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# Reference Frames: If Inertial, Then Geocentric

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## ABSTRACT

Applying the laws of dynamics to discern future motion is not an easy thing to do, for there are cases where these laws fail to predict what's really measured. Inertial frames are thought to provide a stable platform of reference frames from which to solve this failure of dynamics, but current fundamental definitions related to dynamics are often incomplete, in conflict or just illogical.

Adopting a credible definition of inertial frames and applying it to frames of reference in constant relative motion leads to a surprising discovery, challenging the scientific wisdom of the last five centuries and raising far-ranging and deep questions that spill over into modern worldviews and religion.

As usual the epistemology is based on the scientific method's dependence on testing and the rationality of philo-realism.

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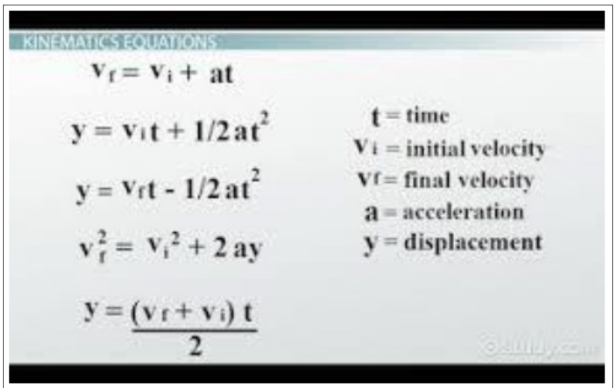
**Back to Basics**

Kinematics: The measurement and interpretation of motion by use of abstract mathematical models to describe point motion via kinetic variables.




Kinematic laws include the acceleration of a path of curvature R and speed v, a = v*v/R, the proper time measurement for a local clock (τ) and a far clock(t), $\tau = t\sqrt{(1-v^2/c^2)}$, and the law of Relativity of Motion, Da,b(t) = -Db,a(t), Va,b(t) = -Vb,a(t), Aa,b(t) = -Ab,a(t), .....ωa,b(t) = - ωb,a(t)….etc.

Kinematics extracts only motion from reality, so its principles above apply to all abstracted motion of real objects when measured.

**Dynamics:** The prediction of motion using the Lagrangian method of functional variation.

Some remarks on the calculus of variation

Hamilton's Principle: $\delta \int_{t_1}^{t_2} L(q_k, \dot{q}_k, t)\,dt = 0$

Evaluated: $\int_{t_1}^{t_2} \left( \frac{\partial L}{\partial q_k} \delta q_k + \frac{\partial L}{\partial \dot{q}_k} \delta \dot{q}_k \right) dt = 0$

Where $\delta q_k$ and $\delta \dot{q}_k$ are not independent!

$$\delta \dot{q}_k = \delta \left( \frac{dq_k}{dt} \right) = \frac{d}{dt} \delta q_k$$

The above integral becomes after integration by parts:

$$\int_{t_1}^{t_2} \left( \frac{\partial L}{\partial q_k} - \frac{d}{dt} \frac{\partial L}{\partial \dot{q}_k} \right) \delta q_k\,dt = 0$$

Which gives rise to Euler-Lagrange equations:

$$\frac{\partial L}{\partial q_k} - \frac{d}{dt} \frac{\partial L}{\partial \dot{q}_k} = 0$$

Note that Lagrange was more mathematician than physicist. His assumption was that generalized coordinates were valid for any observer's state of motion, an assumption whose validity seems to have escaped testing by all physicists since the mid-18th century. This notion of frame independence was documented in Einstein's Principle of General Covariance, an axiom of General Relativity

Role of the Lagrangian: Variation of the Lagrangian action integral determines critical points where the Euler-Lagrange equations are valid. These equations determine past and future object motion, if dynamic parameters like mass m and force F are known. The action integral uses generalized coordinates (Lagrange was more mathematician than physicist); like kinematics, measurements by any observer are assumed valid.

Here is the way the two concepts support the scientific method.

- Kinematic data analysis of a system establishes a reason for forming a hypothesis
- theoretical predictions are made via the dynamic Euler-Lagrange equations
- new kinematic test data then either supports or refutes the dynamic theory

Realization that only certain observers or reference frames could validly predict motion was probably first documented by Newton in the 1687 Principia, where the prediction of the spinning bucket observer failed to predict reality…the radial force on the water. But the laws of physics at that time were only Newton's three laws of motion. The later development of the calculus of variations by Euler and Lagrange in 1755 gave an algorithmic prescription that determines the laws of motion by the variation of an energy function integral.

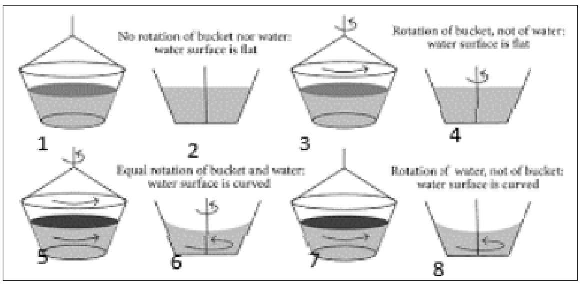
The role of the reference frame choice has not been the focus of formal mechanical study. When the basic definitions are not precise or a distinction between kinematics and dynamics is ignored…or suppressed… then the meaning of inertial frame to physicists is as confused as was the building of Babel.

**Survey of Current Thinking**

The law of general covariance states: Physics laws of motion apply always and everywhere.
Reality check via experiments: Physics laws of motion only apply sometimes and somewhere! Where? When? How Many? And Why?

Lab tests of the Lagrangian equations of motion successfully predicted observed motion initially…science at its best. But tests arose that failed to point to the observed result. Probably the first record of this failure was Newton's bucket anomaly, described in the 1687 Principia.

**Newton's Bucket**




*The flat surface when at rest [2 above] forms a vortex when spinning in the lab frame [6]. The centrifugal force law of dynamics, $F = mv^2/r$, correctly predicts the observed shape of the water surface for Newton's lab frame, using the measured values of m, v and r from the lab's perspective.*

*Newton considered that a different observer, fixed to the bucket, would predict a flat surface, with the same parameters of m and r, since the water isn't spinning for the bucket observer [7].*

*But the vortex still persists, even though the water isn't rotating-as seen in the bucket frame [8].*

**The NB Details**

Now… The bucket is rotating with rim velocity v to Newton, so the bucketeer sees Newton and the lab counter-rotating at -v, by application of the kinematic law of relative motion above. If Newton sees the bucket rotate CW, the bucketeer sees the whole lab rotate CCW.

If the water is rotating with the bucket at v as Newton measures it, the hypothetical bucket observer, co-rotating with the bucket, would measure v = 0 for the water…and predict F = 0 since v = 0…. and that the water surface would thus be flat. But the water surface is a whirlpool, as measured in both lab and bucket frames of reference. Using the laws of dynamics (in this case, , $F = mv^2/r$) the bucketeer cannot explain why the water rises when it is at rest in the bucket frame.

This particular centrifugal law of motion, derived from the Lagrangian, is valid for some observers…and not for others. And it's not an isolated case. Just from common experience examples can be cited indicating the puzzle…some conditions supported the laws of physical motion; other circumstances did not. Perhaps the difference was due to rotational motion…. because the lab and bucket are in relative circular motion. Consider, then, a linear example.

**Bennett's Hiker**

Take the case of a driver heading north accelerating past a hitchhiker. If the hiker measures the car's acceleration *a* and the driver's mass *Md*, the second law predicts the inertial force on the driver is Fd where

*Fd = Md*a*

And this is what is measured; it's the familiar inertial force felt by everyone in an accelerating car.

*Fd = Md*a* is both predicted and measured

The driver and hiker are in relative accelerated motion, so the driver determines the force on the hiker in the same way, but now the driver measures his data, using the car as reference frame. The mass of the hiker is *mh* and the acceleration of the hiker is *-a* or *a south*, using the kinematic law of relative motion. The predicted force on the hiker by the driver is

*Fh = -mh*a* predicted

but… there's no inertial force on the hiker, as we all know from experience. A passing accelerating car may produce a breeze on the hiker, but no inertial force *Fh*

*Fh* = 0 measured

The acceleration of the passing car has no inertial effect on the hiker, but only on the driver. Not only the 2nd Law is violated, but also the 3rd law of action and reaction.

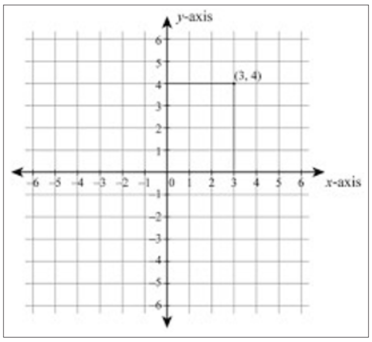
*Fh,d <> -Fd,h*

The attempt to discover why some observers could use the laws of physical motion – Newton and the hiker - and some could not – the bucketeer and the driver - led to the concept of …. inertial frames.

Unfortunately, there are several definitions of inertial frames of reference, which must be sorted out; the conflict among definitions reflects the confusion related to what problem is being solved – why type of observer can predict future motion and another can't. But first we must agree on fundamentals - what reference frames and coordinate systems are. [ all Wiki quotes will be be indented, in italics]

**Coordinate System and Reference Frame Defined**

**Coordinate System**
from Wikipedia - all Wiki quotes will be indented, in italics

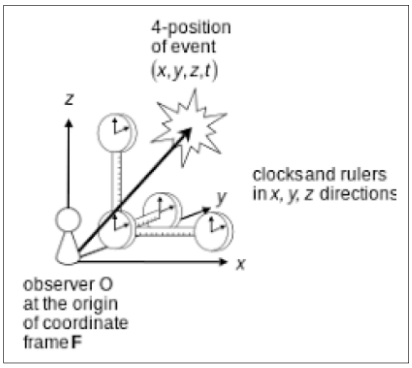



*In geometry, a coordinate system is a system that uses one or more numbers, or coordinates, to uniquely determine the position of the points or other geometric elements on a manifold such as Euclidean space. .... The use of a coordinate system allows problems in geometry to be translated into problems about numbers and vice versa; this is the basis of analytic geometry.*
*... coordinate systems …… are related….by coordinate transformations which give formulas for the coordinates in one system in terms of the coordinates in another system.*

*A coordinate system is a mathematical concept amounting to a choice of language used to describe observations. Too general ... Although the term "coordinate system" is often used (particularly by physicists) in a nontechnical sense, the term "coordinate system" does have a precise meaning in mathematics…*
*...a coordinate system is a mathematical construct, part of an axiomatic system. There is no necessary connection between coordinate systems and physical motion (or any other aspect of reality).*

Being an abstraction of reality, Coordinate System is a measurement tool used in kinematics for measurement.

**Working Definition: Coordinate System is a 3D mathematical framework which locates objects in space. In kinematics the modelling space is abstract; in dynamics the space is real. Sample systems are Cartesian, polar, elliptical**….
**Reference Frame**




A frame of reference (or reference frame) consists of an abstract coordinate system and the set of physical reference points that uniquely fix (locate and orient) the coordinate system and standardize measurements.

from J. D. Norton: John D. Norton (1993). *General covariance and the foundations of general relativity: eight decades of dispute, Rep. Prog. Phys., 56, pp. 835-7.*
*a frame is an observer plus a coordinate lattice*
*…there exists a "universal" time and all other times in all other frames of reference will run at the same rate as this universal time irrespective of their position and velocity.*

*This applies to Newtonian and Galilean frames.*
*..reference frames are used to specify the relationship between a moving observer and the phenomenon or phenomena under observation.*
*An observational frame of reference, often referred to as a physical frame of reference, a frame of reference, or simply a frame, is a physical concept related to an observer and the observer's state of motion. an observational frame of reference is characterized only by its state of motion.*
*Sometimes the state of motion is emphasized, as in rotating frame of reference.*

**Rotating relative to what?**
All these describe how Reference Frames may be used, but not defining what a Reference Frame is.

**Operational Definition: A Reference Frame collects motion data using a coordinate system with an observer and clock at the origin.**

**In kinematics data collection is used for forming hypotheses; in dynamics it's used for testing hypotheses.**

The observer may be a human or a remote detector. The clock at rest with the observer keeps proper time. The observer is at rest in his own frame of reference.

So, **three components for a reference frame: Coordinate System Observer Clock**

**Coordinate System vs Reference Frame**
*In traditional developments of special and general relativity it has been customary not to distinguish between two quite distinct ideas. The first is the notion of a coordinate system, understood simply as the smooth, invertible assignment of four numbers to events in spacetime neighbourhoods. The second, the frame of reference, refers to an idealized system used to assign such numbers […] …… More recently, to negotiate the obvious ambiguities of Einstein's treatment, the notion of frame of reference has reappeared as a structure distinct from a coordinate system.*

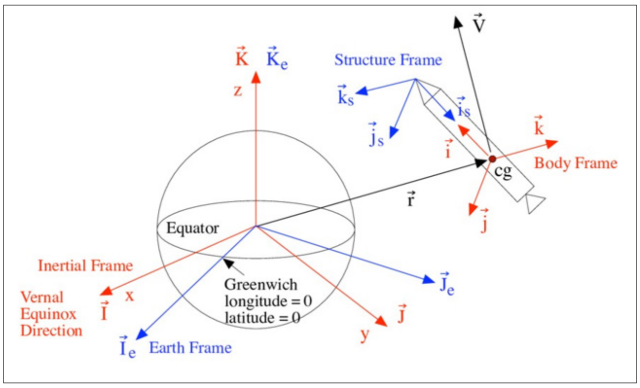
*…... a distinction between mathematical sets of coordinates and physical frames of reference must be made. The ignorance of such distinction is the source of much confusion… the dependent functions such as velocity for example, are measured with respect to a physical reference frame, but one is free to choose any mathematical coordinate system in which the equations are specified.*

*Consequently, an observer…. can choose to employ any coordinate system (Cartesian, polar, curvilinear, generalized, ...) to describe observations made from that frame of reference.*

*The idea of a reference frame is really quite different from that of a coordinate system. .....the ideas of a space, a time, of rest and simultaneity, go inextricably together with that of frame.*

A prime example of Coordinate System and Reference Frame confusion is the Einstein 1905 paper. The document was split appropriately into two sections: Kinematics and Dynamics. Coordinate System was used 18 times but Reference Frame only once. But the difference between Coordinate System and Reference Frame was never defined.

**Inertial Frames - A Stable Platform for Applying the Laws of Mechanics**




The Earth frame as a reference frame for all motion

It pervades the modern understanding of motion…. yet the inertial frame has yet to be well-defined and brought to its logical scientific conclusion. The absence of an inertial frame includes the notion of 'fictitious forces' - a concept of 'fake' physics that grated against my sensibilities when I first heard it in a classroom being seriously proposed as a physical reality!

Using the usual discovery tools of the scientific method and scientific realism, the full implication of the inertial frame will be unwrapped with supporting experiments and the modern errors attendant to the false logic in interpretation will be revealed via reference to supporting documents.

The principal beliefs of modern physicists are scattered throughout textbooks and physics journals, making it difficult to assert what the consensus of mainstream principles are. Short of researching all sources for a majority opinion, we can shortcut the process by using Wikipedia as a reference, since all entries submitted are subject to review by a panel of mainstream gatekeepers.

**Current Beliefs**

**Kinematics**

*All inertial frames are in a state of constant rectilinear motion with respect to each other; an accelerometer moving with any of them would detect zero acceleration.*

*A reference frame in which a mass point thrown from the same point in three different (non-co-planar) directions follows rectilinear paths each time it is thrown, is called an inertial frame.*

*An inertial frame is defined simply as constant motion in a straight line*

All above are as measured, not as predicted by dynamics. They are equivalent to the law of relative motion in kinematics; there's no testing against physical laws of motion.

These kinematic versions of inertial frames are irrelevant to the key dynamic issue – what frames correctly predict the laws of motion in dynamics?

**Dynamics**

Dynamics is the prediction of future motion based on the Euler-Lagrange equations of motion. Dynamic variables include the kinematic variables plus forces, masses, charge and moments of inertia.

*…. the equivalence of inertial reference frames means that scientists within a box moving uniformly cannot determine their absolute velocity by any experiment. Otherwise, the differences would set up an absolute standard reference frame.*

'By any experiment' means 'by applying any law of motion'. "Determine absolute velocity' means to obey the laws of physics only for a particular reference frame or state of motion.

Note the warning that detection of an absolute velocity implies the existence of a universal and absolute reference frame. Hold onto that thought for a while….

*In an inertial frame, Newton's first law, the law of inertia, is satisfied: Any free motion has a constant magnitude and direction.*

*An inertial frame of reference in classical physics and special relativity possesses the property that in this frame of reference a body with zero net force acting upon it does not accelerate; that is, such a body is at rest or moving at a constant speed in a straight line.*

*An inertial frame of reference is one in which the motion of a particle not subject to forces is in a straight line at constant speed.*

In all three paragraphs above: why the restriction to just Newton's first law? It's been validated experimentally that Newton's bucket observer can't apply the centrifugal force law validly, nor can a car driver use the second law to correctly predict his inertial forces.

These overlapping axioms all require the absence of forces - a dynamic condition- but lack universality because they apply only to Newton's first law. Maxwell's laws of Electromagnetism are ignored, but will be included in the final definition of Inertial Reference Frame.

*The laws of motion for mechanics have the same form in all inertial frames.*

'*Equations having the same form in all inertial frames*' is called inertial covariance, not the definition of inertial frame. Having the same form in differing frames does not guarantee the equations will predict the correct test result. So, the following definition of inertial frame is proposed:

**Inertial Reference Frame**

The laws of motion for mechanics and electromagnetism predict the correct test results of motion in all inertial frames.

This defines the central issue: What type of observer can correctly predict future motion using the dynamical laws of physics?

**Non-Inertial Reference Frames**
In a non-inertial reference frame in classical physics and special relativity, the physics of a system vary depending on the acceleration of that frame with respect to an inertial frame, and the usual physical forces must be supplemented by fictitious forces.

*The laws of Newtonian mechanics do not always hold in their simplest form...If, for instance, an observer is placed on a disc rotating relative to the earth, he/she will sense a 'force' pushing him/her toward the periphery of the disc, which is not caused by any interaction with other bodies. Here, the acceleration is not the consequence of the usual force, but of the so-called inertial force. Newton's laws hold in their simplest form only in a family of reference frames, called inertial frames. This fact represents the essence of the Galilean principle of relativity….*

"Simplest form' refers to the three laws of motion stated in the 1687 Principia. When a Reference Frame is not inertial, then additional forces must be added to Newton's laws to make their predictions of motion valid. So, there are two laws of mechanics, a simple one for inertial frames and a complex one for non-inertial frames.

*In a non-inertial reference frame in classical physics and special relativity, the laws of motion vary depending on the acceleration of that frame with respect to an inertial frame.*

The validity of the laws of motion can vary, as can be seen in the bucket and hiker examples.
But there are many inertial frames, so which one should be used to calculate the acceleration?

*Fictitious forces, those that arise due to the acceleration of a frame, disappear in inertial frames, and have complicated rules of transformation in general cases.*

Non-inertial reference frames must add fake forces to make them agree with motion predictions in inertial frames.

*All observers agree on the real forces, F; only non-inertial observers need fictitious forces.*
*…laws of physics in the inertial frame are simpler because unnecessary forces are not present.*

But why do non-inertial frames have unnecessary fake forces? Why aren't all frames inertial?
*Newton demonstrated how these forces could be discovered, thereby revealing to an observer that they were not in an inertial frame: the example of the curvature of the surface of water in a rotating bucket.*

*…. the identification of an inertial frame is based upon the simplicity of the laws of physics in the frame. In particular, the absence of fictitious forces is their identifying property.*

This describes how we can discover an inertial frame…by testing. But how can we predict what frames are inertial without testing?

**Testing Inertial Frames in Constant Relative Motion**
Inertial frames must obey the laws of motion, which include Newton's laws as differential equations, but also the first integral of the laws, the laws of conservation of energy, linear and angular momentum. The scalar energy equation is simplest to illustrate for a total energy of
$E = K + V$

Take the whole Earth of mass M as the system model and a bike plus rider m moving horizontally on its surface – so there's no change in gravitational potential energy.

**Earth Frame**
An Earth observer measures the bike's speed v and predicts that $E_m = mv^2/2 + 0$.
Testing of the bike's energy validates that this prediction is true. E.g., ride the bike up an incline to height h above the level ground. Then $mgh = mv^2/2$.

**Bike Frame**
The biker measures the ground's speed under the bike as also v [or else uses the law of kinematic relative motion]. In either case, $V_{m,M} = -V_{M,m} = v$.
The bike frame energy $E_m = (M-m)v^2/2$
which is about $10^{20}$ larger than EM and clearly $E_M >>>> Em$.

In summary,
**The Earth frame predicts the correct energy; the bike frame does not.**
**The Earth frame is inertial; the bike frame is non-inertial.**
**Inertial frames cannot have relative acceleration or velocity. This is at odds with established belief, that frames in constant relative motion, like the Earth and bike, are both equivalent inertial frames. They are not; only the Earth frame is inertial.**
**The Earth and lab frames are equivalent, as all the laws of physics have been tested in the lab frame, stationary relative to the ground/earth.**
The physical laws were tested on Earth – in stationary laboratories by Galileo and Newton, Faraday and Ampere et al.

The rules being now settled, let's ask a question that seems to have escaped prior inquiries…

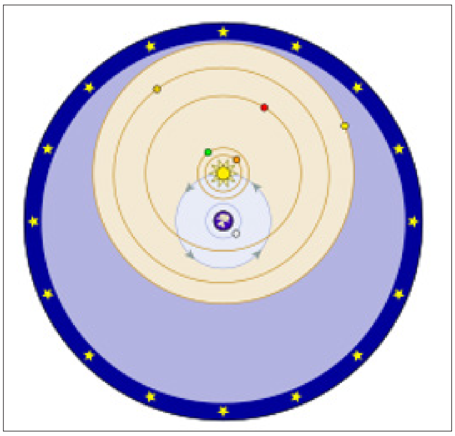
**What is the list of inertial frames?...How many are there?**
The starting point is easy – the Earth/lab frame is inertial.

| Inertial Frame # | Name |
|---|---|
| 1 | Lab/Earth/ECEF |
| 2 | ? |
| 3 | ? |
| …… | ….. |

Any reference frame in motion relative to the lab frame is non-inertial.
That excludes all moving reference frames on the surface: trains, trucks, cars, bikers, joggers….
All cosmic objects are in motion(orbit) in the lab frame (except for one type).
The elimination of inertial frames is fast and exhaustive…

**Only the Earth frame predicts true motion, motion as measured.**
**So, the list is short – one inertial lab frame, making the world of dynamics...geocentric.**

| Inertial Frame # | Name |
|---|---|
| 1 | Lab/Earth/ECEF |



***The geocentric model of Tycho Brahe, replacing the Ptolemaic world system. Earth has two satellites, Sun and Moon; the Sun has 7 planets with moons.***

**Consequences of the Geocentric Inertial frame – GIF**

1. **The result of the GIF model is that relative dynamics must be rejected under the realization that the Earth - for whatever reason – is the absolute reference frame in dynamics.**
2. **Time must be measured in the GIF, so all clocks on Earth record absolute proper time.**

The GALILEAN TRANSFORMATIONS:

Coordinates:

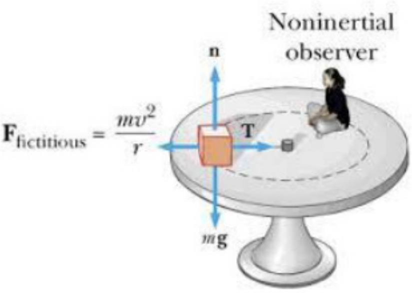
$$x' = x - ut \quad (1)$$
$$y' = y \quad (2)$$
$$z' = z \quad (3)$$
$$t' = t \quad (4)$$

Velocities:

$$v'_{A_x} = v_{A_x} - u \quad (5)$$
$$v'_{A_y} = v_{A_y} \quad (6)$$
$$v'_{A_z} = v_{A_z} \quad (7)$$

The Galilean transform of kinematics now becomes absolute, not relative, in dynamics, with the form

$$x' = x(1-v/c)$$
$$t' = \tau/\sqrt{(1-v^2/c^2)}$$ ıs or Real?




Fictitious forces were always a crude crutch, a form of fake physics, to find correct predictions of motion in non-inertial, non-lab frames.
The fake forces in NIF required that

1. The non-inertial frame be transformed into the lab frame.
2. The event be measured in the lab frame and the laws of physics applied.
3. The result be transformed back into the NIF In the inertial lab frame only step 2 is needed.

The situation can be clarified by this parable:

Suppose that 1+2 = 3 in the lab frame but 1+2 = 0 when in a non-lab frame, moving relative to the lab.

Would we find out what to add in the non-lab frame by looking at the lab frame and then add 3 to the right side to correct the equation? Or would the math be done in the lab frame from the start? If there are two laws for reference frames, then there really isn't a universal law at all.

There are two major reversals of current thinking in physics here: **The laws of physics are not valid in reference frames in constant relative motion. There is only one inertial frame – the Earth/laboratory frame of reference**.

The above has followed from a careful analysis of fundamental concepts of motion: coordinate systems, reference frames, and inertial frames. With the epistemology of scientific method and philo-realism, the two assertions above have surfaced from experimental analysis. The refutation of either or both must use the same epistemics.

**The History of Physics – Not Free Of Error**

The lack of a common worldview in physics has led to the misinterpretation of test results and the propagation of errors, some of which were not corrected for a considerable time. Wellknown historical mistakes are the caloric and phlogiston theories, alchemy, the presence of canals on Mars, the rejection of quantum mechanics by classicists (Einstein), etc.
Can we be assured that the accepted concept of inertial frames today will not be upset in the future…or now?

**Logical Outline**

A consistent set of definitions is rendered for coordinate systems, reference frames and inertial frames.

The conservation laws, which are laws of physics, are only valid in the lab frame.
So any frame moving relative to the lab frame is a non-inertial frame.
There is only one inertial frame, the geocentric Earth/lab/ECEF reference frame.

**Summary of the Geocentric Inertial Frame model**

Tests of reality rely on collection of event data with the reference frame which is composed of

1. A tool to measure location in space(ruler)
2. A tool to measure elapsed time relative to the stars(clock)
3. An observer to collect and analyze the event data

Optional: A graphic tool to display data on a grid(coordinate system)…. All three are located at the origin of the grid.

Mechanics is divided into Kinematics and Dynamics.
Kinematics: Data is collected to analyze and form hypotheses. A potential law of physics is proposed to predict future motion.
Dynamics: Data is collected to compare with the law being

tested. If found valid a law can predict future motion, without measurement.

Data is collected for both, but for different purposes.
Distinguishing the two knowledge domains is crucial to scientific progress.

Physics consensus beliefs (Wiki et al) now confuse kinematics with dynamics and reference frames with dynamics, as well as introduce inconsistent or irrelevant definitions.

In this report inertial frames are associated with reference frames in which the laws of physical motion validly predict the results of measurements. The laws are those of Mechanics, Electromagnetism and Quantum Mechanics.

The Earth/lab frame is clearly inertial, because the laws above were all derived and tested in that frame.

Frames of reference which do not predict measurement results correctly using the laws of motion are called non-inertial.

**Some examples**
A car accelerating past a hitchhiker produces a inertial force on the driver but not on the hiker. The hiker is in an inertial frame (Earth); the driver is not.

Newton's Bucket - A bucket of water rotating in Newton's lab produces an inertial(centrifugal) force and a visible vortex on the surface. Using one of the laws of physics (his 2nd law) Newton correctly predicts the vortex formation but not so for someone in the bucket frame, co-rotating with the water, where F= 0 is forecast. Newton's lab frame is an inertial frame; the rotating bucket frame is not inertial.

The equations of motion simplify when integrated to produce the Conservation Laws of energy and momentum. So inertial frames obey the Conservation laws; non-inertial do not.

Conservation test example: Comparing the kinetic energy of a bike in the Earth frame to the kinetic energy of the Earth in the bike frame finds only the Earth frame to satisfy reality. The Earth is an inertial frame; the bike moving at constant velocity relative to the Earth is a noninertial frame.

In general: Any frame of reference moving at all relative to the Earth is a non-inertial frame; the laws of motion fail to predict true motion in such frames.

Any frame moving at all over the ground is non-inertial. All objects in the sky are moving and so also non-inertial.

The Earth frame (also, lab or ECEF) is the only inertial frame in which the laws of physics can be truly applied. All predicted motion from any other frame is contrary to testing results, where the scientific method defines reality.

The laws of physics in non-inertial frames need to be changed by adding fake forces to make the predictions agree with test results.

**In detail:**
1. In a non-inertial frame predicted motion is computed.
2. The prediction is tested with actual measurements of motion.
3. Results don't agree with measured motion.
4. So we know that we are in a non-inertial frame…and we can't predict future motion. To predict the motion actually observed we must use the lab frame… So why not start with the lab frame and skip steps 1 through 4??!

Note: laws that change with reference frames are NOT LAWS!!

**Reflections and Concerns**
Refuting the result given here of a geocentric inertial frame cannot employ appeals to current or past beliefs…. What is unobservable is also unprovable. Disproof needs evidence from the epistemology used here, the scientific method's testing for hypothesis confirmation ...and the rationalizing of results of philosophical realism.

What needs further exposition is how scientists of the past few centuries have failed to detect what is the proverbial elephant in the living room of science – that is, the logical conclusion that the failure of laws of motion to all observers except those on at rest on Mother Earth is a consequence of the privileged, absolute and unique status of the terrestrial reference frame.

Assuming the scientific giants of the past…and present… were capable of observing the correlation between prediction (of future motion) and location ( the lab frame), then what prevented this 'discovery' from being disclosed long ago? Why not a prior discovery? The supporting evidence can be found in simple tests whose results are familiar to non-scientists and the math is elementary. Why do textbooks speak of inertial frames as if there were many...but there's only one? Aren't fictitious forces part of a fake physics, contrary to a realistic view of reality?

What the intellect sees as true, the will can overrule as evil…if truth conflicts with ideology.

Belief in geocentrism permeated scientific thought …or what is now termed 'pre-scientific' times – until the Copernican-Galilean revolt. This misdirection in scientific progress – marking the modern era of faith-free science - took hold in academic circles and survives to this very day. The reasons for this fundamental error should be subjected to careful retrospective analysis. The wrong turn five centuries ago has had great influence in many human domains.

"There is a principle which is a bar against all information, which is proof against all argument, and which cannot fail to keep man in everlasting ignorance. That principle is
condemnation BEFORE investigation."
Edmund Spencer

One history of geocentrism has notably attempted to correct 'the Dirty-Little-Secret of
Astrophysics' on both scientific and religious grounds: Galileo Was Wrong, Sungenis & Bennett.

GWW in Libraries
The Galileo case was a key moment in belief systems, for it switched the world's objective view of reality from faith to science – while being false to scientific epistemology. Since then the Copernican model has been the prototype of the succession of science over religion, the sentinel signaling the era of objective truth. No doubt this evidence for geocentrism will evoke responses decrying its atavistic throwback to a time when science was suppressed, a reversion to thought five centuries old.

Yet two famous Alberts have voiced their reluctance to join the moving Earth model:

"This conclusion directly contradicts the explanation...which presupposes that the Earth moves."
Michelson, after his first interferometer experiment could NOT detect the movement of aether against the Earth

"I have come to believe that the motion of the Earth cannot be detected by any optical experiment." Einstein

The Geocentric inertial Frame impacts science in many ways, of course. The distinction of measuring motion in kinematics and prediction of motion in dynamics is now seen as crucial and critical. Philosophically our worldview must include the acknowledgement that the Earth is a special place - unlike all others. Observers in a non-lab reference frame must resort, directly or indirectly, to the Earth observer's perspective for true knowledge of future events. We must ponder why we live in the center of the universe and not… *on an insignificant planet of a humdrum star lost in a galaxy tucked away in some forgotten corner of a universe….. as Carl Sagan would have it.*

When he said….. *It is far better to grasp the universe as it really is than to persist in delusion, however satisfying and reassuring….* he was speaking the truth here, but the delusion was his.
One group's paradigm will not be shifting to accept the geocentric universe. Within the broad range of theological thinking the immobile Earth model has been retained– not on the basis of observation, but on revelation of the truth from the source of truth, Whose words have stood the test of centuries since creation. What better source of truth than Truth itself?

Over 30 verses of Scripture affirm either that the Earth is fixed – it cannot be moved….or the Sun and Moon move/rise/set. Consistently geostatic.

Quantum mechanics is philosophically impacted by geocentrism. The energy in the Schrödinger equation must be earth-centered.

The uniqueness of Earth's laws points to the possible uniqueness of a Designer/Creator, of moral and ethical laws …indeed, to the very existential perennial question humans have asked throughout the ages…
Why are we here? What is our purpose?

Kinematics allows relativity of motion.

Dynamics asserts geo-absolutism, removing relativity, special and general, from rational consideration as a scientific theory.

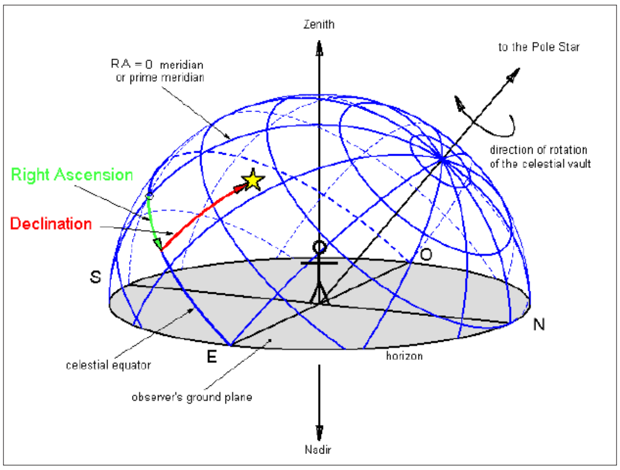
A question was posed above that now can be addressed:
Physics laws of motion only apply sometimes and somewhere! Where? When? And Why?

Response: On Earth - by observers in the lab/ECEF reference frame
It is the 'Why?' that will demand soul-searching across all domains of knowledge …
Why was the geocentric principle discarded centuries ago?
Why hasn't its simple proof been revealed by the physics sages long ago?
What effect will/should the geocentric inertial frame cause in the lifestyle of all residents of the geocentric universe?

Since Geocentrism is true in Dynamics…then what else did we get wrong?

## APPENDIX

**The stellar frame of reference….an inertial frame?**




The concept of inertial frames of reference is no longer tied to either the fixed stars or to absolute space.

In Newton's time the fixed stars were invoked as a reference frame, supposedly at rest relative to absolute space. In reference frames that were either at rest with respect to the fixed stars or in uniform translation relative to these stars, Newton's laws of motion were supposed to hold. In contrast, in frames accelerating with respect to the fixed stars, an important case being frames rotating relative to the fixed stars, the laws of motion did not hold in their simplest form, but had to be supplemented by the addition of fictitious forces…. for example, the Coriolis force and the centrifugal force. An experiment devised by Newton demonstrated how these forces could be discovered, thereby revealing to an observer that they were not in an inertial frame: the curvature of the surface of water in a rotating bucket. Application of Newton's second law would not work for the rotating bucket observer without invoking centrifugal and Coriolis forces to account for the parabolic water surface.

As we now know, the fixed stars are not fixed. Those that reside in the Milky Way turn with the galaxy, exhibiting proper motions. Those that are outside our galaxy (such as nebulae once mistaken to be stars) participate in their own motion as well, partly due to expansion of the universe, and partly due to peculiar velocities. [11] The Andromeda Galaxy is on collision course with the Milky Way at a speed of 117 km/s. [12] So the concept of inertial frames of reference is no longer tied to either the fixed stars or to absolute space.

Rather, the identification of an inertial frame is based upon the simplicity of the laws of physics in the frame. In particular, the absence of fictitious forces is their identifying property.
In practice, although not a requirement, using a frame of reference based upon the fixed stars as though it were an inertial frame of reference introduces very little discrepancy.

For example, the centrifugal acceleration of the Earth, because of its rotation about the Sun, is about thirty million times greater than that of the Sun about the galactic center.

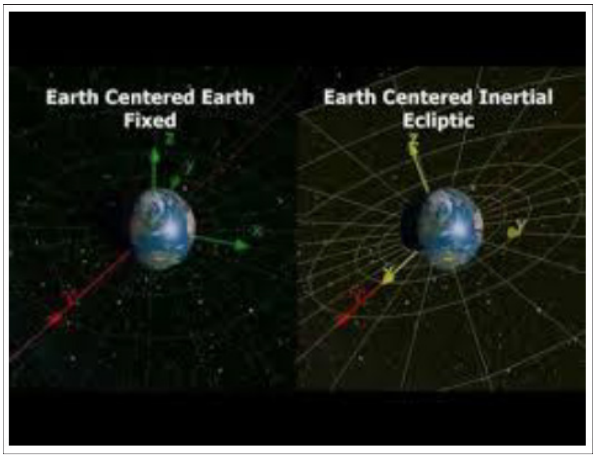
The fundamental problems with an inertial star frame is that the requirement that reference frames have observers centered at their location. Who can tell us where the star frame is situated, so an observer can perform test measurements? Which star should we pick?

Since all have different distances from Earth, the choice of a particular star will affect the observer's data, so each star will have different laws, which indicates the presence of noninertial reference frames. Without a unique testing method, there's no scientific method. And without the scientific method there's no science. A serious shortcoming – for any scientific claim.
Another problem is relativity. When we choose a star A in the sky to replace the Earth frame, then the Earth becomes part of the sky system for observers in A. The sky for star A now contains the Earth, which is moving relative to its own star frame E, but now is at rest in the sky system of A…since it's part of A's sky. This contradiction is related to the lack of uniqueness/identity in defining the stellar frame of reference.

Simplicity of the laws of physics is not the criterion for an inertial frame. After all, the simplest laws would have every variable equal to zero…F=0, v =0, a = 0 , etc. Validity, not simplicity( the Occam Razor's axiom) , is the standard for an inertial frame, as already discussed.

The measured difference between predictions for some laws in the Earth and stellar frames may be undetectable, but logic and other detectable measurements demand that the Earth frame is the only inertial frame, if only for logical consistency.

**GPS use of the stellar frame as ECI**



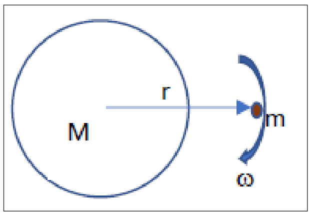

The accepted engineering model for GPS operations is founded on the ECI frame of reference. The Earth Centered Inertial frame co-rotates with the stellar reference pseudo-frame, so it has the same problems as outlined in the text …plus more.

NASA calls the lab frame the Earth Centered Earth Fixed (ECEF) frame. Rotating this frame westward at the same rate as the stars rotate (once every stellar day, 23 hrs, 56 mins) and using it as the reference frame has some serious reality issues.

In the ECI frame the Sun travels about 1 degree each day, not 3650. A location on earth receives 6 months of continuous daylight, and equal number of continuous darkness days… 6 months of heat and 6 months of cold. The moon orbits every 26 days, so there are high tides every 13 days, not every 12 hrs and 50 min. The ECI predicts none of the cosmic cycles observed from Earth, even though it is an Earth-bound frame.

PS: the GPS theory in the lab frame includes aether winds, which explain the Sagnac delay in the communication signal between the GPS satellite and ground receiver. Aetherodynamics and its supporting tests will be covered in a future report on ALFA, the cosmic model of an
Absolute Lab frame and a Fluid Aether.

**Geocentric Frame Evidence**
**Frame comparison for an Earth satellite:**




A satellite m orbits the Earth mass M at distance r from the equator with angular speed

The force of gravity Fg and the centrifugal force Fcf are applied and dynamically analyzed in both the GeoCentric/Lab frame at the center of M and in the Sat frame at the center of m. The scope of the analysis includes artificial satellites for r less than the geostationary radius Rgs, and the natural satellites of Moon and Sun, for r greater than the geostationary radius Rgs.

GIF solution
GC/Lab frame:

$Fm = Fg - Fcf = GmM/r^2 - mr\omega_M^2$

Sat frame:

$F_{□} = Fg - Fcf = GmM/r^2 - Mr\omega_m^2$

In an ideal orbit, r is constant and so the radial F = 0.

When the kinematical Law of Relative Rotational Motion is applied: $\omega_\mu = -\omega_M$ def $= \omega$

GC/Lab frame: $GM/r^2 = r\omega_M^2 \Rightarrow \omega = \sqrt{(GM/r^3)}$

Sat frame: $Gm/r^2 = r\omega_m^2 \Rightarrow \omega = \sqrt{(Gm/r^3)}$

The ω predictions in both reference frames are only true if m = M, which is not possible for satellite masses…. the angular speed and period differ by at least 10 orders of magnitude.

Only the GIF solution $\omega = \sqrt{(GM/r^3)}$ agrees with satellite speed observations.

Summing up, the Lab frame is inertial :

$Fm = Fg - Fcf = GmM/r^2 - mr\omega_{□}^2 \Rightarrow \omega_M = \sqrt{GM/r^3}$

The Sat frame is non-inertial, so the result of the inertial lab frame is used to determine satellite speeds and periods:
This supports the geocentric inertial frame model.

Q: But then, how in general can the laws of dynamics be applied to predict the motion of two orbiting cosmic objects?

R: Clearly, without observations from the geocent $\omega_m = \sqrt{GM/r^3}$ no valid predictions can be made.

**Mass in free fall on the Moon – Frame comparison**
Another test possibility for inertial frames with sufficient data is the free fall measurement of a mass m on the Moon, with the data given below:

the measured free fall acceleration on the

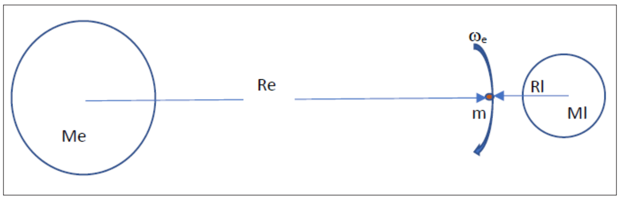
Moon's surface(l => luna)

$g_l = 1.62\ m/s^2$ The distance from Earth's center to m

$Re = 3.8 * 10^8$ m.

$\omega_e^2 = 4\pi^2/T^2 = 4\pi^2$?27.3 days $= 6.86*10^{-12}\ rad^2/s^2$

$Re\omega_e^2 = 0.00266\ m/s^2$




From Earth m is orbiting with the Moon at ω, so the last term below is the predicted centrifugal force. On the Moon m only moves radially, so no Fcf.

Lab frame: $Fe = GmMe/Re^2 - GmMl/Rl^2 - mRe\omega_e^2 = mg_l$

Moon frame: $Fl = GmMe/Re^2 - GmMl/Rl^2 - 0 = mg_l$

$Fe - Fl = -mRe\omega_e^2 \Rightarrow \Delta a = Re\omega_e^2 = 0.00266\ m/s^2$

The predicted difference betwween the two frames is less than the detection threshold with current technology.. But it's clear that the two frames have disparate predictions. And the Moon is non-inertial from the first example of Earth satellite frame comparison.

Once to every man and nation comes the moment to decide,
In the strife of Truth with Falsehood, for the good or evil side…..

Truth forever on the scaffold, Lies forever on the throne.
Yet that scaffold sways the future, and, behind the dim unknown,
Standeth God within the shadow, keeping watch above his own…..

Though the cause of Evil prosper, yet 'tis Truth alone is strong,
And, albeit she wander outcast now, I see around her throng
Troops of beautiful, tall angels, to enshield her from all wrong……

New occasions teach new duties; Time makes ancient good uncouth;
We must upward still, and onward, who would keep abreast of Truth.

The Present Crisis J. R. Lowell

**References**

1. viXra.org e-Print archive, Robert Bennett
2. ALFA Challenge
3. Fixed stars https://en.wikipedia.org/wiki/Fixed_stars.
4. Inertial frame of reference https://en.wikipedia.org/wiki/Inertial_frame_of_reference.
5. Fictitious force https://en.wikipedia.org/wiki/Fictitious_force.
6. Frame of reference https://en.wikipedia.org/wiki/Frame_of_reference.
7. Coordinate system https://en.wikipedia.org/wiki/Coordinate_system.