

## Relativistic Speed Contraction

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Elementary physics defines the speed  $v$  as the rate of change of distance  $\Delta x$  with time  $\Delta t$ , or mathematically,  $v = \Delta x / \Delta t$ . The official SI unit, used in science and physics, is the meter (distance) and second (time), m/sec.

Special relativity states that 1m contracts with a relativistic speed  $v$  according to the equation

$$(1\text{m})_{\text{R}} = (1\text{m})_0 / \sqrt{1 - v^2/c^2} \quad \dots (1)$$

where  $(1\text{m})_{\text{R}}$  is the relativistic moving 1m,  $(1\text{m})_0$  is its non-relativistic value and  $1/\sqrt{1 - v^2/c^2}$  is the Lorentz factor or time dilation factor. In contrast, 1sec dilates with a speed  $v$  according to this relation

$$(1\text{sec})_{\text{R}} = (1\text{sec})_0 [1/\sqrt{1 - v^2/c^2}] \quad \dots (2)$$

where  $(1\text{sec})_{\text{R}}$  is the relativistic moving 1sec and  $(1\text{sec})_0$  is its non-relativistic value. Combining these two equations, we get

$$(1\text{m})_{\text{R}} [(1\text{sec})_{\text{R}}]^{-1} = (1\text{m sec}^{-1}) (1 - v^2/c^2) \quad \dots (3).$$

A relativistic speed can be written as

$$v \{ = \mathcal{N} \times (1\text{m})_{\text{R}} [(1\text{sec})_{\text{R}}]^{-1} \} = \mathcal{N} \times (1\text{m sec}^{-1}) (1 - v^2/c^2) \quad \dots (4)$$

where  $\mathcal{N}$  is a rational number. Then a non-relativistic speed

$$v_{\text{N}} = \mathcal{N} \times (1\text{m 1sec}^{-1}) \quad \dots (5).$$

Dividing these two equations and after a bit of algebra, we have

$$v = v_{\text{N}} (1 - v^2/c^2).$$

In other words, we deal with a relativistic speed contraction.