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Advances in Applied Clifford Algebras

Geometric Algebra and Particle Dynamics

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Abstract. In a recent publication [1] it was shown how the geometric algebra $G_{4,1}$, the algebra of 5-dimensional space-time, can generate relativistic dynamics from the simple principle that only null geodesics should be allowed. The same paper showed also that Dirac equation could be derived from the condition that a function should be monogenic in that algebra; this construction of the Dirac equation allows a choice for the imaginary unit and it was suggested that different imaginary units could be assigned to the various elementary particles. An earlier paper [2] had already shown the presence of standard model gauge group symmetry in complexified $G_{1,3}$, an algebra isomorphic to $G_{4,1}$.

In this presentation I explore the possible choices for the imaginary unit in the Dirac equation to show that $SU(3)$ and $SU(2)$ symmetries arise naturally from such choices. The quantum numbers derived from the imaginary unit are unusual but a simple conversion allows the derivation of electric charge and isospin, quantum numbers for two families of particles. This association to elementary particles is not final because further understanding of the role played by the imaginary unit is needed.

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