Decay of Particle I [mln102]

Particle at rest decays into two particles:

Decay energy: $\epsilon = E_{\rm int}^{(0)} - E_{\rm int}^{(1)} - E_{\rm int}^{(2)}$ (change in internal energy).

Masses of decay products: m_1, m_2.

Momentum conservation: $\mathbf{p}_1 + \mathbf{p}_2 = 0, \quad p_1 = p_2 \doteq p.$

Energy conservation: $E_{\rm int}^{(0)} = E_{\rm int}^{(1)} + \dfrac{p^2}{2m_1} + E_{\rm int}^{(2)} + \dfrac{p^2}{2m_2}.$

$$\Rightarrow \ \epsilon = \frac{p^2}{2m} = T_1 + T_2.$$

Reduced mass $m = \dfrac{m_1 m_2}{m_1 + m_2}.$

Kinetic energies: $T_1 = \dfrac{p^2}{2m_1} = \dfrac{\epsilon m_2}{m_1 + m_2}, \quad T_2 = \dfrac{p^2}{2m_2} = \dfrac{\epsilon m_1}{m_1 + m_2}.$

- Decay products move in opposite directions.
- All directions of $\mathbf{p_1}$ equally likely.
- Kinetic energies T_1, T_2 determined by conservation laws alone.

Particle at rest decays into three particles:

Decay energy: $\epsilon = E_{\rm int}^{(0)} - E_{\rm int}^{(1)} - E_{\rm int}^{(2)} - E_{\rm int}^{(3)}.$

Masses of decay products: m_1, m_2, m_3.

Momentum conservation: $\mathbf{p}_1 + \mathbf{p}_2 + \mathbf{p}_3 = 0.$

Energy conservation: $E_{\rm int}^{(0)} = E_{\rm int}^{(1)} + \dfrac{p_1^2}{2m_1} + E_{\rm int}^{(2)} + \dfrac{p_2^2}{2m_2} + E_{\rm int}^{(3)} + \dfrac{p_3^2}{2m_3}.$

- Relative directions between decay products constrained but not determined by conservation laws.
- Kinetic energies T_1, T_2, T_3 constrained but not determined by conservation laws.
- Maximum kinetic energy T_i limited by ϵ, m_i. →[mex237]