224(8): Further Criticisms of Electroweak Theory.

The electroweak theory depends on the wave function:

$$\psi = \begin{bmatrix} R \\ L \end{bmatrix} = \begin{bmatrix} e_R \\ \nu_e \\ e_L \end{bmatrix} \quad -(1)$$

so

$$R = e_R, \quad L = \begin{bmatrix} \nu_e \\ e_L \end{bmatrix} \quad -(2)$$

where ν_e denotes the left handed electron neutrino and e_R and e_L the right and left handed electrons.

It is a theory in which a lagrangian is set up that does not have mass:

$$\mathcal{L}_1 = i\bar{R}\gamma^\mu D_\mu R + i\bar{L}\gamma^\mu D_\mu L \quad -(3)$$

where:

$$\bar{R} = \bar{e}_R, \quad \bar{L} = \begin{bmatrix} \bar{\nu}_e & \bar{e}_L \end{bmatrix}, \quad -(4)$$

and

$$D_\mu R = \partial_\mu R + i g' X_\mu R \quad -(5)$$

$$D_\mu L = \left(\partial_\mu + \frac{i}{2} g' X_\mu - \frac{i}{2} g \underline{\tau} \cdot \underline{W}_\mu \right) L \quad -(6)$$

$$\underline{\tau} \cdot \underline{W}_\mu = \begin{bmatrix} W_\mu^3 & W_\mu^1 - i W_\mu^2 \\ W_\mu^1 + i W_\mu^2 & -W_\mu^3 \end{bmatrix} \quad -(7)$$

2) Therefore:

$$\mathcal{L}_1 = i\bar{e}_R \gamma^\mu \left(\partial_\mu + i g' X_\mu\right) e_R$$

$$+ i \begin{bmatrix} \bar{\nu}_e & \bar{e}_L \end{bmatrix} \gamma^\mu \left(\left(\partial_\mu + \frac{i}{2} g' X_\mu\right) \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \frac{ig}{2} \begin{bmatrix} W_\mu^3 & W_\mu^1 - iW_\mu^2 \\ W_\mu^1 + iW_\mu^2 & -W_\mu^3 \end{bmatrix} \right) \begin{bmatrix} \nu_e \\ e_L \end{bmatrix}$$

$$= i\bar{e}_R \gamma^\mu \partial_\mu e_R - g' X_\mu \bar{e}_R \gamma^\mu e_R$$

$$+ i \begin{bmatrix} \bar{\nu}_e & \bar{e}_L \end{bmatrix} \gamma^\mu \left(\partial_\mu + \frac{i}{2} g' X_\mu\right) \begin{bmatrix} \nu_e \\ e_L \end{bmatrix}$$

$$- \frac{g}{2} \begin{bmatrix} \bar{\nu}_e & \bar{e}_L \end{bmatrix} \gamma^\mu \begin{bmatrix} W_\mu^3 & W_\mu^1 - iW_\mu^2 \\ W_\mu^1 + iW_\mu^2 & -W_\mu^3 \end{bmatrix} \begin{bmatrix} \nu_e \\ e_L \end{bmatrix}$$

$$= -g' X_\mu \bar{e}_R \gamma^\mu e_R - \frac{g'}{2} X_\mu \bar{e}_L \gamma^\mu e_L$$

$$+ \frac{g}{2} W_\mu^3 \bar{e}_L \gamma^\mu e_L + \dots \qquad (8)$$

The electron part of the Lagrangian is therefore:

3) $$\mathcal{L}_{1e} = -g' X_\mu \bar{e}_R \gamma^\mu e_R - \frac{1}{2}\left(g' X_\mu + g W_\mu^3\right) \bar{e}_L \gamma^\mu e_L \quad -(9)$$

The Higgs field of the theory after spontaneous symmetry breaking is:

$$\phi = \begin{bmatrix} 0 \\ \eta + \frac{\sigma}{\sqrt{2}} \end{bmatrix}, \quad -(10)$$

which is arrived at using local gauge symmetry in a rather arbitrary way. The covariant derivative is:

$$D_\mu \phi = \left(\partial_\mu - \frac{i}{2} g \underline{\tau} \cdot \underline{W}_\mu - \frac{i}{2} g' X_\mu \right) \phi \quad -(11)$$

The Higgs Lagrangian is:

$$\mathcal{L}_2 = (D_\mu \phi)^T (D_\mu \phi) - \frac{m^2}{2} \phi^T \phi - \frac{\lambda}{4} (\phi^T \phi)^2 - G_e \left(\bar{L} \phi R + \bar{R} \phi^T L \right) \quad -(12)$$

in which:

4)

$$D_\mu \phi = \begin{bmatrix} 0 \\ \frac{1}{\sqrt{2}} \partial_\mu \phi \end{bmatrix} - \left[\frac{ig}{2} \begin{pmatrix} W_\mu^3 & W_\mu^1 - iW_\mu^2 \\ W_\mu^1 + iW_\mu^2 & -W_\mu^3 \end{pmatrix} + \frac{ig'}{2} X_\mu \right] \begin{bmatrix} 0 \\ \eta + \frac{\sigma}{\sqrt{2}} \end{bmatrix} \quad -(13)$$

So:

$$(D_\mu \phi)^T (D_\mu \phi) = \frac{1}{2}(\partial_\mu \sigma)^2 + \frac{g^2 \eta^2}{4}\left((W_\mu^1)^2 + (W_\mu^2)^2\right) + \frac{\eta^2}{4}\left(g W_\mu^3 - g' X_\mu\right)^2 + \ldots \quad -(14)$$

On this basis it is claimed that the W_μ^1 and W_μ^1 bosons have mass $g\eta/2$ and that there exists a boson with mass $\eta/2$. It is claimed that the Higgs mechanism gives the mass $\eta/2$. From eq. (14) this boson can only be:

$$Z_\mu = g W_\mu^3 - g' X_\mu \quad -(15)$$

From eq. (9) it is claimed that the electromagnetic potential A_μ can be

5) derived. However, eq. (9) gives two choices, one for e_R and one for e_L. For e_R the electromagnetic potential can only be:

$$eA_{\mu R} = g' X_\mu \quad -(16)$$

while for e_L it can only be:

$$eA_{\mu L} = \frac{1}{2}\left(g' X_\mu + g W_\mu^3\right). \quad -(17)$$

This is all that the theory gives. It cannot "predict" the masses of the W and Z bosons, because there is no way of determining g, g', X^μ and η.

Therefore there is no way of predicting the level of the Higgs boson mass, even at the level of the electroweak theory. In Ryder's eqn. (8.85), page 302, 2nd edition, it is claimed that eq. (9) gives the term:

$$\mathcal{L}_{1e} =? \; -\frac{g g'}{(g^2+g'^2)^{1/2}} \bar{e} \gamma^\mu e A_\mu + \dots \quad -(18)$$

where

$$A_\mu =? \; \frac{g' W_\mu^3 + g X_\mu}{(g^2+g'^2)^{1/2}} \quad -(19)$$

6) Here e is not defined by Ryder. Eq. (18) is not true algebraically.

On the basis of this incorrect algebra, it is claimed that:

$$e = g \sin \theta_W \quad -(20)$$

where the so called "Weinberg angle" is:

$$\sin \theta_W = \frac{g'}{(g^2 + g'^2)^{1/2}} \quad -(21)$$

It is then claimed incorrectly that this incorrect algebra accounts for muon decay:

$$\mu^- \rightarrow e^- + \overline{\nu}_e + \nu_\mu \quad -(22)$$

So the GWS theory cannot "predict" the peak observed in the UA1 Collaboration at CERN.