On relativistic temperature transformation $T=\frac{T_0}{\sqrt{1-\left(\frac{u}{c}\right)^2}}$

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Abstract: Under Lorentz transformation we obtain relativistic temperature transformation $T=\frac{T_0}{\sqrt{1-\left(\frac{u}{c}\right)^2}}$, where T_0 and T denote rest temperature and temperature moving with constant velocity *u*, respectively. PACS numbers: 07.20.Dt, 07. 20. Pe, 03. 30. +p.

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In the Universe there are two matters: (1) observable subluminal matter called tardyon and (2) unobservable superluminal matter called tachyon which coexist in motion. Tachyon can be converted into tardyon, and vice versa. In this paper we study tardyonic and tachyonic temperature transformations.

We first define a ring.

$$Z=\begin{pmatrix} cT & x \\ x & cT \end{pmatrix}=cT+jx, \quad (1)$$

where $x=uT, u$ and T represent the tardyonic velocity and temperature, respectively, c is light velocity in vacuum, $j=\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$.

(1) can be written as Euler form

$$Z=cT_0e^{j\theta}=cT_0(\mathrm{ch}\theta+j\mathrm{sh}\theta), \quad (2)$$

where cT_0 is the tardyonic invariance, θ tardyonic hyperbolical angle.

From (1) and (2) we have

$$cT=cT_0\mathrm{ch}\theta, \quad x=cT_0\mathrm{sh}\theta \quad (3)$$

$$cT_0=\sqrt{(cT)^2-x^2} \quad (4)$$

From (3) we have

$$\theta=\mathrm{th}^{-1}\frac{x}{cT}=\mathrm{th}^{-1}\frac{u}{c} \quad (5)$$

$$\mathrm{ch}\theta=\frac{1}{\sqrt{1-\left(\frac{u}{c}\right)^2}}, \quad \mathrm{sh}\theta=\frac{\frac{u}{c}}{\sqrt{1-\left(\frac{u}{c}\right)^2}} \quad (6)$$

where $c\ge u$ is the tardyonic velocity.

From (3) and (6) we obtain relativistic temperature transformation

$$T=\frac{T_0}{\sqrt{1-\left(\frac{u}{c}\right)^2}}, \quad (7)$$

where T_0 and T represent tardyonic rest temperature and temperature moving with constant velocity, respectively.

If we replace temperature with heat, then we obtain relativistic heat transformation

$$dQ=\frac{dQ_0}{\sqrt{1-\left(\frac{u}{c}\right)^2}}, \quad (8)$$

where dQ_0 and dQ represent tardyonic rest heat and heat moving with velocity u, respectively.

If we replace temperature with time, then we obtain relativistic time transformation.

$$t = \frac{t_0}{\sqrt{1-\left(\frac{u}{c}\right)^2}}, \qquad (9)$$

where t_0 and t denote tardyonic rest time and time moving with velocity u, respectively.

If we replace temperature with mass then we obtain relativistic mass transformation

$$M = \frac{M_0}{\sqrt{1-\left(\frac{u}{c}\right)^2}}, \qquad (10)$$

where M_0 and M denote tardyonic rest mass and mass moving with constant velocity u, respectively.

From above we arrive at a conclusion that temperature, heat, time and mass have the same relativistic transformation.

Using the morphism $j: z \to jz$, we have

$$jz = \overline{x} + jc\overline{T} = \overline{x}_0 e^{j\overline{\theta}} = \overline{x}_0(\text{ch}\overline{\theta} + j\text{sh}\overline{\theta}), \qquad (11)$$

where $\overline{x} = \overline{u}\,\overline{T}$, $\overline{u}$ and $\overline{T}$ denote the tachyonic velocity and temperature, respectively, $\overline{x}_0$ is tachyonic invariance, $\overline{\theta}$ tachyonic hyperbolical angle.

From (11) we have

$$\overline{x} = \overline{x}_0 \text{ch}\overline{\theta}, \quad \overline{T} = \overline{x}_0 \text{sh}\overline{\theta} \qquad (12)$$

$$\overline{x}_0 = \sqrt{(\overline{x})^2 - (c\overline{T})^2} \qquad (13)$$

From (12) we have

$$\overline{\theta} = \text{th}^{-1}\frac{c\overline{T}}{\overline{x}} = \text{th}^{-1}\frac{c}{\overline{u}} \qquad (14)$$

$$\text{ch}\overline{\theta} = \frac{1}{\sqrt{1-\left(\frac{c}{\overline{u}}\right)^2}}, \qquad \text{sh}\,\overline{\theta} = \frac{\frac{c}{\overline{u}}}{\sqrt{1-\left(\frac{c}{\overline{u}}\right)^2}} \qquad (15)$$

where $\overline{u} \geq c$ is the tachyonic velocity.

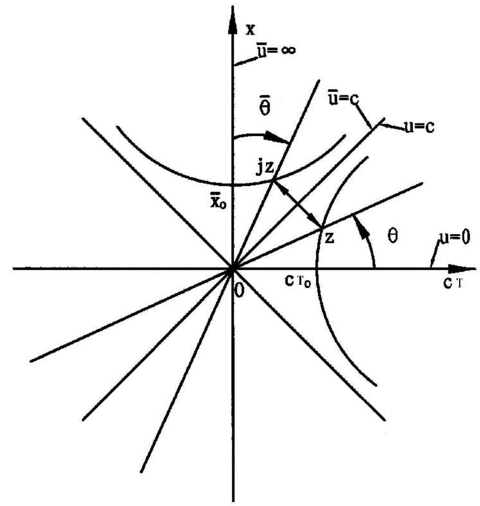

Fig. 1. Tardyonic and tachyonic coexistence, $0 \leq T_0$, $0 \leq \overline{x}_0$

Figure 1 shows the formulas (1) — (15). $j: z \to jz$ is that tardyon can be converted into tachyon, but $j: jz \to z$ is that tachyon can be converted into tardyon. At the $x-$axis we define the tachyonic length

$$\overline{x}_0 = \lim_{\substack{\overline{u}\to\infty \\ T_0 \to 0}} \overline{u} T_0 = \text{constant.} \qquad (15)$$

Since at rest the tachyonic Temperature $T_0 = 0$ and $\overline{u} = \infty$, we prove that tachyon is unobservable. In the same way we obtain rest heat $dQ_0 = 0$, rest time $t_0 = 0$, and rest mass $M_0 = 0$. Therefore tachyon is unobservable. But tachyons exist in the Universe, for example gravitons.

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