

# Constructing the Standard Model Fermions?

PETER ROWLANDS

*Physics Department  
University of Liverpool  
Oliver Lodge Laboratory  
Oxford St, Liverpool, L69 7ZE, UK  
p.rowlands@liverpool.ac.uk*

The Standard Model has three generations of fermions and antifermions, each with two states of isospin, and each of these has both a lepton and a quark in three possible colour states. In total there are 48 states. No known system exists for constructing these from first principles. Here, it is suggested that the number of degrees of freedom required is a consequence of the nilpotent complexified vector-quaternion Dirac algebra, which emerges from the representation of the fundamental parameters mass, time, charge and space as a Klein-4 group, and that these degrees of freedom lead to unique structural representations of each of the individual fermions.

*Keywords:* Standard Model, fermions, quarks, leptons, electric, strong and weak charges