$\Delta I = \frac{1}{2}$ RULE

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(Received September 20, 1960)

One attractive way of formulating the $\Delta I = \frac{1}{2}$ rule is to postulate the existence of "spurions"[1]—neutral isospinor particles carrying no energy and momentum which are emitted or absorbed in decays of strange particles. We wish to point out that conventional field theory contains a perfectly natural realization of spurions. Consider the decay mode $K_1^0 \to \pi^+ + \pi^-$. If the Lagrangian for the process is $f_\omega K_1^0 \pi^+ \pi^-$, it is easy to see that the vacuum expectation value of K_1^0 would not be zero. In fact $\langle K_1^0 \rangle \propto f_\omega$. If we now consider a seemingly isotopic-spin conserving T product of field operators, like $\Lambda N^\dagger \vec{\tau}\cdot\vec{\pi} K$, it not only possesses matrix elements for strong interactions like $N + \pi \to \Lambda + K$, but also a matrix element for the decay $\Lambda \to N + \pi$ (arising from $\Lambda N^\dagger \vec{\tau}\cdot\vec{\pi} \langle K \rangle$) consistent with the $\Delta I = \frac{1}{2}$ rule: $\langle K_1^0 \rangle$ thus gives a realization for the spurion.

One can perhaps reverse the thinking above and reinterpret isotopic-spin nonconservation in the following manner. Let us postulate that all fields possessing the same quantum numbers as the vacuum (and in particular K_1^0 for which $CP = +1$) do have nonzero expectation values. These expectation values define the so-called coupling constants (in this instance the weak coupling constant f_ω). Admitting only seemingly isotopic-spin conserving products of field operators, we obtain both isotopic-spin conserving and isotopic-spin nonconserving matrix elements from the same expression. Apparent nonconservation of isotopic spin is another expression for the fact that K_1^0 had nonzero expectation value.

It is possible to interpret parity nonconservation in the same manner. If there exist[2] K' mesons of opposite (strong) parity to K mesons, $\langle K_2'^0 \rangle \neq 0$. Thus $\Lambda N^\dagger \vec{\tau}\cdot\vec{\pi} \gamma_5 K'$ gives a decay matrix element for $\Lambda \to N + \pi$ of opposite parity to one arising from $\Lambda N^\dagger \vec{\tau}\cdot\vec{\pi} K$, leading to parity nonconservation in the decay phenomenon.

Details of a theory of coupling constants and symmetry properties based on the above ideas will be published elsewhere.

We are grateful to Professor R. G. Sachs for the hospitality of the Summer Institute at the University of Wisconsin.

[1] G. Wentzel, Proceedings of the Sixth Annual Rochester Conference on High-Energy Nuclear Physics (Interscience Publishers, New York, 1956).

[2] M. Gell-Mann has re-emphasized the theoretical necessity of these particles for understanding weak interactions; Report at the Tenth Annual Rochester Conference on High-Energy Nuclear Physics, 1960 (to be published).