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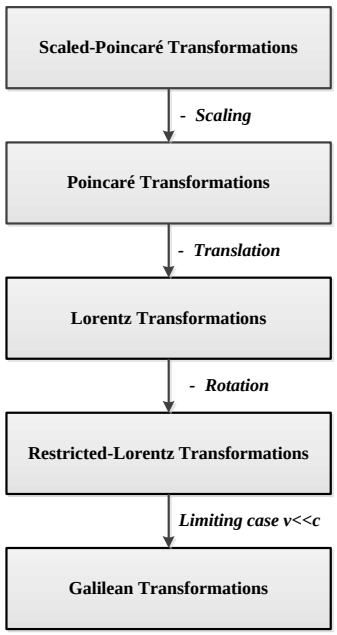
Avoiding Infinities from the Lorentz and the Poincaré Transformations

*Syed Arif Kamal**
Department of Mathematics, University of Karachi; sakamal@uok.edu.pk

From the historical point-of-view, this paper gave history of conceptual development of relativity as well as mathematical formulation of Lorentz transformations. Contrary to the popular belief, giving credit of all contributions in special relativity to Albert Einstein, the paper put into perspective the fundamental conceptual contri-utions of Muslim scientists, *e. g.*, space and time, relative and absolute, long before, Einstein presented his theory. One year before the publication of Einstein's paper, Poincaré (1904) enunciated the principle of relativity. Also, complete mathematical framework was available through works of Voigt (1887) and Lorentz (1904). Long before that Ibn-é-Sina discussed space and time in his *Risala-é-Tabi-yaat* (Journal of Physics). In his book, *Aghaz-o-Anjaam* (Beginning and End), Nasiruddin Tusi (1238 Iranian Year) says that time ascribes everything and, therefore, something is first and something is last relative to time. Time ordering of events (causality) occupies an important place in modern relativity theory. Tusi, further, observes that the entire universe is ascribed by space and in this connection, something is exposed and something is hidden relative to space. In addition, he comments that space and time are not complete in themselves. In theory of relativity space and time are not considered as separate things, but time is considered as a coördinate like space coördinates. Sadruddin Sheerazi, in *Asfar-é- Arbăa* (Four Journeys), says about the doubt of Fakruddin Raazi (*Ouoon-ul-Hikmat* — Springs of Knowledge) that Behmenyar mentioned this doubt and then, himself, refuted it. Behmenyar thinks that if the existence of motion is disproved, then it is that motion, which is called 'absolute motion'. He thinks that absolute motion is not, externally, present. But Ssheerazi thinks that 'relative motion' is not, externally, present. He argues that absolute motion has not any such form in the external as that of things, which are stationary. One may notice that even Lorentz adhered to the notion of absolute rest and absolute motion, whereas Sheerazi and others introduced and discussed the concepts of relative motion. In his paper, *Zur Electrodynamik bewegter Korper* (on the Electrodynamics of Moving Bodies), published in 1905, Albert Einstein combined these existing conceptual and mathematical formulations into an integrated and a unified approach, without giving reference to these contributions. Herman Minkowski formulated the relativity theory in terms of a four-dimensional-vector-field formulation. As early as 1911, it was shown that the assumption of existence of an invariant velocity was not necessary for the derivation of Lorentz transformations. Recami and Mignani (1974) generalized special relativity and set the relevant postulates in the form**:** (*i*) spacetime is homogeneous and space is isotropic, (*ii*) principle of relativity — physical laws of mechanics and electromagnetism are required to be covariant, when passing from an inertial frame to another frame in rectilinear, uniform relative motion and (*iii*) principle of retarded causality (equivalent to Dirac, Stuckelberg, Feynman and Sudershan reinterpretation principle) — negative-energy particles traveling forward in time do not exist. From only the postulates (*i*) and (*ii*) (without intervention of any assumption about the invariant character of the light speed) the remaining principles of special relativity may, actually, be deduced, such as the linearity of transformations and the existence of an invariant squared speed. The Lorentz transformations $\vec{x}' = T\vec{x}$, where $\vec{x}'$ and $\vec{x}$ are spacetime-vector-field formulations in 4 dimensions, relating coördinates of the primed and the unprimed frames. T is 4×4 transformation matrix, whose nonzero elements are $T_{11} = T_{44} = \gamma$, $T_{22} = T_{33} = 1, T_{14} = i\beta\gamma = -T_{41}$, $\beta = \frac{V}{c}$, $\gamma = \frac{1}{\sqrt{1-V^2/c^2}}$. The condition $x' = y' = z' = 0$ should give history of the space origin of the primed system relative to the unprimed one and ensures that $c\beta$ is, actually, velocity of the primed frame with respect to the unprimed one. This paper introduced *Scaled-Poincaré Transformations*, which avoided infinities that appeared due to γ becoming unbounded as β approached unity.



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*Prof. Dr. Syed Arif Kamal (http://ngds-ku.org/kamal), PhD, MA (Johns Hopkins), MS (Indiana, Bloomington), Professor, Department of Mathematics (http://math.uok.edu.pk), University of Karachi (http://www.uok.edu.pk), Karachi 75270, Pakistan; *Telephones***:** +92 21 9926 1300-6 ext. 2380, 2293