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Prepint

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A Trial of the Theory of New Particles

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

Interaction Lagrangian

$$g\vec{\Phi}\bar{\Psi}\gamma_5\vec{\tau}\Psi = \sum_{\alpha,\beta=1,2} g\chi^{\alpha\beta}\bar{\Psi}\gamma_5\tau_{\alpha\beta}\Psi$$

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

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

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

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

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

generalization

$$g\sum_n \sum_{\alpha_1\alpha_2\cdots\alpha_n=1,2} \chi^{(\alpha_1\cdots\alpha_n)}\bar{\Psi}\gamma_5\tau_{(\alpha_1\cdots\alpha_n)}\Psi$$

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

Ψ : ordinary spin 1/2, τ-spin

π-meson field: $\chi_\pi^{\alpha\beta}$ or $\vec{\phi}_\pi$ (τ-spin 1)

θ-meson field: χ_θ^{α} (τ-spin 1/2)

τ-meson field: χ_τ^{α} (τ-spin 1/2)

nucleon field: Ψ^{α} (τ-spin 1/2)

Λ-particle: Ψ_Λ (τ-spin 0)

Σ-particle: $\Psi_\Sigma^{\alpha\beta}$ (τ-spin 1)

Y-particle: Ψ_Y^{α} (τ-spin 1/2)

$$L^{(5)}_{int} = g\sum_{\alpha,\beta=1,2}[\bar{\Psi}\gamma_5\tau_{\pi\alpha\beta}\Psi\cdot\chi^{\alpha\beta} + \bar{\Psi}\gamma_5\tau_{\theta\alpha}\Psi\cdot\chi_\theta^{\alpha}$$

$$+\bar{\Psi}\gamma_5\tau_{\tau\alpha}\Psi\chi_\tau^{\alpha}] + \text{hermitian conj.}$$

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Rotation-Invariance in τ-space

$$L = L_B + L_M + L^{(s)}_{int}$$

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

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

$$\chi^* = (\chi_\pi^{*\alpha\beta}, \chi_\theta^{*\alpha}, \chi_\tau^{*\alpha}), \qquad \underline{\chi} = \begin{pmatrix} \chi_\pi^{\alpha\beta} \\ \chi_\theta^{\alpha} \\ \chi_\tau^{\alpha} \end{pmatrix}$$

$$\underline{\mu}^2 = \begin{pmatrix} \mu_\pi^2 E_3 & & 0 \\ & \mu_\theta^2 E_2 & \\ 0 & & \mu_\tau^2 E_2 \end{pmatrix} \quad E_n : \text{an } (n \times n) \text{ unit matrix}$$

$$\Psi = \begin{pmatrix} \Psi_N^{\alpha} \\ \Psi_\Lambda \\ \Psi_\Sigma^{\alpha\beta} \\ \Psi_Y^{\alpha} \end{pmatrix} \qquad \bar{\Psi} = i\Psi^*\gamma_4 = (\bar{\Psi}_N^{\alpha}, \bar{\Psi}_\Lambda, \bar{\Psi}_\Sigma^{\alpha\beta}, \bar{\Psi}_Y^{\alpha})$$

$$\underline{M} = \begin{pmatrix} M_N E_2 & & & \\ & M_\Lambda E_1 & & \\ & & M_\Sigma E_3 & \\ & & & M_Y E_2 \end{pmatrix}$$

$$\Psi \to \Psi' = \left(1 + \frac{i}{2}\sum_{j,k=1}^{3} \varepsilon_{jk} D^{jk}\right)\underline{\Psi}$$

$$\underline{\chi} \to \underline{\chi}' = \left(1 + \frac{i}{2}\sum \varepsilon_{jk} \mathcal{D}^{jk}\right)\underline{\chi}$$

$$\varepsilon_{jk} = -\varepsilon_{kj}, \quad j, k = 1, 2, 3$$

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

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$$\delta L^{(5)}_{int} = \delta(g\,\tilde{\psi}\gamma_5 \underset{\sim}{T}\, \psi \underset{\sim}{\chi}) = 0$$

$$\rightarrow \quad \underset{\sim}{T}^{jk} \mathcal{D} = [D^{jk}, \underset{\sim}{T}]$$

$(l|T_a|l') = 0$ for $l - l' \neq \pm 1$ or 0

$(l|T_b|l') = 0$ for $l - l' \neq \pm 1/2$

$(l|T_c|l') = 0$ for $l - l' = \pm 1/2$

$$\frac{\partial}{\partial x^\mu}[\tilde{\psi}\gamma^\mu D^{jk}\psi - i\{\underset{\sim}{\chi}^* \mathcal{D}^{jk} \partial^\mu \underset{\sim}{\chi} - \partial^\mu \underset{\sim}{\chi}^* \mathcal{D}^{jk} \underset{\sim}{\chi}\}] = 0$$

$$J_z = \int[\tilde{\psi}\gamma^0 D_z \psi + i(\underset{\sim}{\chi}^* \mathcal{D}_z \frac{\partial \chi}{\partial t} - \frac{\partial \chi^*}{\partial t} \mathcal{D}_z \underset{\sim}{\chi})] \times d\vec{x}$$

$= \text{const.}$

$D_z = D^{12}$, $\mathcal{D}_z = \mathcal{D}^{12}$

Electromagnetic interaction:

$$Q = e\int[\tilde{\psi}\gamma^0 C\psi + i\,\underset{\sim}{\chi}^* C'(\frac{\partial}{\partial t} - ieC'A_0)\underset{\sim}{\chi} - i\{(\frac{\partial}{\partial t} - ieC'A_0)\underset{\sim}{\chi}\}^* C'\underset{\sim}{\chi}]\,d\vec{x} = \text{const}$$

Inversion-Invariance

	P, N	Λ^0	$\Sigma^{\pm,0}$	Y^0, Y^-	$\pi^{\pm,0}$	θ^+, θ^0	τ^+, τ^0
spin	1/2	1/2	1/2	1/2	0	0	0
parity	A* (+)	B (−)	A (+)	B (−)	P.S (−)	S (+)	P.S. (−)
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^α_N	ψ_Λ	$\psi^{\alpha\beta}_\Sigma$	ψ^α_Y	$\chi^{\alpha\beta}_\pi$	χ^α_θ	χ^α_τ