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SIMULTANEITY, TIME DILATION AND THE LORENTZ TRANSFORMATION

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ABSTRACT

The underlying basis for the predictions of non-simultaneity and time dilation in relativity theory is discussed. It is pointed out that Einstein based his conclusions entirely on the Lorentz transformation (LT). He claimed that once one assumes the constancy of the speed of light for all observers (at the same gravitational potential), there is no choice but to replace the Galilean transformation (GT) of classical physics by the LT. Lorentz pointed out as early as 1899, however, that the equations of the LT can only be specified to within a common factor ε based on this information alone. While Einstein mentioned this degree of freedom in his 1905 paper, he presented an argument that he felt settled the issue in favour of the LT (ε=1). The latter choice has the theoretical advantage of guaranteeing Lorentz invariance for the relativistic space-time transformation, but it also rules out the principle of simultaneity of events for observers in relative motion, a position that was revolutionary at the time he presented it. Another consequence of the LT is that it implies that the ancient principle of the objectivity of measurement no longer applies when two observers are in relative motion. For example, it becomes necessary to assume that each observer find that the other's clock is running slower than his own. It is pointed out that this predicted "symmetry" in the theory is actually contradicted by measurements carried out in the 1960s using high-speed rotors, as well as later with atomic clocks onboard circumnavigating airplanes in the 1970s. Moreover, the prediction of non-simultaneity of events is inconsistent with the basic assumptions employed for the Global Positioning System (GPS) technology that has become hugely successful in recent times. It is shown that relativity theory can be formulated in such a way as to remain consistent with both the objective measurement principle and simultaneity as well with the two relativity postulates simply by choosing a different value for ε than Einstein did in order to arrive at the correct relativistic space-time transformation. In agreement with Einstein, however, it does not require the existence of an ether, i.e. a unique reference frame in which the speed of light has a null value. The resulting version of relativity theory is consistent with time dilation and the modern definition of the meter, but not with the Fitzgerald-Lorentz contraction effect (FLC) derived from the LT. The revised theory also rules out the occurrence of time reversal and violations of Einstein causality, that is, that the ratio of the values measured by two observers for the respective elapsed times Δt and Δt' can be negative for a given event.

KEYWORDS: *FitzGerald-Lorentz Length Contraction (FLC), Time Dilation, Remote Non-simultaneity, Clock Puzzle, Lorentz Transformation (LT), Universal Time-dilation Law (UTDL), Newton-Voigt Transformation (NVT)*

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