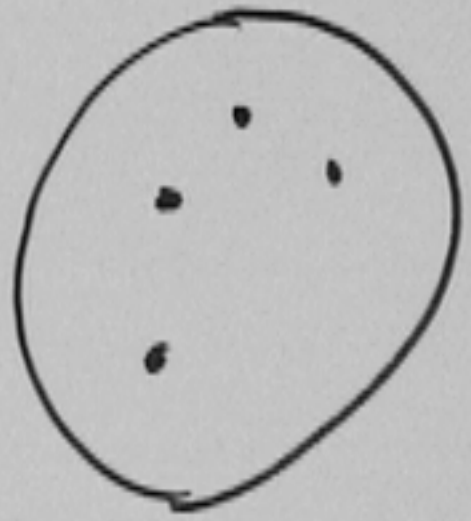
$$\underset{\sim}{u} = (\gamma_u u_x, \gamma_u u_y, \gamma_u u_z, \gamma_u ic)$$

$$\underset{\sim}{p} = (\underbrace{m_0 \gamma_u u_x}_{p_x}, \underbrace{m_0 \gamma_u u_y}_{p_y}, \overbrace{m_0 \gamma_u u_z}^{\rightarrow p_z}, \underbrace{m_0 \gamma_u ic}_{A_4})$$



$$A_4 = \underbrace{m_0 \gamma_\mu}\, i c$$

$$= m \frac{i c^2}{c}$$

$$= i \frac{m c^2}{c}$$

$$= i \frac{E}{c}$$

$$E = \gamma_u m_0 c^2$$

$$E_2 = \gamma_u m_0 c^2$$

$$E_1 = m_0 c^2$$

$$K = E_2 - E_1 = (\gamma_u - 1) m_0 c^2$$

$$= m c^2 - m_0 c^2$$

$$\underset{\sim}{p} \cdot \underset{\sim}{p}$$

$$p_x,\ p_y,\ p_z,\ i\frac{E}{c}$$

$$p_x,\ p_y,\ p_3,\ i\frac{E}{c}$$

$$p^2 - \frac{E^2}{c^2} = -m_0^2 c^2$$

$$p^2 c^2 - E^2 = -m_0^2 c^4$$

$$\underline{E^2 = p^2 c^2 + m_0^2 c^4}$$