An elementary first-postulate measurement of the cosmic limit speed

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Abstract

In 1898 *Henri Poincaré* referred to the speed of light as a probable limit speed but rashly asserted it would never as such be experimentally verifiable. Moving space vehicle measurements of the cosmic limit speed, however, without assuming it equals c, were described by Coleman (2003 *Eur. J. Phys.* **24** 301-13). A more elementary measurement is also possible, involving two mutually stationary vehicles with a third passing between them. A simple formula gives the limit speed in terms of signal speed c and three time intervals.

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Two space stations P and Q, an arbitrary distance D apart, can be made mutually stationary by continual undelayed interchanging of radio signals and consequential adjustments of motion until the return time response interval $2T = 2D/c$—measured by P's clock—ceases to change. A mariner vehicle M, containing a clock identical to P's one, passes between P and Q at an appreciable but *unquantified* constant velocity v. P clocks M's passing and receives from Q a signal after M passes the latter, delayed by T. This establishes M's transit time interval $t = D/v$ in the stations' frame of reference. On passing the second station, M radios its own observed transit time interval t' to station P.

We apply the *Lorentz time transformation equation* established solely on the basis of the first postulate, exemplified by equation ((23)ii) in [2] (with $\Omega = 1/\lambda^2$) where the

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limit speed λ is considered *unquantified, i.e. not necessarily equal to c*. This gives the mariner vehicle's transit time on arrival at station Q as

$$t' = \frac{t - xv/\lambda^2}{\sqrt{1 - v^2/\lambda^2}}. \tag{1}$$

Substituting $x = D$, $v = D/t$ and $D = cT$ respectively we then have

$$t' = \frac{t - \frac{D^2}{t}/\lambda^2}{\sqrt{1 - \left(\frac{D}{t}\right)^2/\lambda^2}} = \frac{t\left(1 - (\frac{cT}{t})^2/\lambda^2\right)}{\sqrt{1 - (\frac{cT}{t})^2/\lambda^2}} = t\sqrt{1 - \left(\frac{cT}{t}\right)^2/\lambda^2}. \tag{2}$$

Solving for the limit speed λ gives

$$\lambda = \frac{cT/t}{\sqrt{1 - (t'/t)^2}}. \tag{3}$$

Alternatively, direct application of the more elementary 'chronocity' equation (24) in [2], $k_v = v/\lambda^2$, with chronocity $k_v = (t - t')/D$ defined as *distance rated disparity of simultaneity*, produces the same result.

This simple formula for independent quantitative establishment of the cosmic limit speed, is presented as a further argument against the continuing *Ptolemaic* prevalence of special relativity's actually redundant second postulate.

References

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[2] Coleman B 2003 *A dual first-postulate basis for special relativity* Eur. J. Phys. **24** 301-13
Coleman B 2003 Eur. J. Phys. **24** 493 (Corrigendum)

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Appendix: *"One may regard this [second postulate] as a statement about the nature of light rather than an independent postulate."*