

The Massivity of Being

The Theory of Relativity (Fundamental Concepts)

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[My Take on Relativity \(Web Page\)](#)

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From “The Lightness of Being” – Frank Wilczek

So: What is the world made of? Subject, as ever, to addition and correction, here is the multifaceted answer that modern physics provides:

- The primary ingredient of physical reality, from which all else is formed, fills space and time. • Every fragment, each space-time element, has the same basic properties as every other fragment.
- The primary ingredient of reality is alive with quantum activity. Quantum activity has special characteristics. It is spontaneous and unpredictable. And to observe quantum activity, you must disturb it.
- The primary ingredient of reality also contains enduring material components. These make the cosmos a multilayered, multicolored superconductor.
- The primary ingredient of reality contains a metric field that gives space-time rigidity and causes gravity. • The primary ingredient of reality weighs, with a universal density.

Wilczek, Frank (2009-03-25). The Lightness of Being: Mass, Ether, and the Unification of Forces (p. 72). Basic Books. Kindle Edition.

There was a young man from Cape Cod

Who found it exceedingly odd

That the Tree

Should continue to Be

With no one about in the quad

“Dear Sir, you astonishment’s odd

I am always about in the quad

And that’s why the tree

Will continue to be

Since observed by –

Yours Faithfully,

God”

“When you achieve the all-encompassing California mellow surfing Wow, you’ll never blow your Buddhist cool..”

“Just because you’re schizophrenic doesn’t mean everything isn’t a figment of your imagination.”

Einstein's view of Special Theory of Relativity

The most common "thought" models of Special Relativity in the popular literature (and even many textbooks) involves freight trains or rocket ships (or similar objects conveying "motion"), chalk marks on the walls of the local universe, etc. to illustrate that "time slows down" or "space contracts" without postulating any physical cause (except for the jolt of the train moving – and even then the result is to confuse the reader by not making clear the distinction between GTR and STR when the concept of the jolt is invoked).

However this is because no attention has been paid to the appearance of the train or rocket ship in an otherwise empty universe; the fundamental root of this inattention is the interpretation of the result of Maxwell's result: $c = 1/\sqrt{\epsilon_0\mu_0}$. By conveniently forgetting about the origin of ϵ_0 and μ_0 (actually by imagining an irresistible force meeting nothing; in particular no equal and opposite force), Maxwell was able to interpret c as the "speed" of light (it is significant that speed is not the same concept as velocity) by invoking Gauss's and Faraday's laws, and invoking "charge" instead of mass. In Maxwell's view, light (electro magnetism) in a vacuum has no mass – that is left up to Newton...

The connection $E_0 = m_0c^2 = (\epsilon_0\mu_0)c^2 = 1$ where $m_0 = \epsilon_0\mu_0$ (where m_0 is positive definite since $m_0 = (\sqrt{\epsilon_0\mu_0})^2$ is not a complex number), is not often mentioned; in fact it can be ignored in these "thought experiments" if one sets $m_0 = 1$ conceptually before the discussion even starts. One is left with the tautology $c = c$ so that all participants are able to "imagineer" at will.

One apparently then is free to use "thought" experiments involving massless freight trains and rocket ships. (In the former case, occasionally a "jolt" is mentioned one of the trains begins to move, (without mentioning a simultaneous jolt in the opposite direction to stop the train) but equally as often, the reader is tasked to imagine chalk marks with which he can mark the surrounding air to mark relative positions of the trains/rocket ships...

This ("no-mass") light is the fundamental concept for Einstein's conception of Special Relativity; and he tries (rather lamely) to identify all mass (inertial and gravitational) with "curved space time); to use such a model with the freight train paradigm would be to invoke the geometry of train tracks in a circle. (Note that it is always assumed one can see the freight trains – there is no agent mentioned explicitly that is responsible for the command "let there be light").

The bottom line in such models is that there is no mention of the origin of either the freight trains or the rocket ships (not to mention the physical effort of marking the air (or tunnel walls for the trains, if that is invoked), or how one is to observe the chalk marks (Einstein's original papers are very confusing, and even Peter Bergmann's "Introduction to the Theory of Relativity" (much I respect it) isn't much better, although many other writers follow his – and Einstein's – train model).

This confusion is responsible for Einstein's comment that he was trying to discover "if God had anything to do with the creation of the Universe".

Our First Particle (“Universe”)

Frank Wilczek’s first postulate is:

- The primary ingredient of physical reality, from which all else is formed, fills space and time. • Every fragment, each space-time element, has the same basic properties as every other fragment.

In contrast, I will begin with a more mundane model; we assume the Universe is absolutely empty (the “Void”), with no property of space or time involved; alternatively we can postulate that a coordinate system (x,t) is a figment of the imagination, which is a key tenet of solipsism (an “observer” – in particular, me :) is a point in the stream of consciousness, with observations (as pure thoughts) having no “reality” of their own. (There is a lot of physics between naïve solipsism and naïve realism..)

We can then divide the perceived Universe into two separate domains; that of a “Coordinate System” in space and time (x, t) , which we can call “thoughts” (admittedly, with some lack of precision) and a second domain (M, P) referring to Mass (M) and Momentum (P) which we will call “Things” (with roughly the same precision as the former concept).

In order to create a “freight train” (which we will model as a point mass) from nothing in the Universe, we will ignore the domain of spacetime, and simply create our initial mass at a single point (somewhere, somewhen) = (anywhere, anywhen). (You can call it an “Origin” if you like, but only if you’re referring to our single particle (“freight train”).

In order to create our single particle, we can imagine a “mass creation rate” C and a “mass creation time” T^0 ; at the end of the mass creation process T^0 we can imagine our “original” mass by the equation $M^0 = \rho CT$ where $\rho = 1$ is the density for one particle. (Think of ρCT as a “mass stick”). We consider this mass to be positive definite; that is, globally positive with $M^0 = \sqrt{(M^0)^2}$ (this means that it will take an imaginary mass $(iM^0)^2 = -(M^0)^2$ to destroy it:

$$(M^0)^2 + [-(M^0)^2] = 0 \text{ (The Void)}$$

(Frank Wilczek thinks of this mass as the Whole Universe, which is ok as long as you don’t imagine a second freight train – uh oh, Universe (sorry about that, Frank)). For advanced readers, we will get to the “Minkowski” metric later in the analysis ...

The creation of this particle, then, is the “jolt” that creates our first “freight train”. (Such a “jolt” can be considered as an “impulse” with a mass; that is a Dirac $\delta(M^0)$ in an otherwise empty Universe.