

SAME CHIRAL?

 σ COUPLING \rightarrow CONSISTENT

a) $(e_L^\dagger)^\dagger \sigma^1 e_L^\dagger$

(X)

b) $(e_L^\dagger)^\dagger \sigma^3 e_L^\dagger$

✓

DIAGONAL \rightarrow ✓

(X)

c) $(e_L^\dagger)^\dagger \sigma^2 e_L^\dagger$

✓

OFF DIAGONAL \rightarrow

(X)

d) $(\mu_L^\dagger)^\dagger \sigma^2 \mu_L^\dagger$

✓

OFF DIAGONAL \rightarrow

(X)

e) $(e_L^\dagger)^\dagger \sigma^1 e_L^\dagger$

✓

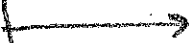
$(\mu_L^\dagger)^\dagger \sigma^2 \mu_L^\dagger$

✓



contract

w/

 $M_{\mu\nu}$ 

REQ. DIAGONAL

 $\Rightarrow \mu = 0 \text{ or } 3$

REQ. OFF DIAGONAL

 $\Rightarrow \nu = 1 \text{ or } 2$ REQUIRES
 $\mu = \nu$ these cannot all be
satisfied

(X)

2 $D_\mu H_0 = \cancel{(\partial_\mu H_0)} - ig W^A T^A H_0 - ig' g_H B H_0$

\circ bc H_0 is constant.

$H_0 = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 \\ v \end{pmatrix}$

$$= -ig \frac{1}{2} \begin{pmatrix} W^3 & \sqrt{2} W^+ \\ \sqrt{2} W^- & -W^3 \end{pmatrix} \frac{1}{\sqrt{2}} \begin{pmatrix} 0 \\ v \end{pmatrix}$$

$$-ig' \cdot \left(\frac{1}{2}\right) \cdot \frac{1}{\sqrt{2}} \begin{pmatrix} 0 \\ Bv \end{pmatrix}$$

nb: $W^\pm = \frac{1}{\sqrt{2}} (W^1 \mp iW^2)$

$$W^A T^A = W^1 T^1 + W^2 T^2 + W^3 T^3$$

$$= \frac{1}{2} \begin{pmatrix} W^3 & W^1 - iW^2 \\ W^1 + iW^2 & -W^3 \end{pmatrix}$$

$$D_\mu H_0 = \frac{-ig}{2\sqrt{2}} \begin{pmatrix} \sqrt{2} W^+ v \\ -W^3 v \end{pmatrix} + \frac{-ig'}{2\sqrt{2}} \begin{pmatrix} 0 \\ Bv \end{pmatrix}$$

$$= \frac{-iv}{2\sqrt{2}} \begin{pmatrix} g\sqrt{2} W^+ \\ g'B - gW^3 \end{pmatrix}$$

$$|D_\mu H|^2 = \frac{v^2}{8} \left[2g^2 W^+ W^- + (g'B - gW^3)^2 \right]$$

↑

$$(g')^2 B^2 - 2gg' BW^3 + g^2 (W^3)^2$$

$$= \left[\left(\frac{g v}{2}\right)^2 W^+ W^- + (B W^3) \begin{pmatrix} (g')^2 & gg' \\ gg' & g^2 \end{pmatrix} \begin{pmatrix} B \\ W^3 \end{pmatrix} \right]$$

↑

M matrix

[3]

$$\mathcal{L} = y H^\dagger L \bar{E} + \text{h.c.}$$

$$y H_0 L \bar{E} = \frac{y}{\sqrt{2}} (0 \ v) \begin{pmatrix} \nu_e \\ e_L \end{pmatrix} e_R^\dagger$$

↙ v is IR by choice

$$= \left(\frac{y v}{\sqrt{2}} \right) e_L e_R^\dagger$$

$$\boxed{m_e = \frac{y v}{\sqrt{2}}}$$