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From the V-A theory of weak interaction to the uniqueness of the standard model and beyond

Parity conservation was first questioned along with some possible experimental tests suggested by TD Lee and CN Yang in 1956. In 1957, several experiments confirmed parity nonconservation in weak interaction. However, the theory of weak interaction: V-A theory was only established in 1958 by Marshak et al. The V-A chiral structure is encoded as the defining feature of the electroweak unified theory.
Through anomalies of chiral gauge fields in four-dimensional space, we show that the representations of quarks and leptons, as well as electric charges, in the SU(3)C x SU(2)L x U(1)Y gauge group of the Standard Model are rather unique. We also discuss some unresolved issues of the Standard Model, particularly the three generations of fermion families and the mass problem of fundamental particles, as well as potential new physics beyond.

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