

The space time interval is defined by:

$$I \equiv x^2 - c^2 t^2$$

Events with common space time intervals lie on a hyperbola of constant I .

True or False: A Lorentz boost (change to another inertial frame) can allow you to shift between different hyperbolas.

- A. True
- B. False

Consider the product of the speed of light and the proper time: $c d\tau$.

Is this quantity invariant?

A. Yes

B. No

C. I don't know how to tell

Is this "4-velocity" a contravariant 4-vector?

$$\eta^\mu \equiv \frac{dx^\mu}{d\tau}$$

A. Yes

B. No

C. I don't know how to tell

What is $\frac{dt}{d\tau}$?

- A. γ
- B. $1/\gamma$
- C. γ^2
- D. $1/\gamma^2$
- E. Something else

With $\eta^0 = c\gamma$ and $\vec{\eta} = \gamma\vec{u}$, what is the square of η ?

$$\eta^2 \equiv \eta \cdot \eta = \eta_\mu \eta^\mu$$

A. c^2

B. u^2

C. $-c^2$

D. $-u^2$

E. Something else

The momentum vector \vec{p} is given by,

$$\vec{p} = \frac{m\vec{u}}{\sqrt{1 - u^2/c^2}}$$

What is $|\vec{p}|$ as u approaches zero?

- A. zero
- B. $m u$
- C. $m c$
- D. Something else

Are energy and rest mass Lorentz invariants?

- A. Both energy and mass are invariants
- B. Only energy is an invariant
- C. Only rest mass is an invariant
- D. Neither energy or mass are invariants

$$E - E_{rest} = (\gamma - 1)mc^2$$

What happens to the difference in the total and rest energies when the particle speed (u) is much smaller than c ?

- A. It goes to zero
- B. It goes to $m c^2$
- C. It goes to $1/2 m u^2$
- D. It depends

What's $p_\mu p^\mu$?

A. γmc^2

B. $-\gamma mc^2$

C. mc^2

D. $-mc^2$

E. Something else

E_{tot} is conserved but not invariant. What does that mean?

- A. It's the same at any time in every reference frame.
- B. It's the same at a given time in every reference frame.
- C. It's the same at any time in a given reference frame.
- D. Something else

m is invariant but not conserved. What does that mean?

- A. It's the same at any time in every reference frame.
- B. It's the same at a given time in every reference frame.
- C. It's the same at any time in a given reference frame.
- D. Something else

Charge is invariant and conserved. What does that mean?

- A. It's the same at any time in every reference frame.
- B. It's the same at a given time in every reference frame.
- C. It's the same at any time in a given reference frame.
- D. Something else