Y^W $\quad \vec{I}^W$ $\quad Q = \frac{Y^W}{2} + I_3^W \rightarrow Y_W = 2(Q - I_3)$

Complex

Y_W

I^W: I_3^W: $\frac{1}{2}$, $-\frac{1}{2}$ $\quad \begin{pmatrix} u \\ d' \end{pmatrix}_L, \begin{pmatrix} c \\ s' \end{pmatrix}_L, \begin{pmatrix} t \\ b' \end{pmatrix}_L, \begin{pmatrix} \nu_e \\ e^- \end{pmatrix}, \begin{pmatrix} \nu_\mu \\ \mu^- \end{pmatrix}, \begin{pmatrix} \nu_\tau \\ \tau^- \end{pmatrix}, \Phi = \begin{pmatrix} \phi^+ \\ \phi^0 \end{pmatrix}$

quarks $S = \frac{1}{2}$ $Y^W = \frac{1}{3}$

Leptons $S = \frac{1}{2}$ $Y^W = -1$

Higgs Boson $S = 0$ $Y^W = +1$

(particle $\leftrightarrow$ antiparticle
$R \leftrightarrow L$)

$I^W = 0$: $u_R, d_R, s_R, c_R, b_R, t_R, \nu_{eR}, e^-_R, \nu_{\mu R}, \mu^-_R, \nu_{\tau R}, \tau^-_R$

Y^W: $\frac{4}{3}$, $-\frac{2}{3}$, $-\frac{2}{3}$, $\frac{4}{3}$, $-\frac{2}{3}$, $\frac{4}{3}$, 0, -2, 0, -2, 0, -2

Gauge Bosons: $\vec{I}^W$: $W^+ \leftrightarrow I^W_{\text{lowering}}$, $W^- \leftrightarrow I^W_{\text{raising}}$, $W^0 \leftrightarrow I_3^W$

coupling: g

Y^W: B^0 coupling: g'

$I^W = 1$

$\begin{pmatrix} W^+ \\ W^0 \\ W^- \end{pmatrix}$ I_3: $+\frac{1}{2}$, 0, $-\frac{1}{2}$

Self-interaction of Higgs :

$M = 81$ GeV

$V = -\mu^2 \phi^\dagger \phi + \lambda (\phi^\dagger \phi)^2 =$

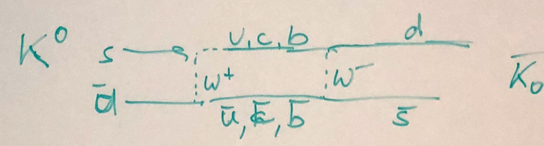
$\Rightarrow$ broken symmetry $\rightarrow \langle \phi \rangle = v = \sqrt{\frac{\mu^2}{\lambda}}$ $\quad \langle \phi \rangle = 0$

Mass eigenstates ?

$$\begin{pmatrix} d' \\ s' \\ b' \end{pmatrix} = \begin{pmatrix} \text{Cabbibo} \\ \text{Kobayashi} \\ \text{Maskawa} \end{pmatrix} \begin{pmatrix} d \\ s \\ b \end{pmatrix}$$

3 mixing angles
$\theta_c, \ldots, + 1$ phase

CP violation



$$\begin{pmatrix} \nu_e \\ \nu_\mu \\ \nu_\tau \end{pmatrix} = \begin{pmatrix} \text{Mixing} \\ \text{Matrix} \\ \text{3 mixing angles} \\ \text{1 phase} \end{pmatrix} \begin{pmatrix} \nu_1 \\ \nu_2 \\ \nu_3 \end{pmatrix}$$

$\rightarrow$ CP violation ?

MASS = Coupling to Higgs

M

0 $\quad \gamma$

92 GeV $\quad Z^0$

$$\begin{pmatrix} \gamma \\ Z^0 \end{pmatrix} = \begin{pmatrix} \sin\theta_W & \cos\theta_W \\ \cos\theta_W & -\sin\theta_W \end{pmatrix} \begin{pmatrix} W^0 \\ B^0 \end{pmatrix}$$

1 mixing angle $\theta_W \simeq 23°$

$$g = \frac{e}{\sin\theta_W}$$

coupling of γ: $g \cdot \sin\theta_W \cdot I_3 + g' \cos\theta_W \cdot Y^W = Qe$

$I_3 = 0 \rightarrow g' \cos\theta_W Y^W = Qe \rightarrow g' = \frac{e}{2\cos\theta_W}$

$I_3 = \frac{1}{2}, Y^W = -1 \Rightarrow g \sin\theta_W \frac{1}{2} - \frac{e}{2} = 0$