NEUTRAL BARYON CURRENTS AND SINGLE PRODUCTION OF HYPERONS

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The weak interaction process $n + n \to \Lambda + n$ is discussed with the aim of finding experiments, that would be possible in principle, and that would verify whether or not neutral currents are present in the weak interaction Lagrangian.

It is customarily assumed at present that the weak interaction Lagrangian is in the form of a product of currents.[1] In order to explain the absence of decays into neutral lepton pairs it is supposed that no neutral lepton currents exist.[1] Some authors generalize this fact in order to obtain a symmetric scheme for weak interactions and assume that there are no neutral baryon currents either.[2,3] So far no experimental data exist to support this assumption. Furthermore, in the absence of neutral baryon currents the Lagrangian does not satisfy the $|\Delta I| = 1/2$ rule, which is in good agreement with experiment.[3]

Do neutral baryon currents exist? An experimental study of weak interaction processes between baryons, for example

$$n + n \to n + \Lambda, \quad (1)$$

$$p + p \to p + \Sigma^+, \quad (2)$$

could in principle shed some light on this question. In the presence of neutral baryon currents with a universal coupling constant a calculation in first order of perturbation theory gives for the cross sections of the indicated processes, at a kinetic energy of 1 BeV† for the incident nucleon, the value

$$\sigma \approx 4 \cdot 10^{-38} \text{ cm}^2$$

The relatively large value of these cross sections in comparison with cross sections for leptonic processes is due to the large mass of the baryons.

In the absence of neutral baryon currents the processes (1) and (2) can proceed only through various intermediate states. The simplest estimates based on data relating to hyperon decays give for the cross sections of the indicated processes the value

$$\sigma \approx 10^{-40} \text{ cm}^2$$

Let the proton beam intensity be equal to 10^{11} particles/sec and the liquid hydrogen target be 1 m in length. Then for process (2) one would observe one event per minute if neutral baryon currents with a universal constant exist, or one event in three-four hours if such currents are absent.

The question is posed to experimentalists: can one observe, or find an upper limit for, the cross sections of the indicated processes? If it should be found experimentally that

$$\sigma \lesssim 10^{-40} \text{cm}^2$$

then this would constitute evidence in favor of absence of neutral baryon currents with a universal constant.

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†The thresholds for reactions (1) and (2) are respectively 356 and 537 MeV, whereas the thresholds for the corresponding reactions in which a pair of strange particles is produced $N + N \to N + \Lambda + K$, $N + N \to N + \Sigma + K$ are respectively 1.55 and 1.77 BeV.

[1] R. P. Feynman and M. Gell-Mann, Phys. Rev. 109, 193 (1958) (Russ. transl.)

[2] L. B. Okun', Usp. Fiz. Nauk **63**, 449 (1959), Ann. Rev. Nuc. Sci. **9**, 51 (1959).

[3] L. B. Okun', Proc. of the 1960 Ann. Int. Conf. on High Energy Phys. in Rochester.

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