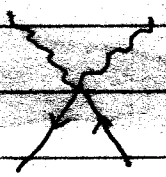
PREPARED BY | DATE

Quiz 9

Sec 0101 $e^+e^- \rightarrow \gamma\gamma$



Momentum conservation says that the two photons leave back to back with equal magnitudes $p_{\gamma_1} = p_{\gamma_2}$. Energy conservation says $2m_ec^2 = E_{\gamma_1} + E_{\gamma_2}$. Since $E^2 = p^2c^2 + (mc^2)^2$ and photons have no mass, $E_\gamma = p_\gamma c$. So

$$2m_ec^2 = 2E_\gamma \Rightarrow E_\gamma = m_ec^2.$$

Sec 0104 $^2H + {}^2H \rightarrow {}^4He$

The hydrogens start at rest, so they both have only rest energy $E_H = m_Hc^2$. The helium, by momentum conservation, must also be at rest, so it has energy $E_{He} = m_{He}c^2$. Energy conservation then says

$$2E_H = 2m_Hc^2 = m_{He}c^2 + E_{out} = E_{He} + E_{out}$$

So $E_{out} = (2m_H - m_{He})c^2$

Sec 0105 $pp \rightarrow pp\pi^0$

For the smallest possible kinetic energy of the ingoing protons, assume all outgoing particles are at rest. Then energy conservation says

$$E_{in} + 2m_pc^2 = 2m_pc^2 + m_\pi c^2$$

$$\Rightarrow E_{in} = m_\pi c^2 \quad \text{For equal } K_{initial} \Rightarrow K_{init} = \frac{m_\pi c^2}{2}$$