1 Honors Seminor S

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1.1 The Quantization of Monopole and Symmetricity

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1.2 Summary

Our group studied about following two models: U(1) gauge model on interaction of identity particles[1] and SU(2) gauge model on general interactions.

U(1) Gauge groups Here we suppose that each electron, dyon, monopole are spin $s = \frac{1}{2}$ particle system. Then we denote the Lagrangian density of system by considering interaction with scalar particles[2] like:

$$\mathcal{L}_{\mathrm{U}(1)} = -\frac{1}{4(q_e^2 + q_g^2)}[D^\mu, D^\nu]^2 + \bar{\psi}(i\not{D} - m)\psi + (D_\mu\Phi)^*(D^\mu\Phi) - m^2(\Phi^*\Phi). \tag{1}$$

Here we define the Covariant derivate:

$$D_\mu \equiv \partial_\mu + iq_e A_\mu + iq_g B_\mu. \tag{2}$$

where, A_μ, B_μ are each four-vectors from electron and monopole.

SU(2) Gauge groups Here we define the SU(2) gauge field $\mathbf{W}_\mu$ of general interaction model following:

$$\mathbf{W}_\mu = (W_\mu^1, W_\mu^2, W_\mu^3) = (q_e A_\mu + q_g B_\mu, 0, q_e A_\mu + q_g B_\mu)\ , \tag{3}$$

$$D_\mu = \partial_\mu + i\begin{pmatrix} W_\mu^3 & W_\mu^1 - iW_\mu^2 \\ W_\mu^1 + iW_\mu^2 & -W_\mu^3 \end{pmatrix}. \tag{4}$$

Then, the Lagrangian density also given by:

$$\begin{aligned}\mathcal{L}_{\mathrm{SU}(2)} = {} & \bar{\psi}_e \left(i\not{\partial} - q_e\not{A} - q_g\not{B} - m\right)\psi_e - \bar{\psi}_e(q_e\not{A} + q_g\not{B})\psi_{\nu_{eg}} \\ & + \bar{\psi}_{\nu_{eg}}\left(i\not{\partial} + q_e\not{A} + q_g\not{B} - m\right)\psi_{\nu_{eg}} - \bar{\psi}_{\nu_{eg}}(q_e\not{A} + q_g\not{B})\psi_e - \frac{1}{8(q_e^2 + q_g^2)}[D^\mu, D^\nu]^2.\end{aligned}$$

From using Hamilton's principles, we get the generalized Maxwell equations.

[1] electron-electron or dyon-dyon, etc.
[2] But, we ignore Yukawa interaction.