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Rethinking Connes' approach to the standard model of particle physics via non-commutative geometry[1] LATHAM BOYLE, SHANE FARNSWORTH, Perimeter Institute for Theoretical Physics — Connes' non-commutative geometry (NCG) is a generalization of Riemannian geometry that is particularly apt for expressing the standard model of particle physics coupled to Einstein gravity. Recently, we suggested a reformulation of this framework that is: (i) simpler and more unified in its axioms, and (ii) allows the Lagrangian for the standard model of particle physics (coupled to Einstein gravity) to be specified in a way that is tighter and more explanatory than the traditional algorithm based on effective field theory. Here we explain how this same reformulation yields a new perspective on the symmetries of a given NCG. Applying this perspective to the NCG traditionally used to describe the standard model we find, instead, an extension of the standard model by an extra $U(1)_{B-L}$ gauge symmetry, and a single extra complex scalar field σ, which is a singlet under $SU(3)_C \times SU(2)_L \times U(1)_Y$, but has $B - L = 2$. This field has cosmological implications, and offers a new solution to the discrepancy between the observed Higgs mass and the NCG prediction.

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