

Proposed rebuttals to date of Einstein's Special Theory of Relativity (STR) may be grouped into three broad categories:

- (1) STR leads to inherent self-contradictions (for example, the so-called 'twins paradox');
- (2) STR leads to conclusions which are utterly implausible (such as two clocks each faster than the other);
- (3) STR is contradicted by empirical evidence (there are various instances).

Cases in category (1) arise from an incomplete knowledge of the maths involved in STR (such as handling of cases involving acceleration). Those in category (2) arise from a limited understanding – or acceptance – of the deeper complexities of STR (notably counter-intuitive – some would say counter-commonsense – aspects). This does not make STR inherently correct, but it **does** make it inherently self-consistent. Such attempted rebuttals may thus be discounted.

Rebuttals in category (3) have, without exception, themselves been rebutted. Claims of experimental situations, or observations of natural phenomena, which contradict principles of STR have in every case been shown to be unfounded. A review dealing with this issue, citing almost 300 relevant references, has shown agreement between a wide range of empirical evidence and predictions of STR to an extremely high level of precision. This paper highlights the uniformity of fundamental measures and measured outcomes of fundamental processes (*Lorentz invariance*) across all *inertial reference frames* (states of constant-velocity gravity-free motion) – precisely as predicted by STR. [1]

The author of that study asserts that "When Lorentz invariance holds there is no preferred frame" – effectively presenting Lorentz invariance as proof of STR, which states that there is no unique frame which may be regarded as 'special', that outcomes of fundamental processes are identical with respect to all such frames. This assertion, presented as *de facto* without need of proof or explanation, is likewise regarded as effectively axiomatic by the wider scientific community: Lorentz invariance proves STR, there is no need for further proof or discussion on the matter.

However, this statement of the apparently obvious contains a hidden flaw, one which does not appear to have been considered to date. There is an implicit assumption that, if a preferred frame *were to* exist, there is no possibility that the state of motion in any other frame could affect measuring devices and other objects in that frame so as to give the illusion of outcomes objectively identical to those in the preferred frame, when actually simply *appearing* to be so or *measuring* as such.

This is by no means as improbable as it may seem. A wealth of evidence from a wide variety of studies supports the possibility that elementary particles of matter are closed-loop constructs of electromagnetic energy ('light'): matter is known to have waveform properties; light is constantly varying between travelling linearly in space and being absorbed as part of the energetic composition of matter; zitterbewegung, a periodic oscillation in an electron at the speed of light, has been confirmed experimentally [2]; various studies have proposed such a structure, including one which explicitly shows quantum characteristics of an electron arising from such a model [3]; two experiments at US government research facilities have demonstrated particle-antiparticle pair creation from photons of electromagnetic energy [4] [5].

If a preferred frame **does** exist, in which uniquely the one-way speed of light is isotropic (the same in all directions), relative to which all other inertial frames are objectively in motion, and if matter **is** formed from light, then it can be very easily shown that time dilation would apply in those other frames exactly as given by STR, and that the speed of light would measure as  $c$  uniformly in all directions, as for the preferred frame. It can further be shown that the Lorentz transformation (used in STR for transferring between inertial frames) would apply identically in this objectively asymmetric situation – symmetrically, to give the impression of a universe as defined by STR. Maxwell's equations can be shown to apply identically in all frames, as can 'invariant' measures such as the rest mass of any particle. [6]

In short: a universe with a unique preferred frame in which the one-way speed of light is isotropic at  $c$ , and in which elementary particles are localised constructs of electromagnetic energy, would present precisely as the universe described by STR. Furthermore, this situation has the benefit of a clear causal explanation – in contrast to the general inference drawn by STR that "The universe is relativistic".

In his Conclusion, Mattingly asks: "When have we tested enough?". In respect of Lorentz invariance, the answer is that no amount of testing will definitively confirm STR; more broadly, the answer must be: "When we can say with certainty that apparent evidence for STR is not simply an artefact of the composition of matter in a preferred-frame cosmos".

### References

- [1] Mattingly, D., Modern tests of Lorentz Invariance, *Living Rev. Relativ.*, 8(1):5. (2005), <https://doi.org/10.12942/lrr-2005-5>
- [2] Catillon, P. *et al.*, A Search for the de Broglie particle internal clock by means of electron channeling, *Found. Phys.* 38(7), 659-664 (2008) <https://doi.org/10.1007/s10701-008-9225-1>
- [3] Williamson, J.G., & van der Mark, M.B.: Is the electron a photon with toroidal topology? *Ann. Fond. L. de Broglie* 22(2), 133-160 (1997), <https://fondationlouisdebroglie.org/AFLB-222/MARK.TEX2.pdf>
- [4] Bamber, C. *et al.* (1997), Positron production in multiphoton light-by-light scattering, (SLAC), <https://doi.org/10.1063/1.52962>
- [5] Adam, J. *et al.* (2021), Measurement of e+e- momentum and angular distributions from linearly polarized photon collisions, (RHIC), <https://doi.org/10.1103/PhysRevLett.127.052302>
- [6] Blackwell, G. (2004-2025), Various supporting files, with summary and link for each, at: <https://r.ihs.ac>