Leptonic Sector of electroweak theory

Leptons e, μ, τ and anti-particles

Neutrinos νe, νμ, ντ

Neutrinos are left-handed

Decompose leptons into left-handed and right-handed components

\[ e = e_R + e_L \]
\[ \Psi^R = \frac{1 + \gamma^5}{2} \Psi \]
\[ \nu = \nu_R + \nu_L \]
\[ \Psi^L = \frac{1 - \gamma^5}{2} \Psi \]

\[ \Psi^5 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \]

\[ \langle \Psi^5, \Psi^5 \rangle = 0 \]

Left-handed doublets

\[ (\nu^L) (\tau^-) (\mu^L) \]

Right-handed singlets \( e_R, \nu_R, \tau_R \)

Gauge group \( SU(2) \times U(1) \)

\( U(1) \) hypercharge; both left handed and right handed components are gauge by \( \Psi \rightarrow e^{\frac{i\pi}{2}} \Psi \) hypercharge