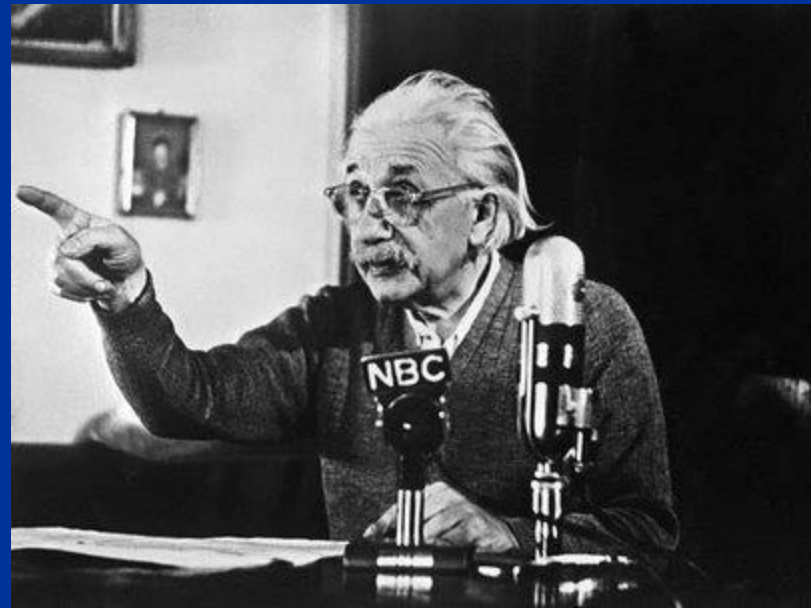# Special Theory of **Relativity**

10th Lecture

Causality

Causality

Causality is the relationship between an event (the cause) and a second event (the effect), where the second is a consequence of the first.

Theories of causality in Indian Philosophy focus mainly on the relationship between cause and effect. The various philosophical schools (*darsanas*) provide different theories.
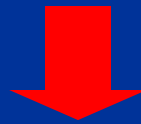
Causality in Eastern Philosophy

According to Lard Buddha's philosophy of causality, " **There is a cause for every effect and the cause precedes the effect !** "

$$t_{effect} - t_{cause} > 0_{always}$$

How do you explain "Child's Death" ???

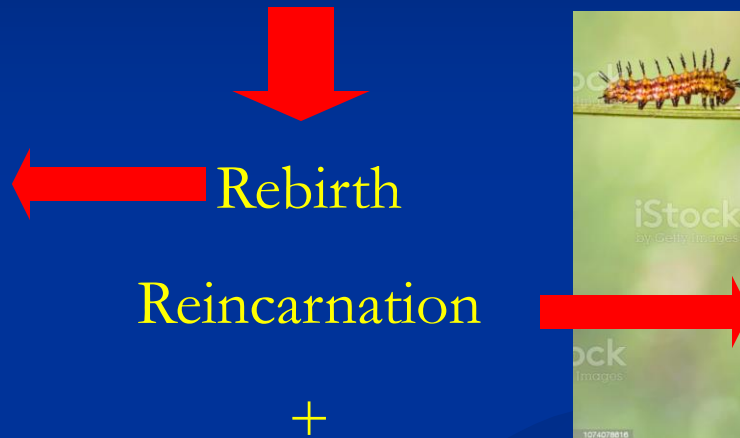How do you explain "Child's (foetus) Abortion" ???

Rebirth

Reincarnation

+

Karma

Causality in Eastern Philosophy

How do you explain "Child's Death" ???

How do you explain "Child's (fetus) Abortion" ???

Rebirth

Reincarnation

+

Karma

A new or second birth. The rebirth of the soul.

Buddhists believe that **when someone dies, they will be reborn again as something else**. What they are reborn as depends on their actions in their previous life (karma). The cycle of rebirth is called samsara and it is an ongoing cycle of life, death and rebirth.

eg: Caterpillar → Butterfly

Causality in Western Philosophy

According to the Newton's third law, " **every action has a reaction equal in magnitude and opposite in direction** "
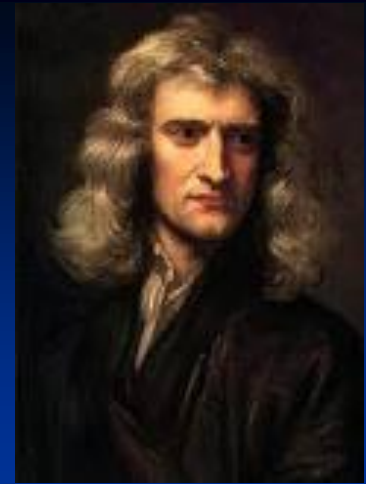
Whenever a particle A exerts a force on another particle B, B simultaneously exerts a force on A with the same magnitude in the opposite direction. The strong form of the law further postulates that these two forces act along the same line. Newton's third law is sometimes referred to as the **action-reaction law**.

Action → Cause

Reaction → Effect

$$t_{effect} - t_{cause} > 0_{always}$$

Causality

How the Special Theory of Relativity was strengthened by the concept of causality ???

If we consider some effect due to some cause in frame S,

For cause in frame S, $\boxed{(x_1,\ y_1,\ z_1,\ t_1)}$

For effect in frame S, $\boxed{(x_2,\ y_2,\ z_2,\ t_2)}$ where, $\boxed{t_2 > t_1}$

If we consider some effect due to some cause in frame S',

For cause in frame S', $\boxed{(x_1^1,\ y_1^1,\ z_1^1,\ t_1^1)}$

For effect in frame S', $\boxed{(x_2^1,\ y_2^1,\ z_2^1,\ t_2^1)}$ where, $\boxed{t_2^1 > t_1^1}$

Using the Lorentz Transformation Equation,

$$\boxed{t^1 = \gamma\left(t - \frac{v}{c^2}x\right)}$$ where, $\boxed{\gamma = \frac{1}{\sqrt{1 - v^2/c^2}}}$

How the Special Theory of Relativity was strengthened by the concept of causality ???

For cause ;
$$t_1^1 = \gamma\left(t_1 - \frac{v}{c^2}x_1\right)$$

For effect ;
$$t_2^1 = \gamma\left(t_2 - \frac{v}{c^2}x_2\right)$$

Then,
$$t_2^1 - t_1^1 = \gamma\left(t_2 - \frac{v}{c^2}x_2\right) - \gamma\left(t_1 - \frac{v}{c^2}x_1\right)$$

$$t_2^1 - t_1^1 = \gamma\left([t_2 - t_1] - \frac{v}{c^2}[x_2 - x_1]\right)$$

$$\Delta t^1 = \gamma\left(\Delta t - \frac{v}{c^2}\Delta x\right)$$

$$\Delta t^1 = \gamma\,\Delta t\left(1 - \frac{v}{c^2}\frac{\Delta x}{\Delta t}\right)$$

How the Special Theory of Relativity was strengthened by the concept of causality ???

$$\Delta t^{1} = \gamma \, \Delta t \left(1 - \frac{v}{c^{2}} \frac{\Delta x}{\Delta t} \right)$$

$$\Delta t^{1} = \gamma \, \Delta t \left(1 - \frac{v u}{c^{2}} \right)$$

If $\Delta t^{1} < 0$ ➡ $1 < \dfrac{u v}{c^{2}}$ because $\Delta t^{1} < 0$ & $\Delta t > 0$

∴ $c^{2} < u v$ ∴ $c < u$

Because relative velocity of the two frames S & S', v < c

In causality, $\Delta t^{1} < 0$ is not correct!

According to the causality, $\Delta t > 0$ and $\Delta t^{1} > 0$,

➡ $1 > \dfrac{u v}{c^{2}}$ that means $c^{2} > u v$

∴ $c > u$ because $c > v$

This result supports to the Einstein's Special Theory of Relativity !
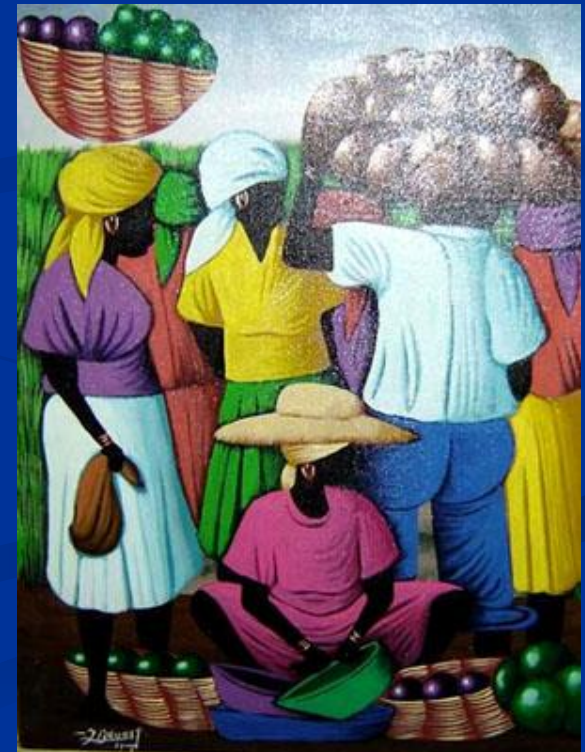
Special Theory of Relativity
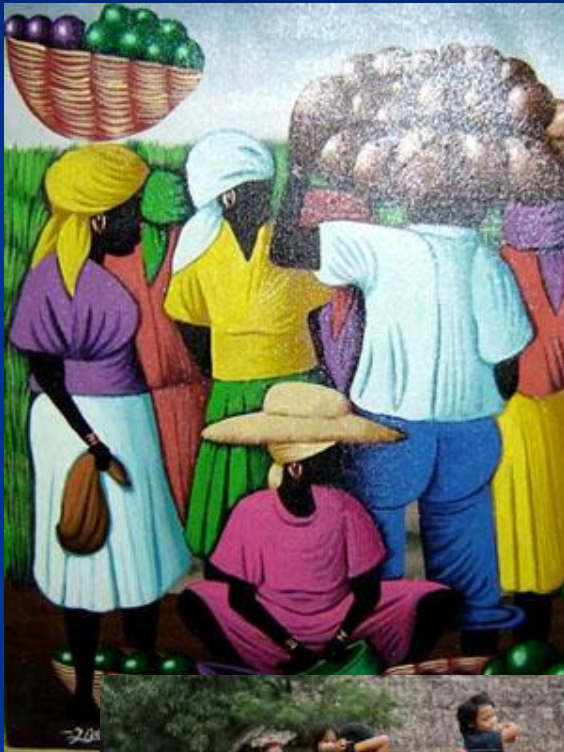
For day to day life

Special Theory of Relativity For day to day life

Love

Society

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Women

Men

Special Theory of Relativity For day to day life

Marriage

Politics

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Concepts

Views

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. . . .

General Theory of Relativity

Thank You !