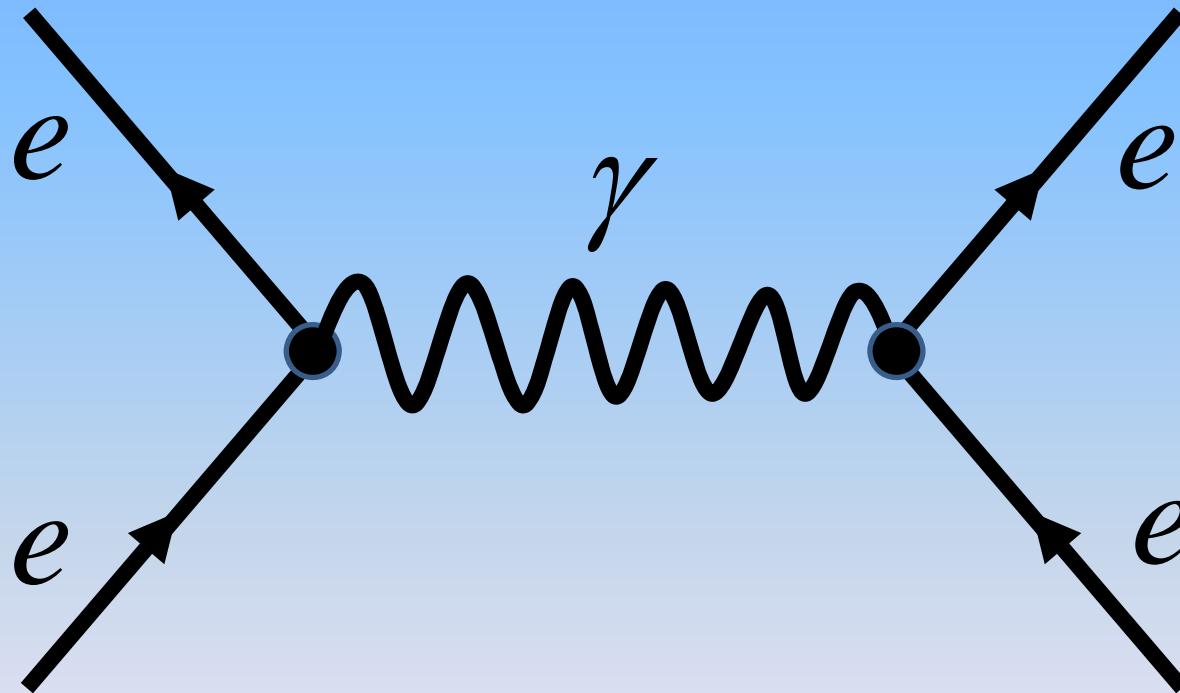
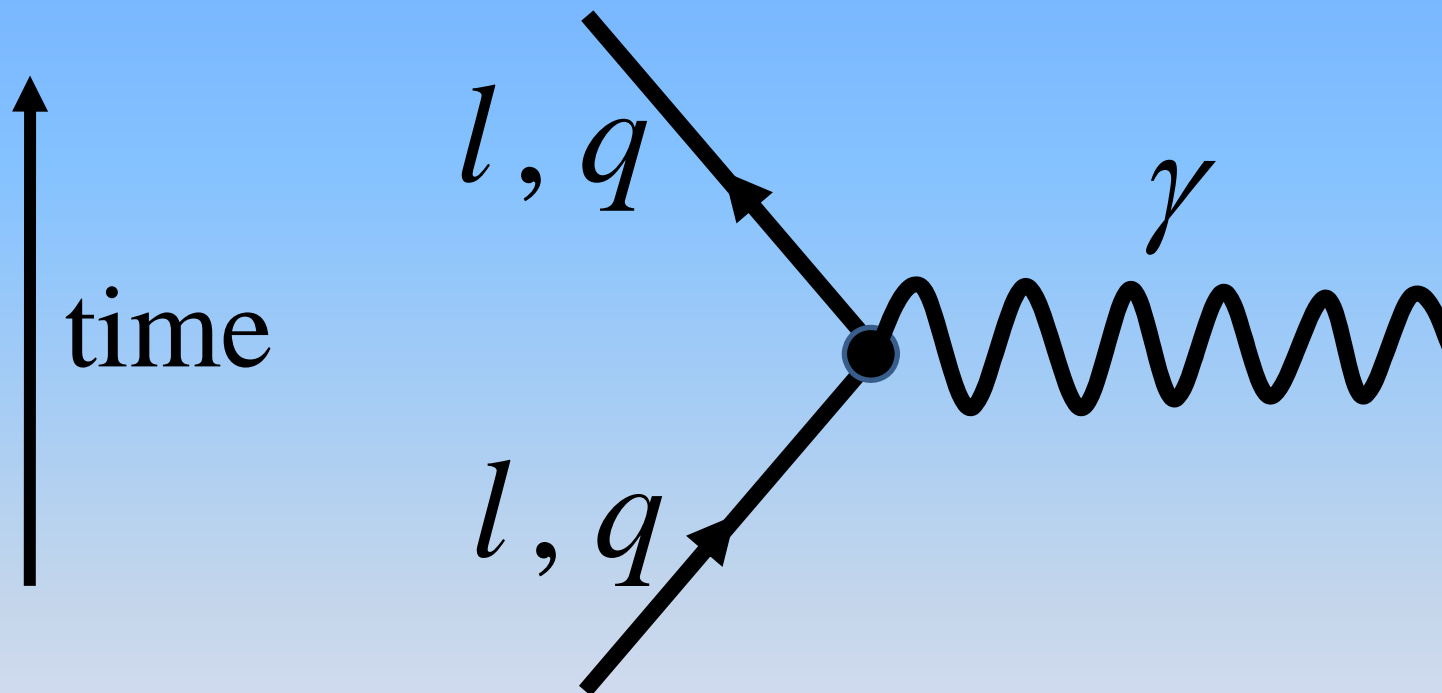


The Feynman Diagrams

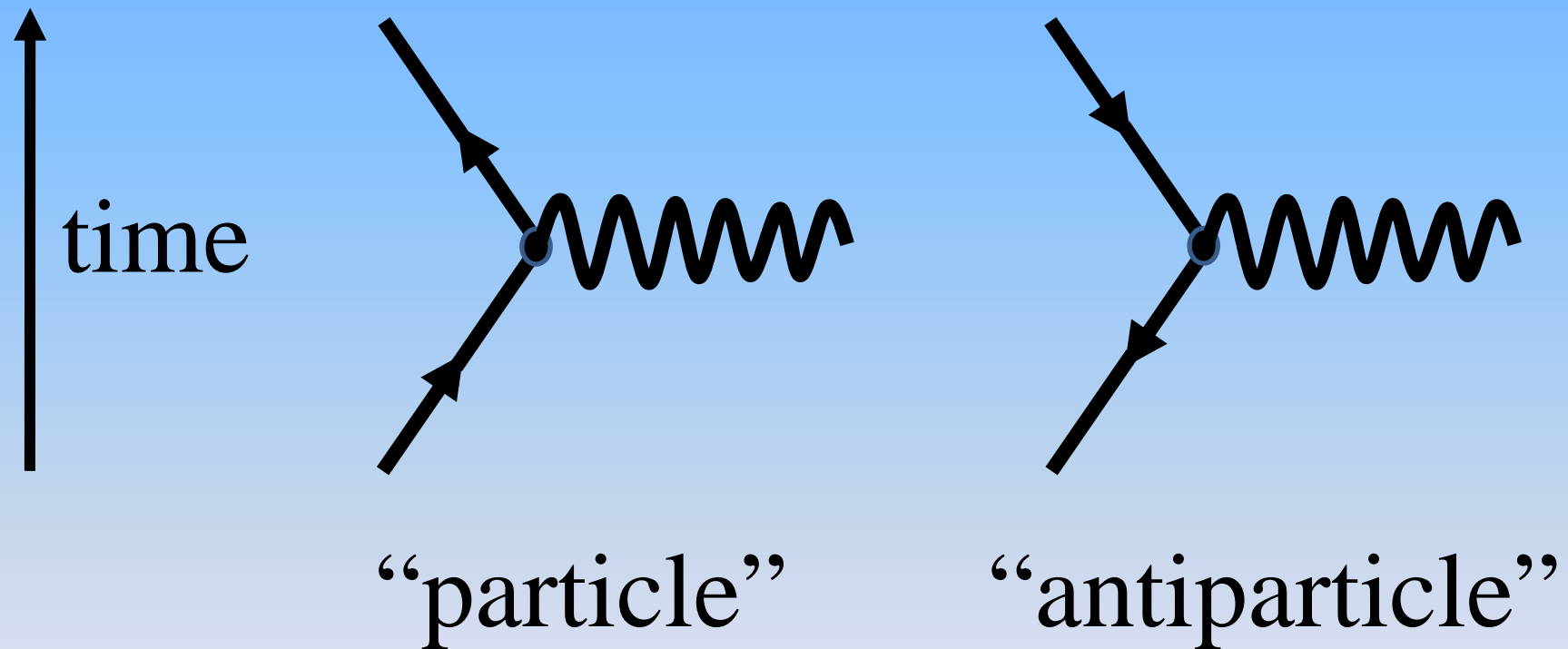


Quantum Electrodynamics (QED)

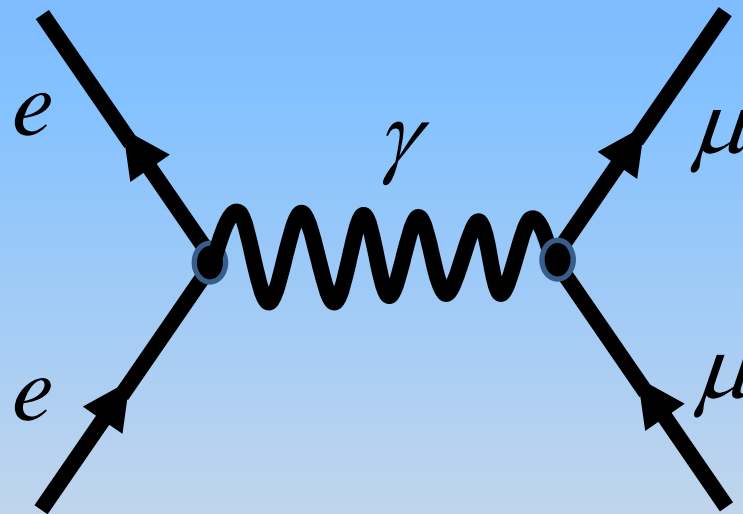


“Primitive Vertex”

Quantum Electrodynamics (QED)



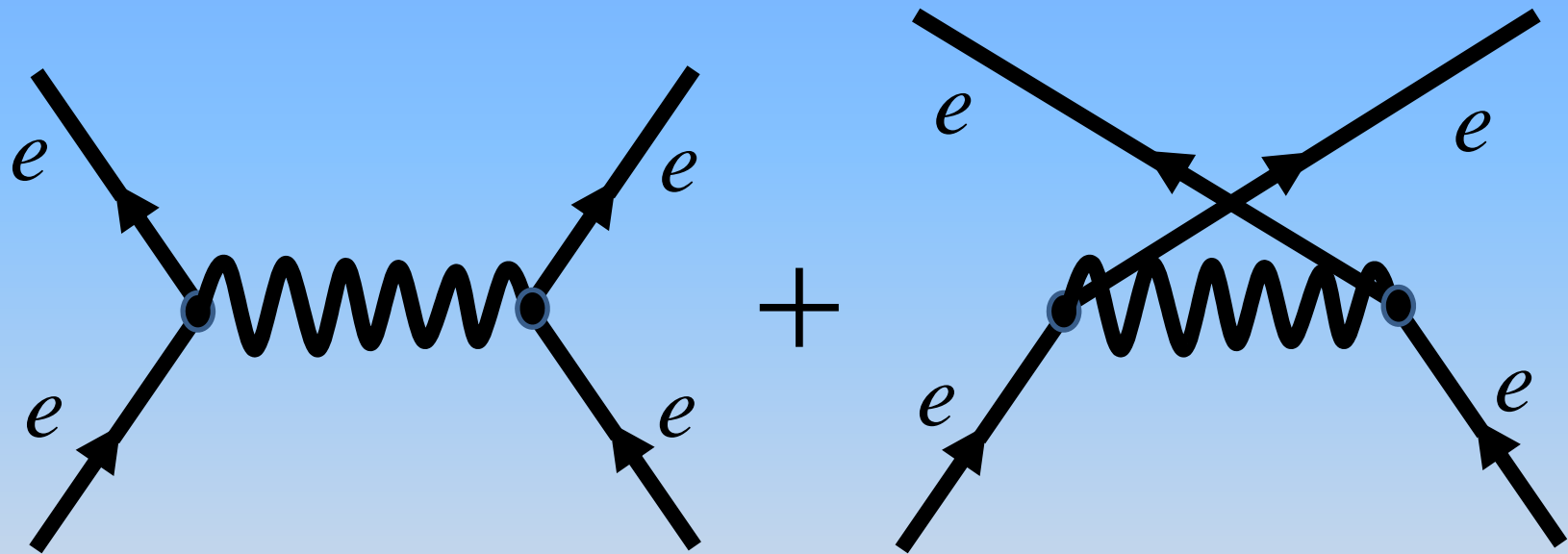
Quantum Electrodynamics (QED)



$$e^{-} + \mu^{-} \rightarrow e^{-} + \mu^{-}$$

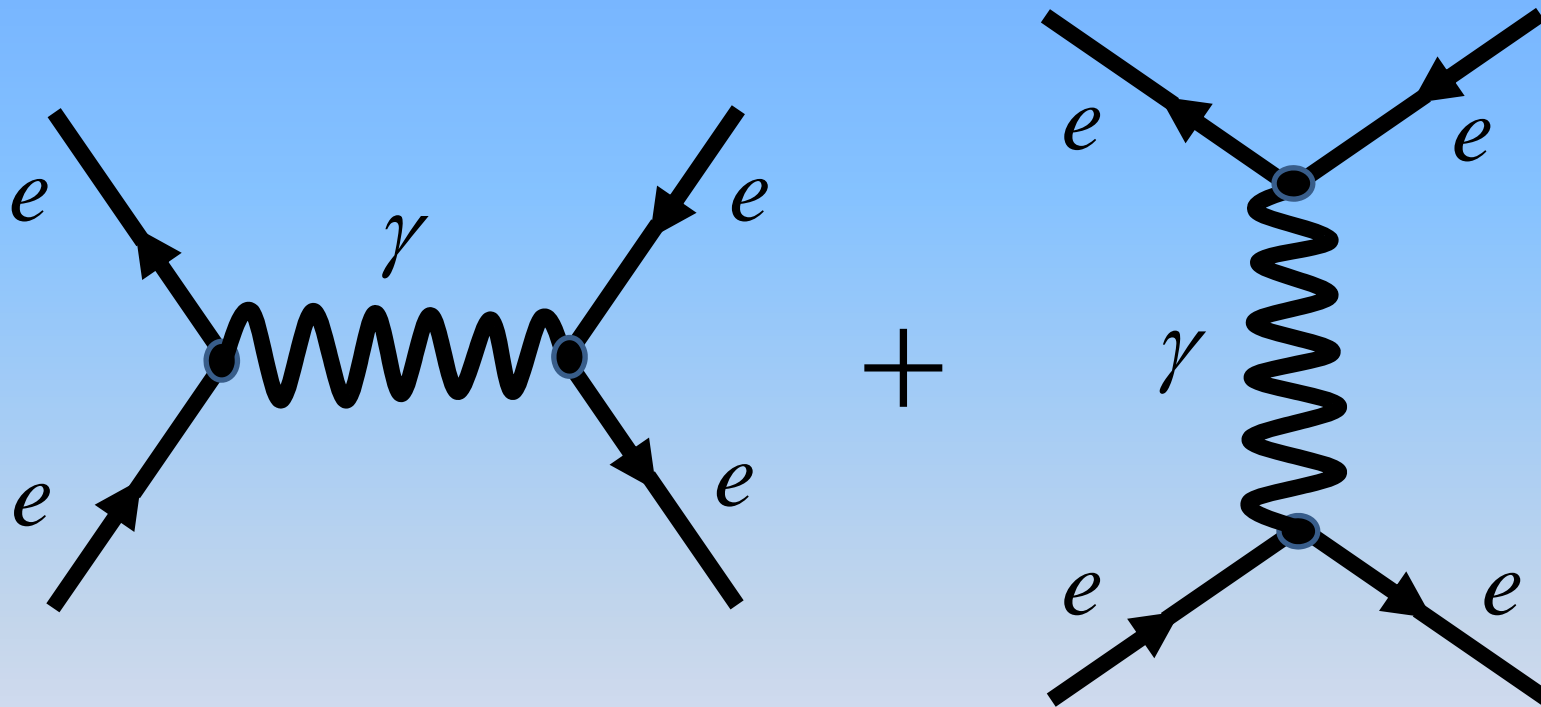
“Lowest Order Diagram”

Quantum Electrodynamics (QED)



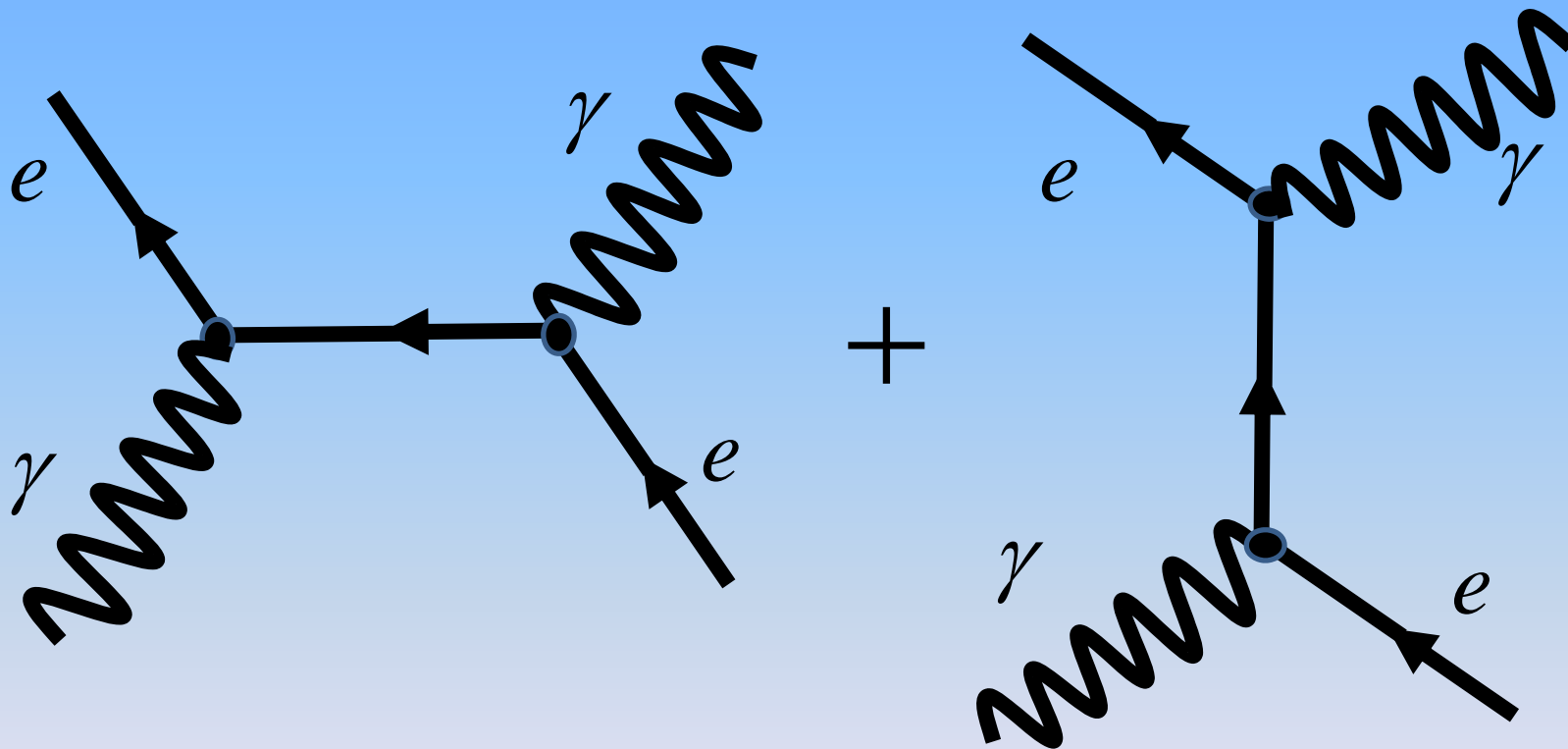
$$e^{-} + e^{-} \rightarrow e^{-} + e^{-}$$

Quantum Electrodynamics (QED)



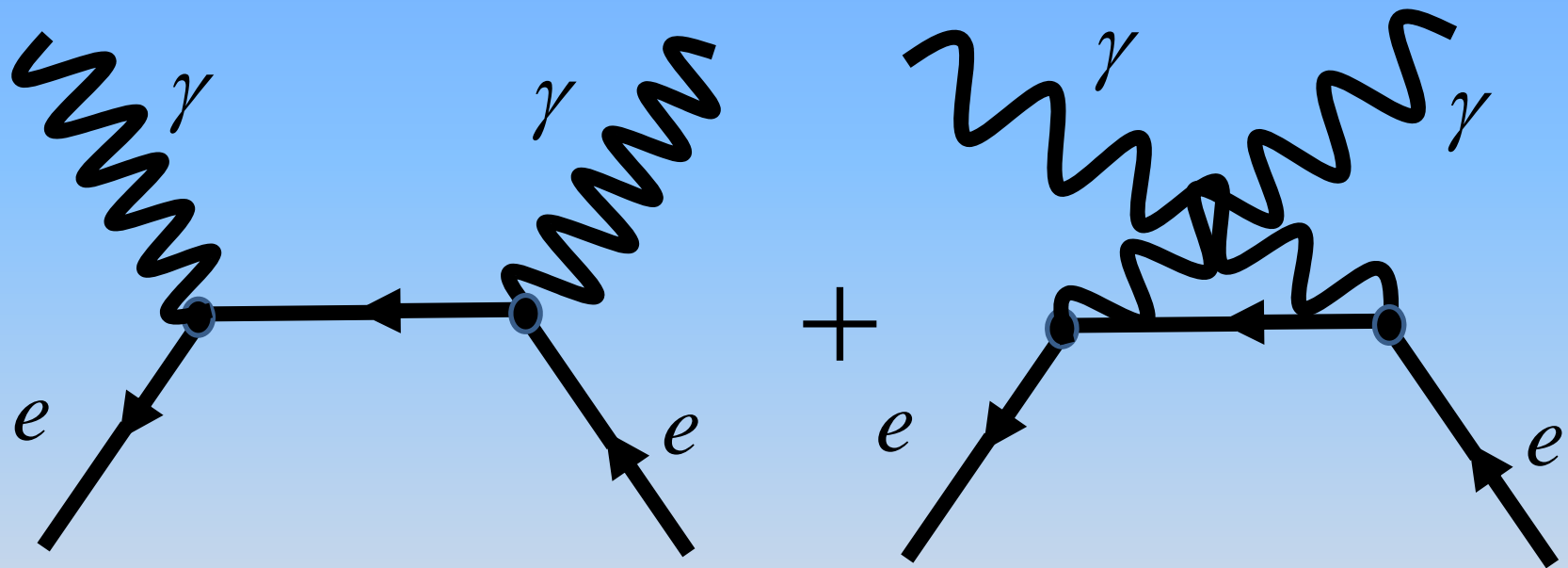
$$e^- + e^+ \rightarrow e^- + e^+$$

Quantum Electrodynamics (QED)



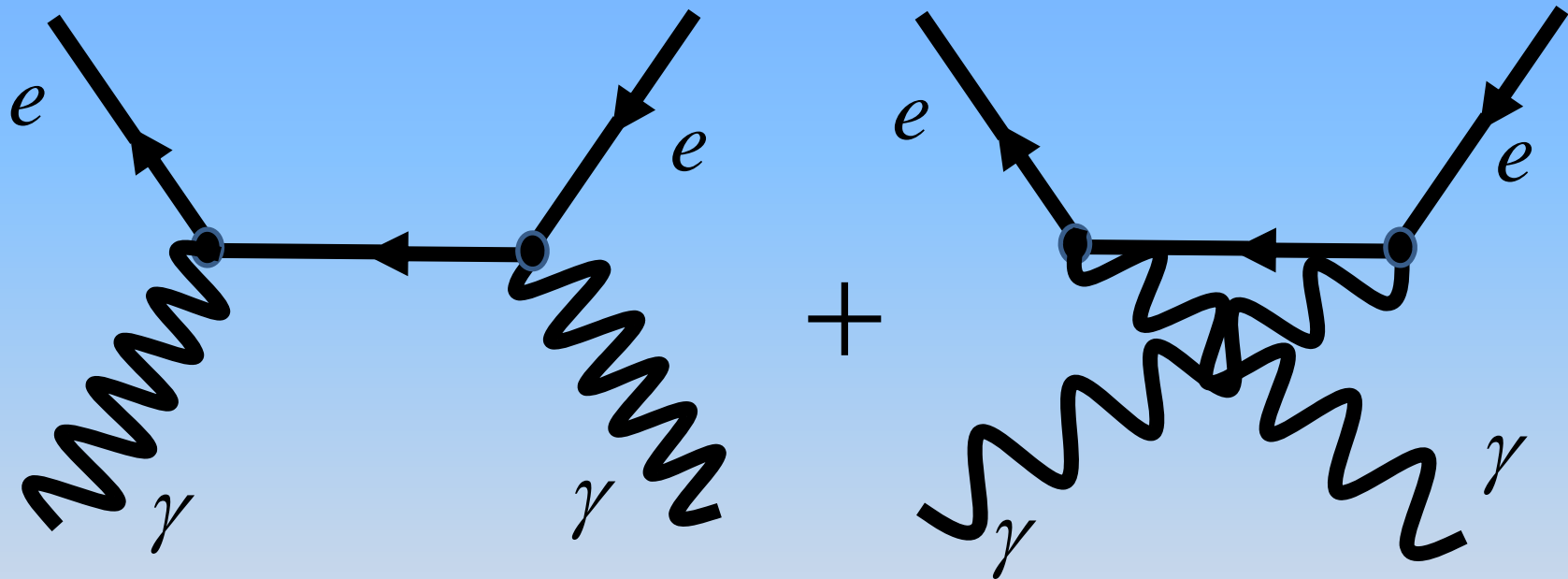
$$\gamma + e^{-} \rightarrow \gamma + e^{-}$$

Quantum Electrodynamics (QED)



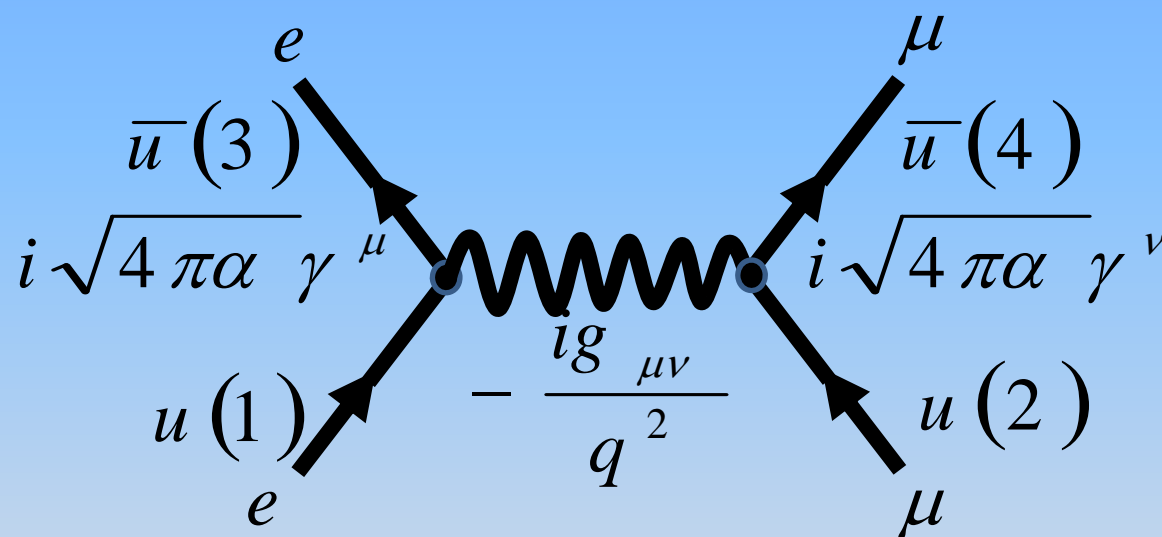
$$e^{-} + e^{+} \rightarrow \gamma + \gamma$$

Quantum Electrodynamics (QED)



$$\gamma + \gamma \rightarrow e^{-} + e^{+}$$

Quantum Electrodynamics (QED)

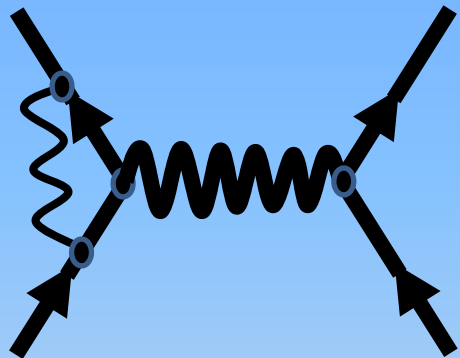


$$\alpha \approx \frac{1}{137}$$

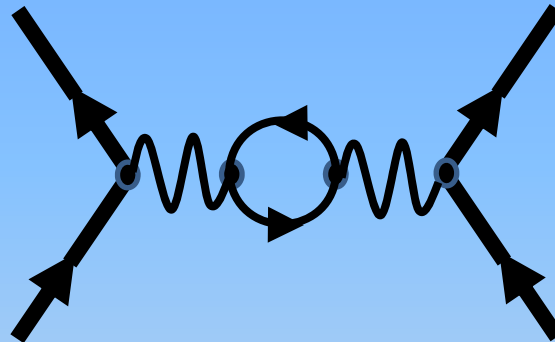
“Fine-structure Constant”

$$\mathcal{M} = -\frac{4\pi\alpha}{q^2} [\bar{u}(3)\gamma^\mu u(1)] [\bar{u}(4)\gamma_\mu u(2)]$$

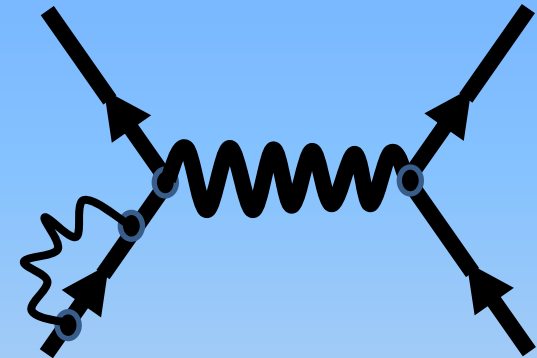
Quantum Electrodynamics (QED)



“vertex
correction”



“vacuum
polarization”



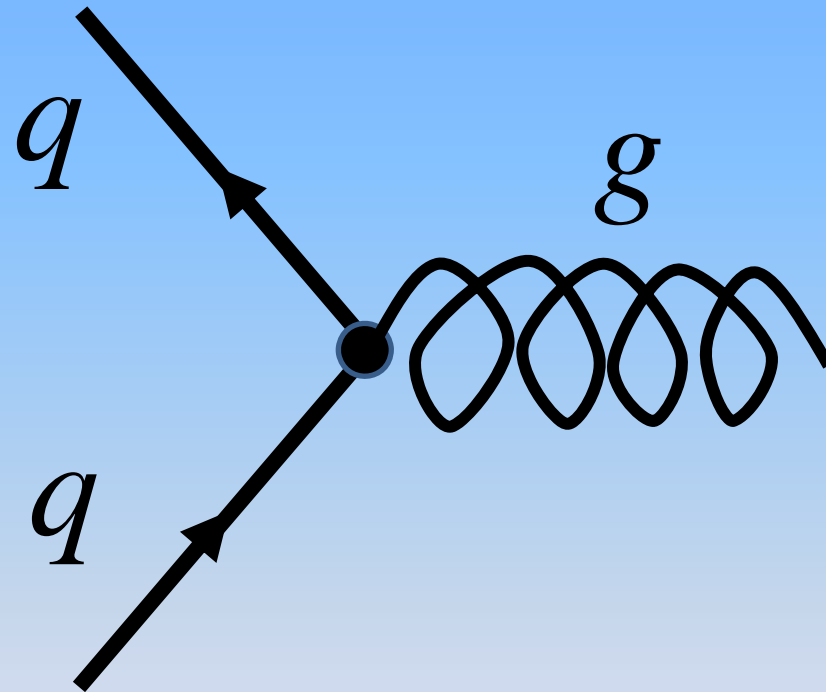
“self-energy”

“Higher Order Diagrams”



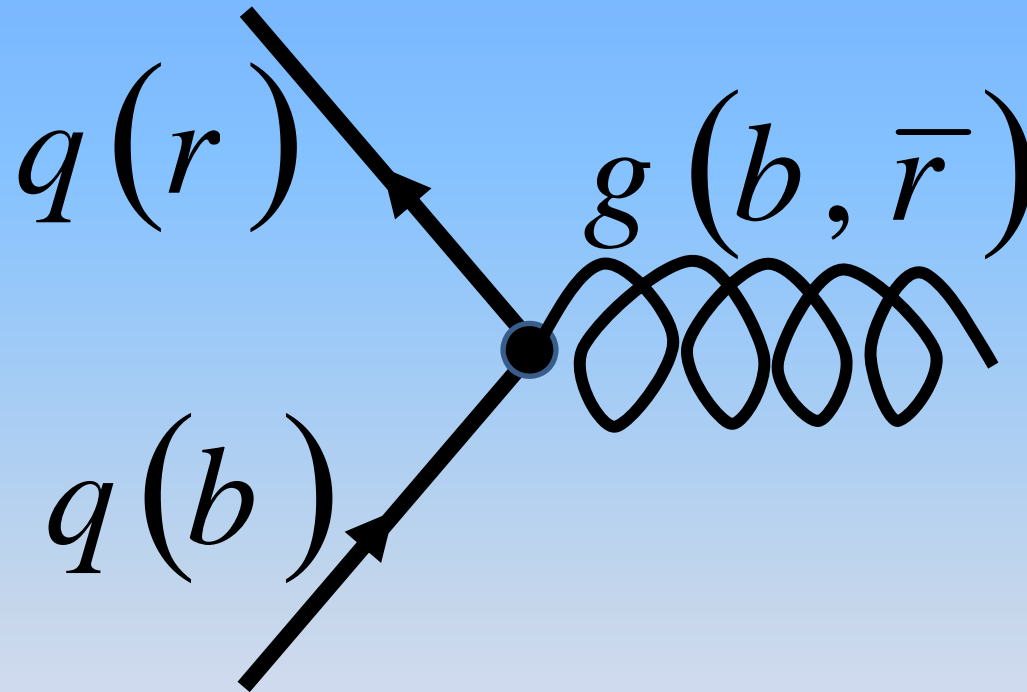
“Renormalization”

Quantum Chromodynamics (QCD)



“Primitive Vertex”

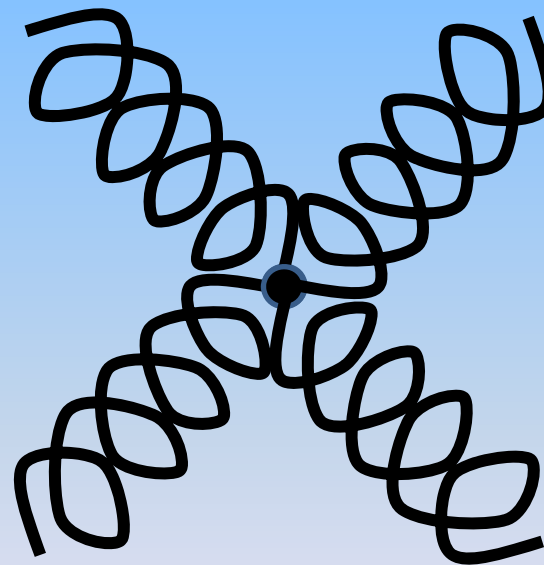
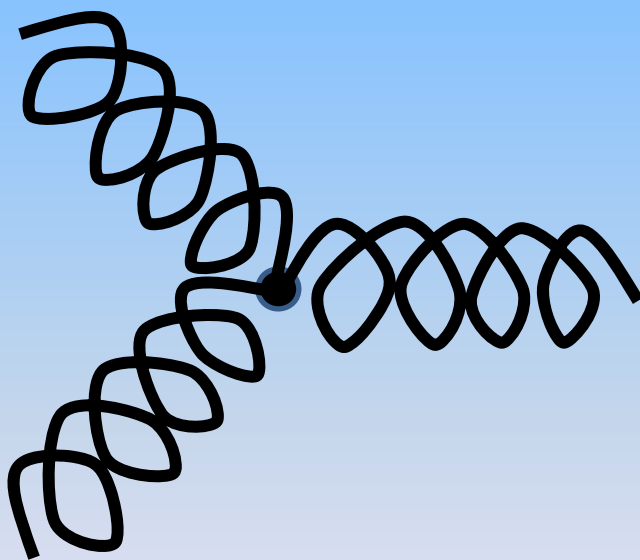
Quantum Chromodynamics (QCD)



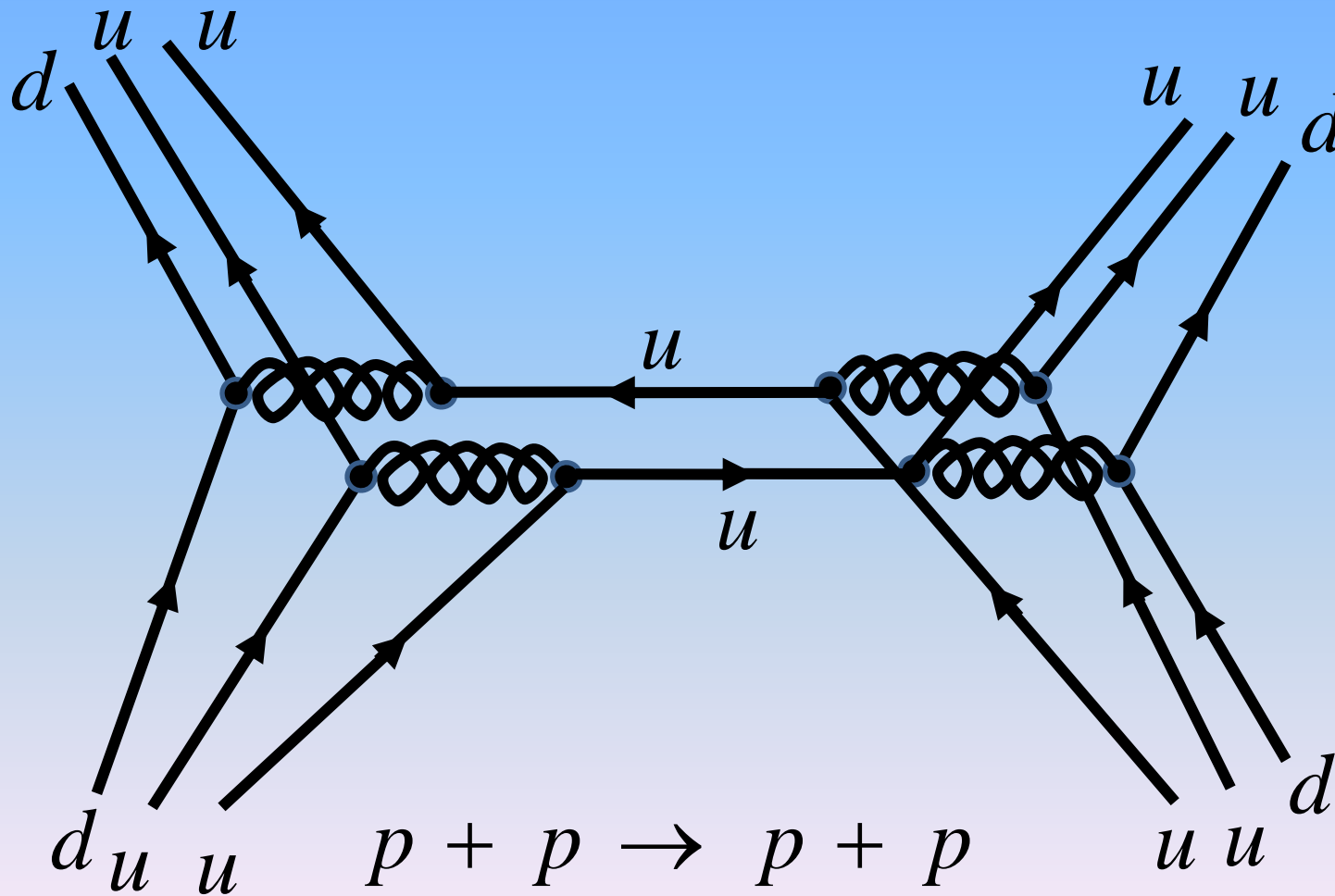
“Color Charges”

Quantum Chromodynamics (QCD)

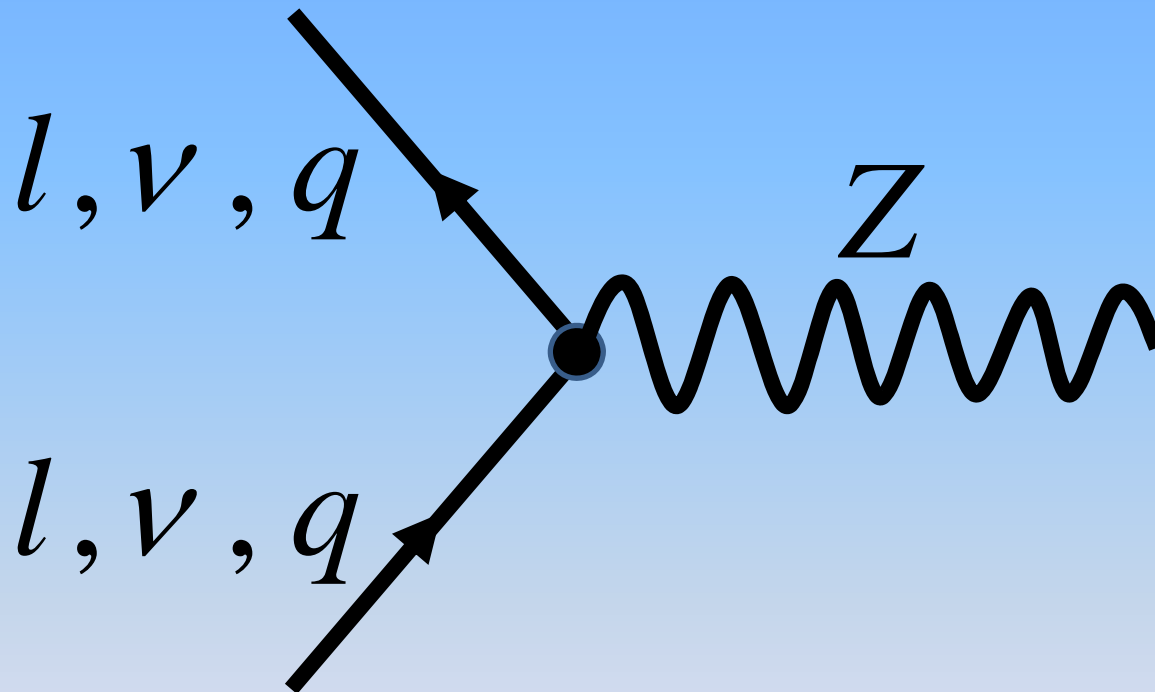
However, ...



Quantum Chromodynamics (QCD)

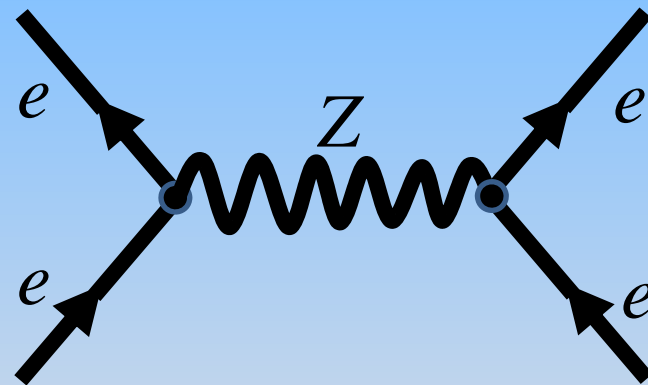
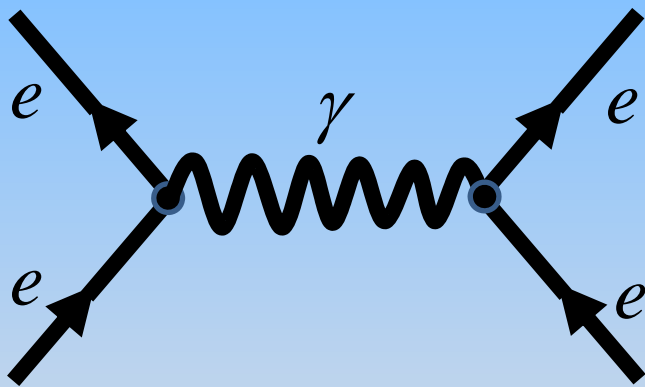


Weak Interactions

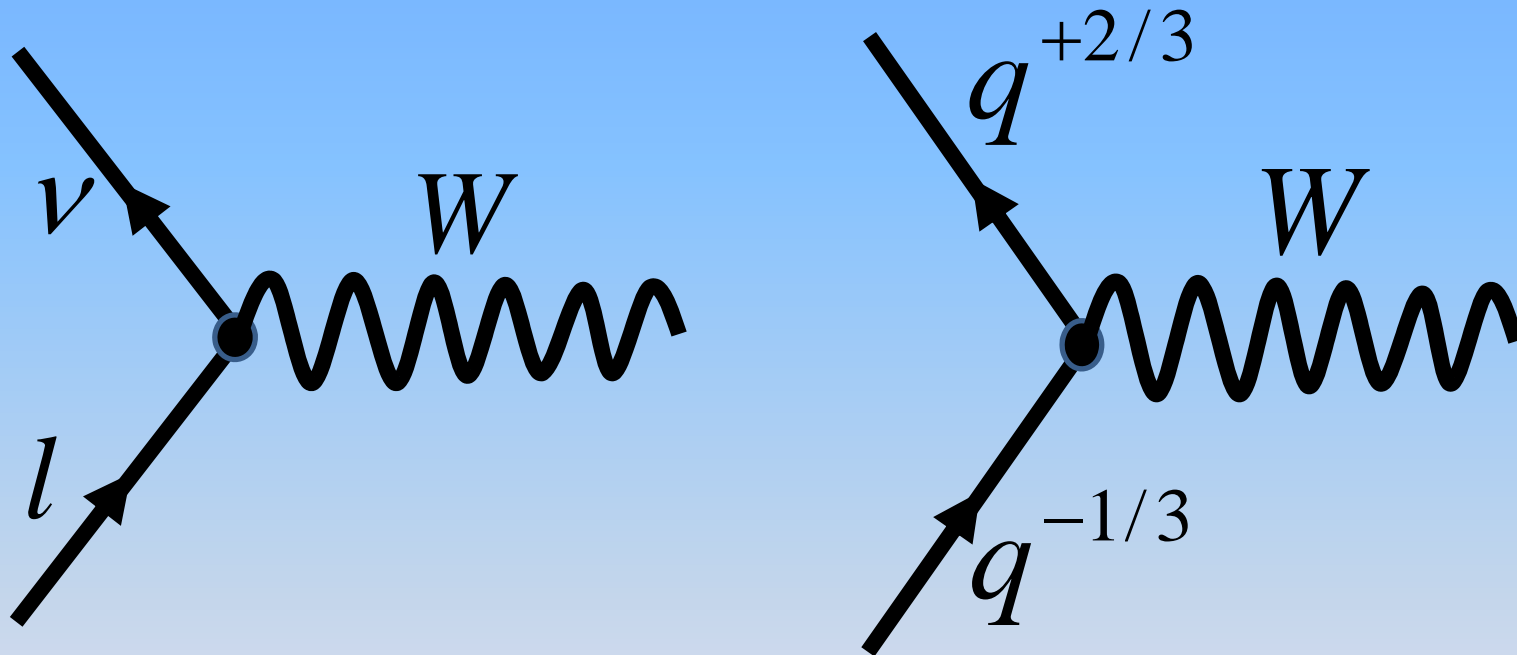


“Primitive Vertex” - Neutral

Weak Interactions

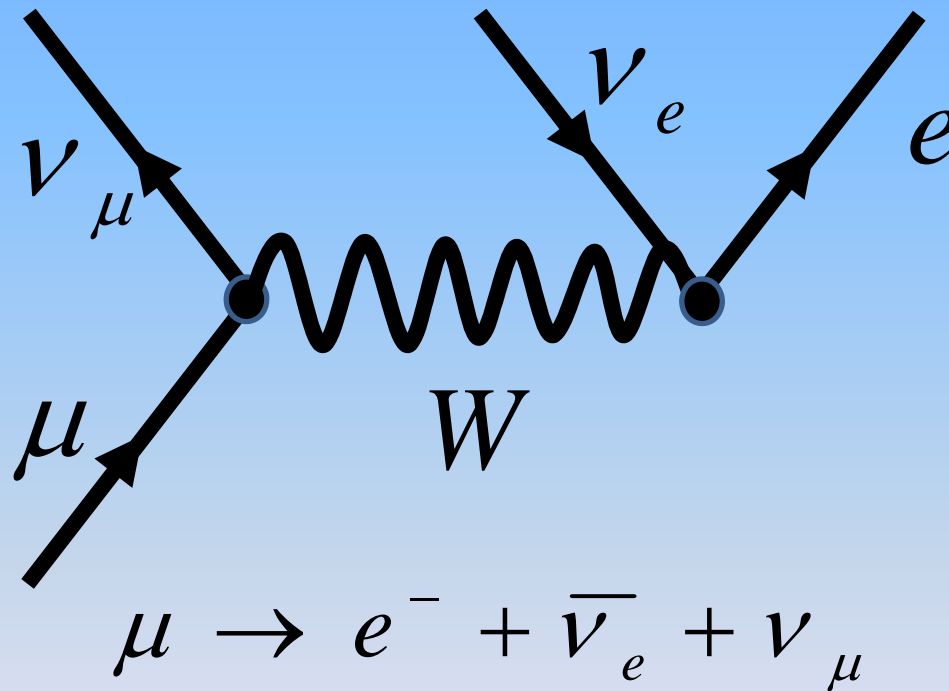


Weak Interactions



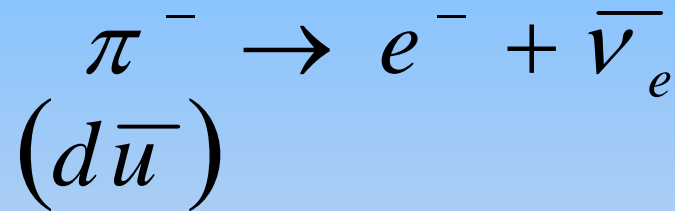
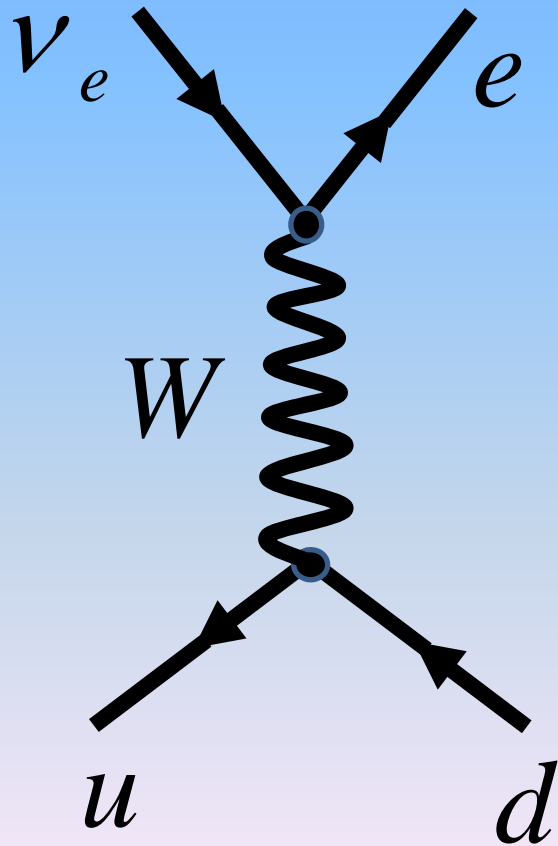
“Primitive Vertex” - Charged

Weak Interactions



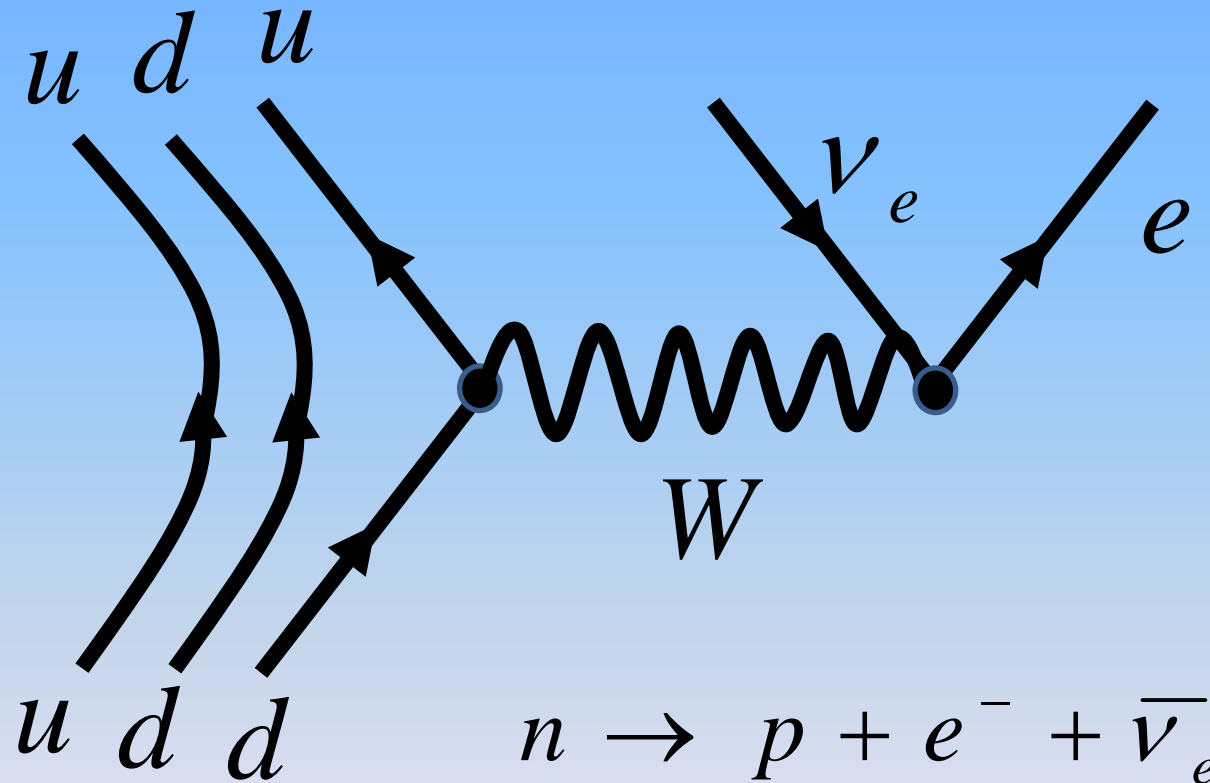
“Leptonic Process”

Weak Interactions



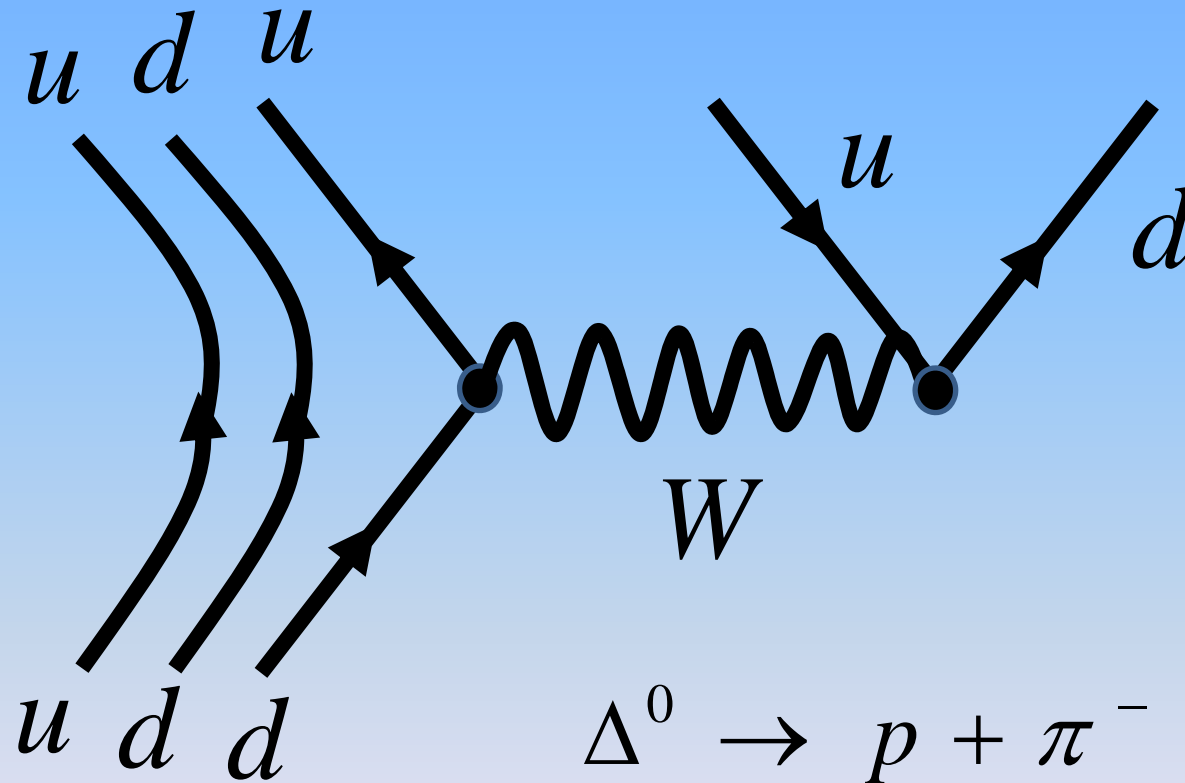
“Semileptonic Process”

Weak Interactions



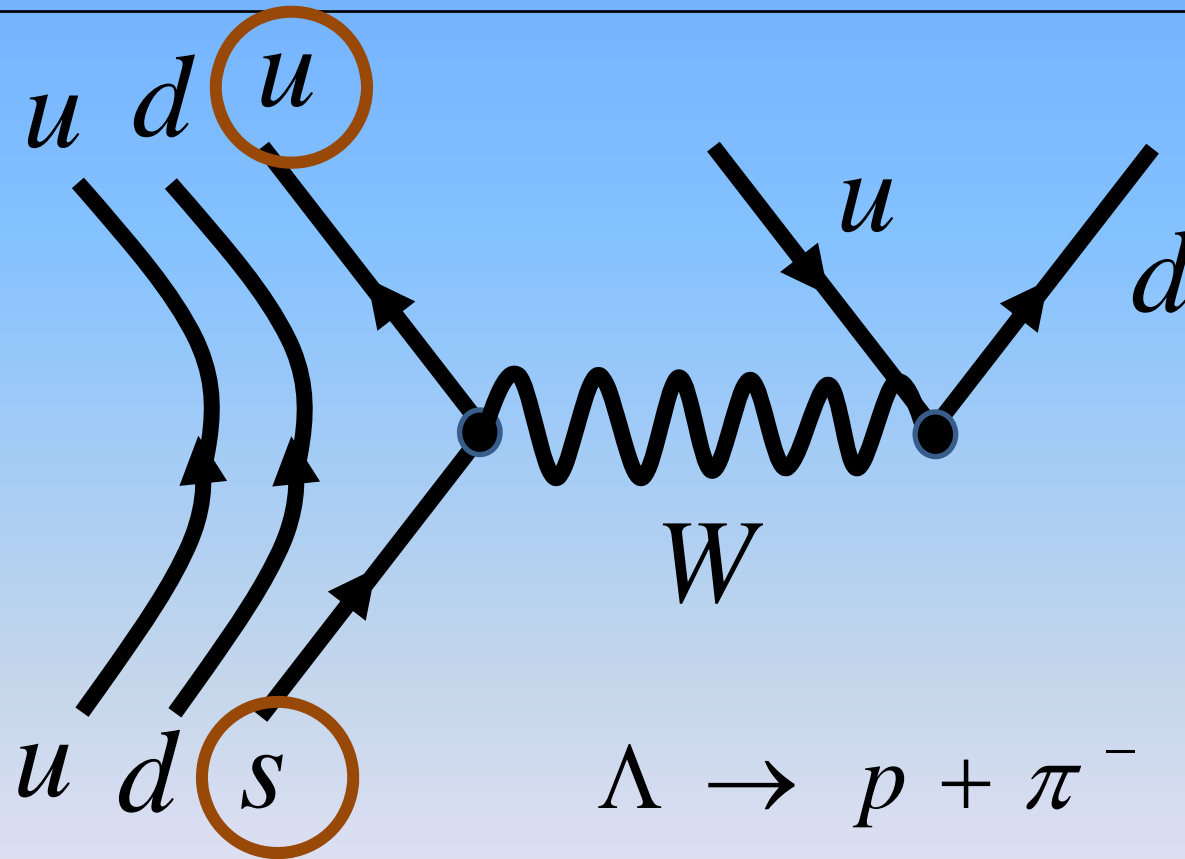
“Semileptonic Process”

Weak Interactions



“Hadronic Process”

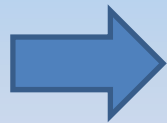
Weak Interactions



“Cross Generation”

Weak Interactions

Instead of $\begin{pmatrix} u \\ d \end{pmatrix}$, $\begin{pmatrix} c \\ s \end{pmatrix}$, $\begin{pmatrix} t \\ b \end{pmatrix}$

 $\begin{pmatrix} u \\ d' \end{pmatrix}$, $\begin{pmatrix} c \\ s' \end{pmatrix}$, $\begin{pmatrix} t \\ b' \end{pmatrix}$

Weak Interactions

where

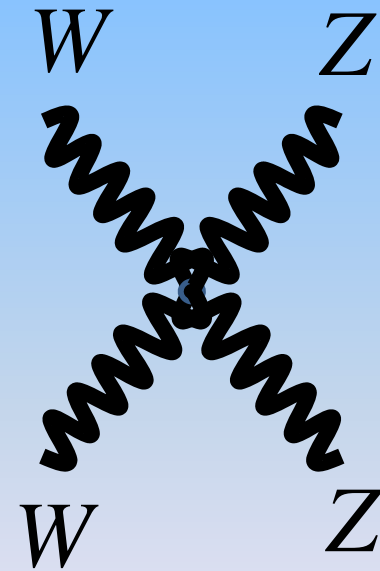
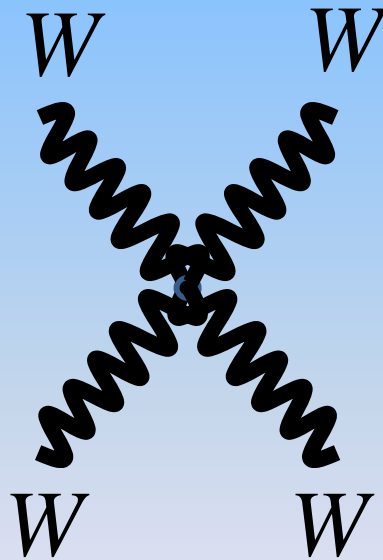
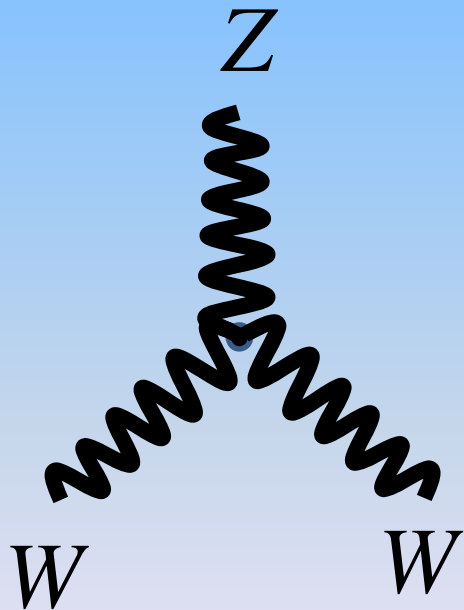
$$\begin{pmatrix} d' \\ s' \\ b' \end{pmatrix} = \begin{pmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{pmatrix} \begin{pmatrix} d \\ s \\ b \end{pmatrix}$$



“Cabibbo-Kobayashi-Maskawa
(CKM) Matrix”

Weak Interactions

Moreover ...



Weak Interactions

and ...

