Theory of EW interactions with dynamically generated scalars, gauge fixings, and masses of Z and W bosons

Bing An Li
Department of Physics, Univ. of Kentucky, Lexington, USA

A new theory of the EW interactions without spontaneous symmetry breaking, Higgs, and Fadeev-Popov procedure is presented in this talk. It consists of three parts: $SU(2)_L\times U(1)$ gauge fields, massive fermion fields, and their interactions. New mechanism of $SU(2)_L \times U(1)$ symmetry breaking caused by the fermion masses are found. Nonperturbative solutions are found. The vacuum polarization of the Z field is expressed as

$$\Pi_{\mu\nu}(q^2) = \{F_1(q^2)(q_\mu q_\nu - q^2 g_{\mu\nu}) + F_2(q^2)q_\mu q_\nu + \frac{1}{2}\Delta m_Z^2 g_{\mu\nu}\}.$$

Therefore, both the gauge fixing term(F_2) and the mass term of the field are dynamically generated from the fermion masses. Top quark mass plays a dominant role. No zero $\partial_\mu Z^\mu$ leads to a scalar field and a gauge fixing term for the Z field. The mass of the scalar field is determined to be

$$m_{\phi^0} = m_t e^{\frac{m_Z^2}{m_t^2}\frac{16\pi^2}{3\bar{g}^2}+1} = 3.78 \times 10^{14} GeV.$$

The gauge fixing is determined to be

$$\xi_z = -1.18 \times 10^{-25}.$$

After renormalization it is determined

$$m_z = \frac{1}{2}\bar{g}^2 m_t^2$$

it agrees well with the data. Similarly, the vacuum polarization of W boson is found. A charge scalar field is dynamically generated

$$m_{\phi^\pm} = m_t e^{\frac{m_W^2}{m_t^2}\frac{16\pi^2}{3g^2}} = 9.31 \times 10^{13} GeV.$$

$$\xi_W = -3.73 \times 10^{-25}.$$

After renormalization the mass of the W boson is determined as

$$m_W^2 = \frac{1}{2}g^2 m_t^2.$$

It agrees well with the data. It also obtain

$$\frac{m_W^2}{m_Z^2} = \frac{g^2}{\bar{g}^2} = cos^2\theta_W.$$

$$G_F = \frac{1}{2\sqrt{2}m_t^2}.$$

The Fermi coupling constant in good agreement with data. The propergators of Z- and W- fields are derived as

$$\Delta_{\mu\nu}^Z = \frac{1}{q^2 - m_Z^2}\{-g_{\mu\nu} + (1 + \frac{1}{2\xi_Z})\frac{q_\mu q_\nu}{q^2 - m_{\phi^0}^2}\}$$

$$\Delta_{\mu\nu}^W = \frac{1}{q^2 - m_W^2}\{-g_{\mu\nu} + (1 + \frac{1}{2\xi_W})\frac{q_\mu q_\nu}{q^2 - m_{\phi_W}^2}\}$$

This theory can be tested by LHC experiments.