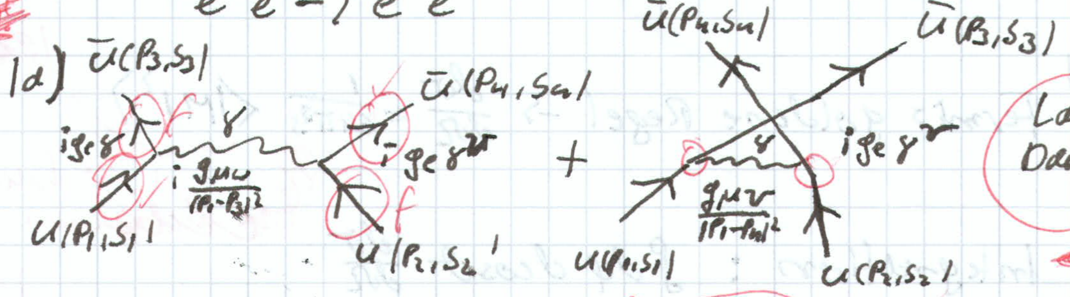
Blatt 9

Lars David

$e^-e^- \to e^-e^-$

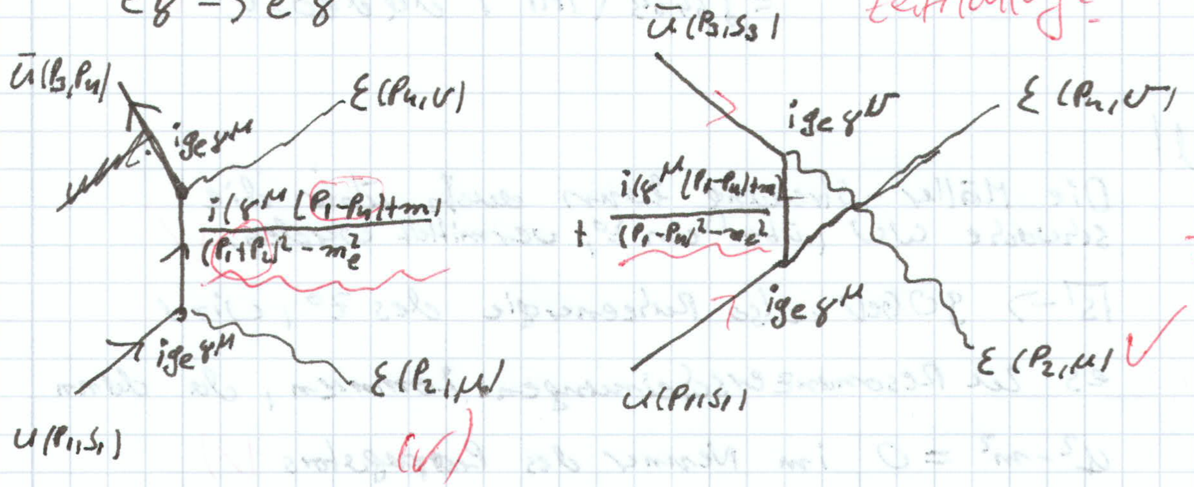
1a)



1,5P

Zeitrichtung?

$e^-\gamma \to e^-\gamma$



2,5P

b) Møller-Streuung $\quad M = M_1 + M_2$ f

$$M_1 = i\int\frac{d^4q}{(2\pi)^4}\cdot\left(\bar u(p_3,s_3)\cdot(ig_e\gamma^\mu)u(p_1,s_1)\right)\cdot(2\pi)^4\delta(p_3+p_4-(p_1-p_3))$$
$$\cdot\left(-\frac{ig_{\mu\nu}}{(p_1-p_3)^2}\right)\cdot\left(\bar u(p_4,s_4)\cdot(ig_e\gamma^\mu u(p_2,s_2)\right]$$
$$= \frac{-g_e^2}{(p_1-p_3)^2}\left[\bar u(p_3,s_3)\gamma^\mu u(p_1,s_1)\right]\left[\bar u(p_4,s_4)\gamma_\mu u(p_2,s_2)\right]$$

$$M_2 = \frac{g_e^2}{(p_1-p_4)^2}\left[\bar u(p_4,s_4)\gamma^\mu u(p_1,s_1)\right]\left[\bar u(p_3,s_3)\gamma_\mu u(p_2,s_2)\right]$$

2P

Compton-Streuung

$$M_1 = i\int\varepsilon_\mu(p_2)\left[\bar u(p_3,s_3)(ig_e\gamma^\nu)\left(i\left(\frac{\gamma^\mu(p_1+p_2)_\mu+m_e}{(p_1+p_2)^2-m_e^2}\right)\right)(ig_e\gamma^\mu u(p_1,s_1)\right]\cdot$$
$$\cdot\,\varepsilon_\nu(p_4)(2\pi)^4\delta^4(-p_4+p_1-(p_1+p_2))(\delta^4(p_2-p_3+p_1+p_2)\,d^4q$$

$$M_2 = i\int\varepsilon_\mu(p_2)\left[\bar u(p_3,s_3)(ig_e\gamma^\nu)\left(\frac{i(\gamma^\mu(p_1-p_4)_\mu+m_e}{(p_1-p_4)^2-m_e^2}\right)(ig_e\gamma^\mu)u(p_1,s_1)\right]$$
$$\varepsilon_\nu(p_4)(2\pi)^4\delta^4(p_1-p_4-(p_1-p_4))\,\delta^4(p_2-p_3+p_1+p_2)\,d^4q$$

2P

$$M_1 = \frac{g_e^2}{(p_1+p_2)^2-m_e^2}\left[\bar u(p_3,s_3)\gamma^\mu\varepsilon_\mu(p_4)(\gamma^\mu(p_1+p_2)+m_e)\gamma^\nu\varepsilon_\nu(p_2)u(p_1,s_1)\right]$$

$$M_2 = \frac{g_e^2}{(p_1-p_4)^2-m_e^2}\left[\bar u(p_3,s_3)\gamma^\mu\varepsilon_\mu(p_2)(\gamma^\mu(p_1-p_4)_\mu+m_e)\gamma^\mu\varepsilon_\nu(p_4)u(p_1,s_1)\right.$$

c) Fermis goldene Regel $\rightarrow \frac{d\sigma}{d\Omega} = \frac{1}{64\pi^2 s} \langle |M|^2 \rangle$ ✓

~~Woher bekommt~~ Wie bekommt man das?

Integration : $\int d\varphi \, d\cos\vartheta \, \frac{d\sigma}{d\Omega}$

$= \int \frac{1}{64\pi^2 s} \langle |M|^2 \rangle \, d\varphi \, d\cos\vartheta$ ✓

Vertauschbarkeit?

1P

d) Die Möller-Streuung kann auch über die schwache WW, über ein Z^0, vermittelt werden. ✓

$\sqrt{s} \rightarrow 90$ GeV, also Ruheenergie des Z^0, wird es zu Resonanzerscheinungen kommen, da denn $q^2 - m^2 = 0$ im Nenner des Propagators (✓)

Compton Streuung kann nicht anders vermittelt werden. ✓
Die Photonen sind reell & der Propagator ist der eines Elektrons

2P

11P