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Dear Dr. Gürsey:

Many thanks for your letter of March 30. I enjoyed reading about your wave matrix formalism for strange particles. By using a 4 dimensional formalism the 4 dimensional symmetry in isospin space comes out in a pretty way.

As for G & ~~ispin~~ inversion in isospin space we have to be a little careful about what one means by ~~is~~ inversion in isospin space. G invariance can be generalized to include strange particles as done by Marx & Györgi (N.C. Suppl. 5, 159 (1957)) and by Schwinger (Ann. of Phys.) but this generalization is not what d'Espagnat, Prentki & Raccah mean by inversion in isospin space. The d'E-P-R inversion doesn't contain charge conjugation. Note also that π is an axial vector in d'E-P-R

$$\underline{\pi} \rightarrow +\underline{\pi}$$

whereas in the G conjugation formalism π must be a polar vector

$$\underline{\pi} \rightarrow -\underline{\pi}$$

if we mean ~~by~~ by inversion in isospin space (G ~~inv~~ conjugation.). I am more inclined to take the Marx - Györgi - Schwinger point of view, and define G as

$$G = C \exp i I_2$$

for every strange particle. We can let the phase factor η_c arising from charge conjugation absorb Raccah's isoparity $\exp(i\xi\frac{U}{2}\pi)$ since U conservation is a super-selection rule as far as the strong interactions go.

What the enclosed abstract says is not as profound as it may sound.

If we take interactions containing χ_+ (eigenspinor of γ_5 with eigenvalue +1) only (this means parity-violating S-(V) interactions) we can generate interactions containing χ_- by G conjugation for strangeness-conserving processes, e.g.

$$\overline{K^+}\,\overline{\Lambda}_+ P_+ \xrightarrow{G} K^0\,\overline{n}_-\Lambda^0_-$$

$$\pi^-\,\overline{\Sigma}^0_+\,\Sigma^+_+ \xrightarrow{G} -\pi^-\,\overline{\Sigma}^-_-\,\Sigma^0_-$$

where the subscript means chirality. This is no longer the case for strangeness violating processes, e.g.

$$\pi^-\,\overline{\Lambda}_+ P_+ \longrightarrow \pi^-\,\overline{n}_-\Lambda_-$$

which doesn't conserve charge. Another way of seeing this is to note

$$\langle I_3\rangle \xrightarrow{G} \langle I_3\rangle \qquad \text{but } \langle U\rangle \xrightarrow{G} -\langle U\rangle \qquad U;\ \text{isofermion no.}$$

so that unless $\Delta I_3 = \Delta U = 0$ G conjugation connects charge-conserving processes with charge-violating processes.

I too have looked for schemes in which PG corresponds to a simple conjugation. In your generalized wave matrix formalism this conjugation takes an awkward form since

$$\begin{pmatrix}\Sigma^+_+\\ Y^0_+\end{pmatrix} \rightarrow \begin{pmatrix}-\overline{\Sigma}^-_-\\ \overline{Z}^0_-\end{pmatrix} \text{ etc.}$$

whereas $\begin{pmatrix}p_+\\ n_+\end{pmatrix} \rightarrow \begin{pmatrix}-\overline{n}_-\\ \overline{p}_-\end{pmatrix}$

At present I no longer have any intention to publish what I wrote to you last time. I might incorporate it in a bigger paper if I ever write something in that line.

Is there anything interesting going on at Berkeley? I heard that Pauli now makes nasty comments on the sort of publicity Heisenberg has been receiving.

Sincerely, J. J. Sakurai

Abstract for Ithaca meeting of the American Physical Society

Connection between Parity and Strangeness. J. J. Sakurai, Cornell University. The conjecture that the weak interactions are "minimal" in the sense that Nature picks out just one (χ_+) of the two eigenspinors (χ_+ and χ_-) of γ_5 has been confirmed by various recent experiments. The important question still remains why both eigenspinors must appear symmetrically in the parity-conserving strong interactions. In the case of the charge-symmetric pion-nucleon interaction inversion invariance (G invariance) in isotopic spin space necessitates the symmetric appearance of χ_+ and χ_-. An attempt is made to generalize this view to strange-particle interactions as first suggested by Gell-Mann. For strangeness-conserving processes, even if we start with interactions containing χ_+ only, we can generate interactions containing χ_- by means of G conjugation. (For simplicity we have assumed that the Yukawa interaction must involve derivatives of the meson field.) For strangeness-violating processes the above procedure leads to inadmissible interactions that do not conserve electric charge; hence there is no compelling reason why χ_- should appear in addition to χ_+. Thus if we accept the view that the strong interactions are invariant under G conjugation, we have some understanding of the puzzling fact that strangeness-conserving processes conserve parity whereas strangeness-violating processes may not.