We also find:

$$\partial \psi' - m \partial \nu \psi' + \partial \nu \psi' = m(\partial \psi - \partial \nu \psi + \partial \nu \psi')$$

and therefore:

$$D'_\mu \psi' = (\partial_\mu - igV_\mu') \psi' = m[\partial_\mu \psi - \partial_\nu \psi + \partial_\nu \psi'] - \frac{ig}{\sqrt{g'}} \frac{1}{\sqrt{g}} \partial_\mu \psi'$$

$$= m D_\mu \psi'$$

so:

$$\bar{\psi}' \gamma^\mu D_\mu \psi' = \bar{\psi} \gamma^\mu D_\mu \psi$$

and hence:

$$V'_\mu V'_{\nu} = V_\mu V_{\nu}$$

Q.E.D.

Let's probe several theories about gauge fixing.

It is possible to choose U(\kappa) such that:

the gauge transformation can bring V_\mu from 'by configuration V_\mu = F_\mu \lambda' to
1) the $V^0 = 0$ called time-axial or Weyl gauge.

2) the space-axial gauge in which one of the spatial components, say $V^1(r) = 0$

3) the Coulomb gauge in which

\[ \nabla \cdot V(r) = 0 \]

1) From any configuration $V_{\mu} = E_{\mu}(r, t)$, we may choose $u^0$ to be the following

line defined function

\[ u^0(r, t) = \frac{1}{T} \exp \left\{ -i \int_0^t \textbf{F}_0([r, t')] \cdot \textbf{g} \right\} \]

Hence:

\[ \frac{\partial u^0(r, t)}{\partial t} = -i \textbf{g} \cdot \textbf{F}_0 \cdot u^0 \]

On:

\[ u^0 \textbf{F}_0 u^0 + \frac{i}{g} u^0 \frac{\partial u^0}{\partial t} = 0 = V^0 \]
2) Change $t \rightarrow x_1$

3) From our given configuration $V_n = \tilde{e}_n \cdot \vec{v}(t)$

we can define

$$A^i = n^F u^+ - \frac{i}{2} n^A u^+ = A^i n^+$$

and:

$$T[A] = \int d^3r \text{ trace } (\vec{A} \cdot \vec{A}^*) = \frac{1}{2} \int d^3r A^i A^i \cdot n^+$$

Keeping $n$ and $F$ fixed, from the two equations above we have $T[A]$ and $A^i$ both as functions of $u(r)$. Since by definition $\pm[A] > 0$

we would have a minimum if we vary $u(r)$

to search for his minimum.

$$u(r, t) = e^{-i \theta(r, t) \tau}$$

$$\Rightarrow \delta u(r, t) = -i \theta(r, t) \tilde{e}_1$$
We have:

\[ \delta A_i^e = \oint \delta u T^e n + F_i e T^e 0 w \]

\[ = -\frac{i}{\hbar} \delta u \cdot u^A + \frac{i}{\hbar} \delta u V_i^o u \]

\[ = -i \delta^{\Theta}(x) \cdot T^e + F_i e T^e 0 \cdot T^e \\
= -i \delta^{\Theta}(x) \cdot T^e + \frac{i}{\hbar} \delta \Theta 0 \cdot T^e \\
= \Theta f \min A_i^e T^e \frac{1}{\hbar} \delta \Theta 0 \cdot T^e + O(\Theta) \]

\[ \delta A_i^e = \oint f A_i^e T^e \frac{1}{\hbar} \delta \Theta 0 \cdot T^e \]

\[ = \oint f A_i^e T^e \frac{1}{\hbar} \delta \Theta 0 \cdot T^e \]

When \( f \) is antisymmetric we have

\[ A_i^e \delta A_i^e = \frac{1}{\hbar} \delta A_i^e \delta \Theta 0 \cdot T^e \]

\[ \delta \Gamma = \oint A_i^e \delta A_i^e d^3 r = \frac{1}{\hbar} \int \Theta^e (x) \cdot \delta \Theta 0 \cdot A_i^e (r) d^3 r \]

\[ \delta \Gamma \] will vanish if \( A \rightarrow \omega \) w.r.t. \( \omega \) put into equation.