Unification of the Four Forces in the Spin (11,1) Geometric Algebra

ANDREW HAMILTON, University of Colorado, Boulder

The spinors of the group Spin(N) of rotations in N spacetime dimensions are indexed by a bit-code with \( \lceil N/2 \rceil \) bits. A well-known promising grand unified group that contains the standard-model group is Spin(10). Fermions in the standard model are described by five bits \( durgb \), consisting of two weak bits \( d \) and \( u \), and three color bits \( r, g, b \). If a sixth bit \( T \) is added, necessary to accommodate a time dimension, then the enlarged Spin(11,1) algebra contains the standard-model and Dirac algebras as commuting subalgebras, unifying all four forces. The largest subgroup of Spin(11,1) that commutes with the Poincaré group is Spin(5) \( \times \) Spin(6), suggesting that the latter is a partial unification on the way to complete unification in Spin(11,1). The Spin(5) \( \times \) Spin(6) algebra contains a subalgebra with precisely the properties of the electroweak Higgs field. The Spin(5) \( \times \) Spin(6) symmetry contains, and is spontaneously broken by, a U(1) symmetry related to the \( U_{B-L}(1) \) symmetry. Grand unification is associated with a change in the dimensionality of spacetime.

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