# 大学物理第八次作业

9.3, 9.6, 9.13, 9.17, 9.19

9.3

(a)

已知 
$$l_0=200~\mathrm{m}, \beta=0.60, x'=-200~\mathrm{m}$$

$$\because t = \gamma(t' + \frac{u}{c^2}x')$$

$$\therefore t' = -\frac{u}{c^2}x' = \frac{0.6 \times 200 \text{ m}}{c} = 0.40 \ \mu\text{s}$$

(b)

$$\therefore x' = \gamma(x - ut)$$

$$\therefore t = -\frac{x'}{\gamma u} = 0.89 \ \mu s$$

(c)

$$\therefore x = \gamma(x' + ut')$$

$$\therefore t' = \frac{-x'}{u} = 1.1 \ \mu s$$

9.6

$$\therefore eta = rac{\left(rac{\lambda}{\lambda_0}
ight)^2 - 1}{\left(rac{\lambda}{\lambda_0}
ight)^2 + 1} = 0.742$$

$$\therefore v = \sqrt{rac{1-eta}{1+eta}}c = 2.23 imes 10^8 ext{ m/s}$$

$$\because v_x' = \frac{v_x - u}{1 - v_x \frac{u}{c^2}}$$

$$\therefore v'_x = -u$$

$$v_y'=rac{v_y}{\gamma}=0.48c$$

$$\theta = \arctan \frac{0.48c}{0.80c} = 31^{\circ}$$

## 9.17

不妨假设原来  $\Sigma$  速度  $v_0$  方向向右,且  $\pi$  介子方向向上, $E_k=\frac{1}{2}m_\Sigma v_0^2=250~{
m MeV}$  假设中子向下速度为  $v_y$ ,向右速度为  $v_x=v_0$ 

### 由竖直动量守恒

$$\therefore m_{\pi}v_y' = m_n v_y$$

#### 由能量守恒

$$\therefore rac{1}{2}m_{\Sigma}v_{0}^{2}+(m_{\Sigma}c^{2}-m_{\pi}c^{2}-m_{n}c^{2})=rac{1}{2}m_{\pi}v_{y}'^{2}+rac{1}{2}m_{n}v_{y}^{2}+rac{1}{2}m_{n}v_{0}^{2}$$

最终可解得结果, 且中子运动方向向右下方.

## 9.19

$$\therefore p^2c^2 = E^2 - m_0^2c^4 = E^2\left(1 - rac{m_0^2}{m^2}
ight) = E^2\left(1 - rac{1}{\gamma^2}
ight)$$

$$\therefore p = rac{E}{c} \left(1 - rac{1}{\gamma^2}
ight)^{rac{1}{2}} pprox rac{E}{c} \left(1 - rac{1}{2\gamma^2}
ight)^{rac{1}{2}}$$