

# WHY DO QUARKS HAVE ELECTRIC CHARGES?

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ABSTRACT. Quarks and leptons are the only known fundamental particles or fermions. The fermionic properties of these particles are determined by their weak interactions, the ultimate sources of which are their net weak charges. If the presence of nonzero net weak charge separates fermions from the gauge bosons which are the field quanta of their interactions, then the respective presence or absence of nonzero net strong charge separates out the two classes of fundamental particle described as quarks and leptons. The strong interaction is completely independent of the presence or absence of units of electric charge. However, although some leptons (the neutrinos) exist without electric charge units, no quarks appear to be without them. It is proposed that the solution of this mystery lies in subtle aspects of the  $SU(3) \times SU(2) \times U(1)$  symmetry breaking of the three interactions and is a consequence of the way in which this symmetry breaking arises.