrary time intervals. Consequently, angular momentum conservation is temporarily violated during specific phases of the motion. However, these violations are localized and cancel out over a full cycle:

- The system loses angular momentum in one direction but regains it in the opposite direction.
- Energy is conserved over the full cycle, ensuring global conservation of angular momentum.

This behavior is consistent with Noether's theorem, which states that conservation laws arise from symmetries. But the Lagrangian should be modified such that it only retains global rotational symmetry but not local invariance, then the usual derivation of a locally conserved Noether current is altered. Because local violations occur during individual phases of rotation, symmetry is preserved over the full cycle, maintaining the validity of conservation laws. This framework allows for small anisotropies without contradicting fundamental physical principles, opening the door for potential expansions of the Standard Model and many quantum gravity models.

4.6. Alternative Method to Detect Larger Drag-Equivalent Force

To detect a significantly larger drag-equivalent force and larger than F_{DET}, we propose an alternative approach that avoids measuring the tiny fluctuating force F_{DET}experienced by the rotating mass during each half-cycle. Instead, we focus on detecting changes in angular velocity and fictitious forces (e.g., Euler forces or changes in centrifugal force) when the plane of the entire rotating system is aligned with or perpendicular to the Earth's drifting direction. This method will add the drifting velocity (which is very large comparatively) to the tangential velocity (which is very small) when the plane of rotation aligned in the direction of drifting motion, then completely cancel it when the plane of rotation is perpendicular to the drifting vector.

4.7. Alignment with Drifting Direction

- When the free-to-oscillate mass rotates in a plane perpendicular to the Earth's drift direction, it will not experience any change in angular velocity (ω). This is because no resistive force acts to alter its motion.
- However, when the plane of rotation aligns with the drift direction, the drag-equivalent force due to the Earth's drift velocity F_{DE} becomes significant. This force adds energy to the rotating mass, increasing its angular velocity and energy.
  The Earth's drift velocity is much higher than any tangential velocity of the rotating mass we can achieve in lab, so the energy increment caused by F_{DE} is substantial compared to the small drag-equivalent force F_{DET}associated with the system's tangential velocity.
  Conversely, when the plane of rotation is perpendicular to the drift direction, F_{DE} acts equally on all positions of the rotating mass, resulting in no net fictitious forces.

4.8. Scanning the Full Sphere

To measure F_{DE} effectively:

1. Rotate the plane of rotation in 360° to scan the full sphere.
2. The magnitude of fictitious forces will be most pronounced when the plane of rotation aligns with the drift direction and minimal when perpendicular to it.
   This scanning process amplifies the measurable signal, making it easier to detect F_{DE}.
   - If this measurement is being run in space, we can easily rotate the plane of rotation and immediately measure the effect (we should factor in the gyroscopic effect).
   - If this measurement is running on earth, it should be in location near the equator, and first measurement will happen when the plane of rotation is aligned with the drifting

direction and that will be at mid-day or mid-night, and the second measurement should be after six hours from the first measurement, when the plan of rotation at the location of the experiment is perpendicular to the drifting direction.

4.9. Example: Measuring Drag-Equivalent Force F_{DE} in a Drifting Rotational System

Suppose the Earth is drifting at 400 km/s (relative to the Cosmic Microwave Background, CMB) during the measurement time and day of the year. When the plane of rotation is aligned with the drifting direction. In this scenario:

- At peak alignment with the drift vector (e.g., at 9:00 O'clock on an analog clock), the tangential velocity of the rotating mass adds to the Earth's drift velocity.
- The total velocity at this position becomes v_{total}=400,100m/s, where 400,000m/s is the drift velocity and 100m/s is the tangential velocity of the rotating mass. Hence this force F_{DE} is many times larger in magnitudes than F_{DET} owing to this big difference in velocities.
- The corresponding kinetic energy of the 1 kg mass when aligned in the direction of drifting is:

$$E = \frac{1}{2} * 1 * 400100^2 = 80{,}040{,}005{,}000\, Joules$$

At the 9:00 O'clock position, the energy peaks due to alignment with the drift vector, producing a higher Euler force due to the change in angular velocity. This force arises primarily from the influence of the drift velocity, not the mass's tangential velocity (which imposes a negligible contribution). The drag-equivalent force F_{DE} at this position is:

$$\frac{9^{16}}{80{,}040{,}005{,}000} = \frac{9.8}{F_{DE}}$$

Or:

$$F_{DE} = \frac{1}{\sqrt{1 - \frac{400100^2}{3 * 10^{8^2}}}} * 9.81 - (1 * 9.81)$$

$$F_{DE} \approx 8.715 * 10^{-6} N$$

When the plane of rotation is perpendicular to the drifting vector, the drifting velocity will not be add to the velocity of the rotational mass there will be no increment in its kinetic energy.

4.10. Measurements Methodologies:

- **Laser Interferometry:** A laser interferometer can detect minute displacements by analyzing interference patterns between beams originating from the rotating platform and the oscillating mass within its constrained track.
- **Piezoelectric Sensors:** An alternative method involves placing piezoelectric sensors to measure force variations experienced by the oscillating mass during acceleration, with data captured via an appropriate acquisition system. The method should employ high speed data acquisition system to register very accurate force profile.
- **Advanced Measurement Techniques:** More precise detection can be achieved using advanced methods such as atomic interferometry or superconducting quantum interference devices (SQUIDs), which offer higher sensitivity than piezoelectric sensors.
- **Accelerometer:** Sensitive accelerometer is used to detect any minuscule changes in the angular velocity
  Since the force being measured is very small, the measurement methods may not be able to quantify it accurately, but if any predicted force were measured in many experiments, it will imply the direction of drifting although these experiments may differ if quantifying it because of the big challenge.

  This setup ensures that any detected oscillations or damping variations can be attributed to external influences, such as motion through an absolute reference frame, rather than internal system dynamics.

5. Comparison to Michelson-Morley and Other Tests

Table 1: Comparison between preferred rest frame detecting experiments

Experiment	Measured Effect	Outcome	Key Difference
Michelson-Morley	Light speed anisotropy	No ether found	Tested light, not inertia
Kennedy-Thorndike	Light speed with varying velocity	No anisotropy	No time-dependent effects

Hafele-Keating	Time dilation in airplanes	Matches relativity	Confirms time dilation but not absolute motion
This Proposal	Inertial force anomalies	**New Test**	Uses fermions instead of massless bosons

6. Expected Outcomes and Implications

6.1. If No Unexpected Force is Detected

- This would support the **standard interpretation of relativity**—that uniform motion is purely relative and there is no preferred frame.
- The experiment would serve as **another null result**, akin to Michelson-Morley.

6.2. If a Tiny Unexpected Force is Detected

- This would indicate an **anisotropic effect**, potentially revealing an **absolute frame of reference**.
- The Earth's motion through space could be **measured directly** for the first time.
- This could support a **Lorentzian interpretation of relativity** (or even new physics beyond current models).

7. Conclusion

This paper proposes a **novel experimental approach to detecting absolute motion**, based on inertial forces rather than light-speed anisotropy. If a preferred frame exists, an unexpected tiny force should appear in any non-inertial system (rotational system in our experiment) with a constrained oscillating mass. If confirmed, this experiment could provide **direct empirical evidence for an absolute state of motion**, challenging the foundation of Einsteinian relativity.

We have to emphasize again that quantum vacuum isn't a medium and imposes no drag force what so ever like classical physics, we are using the drag-equivalent term as analogy only to similar effect in quantum vacuum that has completely different mechanism which is increased inertial due to increased energy.

8. References

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9. Acknowledgment”

9.1. Funding: This research received no external funding.