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Effect of Threshold Corrections on Proton Lifetime and Emergence of Topological Defects in Grand Unified Theories

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Abstract : The grand unified theory (GUT) rationales the arbitrariness of the standard model (SM) and explains many enigmas of nature at the outset of a single gauge group. The GUTs predict the proton decay and, the spontaneous symmetry breaking (SSB) of the higher symmetry group may lead to the formation of topological defects, which are indispensable in the context of the cosmological observations. The Super-Kamiokande (Super-K) experiment sets sacrosanct bounds on the partial lifetime (τ) of the proton decay for different channels, e.g., $\tau(p \rightarrow e+ \pi 0) > 1.6\times10^{34}$ years which is the most relevant channel to test the viability of the nonsupersymmetric GUTs. The GUTs based on the gauge groups SO(10) and E(6) are broken to the SM spontaneously through one and two intermediate gauge symmetries with the manifestation of the left-right symmetry at least at a single intermediate stage and the proton lifetime for these breaking chains has been computed. The impact of the threshold corrections, as a consequence of integrating out the heavy fields at the breaking scale alter the running of the gauge couplings, which eventually, are found to keep many GUTs off the Super-K bound. The possible topological defects arising in the course of SSB at different breaking scales for all breaking chains have been studied.

Keywords : grand unified theories, proton decay, threshold correction, topological defects
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