

## Connecting $E = mc^2$ to the Lorentz Transformation

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21<sup>st</sup> November 2023*

**Abstract.** The Lorentz transformation and the equation  $E = mc^2$  are two separate issues. This article will examine the individual physical contexts in which each of them apply separately, and when they apply simultaneously.

### The Lorentz Transformation

**I.** The Lorentz transformation is observed in optics as the return-path longitudinal Doppler effect [1], and the maths also applies to the optical transverse Doppler effect. It further applies to the fields surrounding charged objects and how these fields alter when the source charge is in motion relative to the wave-carrying medium. An electrostatic field morphs into a magnetic field as the source charge accelerates towards the speed of light, [2].

The commonality between the optical Doppler effect and the transformation of fields in motion must therefore be rooted in the fabric of the physical medium within which electromagnetic waves propagate, and within which a magnetic field is constructed.

### Radiation Pressure

**II.** The equation  $E = mc^2$  has got no immediate connection to the Lorentz transformation. It relates to the energy in wireless electromagnetic radiation, and it can be derived by considering the momentum of the radiation in conjunction with Maxwell's equation for radiation pressure, [3].

### Conclusion

**III.** Except in the case of tiny rotating electron-positron dipoles whose circumferential speed is equal to the speed of light, the Lorentz transformation cannot be applied to the kinematics of particle motion, at least not without introducing some kind of scaling factor to take account of the complexities of the atoms and molecules of ponderable matter. Both  $E = mc^2$  and the Lorentz transformation only relate either to wireless electromagnetic radiation or to the tiny dipolar vortices that comprise the wave-carrying medium, known as

luminiferous medium, [4], [5], [6]. These tiny vortices are in fact the tiny rotating electron-positron dipoles mentioned above, [3], [7]. The equation  $E = mc^2$  applies to the centrifugal pressure in the equatorial plane of the vortices [3], [8]. and as well as deriving it from Maxwell's radiation pressure equation, it can also be derived from electron-positron pair annihilation and production, because this equation is ultimately just Newton's equation for the speed of a wave in an elastic solid, the elastic solid in question being comprised of electrons and positrons, [9], [10].

As for the Lorentz transformation, it is not a coordinate frame transformation at all. It relates to the precession of the tiny dipolar vortices in the fields surrounding charged objects that are accelerating through the luminiferous medium, [11]. There is no time dilation. The time terms refer exclusively to the angular frequency of the tiny vortices that fill all of space, and without the presence of this sea of vortices, the Lorentz transformation is meaningless.

In the case of EM radiation being absorbed by targets that are in motion through the luminiferous medium,  $E = mc^2$  and the Lorentz transformation combine together into the energy-momentum four-vector to yield the relevant energy changes. This is important when it comes to atomic clocks in orbit in the Global Positioning System, [12].

The so-called relativistic mass, which is inferred from the energy-momentum four-vector, is merely a velocity dependent product involving actual mass. It should not be read that the actual mass itself increases with speed.

## References

[1] Gupta, P.D., "*Exact derivation of the Doppler shift formula for a radar echo without using transformation equations*", Am. J. Phys., vol. 45, No. 7, pp. 674-675, (July 1977)

[2] Tombe, F.D., "*The Lorentz Aether Theory*", (2020)  
<https://www.researchgate.net/publication/339696770> The Lorentz Aether Theory

[3] Tombe, F.D., "*The Double Helix Theory of the Magnetic Field*", (2006)  
 Galilean Electrodynamics, vol. 24, number 2, p.34, (March/April 2013)  
 See Section IV for centrifugal pressure and Section VI for radiation pressure.  
<https://www.researchgate.net/publication/295010637> The Double Helix Theory of the Magnetic Field

[4] Whittaker, E.T., "*A History of the Theories of Aether and Electricity*", Chapter 4, pages 100-102, (1910)

*"All space, according to the younger Bernoulli, is permeated by a fluid aether, containing an immense number of excessively small whirlpools. The elasticity which the aether appears to possess, and in virtue of which it is able to transmit vibrations, is really due to the presence of these whirlpools; for, owing to centrifugal force, each whirlpool is continually striving to dilate, and so presses against the neighbouring whirlpools."*

[5] Maxwell, J.C., “*On Physical Lines of Force*”, Philosophical Magazine, Volume XXI, Fourth Series, London, (1861)  
[http://vacuum-physics.com/Maxwell/maxwell\\_oplf.pdf](http://vacuum-physics.com/Maxwell/maxwell_oplf.pdf)

[6] Lodge, Sir Oliver, “*Ether (in physics)*”, Encyclopaedia Britannica, Fourteenth Edition, vol. 8, pp. 751-755, (1937)

See pp. 6-7 in the pdf file in the link below, beginning at the paragraph that starts with, **Possible Structure.** –, and note that while the quote suggests that the ether is incompressible, this is almost certainly not the case. The quote in question, in relation to the speed of light, reads,

**“The most probable surmise or guess at present is that the ether is a perfectly incompressible continuous fluid, in a state of fine-grained vortex motion, circulating with that same enormous speed. For it has been partly, though as yet incompletely, shown that such a vortex fluid would transmit waves of the same general nature as light waves— i.e., periodic disturbances across the line of propagation—and would transmit them at a rate of the same order of magnitude as the vortex or circulation speed.”**

<http://gsjournal.net/Science-Journals/Historical%20PapersMechanics%20/%20Electrodynamics/Download/4105>

[7] Tombe, F.D., “*The Double Helix and the Electron-Positron Aether*”, (2017)  
[https://www.researchgate.net/publication/319914395\\_The\\_Double\\_Helix\\_and\\_the\\_Electron-Positron\\_Aether](https://www.researchgate.net/publication/319914395_The_Double_Helix_and_the_Electron-Positron_Aether)

[8] Tombe, F.D., “*Radiation Pressure and  $E = mc^2$* ”, (2018)  
[https://www.researchgate.net/publication/325859308\\_Radiation\\_Pressure\\_and\\_E\\_mc](https://www.researchgate.net/publication/325859308_Radiation_Pressure_and_E_mc)

[9] Simhony, M., “*The Electron-Positron Lattice Space, Cause of Relativity and Quantum Effects*”, Physics Section 5, The Hebrew University, Jerusalem, (1990)  
<http://web.archive.org/web/20040606235138/www.word1.co.il/physics/mass.htm>

[10] Tombe, F.D., “*The Positronium Orbit in the Electron-Positron Sea*”, (2020)  
[https://www.researchgate.net/publication/338816847\\_The\\_Positronium\\_Orbit\\_in\\_the\\_Electron-Positron\\_Sea](https://www.researchgate.net/publication/338816847_The_Positronium_Orbit_in_the_Electron-Positron_Sea)

[11] Tombe, F.D., “*The Deception Inherent in Coordinate Frame Transformations*”, (2023)  
[https://www.researchgate.net/publication/372533786\\_The\\_Deception\\_Inherent\\_in\\_Coordinate\\_Frame\\_Transformations](https://www.researchgate.net/publication/372533786_The_Deception_Inherent_in_Coordinate_Frame_Transformations)

[12] Tombe, F.D., “*Atomic Clocks and Relativity*”, (2023)  
[https://www.researchgate.net/publication/372165749\\_Atomic\\_Clocks\\_and\\_Relativity](https://www.researchgate.net/publication/372165749_Atomic_Clocks_and_Relativity)