# BARYON NONCONSERVATION IN STANDARD MODEL, ELECTROWEAK $\theta$-TERM AND YUKAWA INTERACTION

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The electroweak instanton effects have been investigated in the presence of the Yukawa couplings. Particularly a possibility has been considered of CP violation through the electroweak $\theta$-term in the processes with baryon number nonconservation. We have shown that the electroweak $\theta$ term is unobservable in the standard model due to the existence of the fermion zero-mode in the weak instanton field even in the case when the fermion is massive but when the mass is acquired through the Yukawa couplings by spontaneous symmetry breaking. The situation is similar to the case of the usual QCD when one of the quarks is massless: the $\theta$ term can be rotated out by certain chiral transformation.

For the case of the electroweak instanton-like gauge field and a massive fermion we have derived an index theorem which relates the number of the fermion zero-modes with the topological charge of the gauge field. To this end we have found a useful generalization of the usual $\gamma_5$ chirality for the case of massive fermions and proved the index theorems $n_L - n_R = -Q_T$, where $n_L$ ($n_R$) is the number of the left- (right-) handed fermion zero-modes in the sense of this generalized chirality and $Q_T$ is the topological charge. The fermion zero-modes in this index theorem are actually the zero-modes of a certain differential operator which depends not only on gauge but also on Higgs fields.

The possible generalization of the standard model have been discussed which leads to the nonvanishing weak $\theta$ term. In the $SU(2)_L \times SU(2)_R$ model the $\theta$ dependence of the vacuum energy has been computed as well as the mass of the "arion" — analogue of the axion for the electroweak sector of the theory.

REFERENCES

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