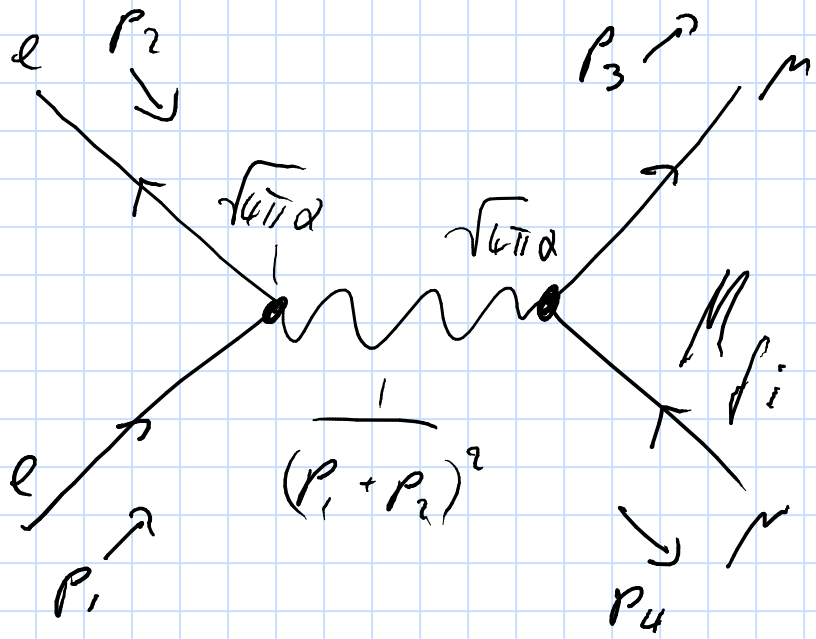
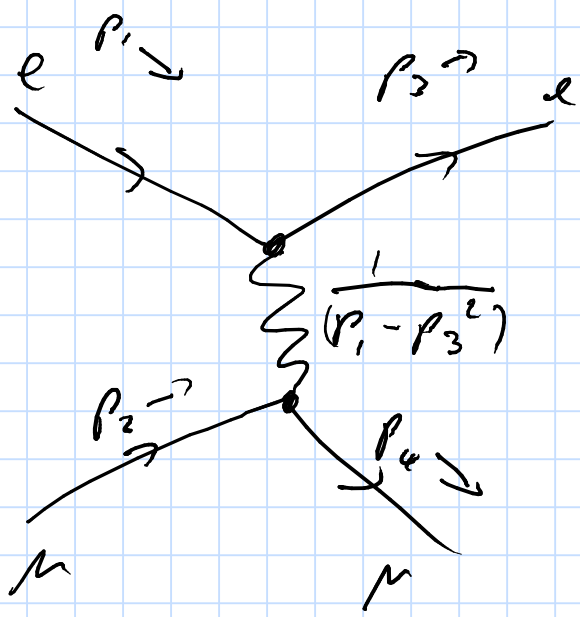


$$\mathcal{M}_{fi} \simeq \frac{4\pi\alpha}{E_{cm}^2} \simeq \frac{4\pi\alpha}{s}$$



$$\mathcal{M}_{fi} \simeq \frac{4\pi\alpha}{(p_1-p_3)^2}$$

$$(p_1-p_3)^2 = p_1^2 + p_3^2 - 2p_1\cdot p_3$$

$$= 2m_e^2 - 2(E_1\cdot E_3 - \vec{p}_1\cdot\vec{p}_3)$$

for $E \gg m_{e,\mu}$: $E = |\vec{p}|$

also, in cm frame: $\vec{p}_1 = -\vec{p}_2$

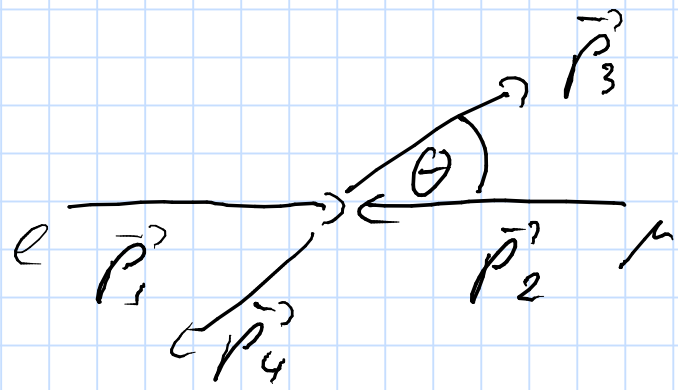
$$p_3 = -p_4$$

$$|\vec{p}_1| = |\vec{p}_3|$$

Then:

$$(p_1-p_3)^2 \simeq 2m_e^2 + 2E_1^2(1-\cos\theta)$$

$$\simeq 2E_1^2(1-\cos\theta) = \frac{1}{2}s(1-\cos\theta)$$



$$\mathcal{M}_{fi} = \frac{8\pi\alpha}{s(1-\cos\theta)}$$