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AN EXPERIMENTAL EVIDENCE AGAINST THE ANGULAR MOMENTUM
NONCONSERVATION SCHEME FOR WEAK INTERACTIONS

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It was shown by Franco Selleri\(^1\) that Lorentz-invariance does not necessarily lead to angular momentum conservation. His mechanism for J-violation is to assume the existence of a particle (spurion) with spin, but with zero four-momentum. This particle would appear in weak interaction strangeness changing reactions. Therefore the angular momentum of detectable particles in weak interaction reactions would not be conserved while their energy and momentum would be strictly conserved.

Observing that the spins of the strange particles K, \(\Lambda\), \(\Sigma\), \(\Xi\) have not been measured directly but have been deduced from the assumptions of total angular momentum conservation, Selleri claimed that several new sets of assignment of spins for strange particles corresponding to different spin values for his spurion, would be consistent with the present experimental evidence.

If the spin of the spurion were \(1/2\), Selleri's assignments of spin for strange particles would be:

\[
\begin{array}{cccc}
K & \Lambda & \Sigma & \Xi \\
1/2 & 1 & 1 & 3/2
\end{array}
\]

with selection rules \(\Delta I = 1/2, \Delta J = 1/2\).

If the spin of the spurion were \(1\), his assignments would be:

\[
\begin{array}{ccc}
K & \Lambda & \Sigma \\
1 & 3/2 & 3/2
\end{array}
\]

with selection rules \(\Delta I = 1/2, \Delta J = 1\).

In either of the above schemes, he claims that the new assignments have theoretical advantages over the conventional assignments while both
assignments are consistent with the present experimental data.

Some of the theoretical advantages are:

1. The $\Delta I = 1/2$ rule becomes rigorous in weak interactions.
2. Strangeness conservation in e.m. interactions becomes a consequence of $J$-conservation.
3. The $\Delta S = 1$ rule becomes a consequence of the $\Delta I = 1/2$ rule.

The weakness of these schemes lies in the assumption of an unobservable particle—spurion, and in the contradiction with the success of the $SU(3)$ scheme. The direct measurements of the spins of the strange particles would prove or disprove this scheme of $J$-violation, however the experimental measurements are very difficult to carry out. We would like to point out here an experimental result on the upper limit of the decay $K^+ \rightarrow \pi^+ + \gamma$ of $1.52 \times 10^{-4}$ measured by Friedell et al.\textsuperscript{2} as an indirect evidence against the $J$-violation scheme. We observe that if the $K$ meson had spin $1/2$ (or 1) and the selection rule in strangeness changing weak interactions were $\Delta I = 1/2$ and $\Delta J = 1/2$ (or $\Delta J = 1$), the decay reaction $K^+ \rightarrow \pi^+ + \gamma$ would be allowed in either set of the new spin assignments.

Further from the simple Feynman diagrams,

where $\chi$ means the decay due to weak interaction, we can estimate that with
the new spin assignments, the branching ratio of $K^+ \rightarrow \pi^+ + \gamma$ would be of the order of $10^{-3}$ if the coupling constant $f_{\pi K}$ is not otherwise suppressed compared with $f_{\rho K}$. This is an order of magnitude higher than the experimental upper limit. Therefore we have here an experimental evidence against the existence of a spurion with nonzero angular momentum but zero four momentum in weak interactions. Only if the $\pi K$ coupling constant is unexpectedly suppressed, then the branching ratio of $K^+ \rightarrow \pi^+ + \gamma$ could drop to $10^{-4}$, comparable to the experimental upper limit. Another experiment is under way to improve the previous result on the branching ratio of $K^+ \rightarrow \pi^+ + \gamma$.

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REFERENCES


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