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Three fermion generations with two unbroken gauge symmetries from the complex sedenions

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We show that three generations of leptons and quarks with unbroken Standard Model gauge symmetry $SU(3)_c \times U(1)_{em}$ can be described using the algebra of complexified sedenions $\mathbb{C} \otimes \mathbb{S}$. A primitive idempotent is constructed by selecting a special direction, and the action of this projector on the basis of $\mathbb{C} \otimes \mathbb{S}$ can be used to uniquely split the algebra into three complex octonion subalgebras $\mathbb{C} \otimes \mathbb{O}$. These subalgebras all share a common quaternionic subalgebra. The left adjoint actions of the 8 \mathbb{C} -dimensional $\mathbb{C} \otimes \mathbb{O}$ subalgebras on themselves generates three copies of the Clifford algebra $Cl(6)$. It was previously shown that the minimal left ideals of $Cl(6)$ describe a single generation of fermions with unbroken $SU(3)_c \times U(1)_{em}$ gauge symmetry. Extending this construction from $\mathbb{C} \otimes \mathbb{O}$ to $\mathbb{C} \otimes \mathbb{S}$ naturally leads to a description of exactly three generations.

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