

General Relativity For Teletubbies

Space-Time Sanity

[Sir Kevin Aylward B.Sc., Warden of the Kings Ale](#)

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Space-Time

This is the section that shouldn't have to be written, but does. Unfortunately there are many, many, otherwise qualified Physicists, that have missed the boat as to the meaning of Physics.

Space-Time is only a mathematical, behavioural model to account for observations. It is not real. Period.

Geometry explains nothing physically.

From the outset, GR/SR does not even try to attempt a physical explanation. It just looks at physical results, and constructs a mathematical model. This is done, because mathematics never cares why or how. Many confuse this to mean that "there is no physical process required". This is false.

Physical space-time cannot possibly exist. The real universe requires real rulers, real clocks and real physical processes to determine what a time interval physically is. "Space" is simply identification that there are many objects not all on top of each other. "Time" is simply identification that objects change their position. No objects, no space, no objects changing position, no time. Geometry does not exist in the real universe without physical objects to define it.

Objects change their motion due to a real, physical process. One only has to look at a candle burning to realise that. Time is a result of a real physical process, fundamentally caused by objects moving. To date, there is no explanation as to what the physical process is that defines time.

Steven Weinberg:

"Gravitation and Cosmology: Principles and Applications Of Relativity" 1972:

"Text books geometric ideas were given a starring role, so that a student who asked why the gravitational field is represented by a metric tensor [or] freely flowing particles move on geodesics [or] the field equations are generally covariant would come away with an impression this [was because] space-time is a Riemannian manifold... This was Einstein's point of view... [but] the geometric approach has driven a wedge between general relativity and the theory of elementary particles ...[we no longer] expect that the strong, weak and electromagnetic interactions can be understood in geometrical terms, and too great an emphasis on geometry can only obscure the deep connection between gravitation and the rest of physics...In place of Riemannian geometry, I have based the discussion of general relativity on a principle derived from experiment: the Principle of the Equivalence of Gravitation and Inertia."

Lee Smolin:

<http://www.guardian.co.uk/books/2013/jun/10/time-reborn-farewell-reality-review>

"...And by making the clock's tick relative - what happens simultaneously for one observer might seem sequential to another - Einstein's theory of special relativity not only destroyed any notion of absolute time but made time equivalent to a dimension in space: the future is already out there waiting for us; we just can't see it until we get there. This view is a logical and metaphysical dead end, says Smolin."

Einstein:

"The theory of relativity belongs to a class of "principle-theories...As such, it employs an analytic method, which means that the elements of this theory are not based on hypothesis but on empirical discovery."

That is, physical hypotheses (mechanisms) are ignored from the outset, so clearly makes no statement as to what those processes might be. Einstein is directly declaring here explicitly, that he not going to offer an explanation, for example, a hypothesis as to why "sources could immediately find a common

speed". However, there is no suggestion or implication that such a physical process does not exist.

Mathematical Modeling

Systems can be mathematically described and analysed in many equivalent by different ways. For example the "square" wave output of a logic gate may be described by a Fourier series. That is, by an infinite sum of harmonic sine waves. However, the signal is physically generated by switching between two voltage levels. A claim that the output *is* a sum of sine waves is therefore physically false.

Gödel's proof of "closed time-like paths" i.e. backwards in time, in GR is clear support for the notion that space-time is really only a behavioural model. Going back in time, just doesn't seem reasonable. It means for the person going back, his atoms and stuff keep moving in a forward time manner for him, yet he is passing by atoms and stuff, going in reverse. Most bizarre.

It's quite typical of behavioural models, that they give nonsense outside specific ranges of validity. Equating the stress energy tensor to the Riemann curvature tensor is just a curve fit, with no physical basis as to why, by design. So, it is not surprising that it might generate garbage with certain ranges of x and t .

Co-ordinate Systems and Reference Frames

There is significant confusion on the distinction between (arbitrary) co-ordinate systems and real, physical reference frames.

Coordinate systems are not the same as "physical frames". Only if the frame motion is "locked" to the virtual co-ordinate motion, such that the variables of the coordinate system have a one to one relation to variable describing the frame itself can one replace frame variables with co-ordinate variables as if they are the same.

Mathematical coordinate systems, are simply a "change of variables" and are completely arbitrary. A physical object cannot be physically changed when described in different co-ordinate systems. One can have, say, a "physical frame" in uniform motion and describe it by say, a rotating coordinate system.

The rotating coordinate system will still not show that there are any real accelerating forces on the uniform motion frame. The change of variables would be just an inconvenience, they don't have any physical interpretation. A frame is physical, and if it rotated, it would feel forces, whether or not any co-ordinate system describing it rotated or not.

Thus the Lorentz Transformation (LT) is not just a co-ordinate transformation. It contains real physics. It is a Frame transformation. A universe described by the LT is physically different from a universe described by the Galilean Transformation (GT). If the LT were only a mathematically change of variables, the physics wouldn't change from the GT. That is, for example, clocks would not read different when subjects to a different velocity profile than a reference clock.

It is a fact that Einstein was also totally confused on co-ordinate systems and their relation to real systems attached to those co-ordinate systems. In his paper "The foundations of the General Theory of Relativity 1916" he states:

"...since we are able to produce a gravitational field merely by changing the coordinates..." and "...if the R_{uab} vanish, then the point moves uniformly in a straight line, these quantities therefore condition the deviation of the motion from uniformity. There are the components of the Gravitational field..."

This is of course nonsense, changing a coordinate system is simple a mathematical change of variables like, $x'=\sin(x)$. Nothing physically can change. A box does not start physically accelerating just because it is described by an accelerating co-ordinate system. The geodesic equation:

<http://www.kevinaylward.co.uk/gr/geodesic/geodesic.html>

does not predict non uniform motion, merely by using say, a spherical co-ordinate system, such that the Christoffel symbols are now non-zero. The Gravitational field is identified by the Riemann curvature tensor. Only if that tensor is zero, is motion uniform.

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