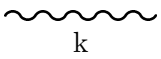
C Feynman rules of the Glashow-Weinberg-Salam model

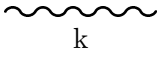
C.1 Propagators

Massless spin 1 boson (Feynman gauge)



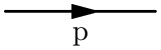
$$-i\,\frac{g^{\mu\,\nu}}{k^2+i\,\epsilon} \tag{C.1}$$

Massive spin 1 boson



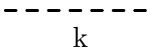
$$-i\,\frac{g^{\mu\nu}-k^{\mu}k^{\nu}/M^2}{k^2-M^2+i\,\epsilon} \tag{C.2}$$

Fermion



$$i\,\frac{\not{p}+m}{p^2-m^2+i\,\epsilon} \tag{C.3}$$

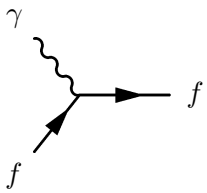
Massive spin 0 boson



$$\frac{i}{k^2-m^2+i\,\epsilon} \tag{C.4}$$

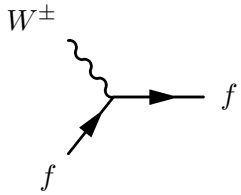
C.2 Vertices

Fermion-fermion-γ vertex



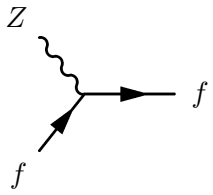
$$-i\,Q_e\,e\,\gamma^{\mu} \tag{C.5}$$

Fermion-fermion-$W^{\pm}$ vertex



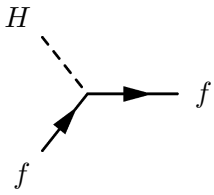
$$-i\,\frac{e}{2\sqrt{2}\,\sin\theta_W}\,\gamma^{\mu}\,(1-\gamma^5) \tag{C.6}$$

Fermion-fermion-Z vertex



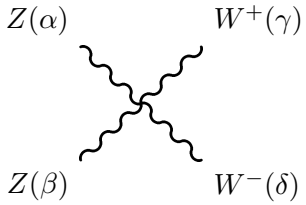
$$-i\,\frac{e}{2\,\sin\theta_{_W}\cos\theta_{_W}}\,\gamma^{\mu}\,\left[\left(I_3^f-2\,Q_f\,\sin^2\theta_{_W}\right)-I_3^f\,\gamma^5\right] \tag{C.7}$$

Fermion-fermion-H vertex



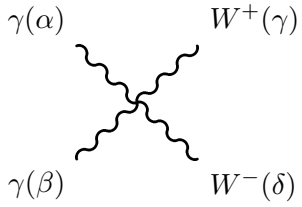
$$-i\,\frac{e}{2\,\sin^2\theta_{_W}}\frac{m_f}{M_{_W}} \tag{C.8}$$

Z-Z-W^+-W^- vertex



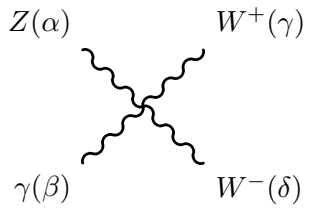
$$i\,e^2\,\frac{\cos^2\theta_{_W}}{\sin^2\theta_{_W}}\,\left[g^{\alpha\delta}g^{\beta\gamma}+g^{\alpha\gamma}g^{\beta\delta}-2\,g^{\alpha\beta}g^{\gamma\delta}\right] \tag{C.9}$$

γ-γ-W^+-W^- vertex



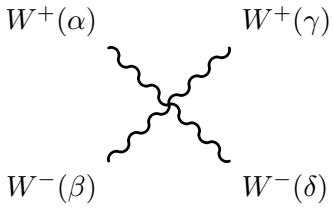
$$i\,e^2\,\left[g^{\alpha\delta}g^{\beta\gamma}+g^{\alpha\gamma}g^{\beta\delta}-2\,g^{\alpha\beta}g^{\gamma\delta}\right] \tag{C.10}$$

Z-γ-W^+-W^- vertex



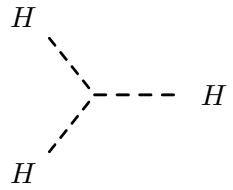
$$i\,e^2\,\frac{\cos\theta_W}{\sin\theta_W}\,\Big[g^{\alpha\delta}g^{\beta\gamma}+g^{\alpha\gamma}g^{\beta\delta}-2\,g^{\alpha\beta}g^{\gamma\delta}\Big] \tag{C.11}$$

W^+-W^--W^+-W^- vertex



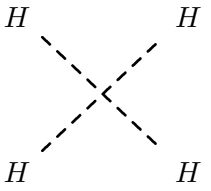
$$i\,\frac{e^2}{\sin^2\theta_W}\,\Big[g^{\alpha\delta}g^{\beta\gamma}+g^{\alpha\gamma}g^{\beta\delta}-2\,g^{\alpha\beta}g^{\gamma\delta}\Big] \tag{C.12}$$

H-H-H vertex



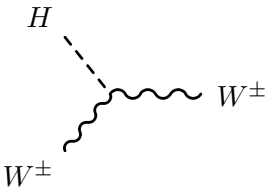
$$-\,i\,\frac{3}{2}\,\frac{e}{\sin\theta_W}\,\frac{M_H^2}{M_W} \tag{C.13}$$

H-H-H-H vertex



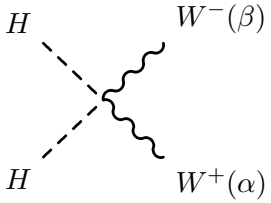
$$-\,i\,\frac{3}{4}\,\frac{e^2}{\sin^2\theta_W}\,\frac{M_H^2}{M_W^2} \tag{C.14}$$

H-W^+-W^- vertex



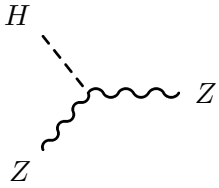
$$i\,\frac{e}{\sin\theta_W}\,M_W\,g^{\alpha\beta} \tag{C.15}$$

H-H-W^+-W^- vertex



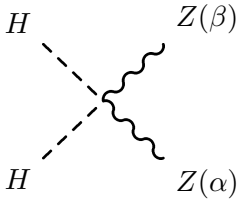
$$i\,\frac{e^2}{2\sin^2\theta_{_W}}\,g^{\alpha\beta} \tag{C.16}$$

H-Z-Z vertex



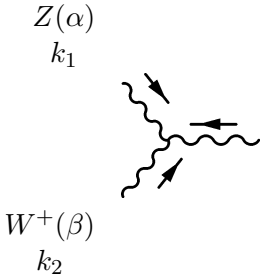
$$i\,\frac{e}{\sin\theta_{_W}\,\cos\theta_{_W}}\,M_{_Z}\,g^{\alpha\beta} \tag{C.17}$$

H-H-Z-Z vertex



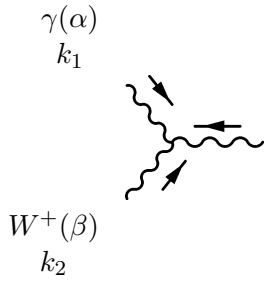
$$i\,\frac{e^2}{2\,\sin^2\theta_{_W}\,\cos^2\theta_{_W}}\,g^{\alpha\beta} \tag{C.18}$$

Z-W^+-W^- vertex



$$i\,e\,\frac{\cos\theta_{_W}}{\sin\theta_{_W}}\,\Big[g^{\alpha\beta}(k_1-k_2)^\gamma + g^{\beta\gamma}(k_2-k_3)^\alpha + g^{\gamma\alpha}(k_3-k_1)^\beta\Big] \tag{C.19}$$

γ-W^+-W^- vertex



$$i\,e\,\Big[g^{\alpha\beta}(k_1-k_2)^{\gamma}+g^{\beta\gamma}(k_2-k_3)^{\alpha}+g^{\gamma\alpha}(k_3-k_1)^{\beta}\Big] \tag{C.20}$$