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 Preprint

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A Trial of the Theory of New Particles

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- a. Isotopic spin I
- b. curious constant A
- c. intrinsic spatial parity ϵ

Interaction Lagrangian

$$g \vec{\Phi} \vec{\tau}_5 \vec{\tau} \Psi = \sum_{\alpha, \beta=1,2} g \chi^{\alpha\beta} \vec{\tau}_5 \tau_{\alpha\beta} \Psi$$

$$\chi^{\alpha\beta} = \chi^{\beta\alpha}$$

$$\tau_{11} = \tau_{22} = i(\tau_1 + i\tau_2)$$

$$\tau_{12} = \tau_{21} = -i\tau_3$$

$$\chi^{11} = \chi^{22*} = -\frac{i}{2}(\phi_1 - i\phi_2)$$

$$\chi^{12} = \chi^{21} = \frac{i}{2}\phi_3$$

Generalization

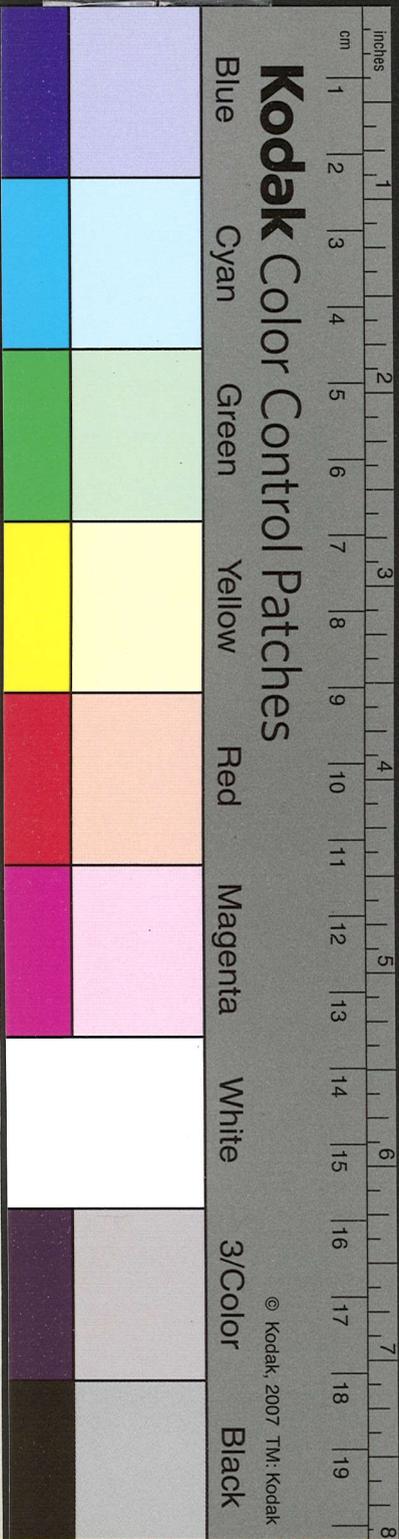
$$g \sum_n \sum_{\alpha_1, \alpha_2, \dots, \alpha_n=1,2} \chi^{(\alpha_1 \dots \alpha_n)} \vec{\tau}_5 \tau_{(\alpha_1 \dots \alpha_n)} \Psi$$

$\chi^{(\alpha_1 \dots \alpha_n)}$: ordinary spin 0, τ -spin $n/2$
 Ψ : ordinary spin $1/2$, τ -spin $1/2$

$\left\{ \begin{array}{l} \pi\text{-meson field: } \chi_{\pi}^{\alpha\beta} \text{ or } \vec{\phi} \text{ } (\tau\text{-spin } 1) \\ \theta\text{-meson field: } \chi_{\theta}^{\alpha} \text{ } (\tau\text{-spin } 1/2) \\ \tau\text{-meson field: } \chi_{\tau}^{\alpha} \text{ } (\tau\text{-spin } 1/2) \end{array} \right.$

nucleon fields:
 Λ -particle Ψ_{Λ}^{α} (τ -spin $1/2$)
 Σ -particle Ψ_{Σ}^{α} (τ -spin $1/2$)
 Ψ^{α} (τ -spin 0)
 $\chi_{\Sigma}^{\alpha\beta}$ (τ -spin 1)
 χ_{Λ}^{α} (τ -spin $1/2$)

$$L_{int}^{(5)} = g \sum_{\alpha, \beta=1,2} [\vec{\Psi} \vec{\tau}_5 \tau_{\alpha\beta} \Psi \cdot \chi^{\alpha\beta} + \vec{\Psi} \vec{\tau}_5 \tau_{\alpha} \Psi \cdot \chi^{\alpha} + \vec{\Psi} \vec{\tau}_5 \tau_{\alpha} \Psi \cdot \chi^{\alpha}] + \text{hermitian conj.}$$



(2)

Rotation - Invariance in T-space

$$L = L_B + L_M + L_{int}^{(S)}$$

$$L_B = i \bar{\Psi} (\gamma^\mu \partial_\mu + \underline{M}) \Psi$$

$$L_M = - (\partial_\mu \chi^* \cdot \partial^\mu \chi + \chi^* M^2 \chi)$$

$$\chi^* = (\chi_a^{*ps}, \chi_0^{*a}, \chi_b^{*a})$$

$$\chi = \begin{pmatrix} \chi_a^{ps} \\ \chi_0^{ps} \\ \chi_b^a \\ \chi_c^a \end{pmatrix}$$

$$M^2 = \begin{pmatrix} M_{\pi}^2 E_3 & & 0 \\ & M_0^2 E_2 & \\ 0 & & M_b^2 E_2 \end{pmatrix}$$

$E_n = \text{an } (n \times n) \text{ unit matrix}$

$$\Psi = \begin{pmatrix} \Psi^a \\ \Psi^b \\ \Psi^{aps} \\ \Psi^a \end{pmatrix}$$

$$\bar{\Psi} = i \Psi^* \gamma_4 = (\bar{\Psi}^a, \bar{\Psi}^b, \bar{\Psi}^{aps}, \bar{\Psi}^a)$$

$$M = \begin{pmatrix} M_N E_2 & & & \\ & M_A E_1 & & \\ & & M_E E_3 & \\ & & & M_Y E_2 \end{pmatrix}$$

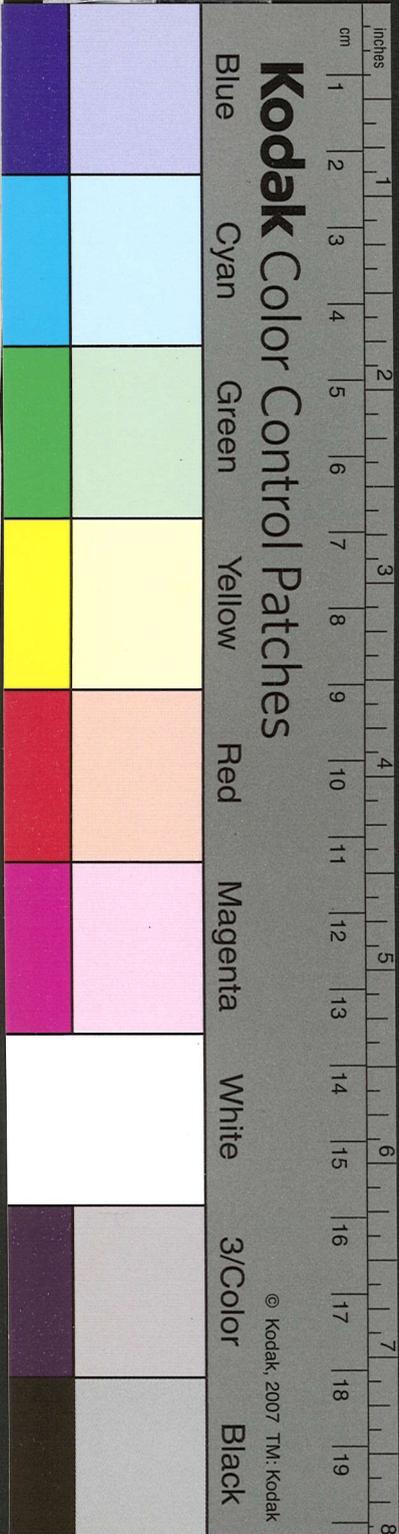
$$\Psi \rightarrow \Psi' = \left(1 + \frac{i}{2} \sum_{j,k=1}^3 \epsilon_{jkr} D^{jr} \right) \Psi$$

$$\chi \rightarrow \chi' = \left(1 + \frac{i}{2} \sum_{j,k=1}^3 \epsilon_{jkr} \mathcal{D}^{jr} \right) \chi$$

$$\epsilon_{jkr} = -\epsilon_{kjr}, \quad j, k, r = 1, 2, 3$$

$$D = \begin{pmatrix} D(1/2) & & & \\ & D(0) & & \\ & & D(1) & \\ & & & D(1/2) \end{pmatrix}$$

$$\mathcal{D} = \begin{pmatrix} D(1) & & \\ & D(1/2) & \\ & & D(1/2) \end{pmatrix}$$



$\delta L_{int}^{(S)} = \delta (g \bar{\psi} \gamma_5 \not{D} \psi) = 0$
 $\rightarrow \not{D} \gamma_5 = \gamma_5 \not{D}$

$(l | \not{D} | l') = 0$ for $l-l' \neq \pm 1$ or 0

$(l | \gamma_5 \not{D} | l') = 0$ for $l-l' \neq \pm 1/2$

$(l | \not{D} \gamma_5 | l') = 0$ for $l-l' = \pm 1/2$

$\frac{\partial}{\partial x^\mu} [\bar{\psi} \gamma^\mu \not{D} \psi - i (\chi^* \not{D} \chi - \not{D} \chi^* \chi)] = 0$

$J_3 = \int [\bar{\psi} \sigma^3 \not{D}_z \psi + i (\chi^* \not{D}_z \chi - \not{D}_z \chi^* \chi)]$
 $= \text{const.}$
 $D_z = \not{D}^z, \quad \not{D}_z = \not{D}^z$

Electromagnetic Interaction:

$Q = e \int [\bar{\psi} \sigma^3 \psi + i \chi^* C' (\frac{\partial}{\partial t} - ieC'A_0) \chi - i (\frac{\partial}{\partial t} - ieC'A_0) \chi^* C' \chi] dx^3 = \text{const}$

Inversion - Parity

	P, N	Λ^0	$\Sigma^{\pm, 0}$	Υ^0, Υ^-	$\pi^{\pm, 0}$	θ^+, θ^0	τ^+, τ^0
spin	$1/2$	$1/2$	$1/2$	$1/2$	0	0	0
Parity	A^+	B^+	A^+	B^+	PS	S^+	PS_1
T-spin	$1/2$	0	1	$1/2$	1	$1/2$	$1/2$
A-value	$1/2$	0	0	$-1/2$	0	$1/2$	$1/2$
wave fn	ψ^a	ψ^a	ψ^a	ψ^a	χ^a	χ^a	χ^a