Predictions for the Results of Impact of Leptons Coming from Some Nonstandard Models

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Abstract

According to a left-right electroweak unified model, there are the gauge bosons $U^{\pm\pm}$ with its mass $M(U) > 1.5M(W)$ and $V^{\mp}$ with its mass $M(V) > 1.8M(W)$, there is the sort of reaction that two electrons mutually impacting with their energy high enough can transform into two muons via the gauge boson $U^{\pm\pm}$. The present paper points out that there are the reaction that two electrons mutually impacting with their high enough can transform into two asymmetric jets via the boson $U^{\pm\pm}$ and the reaction that an electrons and a neutrino of electron-type mutually impacting with their high enough can transform into a muon and a neutrino of muon-type via the boson $V^{\mp}$ as well. According to a grand unified model in which hadrons are regarded as nontopological solitons, both quarks can exist inside a hadron and their properties are the same as those of the given quarks, and can also exist as free particles with their integer charges and massive masses. The present paper points out that there is the reaction in which an electron and a positron mutually impacting with their high enough can transform into a free quark and a free antiquark, and the free quark and the free antiquark will fast decay into hadrons and leptons.

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I. INTRODUCTION

Although the GWS electroweak unified model has acquired brilliant achievements, it still is not the ultimate theory. This is because the GWS model is not verified by experiments in higher energy and cannot expands why is right-left asymmetric. In view of this, many models generalizing the GWS model are constructed[1][2][3]. A sort of these models is the electroweak unified model which is right-left asymmetric before symmetry is broken and is right-left asymmetric after symmetry is broken[1][2]. The other sort of these models is the grand unified model[3]. These model are consistent with the GWS model in the experiments in low energy. But the predicts of these models for the experiments in higher energy are different from these of the GWS model. The present paper discusses some predicts of a generalizing electroweak model[1] and a grand unified model[3].

II. SOME PREDICTIONS OF A GENERALIZING ELECTROWEAK UNIFIED MODEL[1]

There are the following coupling terms connected with left-handed leptons in the $SU(3)\times U(1)$ model [1] is

$$\begin{aligned}
\mathcal{L}_{lG} &= \frac{i}{\sqrt{2}}g(\overline{l^-}_{lL}\gamma_\mu W_\mu^- \nu_{lL} + \overline{l^+}_{lL}\gamma_\mu V_\mu^+ \nu_{lL} + \overline{l^+}_{lL}\gamma_\mu U_\mu^{++} l_{lL}^-) + h.c \\
\mathcal{L}_{lH} &= \left(f_{lA} C\widetilde{\psi_{lL}}\phi_A \psi_{lL} - f_{lB} C\widetilde{\psi_{lL}}\phi_B \gamma_5 \psi_{lL}\right) + h.c, \qquad l = e, \mu, \tau, \qquad (1)
\end{aligned}$$

where

$$\psi_{lL} = \begin{pmatrix} \nu_{lL} \\ l^-_{lL} \\ l^+_{lL} \end{pmatrix}, \quad \phi_{A,B} = \frac{1}{2} \begin{pmatrix} \sqrt{2}\varphi^1_{A,B} & \varphi^2_{A,B} & \varphi^3_{A,B} \\ \varphi^2_{A,B} & \sqrt{2}\varphi^4_{A,B} & \varphi^5_{A,B} \\ \varphi^3_{A,B} & \varphi^5_{A,B} & \sqrt{2}\varphi^6_{A,B} \end{pmatrix}, \tag{2}$$

V^+ and U^{++} are the unknown gauge particles. According to the model, there are the following reactions,

$$\nu_{eL} + e^-_R \to V^- \to \nu_{\mu L} + \mu^-_R, \tag{3}$$

$$e^-_L + e^-_R \to U^{--} \to \mu^-_L + \mu^-_R. \tag{4}$$

On the basis of now experimental data, [4] gets $m(V) \gtrsim 1.5m\,(w) \approx 123Gev$, $m(U) \gtrsim 1.8m\,(W) \approx 150Gev$.

The present paper points out that if the baryon number B is not defined, and a quantum number J substituting B is defined whose product is conservational, there may be the following reactions,

$$e^-_L + e^-_R \to U^{--} \to d_L + t^c_R \to jet_1 + jet_2, \tag{5}$$

$$\nu_{eL} + e^-_R \to V^- \to u_L + t^c_R \to jet_1 + jet_2. \tag{6}$$

where t^c is a unknown massive antiquark with its charge $-5/3$. jet_1 and jet_2 are asymmetric because $m\,(t) \gg m\,(d)$. For quarks and antiquark, $J = -1$; for the other particles, $J = 1$. Because J is conservational, there is no coupling of a lepton and a quark.

III. SOME PREDICTIONS OF A GRAND UNIFIED MODEL[3]

According to a grand unified model[3], there are the three generations of leptons in one multiplet; quarks can exist inside a hadron, can also exist as free particles outside hadrons; hadrons are regarded as nontopological solitons composed of quarks; leptons and hadrons are the same in essence; the differences between both are caused by spontaneous symmetry breaking. When a quark is located inside a hadron, its properties will be same as those of a known quark and its mass will be small. When a quark is located outside hadrons, its properties will be same as those of a known lepton, its charge is an integer, its mass will be very large and will rapidly decay to hadrons and leptons. Except the known charge Q_0 and fermion number F_0 which are exactly conservational are defined, the new quantum numbers inside a hadron, interior colour charges, interior charge and interior fermion number, are defined as well. The breaking form of the $SU(5)$ symmetry is

$$SU(5) \xrightarrow{\phi} SU(3) \times SU(2) \times U(1) \xrightarrow{H_l, S} U(1). \tag{7}$$

The leptons in the $SU(5)$ grand unified model are

$$\psi_L^T = \begin{pmatrix} \nu_e^c & \nu_\mu^c & E_1^- & E_2^+ & -N_2^c \end{pmatrix}_R, \qquad N_{2L}^c, \tag{8}$$

$$\psi_R = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 & N_1^c & -\mu^- & -e^+ & -\nu_e^c \\ -N_1^c & 0 & e^- & -\mu^+ & -\nu_\mu^c \\ \mu^- & -e^- & 0 & -N_1 & -E_1^- \\ e^+ & \mu^+ & N_1 & 0 & -E_2^+ \\ \nu_e^c & \nu_\mu^c & N_1 & E_2^+ & 0 \end{pmatrix}_R \tag{9}$$

where N_1 and E_1^- can be identified with ν_τ and τ^-, respectively (U_3 and D_3 are identified with ν_τ and τ^-, respectively, in [3]), because $m(\tau) \neq 0$. E_2^+ and N_2^c are the unknown leptons with massive masses which can decay into leptons given leptons. The quarks are

$$\chi_{nR}^T = \begin{pmatrix} d_{n1} & d_{n2} & d_{n3} & D_n^+ & U_n^c \end{pmatrix}_R, \qquad U_{nL}^c, \tag{10}$$

$$\chi_{nL} = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 & u_{n3}^c & -u_{n2}^c & -u_{n1} & -d_{n1} \\ -u_{n3}^c & 0 & u_{n1}^c & -u_{n2} & -d_{n2} \\ u_{n2}^c & -u_{n1}^c & 0 & -u_{n3} & -d_{n3} \\ u_{n1} & u_{n2} & u_{n3} & 0 & -D_n^+ \\ d_{n1} & d_{n2} & d_{n3} & D_n^+ & 0 \end{pmatrix}_L \tag{11}$$

where $n = 1, 2, 3$, $d_1 = d$, $d_2 = s$, $d_3 = b$, $u_1 = u$, $u_2 = c$, $u_3 = t$; the subscripts 1, 2, 3 denote the interior colors; D_n^+ and U_n^c are fermions with their massive masses which can decay into quarks and leptons by gauge bosons X_n or Y_n.The gauge fields are

$$A = I_\alpha A_\mu^\alpha = \frac{1}{\sqrt{2}} \cdot$$

$$\begin{pmatrix} \frac{A_3}{\sqrt{2}} + \frac{A_8}{\sqrt{6}} - \frac{2B}{\sqrt{30}} & G_3 & G_2 & X_1 & Y_1 \\ \overline{G}_3 & -\frac{A_3}{\sqrt{2}} + \frac{A_8}{\sqrt{6}} - \frac{2B}{\sqrt{30}} & G_1 & X_2 & Y_2 \\ \overline{G}_2 & \overline{G}_1 & -\frac{2A_8}{\sqrt{6}} - \frac{2B}{\sqrt{30}} & X_3 & Y_3 \\ \overline{X}_1 & \overline{X}_2 & \overline{X}_3 & \frac{W_3}{\sqrt{6}} + \frac{3B}{\sqrt{30}} & W^+ \\ \overline{Y}_1 & \overline{Y}_2 & \overline{Y}_3 & W^- & -\frac{W_3}{\sqrt{6}} + \frac{3B}{\sqrt{30}} \end{pmatrix} \tag{12}$$

The Higgs fields are

$$\underline{24}:\phi^{\alpha}_{\beta}=\left(I^{b}\varphi_{b}\right)^{\alpha}_{\beta},\qquad \underline{45}:S^{\alpha\beta}_{\gamma}=-S^{\beta\alpha}_{\gamma},\quad S^{\alpha\beta}_{\alpha}=0,$$
$$\underline{5}=H^{\alpha}_{l},\quad l=A,B,C,D,\quad b=1,2\cdots 24,\quad \alpha,\beta,\gamma=1,2\cdots 5. \tag{13}$$

The Lagrangian density connected with fermions is

$$\mathcal{L}_{FA}=-\overline{\psi}_{L}\gamma_{\mu}D_{\mu}\psi_{L}-tr\overline{\psi}_{R}\gamma_{\mu}D_{\mu}\psi_{R}-\overline{\chi}_{nR}\gamma_{\mu}D_{\mu}\chi_{nR} \tag{14}$$
$$-tr\overline{\chi}_{nL}\gamma_{\mu}D_{\mu}\chi_{nL}-\overline{N^{c}_{2R}}\gamma_{\mu}\partial_{\mu}N^{c}_{2R}-\overline{U^{c}_{nR}}\gamma_{\mu}\partial_{\mu}U^{c}_{nR},$$

$$\mathcal{L}_{FH}=\{-(f_{S}\overline{\psi^{\alpha\beta}_{R}}\psi^{\gamma}_{L}+K_{Sn}\overline{\chi^{\alpha\beta}_{nL}}\chi^{\gamma}_{nR})S^{\alpha\beta}_{\gamma}-f_{B}\overline{\psi^{\alpha\beta}_{R}}\psi^{\alpha}_{L}H^{\beta}_{B}$$
$$+\overline{\chi^{\alpha\beta}_{nL}}\chi^{\alpha}_{nR}(K_{Bn}H^{\beta}_{B}-K_{An}H^{\beta}_{A})+\varepsilon_{\alpha\beta\gamma\delta\rho}[\psi^{\alpha\beta T}_{R}C\psi^{\gamma\delta}_{R}(\eta_{B}H^{\rho}_{B}+\eta_{A}H^{\rho}_{A})$$
$$+\chi^{\alpha\beta T}_{L}C\chi^{\gamma\delta}_{L}(q_{An}H^{\rho}_{B}-q_{Bn}H^{\rho}_{B})]+\overline{\chi^{\alpha}_{nR}}U^{C}_{nL}(\xi_{Bn}H^{\alpha}_{Bn}-\xi_{An}H^{\alpha}_{A})$$
$$-\overline{\psi^{\alpha}_{L}}N^{C}_{2R}(b_{A}H^{\alpha}_{A}-b_{B}H^{\alpha}_{B})\}+h.c. \tag{15}$$

The Lagrangian of the model has a separate symmetry. Let its quantum number be I, $I=-1$ for χ_{nL}, χ_{nR} and U^{c}_{nL}, $I=-1$ for the other fields.

The present paper points out that there is the following reaction in which an electron and a positron mutually impacting with their energy high enough can transform into a free quark and a free antiquark and they finally decay into hadrons and leptons.

According to the present model, there are free quarks. Because the mass $m_0(q)$ of a free quark are very large, $m_0(q)\gg m_i(q)$, here $m_i(q)$ is the mass of the quark which is inside a soliton (interior mass), when there is a free quark, the vacuum expectation values of the Higgs fields in a finite area where the quark is in will change so that a soliton forms. Such a soliton is not colourless (inside the soliton), oppositely, possesses a sort of interior colour. Because the area is finite, the mass $m_S(q)$ of the soliton is large, but is not very large, i.e., $m_0(q)>m_S(q)\gg m_i(q)$. The state of the soliton with its interior colour only is a transiting state, is unsteady and will fast decay into colourless hadrons and leptons. Thus, when an electron and a positron with their energies high enough impact, a free quark and a free antiquark can come into being, and they will finally decay into hadrons and leptons. The process can be expand by an example as follows. The term

$-f_B\overline{\psi_R^{\alpha\beta}}\psi_L^\alpha H_B^\beta+\overline{\chi_{nL}^{\alpha\beta}}\chi_{nR}^\alpha(K_{Bn}H_B^\beta-K_{An}H_A^\beta)$ in (15) contains the following coupling

$$
\begin{aligned}
&-f_B[H_B^1(\overline{\mu_R^-}\tau_L^- - \overline{\nu_{\tau R}^c}\nu_{\mu L}^c)+H_B^2(\overline{\nu_{\tau R}^c}\nu_{eL}^c-\overline{e_R^-}\tau_L^-)+H_B^3(\overline{e_R^-}\nu_{\mu L}^c-\overline{\mu_R^-}\nu_{eL}^c)] \\
&+(K_{B1}H_B^1-K_{A1}H_A^1)(\overline{u_{2L}^c}d_{3R}-\overline{u_{3L}^c}d_{2R}]+(K_{B1}H_B^2-K_{A1}H_A^2)(\overline{u_{3L}^c}d_{1R}-\overline{u_{1L}^c}d_{3R}] \\
&+(K_{B1}H_B^3-K_{A1}H_A^3)(\overline{u_{1L}^c}d_{2R}-\overline{u_{2L}^c}d_{1R}]+h.c. \qquad (16)
\end{aligned}
$$

From (16) we see that there is the process shown by figure 1.

$$e^-+e^+\longrightarrow\gamma\longrightarrow u_3+u_3^c, \qquad (17)$$

here u_3 and u_3^c are the free $u-quark$ and $u-antiquark$. Because $m_0(u)\gg m_i(u)$, a soliton forms. Inside the soliton

$$
\begin{aligned}
u_3 &\longrightarrow (u_3u_2d_1)+(u_2^cd_1^c), \\
u_3^c &\longrightarrow (u_3^cu_2^cd_1^c)+(u_2d_1) \qquad (18)
\end{aligned}
$$

$(u_2^cd_1^c)$ transforms into e_R^- and $\nu_{\mu R}$ or μ_R^- and ν_{eR} by Higgs particle H_B^3, (u_2d_1) transforms into e_L^+ and $\nu_{\mu L}^c$ or μ_L^+ and ν_{eL}^c by Higgs particle H_B^3,i.e.,

$$u_2^c+d_1^c\longrightarrow H_B^3\longrightarrow e_R^-+\nu_{\mu R},\ e_L^-+\nu_{\mu L}\ \text{ or }\ \mu_R^-+\nu_{eR},\ \ \mu_L^-+\nu_{eL} \qquad (19)$$

$$u_2+d_1\longrightarrow H_B^{3c}\longrightarrow e_L^++\nu_{\mu L}^c,\ \ e_R^++\nu_{\mu R}^c\ \text{ or }\ \mu_L^++\nu_{eL}^c,\ \ \mu_R^++\nu_{eR}^c \qquad (20)$$

It should be emphasized that inside the soliton u_2^c, d_1^c and H_B^3 possess their interior charges $-2/3$, $1/3$ and $-1/3$, respectively; and outside the soliton u_2^c, d_1^c and H_B^3 possess their charges -1, 0 and -1. If e_R^- and $\nu_{\mu R}$ were inside a soliton, they would possess their interior charges $-2/3$ and $1/3$, respectively. The process is shown by figure 1.

There are the following coupling terms in (14)

$$\frac{1}{2\sqrt{2}}g\{G_1(\overline{\nu_\tau^c}\gamma_\mu\mu^-+\overline{u_3^c}\gamma_\mu u_2^c)+G_2(\overline{\nu_\tau^c}\gamma_\mu e^-+\overline{u_3^c}\gamma_\mu u_1^c)+G_3(\overline{\mu^-}\gamma_\mu e^-+\overline{u_2^c}\gamma_\mu u_1^c)\}+h.c. \quad (21)$$

By the similar discussion, from (21) we obtain the following process

$$e^-+\mu^+\longrightarrow G_3\longrightarrow u_2^c+u_1\stackrel{H_B^{2c},\,H_B^1}{\longrightarrow}[(u_2^cu_1^cd_3^c)+e^++\tau^-]+[(u_1u_2d_3)+\mu^-+\tau^+], \qquad (22)$$

in detail,

$$u_2^c\longrightarrow(u_2^cu_1^cd_3^c)+(u_1d_3), \qquad (23)$$

$$u_1\longrightarrow(u_1u_2d_3)+(u_2^cd_3^c), \qquad (24)$$

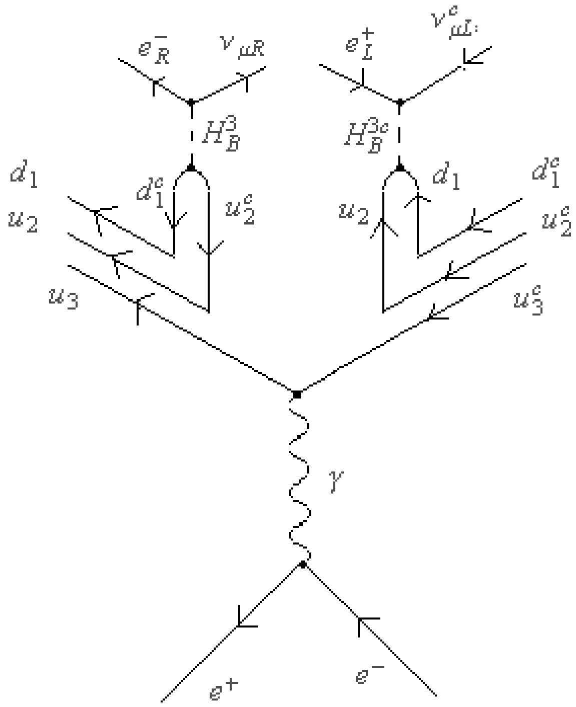

FIG. 1: $e^- + e^+ \longrightarrow [(u_3 u_2 d_1) + e_R^- + \nu_{\mu R}] + [(u_3^c u_2^c d_1^c) + e_L^+ + \nu_{\mu L}^c]$

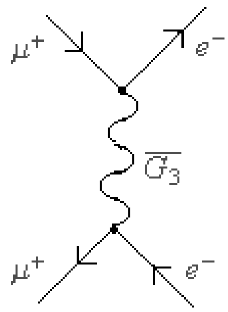

FIG. 2: $\mu^+ + e^- \longrightarrow \overline{G_3} \longrightarrow \mu^+ + e^-$.

$$u_1 + d_3 \longrightarrow H_B^{2c} \longrightarrow e^+ + \tau^- \quad \text{or} \quad \nu_e^c + v_\tau, \tag{25}$$

$$u_2^c + d_3^c \longrightarrow H_B^1 \longrightarrow \mu^- + \tau^+ \quad \nu_\tau^c + \nu_\mu. \tag{26}$$

(21) implies that there is the following reaction shown by figure 2.

$$\mu^+ + e^- \longrightarrow \overline{G_3} \longrightarrow \mu^+ + e^-. \tag{27}$$

Because $m_0(G_3)$ is large, the reaction causes the correction to the scattering cross-section $\sigma(\mu^+ + e^- \longrightarrow \mu^+ + e^-)$ obtained by the known theory to be very small.

IV. CONCLUSION

The present paper points out from an electrweak unified model that there are the reaction that two electrons mutually impacting with their high enough can transform into two asymmetric jets via the boson $U^{\pm\pm}$, i.e., $e_L^- + e_R^- \to jet_1 + jet_2$, and the reaction that an electrons and a neutrino of electron-type mutually impacting with their high enough can transform into two asymmetric jets via the boson $V^{\mp}$, i.e., $\nu_{eL} + e_R^- \longrightarrow jet_1 + jet_2$.

The present paper points out from an grand unified model that there is the reaction in which an electron and a positron mutually impacting with their high enough can transform into a free quark and a free antiquark, and the free quark and the free antiquarkand finally decay into hadrons and leptons, i.e.,

$$e^- + e^+ \longrightarrow \gamma \longrightarrow u_3 + u_3^c \overset{H_B^3,\, H_B^{3c}}{\longrightarrow} [(u_3u_2d_1) + e_R^- + \nu_{\mu R}] + [(u_3^cu_2^cd_1^c) + e_L^+ + \nu_{\mu L}^c],$$

$$e^- + \mu^+ \longrightarrow G_3 \longrightarrow u_2^c + u_1 \overset{H_B^{2c},\, H_B^1}{\longrightarrow} [(u_2^cu_1^cd_3^c) + e^+ + \tau^-] + [(u_1u_2d_3) + \mu^- + \tau^+].$$

We will discuss the predictions in detail in the following paper.

I am very grateful to professor Zhan-yao Zhao for his strong support.

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